ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR RECONSTRUCTION OF 108KM BENIN - DELTA (UGHELI) TRANSMISSION LINE TO 330KV DOUBLE CIRCUIT QUAD CONDUCTORS

A TCN/AfDB PROJECT

ESIA REPORT

Prepared by:

Geomatics Nigeria Limited

Ibadan Oyo State

Submitted to:

The Project Manager
AfDB TCN-PIU
Plot 1285, Wikki Spring Street, Maitama Extension
Abuja

NOVEMBER 2019

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR

RECONSTRUCTION OF 108KM BENIN - DELTA (Ugheli) TRANSMISSION LINE TO 330KV DOUBLE CIRCUIT QUAD CONDUCTORS

Client: TCN

Date of Report: **NOVEMBER, 2019**

Project Consultant: **GEOMATICS NIGERIA LIMITED**

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LIST OF ABBREVIATIONS AND ACRONYMS

4WD-	Four Wheeled Drive
AAC-	All Aluminium Conductor
ACSR-	Aluminium Conductor Steel Reinforced
ACSR-	Aluminum Alloy Conductor Steel Reinforced
AfDB-	African Development Bank
AfDB-PIU-	African Development Bank- Project Implementation Unit
ALARP-	As Low as Reasonably Practicable
AN-	Air Quality and Noise Quality
AOO-	Area of Occurrence
AS-	Aquatic species
ATR-	Animist/ African Traditional Religion
B-	Biodiversity
BMP-	BiodiversityManagementProgram
BOD-	Biochemical Oxygen Demand
C of O-	Certificates-of-Occupancy
CA-	Community Agitation
CD-	Compact Disk
CEMP-	Construction Environmental Management Plan
CEO-	Chief Executive Officer
CH_4	Methane
CITES-	Convention to Regulate international trade in Endangered species
Cl_{2-}	Chlorine
CLO-	Community Laison officer
CM-	Centimetre
CMS-	Conservation of Migratory Species
CO-	Carbon monoxide
CO_2	Carbon dioxide
CoC -	Code of Conduct

CoE- College of Education

dB - decibels

DBH- Diameter at Breast Height

DC- Direct Current

DisCos - Distribution Companies

DMLSUD - Delta State Ministry of Land Survey and Urban Development

DO- Dissolved Oxygen

DSEPA/ DELSEPA - Delta State Environmental Protection Agency

DSMEnv - Delta State Ministry of Environment

DSS- Defense Security Service

DSWMB - Delta State Waste Management Board

E&S- Environmental and Social

EC- Electrical Conductivity

ECN- Energy Commission of Nigeria

EEE- Electrical/Electronic Equipment

EEWMB- Edo State Environmental and Waste Management Board

EF- Emission Factors

EHS- Environmental Health and Safety

EIA- Environmental Impact Assessment

EIS- Environmental Impact Statement

EIS- Environmental Impact Study

EMF- Electromagnetic Force

EMPPUD - Edo State Ministry of Physical Planning and Urban Development

EMS-- Electricity Management Services

EMSL- Electricity Management Services Limited

ENUPDA- Edo State Urban Planning and Development Authority

EOO- Extent of Occurrence

EPA- Environmental Protection Agency

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
ESMEPU-	Edo state Ministry of Environment and Public Utilities
ESMF-	Environmental and Social Management Framework
ESMP-	Environmental and Social Management Plan
ESMS-	Environmental and Social Management System
F-	Feeding
FAO-	Food and Agriculture Organization
FDI-	Developmental Financial Institutions
FEPA-	Federal Environmental Protection Agency
FGM-	Female Genital Mutilation
FGN-	Federal Government of Nigeria
FL-	Flight
FMEnv-	Federal Ministry of Environment
FRSC-	Federal Road Safety Commission
Ft-	Feet
GAXT-	Gas Alert Extreme
GBV-	GenderBasedViolence
GEMIS-	Global Emission Model of Integrated Systems
GenCos-	Generating companies
GHG-	Green House Gases
GIS-	Geographic Information System
GIS	Gas Insulated System
GNL-	Geomatics Nigeria Limited
GPa-	Global Programme of Action
GPS-	Global Position System
GRM-	Grievance Redress Mechanism
GSI-	Gonado Somatic Index

GW-	Groundwater
GWP-	Global warming potential
GZTACSR-	Gap-type ZT-aluminum conductor steel reinforced
HC-	Hydrocarbons
HCN-	Hydrogen Cyanide
HDT-	Heavy Duty Truck
HIV/AIDS-	Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome
HPDE-	High Performance Driver's Education
HS-	Health and Safety
HS3-	Health, Safety and Security
HSE-	Health, Safety and Environment
HSEQ-	Health, Safety and Environment Quality
HTH-	High Test Hypochlorite
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
IPCC-	Intergovernmental Panel on Climate Change
ISO-	International Organization for Standardization
ISS-	Integrated Safeguard Systems
IUCN-	International Union for the Conservation of Nature
JIV-	Joint Investigation team
K-	Kilos
Kg –	Kilograms
km-	Kilometres
km/hr-	Kilometres per Hour
kV-	Kilovolts
KVrms-	Kilovolts root mean square

KW-	Kilowatts
kWh-	Kilowatt hour
LASEPA-	Lagos State Environmental Protection Agency
Lb-	Pounds
LC-	Least Concern
LCD-	Liquid Crystal Detector
LFN-	Legal Framework of Nigeria
LGA-	Local Government Authority
LGAs -	Local Government Areas
LI-	Land Use Impacts
LWR-	Length – Weight Relationship
M^{3-}	Cubic Metres
MEPU-	Ministry of Environment and Public Utilities
mg/kg-	Milligrams per Kilograms
Mg/l –	Milligram per Litres
MM-	Millimetres
Mph-	Metres Per Hour
MT-	Metric Tonnes
$MTCO_{2-}$	Metric Tonnes of CO_2
MVA-	Motor Vehicle Administration
MW-	Megawatt
N-	North
N_2O-	Nitrogen dioxide
NaCl-	Sodium Chloride
NA-	Not Applicable
NBET-	Nigerian Bulk Electricity Trading Plc
NBS-	National Bureau of Statistics
NCMM-	National Commission for Museums and Monuments
NCP-	National Council on Privatization
NCSDC-	Nigerian Security and Civil Defense Corps

ND-	Not Detected
NE-	North East
NEEDS-	National Economic Empowerment and Development Strategies
NELMCO-	Nigerian Electricity Liability Management Company
NEMSA-	Nigerian Electricity Management Services Agency
NEPA-	National Electric Power Authority
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
NGO- Non-	Governmental Organization
NID-	National Immunization days
NOx-	Oxides of Nitrogen
NQ-	Noise Quality
NSCDC-	Nigeria Security and Civil Defence Corps
NTEP-	Nigeria Telecommunication Expansion Program
OGEPA -	Ogun State Environmental Protection Agency
OHL-	Over Head Lines
OHSAS-	Occupational Health and Safety Management Systems
OPGW-	Optic Protective Ground Wires
OPV-	Oral Polio Vaccine
OS-	Operational Safeguards
Pa-	Pascal
PAC-	Project Affected Communities
PAP-	Project Affected Persons
PHC-	Primary Health Centres
PHCN-	Power Holding Company of Nigeria
PIU-	Project Implementation Unit
PM-	Particulate Matter

PPAs-	Power Purchase Agreements
PPE-	Personal protective equipment
Ppm-	parts per million
PTL-	Priority Testing List
QHSE-	Quality Health, Safety and Environment
R-	Resting
R-	Riparian Habitat
RAP-	Resettlement Action Plan
REA-	The Rural Electrification Agency
REDD+-	Reducing emissions from deforestation and forest degradation
RF-	Riparian Forest
RH-	Relative humidity
RoW-	Right of Way
SC-	Successor Companies
SCADA-	Supervisory Control and Data Acquisition
SCEG-	Security in Complex Environments Group
SE-	Socio – Economic
SEA-	Sexual Exploitation andAbuse
SF-	Secondary Forest
SF-	Sulfur hexafluoride
SHE&S-	Safety, Health, Environment & Security
SME-	Small and medium-sized enterprises
SO_2 –	Sulfur dioxide
SPL-	Sound Pressure Level
SQ-	Soil Quality
SS-	Sudan Savannah
STDs-	Sexually Transmitted Diseases
STI-	Sexually Transmissible Infections
SV-	Savanna
SW-	Surface Water

TBD-	To Be Determined
TCN-	Transmission Company of Nigeria
TDP-	Titled Deed Plan
TDS-	total dissolved solid
TEP-	Telecommunication Expansion Program
THB-	Total Heterotrophic Bacteria
THC-	Total Hydrocarbon
THF-	Total Heterotrophic Fungi
TL-	Transmission Line
TLROW-	Transmission Line Right of Way
TMP-	Traffic Management Plan
ToR-	Terms of Reference
TPM-	Total Particulate Matter
TPM-	Total Productive Maintenance
UEEE-	Used Electrical/Electronic Equipment
UNFCCC-	United Nations Framework Convention on Climate Change
USEPA-	United States Environmental Protection Agency
VI-	Visual Impacts
VOC-	Volatile organic compounds
W-	Water
WC-	Water Closet
WHL-	Western Highlands
WHO-	World Health Organisation
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 decommissioning of the existing Single Circuit (SC)330kV Benin – Delta (Ughelli) TL line and the reconstruction and upgrade of the line to double circuit Quad Conductor of 330kV type with a total length of about 108 km. The line traverses from Delta (IV) Power Station, Ughelli - sub-station, linking the Sapele substation in Delta state and terminates at the Benini substation in Edo state. The goal of the proposed Delta and Edo States Transmission Project is to strengthen the national grid around the country for a more reliable electricity supply. The project shall involve:

- ✓ Validation of existing track roads
- ✓ Decommissioning of the existing towers and lines
- ✓ Reconstruction of a single circuit to double circuit Quad Conductor of 330kV type transmission 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)
	Aluminium Conductor Steel Reinforced (ACSR)	
	All Aluminium Conductor (AAC)	
Number of conductors	Single circuit conductors	Double circuit conductors
	Multi-Circuit conductors	
	Double circuit conductors	
Tower type	Lattice	Lattice
	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

Figure ES-1 shows a map of the project area. It shows that the project area cuts across two states (Delta and Edo respectively). Five of the LGAs (Sapele, Ethiope West, Okpe, Ugheli North and Uvwie) are in Delta state and one (Ikpoba-okha) is in Edo state. The Project's direct impacts outside of the footprint area include the biophysical and socio-economic impacts. It is expected that all direct biophysical impacts resulting from initial decommissioning of the existing towers to be replaced, reconstruction and operation of the new installed 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 substations. The socio-economic 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 Ethiope River and Ologbo River. The project region is characterized by relatively long wet season lasting 8-10 months with extensive Forest belts. The project area is characterized by secondary forest and freshwater swamp. The protected areas in the project area are Okomu game reserved (60km from Benin substation), Gele games reserve (30 km from Benin substation) and Ologbo Game Reserve (39 km from Proposed Benin substation and 29 km from

Sapele substation). Topographically, the project area lies in and beyond the swamp zone with an elevation ranging from as low as 0.7m to 71.1m. The project area is predominantly underlayed by sedimentary rocks with the following stratigraphic units underlying most part of the region: the Benin Formation, the Ogwashi - Asaba Formation, the Bende-Ameki Formation, Imo Shale Formation, Nsukka Formation and Ajali Formation.

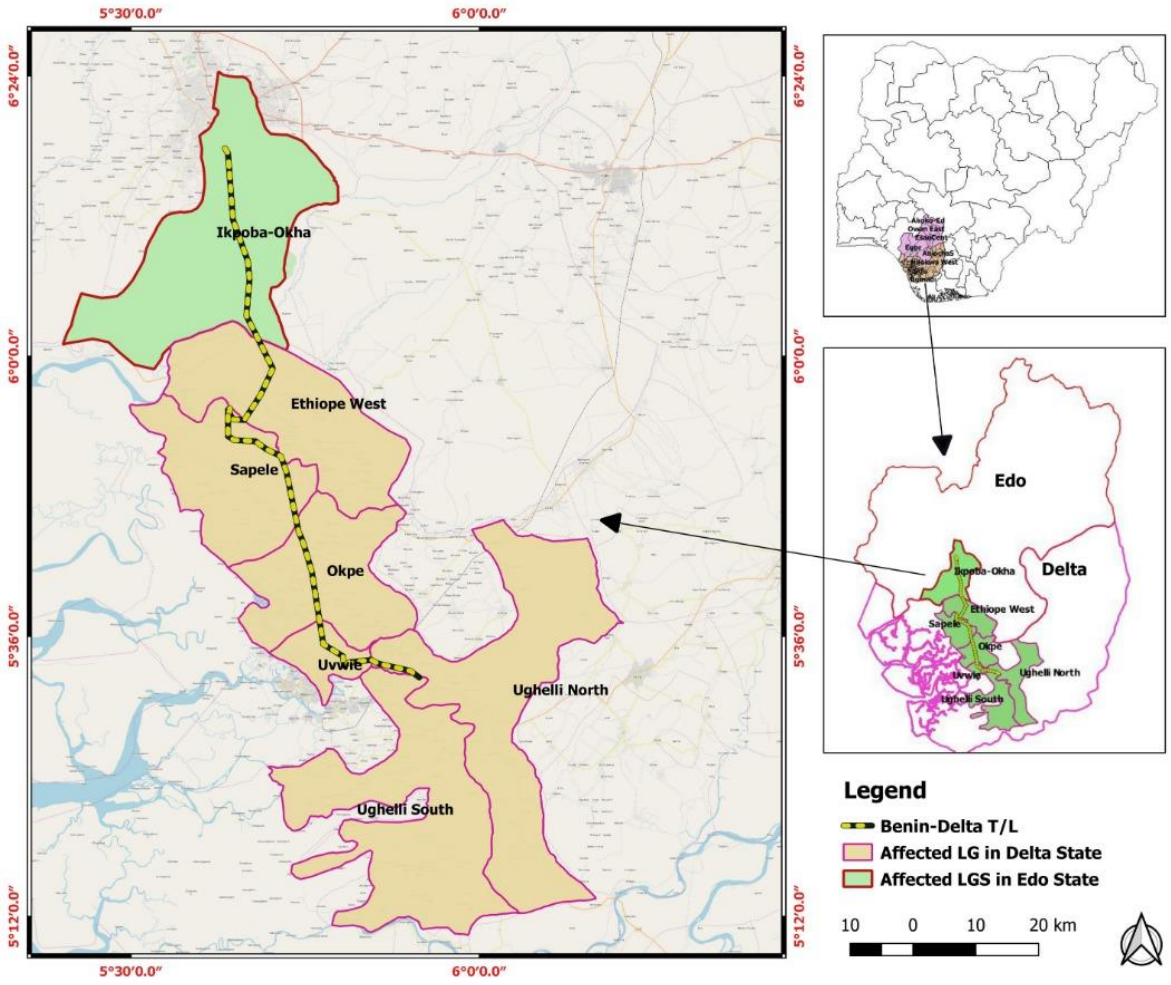


Figure ES-1: Map of the project area

ES 1.2.1 Land Cover

The Transmission Line Right of Way (ROW) to be acquired for the project is approximately 108 km in length and 50 m wide, thereby giving a total area of about 5,490,000 m^2.

ES 1.2.2 Baseline Condition of Bio-Physical 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
Ambient Air quality	All parameters were within Fmenv/ WHO regulatory limits except for SO_2. The concentrations were above regulatory limit across all sampling stations except stations 4 and 14 in Ekae and Ajekimoni respectively. The increased level of SO_2 in these areas could be attributed to highways where burning of fossils as well as exhaust fumes from automobile engines is rife
Noise quality	Result of noise quality showed an elevated noise level above the day time threshold stipulated for the various environments (school, hospital, residential and farmlands) for all the sections except for Benin - Sapele section which recorded slight increment above the threshold for residential areas only in two of the stations NQ12 (Oviri) and NQ18 (Oharhe). 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 underlayed by sedimentary rocks with the following stratigraphic units underlying most part of the region: the Benin Formation, the Ogwashi - Asaba Formation, the Bende-Ameki Formation, Imo Shale Formation, Nsukka Formation and Ajali Formations.
Pedology	Three soil types characterized the area: Alluvial soil: Zones of alluvial deposits were observed in Sapele and okpe areas While hydromorphic zones were observed in Ogorode, Ologbo, Oghareki and Oviri court areas of the TL Presence of feral soil types were observed in Okha, Etete and Binin areas of the TL. All these would require specific tower considerations.
Soil quality	All physicochemical parameters measured in the soil samples were within WHO/FMEnv threshold values. *Bacillus Pseudonomas Staphylococcus Proteus ArthrobacterEnterobacter Micrococcus* were some of the THB *taxa assayed in the area while Aspergillus, Mucor Penicillium and Fusarium* accounted for the THF taxa. Possible organic waste substrates for these organism could include nitrogenous, peptide rich and sugar rich food sources.
Ground water	Physicochemical parameters analyzed for the three ground water samples revealed concentrations within WHO/FMEnv limits. The result compared well with reviewed secondary data.

Hydrology/drainage	Ethiope River and the Ologbo River are the two water bodies draining the project r area. Each of the river made intersection with the TL. Ologbo river made contact withy the TL at Ologbo while Ethiope River made contacts with the TL at Oghara and Sapele. TheEthiope River drains the Okpe, Uvwie and Ughelli axis of the Tl where it becomes swampy and marshy. The width of Ologbo river at intersection point at Ologbo is about 200m, while that of Ethiope River is about 700m. The water levels are generally low with little signs of erosion. At intersection points, River Ologbo has a bank height of 3m while Ethiope River has a bank height of 0.8m. At point of intersection, River Ologbo was observed to have about20:25:55 Clay/silt/Sand ratio =55 as against Ethiope river at points of intersection with about 30:30:40 Clay/Silt/sand ratio. *Lophira* and *Saleginella* are dominant plant taxa and both sites have potentials as breeding/seed recruitment grounds.
Surface water	Surface water was collected in ten points. All physico chemical parameters analyzed were within FMEnv/WHO threshold values, except for Dissolved Oxygen (DO) and turbidity. Possible causal factors could be increased input of organic waste load resulting in increased number of cells that correspondingly depletes dissolve oxygen. The microbial study revealed the presence of faecal indicator species *Escherichia sp is* indicative of fecal discharge into the water bodies.
Sediment	All physico 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, except for the absence of faecal indicators, inferring possibly, efficient consumption of the feacal waste load at the upper water column by surface water dwelling organisms
Hydrobiology	A total of thirty-one species were observed with 19 phytoplankton, 7 zooplankton and 5 macro benthos with the presence of pollutant sensitive species such as *Nereissp, Polydora ciliiata* of the Polycheate group as well as *Keratella cochlearis, Keratella quadrata and Trichocerca cylindrical. These results mirrors that obtained in the reviewed secondary data.*
Fisheries	Overall, 29 fish species belonging to 19 families were assayed in the water bodies consisting of mainly freshwater species with a total of 480 individual fishes. Information was sourced from local fishermen and market women. Cichlidae, Bagridae and Characidae were the most dominant families. Five (5) species, *Chrysichthys nigrodigitatus* (Bagridae) *Hemichromis fasciatus* (Cichlidae), *Brycinus nurse* (Characidae), *Pellonula afzellusi* (Clupeidae), and *Clarias anguillaris* (Clariidae) were the dominant taxa accounting for about 80%. The educational qualification of the fisher folks 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 only about 5% 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 N1, 000 to N3, 000 for the sale of fish per day depending on the total catch.
Vegetation	The biodiversity of the Benin – Delta TL project was studied, and the various sampled plots were grouped into two respective sections: Ughelli- Sapele & Sapele-Benin The study area consists of two habitats. Secondary forest accounted for about 41.7% while Freshwater swamp made up the remainder 58.3%. A total of 36 species were inventoried for the entire study Species richness for Secondary Forest Habitat (SFH) was 18 and 27 for Fresh Water swamp (FWS) Woody species with DBH of between 6-8inches and height of 20m and above were used to estimate possible vegetal waste to be generated during preconstruction. No woody tree met this criterion and hence negligible vegetal waste would be generated. The Shannon index of 0.78 is indicative of a habitat under threat and continuous disturbance. *Cedrala odarata and Dalbergia latifolia* censored in the SFH habitat were the two IUCN Threatened species. However, due to the relative distance of the project from protected areas and their presence in these reserves, weeding of the species during project activities poses no threat. Thirteen (13) species representing about 36% were observed to have indigenous uses. *Carapa procera, Mimosa pudica, Funtunia elastica, Alchonea cordifolia* and *Berlinia grandifolia* are the most used plant species in the study area as they are used for a wide range of products including sources of herbal medicine, fuel wood, raw material (wood for construction of bridge, houses and electric pole, etc.).*Chromolaena odorata was* the only alien as well as invasive species in the study area.
Fauna and wildlife	**Herpetofauna** Eight Amphibians and six reptilian species were censored in the study area. Fresh water recorded the highest number of species abundance. *Rana lithobates*, *Hyperodius concolor, Agama agama, Panaspis togoensis, Mabuya sp, Ptychadena oxyrhynchus* are the sighted herpatofauna species of the study area. There was no species of conservation interest in the study area
	Avian study -A total of fourteen (14) sighted avian species were censored in the area, some of the species include: *Milvus migrans, Necrosyrtes monachus, Polyboroides typus, Streptopella semitoquata and Turtur brehemeri*.

	-The Secondary forest accounted for about 62% of the bird diversity. -Their preference for this habitat could be linked to food resources, breeding grounds/winthering grounds. Thirty-six 36 individuals were censored across the counting and observation stations. -The findings revealed *Apus affinis* as the most abundant species accounting for about 22% of the total counts. -Three behavioral tendencies were evaluated at the time of censoring, feeding, resting and flight. -A total of nine individuals each were observed in flight or resting behaviour -Fourteen individuals were observed feeding. In the secondary forest, eight (8) individuals each were either observed at flight or feeding and two (2) resting. -In the fresh water, thirteen (13) individuals were observed feeding; four were on flight and eight resting. -Individuals of *Milvus migrans, Necrosyrtes monachus, Streptopelia semitoquata, Turtur brehemeri and Tytaalba*were always observed feeding, while others exhibited more than one bird behavior. The birds were observed flying in three main directions. -A total of nineteen individuals were observed flying in the NE direction as against two flying the in the South easterly direction. -Five individuals were observed flying in the south westerly direction. -Flight altitude was also evaluated. The findings showed that twenty-one (21) individuals of six (6) species were flying within 0-50m altitude. Six (6) individuals were observed within the 50-75m The species flying in these heights are *Necrosyrtes monachus, Polyboroides typus, Ralluscaerulescens, and Muscicapa ocreata*. -The only individual of *Milvus migrans* censored was seen flying above 75m. -On the other hand, eight (8) individuals of three (3) species were seen flying within 0-5 m. -Other species were observed not to have specific flight range. *Apus affinis* is the only species observed to be flying within the 25 – 50m range. This height is typical of that of transmission line and these species are vulnerable *-Polyboroides typhus* was the only raptor as well as migratory species in observed These species are known for their inherent natural waste cleansing capabilities None of the species censored in the study area were of conservation interest.
	Mammals -A total of 12 Mammalian species were censured in the study area. -These include seven sighted species and 5 species via indirect evidences.

	-The Secondary forest was the preferred habitat for mammals in the study area, since three of the -four sighted species were sighted solely in this habitat. -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	Okumu Forest Reserve, Edo state which is 60 km from Benin substation Gele-Gele Games Reserve, Edo state which is 30 Km from Benin substation Ologbo Game Reserve, Edo state which is 39 km from Benin substation and 29 km from Sapele substation

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

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

Parameters	Summary
Political context	Nigeria is a Federal Republic made up of 36 States and a Federal Capital Territory of which Delta and Edo states are component parts. Delta State currently has 25 LGAs, including, Ughelli North, Okpe, Uvwie, Sapele and Ethiope West while Edo State has 17 LGAs of which Ikopba-Okha is one.
Demography	Delta State has a population of 4,112,445, a land area 17,698km^2 land area while Edo state on the other hand has a the population of 3,233,366 and a land area of 17,802km^2 In both states, men population is marginally above that of the female in contrast to that of Nigeria. Age group of 0-14 years constituted about a-third of the population of both states. Literacy level is 69.9% and 63.5% in Delta and Edo States 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. Potential sources of conflicts in the project area include Non-recognition of communities as critical stakeholders, land disputes, agitation for employment/contracts, issue of non -payment of compensation when the existing route was acquired, non-compliance with court rulings and orders especially for cases in court between Etete/ Evboraria communities versus TCN, divide and rule tactics and ineffective communication channels
Sources of Data	Two types of questionnaires were administered – Household and community based. The household questionnaires were administered to all available homesteads within 1km on either side of the RoW and all 113 communities.

	The people were assisted (mainly in pidgin and local dialects) in responding to the questionnaires. A total of 200 questionnaires were administered and 124 household questionnaires were retrieved representing a success rate of about 62% while 84 community questionnaires were recovered representing a success rate of 74.3.%
Gender of heads of household	About 71.1% male household heads was recorded in the project area against the Nigerian average of 85.7%, and 76.6% for South-South states implying more female house heads in the project area than the Nigerian average
Marital Status of Head of Household	About 64.52% of the respondents are married. This is less than the Nigerian average of 77.4% and that of South-South at 65.7%.
Nature of Marriage in Households	A 63.63% monogamousmarriage was recorded in the study against the Nigerian and South-South averages of 60.7 and 57.7% respectively.
HOUSEHOLD SIZE	Household sizes in the project area are mainly made up of 3-5 persons and 6-10 persons accounting for about 90% of the respondent populations. The data closely mirrors that of Nigeria and South South.
Ethnic Composition	The dominant ethnic groups in the project area are Urhobos, okpes and Binis. Other ethnic groupings surveyed are the Anioma/ibo, Iteskiri, Ijaw, Afemai, Ishan and Isoko, Yorubaand the Hausa/Fulani. These are reflective of the accommodative nature of the people
Religion	The respondents are adherents of Christianity, Animist/ African Traditional Religion (ATR) and Islam with the Christian Faith accounting for about 90%, ATR with about 11.2% and 0.04% for the Islamic Faith
Educational Facilities	A total of 755 primary schools, 181 secondary schools and 3 tertiary institutions were reviewed for the communities within the spatial boundary of the project area with Sapele LGA accounting for about 14% of these schools. About 75 % of these schools are privately owned.
Water facilities	Privately and publicly owned boreholes were recorded in the study area with the latter accounting for most of them. Less than 1% of the respondents'population dependsentirely on communal borehole boreholes for their water needs.
Household facilities	Result on the survey 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	The use of iron sheets, asbestos and aluminum accounted for about 84.67% of the roofing materials. The least used roofing material is thatch, accounting for about 2.42%.

	The relative high percentage of uncompleted building could be indicative of the prevailing economic situation
Walling Materials	On the average, the use of bricks as walling materials is predominant. However, the use of mud bricks is most pronounced among communities in Okpe, Ethiope West and Ikpoba-Okha LGAs.
Flooring Material	Five flooring materials were observed to be in use. Smooth cement and ceramic tiles accounted for well about 87%. The data provided closely mirrors the Nigeria average for Flooring Materials.
Transport Facilities	The project area is traversed by three main roads and other feeder roads: The Benin- Warri express way East-West express way Ogoroderoad, Sapele 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 ETISALAT.
Health Facilities	The health facilities in the area comprise of nine (9) Primary Health Centers (PHC) and fifty-eight (58) hospitals. .
Prevalence of Diseases in the study area	The commonest and most prevalent diseases affecting all age groups in the communities are Malaria Fever, Upper Respiratory Tract Infection, Typhoid Fever, Diarrhoea/vomiting and Rheumatism. Other common ailments in across the entire project LGAs: include Worm Infestation, Diabetes Mellitus, Lower Respiratory Tract Infection, and Arthritis.
Traditional Medical Practice	The practice of traditional medicine was common in almost all the communities, especially those within the Ikpoba-okha, Okpe, Ughelli North and Ethiope west LGA. Traditional birth attendants are also popular. In many of the communities where there are no health facilities, their services were the only functional form of ante-natal and maternal services available.
Sexual Activities and Knowledge of (STI)	Three quarter of the respondents is aware of the causal and preventive measures against STIs.
Land Use	The land uses of the project area are predominantly agricultural fields, swamps and fallow lands.
Occupation	The respondents are mainly into trading, farming, civil service and self-employed.
Artisanal Skills	Experienced pylon assembler, Carpenter, Welder, Electrician, Truck driver, Taxi (car, tricycle, motorcycle), Heavy machinery operator, (*shovel operator, caterpillar, etc.)* Mechanic, Mason, Painter and Chainsaw operator

Income	The average income of households in of the respondents in both states were below ₦500,000 per annum It was observed that the basic challenges to income generating activities in the project area includehigh cost of transportation, high level of post-harvest loss, epileptic power supply, lack of access to credit facilities, lack of farming inputs and inadequate extension services, post-harvestlosses 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 source. On the other hand, kerosene was the most used energy source for cooking.
Households' Main Source of Potable Water	About 66% of households in the project area use 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 isthe prevalent refuse disposal method in the area followed by refuse incineration. However, most households practice both methods. About 60% and above of respondent's households in Ethiope West, Sapele, Uvwie and Ikpoba-Okha LGAs use the Water Closet (WC) system while about 25% of respondent households in the project area used the pit latrine. About 15% of the households use the bush.
Vulnerable Groups	The most vulnerable group across the LGA's is non-indigenes, children and women.
Cultural Heritage Resources	There are no cultural sites within the way leave and within the 500m on either side of the RoW.
Gender Issues	All the middle-aged female respondent population claimed to be circumcised. However, some teenage respondentsin Okpe and Ughelli North claimed to be uncircumcised. In terms of **land ownership**, there is a higher ratio of male landowners than female in project area. This was claimed to be related to the culture of preferentially giving wealth to men over women on inheritance. About 56.3% of the female respondents claimed been physically abused by their partners.

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

Delta State Environmental Laws

- ✓ The Bendel State Town and Country Planning Laws Cap 165 (as applicable to Delta State) of 1975
- ✓ Delta State Environmental Protection Agency Edict No 5 of 1997
- ✓ Delta State Ecology Law, 2006
- ✓ Bendel State Forestry Law Cap 59, 1976 (now applicable to Delta State).

Edo State Environmental Laws

The enabling legal instruments of the state include;

The enabling legal instruments of the state include;

- ✓ Edo State Pollution and Sanitation Law No 5 of 2010
- ✓ Edo State Ministry of Environment and Public Utilities (MEPU)
- ✓ Edo State Ministry of Land, Housing & Survey

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
- ✓ 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
- ✓ International Labour Organisation C155 and R164 2001: Management of Work Place Health and Safety and Management of Work Place Hazards

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

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

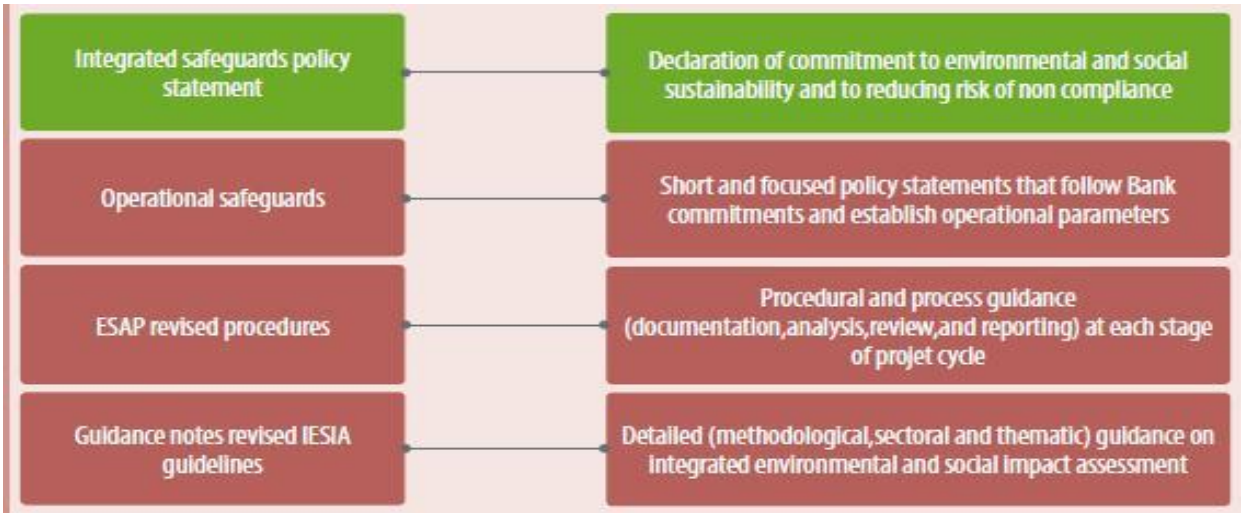


Figure ES-2: Structure of the AfDB ISS

TCN's HSE 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)

- ✓ Delta State Ministry of Environment
- ✓ Delta State Ministry of Land Survey and Urban Development
- ✓ Delta State Ministry of Women Affairs
- ✓ Delta State Ministry of Transport
- ✓ Delta State Waste Management Board (DWMP)
- ✓ Delta State Ministry of Works
- ✓ Edo State Ministry of Environment and Public Utilities
- ✓ Edo State Environmental and Waste Management Board (EEWMB)
- ✓ Edo State Ministry of Transport
- ✓ Edo State Ministry of Women Affairs and Social Development
- ✓ Edo State Ministry of Physical Planning and Urban Development
- ✓ The Customary District Councils head of each affected LGA
    - Uvwie
    - Ugheli North
    - Okpe
    - Ethiope west
    - Sapele
    - Ikpoba-okha

- ✓ 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 =
- area of forest/natural vegetation lost= 102.5 ha
- Surface water physico-chemical parameters above WHO/FMEnv regulatory limits = Turbidity, DO
- Invasive species= *Chromolaena odorata*

- Avian Raptor species= *Polybroides typhus*
- Migratory species = *Polybroides typhus*
- Estimated amount of greenhouse gas to be generated by project activity= 808,990.5 $MTCO_2$ Equivalence
- Number of households to be displaced = 1,693
- Negative net GHG emission = 808,941.68 $MTCO_2e$.
- Economic displacement of about 1,182 (crops = 1,121 and 61 shops)

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-2.

Table ES-2: Details of Stakeholder Consultation

Objectives and Information Provided for Rounds 1: The target group is Institutional Stakeholders. The objective is to apprise them of the pro and cons of the proposed project and obtain their buy –ins and early input					
Reconnaissance Mission with AfDB, TCN and GNL of 19th to 26th April 2019. This is to afford the AfDB team first-hand assessment of the route in order to generate an aide Memmorie for the projects.					
Appraisal Mission of 03-15thJuly involving AfDB, TCN and GNL – The target is to review progress made since last visit. Appraisal Mission of 11th July 2019 involving AfDB, TCN, GNL and FMEnv at Environment House, Abuja. This aim was to ensure that the country's system is been followed and obtain their approval for AfDB ESIA structure which was granted.					
Delta State Round 1			Edo State Round 1		
Target group	Date & Venue	Comment & Implementation	Target group	Date & Venue	Comment & Implementation
FMEnv	Ministry Office 23/7/ 2019	Advised TCN to develop the SEP and strictly implement it throughout the project lifespan, to ensure stakeholder confidence and sustainability.	FMEnv	Federal Secretariat Benin 22/7/ 2019	Ensure Environmentally friendly activity and during operations proper safety equipment and personal protective equipment to perform their work safely was advised.
FMAFNR	Topview Hotel 23/5/ 2019	Stressed the need for State matrix to be applied in computing compensation. Also, transparency in enumeration exercise	FMAFNR	Benin City & Topview Hotel 23/2/ 2019	Compensation for PAPsand PACs was stressed while footprint for

					access route creation should be minimized
FMLS	Ministry Office 23/7/ 2019	They advised that proper route studies be carried out and also affected land developers should be compensated	FMLS	Federal Secretariat Benin 27/2/ 2019	Compensation for PAPsand PACs was stressed. Also, professional conduct was advised.
FMPHUD	Ministry Office 23/7/ 2019	They harped on due process on landand reminded all that the TCN shall bear the processing charges.	FMPHUD	Federal Secretariat Benin 22/7/ 2019	The design and type of equipment should be that which meet international best practice.
NERC	Ministry Office 22/7/ 2019	Ensure that performance standards are met and maintained	NERC	Federal Secretariat Benin 22/7/ 2019	Emphasized that performance standards are maintained
NSCDC	Topview Hotel 23/7/2019	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	Benin City & Topview Hotel22/7/2019	Stressed out the risk in working at night and advised for proper journey management
DSS	Ministry Office 27/5/2019	Security details should be engaged during field exercise	DSS	Federal Secretariat Benin 29/4/2019	Workers should be provided with identity card due to the security threat.

DME	Ministry Office 27/5/ 2019	They advised on occupational health and safety procedures and wearing of reflective clothing on site	EME	Federal Secretariat Benin 29/4/ 2019	They called for compliance with the state environmental laws and regulation
DMWH	Ministry Office 23/7/ 2019	They expressed their desire that TCN should carry them along during enumeration process	EMWH	Federal Secretariat 3/5/ 2019	They expressed their desire to give entitlement metrix
DMLS	Ministry Office 22/05/2019	they advised that proper survey should be done to mark interstate boundaries to prevent communal clash	EMLS	Federal Secretariat Benin 21/7/ 2019	promised to facilitate and fast track the processes to gazette the ROW when TCN applies.
Nigeria Environmental Society (NES)	23-07-19 Ministry office	They advised project managers to show professionalism in handling the project to avoid environmental hazard and pollution	Nigeria Environmental Society	Federal Secretariat Benin 21/7/ 2019	The project should fully understand the livelihood pattern within the area
Ministry of transport and FRSC	23/7/2019 Topview Hotel	They were concerned about the traffic on major road at crossing point in relation to project activities such as unstringing of lines and dismantling of towers	Ministry of transport and FRSC	Federal Secretariat Benin 21/7/2019	They were concerned about the quantity and type of vehicles to be used in the transport of decommissioned and construction materials
Nigeria Conservatio	Ministry office 23/7/2019	There were concerned about the measures TCN has put in place to mitigate impact on heavier nest during tower dismantling	Nigeria Conservatio	Benin City & Topview Hotel 3/5/2019	They were concerned about routing of the line and the impact it will put on important biodiversity hotspot

n Foundation				n Foundation			and suggest the existing line be maintained
Delta State				Edo State			
LGAs	**Community**	**Date & Venue**	**Comment & Implementation**	**LGA**	**Community**	**Date & Venue**	**Comment & Implementation**
Sapele	Ojikwa	23-05-19 Village head's palace	They asked for the project Benefits and also employment opportunities for the youths	Ikpoba-okha	Okonaovi	21-07-19 Village head's palace	They complained about dust, noise during construction phase
	Eneose Island	23-05-19 Village head's palace	Their major concern was corona effect they believe it causes impotency among men.		Okaubogu	21-07-19 Village head's palace	They asked about the likely impact caused by electromagnetic fields (EMFs) on animals, people and vegetation
	Amukpe	23-05-19 Village head's palace	They were concerned about their farmlands that would be affected during access road construction		Okabere	21-07-19 Village head's palace	They were concerned about the houses around the right of way and relocation measures put in place by the government.
	Adagbarassa	23-05-19 Village head's palace	They were concerned about the houses around the right		Ekae	21-07-19	They asked for improvement of electricity supply in their village

			of way and relocation measures put in place by the government.			Village head's palace	
	Oyohe	23-05-19 Village head's palace	They were concerned about their farmlands where the project cuts across		Idunmwun ivdiode	21-07-19 Village head's palace	They were scared and showed concern on fire outbreak due to electrical surge
	Oviri	23-05-19 Village head's palace	The people major concern was the effect of the project on their water body which the project cuts across.		Etete	21-07-19 Village head's palace	They complained of not having steady electricity and asked for improvement of electricity supply in their village
	Ogegere	23-05-19 Village head's palace	They advised to beware of swampy areas that cannot be easily detected		Aubriaria	21-07-19 Village head's palace	They asked about the duration of the project and its advantage to their community
	Odjedi	23-05-19 Village head's palace	They asked that the youth in the community be gainfully engaged in the project		Oha	21-07-19 Village head's palace	They asked on how the project will benefitthem and also employment opportunities for the youths
	Gbimidaka	23-05-19 Village head's palace	They were concerned on how access road would be		Obaretin	21-07-19	They asked that electricity supply should be steady in their community

			created and the impact on their farmlands and crops			Village head's palace	
	Egbeku	23-05-19 Village head's palace	They showed major concern on the security of their wives during the project activities		Utesi	21-07-19 Village head's palace	They showed concern on the effect of EMFs on their vegetation and animals
	Ebada	23-05-19 Village head's palace	They asked waste are dumped in their water as that is their source of water		Uhie	21-07-19 Village head's palace	They were happy and pleased to hear about the project
	Utornyatsere	23-05-19 Village head's palace	They were concerned about the houses around the right of way and relocation measures put in place by the government.		Oka	21-07-19 Village head's palace	They were concerned about the compensation given to those whose farmland will be destroyed
	Okwadiokpara	23-05-19 Village head's palace	The major concern of the people of Okwadiokpara is the improvement of electricity supply to their village		Ohoghobi	21-07-19 Village head's palace	They showed concern and advised to beware of swampy areas in the region that can cannot be easily detected

	OWkuovwori	23-05-19 Village head's palace	They asked if the project will benefit their youth		Ogbe Orogho	21-07-19 Village head's palace	They concerned about the security of their wives during project activities
	Ituru	23-05-19 Village head's palace	They requested for steady electricity in their village		Obayantor	21-07-19 Village head's palace	They were scared of sudden fire outbreak from electricity surge
	Ikwewu	23-05-19 Village head's palace	They were concerned about waste being dumped into the water where they fish as this will affect the fish		Imasabor	21-07-19 Village head's palace	They asked for the duration of the project, its advantage and disadvantage to them and their environment
	Igoyo	23-05-19 Village head's palace	They were concerned about compensation being paid to those whose houses are along access road		Ighobaye	21-07-19 Village head's palace	They advised to restrict movement at night to avoid cases of kidnapping
	Elume	23-05-19 Village head's palace	They asked that their sons be made CLOs		Edo camp	21-07-19 Village head's palace	They were happy about the project and pledge their support

	Ebada	23-05-19 Village head's palace	They were concerned about the relocation measures of the government for those where the line cuts across		Agiyo camp	21-07-19 Village head's palace	They were concerned about their farmland and the compensation to be giving to those whose crops are at risk of being destroyed
	Atakolo	23-05-19 Village head's palace	They asked that youth in the community are gainfully employed		Uwosan	21-07-19 Village head's palace	They complained about dust, noise during construction
	Amuegbedi	23-05-19 Village head's palace	They were concerned about their farmland where the line cuts across		Uroho	21-07-19 Village head's palace	Their major concern was the improvement of electricity in their village
Ethiope West	Munro Island	23-05-19 Village head's palace	They asked electricity is steady in their village		Uduehen	21-07-19 Village head's palace	They asked on how the project will benefit them and also employment opportunities for the youths
	Michaga	23-05-19 Village head's palace	They asked that the ethics of the people be followed and obeyed		Ologbo	21-07-19 Village head's palace	They were concerned about the houses around the right of way and relocation measures put in place by the government.

	Jesse	23-05-19 Village head's palace	Their major concern was the improvement of electricity in their village		Okuku	21-07-19 Village head's palace	The people showed major concerned on compensation to landowners affected by the project
	Jamieson River	23-05-19 Village head's palace	They were concerned on the effect of the project		Okha	21-07-19 Village head's palace	The major concern of the people is the improvement of electricity supply to their village
	Wright Greek	23-05-19 Village head's palace	They were concerned about the compensation to those whose farmlands are affected by the project		Okavborhan	21-07-19 Village head's palace	The community was happy about the project and pledged their support
	Warifi	23-05-19 Village head's palace	They scared of fire outbreak from electricity surge		Obenevbueribo	21-07-19 Village head's palace	They asked on how the project will benefit them and also employment opportunities for the youths
	Ovade	23-05-19 Village head's palace	They were concerned about waste being dumped into their rivers		Iyanom0	21-07-19 Village head's palace	The villages made enquiry of how long the project will take and its advantages

	Ugbenu	23-05-19 Village head's palace	Their major concern is the compensation of those whose houses are affected by the project		Evbuomoma	21-07-19 Village head's palace	They asked that their sons be made CLOs
	Sapele	23-05-19 Village head's palace	They asked of the duration of the project and how it will affect their health		Ekosa	21-07-19 Village head's palace	They asked the ethics of the people be followed and obeyed
		23-05-19 Village head's palace	Their major concern was to have steady supply of electricity in their village		Egun	21-07-19 Village head's palace	They asked to beware of interstate boundaries
Udu	Opete	23-05-19 Village head's palace	They were concerned about the houses around the right of way and relocation measures put in place by the government.	Oredo	Ugbor	21-07-19 Village head's palace	Their major concern was their local market which the project would affect
	Obodo	23-05-19 Village head's palace	Their concern was their market which the will affect				

Okpe	Mereje	23-05-19 Village head's palace	They asked questions regarding gaseousemissions and hazardous substances from transformers		Benin City	21-07-19 Village head's palace	They asked on how the project will benefit them and also employment opportunities for the youths
	Orerokpe Stream	23-05-19 Village head's palace	They concerned about the security of their wives				
	Okwuidiemo	23-05-19 Village head's palace	They asked on how the project will benefit them and also employment opportunities for the youths and their community at large				
	Okuruvu	23-05-19 Village head's palace	They were concerned about the houses around the right of way and relocation measures put in place by the government.				
	Okuotomewo	23-05-19 Village head's palace	The people of showed major concerned on compensation to landowners affected by the project and persons who farmed on rented lands				
	Okuoke	23-05-19 Village head's palace	The people asked if the project will improve electricity supply in their village				
	Okuijiorugu	23-05-19 Village head's palace	They were scared of corona effect and asked which measures wasput in place to reduce the effect				
	Okugbogbo	22-06-19 palace of village head	They showed more concern on the safety of their animals during project activity. Also, they were concerned on the advent of fallen poles.				

	Okuetolor	22-07-19 palace of village head	They asked if owners of farmlands and buildings on the RoW would be compensated
	Okuemaife	23-07-19 palace of village head	Their major concern was their local market which the project cuts across and suggested a mitigation plan by the government
	Okuabude	23-07-19 palace of village head	They were concerned on location of access road and its impact on their livelihood
	Odjedi	23-07-19 palace of village head	The villages made enquiry of how long the project will take and its advantages.
	Jakpa	23-07-19 palace of village head	The community was happy about the project and pledged their support
	Iginene	22-07-19 palace of village head	Their major concern is in the improvement of electricity supply to their village
	Egborode	22-07-19 palace of village head	The community expressed concern over their farmland were the project cuts across and suggested compensation
	Ajede	25-05-19 palace of village head	They concerned about advent falling of poles on their houses
	Ukpe sabo	21-05-19 palace of village head	They expressed concern about their farmland were the project cuts across and asked for compensation
	Ukan Market	23-07-19 palace of village head	They were happy about the project and pledge their support

	Oviri court	23-06-19 palace of village head	Youth employment was their major concern
	Ugwagbagere	25-06-19 palace of village head	They asked to be engaged and not be left out in any activity
	Okuvo	25-07-19 palace of village head	They were concerned about the noise during construction
	Opuraja	25-04-19 palace of village head	They asked for the improvement of electricity in their village
	Okuogholo	25-06-19 palace of village head	They were concerned about the duration of the project and how it will affect them
	Okuobadjere	23-07-19 palace of village head	The people showed major concerned on compensation to landowners affected by the project
	Okughurhe	23-05-19 palace of village head	The villages made enquiry of how long the project will take and how equipment would be transported to site without affecting farmlands and buildings
	Okoejeba	23-07-19 palace of village head	They were concerned about the houses around the right of way and relocation measures put in place by the government.
	London	23-07-19 palace of village head	Their major concern was the provision of jobopportunity for the youths
	Iriama	21-05-19 palace of village head	The community expressed concern over their farmland were the project cuts across and requested for compensation

	Adagbrassa	23-07-19 palace of village head	They asked if there is restriction of movement in any of the access roads
Ughelli North	Orho Agbarho	23-07-19 palace of village head	They were concerned about the houses around the right of way and relocation measures put in place by the government.
	Orhokpokpor	23-07-19 palace of village head	They called on youths' employment to be a priority
	Eruemukohwarien	23-07-19 palace of village head	They pleaded that the locals be made to supply goods and services within the RoW segment in their area
	Oguname	25-05-19 palace of village head	They reminded TCN and all third parties the privacy sanctity of their wives when the project activities commence
	Ekrerhevbe	22-07-19 palace of village head	Their major concern was the provision of job opportunity for the youths
Ughelli South	Otokutu	22-07-19 palace of village head	The effect of noise from transmission lines (corona effect) was stressed.
	Ekrokpe	24-05-19 palace of village head	The villages made enquiry of how long the project will take and its advantages. They were also concerned on alternative access roads to be used when and if movement is restricted in any of the existing one
	Ekrejegbe	24-05-19 palace of village head	They cited previous example of dust emission during construction and called for dust suppressants
	Ekakpamre	24-05-19 palace of village head	They were concerned on how access road would be created and the impact on their farmlands and crops

	Egbo	27-07-19 palace of village head	They were concerned about their water and asked that waste should not be dumped into the river.
	Oghrerhe	24-07-19 palace of village head	They requested steady electricity supply in their village and a Step-Down transformer to be installed
Uvwie	Tori	27-07-19 palace of village head	The community was happy about the project and pledged their support. They however called for openness and continuous engagement
	Enerhe	27-07-19 palace of village head	They called for their sons to be made Community Liaison Officer and cited examples of CLO appointment caused frictions in some near by communities.
	Effurun	23-07-19 palace of village head	They were concerned about provision of jobs for their sons

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, drains and roads to avoid excessive build-up of dirt
- ✓ 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 and protection of endangeredor threatened species.

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 HIV status);

Provide guidance and counseling 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 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

ES 1.5.2 Management measures of employees-communities relationship

The contractor with the supervision of the PIU will ensure:

Respect for local residents and customs;

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 or corruption and or 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, 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 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
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.

ES 1.5.2 .1 Specific arrangements and management strategies for GBV risks

Awareness Raising Strategy, which describe show 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 within put 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 with cases;

Mechanisms to hold accountable alleged perpetrators associated to the Project; -Perpetrators to what?

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-3 is an example of the monitoring adopted for the project.

Table ES-3: 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 (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, MEPU and DSME

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 HSE department 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.
- ✓ 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.
- ✓ 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
- ✓ The HSE department 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
- ✓ The Federal Ministry of Environment (FMEnv) has the responsibility for the implementation of the EIA Act 86 of 1992. Furthermore, State Ministries for Environment (Edo and Delta States) and affected LGAs have certain oversight roles, which they perform under coordination of the FMEnv

Responsibilities in the implementation and monitoring of the ESMP are shared between multiple stakeholders, including regulatory and concerned agencies, the AfDB-PIU, the TCN and the contractors (Figure ES-3).

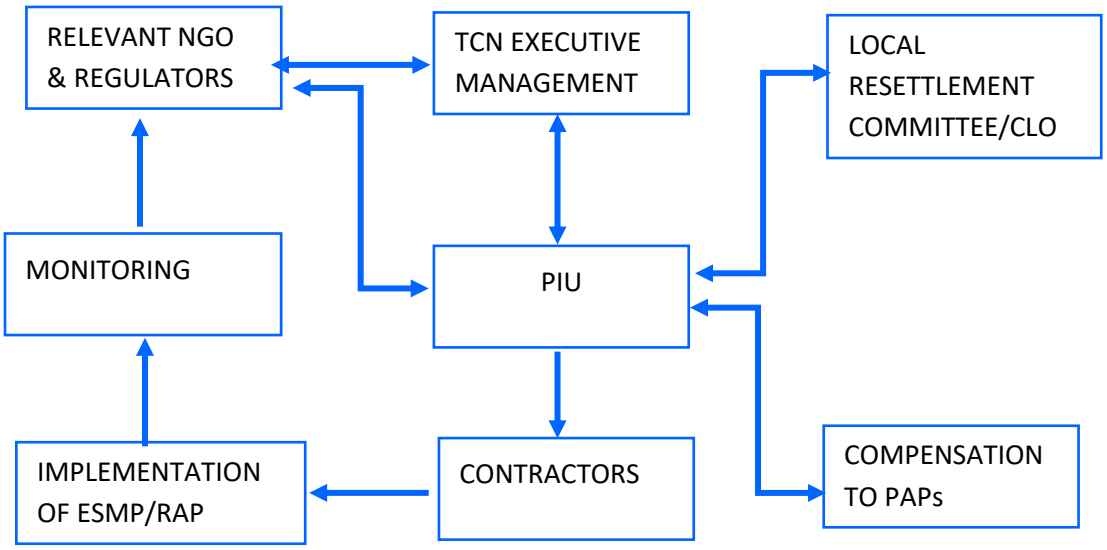


Figure ES-3: Roles and responsibilities for the implementation of the ESMP

Table ES-4: shows the components of each project implementation group.

Table ES-4 Detail of each Project implementation group

Concerned ministries	Competent authorities	Project implementation unit (PIU),	TCN and the contractors
✓ Federal Ministry of Environment, ✓ Edo State Ministry of Environment and Public Utilities	✓ Federal Government of Nigeria ✓ Edo State Ministry of Environment and Public Utilities ✓ Edo state Environmental and Waste Management Board (EEWMB)	✓ AfDB Project Implementation Unit (PIU)	✓ Transmission Company of Nigeria ✓ Local Government Area Representatives

✓ Edo state Ministry of Lands and Survey ✓ Delta state Ministry of Environment	✓ Edo State Ministry of Transport ✓ Edo State Ministry of Women Affairs and Social Development ✓ Edo state Ministry of Physical Planning and Urban Development ✓ Delta state Ministry of Environment ✓ Delta State Ministry of Land Survey and Urban Development ✓ Delta State Ministry of Women Affairs ✓ Delta State Ministry of Transport ✓ Delta state Waste Management Board (DWMP)		

	✓ Delta State Ministry of Works ✓ Local Government Authority (LGA) ✓ Village chiefs of affected Communities		

ES1.6.4Estimated overall budget

Table ES-5 presents the summarized annual estimated ESMP budget without provision for compensation (RAP).

Table ES-5: 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 Management of	4,500,000	Daily at Project site/	18,000,000	Internal Monitoring environmenta	3,700,000

Construction Phase				Operation Phase	
Component	**Cost Estimates (NGN)**	**Frequency**	**Annual Estimates**	**Component**	**Estimate per three years**
PetroleumProducts in use)		Monthly during OPS		Internal Audit (Monitor operational Technology, Codition 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

Construction Phase				Operation Phase	
Component	**Cost Estimates (NGN)**	**Frequency**	**Annual Estimates**	**Component**	**Estimate per three years**
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, 587, 250	4 times a year	6, 349, 000		
Total per project phase			69,899,000		63,430,000
Overall estimate	133,329,000				

CHAPTER ONE
IINTRODUCTION

1.0 INTRODUCTION

1.1 Background Project Information

The Transmission Company of Nigeria (TCN) wholly owned by the Government is responsible for transmitting generated electric power from various power stations to load centers across the country and beyond, ensuring efficient and cost-effective transmission, system operation, and improved service delivery. Huge gap between generation and wheeling capacity necessitated the development of the Transmission Rehabilitation and Expansion Program (TREP) involving several Developmental Financial Institutions (DFIs). This includes; the African Development Bank (AfDB), the World Bank (WB), the Agence Française de Développement (AFD) and Japan International Cooperation Agency (JICA). 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 for which reconstruction of Benin - Delta 330KV Transmissions Line (TL) in the south-south of Nigeria to be financed through loan from African Development Bank (AfDB) is one.

The project is targeted at improving power supply to Delta and Edo States, in order to achieve transmission capacity of 20,000 MW by 2025. TCN is the implementing agency and owners of the project when completed. This entire project plans reinforcement of transmission capacity, improvement of electricity supply and reduced electricity loss by installing high grade transmission systems in the area. It will contribute towards accelerated growth of the economy and development of the communities.

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

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 NTEP 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 a project specific, and implementable ESMP.
- Identify and enumerate the Project Affected Persons, Communities and their economic activities based on AfDB operational Safeguardsas outlined in the Resettlement Policy Framework.

1.2 The Proponent

Transmission Company of Nigeria (TCN), wholly owned by the Federal Government of Nigeria is the project proponent. The mandate of TCN includes the following;

- Management of assets of the High Voltage Transmission System Operations as well as generation dispatch functions.
- Operate 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 the Market Rules.
- Load forecasting and system expansion planning.
- Acquiring the necessary ancillary service 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 observe the Grid Code, Distribution Code and Market rules.

Table 1.1 provides contact details of the proponent.

Table 1.1: Contact Details of Proponents

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 Rationale for the Scoping Report

A scoping report was prepared for the project was prepared and is intended to enable:

- TCN identify and address the key issues at the start of the ESIA process and allow for early recognition of these issues in the design of the project.
- To focus the ESIA on key environmental and social issues to be assessed as part of the preparation of the ESIA and the RAP for the project.
- Improving the already prepared Terms of Reference (TOR) for the ESIA and RAP following appropriate consultation (Scoping Workshop) with all relevant stakeholders as guided by the Stakeholder Engagement Plan (SEP).

The scoping stage of the ESIA process uses a consultative and participative approach with all relevant stakeholders (informed by a Scoping Workshop) in identifying and refining the scope of the environmental and social studies to be undertaken for each of the sub projects. It should be noted that the scope of the ESIA or RAP may also be updated during project execution when new or additional information becomes available either from technical studies or from project stakeholders.

1.4 Objectives of the Scoping Report

The Scoping Report is developed to meet the following objectives:

- Provision of a detailed description of the project;
- Description of the project alternatives including the environmental and social considerations taken in selecting and adopting the preferred transmission line routes and substation locations. Constraints mapping with high resolution satellite imagery will need to be used to inform the preparation of the project alternatives analysis chapter;
- Definition of the direct and indirect project area of influence as determined by the physical, biological and socio-economic conditions. Detailed mapping shall be used in presenting the areas of influence of the individual projects;
- Description of potential projects in the project areas of influence that will be assessed as part of the cumulative impact assessment of the ESIA;
- Description of the existing environmental and socio-economic baseline (prevailing in the absence of the project), including information obtained from site visits undertaken for the purposes of scoping;
- Description of sensitive receptors for all relevant environmental and socio aspects. The identification of sensitive receptors will help to inform the scope of the baseline studies to be undertaken
- Presentation of a methodology for undertaking the environmental and social impact assessment, including identifying significant and residual impacts;
- Preliminary identification of the potential environmental and socio-economic issues associated with the proposed project;
- An analysis of the vulnerability of the project area to climatic changes and their impacts on the transmission lines and assets associated with it
- Organization of a Scoping Workshop (under the auspices of the Federal Ministry of Environment) to obtain early input from key stakeholders in the identification of potential impacts and mitigation measures;
- Identification of key data gaps and define a proposed Terms of Reference (ToR) for the ESIA and RAP study;

- Development of a comprehensive Stakeholder Engagement Plan (SEP) including the identification of analysis of all key stakeholders likely to be involved during project development and implementation of all project phases.
- Define a program for consultation with all relevant stakeholders identified in the Stakeholder Engagement Plan (SEP).

  A key component of the objectives of the scoping report is to ensure that the various Environmental and Social components to be studied in the ESIA of the proposed project are in tandem with the standards of the African Development Bank via its Integrated Safeguards Systems. The scoping report is also required to ensure that the proposed Environmental and Social components to be covered in the ESIA study meets the country's EIA standards as stipulated by the Federal Ministry of Environment.

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 NTEP, 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.

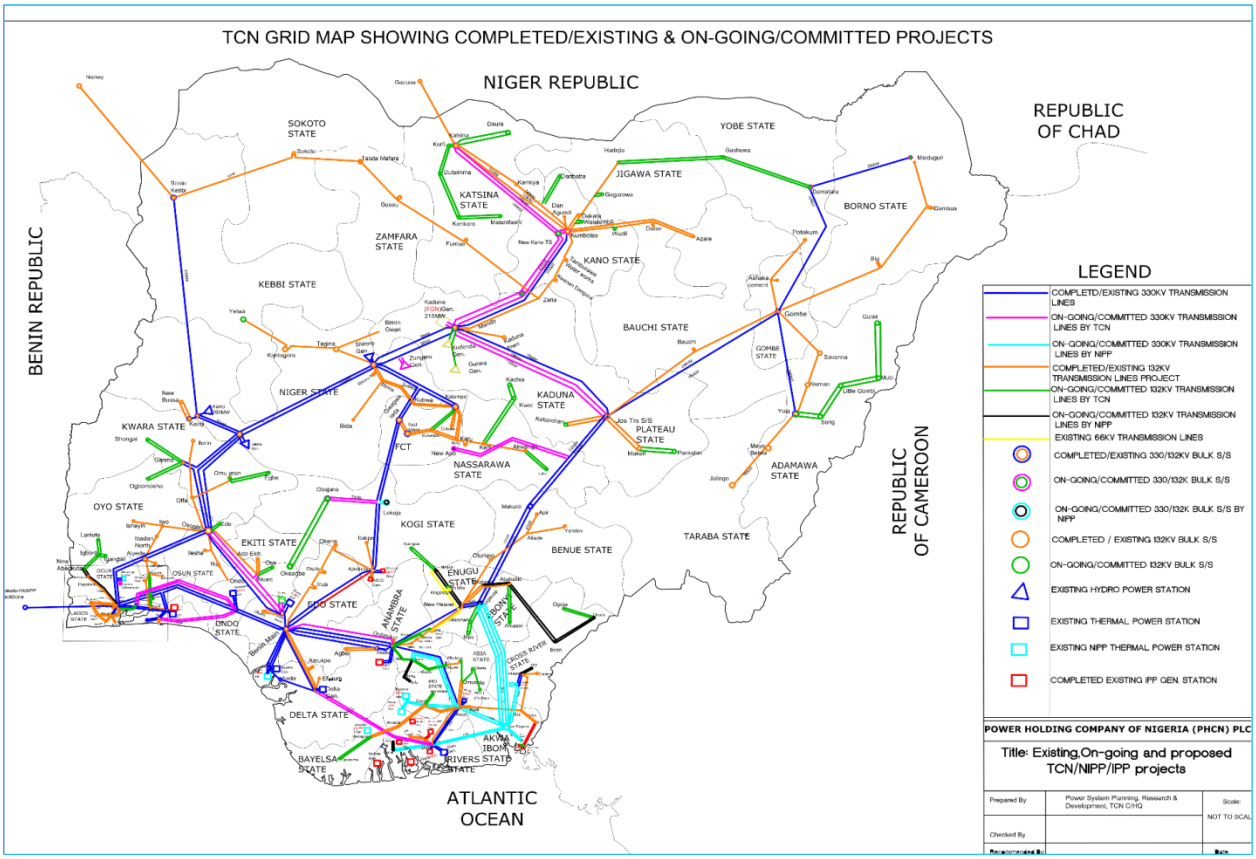


Figure 1.1 : Existing On-Going and Completed Transmission and System Operation Infrastructure

Increase in the generating capacity without a commensurable expansion in the transmission architecture as shown in Fig 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 4,000MW) was also at its lowest ebb (NERC 2018), implying a strong correlation between boost in economic activities and improved power availability.

1.7 Summary of the Key activities undertaken in line with the EIA procedures in Nigeria

Table 1.2 outlines regulatory requirements within the Nigerian Regulatory framework.

Table 1.2: ESIA Approval Process in Nigeria and activities undertaken so far

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
Authority Visit	This step provides the regulatory authorities (FMEnv, affected state and LGAs Environment Ministries and Departments respectively) and the supervisory Ministry (Ministry of Power) 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
Scoping	Scoping workshop was conducted to gain early stakeholders' input into the ESIA process	This step has been satisfied	See Attendant register
Project Categorization	Steps 2 and 3 provides the regulatory and supervisory Ministries with the project overview, environmental settings and stakeholder concerns/perception to be factored into the categorization process	Official Terms of Reference was issued	See Appendix 1.1 for ToR
Data Gathering Exercise	Data gathering exercise was conducted with active involvements of FMEnv, State, LGAs and TCN officials	This was conducted from May28 – 2nd June 2019 and additional studies between June 24-26, 2019 RAP studies and	See Appendix 1.1 for ToR

		further consultations were held between July and August2019	
Submission of Draft ESIA report	FMEnv Specified copies of draft ESIA report is submitted	TBD	Not Applicable yet
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 yet 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 yet Applicable
Issuance of Approval Certificate	This conveys the approval to construct on the client	TBD	Not yet 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	**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 9	**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

CHAPTER TWO

LEGAL AND REGULATORY FRAMEWORK

2.0 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 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, AfDB and 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 environmental and social standards applicable to the 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.

2.1 National Environmental & Social Policies

2.1.1 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 environment 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.

2.1.2 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. FMEnv categorizes mandatory study activities into three categories: Category 3 activities have beneficial impacts on the environment. The Category 2 activities (unless within the Environmentally Sensitive Area) do not require full EIA, while Category 1 activities requires full and mandatory ESIA. 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.

2.1.3 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.

2.1.4 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.

2.1.5 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.

2.1.6 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.

2.1.7 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.

2.1.8 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 tranquility 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.

2.1.9 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.

2.1.10 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.

2.1.11 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 Propertyin 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 E9 LFN 2016	The Act provides for the conservation and management of Nigeria's wildlife and prohibits the hunting, capture and trade of Endangered species.
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 thereto including penalty for offences for individuals and corporate bodies. 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,	The Act provides compensation to employees who suffer from occupational diseases or sustain injuries arising from accidents at

2010	workplace or in the course of employment. Payment of compensation (to the worker or to his dependents in case of death) 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 application for land development would be rejected if such development would harm the environment or constitute a nuisance to the community.
EIA Procedura Guidelines, 1995	Provides Procedural context and guidance for the conduct of EIA in Nigeria
Natural Resources Conservation Act CAP 268 LFN 1990	The Natural Resources Conservation Act CAP 268 LFN 1990 is the 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 Energy Sector Policies and Legal Provisions

2.2.1 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.

2.2.2 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 provides requirements for licensing and stipulates that no person shall construct, own or operate an undertaking or in any way engage in the business of electricity generation (excluding captive generation), electricity transmission, system operation, electricity distribution or trading in electricity without a license except for generating electricity not exceeding 1MW in aggregate at a site or distribution of electricity with a capacity not exceeding 100 kilowatts (KW) aggregate at a site. 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 affords rights holders and/or land occupiers to challenge the declaration by the Commission. It states that any person or group of persons including the right holders or occupiers affected by the decision of the Commission may apply to the Commission for a review of the Commission's decision (Sections 77(8), 50(1) and 78(4), EPRS Act). The EPSR Act also affords the concerned aggrieved party the opportunity of being heard publicly in accordance with Sections 36 and 44 (1) (b) of the 1999 Constitution, as amended. Moreover, an aggrieved party may further appeal against the decision of the Commission to the Federal High Court (Section 49, EPSR Act).

2.2.3 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.

2.2.4 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

2.2.5 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.

2.2.6 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").

2.3 Nigerian Gender Related Policies

2.3.1 The Gender Policy Framework in Nigeria

The 1999 Constitution ofthe 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'.

2.3.2 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 labor legislation and collective bargaining, the particular circumstances of women are considered and that measures are promoted to eliminate discrimination on the basis of gender; and
- Ensure that there is a gender perspective in all sectors of development.

2.4 Nigerian Institutional Provisions and Arrangement

2.4.1 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. Some of the other mandates of the Ministry include but not limited to:

- Advising the Federal Government on national environmental policies and priorities, conservation of natural resources, sustainable development as well as scientific and technological activities affecting the environment and natural resources; and
- Prescribing standards and formulating regulations on water quality, effluent limitations, air quality, atmospheric protection, ozone protection, noise control as well as the removal and control of hazardous substances.
- Issuance of environmental permit to proponents of development projects who meets the country requirements.
- Certifying competent institutions and indiviuals to carry out EIA in Nigeria

2.4.2 National Environmental Standards and Regulations Enforcement Agency (NESREA)

The National Environmental Standards and Regulations Enforcement Agency (NESREA) was established by the NESREA Act of 30th July 2007 as an Agency of the FMEnv. NESREA is charged with the responsibility of enforcing all environmental laws, guidelines, policies, standards and regulations in Nigeria. It also has the responsibility to enforce compliance with provisions of international agreements, protocols, conventions and treaties on the environment to which Nigeria is a party.

2.4.3 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) parastatals 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)
- 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.

2.4.4 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.

2.4.5 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 whom TCN can supply directly.

2.4.6 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.

2.4.7 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

2.5 Delta State Environmental Laws

The Bendel State Town and Country Planning Laws Cap 165 (as applicable to Delta State) of 1975

This law grants the Government and its operating agencies the authority to require lands and undertake layouts and boundary adjustments of plots, if necessary, authority to grant leases and sell plots as necessary as well as preservation of trees, landmarks for amenities, authority to approve building designs and external appearance of structures; prohibition of unsuitable buildings.

Delta State Environmental Protection Agency Edict No 5 of 1997

The DSEPA is an agency under the Delta State Ministry of Environment. Although the EIA decree No 86 of 1992 is the substantive law that regulates the sitting of industrial projects that impinge on environmental elements, with part of the project in Delta State, this edict has a role to play in the overall EIA process as a matter of law. The edict setting up the Delta State Environmental Protection Agency (DELSEPA). Captioned as Edict No 5 of 1997 outlines the primary responsibilities of the agency, which is to protect and develop the general environment of Delta State.

Delta State Ecology Law, 2006

The law empowers the Delta State Ministry of Environment with the responsibility of protecting the environment in order to achieve sustainable environmental development in the State. It empowers the Ministry with the statutory responsibility of handling environmental pollution cases. It liaises with oil companies on pollution matters. It enables, the Ministry to participate in the management of oil spills in the State .It empowers the Ministry to be an integral part of the Joint Investigation team (JIV) that investigates the causes of oil spills; carrying out assessment of damage to the environment, property, health and assessment of the ecological damage to the marine and terrestrial habitat as well as vegetation and ecosystem. The law also empowers the Ministry to handle flood and erosion cases.

Bendel State Forestry Law Cap 59, 1976 (now applicable to Delta State)

This law is all about the sustainable use of Delta State forests and its biodiversity which is a renewable source of wealth in the area especially for tourism, food supply, fuel and timber as well as the protection of the environment in Nigeria

2.6 Edo State Environmental Laws

Edo State Ministry of Environment and Public Utilities (MEPU)

The Ministry is responsible for waste management, flood and erosion control, forest depletion and degradation and general environmental and atmospheric pollution

Edo State Ministry of Land, Housing & Survey

The Ministry acquires, values and allocates public real property for public projects and gazettes such acquisitions by the State with the Ministry

Edo State Pollution and Sanitation Law No 5 of 2010

This deals with the general environmental health and sanitation. Implementation and enforcement in the state.

Edo State Ministry of Local Government regulations

The Ministry is responsible for:

- Co-ordinating the activities of Local Government Councils;

- Resolving Local Government and Communal Boundary Disputes;
- Maintenance of Law and Order in Local Government Areas in collaboration with Law Enforcement Agencies

2.7 Edo and Delta Affected LGAs Bye Laws on Environment

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

2.8 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 2.3.

Table 2.3: Selected international agreements and conventions to which Nigeria is a signatory

Regulations	Year Adopted
1. United Nations Framework Convention on Climate Change (UNFCCC)	1992
2. Basel Convention on the Control of Tran boundary Movements of Hazardous 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. Convention on the Conservation of Migratory Species of Wild Animals (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 physicochemical parameters analyzed for the baseline are presented in Table 2.4.

Table 2.4: 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^oC	6-9		6.5-9	6.5 – 8.5
Elect. Cond. (µS/cm)	1000	1000	35	1000
Turbidity (NTU)		5		5
BOD (mg/L)		2.0		
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		

FMEnv 1998, WHO 2003

Table 2.5 presents WHO Guidelines for community noise.

Table 2.5: 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 classrooms 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

2.9 The African Development Bank (AfDB)

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

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 IntegratedSafeguard Systems (ISS) is designed to promote the sustainability of project outcomes by protecting the environment and people from the potentially adverse impacts of projects.

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

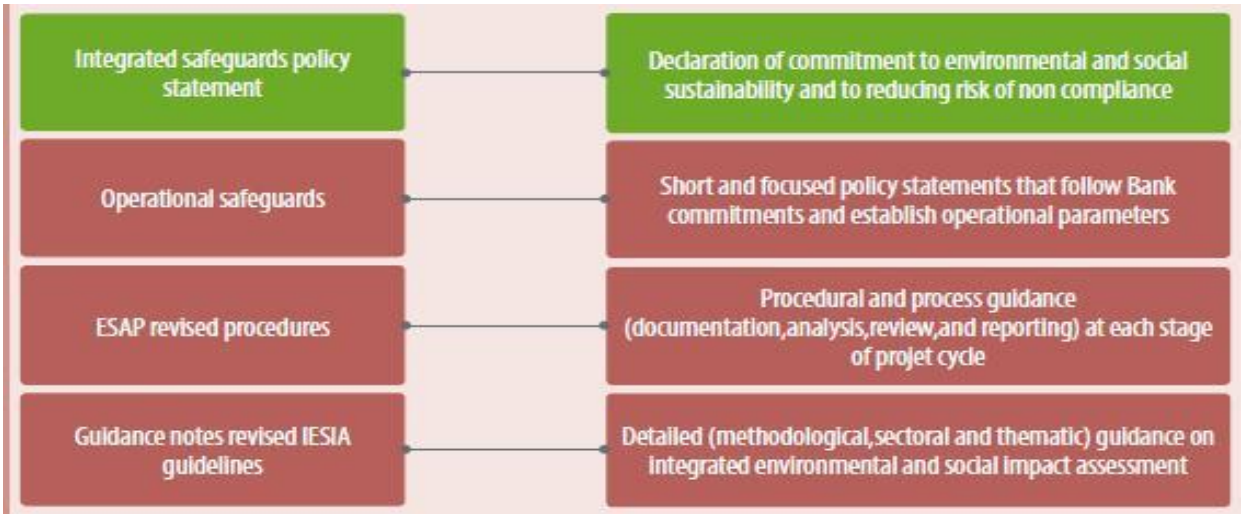


Figure 2.1: Structure of the AfDB ISS

2.9.1.1 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.

2.9.1.2 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 2.6. 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 2.6: 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: LandAcquisition, PopulationDisplacement and compensation	This safeguard consolidates the policy commitments and requirementsset out in the Bank's policy on involuntary resettlement andincorporates a few refinements designed to improve the operationaleffectiveness 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 commitments in the Bank's policy on integrated water resources management into operational requirements.	Triggered
OS 4: Pollution Prevention and Control, Greenhouse Gases,	This safeguard covers the range of key impacts of pollution, wasteand hazardous materials for which there are agreed international conventions, as well as comprehensive	Triggered

Hazardous Materials, Resource Efficiency	industry-specific and regional standards, including greenhouse gas accounting, that other multilateral development banks follow.	
OS 5: Labour Conditions; Health and Safety	This safeguard establishes the Bank's requirements for its borrower'sor clients concerning workers' conditions, rights and protection from abuse or exploitation. It also ensures greater harmonization with mostother multilateral development banks	Triggered

2.9.1.3 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.

2.9.1.4 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, indigenous peoples, 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 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 2.7).

Table 2.7: Benchmarking of Nigerian Legal Provisions and AfDB ISS Specifications

Key Element	Nigerian Provisions	AfDB Integrated Safeguard System	Provision to be Adopted by NTEP 1 Program
ESMF for Projects involving multiple sub-projects	Not a national requirement	OS 1: Environmental and social assessment	OS 1: Environmental and social assessment
Screening	EIA Act Cap E12 LFN 2004	OS 1: Environmental and social assessment	OS 1: Environmental and social assessment
Scoping	EIA Act Cap E12 LFN 2004	OS 1: Environmental and social assessment	EIA Act Cap E12 LFN 2004
Environmental and Social Impact Assessment Guideline	EIA Procedural Guidelines, 1995 EIA Sectorial Guidelines for Power Sector, 2013	IESIA Guidance Notes ESAP	EIA Sectorial guidelines for Power Sector, 2013 and IESIA 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 financial Intermediaries
Environmental and Social Assessment	EIA Act Cap E12 LFN 2004	OS 1: Environmental and social assessment	OS 1: Environmental and social assessment
Environmental and Social Management Plan	EIA Act Cap E12 LFN, 2004	OS 1: Environmental and social assessment	OS 1: Environmental
Consultation and Participation	EIA Act Cap E12 LFN 2004	OS 1 (include provision of IESIA Guidance Notes on consultation)	OS 1 (include provision of IESIA Guidance Notes 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 offered a 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 a range of different compensation packages, resettlement assistance & livelihood improvement options
Pollution Prevention	National Environmental Protection (Pollution	Operational Safeguard	Operational safeguard 4 – Pollution prevention

Control	Abatement in Industries and Facilities Generating Wastes) Regulations, 1991; and National Environmental (Surface & Groundwater Quality Control) Regulations 2011	4 – Pollution prevention and control, Hazardous materials and resource Efficiency	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 Solid and 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, health and 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	There is the need for the project consider the implications of the AfDB Gender Marker System and how to design and implement

		and political Constraints and barriers that women may face.	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 Act or 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.
Indigenous People	No Provision for indigenous people	OS 1: Environmental and Social Assessment	OS 1: Environmental and Social Assessment
Differentiated Measures for Vulnerable Group	No provisions	Provision for Differentiated measures for inclusion ESAP	Provision for Differentiated measures for inclusion)
Environmental Monitoring	EIA Act Cap E12 LFN 2004	ESAP	
Disclosure and Access to Information	EIA Act Cap E12 LFN 2004	OS 1: Environmental and social assessment	OS 1: Environmental and social assessment

2.10 NERC's HSEQ Policy

NERC has a comprehensive Health, Safety and Environment policy as well as a protocol developed for third-party contractors and all parties involved in construction works of grid stations and transmission lines. All parties that will be involved in this project must comply with the HSEQ Policy of TCN. The 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; and
- 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; and
- Electrical Regulations Act1988.

2.11 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/TCN Project Implementation Unit (PIU)
- Benin Electricity Distribution Company
- Edo and Delta State Ministries of Environment
- Edo and Delta States ministries of works and housing
- Edo and Delta States ministries of land and survey
- Truck dealers' association
- Local Governments Authority (LGA): Sapele, Ethiope west, Udu, Okpe, Ugheli North, Ugheli south, Uvwie, Ikpobaokha and Oredo respectively.
- The Customary District Councils head of each affected LGA
- Village Chiefs of Affected Communities

The responsibilities and roles of each of the institutions are discussed.

2.11.1 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.

2.11.2 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 implementation and approval, in accordance with the EIA Act. It has developed certain guidelines and regulations to protect the environment and promote sustainable development. The ministry will from the onset assent to the scope of the ESIA prepared and submitted by a project proponent, participate in data acquisitionprocess, issue country EIA permitmonitor the implementation of mitigation measures, when the project commences. And 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.

2.11.3 Transmission Company of Nigeria (TCN)

TCN as the implementation agency for the project on behalf Federal Government of Nigeria, established the Project Implementation Unit (PIU) for the end to end delivery of the project. The Project Manager heading the PIU reports to the CEO of TCN through a General Manager. (Project Coordinator) for all donor funding project.

2.11.4 Project Implementation Unit (PIU)

The PIU 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). The 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.

2.11.5 BEDC Electricity Plc. (BEDC)

BEDC Electricity Plc. (BEDC) is one of the successor distribution-companies (Discos) created following the unbundling and privatization of the state-owned Power Utility, Power Holding Company of Nigeria Plc. BEDC is responsible for retail distribution of electricity in Delta, Edo, Ekiti, and Ondo States. 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.

2.11.6 Delta State Ministry of Environment

The Ministry of Environment coordinates the environmental activities in the State through the agencies created under the Environmental Management Protection Law such as the Delta State Environmental Protection Agency. DSEPA is responsible for regulations, establishing discharge limits, and issuance of permits among others.

2.11.7 Delta State Ministry of Lands, Survey & Urban Development

This ministry is responsible for the issuance of right of way (ROW) and certificate of occupancy (C of O) for portions of line route and substation sites that falls within Delta State. Other functions of the Agency include

- Preparation and issuance of Certificates-of-Occupancy and other certificate evidencing titles.
- Preparation and issuance of Right-of-Occupancy.
- Production and printing of Titled Deed Plan (TDP).

- Street naming and house numbering.
- Provision of Geospatial information infrastructure.
- Property search and verification of land record.
- Land application processing and administration.

2.11.8 Delta State Ministry of Women Affairs and Social Development

It has the responsibility to:

- promote the survival, protection, participation and development of children;
- promote family harmony and reduce juvenile delinquency;
- provide care, support, rehabilitation and empowerment for the vulnerable groups (challenged persons, older persons, destitute and the likes); and
- collaborate and network with Non-Governmental Organizations, Professional Institutions and other MDAs on issues affecting women, children/vulnerable ones.

2.11.9 Local Government Areas (LGAs)

The project will pass through 5 (five) LGAs in Delta State and 1 (fone) in Edo State. 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 of Environment 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 as well as sites for the substations.

2.11.10 The Customary District Councils

The line route will pass through the Chiefdoms of several villages under them. The Emirs (traditional head of Districts) and Village Heads 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

2.11.11 Witness NGO

To enhance transparency and trust from PAPs it is suggested that a witness NGO, recognized and credible in the project area, be retained, through a public proposal and selection process, by the PIU to provide independent advice and report on RAP implementation and management focusing on consultation activities, compensation and resettlement related activities and grievances management. This NGO could be a recognized and credible Human Right advocacy group or an NGO active in environmental management or rural development.

This outside look will ensure that proper procedures and stated compensation processes are followed, that PAP grievances are well taken care of, and that PAPs are treated with fairness. This mode of supervision was experienced in other projects and gave good results in terms of reduction of grievances in particular.

2.11.12 Contractors

Each contractor shall appoint a qualified environmental manager who, after approval by the PIU will be responsible for daily management on-site and with respect to management measures from the ESMP and RAP. This manager will report regularly to the environment specialist of the PIU during the entire construction period.

Contractors must hold all necessary licenses and permits before the work begins. It will befall on them to provide the PIU with all the required legal documents, including the signed agreements with owners, authorizations for borrow pits and for temporary storage sites, etc.

2.11.13 TCN HSE Department

HSE department 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.

2.11.14 EIA Procedural Guidelines

ESIA is an interactive process involving the public, government, stakeholders, the contractors and other project planning groups so that any identified unacceptable environmental effects of the project are mitigated through feed back into the design and planning. Constant consultation amongst members of the ESIA project team will ensure that all relevant information regarding design, construction, operation and

maintenance are mutually appreciated. Baseline data for the assessment were acquired through field surveys, representative samples collection, laboratory and statistical analysis, structured questionnaires administration, walk through surveys, interviews, review of approved secondary data, supplemented with published data (literature) review. These enabled the existing condition of the environment (physical and social) to be established and from which using criteria set out by ESIA Decree 86 of 1992, this ESIA report was prepared. Upon production of the Draft-final-report and subjected to a public hearing, all relevant inputs of all the stakeholders shall be incorporated into the final report.

2.11.15 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 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 (Appendix 1.1).

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 negatively impacting alternative was selected. However, before presenting the justification and alternative, it is important that the project overview is presented. It involves the reconstruction of a double circuit Quad Conductor of 330kV type with a total length of about 107km between the existing TCN substation at Ughelli and sapele in Delta State and Benin City in Edo state (Figure 3.1). The Reconstruction of existing 330kV single circuit transmission line to double circuit Quad conductor involves:

- Removal of existing towers
- Installation of appropriate towers
- Widening up of access/track roads
- Installation of associated line bays at both ends of the Transmission line

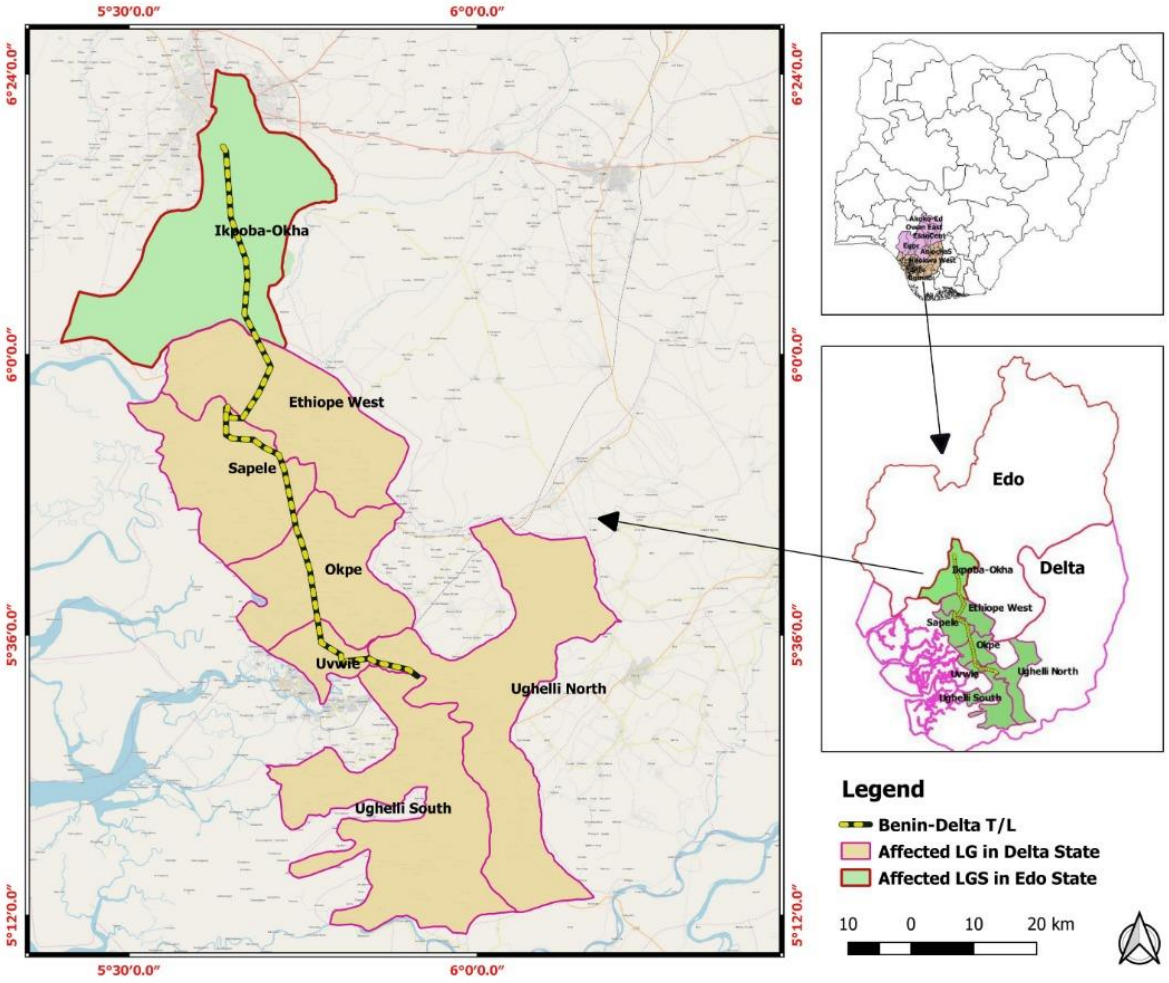


Figure 3.1: Benin - Delta Transmission Line

3.1 Project Justification

3.1.1 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 5900MW 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 Benin - Delta in particular, and the economy of Nigeria in general are numerous.

The following few are worth mentioning;

- Improved and more reliable electric power supply.
- 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 resilience of the project area through overall reduction of the used of personal power generating sets.
- Reduction in green house gases from generating sets that eventually impact the climate adversely.
- General improvement of the standard of living for the populace.

- Improve the country's revenue via improved economic activities from improved power supply.

3.3 Envisaged sustainability

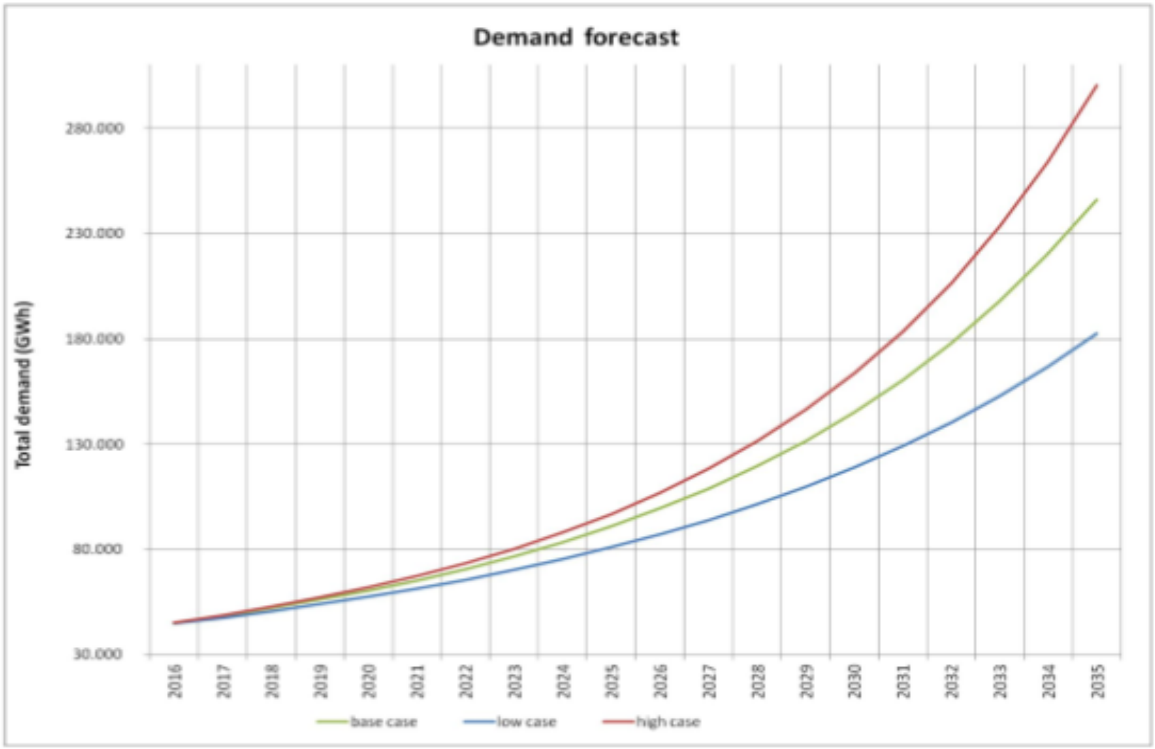
The general sustainability principles (technical, economic, environmental and social) that guided the design of the project are set out below.

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 3.2 below which shows an exponential growth in demand.



Source: Fitchner (2017)

Figure 3.2 : National demand forecast of Nigeria

In the short term, the project will be funded by loan 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 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 Benin – DeltaTransmission 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 Manager who reports directly to the Managing Director. Significant number of ESIAs and environmental audits 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 implementation of the findings and recommendations of the ESIA in the final project design shall ensure 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 shall ensure continuous safeguardingof the Environmental and Social components for ensured sustainabilityin 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 high power demand. Also, the benefit to create job opportunities for unemployed indigenes and Nigerians would ensure social 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. TCN has 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 safeguard policies throughout the various phases of the project shall also ensure the social sustainability of the project.

3.4 Project Alternatives

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. And this will result in increased gaseous emissions with its associated health effects as well as increased greenhouse gas 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 **selected** because it will, provide a more secure and reliable energy supply with all the benefits listed under Section 3.3.

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 Over head 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: Over head 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,

However, in spite of shortcomings listed against underground cabling system, its advantages in limiting the footprint of displaced persons in high density area around Effrun and Benin areas was considered. This was however jettisoned since it was not option considered in the Feasibility Study with its attendant consequences at this stage.

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 **but**accommodates only poor soils and light towers
	Pile Foundation		• It is durable, less expensive, best for only swampy soils **but** 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: Alternatives Considered for Conductor Type and Number of Circuits

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: Circuit 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 considered; the 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 suited to areas with reduced RoW due to encroachment • Can be suited in areas with huge social concerns like Benin areas and Effrun

3.5.6 Line Route Alternatives

Table 3.6 and Figures 3.3 to 3.5 summarize the various line route alternatives considered.

Table 3.6: Summary of the Three Routes Proposed for Benin-Delta T/L

Alternatives	Preferred Alternative	Description	Justification
Route 1	Route 3	This option would entail acquisition of new RoW with all its attendant social and ecological constraints. However, there are some small communities that the transmission line traverses, which will require several angle towers to avoid. It will traverse **River Ethiope and five tributaries at Ugheli, Amukpe, Sapele, Oghara and Ologbo.**	This line alternative was **rejected** because: • It passes through comparable more structure and such will result in more socio-economic issues and financial consequences with regards to resettlement

		Distance = **112km**, No. of Angle Towers =**10**, No. of buildings on RoW = **302**, Land use = **Residential, farming and derived savanna**, Geographical Conditions – Topography is **flat**, ground is **unconsolidated** and **Swampy**, Natural Disaster Risk = **Flooding**	• It crosses about six water bodies. There is high risk of sedimentation and pollution of the water bodies during construction
Route 2		This would entail land acquisition in about two thirds of the route with its attendants' cost and encumbrances. It would also create an impression that government acquired lands can be encroached upon with no consequences. Distance = **110km**, No. of Angle Towers =**8**, No. of buildings on RoW = **over 167**, Land use = **Residential, farming and derived savanna**, Geographical Conditions (Topography- Flat, ground stability = **unconsolidated and Swampy**, Natural Disaster Risk = **Flooding**	Reasons for **rejecting** this alternative as same as Line Route 1
Route 3		The line has been acquired by government except with the presence of unlawful houses and persons conducting economic activities. This option would not require land acquisition with all its attendants' social issues. It will neither require social and ecological challenges. However, the encroachers need be persuaded to vacate the route. Distance = **107km**, No. of Angle Towers =**8**, No. of buildings on RoW = **46**, Land use **Residential, farming and derived savanna**, Geographical Conditions (Topography- Flat, ground stability = **unconsolidated and Swampy**, Natural Disaster Risk = **Flooding**	This line alternative was **Selected** because • It will affect fewer structures with reduced socio-economic issues and financial implications • It does impact on two major natural water bodies only • It is cost effective

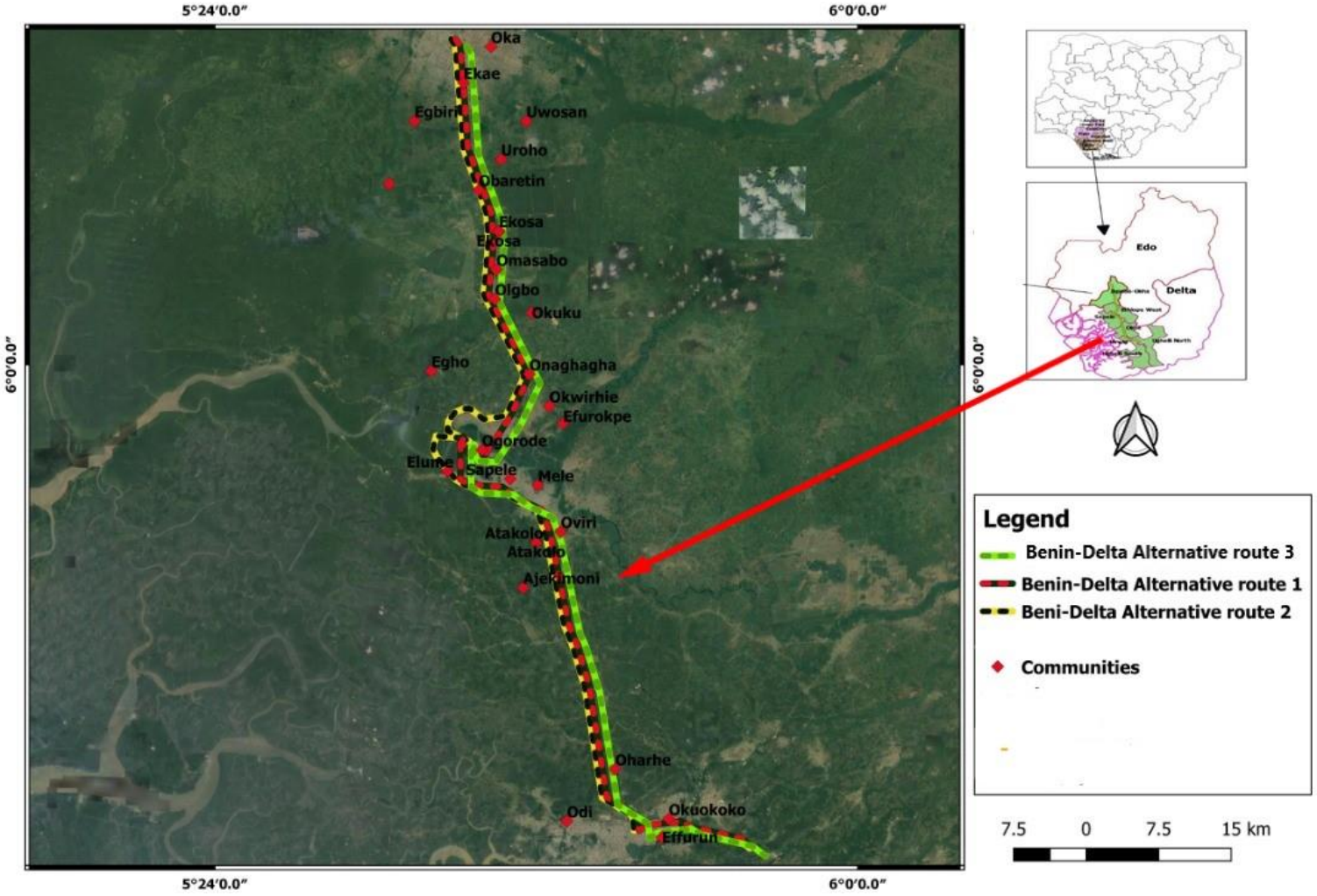


Figure 3.3: The Three Alternative Routes Considered for Benin-Delta Transmission Line

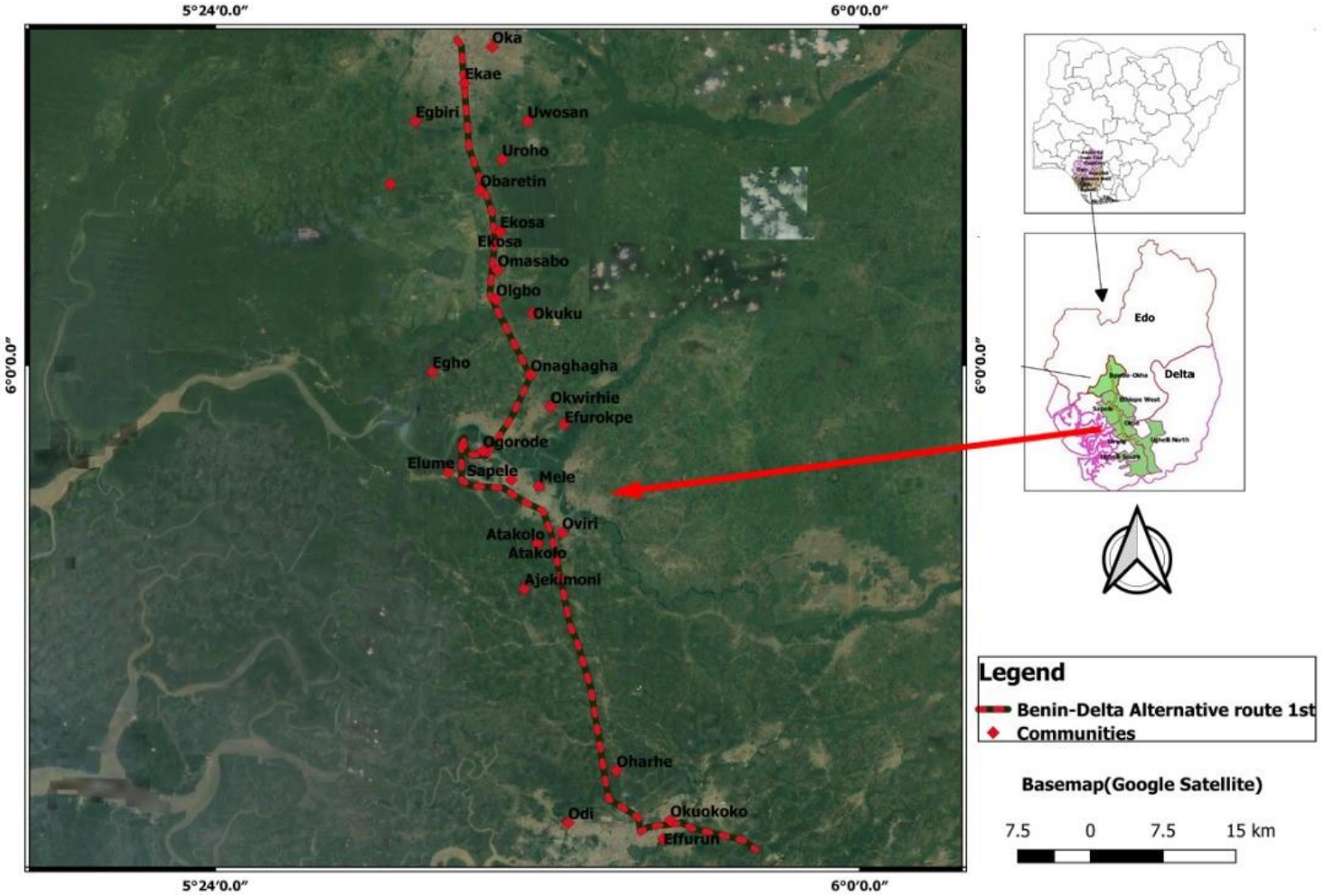


Figure 3.4: Alternative Route 1 Considered for Benin-Delta Transmission Line

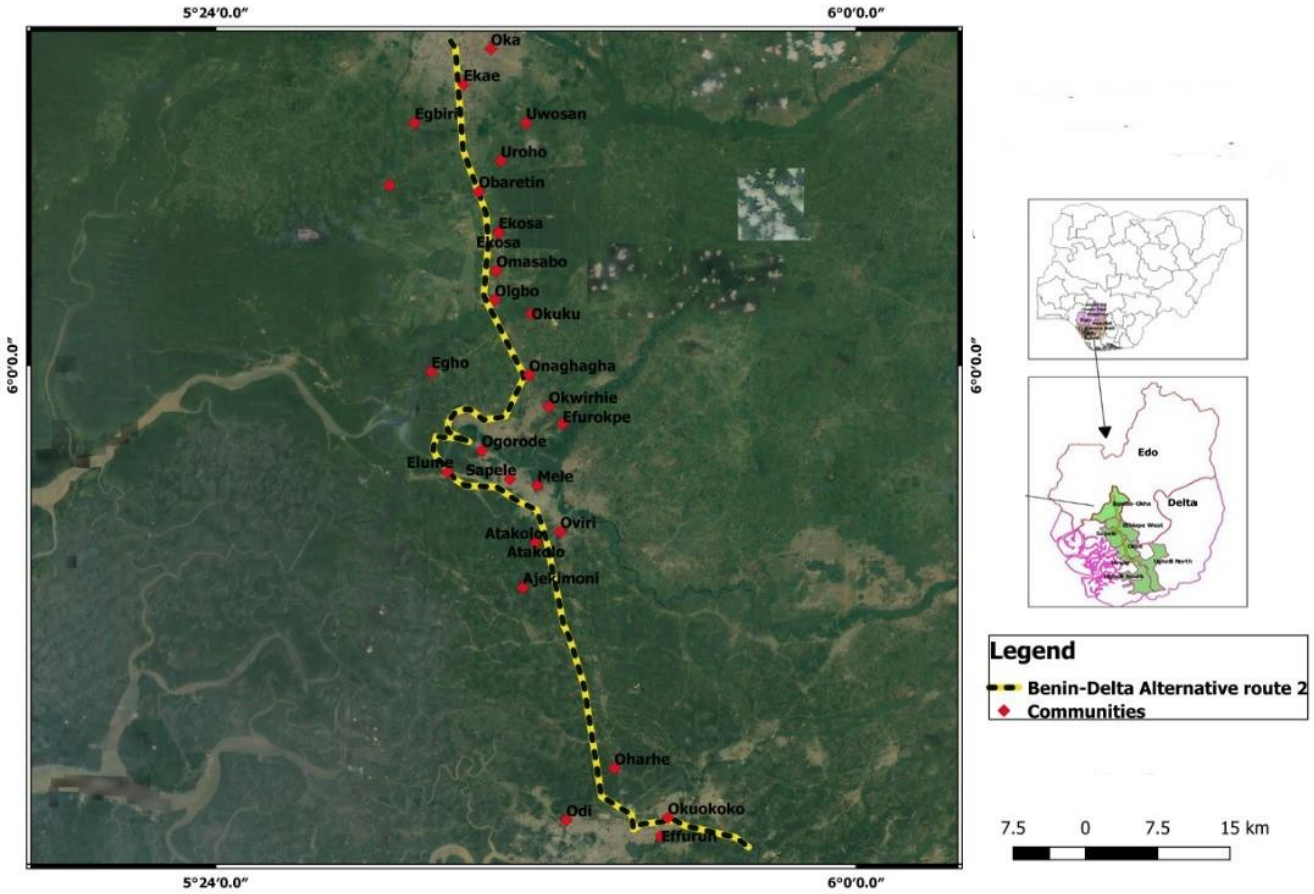


Figure 3.5: Alternative Route 2 Considered for Benin-Delta Transmission Line

CHAPTER FOUR
PROJECT DESCRIPTION

4.1 Introduction

The proposed Benin - Delta 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 107 km, between the existing TCN substation at Ughelli (Delta IV) and Sapele in Delta state and terminating at the Benin subtationin Edo State.

4.2 Project Locations

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 transversed by the Benin - Delta TL

State	Local Government	Communities
Delta	Sapele	Ojikwa, Eneose Island, Amukpe, Adagbarassa, Oyohe, Oviri, Ogegere, Odjedi, Gbimidaka, Egbeku, Ebada, Utornyatsere, Okwadiokpara, OWkuovwori, Ituru, Ikwewu, Igoyo, Elume, Ebada, Atakolo and Amuegbedi.
	Ethiope West	Munro Island, Michaga, Jesse, Jamieson River, Wright Greek, Ogharefi, Ovade, Ugbenu and Sapele.
	Okpe	Mereje, Okwuidiemo, Okuruvu, Okuotomewo, Okuoke, Okuijiorugu, Okugbogbo, Okuetolor, Okuemaife, Okuabude, Odjedi, Jakpa, Iginene, Egborode, Ajede, Ukpe sabo, Ukan Market, Oviri court, Ugwagbagere, Okuvo, Opuraja, Okuokoko, Okuobadjere, Okughurhe, Okoejeba, London, Iriama and Adagbrassa
	Ugheli North	Orho Agbarho, Orhokpokpor, Eruemukohwarien, Oguname and Ekrerhevbe
	Uvwie	Tori, Enerhen and Effurun

Edo	Ikpoba-okha	Okonaovi, Okaubogu, Okabere, Ekae, Idunmwunivdiode, Etete, Aubriaria, Oha, Obaretin, Utesi, Uhie, OkaOhoghobi, Ogbe Orogho, Obayantor, Imasabor, Ighobaye, Edo camp, Agiyo camp, Uwosan, Uroho, Uduehen, Ologbo, Okuku, Okha, Okavborhan, Obenevbueribo, Iyanomo, Evbuomoma, Ekosa and Egun

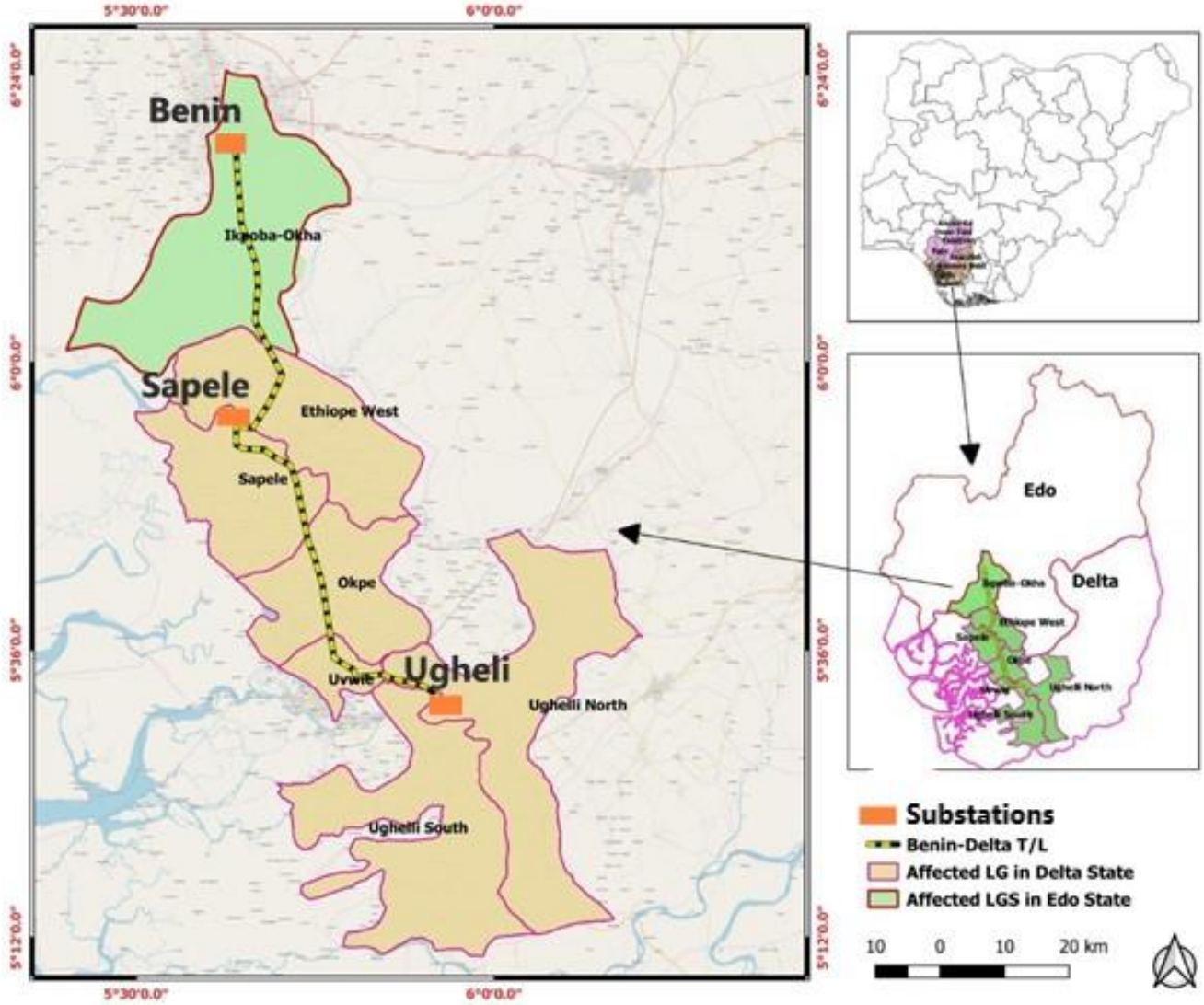


Figure 4.1 : The administrative locations of the component parts of the project

4.3 Design objectives

The proposed re-construction of the transmission line is ultimately intended to cater for the surrounding industrial and residential growth within the Project Areas. Design objectives include:

- accommodating 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 using the existing RoWs to minimize another land acquisition
- providing options for vegetation offsets and re-vegetation works
- adopting environmentally sensitive design features to reduce the clearing of canopy trees within ROWs, where practicable
- 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 107km 330kV Benin-Delta transmissionline 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 Facilities Layout

The layout of the proposed transmission line is shown in Figure 4.2.

4.6 Land Take

The Transmission Line Right of Way to be acquired for the project is approximately 107km in length and 50m wide, thereby giving a total area of about 5,490,000m^2 (54,9 ha).

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 layout of a substation is shown in Figure 4.2 while the environmental, as well as the actual design conditions, considered for the proposed transmission line and ancillary facilities are presented in Table 4.2.

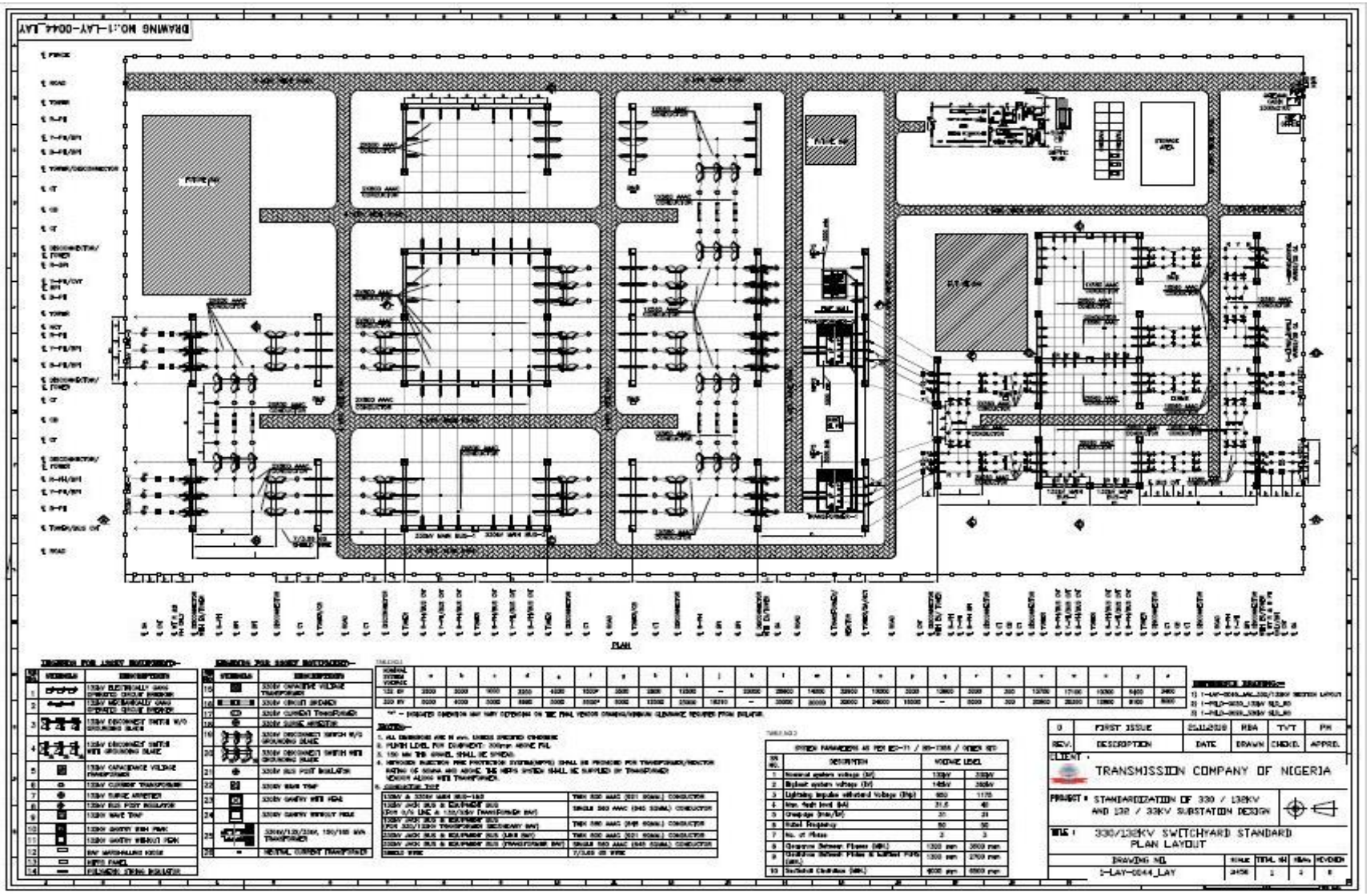


Figure 4.2: Layout of a Substation

Table 4.2: Environmental Design Conditions

Environmental Conditions	
Average Altitude	20.1
Climate	tropical rain forest and swamp forest zones environment
Maximum Ambient Temperature	40^0C
Minimum Ambient Temperature	16^0C
Mean Annual Rainfall	2750 mm
Relative Humidity (Maximum)	75%
Relative Humidity (Average)	25%
Maximum Hourly Wind Speed	33%
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 3.1 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=274, 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 sectionalarea	Aluminum	nm^2	313.1
	Steel core		43.11
	Total		356.2
Weight	Aluminum	kg/km	1227
DC. Resistanceat 20°C		Ω/km	0.0941

Current carrying capacity	GZTACSR (210°C)	A	1255
Modulus of elasticity	Steel core	GPa	206.9
Coefficient of Linear Expansion	Steel core	10-6/°C	11.5

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.

4.10.1 Line Insulation and Fittings

4.10.1.1 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.

4.10.2 Protection and Earthing System Design

4.10.2.1Lighting protection and EarthingSystem

To protect the line and towers against lightning, an earth wire conductor made of copper and galvanized steel at a shield angle of 0° 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 330kV 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. For the substations, TCN has determined that a new access road wide for the Millennium city shall be constructed.

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.

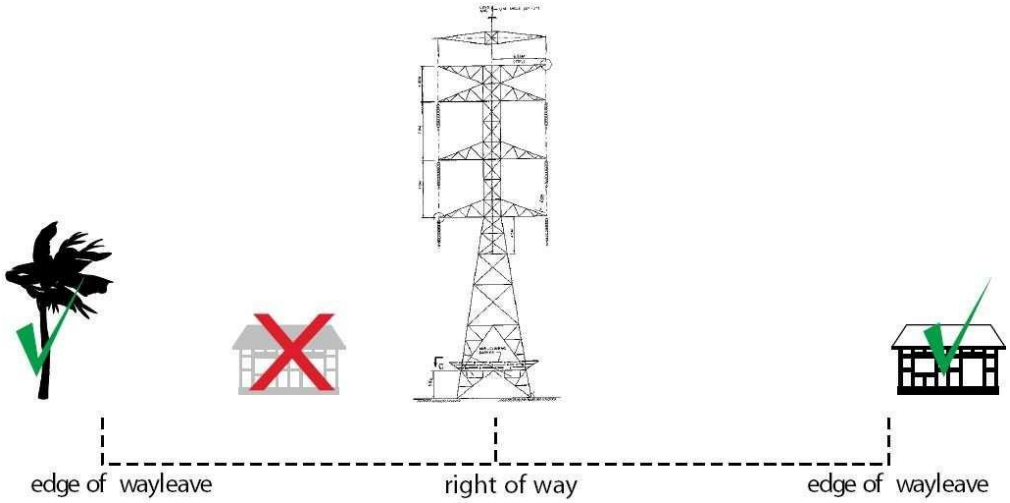


Figure 4.3: ROW Clearance along the Transmission Line

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 Benin-Warri Dual Carriage way and the Western part of the East-West Dual Carriage way. Alternative paved and unpaved link roads exist from these two road networks. One of such is the Old Benin-Sapele-Warri single line carriage which is in good shapeUsually 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.

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 Edo and Delta states waste management regulations. The excavated areas will be backfilled, covered withtopsoil and seeded with an appropriate local mix prior to construction.

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.

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.

Securityatthelay-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 patrolswill likely beused.

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 preparedso that bolt, washer, snap-ring and nut are screwed together and packed again to be carried with tower No X to site.

4.12.3 Bulk Earthworks and Site Leveling

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.

4.12.4 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 Different Phases of the Project

Requirements	Type	Source	Estimated Quantity/Numberinitial decommissioning phase and preconstruction		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
			35	15	80	20	50	10	70	30
	Laborers	Locals in the project area	200	100	2,200	1,300			400	200
	Un skilled	Locals in the project area	200	50	200	100			400	100
Raw Materials	Coarse aggregates	From the nearby existing commercial quarries	302, 400m^3		22,350m^3		Nil		Nil	
	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 liters	10,000,000 liters	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
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
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
	Elevated work 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, 2019

The two Decommissioning phases should be explained to clarify that the first one refers to the removal of old structures from the ROW prior to commencement of commencement of installation of the new ones. The second decommissioningrefers to the dismantling of the poles and other facilities upon the completion of the lifespan of this new project for which this ESIA is prepared.

Transportation

Men and equipment will be transported to the transmission site via

- Benin-Warri dual carriage way and
- East-West Road
- Old Benin-Sapele-Warri single road

Figure 4.4 provides linked roads to TL.

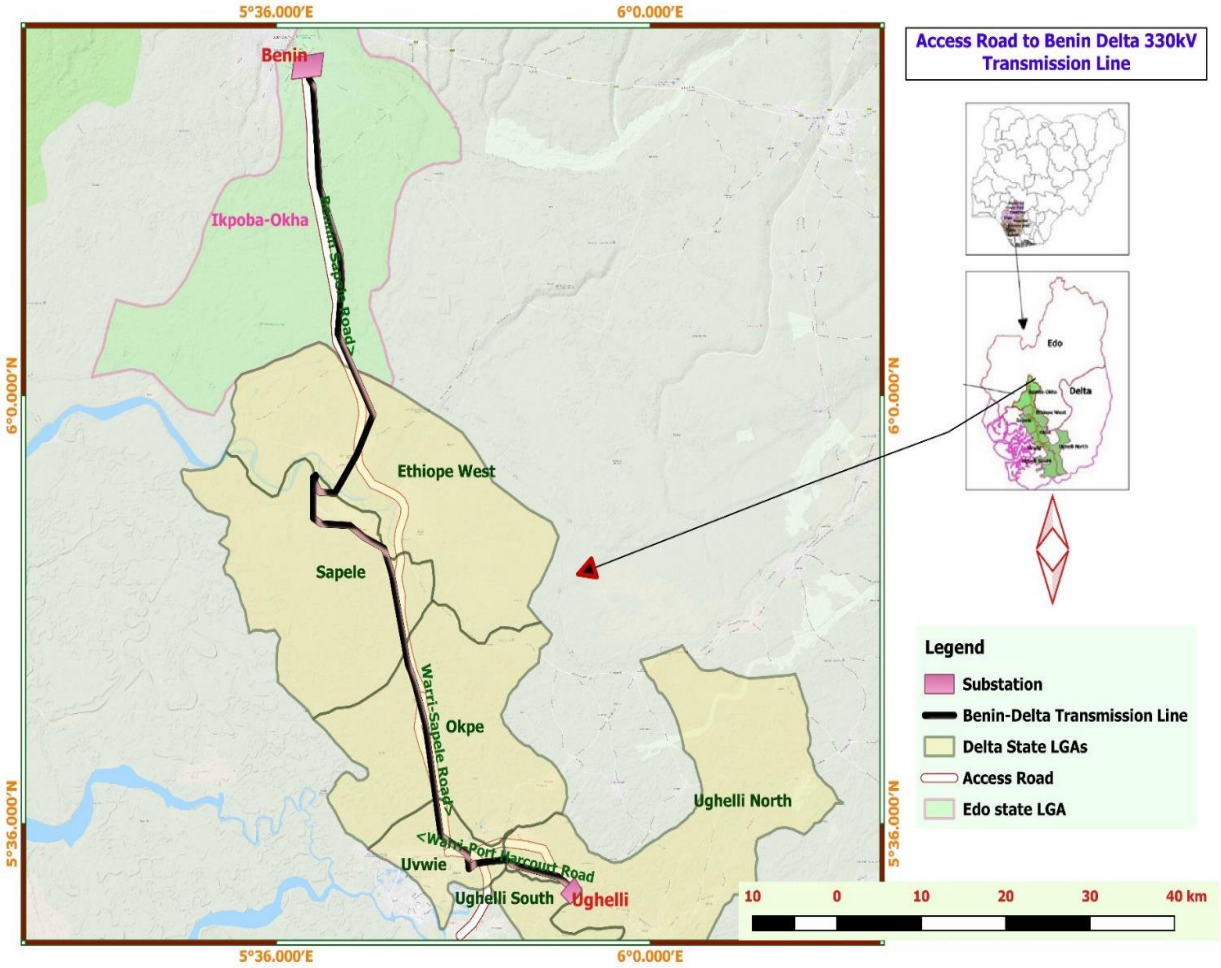


Figure 4.4: Link Roads to the Project Area

The map indicates about 8 link roads from either of the two major roads to the transmission line as shown in Table4.7 below.

Table 4.7: Link roads from either of the two major roads to the transmission line

Name of roads	Name of linked roads	Land use of the immediate environment linking roads with the line route (50m)	Distance of linked roads to the transmission line (Km)
Benin-warri dual carriage express way	Paved Okha road	Swampy	0.95
	Unpaved Ologbo road	Built up	0.28
	Paved Oghara road	vegetation	0.16
	Warri-Ajaokuta Road	Built up area and riparian vegetation	2.51
Old Benin-Warri road	Unpaved road at Oviri court	Marshy	1.53
	Unpaved road at Ebrumede	Swampy area.	0.51
	Unpaved road at Okwovu	Partly built up and partly vegetation	0.37
	Paved road by Mountain of fire campground	Built-up area, riparian vegetation and farmland	0.44
	Unpaved road at Agbarho	swampy	2.18

Plate 4.1 (a-d) shows the various access roads to be used in transporting men and materials to site.

Plate 4.1 (a) RoW at Amukpe, Sapele TL and 4.1(b) T/L cutting through East West road near Ugheli Substation

Plate 4.1 (c): Earth road from old Benin-Warri express road to TL by Oviri court community

Plate 4.1 (d) Earth road from Old Warri Sapele road at Okuovu community in Okpe LGA

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

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

4.13 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.

4.13.1 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:

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:

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

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

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

Where

S = silt content

M = moisture content

The projected particulate emission using the formula above for the proposed project is shown as:

TPM = 0.101E +01

$PM_{(10)}$ = 0.187E + 01

$PM_{(2.5)}$ = 0.975E + 01

4.14 Estimated Green House Gases (GHG) Emission Rate During the Construction Phase of the Project

4.14.1 Overview

Total emissions of GHGs from project equipment and vehicles were determined using the SCEG tool version 5.1 of 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, graders, macadam rollers, tractors, excavators, concrete batching plants) used in construction are classified as "Construction Equipment. Table 4.8 presents the details of equipment and vehicles required for the construction of the TL and access road widening.

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 footprint reduction of about 823,719.7 $MTCO_2e$ for the project life cycle resulting in positive net GHG emissions of 823,720 $MTCO_2e$. Simply put, the project would remove an estimated 274,590 metric tons of CO_2 and its equivalence (N_20 and CH_4) from the environment.

4.15 Quantification of Waste

Waste streams to be generated across the life cycle of the project are projected.

4.15.1 Site Preparation Stage waste quantification

Three types of wastes are expected from this stage:

- Vegetal waste from felled trees
- Over burden spoil
- Others (wastes) = (water sachet, water bottles, snack wraps, nylons and plastics, scraps, concrete debris, textiles, glass etc.).

It is assumed that each person(s) will eat and drink at least once during the maintenance activities and is expected to take place twice a month and will as a result generate wastes as presented in Table.4.23.

4.15.2 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 4.8 presents the details of equipment and vehicles required for the construction of the TL, and access road widening.

Table 4.8: Details of Estimated quantity and types of Equipment/vehicle required for the Project

Type of Equipment/Vehicle	Transmission line decommissioning	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

4.15.3 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 4.9.

Table 4.9: 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_2O (kg)**	**CO_2 (kg)**
Diesel Construction Equip.	17	17.3	383.8	6,640.2	218.8	99.8	17,963.5
Diesel Light-Duty Trucks	5	7.3	535.0	5,580	5.6	8.4	
Diesel Medium- and Heavy-Duty Vehicles	5	7.3	764.4	3,906	19.9	18.7	
Diesel Passenger Cars	2	23.9	76.2	2,232	1.1	2.2	
Total	29		1,759.4	18,358.2	245.4	129.1	17,963.5

In all, a total of 17,963.5 kg of CO_2 is estimated to be emitted in as a result of decommissioning the existing TL. This also includes 245.4 kg of methane and 129.1 kg of Nitrous oxide. This is approximately 60.91 metric tons of CO_2.

4.15.4 Emission Estimation during construction phase

The total estimated GHG emissions expected to result from construction activities is presented in Table 4.10.

Table 4.10: 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.	17	17.3	1535.3	26,560.8	875.1	399.2	427,220.1
Diesel Light-Duty Trucks	7	7.3	4,281	31,248	31.2	46.9	
Diesel Medium- and Heavy-Duty Vehicles	12	7.3	34,533	252,089	1,285.7	1,210.0	
Diesel Passenger Cars	8	23.9	1,494	35,712	17.9	35.7	
Total	44		41,843.3	345,609.80	2,209.9	1,691.8	427,220.1

A total of 427,220.1 kg, 2,209.9 kg and 1,691.8 kg of CO_2, CH_4 and N_20 respectively are estimated to be emitted during the TL construction. This is approximately 955.8 metric tons CO_2 equivalence.

4.16 Energy Consumption (Demand Component) Among PAPS in Benin-DeltaTL

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 4.11. 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 2.57

(http://www.eia.gov/consumption/residential/data/2009/index.cfm?view=consumption). On obtaining the figure, extrapolations weremade using an average household composition of 3.5 for Delta and 3.9 for Ed

Table 4.11: Energy consumption rates, activities and consequence annual CO_2 emitted in the affected LGAs in both states

Activity		Unit	Average Liter of Fuel per day	Average Liter of Diesel per day	Average fuel and diesel consumption Per month (liter)	Estimated CO_2 emitted per year (kg)	Estimated CH_4 emitted per year (kg)	Estimated N_2O emitted per year (kg)
Household lightening	Delta	3120	2	0.5	93,600	2,132,863.9	11,497.5	8,643.6
	Edo	1021			30,630	697,966	3,762.5	2,828.565
Artisanal operations and non-governmental offices	Delta	149	5	2	44,700	1,018,579.4	5,490.78	4,127.9
	Edo	79			22,500	512,707.8	2,763.8	2,077.8
Government offices	Delta	28	-	10	8,400	19,1411.0	1,031.8	775.7
	Edo	16			4,800	109,377.5	589.6	443.3
Banks	Delta (total number 117)	23	-	20	13,800	314,460.5	1,695.1	1,273.8
	Edo (total number 101)	15			9,000	205,083.0	1,105.525	830.7
Schools (Pre-tertiary and tertiary)	Delta	1263	5	12	2,273,400	5,180,398.3	27.925.6	20,994
	Edo	802			1,684,299	3,838,013.4	20,689.3	15,553.9

Hospitals	Delta	37	7	10	77,700	1,517,614.8	7,162.6	6,150.2
	Edo	37			67,200	1,517,614.8	7,162.6	6,150.3
Industries	Delta	154	5	20	462,000	10,527,598.0	56,750.3	42,664
	Edo	89			267,000	5,214,969.6	28,111.9	21,134.1
Total for 2.57 household						32,978,658	175,738.9	133,647.9
Total for 3.7 (combined average household size for Delta and Edo)						**44,371,285.3**	**253,009.3**	**19,2411.4**

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 44,371,285.3 kg, 253,009.3 kg and 51,566,255.2 kg respectively. This is approximately 104,539 of CO_2 equivalence in metric tons.

4.17 Emission Estimation from Fuel Wood Consumption in the Project Area

The total amount of emitted in the project area from household fuel wood consumption for cooking is presented in Table 4.12. 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 (oxidized), 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 tons of CO_2 per cubic metre of wood (Table 4.12).

4.12: 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, 2011	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 Amountin MT/yr.
Delta	5	205,851	49.8	102,513.8	1,044	107,024,407.2	196,282,762.8	196,282.77
Edo	3	318,529	68.9	219,466.5	1,260	276,527,790	507,151,966.9	507,152.00
Total	8	524,380	61.40	321,980.3	2,304	383,552,197.2	703,434,729.7	703,434.77

As could be seen in Tables 4.11 and 4.12, an estimated annual total of 703,434,729.7kg or 703,434.77 MTof CO_2 are emitted on an annual basis in the project area.

Table 4.13 outline 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 4.13: Total $MTCO_2$ Equivalence

GHG supply Component		**GHG Demand Component**	
Project Phases	**$MTCO_2$ Equivalence**	**Activities by PAPs**	**$MTCO_2$ Equivalence**
Initial Decommissioning	**60.91**		**703,434.77**
Construction	955.8	Emissions in Table 4.16 and 4.17	104,539
	1,016.71		807,973.8
Total **GHG Footprint**	**808,990.5**		
Project predicted to reduce GHG emissions by 4.8% in the project area	**4.8 x 1016.71/100**		**48.8**
Net **MTCO2 Equivalence**	808,941.68		

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 4.9 resulting in GHG footprint reduction of about 808,990.5$MTCO_2e$ for the project life cycle resulting in a negative net GHG emissionof 808,941.68 $MTCO_2e$. Simply put, the project would remove an estimated 808,941.68 metricTons of CO_2 and its equivalence (N_2O and CH_4) from the environment.

4.18 Treatment and Waste Disposal Methods

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 the locals.

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.

Fecal waste

A soak away system shall be installed in construction sites and when full, fecal waste shall be disposed of properly by relevant waste disposal agents. For the line routes workers are fully informed on waste management practices.

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.

4.19 Project Schedule

The different stages of the project implementation are contained in the work schedule attached here under Table 4.14

Table 4.14: Project schedule for the Benin-Delta 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	Feasibility studies	12												
2	Line route studies	4												
3	EIA studies	9												
4	RAP studies	9												
5	Front End Engineering Design	12												
6	EPC Contract award Process	6												
7	Mobilization	2												
8	Check survey of EPC Contractors	1												
9	Transmission Line design	2												
10	Material production (tower, conductors, insulators, line hard wares)	7												
11	Material testing	4												
12	Material shipment	2												
13	Clearing and grub site along transmission line corridor	1												

14	Decommissioning (removal of existing towers and TL)	1													
15	Foundations for tower installation and substation works	4													
16	Tower erection and substation works	8													
17	Conductors stringing	6													
18	Commissioning and testing	1													
19	Reinstallation and clean up	1													
20	Demobilization from site	0.5													
21	Commissioning	1 day													

4.20 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.

Include to the decommissioning sub heading thus:

The decommissioning plan after the life cycle of the Transmission Line project shall include conflicts and grievances resolution especially among workers and project host communities during the course of the project implementation. This is with a view to ensure seamless acquisition of the project area in the course of future development. The decommissioningplan shall also outline measures to return the project area to its natural state as much as possible**.**

CHAPTER FIVE
PROJECT AREAS 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 lay down areas and the RoW. In the construction phase, the footprint also includes ancillary infrastructure such as temporary access roads and lay down areas. 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 socio-economic 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 (500 metres on either side of the TL RoW). It is 1.5km^2 base radius for each substation. These widths account for a wider construction corridor, which will likely be required to establish temporary accesses, machinery movement, etc.
- **Socio-economic environment**: Direct socio-economic impacts are expected to be felt mostly by the villages and communities crossed, or near, the alignment. The socio-economic ADI is illustrated using a 2km wide corridor cantered on the line's route. Figures 5.1 and 5.2 (a-d) provide a graphical illustration of the Areas of Influence.

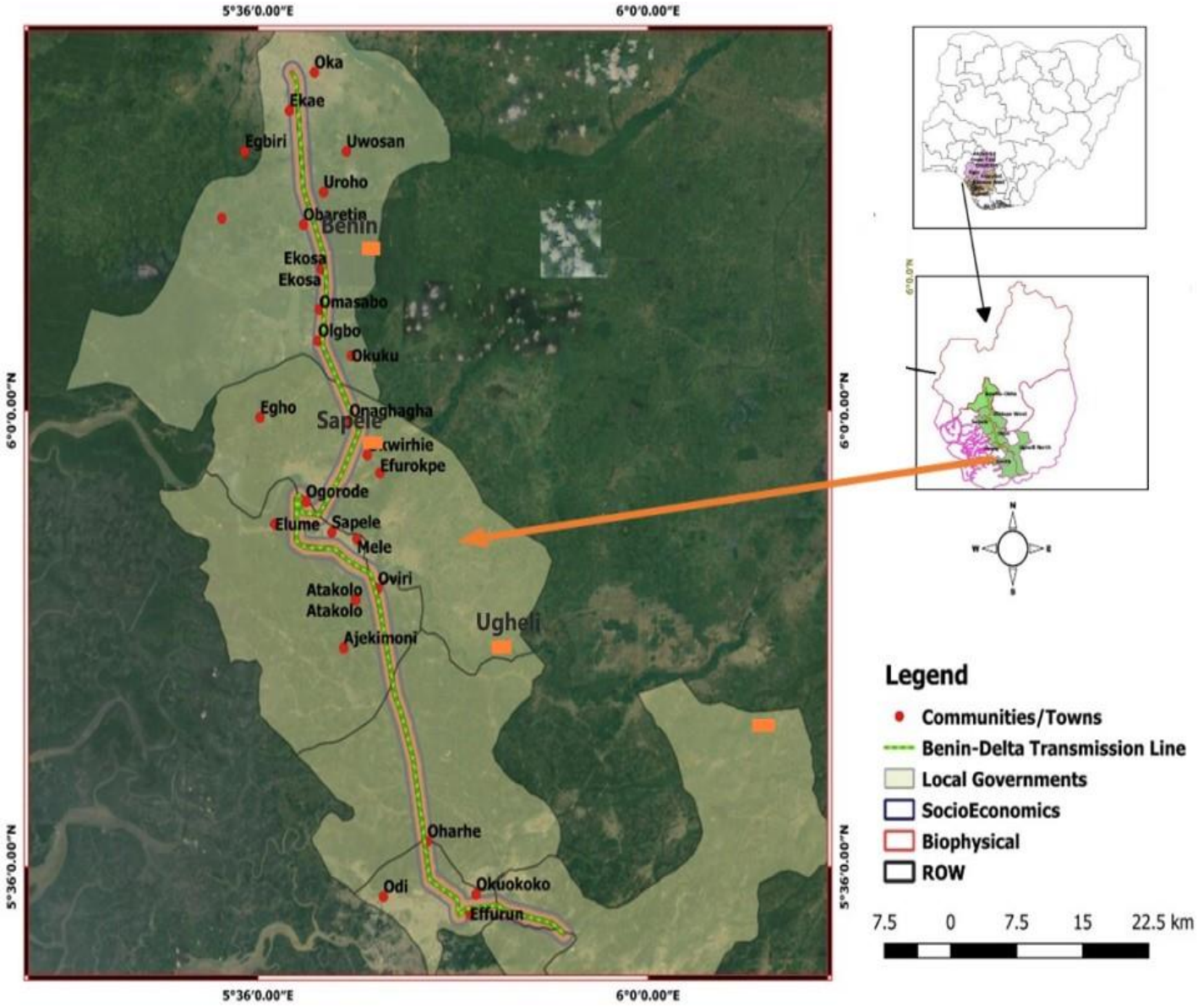


Figure 5.1: Sphere of Influence for the Transmission Line

Direct impacts are also to be expected in the areas where the auxiliary construction and reconstruction facilities will be located (lay down areas, 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 socio-economic 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;
- **Socio-economic 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.

Table 5.1 provides a full list of communities within the biophysical and socio-economic components of the Transmission line andsubstations.

Table 5.1: Communities within Area of Influence

Transmission Line		
Communities within Project Footprint	Communities within Biophysical impacts	Communities within Socio economic
Egbiken, Etete, Evbuabogun, Obaretin, Oghobaye, Evboriaria, Ologbo, Okha, Ubiaza, Owanoba, Ekosa, Obayantor, Agbomoba, Etinosa, Imasabor, Obe, Akenuwa, Okabare, Iyanomon, Evbvomoma, Uvwiama, Ekakpamre, Oghrerhe, Ekrerhavwen, Uvwiamuge, Ugbenu Onoghovo, Adagboyerin, Edjemuoyavwe, Ovade, Obromodu, Ojolu, Okuvwori, Amuajomata, Amukpe, Ogorode, Ikwegwu Oyohen Sapele, Uruakpa, Ugberikoko, Okirighuwere, Igbeku Ibadan-Elume, Osubi Adege, Egborode, Okuovwo, Otomewo, Onyenke, Okufuoma Oviri Court, Okwejeba Ugbomro, Uwodwo Erere, Sapele Road, Ugbolokposu, Uti, Okuatata	Egbiken, Etete, Evbuabogun, Obaretin Oghobaye, Evboriaria, Ologbo, Okha, Ubiaza, Owanoba, Ekosa, Obayantor, Agbomoba, Etinosa, Imasabor Obe, Akenuwa, Okabare, Iyanomon Evbvomoma, Uvwiama, Ekakpamre, Oghrerhe, Ekrerhavwen, Uvwiamuge, Ugbenu, Onoghovo, Adagboyerin, Edjemuoyavwe, Ovade, Obromodu, Ojolu, Okuvwori, Amuajomata, Amukpe, Ogorode, Ikwegwu, Oyohen, Sapele, Uruakpa, Ugberikoko, Okirighuwere, Igbeku, Ibadan-Elume, Osubi Adege, Egborode, Okuovwo, Otomewo Onyenke, Okufuoma, Oviri Court, Okwejeba, Ugbomro, Uwodwo Erere, Sapele Road, Ugbolokposu, Uti, Okuatata	Etinosa, Imasabor Obe, Akenuwa, Okabare, Iyanomon Evbvomoma, Uvwiama Ekakpamre, Oghrerhe Ekrerhavwen, Uvwiamuge, Ugbenu Onoghovo, Adagboyerin, Edjemuoyavwe, Ovade Obromodu, Okuvwori, Amuajomata Amukpe, Ogorode, Ikwegwu, Oyohen, Sapele, Uruakpa, Ugberikoko, Okirighuwere, Igbeku Ibadan-Elume, Osubi Adege, Egborode Okuovwo, Otomewo, Onyenke, Okufuoma, Oviri Court, Okwejeba Ugbomro, Uwodwo Erere, Sapele Road Ugbolokposu, Uti, Okuatata, Egbiken, Etete, Evbuabogun, Obaretin Oghobaye, Evboriaria, Ologbo, Okha, Ubiaza, Owanoba, Ekosa, Obayantor, Agbomoba

CHAPTER SIX

DESCRIPTON OF THE ENVIRONMENT AND SOCIAL BASELINE

6.1 Identification of the Study Area

The study area is located in Delta and Edo states, both in Southern Nigeria. The existing line to be reconstructed is starting from the Ughelli substation (Delta IV) and links through Sapele substation, both in Delta state and terminates at the Benin substation in Edo state. Details of the project location have been provided in chapter three of this report. Figure 6.1 is a map showing the location of the line route in Nigeria.

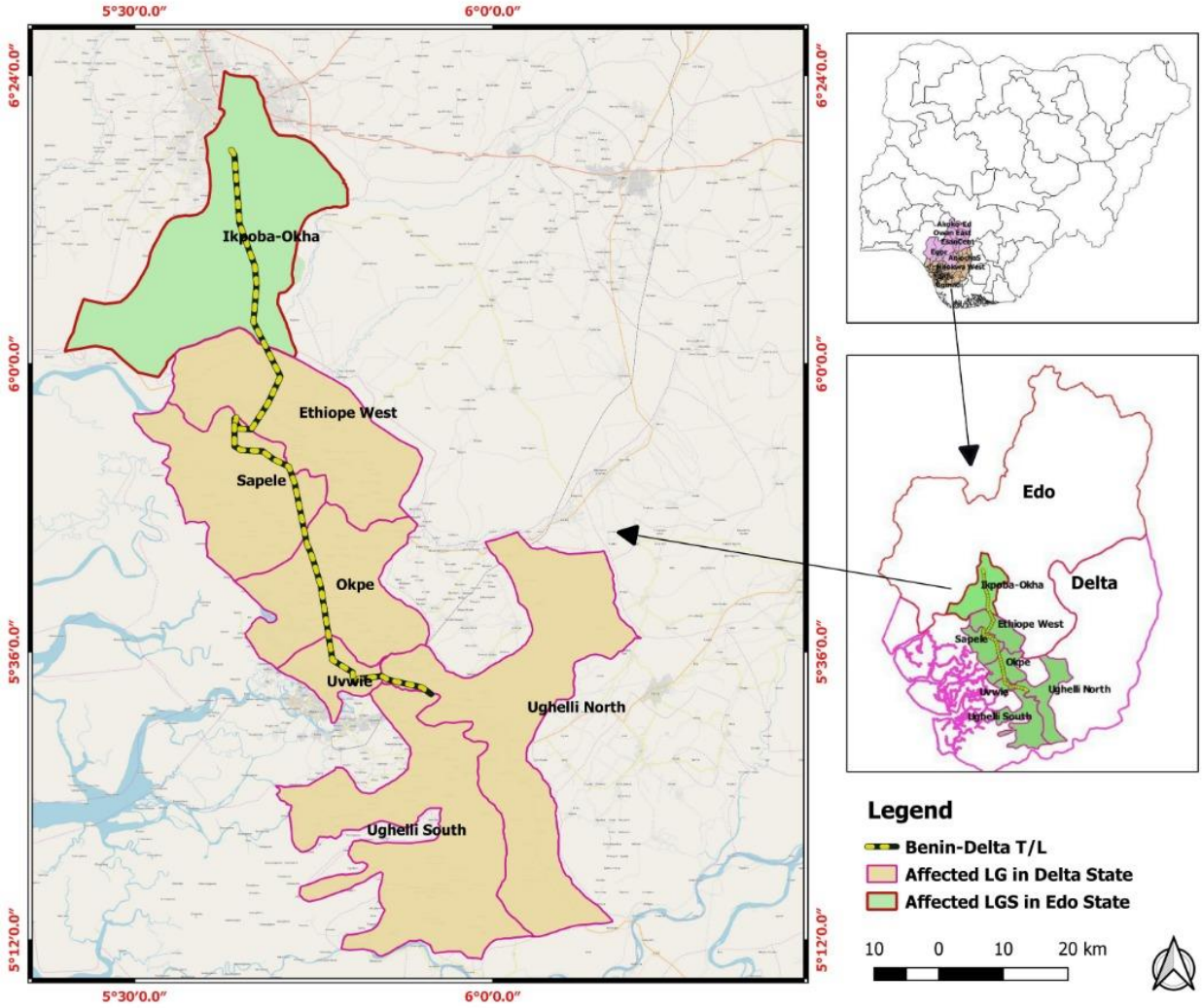


Figure 6.1: Location of the proposed line route

6.1.1 Overall data collection methodology

The summary of baseline conditions is based on information sourced from literatures (see relevant sections) as well as findings from a one season (dry) field sampling program supplemented by secondary data from approved report (Azura Gas Power Project, 2014 wet season), laboratory analyses of samples obtained and socio-economic and health surveys specific to this ESIA. The data acquired will be used in further environmental management decisions and future monitoring of changes, if any, in the environmental components.

Note: The data generated from baseline studies is more recent and takes precedence before the ones reviewed from literature and other secondary sources.

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. This is in accordance with the approved ToR by the FMEnv for this project.

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

- Climate and meteorology
- Air quality and noise levels
- Geology/hydrogeology
- Surface and groundwater
- Soil and
- 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 FMEnv 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 - sample collection (including positioning and field observations), handling, documentation and storage protocols and procedures; and
- demobilization from field; transfer of sample custody to the Mifor Consult laboratory, Calabar for analyses.
- Quality Assurance and Quality Control (QA/QC) for the data gathering.

Materials that were consulted included an approved report 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.

Desktop studies involved the acquisition of relevant background information on the environment of the study area. 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. In order to effectively characterize the ecology and meteorology of study area and determine seasonal variations of specific environmentally related parameters, a one season field data gathering exercise was performed between 28th May through 2nd June 2019 and additional studies between August 18-25th 2019.The specific objectives of the ecological field sampling were to determine:

- ambient air quality and noise level of the study area;
- physicochemical and microbiological characteristics of the soil within the study area;
- physico-chemical and biological characterization of water and sediment samples within the study area;
- hydrobiology and fisheries resources of the study area;
- wildlife abundance and diversity of the study area and environs;
- vegetation characteristics of the area; and
- establish the socio-economic and health status of the host and impacted communities.

A summary of the information on the physical parameters sampled for the project and that of the secondary data (Azura, 2014) including dates of exercise and number of samples are presented in Table 6.1.

Table 6.1 Summary of Data information on the physical parameters sampled for the project and that of the secondary data

	Dry Season data (based on Azura power Project, 2014)	Wet Season (based on data collected between 18th through 25th August		
Environmental/Social Component		Samples requested by FMEnv	Actual No collected	Comments
Climate and meteorology	10	Not specified	20	
Air quality and noise levels	11		20	Air and noise quality samples points were same as for soil and meteorology
Soil	11		20	In all, 40 samples were collected and analyzed
Groundwater	2		3	Three samples were collected
Surface water, Sediment, Hydrobiology	-		10	Samples were collected at 10 points, including a control point

6.2 Physical Environment

6.2.1 Climate

The project areas in the southern region generally fall in the tropical rainforest climate although most parts of Delta state are in the swamp forest zones. Theregion exhibits two major seasons, longer rainy and shorter dry season, Harmattan is a minor season. The rainy season usually begins in April and endsin October. The rainy season is caused by the South West Trade Wind. The dryseason usually lasts for about four months from November to March and characteristically marked by Harmattan wind between December and February. The annual rainfall average usually varies from 1,500mm to 2,200mm (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 90% are recorded.

The key factors that influence temperature in the area are the movement ofthe sun, wind speed and direction, and land configuration. The temperaturein the region is generally high all year round and usually range between 27-30^{0}C between June and December but can rise to 32-36 ^{0}C between Januaryand April, with the last few months of the dry season marked by intense heat.A general assessment of the sunshine hours for the southern region revealed that thelowest sunshine hours of approximately 3.5 hours per day are recordedat the peak of the rainy season (July and August) while the brightest months occur in November where average sunshine hours of up to 7.5 hours.

The south-westerly wind which prevails during the wet season (July- October) accounting for about 33% of annual wind and the southerly winds dominating from March to June as well as the beginning of the dry season in November accounting for about 50% of annual winds. The north-easterly windpredominates during the dry season (December– January) and amounts toabout 16% of the annual winds. The monthly mean wind speed varies from 3.4 to 4.6 metres per second (m/s). Wind speed is strongest at the middle of the rainy season during August and September. The climatic data for Edo and Delta states is presented in Table 6.2.

Table 6.2: Climatic Data of Delta and Edo States (1987-2017)

Parameter	Jan		Feb		March		April		May		June		July		August		Sept		Oct		Nov		Dec	
	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL
Rainfall (mm)	40	50	20	25	105	100	152	154	200	152	253	250	325	3330	254	253	346	351	225	115	53	53	26	30
Comment	Edo and Delta States as in other states in Nigeria is influenced by two seasonal periods, namely the dry and rainy season. The dry season is characterized by the Tropical Continental Air Mass (North East Trade Wind) which blows across the Sahara Desert. It usually starts from January and ends around October. Edo state records significant levels of rainfall in June/July and ends in with the highest level in September while Delta state records significant levels of rainfall in June/July and ends in with the highest level in September. The mean rainfall ranged is 20 mm to 340 mm per year for Edo and 25mm to 358mm for Delta.																							
	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL
Temperature range (0^C)	45	51	25	26	105	100	155	157	200	155	257	250	325	330	255	253	345	351	225	105	55	55	20	25
Comment	The mean monthly minimum temperature for Edo ranged between 24.5°C and 27.5°C while the monthly maximum temperature varies between 28.73°C and 34,25°C. On the other hand, the mean monthly minimum temperature for Delta ranged between 25.2°C and 28.1°C while the monthly maximum temperature varies between 33.1°C and 38.1°C. This variance in temperature is particularly striking between areas of different altitudes. This contrast is clearer in the dry season than in the rainy season.																							

	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL
Mean Rel Humidity (%)	61	71.1	78.5	72	80.1	80	80	80	75.5	82.5	85	85	85	90	85	88.1	85	88.1	85	86.1	85	86.1	75	78. 9
Comment	The relative humidity of Edo ranged from as 64.02 % during the month of January to as high as 87.25 % during the month of August while that of Delta ranged from 73.9% during the month of January to as high as 88.7 % during the month of July.																							

	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL	ED	DL
Wind speed and Direction	5	4	8	3.8	9	3.9	8.9	4	7.5	4	8.9	3.9	6.8	4	7.5	4.7	6	4.5	6.6	3.8	6	3.5	5.8	3.5
Comments	Wind in the study area include; the south-westerly wind which prevails during wet seasons (July to October) accounting for about 33% of annual wind, the southerly winds dominating from March to June as well as the beginning of the dry season in November accounting for 50% of annual winds.																							

6.2.2 Meteorology Measurements (Micro climatic conditions)

The prevailing micro climatic conditions (temperature, rainfall, humidity and atmospheric pressure) operating in the study area was measured on the field.Climate encompasses the statistics of temperature, humidity, atmospheric pressure, wind, rainfall, atmospheric particle count and other meteorological elements in a given region over long period of time. However, measurements of these climatic elements could be measured in a smaller area over a shorter period. This is known as micro climatic measurements. Local condition of relative humidity, temperature, atmospheric pressure Wind speed and direction were measured with the aid of Aeroqualaerocet 531. This equipment was calibrated and held at arm-length towards the direction of the prevailing wind for about two minutes. The value of the climatic elements was read off screen and data documented. The sampling locations for noise and air were same for meteorology. Result of this study for the various sections investigated is presented in Table 6.3.

Table 6.3: Result of On-Site Meteorological Measurement

Sections	**SAMPLING CODE**	**LATITUDE (N)**	**LONGITUDE (E)**	**TIME**	Wind speed	Temp.	RH	**Wind direction (%)**
Benin-Sapele	MET1	6.266667	5.616667	13:30	4.9	29.56	84.42	North-East
	MET2	5.583333	5.583333	11:56	5.3	32.39	77.41	North-East
	MET3	6.283333	5.666667	12:30	5.2	30.01	83.21	North-East
	MET4	5.955555	5.633333	9:19	5.2	31.40	76.90	North-East
	MET5	5.900000	5.733333	11.06	4.7	29.23	80.19	North-East

	MET6	5.866667	5.755555	10:23	4.8	29.71	83.26	North-East
	MET7	6.300000	5.633333	10:29	4.6	29.98	80.20	North-East
	MET8	5.955555	5.633333	15:32	5.4	31.90	83.61	North-East
	MET9	6.316667	5.600000	17:04	4.5	31.45	84.00	North-East
	MET10	6.283333	5.633333	9:19	4.2	32.25	86.67	North-East
	MET11	6.183333	5.655555	10:23	5.1	30.54	77.16	North-East
	MET12	5.999999	5.700000	13:30	5.4	31.32	81.83	North-East
Sapele–Ugheli	MET13	6.216667	5.683333	11:56	5.1	30.05	78.83	North-East
	MET14	5.855555	5.716667	12:30	5.3	31.33	79.87	North-East
	MET15	5.566667	5.883333	9:19	4.7	30.82	82.26	North-East
	MET16	5.655555	5.766667	11.06	4.4	31.08	85.56	North-East
	MET17	5.733333	5.733333	14:53	4.3	30.18	81.47	North-East
	MET18	6.300000	5.666667	16:00	3.8	31.94	82.84	North-East
	MET19	6.133333	5.666667	16:31	5.5	29.79	82.54	North-East
	MET20	6.116667	5.666667	16:56	4.7	33.31	82.12	North-East
Azura IPP,2014					4.3 – 5.2	29.9 – 31.7	76.4 – 80.9	North-East North - West

Source: GNL Survey, 2019

Temperature

All microclimatic data obtained in the field conformed favourably with secondary data (Azura, IPP, 2014). 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 mitigation measures 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 EurIng, 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. 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. This area merges into highly degraded forest inland. To the southwest of the Niger valley lays a rugged landscape defined 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. The northern part of the country is characterized by somewhat lower elevations, level terrain, and sandy soils, where agriculture dominates. Figure 6.2 presents the topographic map of Nigeria.

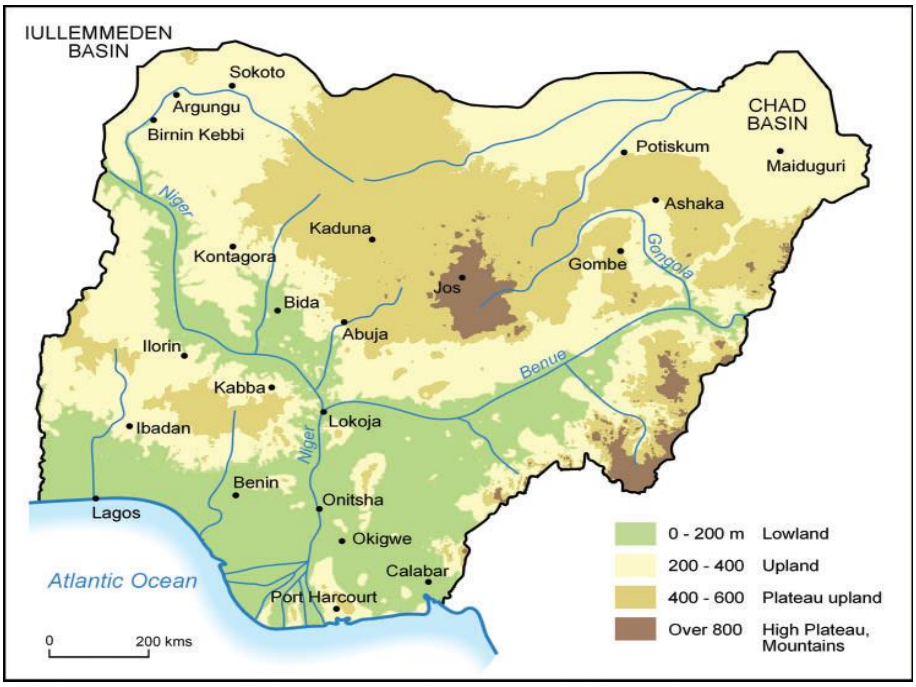


Figure 6.2: Topographic Map of Nigeria

Source: Adelana et al., 2008

The project area lies beyond the swamp zone, from 80 to 160 km (50–100 mi) wide, of undulating tropical rain forestwith an elevation ranging from as low as 0.7m to 71.1m. Figure 6.3a shows the topography of the study area in two dimensions while Figure 6.3b shows it in three dimensions.

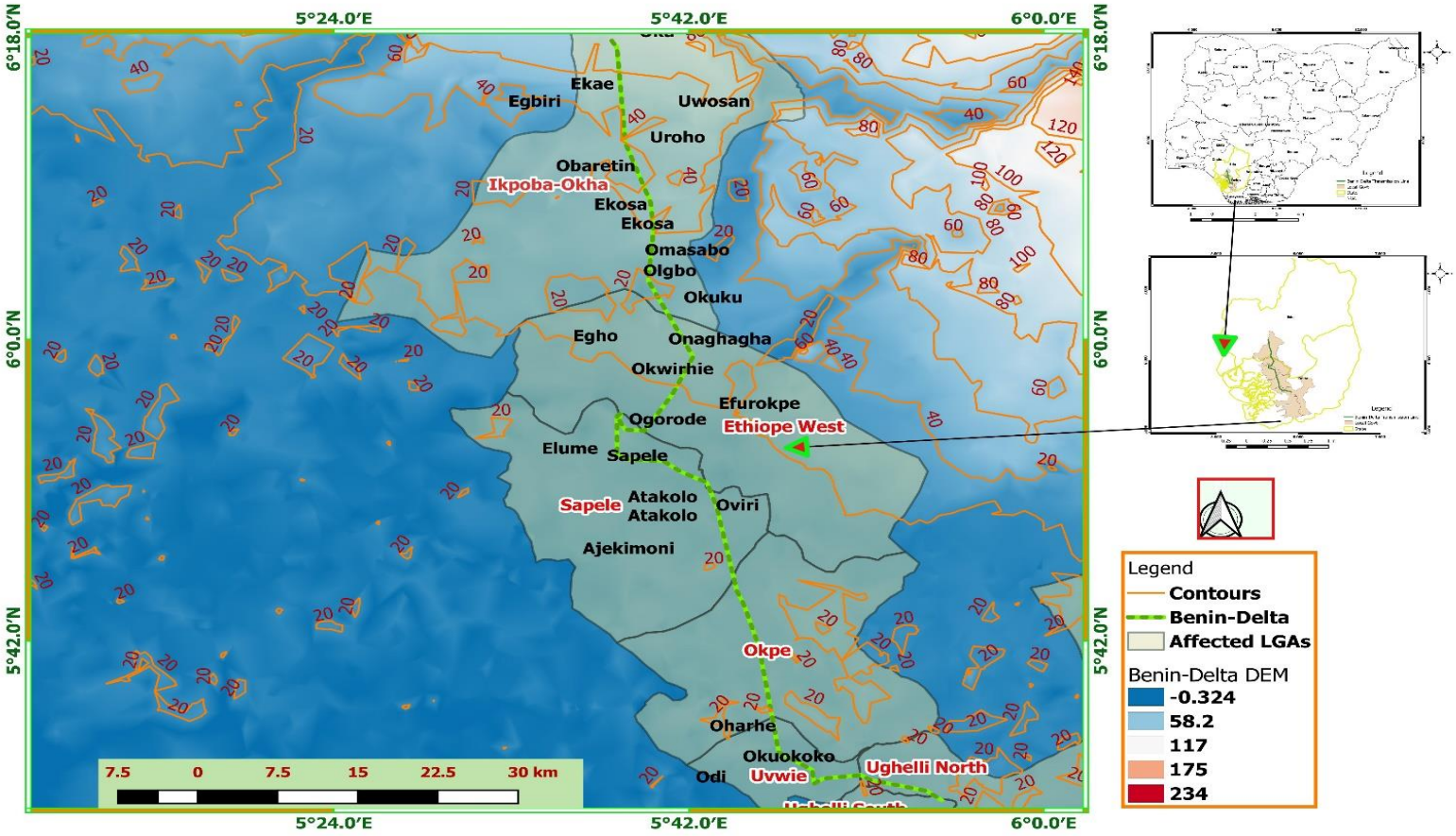


Figure 6.3a: Topography of Study Area in 2-D

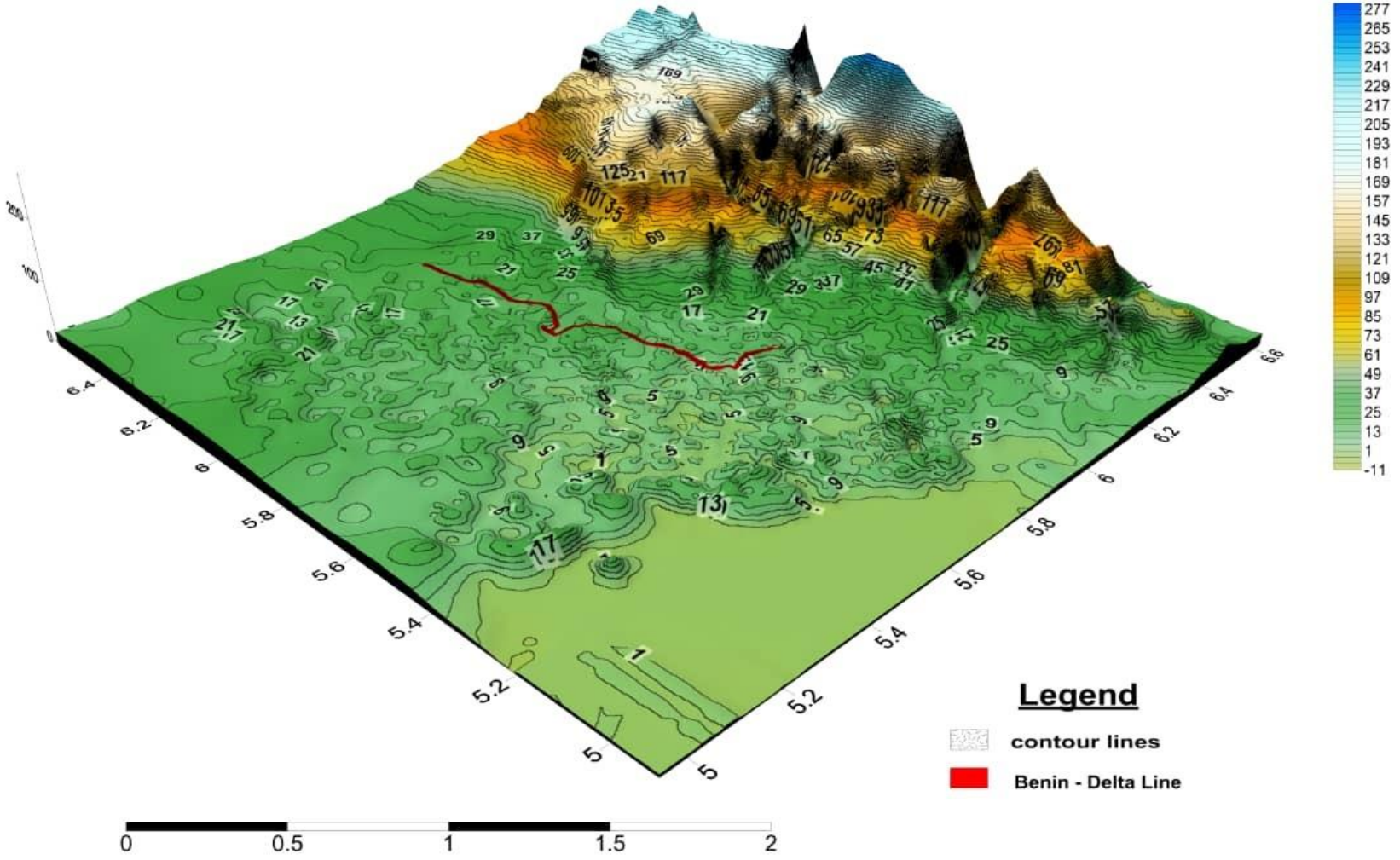


Figure 6.3b: Topography of Study Area in 3-D

6.3 Ambient Air Quality

Air generally contains water vapour, gases, and particulate matter in small but very variable quantities (Oguntoyinbo and Derek, 1987). 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.

6.3.1 Ambient Air Quality Measurement

Atmospheric gases were measured with the aid of Universal Gas Analyzer 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.

Ambient air quality measurements werecarried out on site using *in situ* digital meters (Table 6.3 and Figure 6.4) at 29 locations with three of the locations as control points (control points were outside the spatial boundary). The sampling location is shown in Figure 6.4. Noise quality measurement was also carried out at same locations of air quality sampling.

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

Parameter	Equipment	Detection Limit of the Analytical Equipment.
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 Metre Model 14	10
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

Plate 6.1: Air quality sampling and in-situ Measurements

Source: GNL Survey, 2019

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 are presented in Table 6.5 while Figure 6.4 presents the air, noise and soils quality sampling maps.

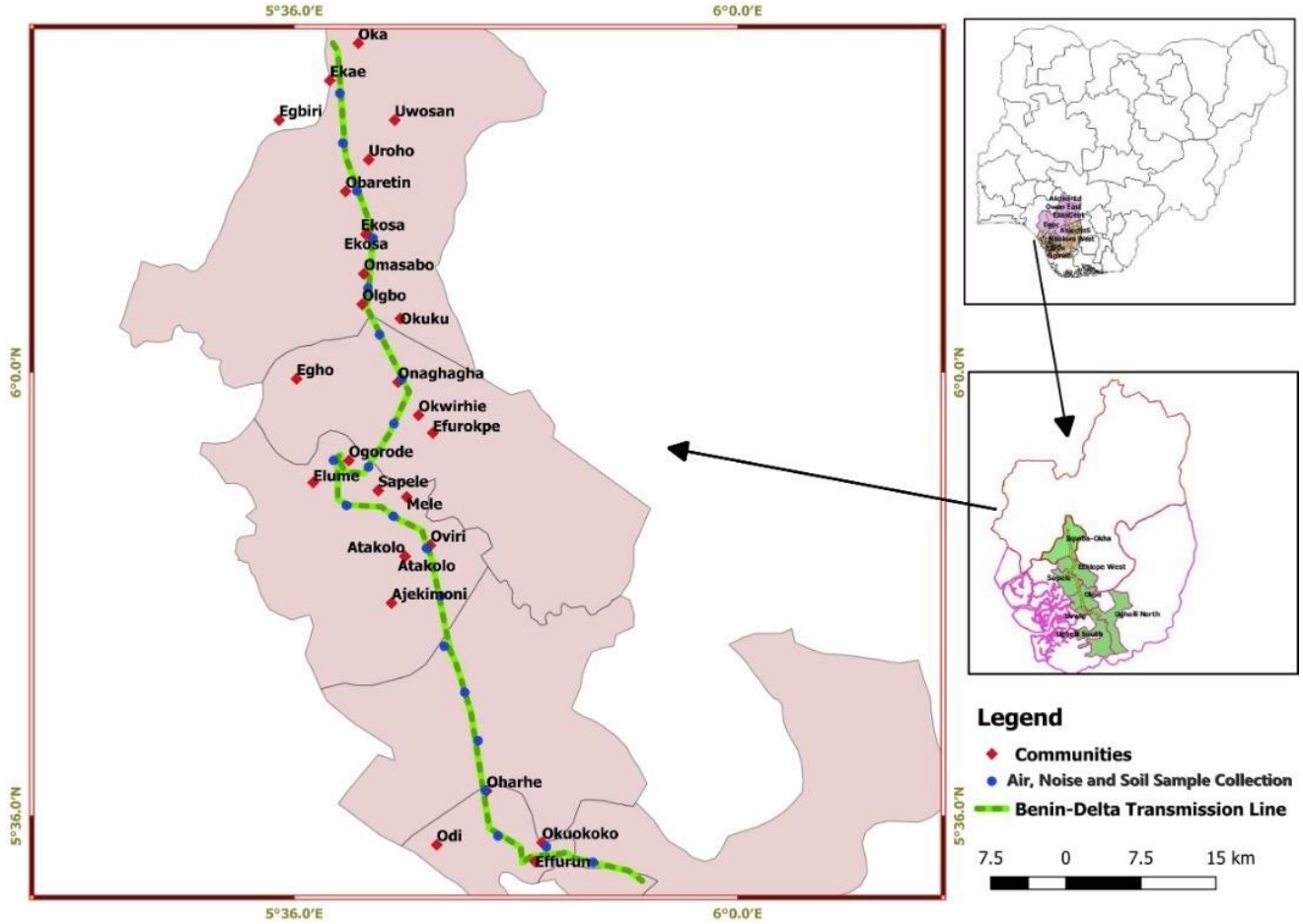


Figure 6.4: Air, Noise and Soil Qualities Sampling Map

Table 6.5: Air Quality /Noise Sampling Locations

CODE	Latitude	Longitude	TIME	Description
AN1	6.266667	5.616667	13:30	Residential
AN2	5.583333	5.583333	11:56	Residential
AN3	6.283333	5.666667	12:30	Residential
AN4	5.950000	5.633333	09:19	Residential
AN5	5.90000	5.733333	11.06	Residential
AN6	5.866667	5.750000	10:23	Residential
AN7	6.300000	5.633333	10:29	sparsely built up area
AN8	5.950000	5.633333	15:32	secondary forest interspersed with farmland, etc.
AN9	6.316667	5.600000	17:04	Farmlands and buildings
AN10	6.283333	5.633333	09:19	Track roads and farmlands
AN11	6.183333	5.650000	10:23	residential area, partially paved road
AN12	5.900000	5.700000	13:30	Stream
AN13	6.216667	5.683333	11:56	Farmlands
AN14	5.850000	5.716667	12:30	Residential
AN15	5.566667	5.883333	09:19	Sparse vegetation
AN16	5.650000	5.766667	11.06	Farmland
AN17	5.733333	5.733333	14:53	Farmland
AN18	6.300000	5.666667	16:00	Sparse vegetation
AN19	6.133333	5.666667	16:31	Dense vegetation
AN20	6.116667	5.666667	16:56	Dense vegetation

SOURCE: GNL survey, 2019

6.3.2 Ambient Air Quality Result

Result of this study is presented according to the various sections of the study as presented in Table 6.6, while Appendix 6.1 contained detailed result. Particular attention was paid to the Greenhouse gases (GHG) like CO_2, N_2O and CH_4.

Table 6.6: Ambient Air Quality Result Measured in the Study Area

SAMPLING PARAMETER	SO_2 (ppm)	NO_2 (ppm)	CO_2 (ppm)	VOC (ppm)	HCl (ppm)	CO (ppm)	H_2S (ppm)	SPM_{10} (ppm)	Comments
BENIN - SAPELE SECTION									All parameters were within the regulatory limits except for SO_2. The concentrations were above WHO regulatory limit across all sampling stations except stations 4 and 14 in Ekae and Ajekimoni respectively. Result compared well with secondary data except for SO_2
Mean	0.021	0.022	0	411.17	0.25	0	1.59	0.31	
Min	0.018	0	385.38	0.02	0	0.13	0.12	0.0432	
Max	0.026	0	432.53	0.47	0	3.73	0.47	0.0829	
SAPELE - UGHELI SECTION									
Mean	0.022	0	411.71	0.20	0	2.36	0.24	0.0516	
Min	0.019	0	403.94	0.03	0	1.42	0.03	0.0142	
Max	0.024	0	422.19	0.36	0	4.66	0.37	0.0784	
Overall mean for all areas	2.8	0	421.2	0.19	0	1.8	1.5	0.0278	
Secondary data (Azura 2014)	<0.10	NA	<0.10	<0.10	**NA**	<0.10	<0.10	NA	
WHO/FMENV daily limit(ppm)	0.002	0.04-0.06	**5000**			10-20	<10	0.15- 0.25	

*Source: GNL, Survey 2019. *NA= Not aAailable*

6.4 Noise Quality and EMF (Electromagnetic Force)

6.4.1 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.limitswere used to benchmark the ambient noise levels measured in the project area.

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, hospitals, roads, project area ROW.

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 nighttime. 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.

6.4.2 Electromagnetic Force (EMF)

Electro Magnetic Force 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).

6.4.3 Noise Quality and EMF Result

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

Table 6.7: Noise and EMF Measurements in the Study Area

SAMPLING CODE	Noise dB(A)	LAF (dBA)	LMIN. (dBA)	LMAX. (dBA)	EMF (µT)
BENIN - SAPELE SECTION					
Mean	58.5	68.3	28.69	60.6	0.23
Min.	50.2	59.4	23.17	50.7	0.22
Max.	58.5	68.3	28.69	60.6	0.23
SAPELE - UGHELI SECTION					
Mean	60.9	59.9	28.94	59.9	0.22
Min.	53.5	52.0	22.60	40.9	0.21
Max.	69.5	65.0	35.22	69.7	0.23
Secondary data (Azura, 2014)	**28.4 – 60**				NA
ICRNIP Limit for EMF					0.3-0.4
WHO/FMEnvRegulatory 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				

SAMPLING CODE	Noise dB(A)	LAF (dBA)	LMIN. (dBA)	LMAX. (dBA)	EMF (μT)
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 4.6 indicated an elevated noise level above the day time threshold stipulated for the various environments (school, hospital, residential and farmlands) for all the sections except for Benin - Sapele section which recorded slight increment above the threshold for residential areas only in two of the stations NQ12 (Oviri) and NQ18 (Oharhe). 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.

With respect to EMF, baseline results of this study as presented in Table 4.7 were all within the limits set by ICNIRP.

6.5 Geology and Pedology

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.

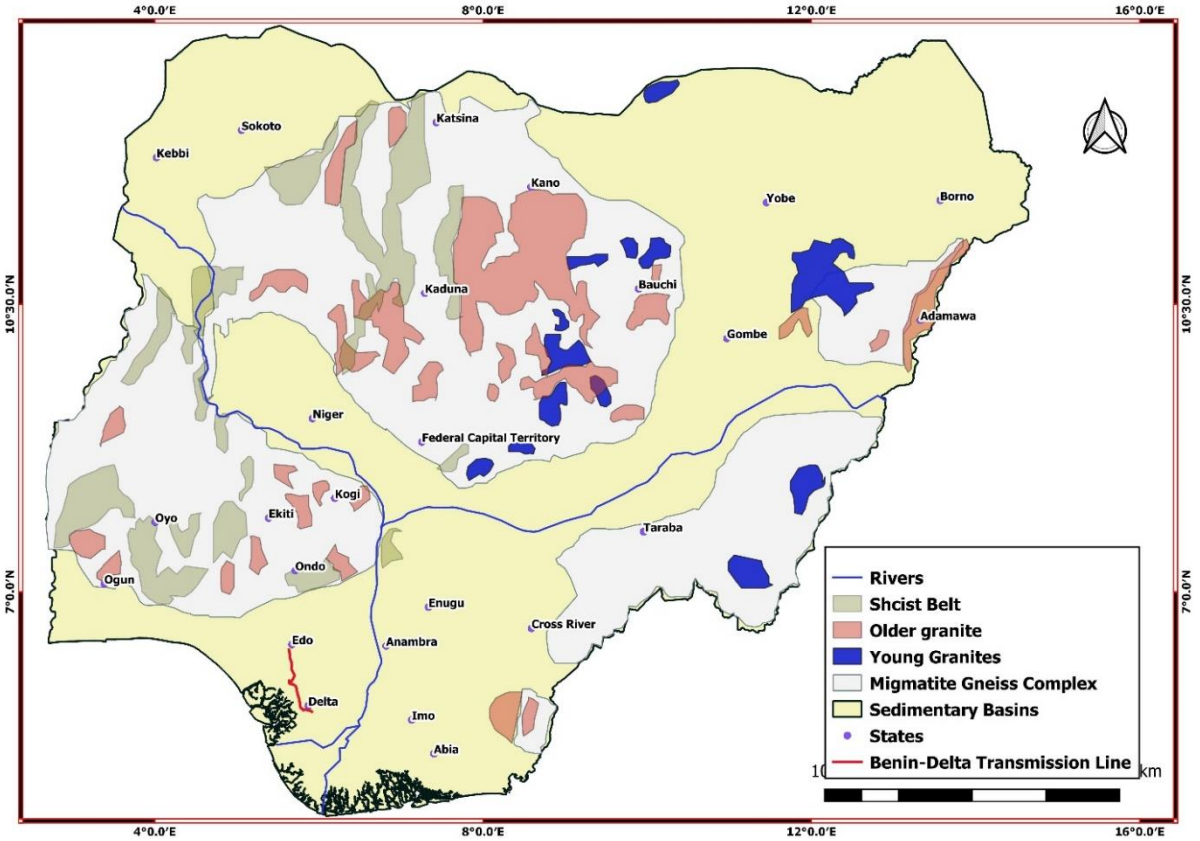


Figure 6.5: Regional Geologic Map of Nigeria showing study area

Source: Ajibade (1983)

Delta and Edo states are predominantly underlayed by sedimentary rocks with the following stratigraphic units underlying most part of the region: the Benin Formation, the Ogwashi - Asaba Formation, the Bende-Ameki Formation, Imo Shale Formation, Nsukka Formation and Ajali Formation(Akaolisa and Selemo, 2009; Nwosu *et al*., 2010). The Benin Formation is overlain by lateritic overburden and underlain by the Ogwashi - Asaba Formationwhich is in turn underlain by the Ameki Formation of Eocene to Oligocene age (Mbonu *et al*., 1991). The Benin Formation consists of coarse-grained gravelly sandstones with minor intercalations of shale's and clay. The sand units which are mostly coarse grained; pebbly and poorly sorted contain lenses of finegrained sands (Onyeaguocha, 1980).

The Ogwashi-Asaba Formation is made up of variable succession of clays, sands and grits with seams of lignite. The Ameki Formation consists of greenish-grey clayey sandstones, shale'sand mudstones with inter-bedded limestone. This Formation in turn overlies the impervious Imo Shale group characterized by lateral and vertical variations in lithology.

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.

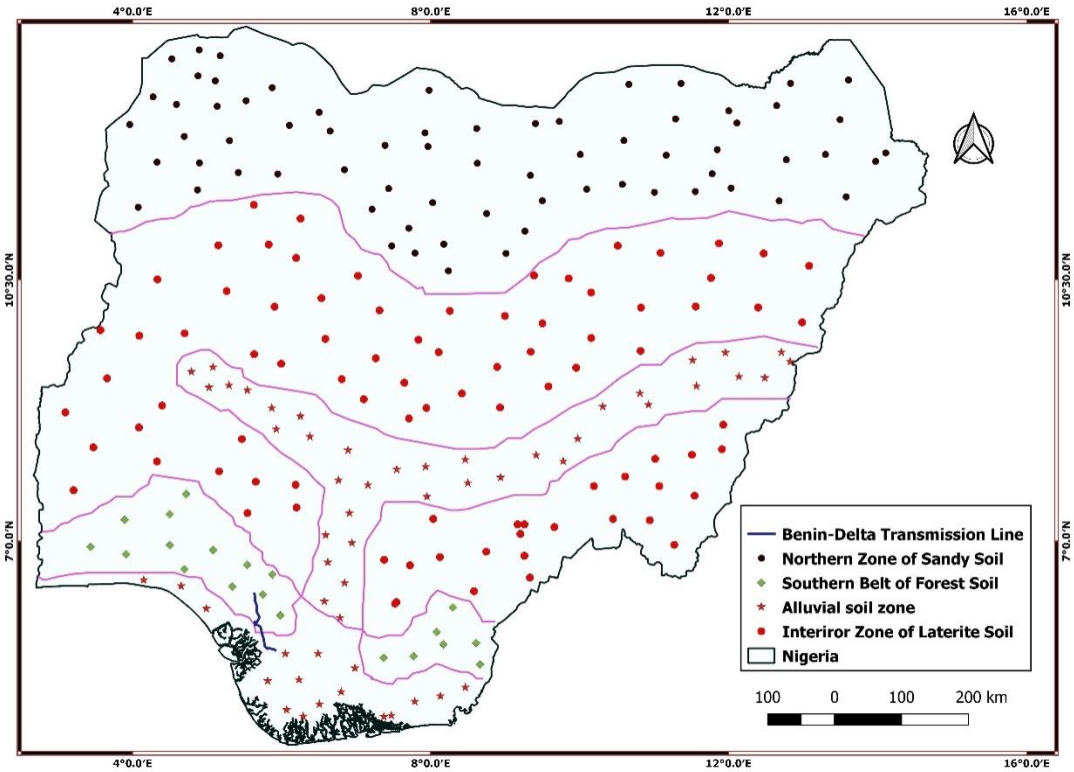


Figure 6.6: Soil zones and types in Nigeria

Source: Adapted from Agriculture Nigeria, ND, 2006

Soils in the area belong to the ferralitic type, mainly orthoxic troproducts and Dystric Farrasols. The soil profile is somewhat uniform throughoutthe study area. Generally, the study area is underlain by intensely weathered andleached uniform sands, loamy sands and clays. The project vicinity and its environs are underlain by the Benin Formation (Coastalplain sands), which is an extensive stratigraphic unit in the south Nigerian sedimentary basin.

Hydrogeology

Aquifers in study area are unconfined. The first aquifer (fine-medium sand) can be penetrated at less than 4meters while the second occurs at less than 14meters to the surface.

The first aquifer is extremely vulnerable to pollution from surface sources especially due to the fact that water could be encountered in this formation even at depth of 4m or less. Consisting essentially of loose to poorly consolidate sandy materials, this aquifer is capped by lateritic soils. Results of aquifer of the project area according to Aweto et al., 2015 revealed that the average transmissivity and hydraulic conductivity values of the aquifer are 418m2/day-1637.3m2/day and 10.50m/day-45.71m/day, respectively.

6.6 Soil Quality

Soil resource is of vital importance for survival and welfare of the people. One of the most severe and widespread problems facing the agriculture industry is the degradation of soil quality due to changes and alteration to various physical and chemical parameters. Soil is a complex natural material made of disintegrated rocks and decayed organic material which provides nutrients, moisture, and support for land plants. This soil is a very important component of the environment.

6.6.1 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. 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 were sub sampled and appropriately labeled using masking tape and indelible ink to indicate sample location and soil depth level. Soil samples were labeled appropriately also using masking tape and indelible ink. Plate 6.2 shows soil sampling activity while Figure 6.4 is a map showing the soil sampling points.

Plate 6.2: Soil sampling activity

6.6.2 Assessment of Soil Quality

Table 6.8 is a summarized physico-chemical result for which detailed results is shown in Appendix 6.2.

Table 6.8: Soil physico-chemical characteristics

		Benin - Sapele						Sapele - Ugheli						Azura IPP, 2014	FMEnv, WHO limits
		0 – 15			15 -30			0 – 15			0 - 30				
Parameters		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean		
pH		5.37	6.61	5.90	4.10	6.42	5.42	5.15	6.24	5.54	4.43	6.87	5.38	5.9	5 – 8.0
Elect. Conductivity (µS/cm)		84.03	94.20	87.84	115.8	203.4	160.3	77.15	92.29	87.35	116.0	193.0	155.7	79.86	
Moisture Content (%)		6.7	13.3	9.7	11.20	18.07	14.70	8.3	13.6	10.5	12.45	17.08	14.68	15.3	
PSD	Clay	1	5.3	3.6	4.40	12.50	9.71	2.2	4.2	3.04	6.30	12.20	9.13	1.7	
	Silt	4.7	12.7	9.2	13.53	19.91	16.70	9.8	17.3	11.9	13.77	18.30	15.86	14.3	
	sand	83.1	91.8	87.0	69.12	77.51	73.60	79.9	87.8	85.1	70.86	79.91	75.10	80.0	
Ext. Nitrate (mg/kg)		2.93	4.60	3.89	4.65	7.13	5.85	2.85	4.58	3.62	4.61	6.51	5.77	2.98	500
Ext. Sulphate (mg/kg)		20.65	22.86	21.83	21.11	23.04	22.08	19.91	22.72	21.78	21.21	22.55	21.98	10.4	500.00
Ext. Phosphate (mg/kg)		0.63	3.27	1.80	0.12	2.75	1.35	0.35	2.20	1.30	0.42	2.65	1.62	0.97	
Phosphorus (mg/kg)		7.56	19.71	15.05	7.41	20.70	15.20	6.20	19.09	14.95	9.55	15.43	13.03	7.22	
Calcium (mg/kg)		4.11	6.36	5.33	3.90	7.02	5.17	3.67	6.30	4.84	3.57	6.66	5.01	-	
Magnesium (mg/kg)		0.65	0.93	0.79	0.64	1.14	0.92	0.52	0.92	0.64	0.61	1.14	0.88	-	0.10-1.0
THC (mg/kg)		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	30.00
Total Chromium (mg/kg)		0.29	0.90	0.72	1.05	2.25	1.46	0.57	0.85	0.72	0.81	1.72	1.34	0.23	100.00
Total Iron (mg/kg)		68.98	106.15	90.91	106.5	130.5	118.3	82.79	110.60	93.89	99.9	126.4	113.0		500-30000
Copper (mg/kg)		4.12	9.10	6.17	6.80	10.52	8.03	4.34	6.44	5.56	8.48	10.91	9.23		36.00
Lead (mg/kg)		0.14	0.30	0.23	0.08	0.24	0.16	0.17	0.28	0.21	0.09	0.25	0.17		85
Manganese (mg/kg)		4.67	7.00	5.77	7.08	8.82	7.99	6.08	6.91	6.43	6.76	8.85	7.56		
Nickel (mg/kg)		0.52	0.89	0.75	0.76	1.19	0.98	0.60	0.97	0.76	0.77	1.08	0.89		35.00
Zinc (mg/kg)		1.00	1.25	1.11	0.49	1.61	1.09	1.06	1.23	1.16	0.74	1.68	1.21		
Arsenic (mg/kg)		0.20	0.34	0.27	0.22	0.53	0.31	0.20	0.31	0.27	0.27	0.40	0.34		
Mercury (mg/kg)		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		0.30

Vanadium (mg/kg)	0.18	0.28	0.22	0.19	0.42	0.29	0.20	0.27	0.25	0.25	0.38	0.31		
Cadmium (mg/kg)	0.31	0.74	0.56	0.27	0.74	0.56	0.43	0.75	0.56	0.49	0.86	0.65		
Boron (mg/kg)	1.15	1.75	1.52	0.83	1.86	1.38	0.86	1.65	1.30	1.09	2.23	1.55		

All physico-chemical parameters measured in the soil samples were within WHO/FMEnv threshold values. The baseline result compared well with the secondary data.

6.6.3 Soil Microbiology

Soil Microbiological Characteristics: The two groups of microorganisms studied are fungi and bacteria, which are the most important organic matter decomposers in the soil. Bacteria and fungi (microbes) counts provide information on the level of on-going biochemical activities in soil. Microbial counts under normal circumstances increases with an increase in thesoil organic matter. About 1g of fertile soil should contain 1 x 10^6 to 1 x 10^8Cfu/g bacteria and fungi (Odu*et al.,* 1985).

The soil samples were contained in sterile glass bottles and were subsequently triturated and homogenized. To evaluate the microbial population, the samples were placed in contact with 0.35% NaCl solution (physiological saline) and shaken vigorously for 30 minutes, to release or extract the *Protists* present in the samples. The samples suspensions were serially diluted before used in the estimation of microbial densities. Microbial counts under normal circumstances increases with an increase in soil organic matter. Soil microbial result for the study area is summarized in Appendix 6.3. However, Table 6.9 shows a summary of the microbial population in the soil samples.

Table 6.9 Summarized Soil Microbial Result

THB		HUB	
Species	**Counts (Cfu/ml)**	**Species**	**Counts (Cfu/ml)**
Bacillus sp *Pseudonomas sp* *Staphylococcus sp* *Proteus sp* *Arthrobacter sp* *Enterobacter sp* *Micrococcus sp* *Actinomyces sp* *Escherichia sp* *Klebsiella sp* *Serriatia sp* *Flavobacterium sp*	6.83 x 10^4	*Bacillus sp* *Pseudonomas sp* *Micrococcus sp* *Staphylococcus sp* *Actinomyces sp* *Escherichia sp* *Flavobacterium sp* *Serriatia sp*	5.79 x 10^3
THF	**Counts (Cfu/ml)**	HUF	**Counts (Cfu/ml)**
Aspergillus sp *Mucor sp* *Penicillium sp* *Fusarium sp*	4.56 x 10^2	*Mucorsp* *Aspergillus sp* *Fusarium sp* *Penicillium sp*	2.45 x 10^2

THB		HUB	
Species	**Counts (Cfu/ml)**	**Species**	**Counts (Cfu/ml)**
Rhizopus sp *Candida sp* *Trichoderma sp*		*Candida sp*	

Note: THB = Total Heterotrophic Bacteria, HUB = Hydrocarbon Utilizing Bacteria, THF = Total Heterotrophic Fungi, HUF = Hydrocarbon Utilizing Fungi.

Since microbes are known to grow on substrates, Table 6.10 is a matrix correlating species observed to possible waste stream based on observed and reviewed food sources in the project area.

Table 6.10: 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
Protuessp	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, phosphate, sulfate Sodium	Meat, fish, cheddar cheese
Mucor sp *Trichoderma sp*	Magnesium Sulfate, Monopotassium Phosphate, Peptone, glucose, Sodium, potassium, iron, calcium	Meat, Groundnut, bread Egg, bean and meat
Fusarium sp *Rhizopus sp*	Sodium, potassium, iron, calcium, glucose	Rice, beans and soya bean

Candida sp		Yam, potatoes, Sugarcane, corn and wheat straw
Aspergillus sp		
Penicillium sp		

Microbial diversity of the study area was largely uniform indicating similar substrate. All microbial species assayed in the soil samples are important in nutrient recycling. Details of the composition, abundance and broad spectrum media nutrients of the microbial species assayed in the various samples is suggestive of stable ecosystem.

6.7 Groundwater Quality

6.7.1 Sampling Methodology

Water samples were collected from three existing boreholes at each substation. Plastic bottles were used for the collection and 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 *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 sampling activity.

Plate 6.3: Groundwater sampling activity near Ugheli substation

The groundwater sampling stations, and their respective coordinates are presented in Table 6.11.

Table 6.11: Groundwater Sampling stations and coordinates

CODE	LOCATION	LATITUDE	LONGITUDE
GW1	Ugheli substation	6.300000	5.633333
GW3	Benin substation	6.316667	5.60000
GW5	Sapele substation	5.550000	5.833333

6.7.2 Assessment of Groundwater quality

As could be seen in Table 6.12, the results recorded for each physicochemical parameter where benchmarked with those from the ESIA conducted for the Azura Gas Power plant Project, and WHO/FMEnv regulatory limit, where one exists. The standard methods of analysis for each parameter are also presented therein.

Table 6.12: Physico-chemical Results for Groundwater

		Ugheli Substation	Benin Substation	Sapele Substation	**Azura (2014)**	**FMEnv limits**	**WHO limits**
Parameters		GWI	GW2	GW3			
General appearance		Clear	Clear	Clear	Clear	Clear	Clear
pH @ 21.2^{o}C		6.68	6.94	7.95	5.82	6.5- 8.5	6.5-9.2
Temperature (^{0}C)		27.8	27.3	26.9	28.9		40 ^{o}C
Turbidity (NTU)		1.12	1.22	1.92	1.83		5
TDS (mg/l)		33.1	9.24	28.2	27.9		
Conductivity (µS/cm)		55.3	35.4	54.3	45.0	1000	250
Total Hardness (mg/l)		6.44	2.64	8.23	-	150	
THC		ND	ND	ND	-	0.3	0.05
PCB (ng/m^{3})		ND	ND	ND	-		0.003
Mineral Oil (mg/l)		<1.00	<1.00	<1.00	-		
COD (mg/l)		4.05	4.91	5.33	7.4		
Chloride (mg/l)		11.6	4	10	-		
Total Alkalinity (mg/l)		<1.00	<1.00	<1.00	-		
Nutrients	Nitrate (mg/l)	2.32	0.58	1.63	1.89	50	10
	Phosphate (mg/l)	0.26	0.16	0.29	0.44		5
	Sulphate (mg/l)	0.26	0.16	0.29	0.19	100	500
Reactive Silica (mg/l)		6.1	10.6	10.6	-		
Cyanide (mg/l)		<0.01	<0.01	<0.01	ND		
Ammonium (mg/l)		<0.02	<0.02	<0.02	0.01		
Aluminium (mg/l)		<0.10	<0.10	<0.10	0.01		
Calcium (mg/l)		0.29	2.09	2.09	1.83		
Magnesium (mg/l)		1.39	0.22	0.22	-		
Sodium (mg/l)		2.77	8.28	4.79	-		
Potassium		0.35	0.31	0.3	-		10

Cyanide (mg/l)		<0.01	<0.01	<0.01	ND		
Heavy Metals	Arsenic (mg/l)	<0.001	<0.001	<0.001	ND		
	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	ND	0.05	0.02
	Zinc (mg/l)	0.11	0.16	<0.05	0.13		
	Total Iron (mg/l)	<0.05	<0.05	0.28	0.21	1.0	0.3
	Copper (mg/l)	<0.05	<0.05	<0.05	0.04	1.0	2.0
	Manganese (mg/l)	<0.10	<0.10	<0.10	-		
	Cadmium (mg/l)	<0.002	<0.002	<0.002	0.019		
	Total Chromium (mg/l)	<0.01	<0.01	<0.01	ND		
	Cobalt	0.03	0.01	0.03	0.01		
	Vanadium	ND	ND	ND	ND		
Total Coliform (cfu/100ml)		2	0	$7.8x10^1$	-		
Faecal Coliform (cfu/100ml)		0	0	$4.2x10^1$	-		
E-coli (cfu/100ml)		0	0	0	-		
Faecal Streptococci (cfu/100ml)		0	0	0	-		
Total Plate Count (cfu/ml)		$1.41x10^3$	$8.40x10^2$	$1.41x10^3$	-		

Source: GGNL Survey, 2019. *ND = Not Detected; NA= Not Available*

As shown in Table 6.12, all physicochemical parameters analyzed in the groundwater samples were within WHO/FMEnv threshold values. The result compared well with the secondary data.

6.8 Hydrology and Drainage

6.8.1 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 whichn form the Niger Delta. There are, however, a few other tributary rivers which drain into the Niger-Benue trough and Lake Chad. 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, Iboe etc. empty directly into the Atlantic Ocean. The majority of small rivers are seasonal (Figure 6.7).

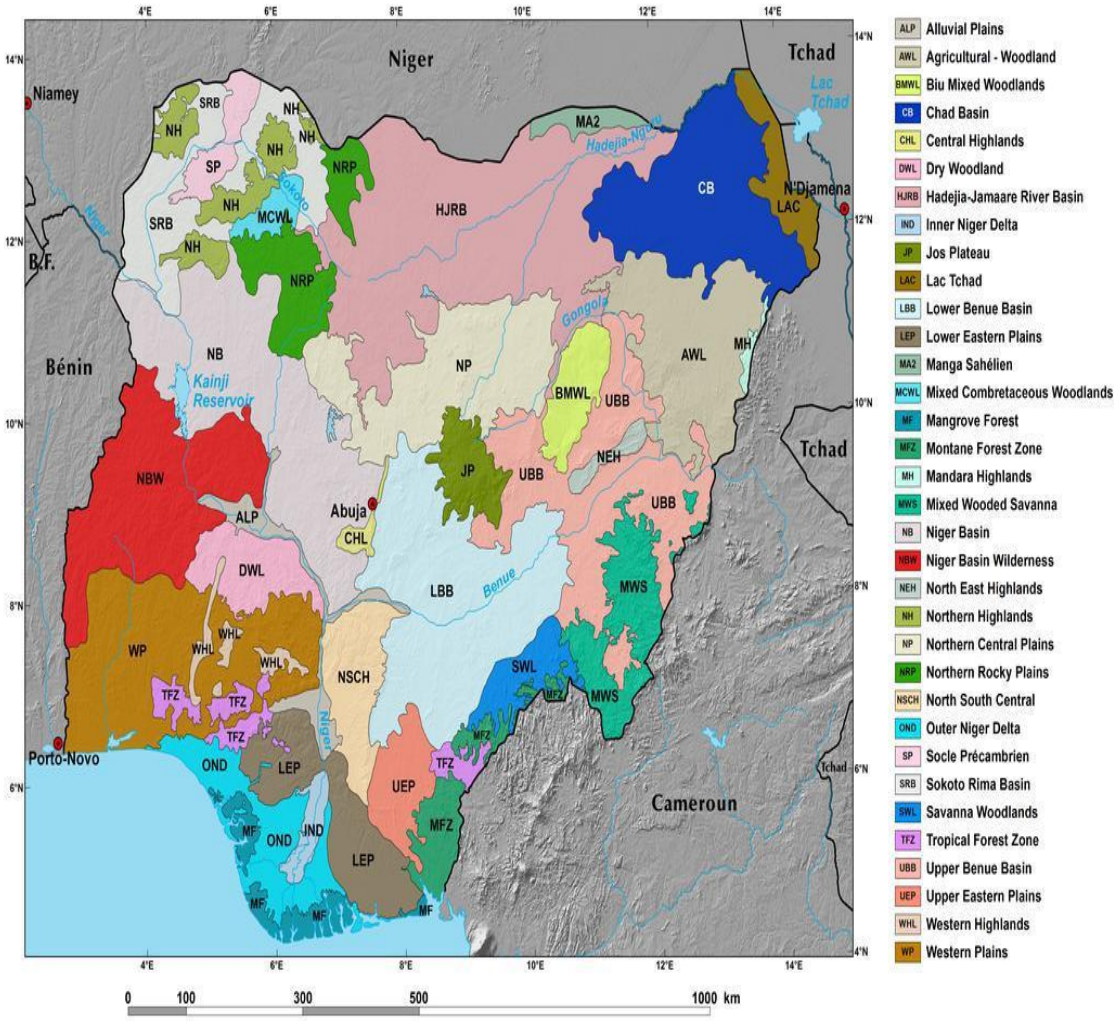


Figure 6.7: Nigeria Drainage System

Three river systems drain the Benin Region. They are the Ikpoba River, the Ogba River and Owigie-Ogbovben River systems. The three rivers constitute a dendrite drainage pattern. The drainage density can be described as lower sparse (Imhangulaya, 2016). Delta state is drained by Ethiope River which forms a major tributary to Benin River. Ethiope River takes its source from a spring at Umuaja in Delta State and flows over 100km to empty into Benin River. This river serves as the terminal point for storm runoff in the area. Inhabitants of the area rely on the river for activities such as washing, fishing, sand mining and inter-village transportation. At the lower reaches of the river, it is subjected to tidal influence of the Atlantic Ocean. Figure 6.8 shows the drainage system in the project area.

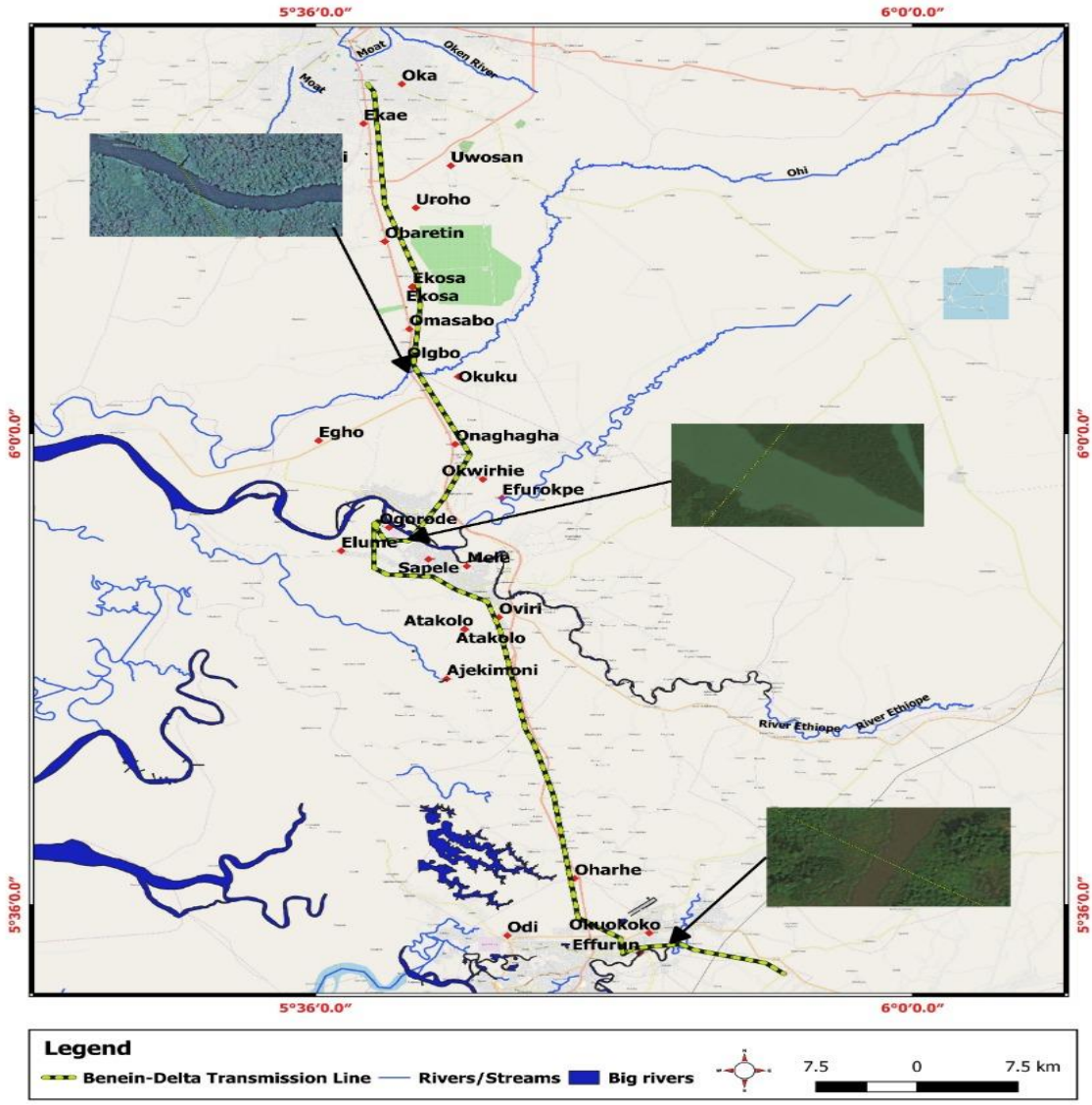


Figure 6.8: Drainage System of the Project Area

6.9 Line Route and Water Crossings

Basically, Ethiope River and Ologbo River are the water bodies (though with different names per traversed community) the line route intersects. The points where the TL crosseswater bodies was observed in Ologbo, the boundary town between Delta and Edo States and a swampy environment from Oghara along the edge and River Ethiope to Ogorode in Sapele.

A (5.916672N, 5.700090E) **B** (5.5500124N, 5.783342E)

Plate 6.4: Water crossing in Ologbo (A) and Oghara (B)

The length of the river where the TL makes contact with the River Ologbo is about 200m, while the width is about 700m. Details of the water bodies at the points of intersection are provided in Table 6.13.

Table 6.13: Water bodies at the points of intersection with the line route

Stream Crossing ID	Co ordinate	Type of water Course	Stream Morphology	Water level	Channel material (%)	Width (m)	Depth (m)	Flood plain (m)	Bank Height (m)	Vegetation Type	Signs of Erosion	Dominant flora	Potential for fauna wildlife
SW1	5.550012 4N, 5.783342E	Intermittent	Tortuose	Low water	Organic = 20 Clay/silt =25 Sand =55	700	6.5	18	3	Freshwater	Yes	*Lophira sp*	Yes
SW2	5.916672N, 5.700090E	Intermittent	Winding	Low water	Organic =30 Clay/Silt =30 Sand=40	50	0.7	2	0.8	Freshwater	Yes	*Sellaginella sp*	*Yes:* Avi fauna and Hepato fauna

The findings are for informed decisions ranging from identifying and mapping sensitive habitats such as breeding grounds and areas with threatened species as shown in Table 6.14 to be made.

Table 6.14: Sensitive habitats at water crossing points

Site ID	Sensitive Component	Geographical Information	Altitude (m)
SW1	Economic species and Threatened species	5.5500124N, 5.783342E	151
SW2	Potential spawning ground	5.916672N, 5.700090E	142

*Identity of the species in each water crossing is provided in Table 6.13

6.10 Surface Water Quality

6.10.1 Sampling Methods

Surface water was collected as appropriate using non isokinetic water sampler. This 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 analyzed for hydrocarbon content (oil and grease, etc.).

All water samples were preserved in ice blocked loaded boxes in the field and refrigerators on site prior to transmission on ice loaded coolers to Mifor Consult laboratory, Calabar. Figure 6.9 shows the water sampling points.

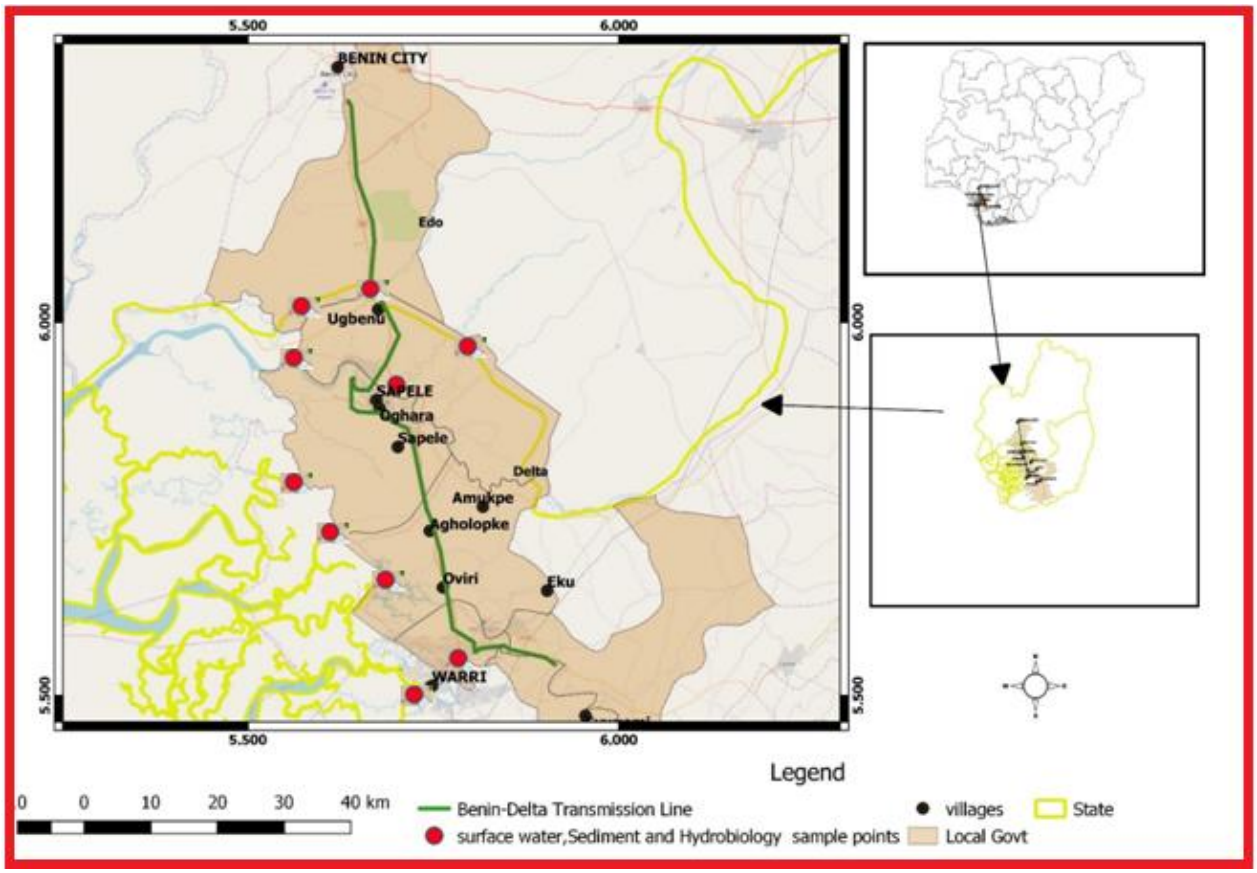


Figure 6.9: Surface water sampling points

6.10.2 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 physicochemical 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 physicochemical 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.

6.10.3 Hydrobiology

Benthic Macro fauna sampling

A pragmatic approach was taken in acquiring benthic macro fauna samples, as 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. As consistent with international best practice and scientific protocols, in-situ measurement is not required for any of the parameters for sediment samples.

6.10.4 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, the GNL Field monitoring team conducted zooplankton sampling exercise

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, zooplanktons 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.

6.10.5 Fishery Methodology

Data for fishery studies were collect from professional observation in the water bodies, nearby markets fishermen and consumers in the area.

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

6.10.6 Result of Hydrobiology

A total of sixty-three (27) species were observed in the study. The breakdown includes; nineteen (19) phytoplankton, seven (7) zooplankton and five (5) macro benthos in the Benin-Sapele area, and 15, 6, 0, respectively for the Sapele-ugheli area.

a) Phytoplankton Study

A total of nineteen (19) species with and a count of 560 individuals were recorded in **Benin - Sapele** section while fifteen (15) species with 203 counts were recorded in the **SapeleUgheli** section. This informationis presented in Table 6.14.

Table 6 .14: Phytoplankton Species Checklist

	Benin-Sapele							Sapele- Ugheli			TOTAL Abundance
Species	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10	
Microcystis aeruginosa	2	8	6	8	7	3	5	0	0	0	39
Anabaena spiroides	7	5	2	1	2	1	4	7	2	6	37
Lyngbya limnetica	2	8	4	3	6	1	1	4	5	8	42
Spirulina sp	8	8	4	2	3	6	5	3	9	5	53
Anabaena sp	7	1	5	7	2	1	7	0	0	0	30
Phormidium tenue	6	0	3	8	9	5	1	7	4	6	49
Lyngbya contorta	2	1	5	2	1	4	3	0	0	0	18
Oscillatoria limosa	5	1	6	6	5	9	1	6	4	5	48
Oscillatoria limnetica	4	2	2	2	10	1	2	4	2	9	38
Oscillatoria sp	6	3	1	3	5	2	8	2	1	6	37
Merismopedia elegans	6	3	0	7	8	7	3	4	5	3	46
Spirulina major	2	6	5	2	2	8	5	3	1	10	44
Phormidium fragile	6	8	4	8	7	3	8	7	5	2	58
Lyngbya circumcreta	1	3	10	2	0	2	5	6	7	5	41

Lyngbya cylindricum	3	7	2	4	0	1	4	0	0	0	21
Melosira granulate	2	4	7	5	7	6	8	3	5	2	49
Melosira granulata var. Angustissima	3	1	1	3	1	7	1	4	9	0	30
Synedra ulna	6	9	2	3	0	9	4	2	4	5	44
Nitzschia sp	1	0	8	5	6	5	8	4	1	1	39
Shannon Index	2.79	2.619	2.728	2.794	2.6	2.716	2.769	2.633	2.522	2.51	
Evenness Index	0.8572	0.807	0.8503	0.8601	0.8415	0.796	0.8388	0.9275	0.8301	0.8793	

This result indicates a diverse community of phytoplankton species. The absence of *Tintinnid* in the water samples must have favored the proliferation of the phytoplankton species in the water body. Tintinnids were important grazers of phytoplankton species (Peter, 1986). Result of the Shannon index showed that SW4 and SW1 were the most diversed stations with respect to phytoplankton composition while SW10 and SW9 were the least diversed. The presence of diatoms in water samples from across both study sections is indicative of possible pollution from anthropogenic sources such as fertilizers and nutrients runoff, leading to eutrophication (Blinn and Bailey, 2001). Ecologically, Diatoms are significant not only as important ultimate source of food for herbivorous zooplankton and fish respectively. They also have direct and indirect economic significance for humans (Nwadiora and Ezefili (1986).

b) Zooplankton Result

A total of six (6) Zooplankton species were sampled in the water samples collected across both study sections. However, forty-one (41) individuals were recorded for the Benin-Sapele sections while fifteen (15) were recorded for the Sapele – Ugheli section. This informationis presented in Table 6.15.

Table 6.15: Zooplankton Species Checklist

ZOOPLANKTON		Benin-Sapele							Sapele- Ugheli			Total
SPECIES	Group	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10	**TOTAL**
Corycaeus obtusus	Crustacea	2	1	1	1	1	0	2	1	0	1	10
Trichocerca cylindrical	Rotifera	1	0	1	0	0	2	0	0	2	1	7
Temora sp	Crustacea	0	1	1	1	1	0	0	2	0	0	6
Keratella quadrata	Rotifera	2	0	0	1	0	0	2	1	1	1	8
Keratella cochlearis	Rotifera	0	1	1	2	1	0	0	0	1	1	7
Cyclopina longicornis	Crustacea	1	0	0	2	1	1	2	1	0	1	9
Acartia clausii	Crustacea	2	2	2	1	1	0	0	0	1	0	9
Shannon index		1.56	1.332	1.561	1.733	1.609	0.6365	1.099	1.332	1.332	1.609	
Evenness index		0.9514	0.9473	0.9524	0.9428	1	0.9449	1	0.9473	0.9473	1	

Result of the study revealed the presence of three pollutant sensitive species (*Keratella cochlearis, Keratella quadrata, Trichocerca cylindrical)* which revealed the euthrophic nature of the water bodies. All species counted in the samples obtained from Benin – Sapele were also counted in those obtained from Sapele - Ugheli**.** This suggests similar nutrients load and environmental conditions across water bodies in the sections under study. Possible sources of these nutrients are sewage and agricultural effluents from anthropogenic activities (Echaniz*et al.,* 2012). Crustacean dominated the observed zooplankton community across both study sections with *Corycaeus obtusus*having the highest count. A close look at the Shannon Weiner indices revealed the zooplankton composition in all sampling points to be less diversed. However, amongs all sampling point, SW5 and SW6 were the least diverse.

c) Benthic study

Five (5) macro benthic species were counted in the sediment samples. However, SW4 was barren of any benthosspecies. Table 6.16 presents this information.

Table 6.16: Macrobenthos Species Checklist

MACRO BENTHOS	Benin-Sapele							Sapele- Ugheli			Total
SPECIES	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10	**TOTAL**
Glycera convulata	2	0	2	0	0	3	1	2	0	0	10
Nereis sp	0	0	4	0	3	0	0	0	0	0	7
Polydora ciliiata	0	0	2	0	2	0	0	0	0	0	4
Tubifex sp	3	2	1	0	1	0	0	2	0	3	12
Hydrobia minuta	0	1	0	0	2	1	2	0	1	2	9
Shannon Index	0.673	0.6365	1.273	0	1.321	0.5623	0.6365	0.6931	0	0.673	
Evenness index	0.9801	0.9449	0.8929	1	0.9367	0.8774	0.9449	1	1	0.9801	

Two pollution (heavy metal) sensitive species (*Nereis sp, Polydora ciliiata)* of the Polycheate group were assayed in the water samples specifically in stations 3 and 5. Macro benthos have active role in biotic and abiotic interactions characterizing aquatic ecosystems. Result on the Shannon index with respect to species diversity station revealed all sampling point to be very low in microbenthos diversity. All sampling sites recorded a Shannon index of less than 1 except for SW3 and SW5 with 1.273 and 1.321 respectively.

6.10.7 Surface water Physico-Chemical Result

The physico-chemical characteristics of the surface water bodies within the proposed project areas are summarized in Table 6.17. The project area is served by the Ethiope, and Ologbo Rivers.

Table 6.17: Summarized Surface Water Physico-chemical Characteristics

SAMPLE STATIONS	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10	AZURA IPP, 2014	FMEnv/WHO (2011) limits for sustenance of Aquatic Lives
PARAMETERS												
Colour	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Clear	Cloudy	Clear	Clear	Clear		
Odour	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil		Odourless
pH	4.76	8.20	7.71	8.45	9.94	7.75	9.24	7.70	7.38	6.48	7.4	4.8-9.2
Temperature (oC)	27.74	28.02	28.21	27.22	26.65	25.10	24.24	25.38	28.50	25.74	29.92	40
Conductivity (µS/cm)	0.33	0.40	0.72	0.06	0.54	0.24	0.46	0.72	0.31	0.13	-	
Salinity (g/l)	1.51	1.76	0.77	0.67	1.46	1.96	0.97	1.03	0.99	0.37	-	
DO (mg/l)	2.66	2.64	2.51	3.20	2.72	1.87	3.41	2.53	2.79	1.56	5.3	4 - 9
Turbidity (NTU)	25.55	26.88	26.36	25.71	25.24	25.76	25.33	25.82	25.28	25.21	37.1	≤25
Total Dissolved Solids (mg/l)	111.8	158.3	151.1	63.7	216.1	170.7	193.8	143.2	214.0	269.3	-	
Oil & Grease (mgl)	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	-	
BOD_5 (mg/l)	3.55	3.08	3.49	4.03	3.81	3.20	2.94	2.07	4.28	2.95	4.2	≤10
COD (mg/l)	4.18	3.26	5.86	5.29	3.93	4.15	3.44	3.74	2.88	3.39	8.3	40
Chloride (mg/l)	78.04	76.11	78.79	77.51	77.78	75.28	77.40	76.18	75.31	76.17	-	
Nitrate (mg/l)	0.23	0.15	0.15	0.17	0.22	0.21	0.16	0.14	0.20	0.18	6.7	50
Phosphate (mg/l)	4.89	5.00	5.26	4.14	5.85	7.28	6.18	4.16	2.82	5.44	5.3	500
Sulphate (mg/l)	1.45	0.49	1.89	1.20	0.45	1.61	0.74	2.19	2.34	1.31	-	500
Phenol (µg/l)	0.04	0.02	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.03	-	
Magnesium (mg/l)	15.6	12.3	11.1	19.5	7.8	4.1	6.6	19.3	14.5	11.7	-	200
Potassium (mg/l)	6.91	5.75	2.83	3.28	4.24	5.49	4.71	2.96	1.99	1.68	-	10

Sodium (mg/l)	10.20	10.22	6.34	5.92	3.65	12.13	3.57	7.76	10.05	8.19	-	200
Calcium (mg/l)	5.05	0.29	6.05	4.98	1.59	2.98	3.71	3.88	6.12	7.82	-	200
Chromium (mg/l)	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	-	50
Manganese (mg/l)	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	100
Lead (mg/l)	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.002	25
Zinc (mg/l)	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.002	5000
Copper (mg/l)	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.002	1500
Total Iron (mg/l)	1.76	1.44	1.39	1.96	1.31	1.31	0.33	1.22	1.57	0.85	1.17	300
Nickel (mg/l)	1.29	1.59	1.12	1.25	1.09	1.13	1.30	1.35	1.03	0.98	1.21	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	-	0.03

Source: GNL Survey, 2019

As shown in Table 6.18, all physico chemical parameters analyzed in the water samples were within threshold values, except for turbidity and Dissolved Oxygen (DO) which had values above and below threshold limits respectively.

Details of sampling, possible source and environmental/health implications and site/community where the samples were obtained are presented in Table 6.18.

Table 6.18: Details of Surface Water Sites with Elevated Turbidity and Depleted DO Levels

Parameter	Community (Sampling Sites)	Possible source	Implication/comment
DO	All sampling points	Increased baseline turbidity and BOD level may have triggered the depletion of DO levels	Water bodies with reduced DO levels are usually anoxic and unhealthy for aquatic organism.
Turbidity	All sampling points	sedimentation from the increased flow rate of the water bodies and soil erosion from intense wind regime in the areas	Suspended particles associated with turbidity are known to increase water temperature and in turn reduce DO levels. Considering the baseline concentrations, the water in the project area is not safe for drinking

Source: GNL 2019

6.10.8 Surface Water Microbiology

The densities and taxa of microorganisms in the water bodies within the project environment are presented in Table 4.19.

Table 6.19: Summarized 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	*Bacillus sp, Micrococcus sp Pseudomonas sp, Staphylococcus sp, Micrococcus s, 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 2	*Streptococcus sp, Flarobacterium sp Alcaligenes sp, Proteus sp Escherichia sp*	2.84×10^4	*Flarobacterium sp Alcaligenes sp*	1.04×10^1	*Streptococcus sp Flarobacterium sp Alcaligenes sp, Proteus sp*	2.32×10^2	*Streptococcus sp Flarobacterium sp Proteus sp*	2.06×10^1
SW 3	*Micrococcus sp, Pseudomonas sp Staphylococcus sp, Streptococcus sp, Flarobacteriumsp, 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 Flarobacterium sp*	3.65×10^4	*Micrococcus sp Pseudomonas sp Staphylococcus sp*	2.31×10^2
SW 4	*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 5	*Staphylococcus sp, Micrococcus sp Streptococcus sp, Flarobacterium sp Alcaligenes sp, Escherichia sp*	3.69×10^5	*Micrococcus sp Streptococcus sp Flarobacterium sp Alcaligenes sp*	3.12×10^3	*Staphylococcus sp Streptococcus sp Flarobacterium sp Alcaligenes sp*	2.78×10^4	*Staphylococcus sp Streptococcus sp Flarobacterium sp*	2.42×10^2

SW 6	*Escherichia sp, Arthrobacter sp Micrococcus sp, Pseudomonas sp*	4.15 x 10^4	*Micrococcus sp*	1.66 x 10^2	*Arthrobacter sp Micrococcus sp Pseudomonas sp*	3.47 x 10^3	*Arthrobacter sp Micrococcus sp*	2.20 x 10^2
SW 7	*Micrococcus sp, Streptococcus sp Flarobacteriumsp, Alcaligenes sp Proteus sp, Escherichia sp*	5.03 x 10^6	*Flarobacteriumsp Alcaligenes sp Proteus sp Escherichia sp*	3.74 x 10^4	*Micrococcus sp Streptococcus sp Flarobacteriumsp*	3.56 x 10^2	*Streptococcus sp*	1.71 x 10^1
SW 8	*Flarobacterium sp Alcaligenes sp Proteus sp Escherichia sp Actinomyces sp*	4.01 x 10^2	*Proteus sp Escherichia sp*	2.62 x 10^1	*Alcaligenes sp Proteus sp Escherichia sp Actinomyces sp*	3.42 x 10^3	*Escherichia sp Actinomyces sp*	2.12 x 10^2
SW 9	*Bacillus sp, Micrococcus sp Pseudomonas sp. Staphylococcus sp*	3.8 x 10^4	*Micrococcus sp Pseudomonas sp Staphylococcus sp*	2.33 x 10^2	*Bacillus sp, Micrococcus sp Pseudomonas sp, Staphylococcus sp*	3.47 x 10^3	*Bacillus sp Micrococcus sp*	2.03 x 10^1
SW 10	*Streptococcus sp, Flarobacterium sp Alcaligenes sp, Proteus sp Escherichia sp, Arthrobacter sp*	5.3 x 10^3	*Escherichia sp Arthrobacter sp*	2.85 x 10^1	*Flarobacterium sp Alcaligenes sp Proteus sp*	3.8 x 10^4	*Flarobacterium sp*	1.27 x 10^3

Source: GNL Survey, 2019

Table 6.20: 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	Starch
Arthrobacter sp	Nitrogen, carbon	Cassava tubers, corn
Flavobacterium sp	Proteosepeptone, acids, Yeast, Dextrose, Soluble starch, phosphate, Magnesium Sodium,	Meat, fish, cheddar cheese
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, cheddar cheese
Actinomyces sp	vitamins, carbohydrates, nitrogen, and salts	Meat, fish, cheddar cheese

The presence of faecal contamination indicator species such as*Escherichia sp*in the water bodies across both sections of the project area is suggestive of polluted water bodies. However, the samples were devoid of water-borne pathogens such as *Giardia lamblia* and *Vibrio cholera. D*etails 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 to play key ecological roles in various water systems especially nutrient recycling. The microbial load of the water body indicates pollution and the capability of the water body to break down contaminants.

6.10.9 Sediment study

6.10.9.1 Sediment Physico-Chemical Analyses

Sediment (bottom of the surface water body) serve as sink for contaminants from the overlying water. The physic-chemical characteristics of the sediment are an indication of the pollution level and the type of pollutants that has been in the overlying surface water.

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 ten (10) heavy metals. 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 6.21: Summarized Sediment Physico-chemical Results

SAMPLE STATIONS	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8	SD9	SD10	Azura, 2014	FMEnv	ISQG Limits
PARAMETERS													
PH	8.01	6.62	7.09	6.86	8.89	7.34	7.73	8.61	7.81	7.37	6.99	6.5-9	6.0-9.0
Oil and Grease	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	3.12		
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	76.65	77.59	75.44	74.40	74.98	76.22	74.92	76.05	73.45	77.16	23.4		
Ext. nitrate(mg/kg)	0.23	0.24	0.20	0.18	0.12	0.23	0.16	0.16	0.16	0.20	3.91		
Ext. phosphate	4.25	2.39	6.10	4.44	5.21	4.48	2.93	0.93	3.54	3.15	5.12		
Ext. sulphate	2.29	2.42	0.32	0.59	1.20	0.48	0.84	1.80	1.53	0.22	1.93		
Chromium	0.21	0.21	0.23	0.23	0.23	0.20	0.24	0.24	0.22	0.19	1.67	50	
Lead(mg/kg)	0.09	0.08	0.09	0.07	0.05	0.12	0.07	0.10	0.07	0.07	0.002		
Zinc(mg/kg)	1.24	1.30	1.42	1.31	1.35	1.60	1.68	1.82	1.37	1.73	2.12	5000	120-540
Copper(mg/kg)	2.98	3.43	3.44	3.34	3.42	3.97	4.09	3.40	3.38	3.71	6.19	35.7	
Total iron	1.57	0.93	1.55	1.39	1.59	0.93	1.25	0.68	1.50	1.49	6.23	300	
Nickel	0.98	1.10	0.77	0.82	0.77	1.05	0.76	0.87	0.82	0.78	-	88	

Cobalt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-		123-540
Cadmium	<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	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	-		
Manganese	0.89	1.021	1.125	0.913	1.403	1.611	0.991	1.31	1.331	1.086			

As shown in Table 6.21, all physico chemical parameters analyzed in the sediment samples were within ISQG and FMEnv threshold values. This is not the only reason for acquiring the baseline status of the the sediment of the study area.

6.10.9.2 Sediment Microbiology

Sediment samples were also analyzed for microbial content. Table 6.22 presents the result.

Table 6.22: Summary of Sediment Microbiology

SW1	*Pseudomonassp Bacillus sp Staphylococcus p Micrococcus sp Actinomyces sp Proteus sp*	4.91 x 10^4	*Pseudomonas sp Staphylococcus p Micrococcus sp*	2.6 x 10^2	*Candida sp Rhodotorulasp Penicillium sp Mucor sp Fusarium sp*	3.1 x 10^3	*Penicillium sp Mucor sp*	1.52 x 10^2
SW2	*Staphylococcus p Micrococcus sp Actinomyces sp Proteus sp*	3.44 x 10^3	*Actinomyces sp Proteus sp*	2.83 x 10^1	*Rhodotorulasp Penicillium sp Mucor sp Fusarium sp*	2.79 x 10^2	*Mucor sp*	1.2 x 10^1
SW3	*Micrococcus sp Actinomyces sp Pseudonomas sp Bacillus sp Protues sp*	4.2 x 10^4	*Pseudonoma p Bacillus sp*	2.16 x 10^2	*Penicillium sp Mucor sp Fusarium sp*	3.28 x 10^4	*Fusarium sp Penicillium sp*	2.04 x 10^3
SW4	*Bacillus sp Staphylococcus p Micrococcus sp Actinomyces sp Proteus sp*	3.86 x 10^3	*Staphylococcus sp Micrococcus sp*	2.0 x 10^2	*Aspergillus sp Candida sp Rhodotorula sp*	3.24 x 10^3	*Aspergillus sp Candida sp*	1.68 x 10^1
SW5	*Micrococcus sp Actinomyces sp Proteus sp*	3.75 x 10^5	*Actinomyces sp Proteus sp*	2.14 x 10^3	*Candida sp Rhodotorulasp Penicillium sp Mucor sp*	3.22 x 10^4	*Penicillium sp Mucor sp*	2.42 x 10^3
SW6	*Bacillus sp Staphylococcus sp Micrococcus sp Actinomyces sp*	2.89 x 10^4	*Staphylococcus sp Micrococcus sp Actinomyces sp*	2.13 x 10^3	*Aspergillus sp Candida sp Rhodotorula sp*	2.06 x 10^3	*Candida sp*	1.34 x 10^1
SW7	*Staphylococcus sp Micrococcus sp Actinomyces Pseudonomas sp Bacillus sp*	4.63 x 10^3	*Micrococcus sp Actinomyces Bacillus sp*	3.18 x 10^2	*Aspergillus sp Candida sp Rhodotorulasp Penicillium sp*	3.42 x 10^3	*Rhodotorulasp Penicillium sp*	2.11 x 10^2
SW8	*Actinomyces Pseudonomassp Bacillus sp Protuessp*	3.6 x 10^4	*Bacillus sp Pseudomonas sp Protues sp*	2.78 x 10^2	*Aspergillus sp Candida sp Rhodotorulasp Penicillium sp Mucor sp Fusarium sp*	2.38 x 10^3	*Rhodotorulasp*	1.85 x 10^2

SW9	*Staphylococcus Micrococcus sp Actinomyces Proteus*	5.23 x 10^6	*Actinomyces sp Micrococcus sp*	3.51 x 10^4	*Rhodotorulasp Penicillium sp Mucor sp Fusarium sp*	4.2 x 10^3	*Penicillium sp Mucor sp*	3.17 x 10^2
SW10	*Pseudonomassp Bacillus sp Staphylococcus p Micrococcus sp Actinomyces Proteus*	3.41 x 10^4	*Bacillus sp Staphylococcus sp Micrococcus sp*	2.14 x 10^2	*Aspergillus sp Candida sp Rhodotorulasp Penicillium sp*	3.03 x 10^3	*Aspergillus sp Candida sp*	1.2 x 10^2

Source: GNL Survey, 2019

Table 6.23 presents possible substrate matrix for the microbial species observed in the surface water samples.

Table 6.23: Possible species- substrate matrix for Sediment samples

Species	Broad spectrum of growth media	Examples of local foods as possible growth medium
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
Proteus sp	Nitrogen, vitamins, lactose	Starch, fufu
Actinomyces sp	Propionic acid, *sodium salt, nitrogen*	Meat, Groundnut, bread
Staphylococcus sp	vitamins, carbohydrates, nitrogen, and salts	Meat, Groundnut and Bread
Streptococcus sp		
Aspergillus sp	Sodium, potassium, iron, calcium, glucose	Rice, beans and soya bean, Yam, potatoes, t. Sugarcane, corn and wheat straw
Candida sp		
Penicillium sp		
Rhizopus sp		
Fusarium sp		
Mucor sp	Magnesium Sulfate, Monopotassium Phosphate, Peptone, glucose, Sodium, potassium, iron, calcium	Starch, fufu
Rhodotorula sp		

Source: GNL, 2019.

The microbial composition of sediments is similar to those observed in the surface water samples, except for the absence of faecal contamination indicators. The presence of*Escherichia sp* in the surface water and subsequence absence in the sediment is suggestive of low volume of faecal input from the terrestrial environment and the presence of surface dwelling faecal consuming organisms in the water bodies. The microbial composition in the sediment samples were. Generally, the microbial species composition in the samples is indicative of sewage contamination, especially from food sources (Table 6.24).

6.11 Fisheries

Traditionally, fish has been one of the major sources of food for the people of Edo and Delta. Key fish species in the area include Silver catfish, Tilapia, and the Bagrids. Fishing is a year-round activity that is pursued more vigorously in the wet season and early dry season. Economically fish provides an important source of food and income for some men and women and fishing has an important social and cultural position in the communities that form part of the study area.

6.11.1 Fishery Inventory Methods

Fishery Studies

The general objective of the field study was identification of the present status of the fishery resources in the area. The fisheries studies were carried out by interviewing fishermen, fish sellers and consumers on different locations within the study area.

Plate 6.5: Pictures of fishing gears and fishermen in Ethiope River at Oghara

The survey was aimed at the identification of:

- Present types of fisheries in the area
- Main locations of each type of fisheries
- Fishing methods and gear currently in use
- Present fish species in the area and their values
- Ascertaining the pattern of fish movement and migration in the area

The study aimed is to give a vivid record of the fish community structure in and around the project area. Investigate fish species diversity and ecosystem status. It also entailed documenting seasonal changes in the fish community and size distribution of key species. Information on fish species diversity in the study area will be obtained from interviews with local fisher men and inhabitants of small fishing settlements along the Ethiope River and from existing sources. Sampling was stratified to include an equivalent amount of effort in the different communities within the study area. Fish capture techniques used in the study area was documented along with other findings.

The status of fish storage technologies in the study area was evaluated using semi-structured interview and field observation to assess the existing fish storage techniques in some fishing communities that were visited in the study area.

6.11.2 Sampling procedure

Based on the two water bodies (Ologbo and Ethiope), existing within the study area, fishery studies were conducted in Oghareki (Oghara), Ugwanja (sapele) and in Ologbo market in addition to the two water bodies.

6.11.3 Data Collection

Collection of information was based on a combination of methods: direct observation of fishermen's catches in their canoe and nets at the fishing grounds and consultation in the field with fishermen. Thereafter, fish markets in Ologbo town were visited to ascertain the type of fish species being sold. Fish samples observed were identified with flash cards, checklists, photographs and scientific identification keys. Some fishermen were interviewed at the river side. All the data gathered were documented for use in the ESIA report.

6.11.4 Species Diversity and Richness

The fish assemblages in the river are presented in Table 6.24. A total of 29 species of fish representing 19 families were collected. The relatively low species richness can be traced to the habitat and water quality of the river becoming stressed with various anthropogenic activities. A greater number of the fish species were pelagic, which moved within the upper strata of the water column and are more likely to move away from environmental perturbation. The demersals occupy the lower stratum and could be more susceptible to habitat perturbation. The presence of *Cynoglossus senegalensis* (see Table 6.24) in the dry season catch is a pointer that this fish must have migrated from the ocean during this season and is able to tolerate the salinity of the freshwater at this time of the year (Idodo-Umeh, 2003). Overall, 29 fish species belonging to 19 families were collected in the water bodies consisting of mainly freshwater species and a few saltwater species with a total of 480 individual fishes. Cichlidae (4 species), Bagridae (3 species) and Characidae (2 species) were the most dominant families. Five (5) species, *Chrysichthys nigrodigitatus* (Bagridae) *Hemichromis fasciatus* (Cichlidae), *Brycinus nurse* (Characidae), *Pellonula afzellusi* (Clupeidae), and *Clarias anguillaris* (Clariidae) dominated the sample and accounted for about 80%. *Chrysichthys nigrodigitatus* (Bagridae) constituted the major dominant species and accounted numerically for about 30% of the total catches and 52% of the total biomass.

Fish abundance and the biotic integrity are likely to be influenced by any habitat degradation including discharge of effluents and other anthropogenic activities. These would lead to fish mortality including adult, Juveniles and egg/larvae mainly through degradation in water quality and alteration of the food resources. Eventually, the recruitment pattern will be altered and drastically reduced resulting in lower fish abundance.

Table 6.24: Inventory of Fishery Resources in the Project Area

Family	Taxa	Common name
Cichlidae	*Chromidotilapia guentheri (Sauvage, 1882)*	Cichlid
	Hemichromis fasciatus (Peters, 1857)	Jewel fish
	Oreochromis niloticus (Trawavas, 1980)	Cichlid
	Tilapia galilaeus (Genvais, 1848)	Cichlid
Clupeidae	*Pellonula afzellusi (Johnels, 1954)*	Clupeid
Bagridae	*Auchenoglanis occidentalis (Cuvier and Valenciennes, 1840)*	Catfish

	chrysichthys nigrodigitatus (Lacepede, 1903)	Silver catfish
	Chrysichthys auratus longifilis (Geoffrey St. Hilaire, 1809)	Silver catfish
Osteoglossidae	*Haterotis niloticus (Cuvier, 1829)*	African bony tongue
Channidae	*Parachanna africana (Gunther, 1861)*	Snake head
Characidae	*Brycinus nurse (Ruppel, 1832)*	Silverside fish
	Brycinus longipinnis (Gunther, 1864)	Silverside fish
Clariidae	*Clarias anguillaris (Linnaeus, 1758)*	Mud catfish
	Clarias gariepinus (Burchell, 1822)	Mud catfish
Mormyridae	*Mormyrus rume (cuvier and Valenciennes, 1846)*	Elephant snout fish
	Marcusenius ihuysi (Steindachner, 1870)	Mormyrid
Hepsetidae	*Hepsetus odoe (Bloch, 1794)*	African river pike
Notopteridae	*Papyrocranus afer (gunther, 1868)*	African seetu
Schilbeidae	*Schrilbe uranoscopus (Rupell, 1832)*	Butterfish
Polypteridae	*Erpetoichthys calabaricus (smith, 1866)*	Calabar Snake fish
	Polypterus senegalus (Cuvier, 1829)	Sailfin
Cyprinidae	*Labeo senegalensis (Cuvier, 1832)*	African pike
Citharinidae	*Citharinus citharus (Geoffrey St. Hilaire, 1809)*	Moon fish
Cynoglossidae	*Cynoglossus senegalensis (Kaup, 1858)*	Flat fish
Pomadasyidae	*Pomadasys jubelini (Cuvier, 1830)*	Grunter
	Pomadasys peroteti (Cuvier, 1830)	Grunter
Carangidae	*Trachinotus goreensis (Cuvier, 1832)*	Longfin pompano
Anabantidae	*Ctenopoma petherici (Gunther, 1844)*	Climbing perch
Monodactylidae	*Monodactylus sebae (Cuvier and Valenciennes, 1829)*	African moony

Source: GNL, 2019

(A) Clarias gariepinus *(B) Menidia menidia*

(B) Cynoglosus macrolepidotus (D) *Atyoida bisulcata*

(E) Synodontis budgetti *(F) Heterobranchus longifilis* *(G) Hemichromis fasciatus*

(I) Clarias camerunensis *(J) Polycentropsis abbreviate*

Plate 6.6 (A-J): Some Censored Fish Species of the Water Bodies in the Study Area

The fishing crafts are non-motorized canoes driven with paddles and sails, each craft is about 6.7m long, with a maximum of (3) three fishermen. The shell fishery is exploited by three gears: beach seine, push net (active) and trap (passive). Three *Macrobrachium* species and *Penaeus* nuptials (Table 6.25) form the bulk

of the catch. The catch is sold fresh to local consumers in the surrounding markets. It is a relatively cheap source of protein to the residents in the area.

Table 6.25: Shellfish Assemblage in the Study Area

Family	Taxa	Common name
Atyidae	*Caridina gabonensis*	Shrimp
Palaemonidae	*Macrobrachium dux*	Prawn
	Macrobrachium macrobrachion	Prawn
	Macrobrachiurn vollenhovenii	Prawn
	Penaeus nuptials	Red shrimp

The fish community was numerically dominated by detritivores (39.0%) and planktinovores/micro carnivores (16.0%) and intermediate carnivores (29.0%) comprised a relatively high species number of ten (10) intermediate carnivores and four (4) predators (Table 6.26). Trophic categories, relative abundance and fisheries importance of the fish caught at the Ologbo and Ethiope Rivers. Detritivores and planktinovores/microcarnivores dominated the sample (Table 6.26).

Table 6.26: Tropic Structure of Fish Composition

Species	Relative abundance (%)	Life history stage	Fisheries importance
Erpetoichthys calabaricus	2.02	J/A	MC
Planktinovores/micro	**Carnivores**		
Auche noglanis occidentalis	1.40	J/A	HC
Chromidotilapia guentheri	2.80	A	HC
Citharinus citharus	1.00	J/A	MC
Papyrocranus afer	3.98	J	MC
Heterotis niloticus	2.40	J/A	HC
Pellonula afzellusi	4.18	J/A	HC
Herbivores			
Tilapia zillii	1.40	J/A	HC
Oreochromis niloticus	1.20	J/A	HC
Marcusenius ihuysi	2.40	A	MC
Brycinus longipinnis	2.10	J/A	HC
Citharinus citharus	1.80	A	HC

Labeo senegalensis	2.10	A	MC
Intermediate carnivores			
Clarias angullaris	5.05	A	HC
Ctenopoma petherici	1.20	A	MC
Cynoglossus senegalensis	1.80	A	MC
Monodactylus sebae	2.80	J	HC
Hemichromis fasciatus	16.20	J/A	MC
Papyrocranus afer	0.50	A	MC
Pomadasys jubelini	0.50	J/A	HC
Pomadasys peroteti	0.44	J/A	HC
Mormyrus rume	0.44	A	MC
Hepsetus odoe	0.44	J/A	HC
Predators			
Polypterus senegalus	1.0	J/A	HC
Parachanna africana	1.0	A	HC
Schilbe uranoscopus	1.0	J	MC
Trachinotus goreensis	1.2	A	
Trachinotus goreensis	1.2	A	
Total	**100.00**	**A**	

- **J: Juvenile; A: adult; HC highly commercial; MC: moderately commercial; NV: no value**

Source : GNL, 2019

Herbivores species (*Oreochromis niloticus, Tilapia zillii*) comprised 2.60%. In terms of biomass, detritivores dominated the sample (52.3% of the total biomass) due to the predominance of *Chrysichthys nigrodigitatus* which constituted 45% of the total biomass. The intermediate carnivores and the top predators, despite their number (14 species), had a relatively low biomass proportion (4.5%; 7.8%). Relative to economic value of the fishes, two categories according to their commercial value: (1) fishes of high commercial value (HC), and (2) fishes of moderate commercial value (MC). From the fish sampled, about 80 % had a high economic value, from which 82% were juveniles and adults. There was no species in the any commercial value class. This indicates that the freshwater habitat is under a multi-species fishery where about 98% of the fish species is exploited including shell fishes. In contrast, in term of abundance, top predators tend to be reduced even though the number of species seems to be relatively high.

6.11.5 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.

6.11.6 Breeding Habitat and Migratory Habit

Some brackish water fish families such as Cynoglossidae, Clupeidae and Bagridae were encountered upstream of indicating a slight alkalinity increase in the habitat especially in tidal system. Some of the species such as *Chrysichthys nigrodigitatus* are also known to undergo spawning - migratory movement upstream of the Ologbo River. This corroborates the evidence of Obasohan and Oronsaye (2009) that *Chrysichthus nigrodigitatus* migrate upstream of the Ethiope River to spawn during the rainy season. Downstream of Ologbo River are limited flood plain areas, which serve as nursery ground for many fishes. This is possible because of the existence of rich food resources washed into the flood plains and swamp from upland. The maintenance of such migratory routes by several fish species is important for the sustenance of the fish population. Fisheries breeding habitat therefore include the flood plains/ swamps and Creeks, which are rich in food resources. This is however threatened by the use of non-selective gears, which harvest both adult and juveniles and could reduce recruitment into stock. Such breeding habitats are sensitive environments and any degradation in water quality would affect fish abundance. Worthy of note here is the presence of *Cynoglossus senegalensis* which is known to migrate to brackish and freshwater during the dry season to breed. They were caught in high number during this study indicating their ability to tolerate the salinity of the freshwater (Idodo-Umeh, 2003).

6.11.7 Threatened or Endangered Species

None of the species encountered in the present study is in IUCN Red list of threatened species.

6.11.8 Crafts Survey

Fish capture techniques used in the study area included canoe netting, seining, and trapping. Setlines were deployed for an overnight period in suitable deep-water locations on Rivers. The common fishing craft is the traditional dug - out canoe or half plank-constructed canoe. Fishing gears commonly used in fish exploitation include traps, set gill net and cast nets. The set gill net with mesh size ranging between 30 and 120mm are bottom set and used in the open water and Creeks. 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. For the shrimps, and other shell fishes, the fishing crafts are non-motorized canoes driven with paddles and sails, each craft is about 6.7m long, with a maximum of (3) three fishermen. The fishery is exploited by three gears: beach seine, push net (active) and trap (passive).

6.11.9 Fisheries Survey Socioeconomics

There is actually no secluded location for fishermen as they live among other people of various trades and occupation in the study area. 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 95% of the households in the study area are headed by male members. 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 N1, 000 to N3, 000 for the sale of fish per day depending on the total catch.

In the study area, the commonest fish processing and preservation method is smoke-drying Storage of processed fish is mostly done at artisanal level by women in this community whose main economic activities are fish processing, distribution and marketing. Immediately after landing, fish were thoroughly washed with either clean water or saltwater to remove dirt and microorganisms on the surface. This slows down rate of deterioration.

6.12 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 6.9).

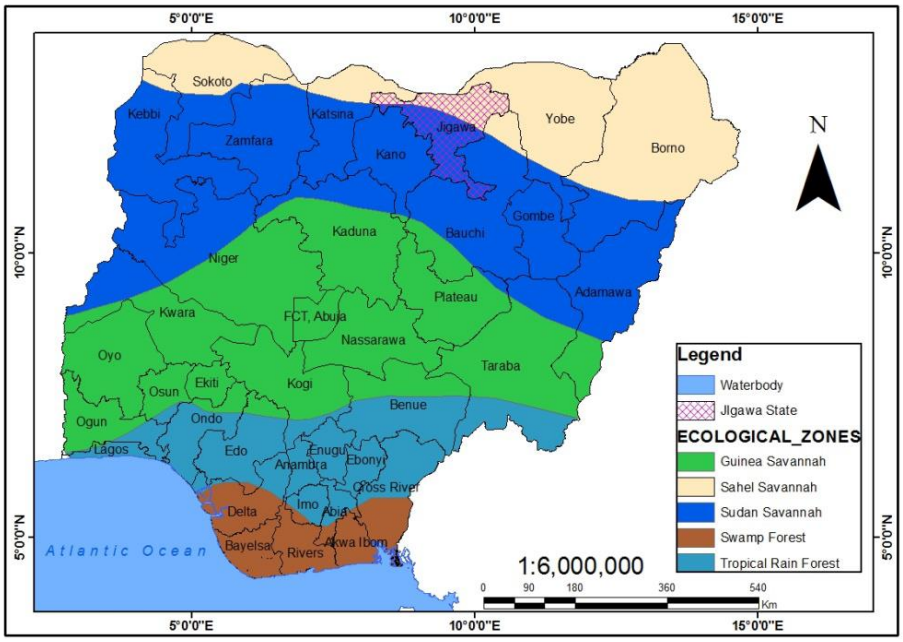


Figure 6.9: Map showing Different Vegetation Belts in Nigeria

Both states are covered by rain forest, derived savanna and freshwater swamp. In addition to these habitats, Delta state is home to mangrove habitats also. The areas are currently experiencing seasonal and episodic flooding regimes.

6.12.1 Sampling parameters and methods (Flora)

Specific and standard methodology (See Table 6.27) was adopted for specific floral taxon for which baseline information. Some of the floristic parameters to be determined as shown in Table 6.27 include specific and family information (life forms, diversity richness, alien species inventory and indigenous uses. Twelve sampling points were delineated using plant species physiognomic conditions and habitat types. An average of 2 hectares was adopted as sampling size per sampling point. This resulted in a total sampled area of 24 hectares. Species touching or overshadowing the line transect were manually enumerated and converted to the Blanquette 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 2019 version 2 standards was used in computing IUCN status. Table.6.27 is a summarize methodology protocols. A total of 12 transects were studied.

Table 6.27: 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, ln = log. E= EQ = -ΣPilnPi / lnS; 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		Number of plots in which species/family is recorded x 100 Total number of plots censured (Sutherland et al 1996).
Species density		Number of plant species recorded 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 2019	Number of threatened species x 100 Total number of species
Protected species	IUCN database 2019 and CITES ACT 2016	-

Table 6.28 presents the sampling coordinates for biodiversity study.

Table 6.28: Sampling Habitats and Coordinates

S/N	COORDINATES (TRANSECTS)		COMMUNITY	HABITAT
1			Evboraria	Secondary forest
2	6.183333	5.63333	Okha	Secondary forest
3	6.050000	5.66667	Ologbo	Freshwater swamp
4	6.065356	5.73247	Ovade	Freshwater swamp
5	5.833333	5.76667	Ogorode	Freshwater swamp
6	5.86667	5.71666	Amukpe	Freshwater swamp
7	5.90000	5.61666	Elume	Freshwater swamp
8	5.55000	5.78333	Effurun	Freshwater swamp
9	5.78764	5.83568	Okuogholo	Secondary forest
10	5.56641	5.84416	Ugbomoro	Freshwater swamp
11	5.58333	5.86666	Agbarho	Secondary forest
12	5.53333	5.93333	Eruemokokwraine	Secondary forest

Figure 6.10 shows the vegetation sampling map.

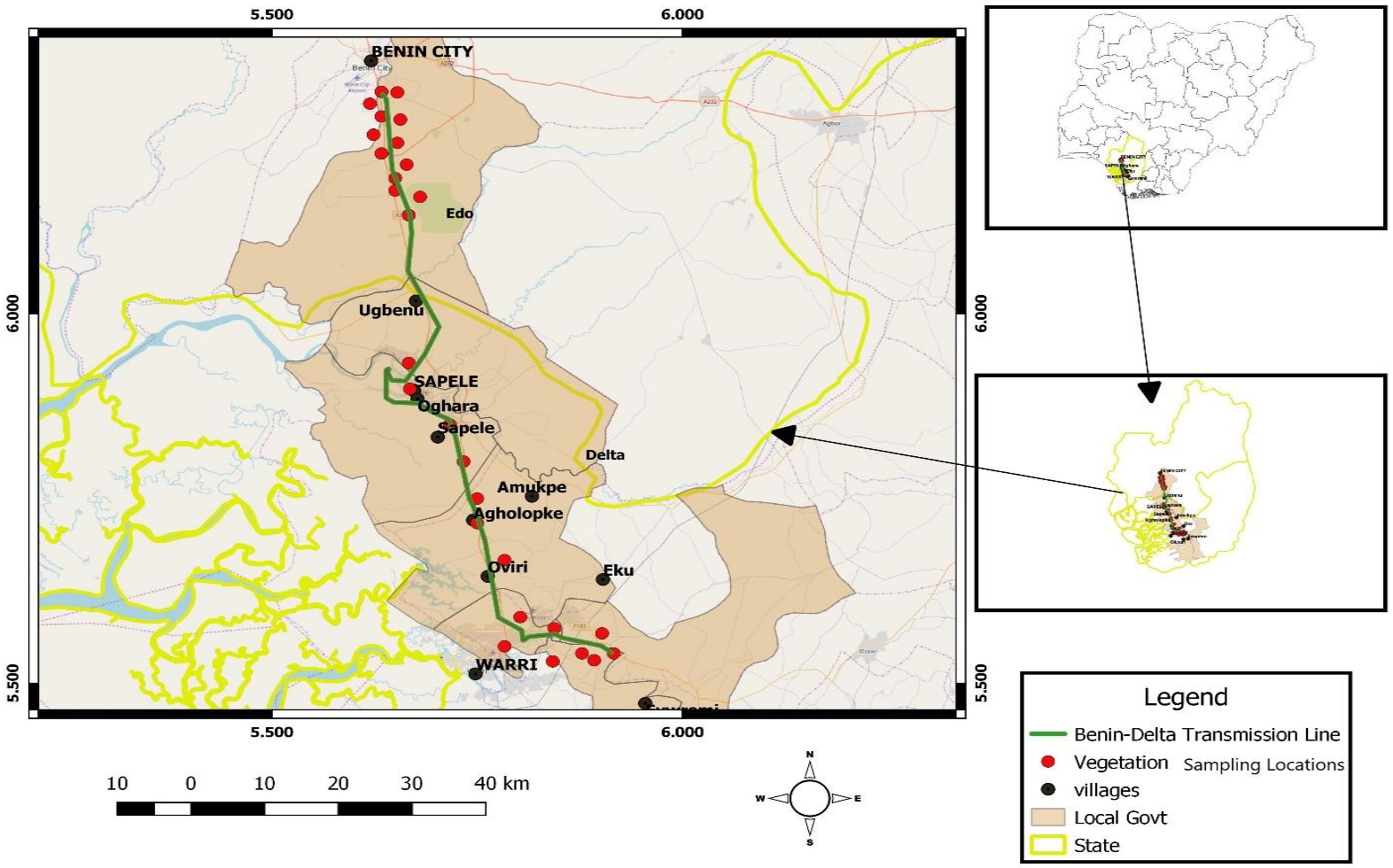


Figure 6.10: Vegetation sampling map

6.12.2 Baseline Characterization

Discussion on the flora resources was conducted on section basis. The various sampled plots were grouped into two respective sections (Ugheli-Sapele & Sapele-Benin) as shown in Table 6.29.

6.12.3 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 two habitats distributed. Secondary forest sampled constituted about 41.7% while freshwater swamp made up the remainder 58.3%. The total footprint of the route is 54ha implying sampling was conducted in about 44.4% of the line route Plate 6.7 is a representative photograph of the habitat types in the study area.

Freshwater swamp

Secondary forest

Plate 6.7: Overview of the Study Habitats

6.12.4 Flora Result

6.12.4.1 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 36 species were inventoried. A comprehensive list of the censored flora

including those for each transect is shown in Appendix 6.4 while the summarized result is presented in Table 6.29.

Table 6.29: Species Richness per Habitat

Habitat	Species Richness per habitat	Species Richness per section	
		Ugheli-Sapele	Sapele- Benin
Secondary Forest	18	36	29
Freshwater swamp forest	27		

Source: GNL 2019

Expectedly, routine vegetal clearing along the transmission line contribute significantly to the recorded sparse species in the study area. Also, the relatively high species richness recorded in the freshwater habitat compared to secondary forest habitats could be attributed the dominant presence of the habitat in the study area.

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.

6.12.4.2 Shannon and evenness indices

Shannon wiener index and evenness index were used to evaluate species diversity for the study area. A 0.78 and 0.87 Values were observed for Shannon and Equitability indices respectively. This is indicative of a habitat under threat and continuous disturbance.

6.13.4.3 Species Growth Habit

Species Growth Habit is the form in which a species exists. The censored species exhibited three(3) growth habits comprising 52.7% Trees, 41.6% Shrub and 5.5% Herbs. Though the species growth habit shows a relative high proportion of woody species in the study area compared to the non-woody species, the Diameter at Breast Height (DBH) study on the other hand, revealed a general low DBH value indicative of

a resurging habitat inhabited by wildling tree species and an environment under disturbances. The DBH values ranged from 13.2 cm to as low as 2 cm. *Camplyspermum flavo, Canarium schweinfurthi, Cleistopholis patens,* and *Ekerbergia capensis* were the few tree species with DBH values of between 10-13cm. On the other hand*, Chromolaena odorata, Mimosa pudica, Bridela micrantha and Chaetacme aristata* were the tree species with the lowest DBH values of about 2cm each.

6.13.4.4 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 one (1) of these species (*Chromolaena odorata*) is invasive and also alien in the study area. The presence of these alien/invasive species in the study area signifies a disturbed ecosystem with fertile loci for proliferation. Plates 4.5 arepictures of the species.

Chromolaena odorata (Invasive, Alien)

Plate 6.8: Invasive species of study area

6.12.4.5 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 two (*Cedrala odarata, Dalbergia latifolia*) species are of conservation concern. They are both in the Vulnerable category in the IUCN Red List of Threatened Species (Version 2019). Plate 6.9 shows pictorial images of these threatened species.

Cedrala odarata *Dalbergia latifolia*

Plate 6.9: Pictures of threatened species in the study area

Table 6.30 provides a reviewed data of the two threatened species.

Table 6.30: Threats and Conservation Actions of the Threatened Plant Taxa of the Study Area

Species	Common name	2019 IUCN Conservation status	Threats	Habitats and locations surveyed	Reserves Protected in Nigeria
Cedrela odorata	Cigerbox wood	Vulnerable A1cd ver 2.3	Unsustainable harvest of timber; Deforestation and associated habitat loss	Secondary Forest (Eyboraria, Okha)	Division of the Okwangwo Forest and Oban Cross River State National Park. Okomu National Park
Dalbergia latifolia	Rosewood	Vulnerable A1cd ver 2.3	Unsustainable harvest of timber; Deforestation and associated habitat loss	Secondary Forest (Agbarho, Eruemokokowraine)	Kamuku National Park

Adeyemi, et al, (2015), Wahab, (2012), IUCN, (2019)

6.12.4.6 Habitats of higher ecological integrity

Important flora resources censored in this study were mapped as shown in Table 6.31. 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 6.31: Ecologically sensitive species and their locations

Category	Species	Ecosystem Services			Locations/Habitats
		Medicine	Food	Raw Materials	
Species with high indigenous uses	*Chromolaenaodorata*	√			1, 7 &12
	Carapa procera	√	√	√	2, 4, 6, 8, 9 &11
	Crateavaadansonii		√	√	3 & 10
	Mimosapudica	√	√	√	2, 3, 5, 6, 9 & 11
	Ekerbergiacapensis			√	1, 2, 9 & 11
	Campylospermumflava			√	6 & 7
	Alchorneacordifolia		√	√	2, 3, 5 & 8
	Funtunia elastica	√	√		4, 6, 10 & 12
	Cleistopholia patens			√	5, 7, 9 & 11
	Boswellia papylifera			√	1, 6, 8 & 11
	Berliniagrandifloria		√	√	3 & 7
	Canariumschweinfurthi			√	1, 3 & 7
	Clausenaanisata		√	√	3, 5, 9 & 12
	Vulnerable (VU)	*Cedrala odarata*			2, 6, 10 & 12
		Dalbergia latifolia			2, 6, 8 & 11
Alien Species		*Chromolaena odorata*			1, 7 & 12
Invasive Species		*Chromolaena odorata*			1, 7 & 12

6.12.4.7 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.

Table 6.32: provide information on the various indigenous uses of the flora resources.

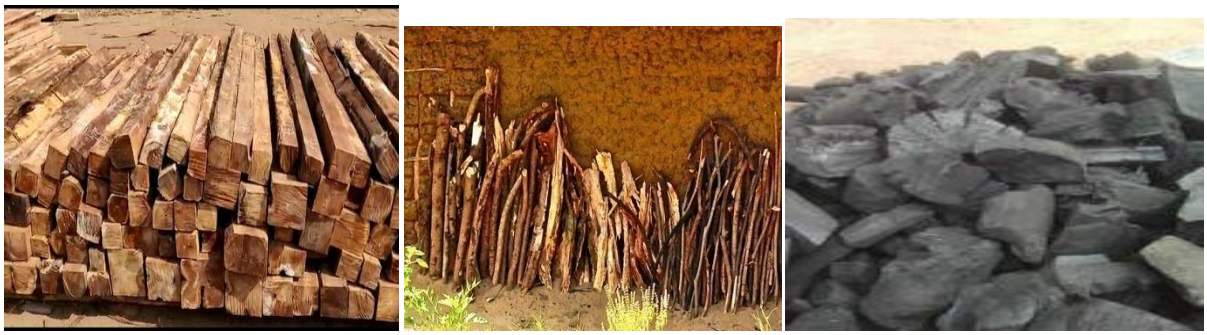
Table 6.32: Summary of Percentage of Indigenous Uses of Censored Species

Indigenous Services	**% Usage**
Fuelwood	50
Charcoal	30.56
Medicinal	86.11
Fruits and Seeds	44.4
Nuts	0
Vegetables	25
Spices, Flavouring and Thickeners	25
Chewing sticks	16.67
Sweeteners	5.56

Fodders	2.78
Gums and Adhesives	25
Fibres	19.44
Beverages and drinks	13.89
Tannins	16.67
Sundry products	30.56
Wrapping leaves	5.56
Fence	41.67
Wattles	0
Poles	38.89
Green manure and soil reclamation shade from sun	25
Shade from sun	30.56
Prevention of soil erosion	11.1
Roof Trusses (Roof rafters) and Purloins	25
Frames for doors and windows	44.4
Stairs	6.6

GNL Survey 2019

The following were observed, and detailed results are presented in plant flora appendix 6.4. Thirteen (13) species representing about 36% have indigenous uses. *Carapaprocera, Mimosa pudica, Funtunia elastic, Alchonea cordifolia*and *Berlinia grandifolia* 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, *Canariumschweinfurthi, Cleistopholia patens, and Campylospermum flava* 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)Timber (b) Fuelwood (c) Charcoal

Plate 6.9 (a-c): Products from plant taxa censored

6.12.5 Fauna Study

6.12.5.1 Herpetofauna 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, using transects already established for flora. Transects were walked slowly and all reptiles and amphibians encountered carefully observed. The sighted herpetofauna were snapped where 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, , holes/diggings or scratching, habitats, vocals, call outs and carcass). Local land users were also interviewed about herpetofauna 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 especially the hunters include habitat history, faunal distribution pattern, seasonal migration, harvesting methods and threats to biodiversity in the study area. A summarized sampling protocol is provided in Table 6.33.

Table 6.33: Sampling Methods used for the Herpetofauna groups

Herpetofauna 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	30mins on two separate nights
	Playback of recorded calls	Once on each of 2 separate nights
Specific habitat searches	Pitfall trapping	2hrs per 200 metres of water body

Conservation Statuses

The global conservation status of all species was obtained from the IUCN Red List of Threatened Species Version 2019-2. IUCN categories rank the relative risk of individual taxa becoming extinct in the wild based on a set of standardized criteria.

Result

Result showed that herpetofauna species were censured across the three habitat types in the study area. Table 6.34 shows this information.

Table 6.34: Result of herpetofauna in the study area

						Herpetofauna					
Taxa	Species	Common name	Conservation Status			Habitat Censored		Reviewed Literature			
			Endangered Act 2016	IUCN	Endemism	SF	FW	Breeding	IUCN	Feeding	Threats/Conservation Actions
Amphibians	*Limnonectes malesianus*	*river frog	Not listed	LC	NO		3	Late Feb-March	LC	Insects, algae, leaves, fish	Not under threat
	Hoplobatrachus occipitalis	*African Groove-crowned Frog	Not listed	LC	NO		1	Feb -April	LC		
	Ptychadena bibroni	*Broad-banded Grass Frog	Not listed	LC	NO			Variable	LC		
	Ptychadena Oxyrhynchus	Grass frogs	Not listed	LC	NO			Variable	LC		
	Hyperodius concolor	Tree frog	Not listed	LC	NO		3	Variable	LC		
	Rana lithobates	Frog	Not listed	LC	NO				LC		
	Leptopelis hyloides	*African Tree Frog	Not listed	LC	NO				LC		
	Amietophrynus maculata	*Savannah Toad	Not listed	LC	NO	2			LC		
Reptilia	*Agama agama*	Common rainbow lizard	Not Listed	LC	NO	2	2	-	LC	Insects	

	Mabuya spp	Skink	Not Listed	LC	NO			Dry season	LC	Amphibians and fish	
	Panaspis togoensis	Togo Skink	Not Listed	LC	NO	1		Variable	LC	Amphibians smaller reptiles	Biological resource use and Agricultural activities. In situ conservation in reserves
	Naja nigricollis	*Spitting cobra	Not listed	LC	NO			-	LC	plants	
	Bitis arietans	*African puff adder	Not listed	LC	NO			-	LC	plants	
	Grayia smythii	*Smyth's Water snake	Not listed	LC	NO		1	Variable	LC	Amphibians smaller Reptiles	

*SF=Secondary forest, FW=Freshwater

Freshwater recorded the highest number of species and species abundance (Table 6.35). This indicates the relative preference for this habitat by herpato-fauna in the study area, especially the amphibian species. 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 5 individuals compared to Amphibians with 9. 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. Expectedly, the Common rainbow head lizard (*Agama agama*) was the most abundant hepertofauna species censored. Only one (1) individual each of the African Groove-crowned Frog, Smyth's Water snake, and Togo Skink were sighted.

There was no species of conservation interest in the study area. In situ conservation in reserves is suggested since this group of herpatofauna play important role in ecosystem balancing and moderation.

6.12.6 Avian Fauna

6.12.6.1 Study Methodology

Methodology for Survey of Birds

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 movementsin 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); and

Identification of breeding/wintering grounds if present.

To meet these objectives, three inventory methods were used. These methods are described herein below.

6.12.6.2 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 were established along each transect. Counting was done between 6-9AM when singing bird activity is at its maximum. The counting stations were established preferably in homogenous habitat patches. Additional points were also conducted in rare habitats.

At each point count, ornithologists arrive at a site and wait still for one minute to let the birds settle down, in case they had been disturbed. The observer then makes 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 noted all bird seen or heard. Subsequently, only the additional individuals were noted (for second and third 5-minutes periods).

General information was taken:

- station name,
- observer name,
- date,
- time (start and end),
- temperature (°C),
- cloud (%),
- precipitation (rain, fog etc.),
- wind speed (Beaufort scale),
- wind direction and
- observation conditions.

Finally, general notes on the inventoried habitats were taken, as well as pictures.

6.12.6.3 Observation Stations - Migration Survey

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

The field crew noted observations at each station for 60 minutes. Binoculars were used by the observers to identify birds (raptors, waterfowl and other aquatic birds, passerine, others). The surveys were conducted 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 logged 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) was also determined. The observations were compiled on a field datasheet. Finally, general notes and pictures were taken on the inventoried habitats.

6.12.6.4 Conservation Status

The global conservation status of all species was obtained from the IUCN Red List of Threatened Species Version 2019-2 while Endangered species Act 2016 was used in compiling the national status.

BIRD SAMPLING STATIONS

Details of the bird sampling stations are presented in Figure 6.11.

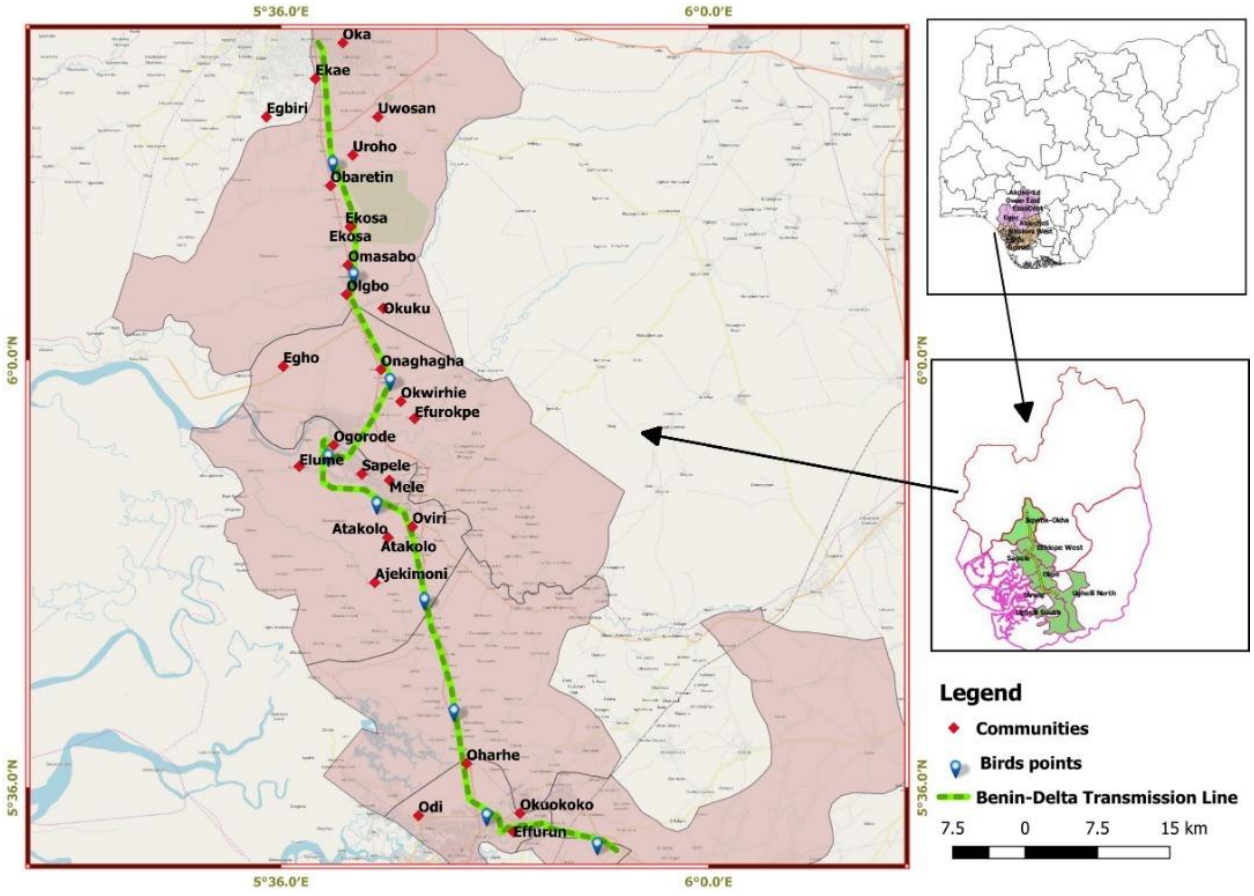


Figure 6.11: Bird Sampling Points

6.12.6.2 *Result*

6.12.6.2.1 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. It is in light of this that bird study was conducted to document their baseline data.

6.12.6.2.2 Species richness

Species richness is the number of different species represented in an ecological community. A total of fourteen (14) sighted avian species were censored (Table 6.35). Some of the species censored include; *Milvus migrans, Necrosyrtes monachus, Polyboroides typus, Streptopella semitoquata and Turtur brehemeri*. Plate 6.10 is a representative picture of the avian taxa.

(A) Milvus migrans *(B) Turtur brehemeri* *(C) Streptopella semitoquata*

Plate 6.10: Representative avian taxa censored

The secondary forest accounted for about 62% of the 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 6.35 is a summarized avian checklist for the study.

Table 6.35: Summarized checklist Bird Characters

Species	Common Name	FREQUENCY	ABUNDANCE	BEHAVIOUR	Habitats		SEX	FLIGHT DIRECTION	ALTITUDE	IUCN
					SF	FW				
Milvus migrans	Black kite	1	1	FL	1			NE	75&ABOVE	LC
Necrosyrtes monachus	Hooded vulture	1	1	FL	1			NE	50-75	LC
Polyboroides typus	*African harrier hawk	2	3	R, F, FL	1	2	M, F	NE, SW	50-75.	LC
Ralluscaerulescens	*African rail	1	2	F, FL	2		f	NE, SW	50-75. 0-50	LC
Cypsiurus parvus	*African palm swift	1	2	FL	1	1		SE	0-50	LC
Apus affinis	*Little swift	1	8	R. F, F, FL. F, F	7	1	f, f	NE, NW. NE	25-50	LC
Muscicapacassini	*Cassins flycatcher	2	2	F. F		2	M	NE. SW	0-50	LC
Muscicapaocreata	African flycatcher	1	1	FL		1	f	NE.	50-75.	LC
Streptopeliasemitoquata	Red eyed dove	1	1	F	1		f	-	0-5	LC
Turturbrehemeri	Blue headed wood dove	1	1	F		1		-	0-5	LC
Treroncalvus	*African green fruit pigeon	1	1	FL		1		SW	0-50	LC
Numidameleagris	*Guinea fowl	1	6	F, R. FL	6		f, M,	NE	0-5	LC
Tyto alba	barn owl	2	1	F	1			NE.	0-50	LC
Strix alba	Owl	2	6	R. F	1	5		-		LC

*F= Feeding, *f=female,* FL= Flight, R=Resting, SW=southwest, NE=northeast, NW=Northwest LC=Least concern,

M=male, F=female

6.12.6.2.3 Species abundance

A total of 36 individuals were censored across the counting and observation stations. The findings revealed that *Apus affinis* as the most abundant species accounting for about 22% of the total counts. Backland 1994 recorded similar species abundance and attributed their dominance to adaptability to a variety of habitats. In terms of habitat, Savanna forest recorded 22 individuals as against 14for the freshwater.

6.12.6.2.4 Species Frequency

Bird species frequency was also evaluated. *Polyboroides typus, Cypsiurus parvus, Muscicapa cassini, Tyto alba, Strix alba* were the most observed species, each being observed two (2) times while 9 species representing about 25% of the bird resources inventoried were observed only once. The species observed in at least two different habitats are usually 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.

6.12.6.2.5 Bird Behavior

Three behavioral tendencies were evaluated at the time of censoring. They were feeding, resting and flight. A total of nine individuals each were observed in flight or resting while fourteen individuals were observed feeding. In the secondary forest, eight (8) individuals each were either observed at flight or feeding and two (2) resting. In the freshwater, thirteen (13) individuals were observed feeding; four were on flight and eight resting. Individuals of*Milvus migrans, Necrosyrtes monachus, Streptopelia semitoquata, Turtur brehemeri and Tytaalba*were always observed feeding, while others exhibited more than one bird behavior. De bushing would adversely impact these species observed as resting always.

6.12.6.2.6 Flight direction

Flight direction was equally observed and evaluated. The birds were observed flying in three main directions. A total of nineteen individuals were observed flying in the NE direction as against two flying the in the South easterly direction. Five individuals were observed flying in the south westerly direction. Nevertheless, there was no observable peculiarity in flight direction among other bird species. Species with no record of flight direction were those not observed at flight.

6.12.6.2.7 Sex evaluation

The bright coloration of the male was used as discriminatory character. A total of seven (7) individuals were identified as belonging to any of male or female. Seven were female and eight were male. No defined flocking patterns were observed either among the individuals or among the specific sexes in anyone habitats.

6.12.6.2.8 *Altitude*

Flight altitude was also evaluated. The findings showed that twenty-one (20) individuals of six (6) species were flying within 0-50m altitude. Six (6) individuals were observed within the 50-75m range, a height typical of a transmission tower. The species are ***Necrosyrtes monachus, Polyboroides typus, Ralluscaerulescens, and Muscicapaocreata***. The only individual of Milvus migranscensored was seen flying above 75m. On the other hand, eight (8) individuals of three (3) species were seen flying within 0-5 m. Other species observed not to have a specific flight range. *Apus affinis* is the only species observed to be flying within the 25 – 50m range. This height is typical of that of transmission line and these species is vulnerable to collisionSpecies within this altitudinal range seems attracted to feeding and resting. A strong correlation coefficient of 0.82 was obtained between altitude and bird behavior in this study.

6.12.6.2.9 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 (veenetal.,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 6.36.

Table 6.36: Details of migratory birds censored in the project area

Species	Local 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

Source: GNL survey, 2019

Plate 6.11 is a picture of the Polyboroides typus.

Polyboroides typus

Plate 6.11: Migratory Species of the study area

6.12.6.2.10 *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 (Fowleretal., 2009). *Polyboroides typhus* the only raptor species censored in the study. Table 6.37 shows details of this species.

Table 6.37: Raptors of the StudyArea

S/N	Species	Common Name	Prey
1	Polyboroides typus	Harrier hawk	Rodents, bats, birds, amphibians, lizards and insects

Source: GNL, Survey (2019)

6.12.6.2.11 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 species censored in the study area were of conservation interest as all fourteen (14) species were categorized as Least Concern (LC).

6.12.6.2.12 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 bird's activities that would be impacted the most during construction and operational phases of the project. Table 6.38 shows the result.

Table 6.38: Ecologically important habitat for birds

Indicator	**Secondary Forest**	**Freshwater**
Species Diversity	10	8
Flight Altitude above 50m	3	2
Species Abundance	22	14
Bird Behavior – Resting	2	8
Bird Behavior – Feeding	8	13
Migratory Species	1	1
Raptors Species	0	0
Flight Direction in relation to line route (NW and SW)	6	6
Total	**52**	**52**

Analysis on sensitivity index for the two habitats as having equal preference and priority for the bird species.

6.12.7 Mammals

6.12.7.1 Study Methodology

6.12.7.1.1 Direct observations

Diurnal and nocturnal expeditions to recognizing evidence of Mammalian 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. 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.

6.12.7.1.2 Indirect observations

Table 6.39 presents the sampling methods.

Table 6.39: Sampling Methods used for the Mammalian groups

Mammalian Group	Survey Technique	Survey Effort per Vegetation Community
	Small mammal traps	5 traps over 2 consecutive nights
	Hair tubes	2 sites- per site
	Pitfall trapping	2 sites- per site
Small terrestrial	Line transect	2 sites- per site
	Cage / B Elliott traps	-5 traps over 2 consecutive nights per sampling site
Medium terrestrial	Hair tubes	2 sites- per site
	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 m2
	Spotlighting	Walking rate of 200metre/ hour.
Arboreal mammals	Hair tubes	2 consecutive nights per site
Micro chiropteran		
	Harp traps	1 harp trap nights per site
	Echolocation call	45minute continuous recording plus I call activated all night
Bats	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 Status

The global conservation status of all species was obtained from the IUCN Red List of Threatened Species Version 2019-1. IUCN categories rank the relative risk of individual taxa becoming extinct in the wild based on a set of standardized criteria.

6.12.7.2 *Result*

A total of 12 Mammalian species were censured in the study area. These include seven sighted species and the 5 species censured via indirect evidences. Table 6.40 shows details of the findings.

Table 6.40: Result of Mammalian fauna in the study

S/N	Scientific name	Local names (Hausa)	Common name	Family							
					SF	FW	IUCN	National	Endemic	Feeding	Threats/Conservation Actions
1	*Civetticus civetta*		*African civet	Molosidae			LC	Nil	No	Frutivore	Logging
2	*Nandinabinotata*		*African palm civet				LC	Nil	No	Herbivore	Hunting
3	*Potamochoerusporcus*	Esioha or Esi	* Red River Hog				LC	Nil	No	Herbivore	Hunting
4	*Tragelaphus spekii*		*Sitatunga or marshbuck	Nycteridae			LC	Absolutely prohibited	No	Herbivore, Frutivore	Hunting
5	*Tragelaphus scriptus*		*Bush buck	Sciuridae				Absolutely prohibited	No	Herbivore, Frutivore	Hunting
6	*Heliosciurusrufobrachium*	Otan	Red-legged sun squirrel	Hystricidae	3	1	LC	Absolutely prohibited	No	Herbivore	Hunting
7	*Cricetomys gambianus*	Ofen	Northern Giant Pouched Rat	Soricidae	2		LC	Nil	Yes	omnivore	Hunting
8	*Chaerephon nigeriae*	Equen	Nigerian free-tailed bat	Thryonomyidae	5	1	LC	Nil	No	Herbivore	Hunting
9	*Chaerephon pumilus*	Eguen	Little Free-tailed Bat	Herpestidae	3		LC	Absolutely prohibited	No	Carnivore	Hunting

* SF=Secondary Forest, LC=Least concern

6.12.7.2.1 Species Diversity

This is the record of all censored taxa in a sampled area. The species sighted in the study area were *Heliosciurus rufobrachium, Cricetomys gambianus, Chaerephon nigeriae, and Chaerephon pumilus*. Species were censored in either the secondary forest or freshwater, no mammalian species was censored in the riparian habitat. The Secondary forest was the preferred habitat for mammals in the study area, since three of the four sighted species were sighted solely in this habitat. 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. Species Abundance.

The total number of individual sighted where nine (9) with *Chaerephon nigeriae* accounting for five (5), *Heliosciurusrufobrachium and Chaerephon pumilusaccounting* for three individuals each while only a single individual of *Chaerephon nigeriae* was observed. All five individuals of the Nigerian free-tailed bat were censored in the secondary forest. The presence of fruit producing shrub species could be the causal factor of their occurrence in this habitat. 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.

6.12.7.2.2 IUCN Status

All sighted species were of Least Concern (LC) status using the IUCN Red list 2018 version one criterion. The major threat for all the species is hunting. No endemic mammalian species was recorded.

6.12.7.2.3 Habitat of High Value

The Secondary forest habitat is the priority habitat to the mammalian taxon.

6.12.8 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.

Some of the protected areas which may likely be in the wider area of influence of the project are presented in Table 6.41. However, there are no protected areas along the RoW of the proposed Benin-Delta transmission line.

Table 6.41: Details of Protected Area in Proximity to Project area

Name	State	Nature	Area (km2)	Approximate distance from route or substation
Okumu Forest Reserve	Edo	Game/forest reserve	1082	60 km from Benin substation
Gele-Gele Games Reserve	Edo	Game reserve	363	30 Km from Benin substation
Ologbo Game Reserve	Edo	National Park	194.4	39 km from Benin substation and 29 km from Sapele substation

6.12.9 Key Ecological Problems

- Commencement and operations of developmental projects shall result in the following ecological problem; the direct removal or disturbance of plants, animal
- Species migration occasioned by developmental activities (noise) and poor enforcement of ESMP
- Soil erosion and alteration of hydrologic pattern.

Appropriate mitigation measures have been provided in chapter six of this ESIA report to ameliorate these impacts.

6.13 Social Environment

6.13.1 Political Context

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. It started off with three regions namely Eastern, Northern and Western regions until a fourth; the Mid-West region was created in 1963 Delta and Edo States was created in 1991 out of the then Bendel State. Delta State currently has 25 LGAs, including, Ugheli North, Okpe, Uvwie, Sapele and Ethiope West. Edo state currently has 17 LGAs including Ikpoba-Okha.

6.13.2 Administrative structure

. The administrative structure of Nigeria is presented in Table 6.42

Table 6.42: Administrative structure of Nigeria and Affected States

<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="4">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 President and the House of Representative is headed by a Speaker</td></tr>
<tr><td>Senatorial District</td><td>House of Representative</td></tr>
<tr><td>There are 109 senatorial districts in Nigeria. The project area is represented by two senators representing the Central Senatorial (Delta state) District and South Senatorial (Edo state).</td><td>There are 360 House members in the national assembly. Edo has nine House members while Delta has ten members. The project cut across one Federal constituency in Edo State- Oredo) and 3 in Delta State. Ethiope, Okpe/Sapele/Uvwie and Ugheli North/South/udu Federal Constituencies</td></tr>
<tr><td colspan="2">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</td></tr>
<tr><td rowspan="3">State Arm of Government</td><td colspan="2">Executive- There are 36 states in Nigeria and the Federal Capital Territory. The Executive arm of the state government isheaded by an elected Governor. The proposed project transverse 2 states (Delta and Edo).</td></tr>
<tr><td colspan="2">Legislature - Each state operates a unicameral system headed by a Speaker. The project transverses Ikpoba-Okha state Assembly of the total 24 in Edo State. In Delta State, the project transverses Ethiope, Sapele, Okpe, Uvwie and Ugheli North.</td></tr>
<tr><td colspan="2">Judiciary - There is the State High court, customary courts, and Magistrate courts. The head of the state judiciary arm is the Chief Judge.</td></tr>
<tr><td rowspan="2">Local Government Arm of Government</td><td colspan="2">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 Delta and Edo State.</td></tr>
<tr><td colspan="2">Legislature - The legislature is formed by at least ten wards in each LGA. The make bye laws for the LGA. It's headed by a Speaker. The project cuts across fiveLGA houses of assembly in the project area in Delta State and one in Edo State</td></tr>
</table>

6.13.3 Demography

Table 6.43 shows the demography of the two States affected by the project compared with national values while 6.44 shows similar parameters for the local government areas affected by the project. Table 6.45 shows the livelihood indices in the project area.

Table 6.43: National and State Socioeconomic Parameters

		General statistics in Nigeria	Delta State	Edo State
Total population (2006 Census)		140,431,790	4,112,445	3,233,366
Projected population (2018 based on an exponential growth rate of 3.2%)		180,735,714	4,674,011	3,602,124
Total Area of Land		923,763km^2	17,698km^2	17,802km^2
Population Density		198.6/km^2	17,108 km²	19,187 km²
Population Distribution				
Men		71,345,488	2,069,309	1,633,946
Women		69,086,302	2,043,136	1,599,420
Children (age 0-14)		41.8%	31.8%	35.2%
15–29		25.4%	26.0	24.8
30 -44		18.0%	21.9	17.9
Elderly (>65)		3.2%	4.45%	5.89%
Population (2010)		159,538,079	4,112,445	3,233,366
Literacy rates		59.6	69.9%	63.5%
infant mortality level		64.8/1000 live births	0.00648%	0.055%
life expectancy		55 years	49Years	51Years
Youth Literacy in any Language	Female	63.7	90.4	92.6
		79.3	85.4	93.3

Source: NBS, 2012

Table 6.44: Socioeconomic Parameters of LGAs

	Delta					Edo
	Ethiope West	Okpe	Sapele	Ugheli North	Uvwie	Ikpoba okha
Total Area of Land	536km^2	445km^2	450km^2	818km^2	95.0km^2	862 km^2
Population Density	320.0 persons/km^2	397.3 persons/km^2	533.3 persons/km^2	392.4 persons/km^2	1,887 persons/km^2	429.3 persons/km^2
Population Distribution	102,750	128,398	174,273	320,687	188,728	370,080
Men	102,750	65,270	86,167	160,53	93,999	184,725
Women	99,962	63,128	88,100	160,137	94,729	187,355

Source: NBS, 2012

Table 6.45: Relevant livelihood indices in the project states

Livelihood Indices	**Nigeria**	**Delta State**		**Edo State**	
Population (2010)	159,538,079	4,112,445		3,233,366	
Literacy (%)	59.6	Male	Female	Male	Female
Youth Literacy in any language	72.8	90.4	85.4	92.6	93.3
Adult literacy in English language	53.8	Male	Female	Male	Female
		83.8	74.5	76.6	66.7
Infant Mortality	64.8/1000 live births	38/1,000 live births		55/1,000 live births	
Life expectancy	55 years	49 years		51 years	

Source: NBS (2012)

6.13.4 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.

6.13.5 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 criticalstakeholders
- Border landdisputes
- Agitation foremployment/contracts
- Issue of non -payment ofcompensation when the existing route was acquired
- Non-compliance with court rulings andorders especially for cases in court between Etete and Evboraria communities
- Perceived intimidation of thecommunities
- Perceived "divide and ruletactics"
- Ineffective communicationchannels

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.

6.13.6 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 and all 113 communities. The people were assisted (mainly in pidgin and local dialects) in responding to the questionnaires. A total of 200 questionnaires were administered and 124 household questionnaires were retrieved representing a success rate of about 62% and about 50% of the population while 84 community questionnaires were recovered representing a success rate of 74.3%, same as the percentage of the total number of communities. The results shall be presented on LGA basis for ease of clarity.

6.13.7 Traditional Governance

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. Based on the information collected during the socio-economic surveys, none of the communities in the project area had any known records of security threats including suicide attacks, vandalism etc. 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 foremployment/contracts
- Issue of non -payment ofcompensation when the existing route was acquired
- Non-compliance with court rulings and orders especially for cases in court between Etete and Evboraria communities
- Perceived intimidation of thecommunities
- Perceived "divide and ruletactics"

- Ineffective communicationchannels

Agitation remains for issues such as economic displacement, loss of land and livelihood, impact of the project on community health and compensation.

6.13.8 Socioeconomic Sampling Approach

Two types of questionnaires were administered – Household and community based. The results shall be presented on LGA basis for ease of clarity. Table 6.46 provides information of the socioeconomic sampling framework.

Table 6.46: Socioeconomic Sampling Protocols

Group /Nature of Interview	Relevance	State	Project Affected LGA	Total No of communities/ Persons (KII and FGD)	No of Households /Communities	Household/ Community Number Interviewed	Number and % of Questionnaires retrieved	Date of Interview	Venue
Household hold questionnaires	To obtain socio economic profile of households found on 500m either side of the RoW	Delta	Ethoipe West	6	32	28	22 (79%)	23-05-19	Homes of the Affected Persons
			Okpe	15	23	20	18 (90%)		
			Sapele	11	65	24	18 (75%)		
			Ugheli North	3	25	24	21 (88%)	24-05-19	
			Ugheli South	2	0	0	0 (-%)		
			Udu	1	0	0	0(-%)		
			Uvwie	2	16	14	12 (86%)		
		Edo	Ikpoba Okha	18	126	49	33 (67%)	25-07-19	
Community questionnaires	To obtain data relating to shared socioeconomic value systems and norms within the communities found within 1km either side of the RoW	Delta	Ethoipe West	8	NA	8	4	27th May2019	Oghareki Town Hall
			Okpe	27		21	5	30th May 2019	Elume Town Hall, Elume
			Sapele	22		17	5	30th May 2019	Okpe Hall, Sapele
			Ugheli North	5		4	2	6th June 2019	Agbarho Primary School, Agbarho
			Ugheli South	6		4	1	7th June 2-019	Ekakprame Town Hall
			Udu	2		2	1	2019	
			Uvwie	2		2	1	10th June 2019	Enerhen motel Effrun

		Edo	Ikpoba Okha	30		16	5	12th June 2019	Dasuya Royal Hotel, Benin
				Issues discussed					
Key Informant Interview	To obtain in depth information from professionals and residents	Delta	Sapele	Issues discussed with Okpeelders forum include epileptic power supply and overgrown weeds in the way leave				30th May 2019	Okpe Town Hall
			Okpe						
		Edo	Uvwie	Issues discussed with the leadership of Truck Motor Park Union centered on impact of reconstruction activities on the park operations				10th June 2019	Effrun Truck Park
			Ethoipe West	Issues bordering on traffic and material movement due to TL road crossing in Oghara along the Benin-Warri and impacts of the upgrade on lumbering activities by their people by the Ethoipe River				27th May 2019	Oghareki Town Hall
			Ugheli North	Issues centered on engagement of locals for construction activities was harped				6th June 2019	Agbarho Primary School, Agbarho
			Ikpoba Okha	Issues of nonpayment of compensation when the RoW was acquired and also the need for transparency in the ongoing process				12th June 2019	Dasuya Royal Hotel, Benin
Focus Group Discussion	This was done to harvest specific information affecting youths and women of the project area		Same as in KII	Women in Delta State	They called for them to be allowed to supply foods in the base camps and livelihood restoration programs for those who will be affected by the re construction activities			Same date as in KII	Same venues as in KII
				Women in Edo State	They called on TCN to settle out of court with the communities so that they be allowed to participate				

					actively in the ESIA process without sanction		
				Youths across both States	They called on employment opportunities and provision of additional step-down transformers to enhance their business		

Pictorial evidences are in the stakeholder engagement section

6.13.9 Population and Sex

The respondent population and sex of the project area are presented in Table 6.47.

Table 6.47: Respondent population age and sex

Age Bracket	Ethiope West		Okpe		Sapele		Ugheli North		Uvwie		Ikpoba Okha	
	Male (%)	**Female (%)**	**Male (%)**	**Female (%)**	**Male (%)**	**Female %)**	**Male (%)**	**Female %)**	**Male (%)**	**Female (%)**	**Male (%)**	**Female (%)**
1-18	11.3	13.7	12.8	13.2	11.9	**9.1**	**10.7**	**11.9**	11.3	13.7	12.5	13.5
19-39	17.4	12.6	18.3	15.7	23.2	16.8	19.7	13.4	17.4	12.6	16.9	14.8
40-65	15.7	14.3	17.6	5.4	7.7	11.3	15.7	18.1	15.7	14.3	15.7	17.1
>65	4.5	10.5	5.4	11.6	7.9	12.1	4.3	6.2	4.5	10.5	5.8	3.7

Persons within the age bracket of (19-39) years formed the bulk of the population (above 30%) across the LGAs, while those above 65 year of age were the least (below 15%) represented in the project area. This also implies that the communities have able-bodied labour force that could participate actively in the various activities that will take place during the construction and operation phase of the transmission line. However, according to the Annual Abstract of Statistics 2012, persons within the age bracket (0-18) form the bulk of Nigerian population in contrast to the respondent age and sex in the project area. Marjorie *et al* 1995 attributed urban pull factors as a determining criterion in age bracket configuration.

6.13.10 Gender of Heads of Household

Information on the gender and number of household heads in the project area is presented in Table 6.48.

Table 6.48: Gender of Head of Household

GENDER	Ethiope West	Okpe	Sapele	Ugheli North	Uvwie	Ikpoba Okha	TOTAL	PERCENT (%)
Male	19	14	16	18	10	24	101	81.45
Female	3	4	2	3	2	9	23	18.55
TOTAL	22	18	18	21	12	33	124	100

The 81.45 % where male is the household head is less than the Nigerian average of 85.7%, and 76.6% for South-South states implying more female house heads in the project area than the 14.3% Nigerian and south-southaverage. Nonetheless all areas in the line route have more male house heads.

6.13.11 Marital Status of Head of Household

Table 6.49 shows the marital status of heads of household.

Table 6.49: Marital Status of Heads of Household

GENDER	Ethiope West	Okpe	Sapele	Ugheli North	Uvwie	Ikpoba Okha	TOTAL	PERCENT (%)
Single	7	4	4	6	4	10	35	28.22
Married	12	10	12	12	6	14	66	53.23
Widowed	2	2	2	1	1	6	14	11.29
Divorced/Separated	1	2	0	2	1	3	9	7.26
TOTAL	22	18	18	21	12	33	124	100

The married status of respondents in the project area of 64.52% (53.23% married and 11.29% widowed) is less than the Nigerian average of 77.4% but slightly less than the South-South average of 65.7%. It was observed that most of the household heads that widowed are females. In addition, there are more married and single household heads in all the LGAs. The nature of these marriages is presented in Table 6.50

Table 6.50: Nature of Marriage in Households

GENDER	Ethiope West	Okpe	Sapele	Ugheli North	Uvwie	Ikpoba Okha	TOTAL	PERCENT (%)
Polygamous	5	2	4	6	1	6	24	36.36
Monogamous	7	8	8	6	5	8	42	63.64
TOTAL	12	10	12	12	6	14	66	100

The 63.64% of monogamous marriages across all the communities in the project area is above the Nigerian and South-South averages of 60.7 and 57.7% respectively. A 1:1 ratio between monogamous and polygamous marriages was recorded among respondents in Ugheli North while a close call was recorded among respondents in Ethiope West and Ikpoba-Okha. The culture of the people as espoused by the respondents does not prohibit men from marrying more than one wife.

6.13.12 Household Size

Information on household size of the communities in each of the LGAs is presented in Table 6.51.

Table 6.51: Household Size of Project Area

Numbers per household	**Ethiope West**		**Okpe**		**Sapele**		**Ugheli North**		**Uvwie**		**IkpobaOkha**		**Total**	**%**
	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	Male	Female		
1-2	2	1	6	5	1	0	0	0	1	0	0	0	**16**	1.86
3-5	21	25	43	47	43	36	20	23	46	41	33	26	**404**	46.97
6-10	28	32	38	33	27	27	31	30	14	10	41	53	**364**	42.33
11-15	15	21	0	1	3	2	6	7	2	0	7	11	**75**	6.72
>15	0	0	0	0	0	0	0	1	0	0	0	0	**1**	0.12
TOTAL	**66**	**79**	**87**	**86**	**74**	**65**	**57**	**61**	**63**	**51**	**81**	**90**	**860**	**100**

Source: GNL, 2019

The dominant household sizes in the project area are those made up of 3-5 persons and 6-10 persons accounting for about 89.30% of the households. The findings are in tandem with 2012 NBS statistics which put the average family size in Delta State at 3.5 persons as against Edo State with 3.9 persons. At the national level, the number of persons in the size class 3-5 was about 43m as against 93million for that in the 6 to above 8 person's size class. The data also revealed a linear correlation between nature of household's marriages with family sizes. For instance, LGAs with higher monogamous percentage closely mirror families with lower family size as exemplified by communities in Uvwie and Okpe LGAs. With the exception of only one family in OrhoAgbarho in Ugheli North has a family size of 16 persons, no other community along the RoW have representation in the 11-15 family size category. Also, the ratio of male to female among the LGAs was 1:1. However male population accounted for 49.18% as against female population with 50.82%.

6.13.13 Ethnic Composition

Eleven 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 6.52.

Table 6.52: Ethnic Groups of the Project Area

Ethnicity	Local Governments							
	Ethiope West	**Okpe**	**Sapele**	**Ugheli North**	Uvwie	**IkpobaOkha**	**Total**	**%**
Afemai	0	0	1	1	0	2	4	3.23

Anioma/ibo	3	4	2	2	2	5	18	14.52
Edo	1	0	1	0	0	16	18	14.52
Hausa/Fulani	0	1	0	0	0	1	2	1.61
Ijaw	1	0	0	0	1	0	2	1.61
Ishan	0	1	1	1	0	5	8	6.45
Isoko	1	1	2	3	1	0	8	6.45
Itsekiri	1	1	3	0	0	0	5	4.03
Okpe	3	7	4	2	1	1	18	14.52
Urhobo	11	3	3	11	6	2	36	29.03
Yoruba	1	0	1	1	1	1	5	4.03

Source: GNL, Survey, 2019

Expectedly, the data revealed dominance of the landowners (Urhobo, Okpe and Edo) 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/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 (Benin, Effrun, Sapele, Oghara and Ugheli).

6.13.14 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 88.4% of the respondents across the LGA's. This was followed by ATR with an average of 11.2%. While about 0.04% were adherents of the Islamic Faith. This information is presented graphically in Figure 6.12.

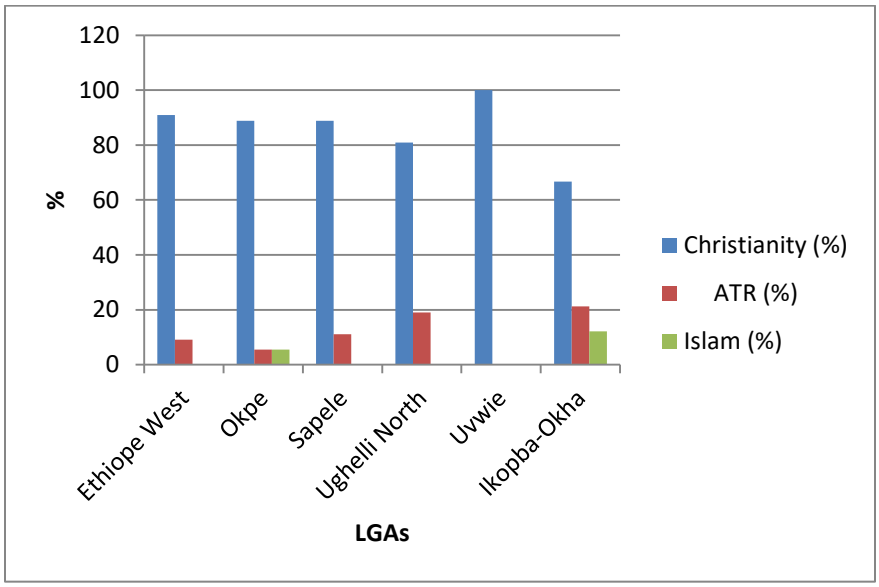


Figure 6.12: Main religious groups in the LGAs

The adherents of these various religions observe one festival or the other. For example, notable ATR festivals in the area include Igbe (in the Delta axis) and Igue and Ewere (along the Bini axis). The Islamic and Christianity adherents in the area observe the worldwide traditional Muslim and Christian festivals respectively.

Plate 6.12: ATR worshipers in Ebrumede (Okpe LGA, Delta State)

These festivals are celebrated with pomp and pageantry and have spiritual, traditional, socio-economic and financial implication for both the indigenes and settlers. Traditional festivals offer opportunities for the people to seek divine favour, prosperity, bumper harvest, peace, security, long lives and good health for the communities.

6.14 Existing Infrastructures

6.14.1 Educational Facilities

Field survey, information from questionnaires, and responses from respondents during FGD's revealed the presence of over 755 primary schools, 181 secondary schools and 3 tertiary institutions in communities within the spatial boundary of the project area. In addition, Sapele LGA accounts for about 14% of these schools. About 75 % of these schools are privately owned with high tuition fees that many of the households cannot afford. Most of the communities in the study area, especially in Okpe and Ugheli North, LGAs only have access to government owned secondary schools. Information on the educational facilities in the project LGA is presented in Table 6.53.

Table 6.53: Educational Facilities in the Project Area

Age Bracket	Ethiope West		Okpe		Sapele		Ugheli North		Uvwie		Ikpoba Okha	
	Total Number	**Number Connected to Power Grid**	**Total Number**	**Number Connected to Power Grid**	**Total Number**	**Number Connected to Power Grid**	**Total Number**	**Number Conneted to Power Grid**	**Total Number**	**Number Connected to Power Grid**	**Total Number**	**Number Connected to Power Grid**
Primary	45	45	21	17	62	62	15	13	18	18	58	52
Secondary	33	33	15	15	46	46	9	9	12	12	36	36
Tertiary	1	1	0	0	0	0	0	0	2	2	1	1

** N.G = National Grid; Source: GNL 2019*

The manpower in virtually all the schools is inadequate with high teacher/student ratio of over 1:40. About 55% of the existing schools lack basic facilities like water supply and toilet. In addition, instruction materials are grossly inadequate. The pressure placed by the inadequate educational facilities often compel some parents with children of secondary school age to send their children to relatives and friends in bigger towns in order to access secondary school education. As at present, five tertiary educational institutes - Federal

University of Petroleum Resources, Effrun, Petroleum Training Institute (Uvwie LGA) and Delta State Polytechnic, Oghara and Western Niger Delta University (Ethiope West LGA) and Benson Idahosa University, Okha in IkpobaOkha LGA of Edo State are present in the project area. In addition, there are adult literacy schools in the urban towns and Sapele technical colleges and School of Midwifery – Sapele which improves the literacy level among adults and enhances availability of middle level manpower.

Plate 6.13: Oton Primary School in Sapele

Nonetheless, it was observed that all communities within the project area are connected to the National Grid.

6.14.2 Water

Information on the number of boreholes as well as protected streams in each of the project LGA is presented in Table 6.54.

Table 6.54: Number of water sources across the project area

Age Bracket		Ethiope West		Okpe		Sapele		Ugheli North		Uvwie		Ikpoba/Okha	
Category		Total Number	Number Connected to national Grid	Total Number	Number Connected to national Grid	Total Number	Number Connected to national Grid	Total Number	Number Connected to national Grid	Category	Total Number	Number Connected to national Grid	Total Number
Communal		2	22	3	15	0	18	3	20	0	12	0	33
Private		20		15		18		18		12		33	
Protected spring (wells)		0		0		0		0		0		0	

Source: GNL 2019

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. With the exception of the community borehole in Obada-Elume, in Okpe LGA and OrhoAgbarho in Ugheli North, others are powered from light source provided by the National. Been connected to the national grid is not enough as all the functional boreholes rely more on AC powered sources to pump water. It was also observed that the communally owned boreholes ones have obsolete pipes and fittings. The Nigeria average shows the percentage distribution of household major source of water for drinking and cooking,2008.Pipeborne water treated 7.7%, pipe borne; water untreated 1.1%, borehole hand pump28.4%, well spring protected 14.0%, well spring unprotected 17.5%, rain water 0.5%, stream pond river 27.1%, tanker truck vendor 3.2%.

6.14.3 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 6.55). Most of these facilities are meant to improve the livelihood of the households while others are income generating.

Table 6.55: Household Facilities among Respondents

FACILITIES	Ethiope West	Okpe	Sapele	Ugheli North	Uvwie	Ikpoba Okha	TOTAL
Power generator	14	13	15	13	10	23	88
Gas stove/Kerosene	12	15	14	12	10	22	85
Refrigerator	13	14	12	12	9	18	78
Television	16	13	12	14	8	21	84
Radio/cassette/music system	16	10	12	17	6	23	84
Car/Truck	10	4	6	7	5	15	47
Motor Cycle	4	5	4	4	3	6	26
Bicycle	1	2	1	0	2	2	8
Plow	0	0	0	0	0	0	0
Cart	0	0	0	0	0	0	0
House in town	3	3	2	2	2	3	15
Land in town	2	1	1	4	3	5	16

TOTAL	92	82	81	84	57	136	**533**

Source: GNL, Survey, 2019

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.

6.14.4 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.

Roofing materials

Results on the roofing materials are presented in Table 6.56.

Table 6.56: Roofing Materials

Material	Ethiope West	Okpe	Sapele	Ugheli North	Uvwie	Ikpoba Okha	Average (%)
Corrugated Iron Sheets	9	11	9	6	3	10	38.71
Thatch	0	1	0	2	0	0	2.42
Asbestos	2	1	3	3	3	6	14.52
Bamboo/reed	0	0	0	0	0	0	0.00
Aluminum roofing	8	3	5	7	5	11	31.45
Nil / No roof / Not completed	3	2	1	3	1	6	7.26

Source: GNL Survey, 2019

The use of iron sheets, asbestos and aluminum accounted for about 84.67% of the roofing materials. The least used roofing material is thatch, accounting for about 2.42%. The percentage of uncompleted building could be indicative of the prevailing economic situation. The data do not reveal any building with Bamboo/reed roofing. The Nigeria average statistics shows the percentage distribution of regular household by type of main material used for the roof of dwelling unit-National 2006. Thatch as a roofing material in

project area is 2.42% which is lower than the Nigeria average statistics for roofing material which is 15.8%, this is because average was taken in urban region where the use of thatch is low. While materials like asbestos and aluminum roofing is higher in this region.



(A) Aluminum roofing in Oghara (B) Corrugated iron sheet in Sapele (C) Asbestos in Evboraria

Plate 6.14 (A-C): Roofing materials for household dwellings

Walling Materials

Results of household walling materials are presented in Table 6.57.

Table 6.57: Walling Materials of Respondent Houses in the Project Area

Walling Material Type	Ethiope West	Okpe	Sapele	Ugheli North	Uvwie	Ikpoba-Okha	Average (%)
Mud	0	2	0	1	0	4	5.64
Mud bricks	2	3	0	1	0	2	6.45
Wood	0	0	0	0	0	0	0.00
Thatch	0	1	0	1	0	2	3.23
Compacted (combine)	0	0	0	2	0	1	2.42
Concrete (blocks)	20	12	18	16	12	24	82.26
Others (Tarpaulin, zinc)	0	0	0	0	0	0	0.00

Source: GNL Survey 2019

On the average, the use of bricks as walling materials is predominant. However, the use of mud bricks is most pronounced among communities in Okpe, Ethiope West and Ikpoba-Okha LGAs. It was also observed that woodswas not recorded as walling material type.

(A) Mud walling in Adeje (B) concrete in Etete

Plate 6.15 (A-B): Walling materials for household dwellings

Flooring Material

Table 6.58 is the results of flooring material from the study.

Table 6.58: Flooring Materials of Respondent Houses in the Project Area

Material type	Ethiope West	Okpe	Sapele	Ugheli North	Uvwie	Ikpoba-Okha	Average (%)
Earth/sand/dirt/straw	1	2	0	2	0	2	5.65
Smoothed mud	1	2	0	1	0	1	4.03
Smooth cement	11	10	12	10	7	19	55.65
Wood/planks	1	1	0	1	0	1	3.23
Ceramic tiles	8	3	6	7	5	10	31.45

GNL, Survey 2019

Five flooring materials were observed to be in use. While smooth cement and ceramic tiles accounted for well about 87%, sand, wooden planks and smothered muds observed in Adeje, Ekae, Okha, Okuabude accounted for the remainder 13%. The data provided closely mirrors The Nigeria average for Flooring Materials.

6.14.5 Transport Facilities

The project area is traversed by several roads, amongst which are:

- The Benin- Warri express way
- East-West express way
- Ogorode road, Sapele road

- Smaller feeder roads linking the major roads with the impacted communities, and
- Unpaved roads connecting small villages and settlements.

Plate 6.16 is some Road network in Project area.

(A) RoW at Amukpe, Sapele **(B) TL cutting through East West road near Ugheli Substation**

(C) Water Crossing at Ologbo **(C) Access road to Benson Idahosa University on RoW**

Plate 6.16: Road network in Project 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

6.14.6 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 ETISALAT. There are no postal services in any of the communities, but the inhabitants obtain news about other parts of Nigeria and the world through radio, television and the mobile handsets.

6.14.7 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

The health facilities in the area comprise of nine (9) Primary Health Centres (PHC) and fifty-eight (58) hospitals (Table 6.61). The grossly inadequate health facilities provide both outpatient and in-patient services. The number of health facilities present in each LGAs of the project area is presented in Table 6.59.

Table 6.59: Number of health facilities in the project area

Age Bracket	Ethiope West		Okpe		Sapele		Ugheli North		Uvwie		IkpobaOkha	
Category	**Total Number**	**Number Connected to Power Grid**	**Total Number**	**Number Connected to Power Grid**	**Total Number**	**Number Connected to Power Grid**	**Total Number**	**Number Connected to Power Grid**	**Total Number**	**Number Connected to Power Grid**	**Total Number**	**Number Connected to Power Grid**
PHC	3	3	4	4	5	5	4	3	6	6	2	2
Hospital	15	15	9	7	23	23	4	4	15	15	12	12

Source: GNL 2019

The ratio of public to private hospitals in the project area is about 1:4. All of the LGAs have PHCs. Interestingly, about 98% of the health facilities are connected to the national grid.

Prevalence of Diseases in the study area

The common causes of Morbidity and Mortality in the Sudy Area

The commonest and most prevalent diseases affecting all age groups in the communities are Malaria Fever (32.8%), Upper Respiratory Tract Infection (21.8%), Typhoid Fever (11.7%), Diarrhoea/vomiting (10.5%) and Rheumatism (7.5%). 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 6.60 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 6.60: Prevalence of Diseases in the project area

S/N	Disease	Proportion of Infection (%)
1	Malaria Fever	**30.8**
2	Upper Respiratory Tract Infection	**19.8**
3	Typhoid Fever	**11.7**
4	Hypertension	**7.5**
5	Vomiting and Diarrhoea	**10.5**
6	Worm Infestation	**5.7**
7	Diabetes Mellitus	**5.1**
8	Lower Respiratory Tract Infected	**4.3**
9	Arthritis	**2.4**
10	**Others**	**2.5**

Source: GNL 2019

Traditional Medical Practice

The practice of traditional medicine was common in almost all the communities, especially those within the Ikpoba-okha, Okpe, Ugheli North and Ethiope west LGA. Their practice commonly involved the use of herbs and body charms. Body massaging and scarification were also common. The services offered by these practices are shrouded in secrecy. Traditional birth attendants are also popular. In many of the communities where there are no health facilities, their services were the only functional form of ante-natal and maternal services available.

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) (Figure 4-18). 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 75% 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.

6.14.8 Land Use

6.14.8.1 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 landowner's 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 are mostly rural settlements except Ugheli, Effrun, Sapele, Oghara, Ologbo (semi urban) and Benin that 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 Ebrumede, Ugbomro, Okha, Elume and Eruemukohkiawaine are sparsely populated with low cost, single unit dwellings on small stands. Majority of the inhabitants of these areas live on lower income (see discussion on livelihood).

Table 6.61: Land use pattern of the project area

Type of Land use pattern	***Percentage/Area occupied (%)***	***Notable communities in the RoW***
Built-Up Area	30.69	*Oka, Ekae, Egbiri, Uwosan, Uroho, Obaretin, Ekoswa, Omasabo, Ologbo, Okuku, Egho, Onaghagha, Okwirhie,*
Forest	16.21	
Shrubs	7.33	

Grassland	17.84	*Efurokpe, Ogorode, Elume, sapele, Mele, Oviri, Atakolo, Ajekimoni, Oharhe, Odi, Okuokoko, Effurun.*
Cropland	21.35	
Water Bodies	6.58	
	100.00	

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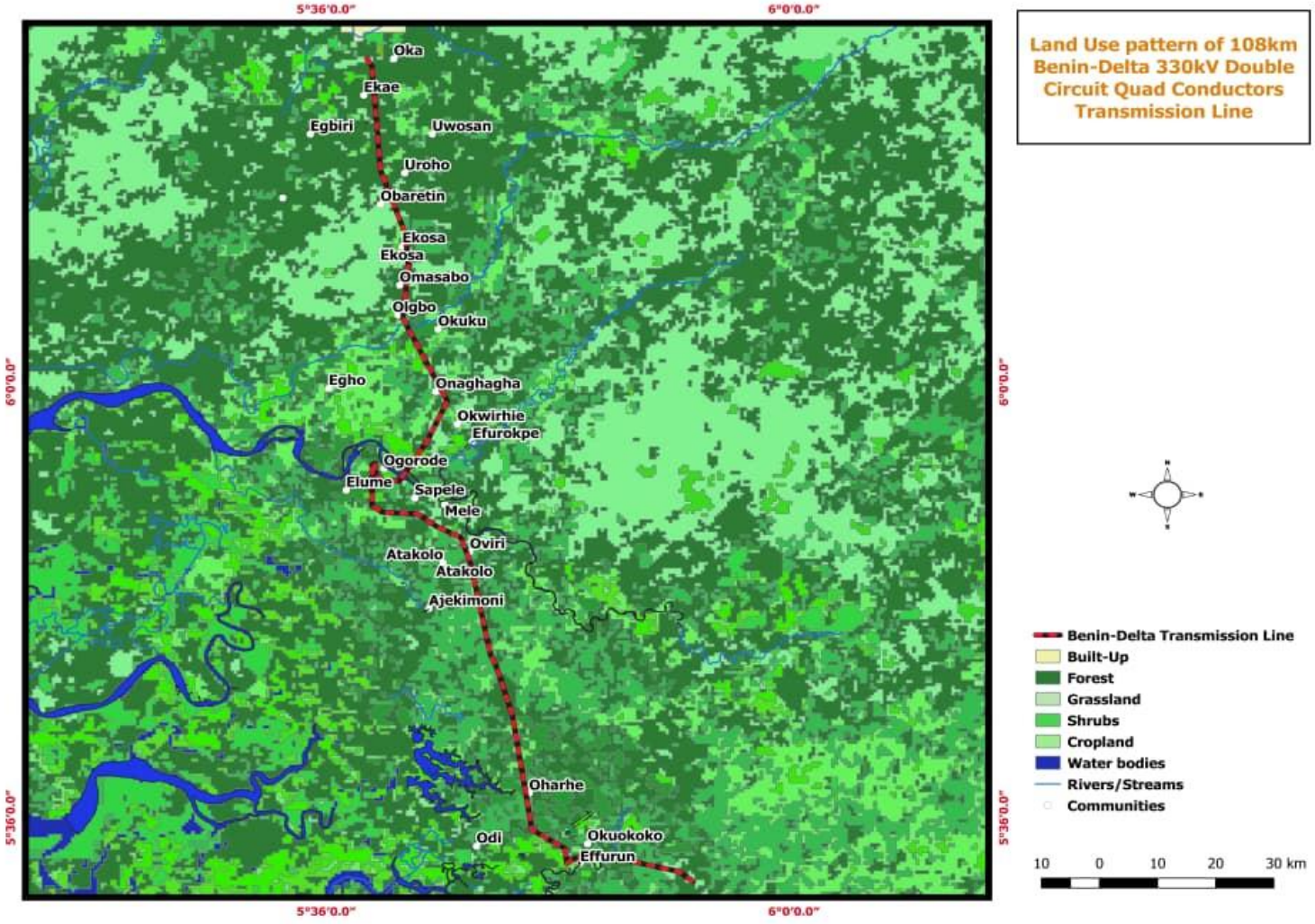


Figure: 6.13 Land Use Details

6.14.9 Educational Attainment

The educational attainment among respondents in the Project LGAs is presented in Table 6.62.

Table 6.62: Educational attainment of respondents

	Ethiope West	Okpe	Sapele	Ugheli North	Uvwie	IkpobaOkha	Average (%)
No formal education	2.0	3.4	4.1	1.7	3.5	2.7	2.93
Primary	17	7.7	16.7	15.5	14.8	13.7	14.39
Secondary	62.5	48.7	Table 6.64 Educational Status among the respondents in the Project Area 33.3	22.4	53.4	45.2	44.74
CoE and polytechnic	6	12.4	25	20.7	14.1	12.9	15.35
University Degree	12.5	21.4	20.8	39.7	14.2	25.5	22.59

The high literacy level in the project area is exemplified by about 82.68% of the respondent population having up to secondary school or tertiary education. Those with having no formal education or primary education summed up to be 17.32%.

6.14.10 Economics and Livelihoods of Households

Occupation

The economic life of the communities revolves mainly around trading and fishing. The percentage occupational distribution of the people is shown in Table 6.63.

Table 6.63: Occupational Distribution of Respondents in the Study area

Occupation	Ethiope West	Okpe	Sapele	Ugheli North	Uvwie	Ikpoba Okha	Average (%)
Farming	2	4	3	3	0	3	11.72
Pastoralist	0	1	0	0	1	1	2.34
Self-employed	5	2	4	4	3	5	17.97
Private employee	2	2	3	3	2	3	11.72
Public employee	4	3	4	3	4	7	19.53
Trading and Fishing	11	8	4	8	2	14	36.72

Source: GNL Survey 2019

It is clear from the above that majority of the inhabitants in the project area are traders/fisher folks public andself-employee. Farming accounts for about 11.72% and 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 area is also blessed with oil palm products. Those engaged in brewing of local gin jokingly referred to as Sapele Water.

Plate 6.17: Cassava Processing

Plate 6.18: Oil palm plantation near Amukpe

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, persons available as commercial farm workers, carpenters and masons make up more than three-fifths of the skills.

Table 6.64: Population with skills related to TCN work in the project area

Skills	Ethiope West	Okpe	Sapele	Ugheli North	Uvwie	IkpobaOkha
Experienced pylon assembler	1	1	1	1	1	2
Carpenter	2	2	3	3	3	5
Welder	2	2	3	3	3	5
Electrician	3	2	4	4	3	5
Truck driver	1	1	1	2	2	4
Taxi (car, tricycle, motorcycle)	3	2	3	3	4	5

Heavy machinery operator (*shovel operator, caterpillar, etc.)*	1	1	2	2	3	3
Mechanic	2	3	4	4	5	5
Mason	3	3	4	4	5	6
Painter	2	2	4	3	5	5
Chainsaw operator	1	1	3	2	2	2
Commercial Farm workers	2	3	1	3	2	2
Plumbing	3	2	3	3	3	4

Source: GNL, 2019

The data revealed presence of all relevant artisanal skills in the project area with electrician, cab men, mechanic been the most abundant skills.

Income

The income generating activities of the people in the communities of the project area include crop farming, trading, artisanship, livestock rearing, processing of farm produce, hunting, and fishing and self-employment... About 79.5% of the respondents in communities within Ikopbaokha earn below ₦500, 000 per annum while 20.5% earned above ₦500, 000 per annum from all sources combined. Also, About 90.5% of the respondents in communities within Ugheli and Sapele LGA earn below ₦500,000 per annum while 9.5% earned above ₦500,000 per annum, while 89.5% of the respondents in communities within IkpobaOkha and Ethiope West earn below ₦500,000 per annum while 10.5% earned above ₦500,000 per annum (See Table 6.65).

Table 6.65: Income Level in the project area

		IkopbaOkha	Ugheli North	Sapele	Uvwie	Okpe	Ethiope West
S/N	Annual Income (N)	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	**Frequency (%)**
1	Less than 100,000	5.5	12.8	10.2	9.0	9.8	**10.1**
2	100,000 –199,999	10.6	10.5	17.6	13.8	13.4	**14.2**
3	200,000 – 299,999	10.3	13.2	11.2	13.2	12.7	**11.9**
4	300,000 –399,999	37.4	44	42.5	44.5	45.1	**42.7**
5	400,000 –499,999	15.7	10	9.0	9.8	7.2	**9.9**
6	**500,000 +**	**20.5**	**9.5**	**9.5**	**10.5**	**11.8**	**11.2**

Source: GNL 2019

The major hindrances to the economic development identified in the study area include low patronage of crop farming produce, lack of storage facilities for safe keeping of unsold farm produce, inadequate credit facilities to expand businesses, absence of electricity, poor access road that hinder intra mobility and inadequate safe drinking water. The rural access roads are usually inaccessible during the wet seasons thereby hindering movement to market. This results into large scale post-harvest loss. In addition, Agriculture Extension Officials from the State Ministry of Agriculture seldom visit the farmers while the introduction of improved seedlings and modern implements are at the lowest ebb.

It was observed that the basic challenges to income generating activities in the project area include:

- High cost oftransportation;
- High level of post-harvestloss;
- Absence of electricity
- Lack of access to creditfacilities;
- Lack of productive inputs and inadequate extensionvisitation;
- Poor storage and processing facilities and
- High cost of labour amongothers.

The availability or improvement of electricity supply would hopefully ameliorate the situation.

Households' Main Source of Energy

The result on the survey of the sources of energy used by household in the project area is summarized in Table 6.66. A total of ten (10) energy sources for both lighting and cooking were identified in the project area.

Table 6.66: Respondents Households' Main Source of Energy (%)

	Ethiope West		Okpe		Sapele		Ugheli North		Uvwie		IkpobaOkha	
	Cooking	Lighting	Cooking	Lighting	Cooking	Lighting	Cooking	Lighting	Cooking	Lighting	Coking	Lighting
Main electricity	1	74	2	50	0	38	2	67	5	70	5	60
Solar	0	1	2	5	0	1	0	2	0	0	0	0
Gas	38	0	39	0	10	0	34	0	70	0	65	0
Paraffin/kerosene	40	7	43	14	45	32	41	9	25	0	30	0
Charcoal	2	0	1	0	9	0	5	0	0	0	0	0
Wick lamp	0	6	0	7	0	12	0	2	0	5	0	20
Candles	0	2	0	3	0	2	0	1	0	0	0	0
Firewood (biomass)	19	0	13	0	36	0	18	0	0	0	0	0
Generators	0	8	0	20	0	13	0	17	0	25	0	20
Touch light	0	2	0	1	0	2	0	2	0	0	0	0

Source: GNL Survey, 2019

According to Table 6.64, electricity from the national grid is the main source of lighting in the project area. Other frequently used energy source for lighting are Kerosene and generator. Conversely, solar, touch lights, candles and wick lamp 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 40% 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.

Households' Main Source of Potable Water (%)

A total of eleven (11) 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 6.17.

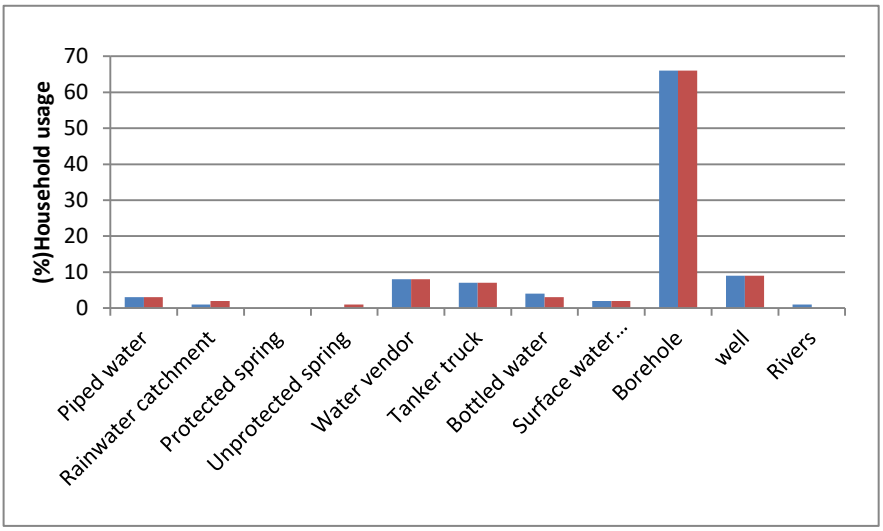


Figure 6.14: Households' Main Source of Potable Water (%)

According to Figure 6.14, water from boreholes was the most used by households in the project area. About 66% of households in the project area use 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.

6.14.11 Waste Disposal by Households

Refuse

Figure 6.15 shows refuse disposal methods by households. Open dumping and burning are the two waste methods practiced by the communities.

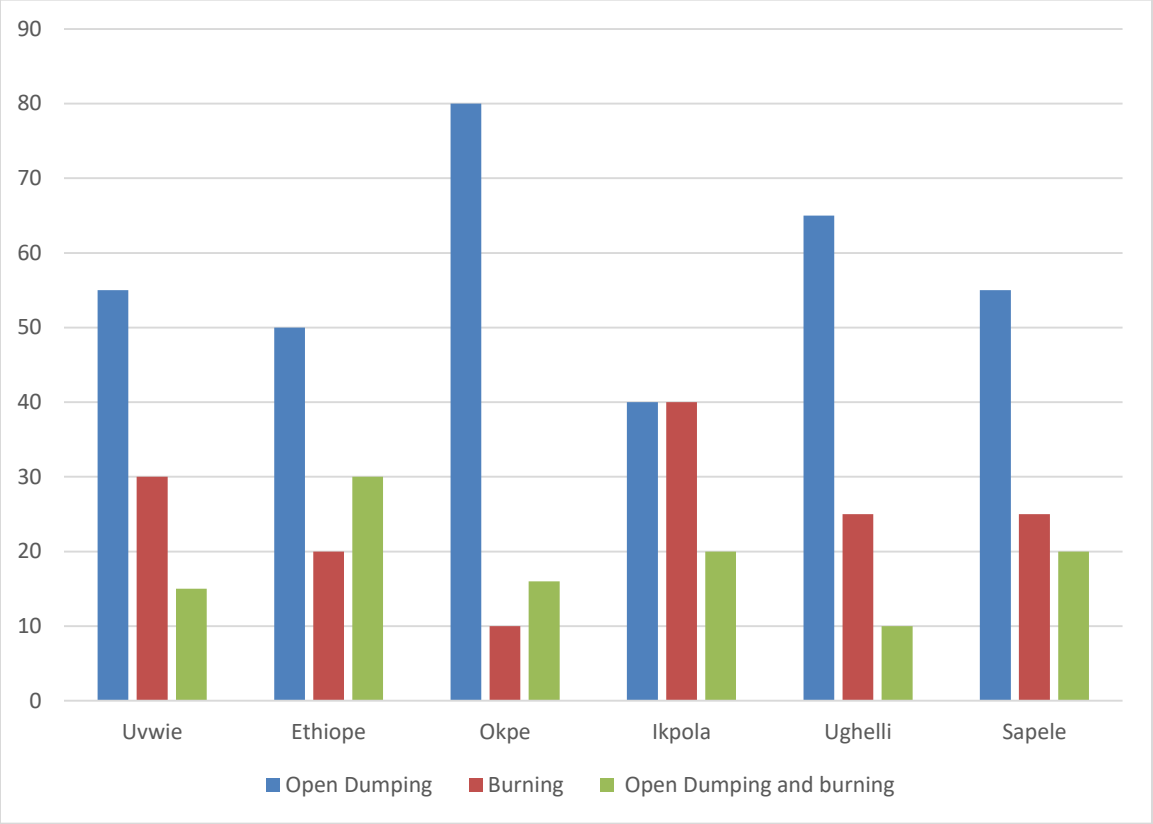


Figure 6.15 Refuse Disposal

Source: GNL Survey, 2019

Open dumping is the prevalent refuse disposal method in the area followed by refuse incineration. However some households practice both methods.

Waste Disposal (Sewage)

Sewage disposal by households were either by pit latrine, bush or by water closet as shown in Figure 6.16

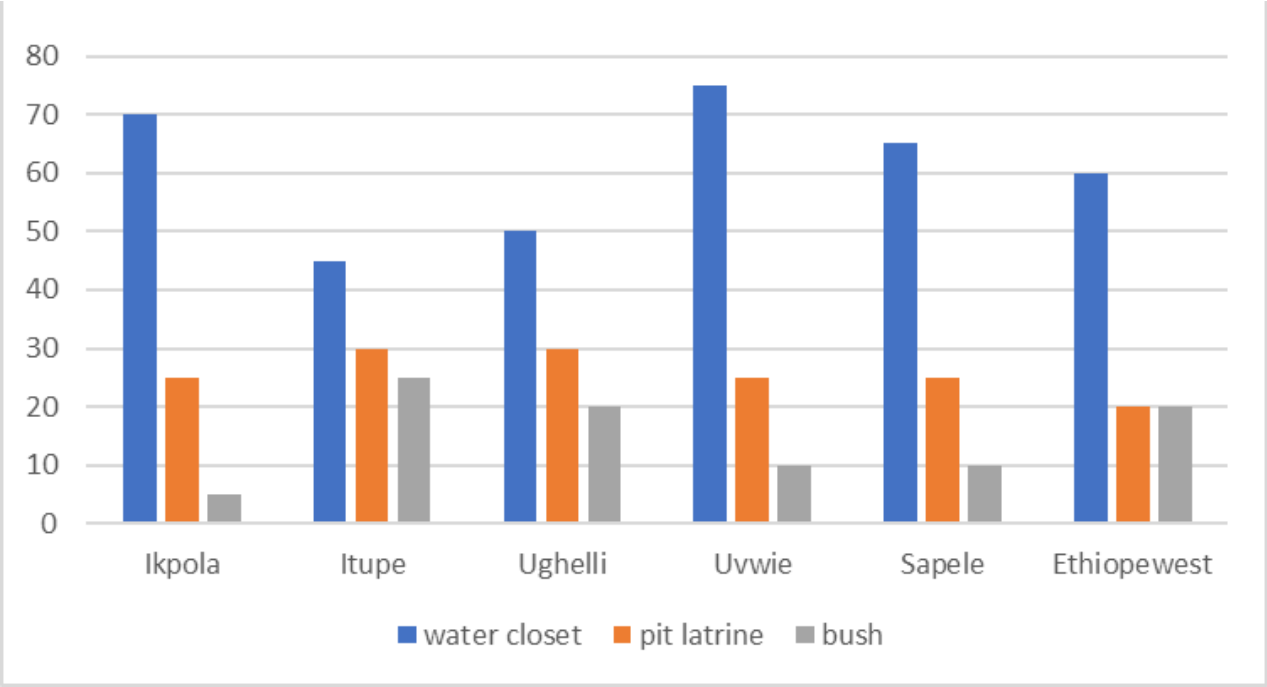


Figure 6.16 : Sewage disposal methods by households

According to Figure 6.19, about 60% and above of respondent's households in Ethiope West, Sapele, Uvwie and Ikpoba-Okha LGAs use the Water Closet (WC) system while about 25% of respondent households in the project area used the pit latrine. About 15% of the households use the bush.

6.14.12 Vulnerable Groups

The category and number of vulnerable groups in the communities within the six LGAs of the project area were identified and analyzed as shown in Table. 6.67. This was compiled with assistance with the village heads.

Table 6.67: Proportion of vulnerable groups in the project area

Vulnerable groups / LGAs	Children	Land tenants	Women	Non indigenes	Elderly	Infirm/physically challenged	Herdsmen	**Total**
Ikpoba Okha	48	20	40	50	23	19	9	**209**
Okpe	40	26	31	63	14	10	3	**187**
Ughelli North	32	27	54	60	29	38	8	**248**

Ethiope West	41	21	23	40	25	46	8	**204**
Uvwie	**32**	**20**	**17**	**27**	**18**	**31**	**6**	151
Sapele	**28**	**18**	**16**	**31**	**16**	**28**	**4**	141
Total	**221**	**132**	**181**	**271**	**125**	**172**	**38**	1140

Source: GNL 2019

From the illustration above, the most vulnerable group across the LGA's are non-indigenes, children and women while the least vulnerable group is the herdsmen. The total number was 1140 individuals representing about 47.56% of the respondent population.

6.14.13 Indigenous People

IFC Performance Standard 7 recognizes Indigenous Peoples as social groups with identities that are distinct from mainstream groups in national societies. There are no indigenous people in the area.

6.14.14 Cultural Heritage Resources

There are no cultural sites within the way leave and within the 500m on either side of the RoW.

Gender Issues.Data relating to gender issues were obtained using community questionnaires, involving all the communities in the Row. Male and female folks were separated and assisted in responding to the gender indicators parameter in the questionnaire. Result is represented in Table 4.68.

Table 6.68: Gender Parameters in Project Area

	Ethiope west		Okpe		Sapele		Ugheli west		Uvwie		Ikpoba Okha	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Circumcision	100	100	95	100	100	100	90	100	100	100	100	100
Land ownership	78	10	85	15	63.5	12	77.2	8.5	61	5	85	15
Access to credit	28	5	15	O	33	8	25.1	3	31.7	3	32	10
Decision making at household	100	28	100	12	100	38	100	20	100	35	100	35

Decision making at country level	80	20	70	30	65	35	70	30	65	35	75	25

6.14.15 Circumcision

The non-therapeutic alteration of children genitals is typically discussed in two separate ethical discourses;

- one for girls in which such alteration is conventionally referred to as Female Genital Mutilation (FGM) and one for boys which is conventionally referred to as male circumcision.
- There is an increased risk of adverse health outcome with increase severity of FGM. Health agencies and medical practitioners are opposed to all forms of FGM and is emphatically against the practice being carried out by health care providers. Some of the effects of FGM include; severe pain, excessive bleeding, shock, genital tissue swelling and infection.
- In the project area 100% of the male were circumcised excluding Okpe and Ugheli North, which recorded 95% and 90% respectively, while 100% of female were circumcised in all the project areas, which shows the need forincreased FGM sensitization. This position was supported by Immigration and Refugee board of Canada 2015 and Okeke *et al* 2012 However personal communication tends to suggest that lower circumcision rate among younger female gender. When the age distribution of the female respondents was computed the data showed about 72.5 within age bracket above 35 years. Nigeria average for circumcision for male is 93.2% while for female is 27.8%, the reason for the lower percentage of circumcision among female as compared to the data obtained from project area is due to the sensitization of FGM in other regions of the country.Nigeria average for circumcision for male is 93.2% while for female is 27.8%. The reason for the lower percentage of circumcision among female as compared to the data obtained from project area is due to the sensitization of FGM in other regions of the country.

6.14.16 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. It was reported by the respondents that itscustomary for female folks to be excluded in sharing inherited properties. Nonetheless, the Nigerian average (NBS 2012) which showed a 5:1 in favour of the male folks closely mirrors the findings of this report.

6.14.17 Access to Credit

Banks and lending agencies including local thrift societies in the project area often establish one set of criteria for male folks and another, including a male surety for the female folks. The imperativeness to fulfill this criterion is perhaps a factor why the obtained data do not correlate strongly with the Nigerian averagewhichwas put at 55:45 by NBS 2012.

6.14.18 Decision Making at Household

Socio-cultural and religious bias in favour of the male folks in household decision process is evident in the data obtained. Households with proportionate decision-making process between the male and female partner reported degree of exposure educational background and working status of the female gender as influencing factors. The Nigerian average is almost at 1:1 (NBS 2012).

6.14.19 Decision Making at Community Level

Same reasons adduced for *decision making at household level*spertains here also. However, reserve of some exclusive traditional titles and roles for the female folks in the project area accounted for the higher proportionate representations in this parameter than the former. Some of these titles in Urhobo kingdoms include Amebo, Okpe, Okpako, Eweya, Emeteinclude the data obtained in this report bettered the Nigeria average of 6:1 due perhaps primarily to the strong traditional institutions within the project area. In Bini Kingdom, Eyeye of Benin and the giving of coral beads are evidences of women participation in decision making at the community levels.

6.14.20 Consultation of Stakeholders

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 6.69).

Table 6.69: 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
	Delta and Edo Ministries of Environment		X		X	X
	Delta and Edo Ministries of Works and Housing		X		X	X
	Delta and Edo Ministries of Lands and Survey		X		X	X
	All 8 affected LGAs			X	X	X
Local Communities	Thirty-one 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
	Truck dealers' association			X		X

6.15 Stakeholders' 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 ESIA process. These included the scoping stage (1st round), the route assessmentand the documentation of the displaced households' stage (2nd round). The third round of consultations is for on-going disclosure of the ESIA, ESMP and RAP preliminary results (3rd round).

Table 6.70 present outlines the studies' stakeholder engagement process and presents, for each consultation round, the specific engagement objectives, target groups and implementation periods.

Table 6.70: Stakeholder Engagement

Objectives and Information Provided for Rounds 1: The target group is Institutional Stakeholders. The objective is to apprise them of the pro and cons of the proposed project and obtain their buy –ins and early input					
Reconnaissance Mission with AfDB, TCN and GNL of 19th to 26th April 2019. This is to afford the AfDB team first-hand assessment of the route in order to generate an aide Memmorie for the projects.					
Appraisal Mission of 03-15thJuly involvingAfDB, TCN and GNL – The target is to review progress made since last visit. Appraisal Mission of 11th July 2019 involving AfDB, TCN, GNL and FMEnv at Environment House, Abuja. This aim was to ensure that the country's system is been followed and obtain their approval for AfDB ESIA structure which was granted.					
Delta State Round 1			Edo State Round 1		
Target group	Date & Venue	Comment & Implementation	Target group	Date & Venue	Comment & Implementation
FMEnv	Ministry Office 23/7/ 2019	Advised TCN to develop the SEP and strictly implement it throughout the project lifespan, to ensure stakeholder confidence and sustainability.	FMEnv	Federal Secretariat Benin 22/7/ 2019	Ensure Environmentally friendly activity and during operations proper safety equipment and personal protective equipment to perform their work safely was advised.
FMAFNR	Top view Hotel 23/5/ 2019	Stressed the need for State matrix to be applied in computing compensation. Also, transparency in enumeration exercise	FMAFNR	Benin City &Top view Hotel 23/2/ 2019	Compensation for PAPsand PACs was stressed while footprint for access route creation should be minimized
FMLS	Ministry Office 23/7/ 2019	They advised that proper route studies be carried out and also affected land developers should be compensated	FMLS	Federal Secretariat Benin 27/2/ 2019	Compensation for PAPsand PACs was stressed. Also,

					professional conduct was advised.
FMPHUD	Ministry Office 23/7/ 2019	They harped on due process on landand reminded all that the TCN shall bear the processing charges.	FMPHUD	Federal Secretariat Benin 22/7/ 2019	The design and type of equipment should be that which meet international best practice.
NERC	Ministry Office 22/7/ 2019	Ensure that performance standard are met and maintained	NERC	Federal Secretariat Benin 22/7/ 2019	Emphasized that performance standard are maintained
NSCDC	Top view Hotel 23/7/2019	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	Benin City &Top view Hotel22/7/2019	Stressed out the risk in working at night and advised for proper journey management
DSS	Ministry Office 27/5/2019	Security details should be engaged during field exercise	DSS	Federal Secretariat Benin 29/4/2019	Workers should be provided with identity card due to the security threat.
DME	Ministry Office 27/5/ 2019	They advised on occupational health and safety procedures and wearing of reflective clothing on site	EME	Federal Secretariat Benin 29/4/ 2019	They called for compliance with the state environmental laws and regulation
DMWH	Ministry Office 23/7/ 2019	They expressed their desire that TCN should carry them along during enumeration process	EMWH	Federal Secretariat 3/5/ 2019	They expressed their desire to give entitlement matrix
DMLS	Ministry Office 22/05/2019	they advised that proper survey should be done to mark interstate boundaries to prevent communal clash	EMLS	Federal Secretariat Benin 21/7/ 2019	promised to facilitate and fast track the processes to gazette the ROW when TCN applies.

Nigeria Environmental Society (NES)	23-07-19 Ministry office	They advised project managers to show professionalism in handling the project to avoid environmental hazard and pollution	Nigeria Environmental Society	Federal Secretariat Benin 21/7/ 2019	The project should fully understand the livelihood pattern within the area
Ministry of transport and FRSC	23/7/2019 Top view Hotel	They were concerned about the traffic on major road at crossing point in relation to project activities such as unstringing of lines and dismantling of towers	Ministry of transport and FRSC	Federal Secretariat Benin 21/7/2019	They were concerned about the quantity and type of vehicles to be used in the transport of decommissioned and construction materials
Nigeria Conservation Foundation	Ministry office 23/7/2019	There were concerned about the measures TCN has put in place to mitigate impact on heavier nest during tower dismantling	Nigeria Conservation Foundation	Benin City & Topview Hotel 3/5/2019	They were concerned about routing of the line and the impact it will put on important biodiversity hotspot and suggest the existing line be maintained
Ministry of transport and FRSC	23/7/2019 Top view Hotel	They were concerned about the traffic on major road at crossing point in relation to project activities such as unstringing of lines and dismantling of towers	Ministry of transport and FRSC	Federal Secretariat Benin 21/7/2019	They were concerned about the quantity and type of vehicles to be used in the transport of decommissioned and construction materials

Delta State				Edo State			
LGAs	**Community**	**Date & Venue**	**Comment & Implementation**	**LGA**	**Community**	**Date & Venue**	**Comment & Implementation**
Sapele	Ojikwa	23-05-19 Village head's palace	They asked for the project Benefits and also employment opportunities for the youths	Ikpoba-okha	Okonaovi	21-07-19 Village head's palace	They complained about dust, noise during construction phase

	Eneose Island	23-05-19 Village head's palace	Their major concern was corona effect they believe it causes impotency among men.		Okaubogu	21-07-19 Village head's palace	They asked about the likely impact caused by electromagnetic fields (EMFs) on animals, people and vegetation
	Amukpe	23-05-19 Village head's palace	They were concerned about their farmlands that would be affected during access road construction		Okabere	21-07-19 Village head's palace	They were concerned about the houses around the right of way and relocation measures put in place by the government.
	Adagbarassa	23-05-19 Village head's palace	They were concerned about the houses around the right of way and relocation measures put in place by the government.		Ekae	21-07-19 Village head's palace	They asked for improvement of electricity supply in their village
	Oyohe	23-05-19 Village head's palace	They were concerned about their farmlands where the project cuts across		Idunmwunivdiode	21-07-19 Village head's palace	They were scared and showed concern on fire outbreak due to electrical surge
	Oviri	23-05-19 Village head's palace	The people major concern was the effect of the project on their water body which the project cuts across.		Etete	21-07-19 Village head's palace	They complained of not having steady electricity and asked for improvement of

							electricity supply in their village
	Ogegere	23-05-19 Village head's palace	They advised to beware of swampy areas that cannot be easily detected		Aubriaria	21-07-19 Village head's palace	They asked about the duration of the project and its advantage to their community
	Odjedi	23-05-19 Village head's palace	They asked that the youth in the community be gainfully engaged in the project		Oha	21-07-19 Village head's palace	They asked on how the project will benefit them and also employment opportunities for the youths
	Gbimidaka	23-05-19 Village head's palace	They were concerned on how access road would be created and the impact on their farmlands and crops		Obaretin	21-07-19 Village head's palace	They asked that electricity supply should be steady in their community
	Egbeku	23-05-19 Village head's palace	They showed major concern on the security of their wives during the project activities		Utesi	21-07-19 Village head's palace	They showed concern on the effect of EMFs on their vegetation and animals
	Ebada	23-05-19 Village head's palace	They asked waste are dumped in their water as that is their source of water		Uhie	21-07-19 Village head's palace	They were happy and pleased to hear about the project
	Utornyatsere	23-05-19 Village head's palace	They were concerned about the houses around the right of way and relocation measures		Oka	21-07-19 Village head's palace	They were concerned about the compensation given

			put in place by the government.				to those whose farmland will be destroyed
	Okwadiokpara	23-05-19 Village head's palace	The major concern of the people of Okwadiokpara is the improvement of electricity supply to their village		Ohoghobi	21-07-19 Village head's palace	They showed concern and advised to beware of swampy areas in the region that can cannot be easily detected
	OWkuovwori	23-05-19 Village head's palace	They asked if the project will benefit their youth		Ogbe Orogho	21-07-19 Village head's palace	They concerned about the security of their wives during project activities
	Ituru	23-05-19 Village head's palace	They requested for steady electricity in their village		Obayantor	21-07-19 Village head's palace	They were scared of sudden fire outbreak from electricity surge
	Ikwewu	23-05-19 Village head's palace	They were concerned about waste being dumped into the water where they fish as this will affect the fish		Imasabor	21-07-19 Village head's palace	They asked for the duration of the project, its advantage and disadvantage to them and their environment
	Igoyo	23-05-19 Village head's palace	They were concerned about compensation being paid to those whose houses are along access road		Ighobaye	21-07-19 Village head's palace	They advised to restrict movement at night to avoid cases of kidnapping

	Elume	23-05-19 Village head's palace	They asked that their sons be made CLOs		Edo camp	21-07-19 Village head's palace	They were happy about the project and pledge their support
	Ebada	23-05-19 Village head's palace	They were concerned about the relocation measures of the government for those where the line cuts across		Agiyo camp	21-07-19 Village head's palace	They were concerned about their farmland and the compensation to be giving to those whose crops are at risk of being destroyed
	Atakolo	23-05-19 Village head's palace	They asked that youth in the community are gainfully employed		Uwosan	21-07-19 Village head's palace	They complained about dust, noise during construction
	Amuegbedi	23-05-19 Village head's palace	They were concerned about their farmland where the line cuts across		Uroho	21-07-19 Village head's palace	Their major concern was the improvement of electricity in their village
Ethiope West	Munro Island	23-05-19 Village head's palace	They asked electricity is steady in their village		Udueheh	21-07-19 Village head's palace	They asked on how the project will benefit them and also employment opportunities for the youths

	Michaga	23-05-19 Village head's palace	They asked that the ethics of the people be followed and obeyed		Ologbo	21-07-19 Village head's palace	They were concerned about the houses around the right of way and relocation measures put in place by the government.
	Jesse	23-05-19 Village head's palace	Their major concern was the improvement of electricity in their village		Okuku	21-07-19 Village head's palace	The people showed major concerned on compensation to landowners affected by the project
	Jamieson River	23-05-19 Village head's palace	They were concerned on the effect of the project		Okha	21-07-19 Village head's palace	The major concern of the people is the improvement of electricity supply to their village
	Wright Greek	23-05-19 Village head's palace	They were concerned about the compensation to those whose farmlands are affected by the project		Okavbor han	21-07-19 Village head's palace	The community was happy about the project and pledged their support
	Warifi	23-05-19 Village head's palace	They scared of fire outbreak from electricity surge		Obenev bueribo	21-07-19 Village head's palace	They asked on how the project will benefit them and also employment opportunities for the youths

	Ovade	23-05-19 Village head's palace	They were concerned about waste being dumped into their rivers		Iyanom0	21-07-19 Village head's palace	The villages made enquiry of how long the project will take and its advantages
	Ugbenu	23-05-19 Village head's palace	Their major concern is the compensation of those whose houses are affected by the project		Evbuom oma	21-07-19 Village head's palace	They asked that their sons be made CLOs
	Sapele	23-05-19 Village head's palace	They asked of the duration of the project and how it will affect their health		Ekosa	21-07-19 Village head's palace	They asked the ethics of the people be followed and obeyed
		23-05-19 Village head's palace	Their major concern was to have steady supply of electricity in their village		Egun	21-07-19 Village head's palace	They asked to beware of interstate boundaries
Udu	Opete	23-05-19 Village head's palace	They were concerned about the houses around the right of way and relocation measures put in place by the government.	Oredo	Ugbor	21-07-19 Village head's palace	Their major concern was their local market which the project would affect
	Obodo	23-05-19 Village head's palace	Their concern was their market which the will affect				
Okpe	Mereje	23-05-19 Village head's palace	They asked questions regarding gaseous emissions and hazardous substances from transformers		Benin City	21-07-19 Village head's palace	They asked on how the project will benefit them and also employment opportunities for the youths

	Orerokpe Stream	23-05-19 Village head's palace	They concerned about the security of their wives
	Okwuidiemo	23-05-19 Village head's palace	They asked on how the project will benefit them and also employment opportunities for the youths and their community at large
	Okuruvu	23-05-19 Village head's palace	They were concerned about the houses around the right of way and relocation measures put in place by the government.
	Okuotomewo	23-05-19 Village head's palace	The people of showed major concerned on compensation to landowners affected by the project and persons who farmed on rented lands
	Okuoke	23-05-19 Village head's palace	The people asked if the project will improve electricity supply in their village
	Okuijiorugu	23-05-19 Village head's palace	They were scared of corona effect and asked which measures wasput in place to reduce the effect
	Okugbogbo	22-06-19 palace of village head	They showed more concern on the safety of their animals during project activity. Also, they were concerned on the advent of fallen poles.
	Okuetolor	22-07-19 palace of village head	They asked if owners of farmlands and buildings on the RoW would be compensated
	Okuemaife	23-07-19 palace of village head	Their major concern was their local market which the project cuts across and suggested a mitigation plan by the government
	Okuabude	23-07-19 palace of village head	They were concerned on location of access road and its impact on their livelihood
	Odjedi	23-07-19 palace of village head	The villages made enquiry of how long the project will take and its advantages.
	Jakpa	23-07-19 palace of village head	The community was happy about the project and pledged their support

	Iginene	22-07-19 palace of village head	Their major concern is in the improvement of electricity supply to their village
	Egborode	22-07-19 palace of village head	The community expressed concern over their farmland were the project cuts across and suggested compensation
	Ajede	25-05-19 palace of village head	They concerned about advent falling of poles on their houses
	Ukpe sabo	21-05-19 palace of village head	They expressed concern about their farmland were the project cuts across and asked for compensation
	Ukan Market	23-07-19 palace of village head	They were happy about the project and pledge their support
	Oviri court	23-06-19 palace of village head	Youth employment was their major concern
	Ugwagbagere	25-06-19 palace of village head	They asked to be engaged and not be left out in any activity
	Okuvo	25-07-19 palace of village head	They were concerned about the noise during construction
	Opuraja	25-04-19 palace of village head	They asked for the improvement of electricity in their village
	Okuogholo	25-06-19 palace of village head	They were concerned about the duration of the project and how it will affect them
	Okuobadjere	23-07-19 palace of village head	The people showed major concerned on compensation to landowners affected by the project
	Okughurhe	23-05-19 palace of village head	The villages made enquiry of how long the project will take and how equipment would be transported to site without affecting farmlands and buildings
	Okoejeba	23-07-19 palace of village head	They were concerned about the houses around the right of way and relocation measures put in place by the government.
	London	23-07-19 palace of village head	Their major concern was the provision of jobopportunity for the youths

	Iriama	21-05-19 palace of village head	The community expressed concern over their farmland were the project cuts across and requested for compensation
	Adagbrassa	23-07-19 palace of village head	They asked if there is restriction of movement in any of the access roads
Ugheli North	Orho Agbarho	23-07-19 palace of village head	They were concerned about the houses around the right of way and relocation measures put in place by the government.
	Orhokpokpor	23-07-19 palace of village head	They called on youths' employment to be a priority
	Eruemukohwarien	23-07-19 palace of village head	They pleaded that the locals be made to supply goods and services within the RoW segment in their area
	Oguname	25-05-19 palace of village head	They reminded TCN and all third parties the privacy sanctity of their wives when the project activities commence
	Ekrerhevbe	22-07-19 palace of village head	Their major concern was the provision of job opportunity for the youths
Ugheli South	Otokutu	22-07-19 palace of village head	The effect of noise from transmission lines (corona effect) was stressed.
	Ekrokpe	24-05-19 palace of village head	The villages made enquiry of how long the project will take and its advantages. They were also concerned on alternative access roads to be used when and if movement is restricted in any of the existing one
	Ekrejegbe	24-05-19 palace of village head	They cited previous example of dust emission during construction and called for dust suppressants
	Ekakpamre	24-05-19 palace of village head	They were concerned on how access road would be created and the impact on their farmlands and crops
	Egbo	27-07-19 palace of village head	They were concerned about their water and asked that waste should not be dumped into the river.
	Oghrerhe	24-07-19 palace of village head	They requested steady electricity supply in their village and a Step-Down transformer to be installed

Uvwie	Tori	27-07-19 palace of village head	The community was happy about the project and pledged their support. They however called for openness and continuous engagement
	Enerhe	27-07-19 palace of village head	They called for their sons to be made Community Liaison Officer and cited examples of CLO appointment caused frictions in some nearby communities.
	Effurun	23-07-19 palace of village head	They were concerned about provision of jobs for their sons

Plates 6.18 (A-U) are some pictures taken at the stakeholder meetings

(A)Ukpe sabo (Palace of village head, 21-05-19)

(B) Evboriaria, 21-05-19, Town Hall

(C) Ajede, 25-05-19 palace of village head

(D) Iriama, 21-05-19 palace of village head

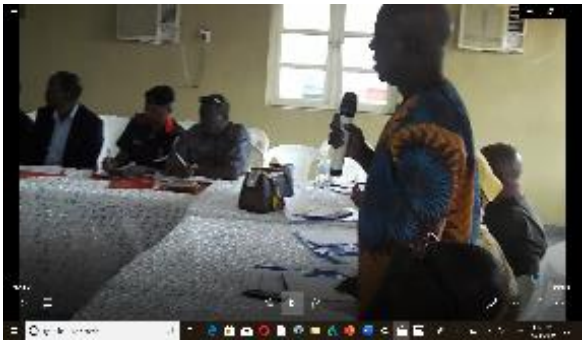
(E)Etete, 25-05-19 palace of village head

(F) Opuraja25-04-19 palace of village head

(G)Okoejeba 23-07-19 palace of village head head

(H) Okughurhe 23-05-19 palace of village

Ekrerhevbe 22-07-19 palace of village head



(I)

(J).Ekrokpe24-05-19 palace of village head

(K). Eruemukohwarien 23-07-19 palace of village head (L) Otokutu22-07-19 palace of village head

(M). Ekrejegbe 24-05-19 palace of village head (N) Ekakpamre24-05-19 palace of village head

(O). Effurun 23-07-19 palace of village head

(P). FMLS, Ministry Office 23/7/ 2019

(Q) Iriama21-05-19 palace of village head
(R). Orho Agbarho23-07-19 palace of village

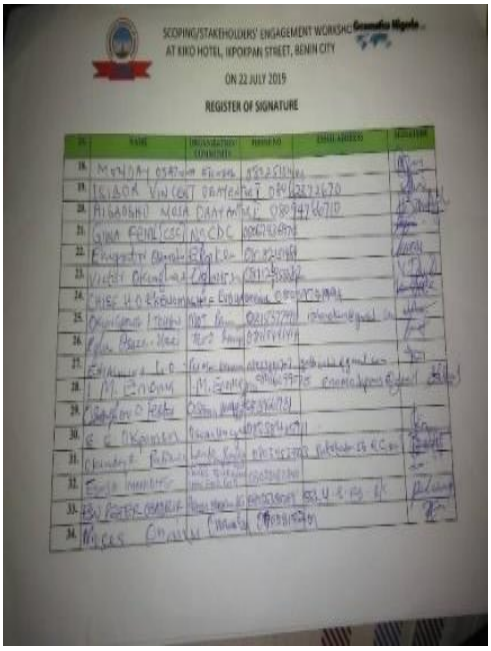
(U) DSSMinistry Office27/5/2019

Plates 6.18 (A-U): Pictures taken during some stakeholder engagements

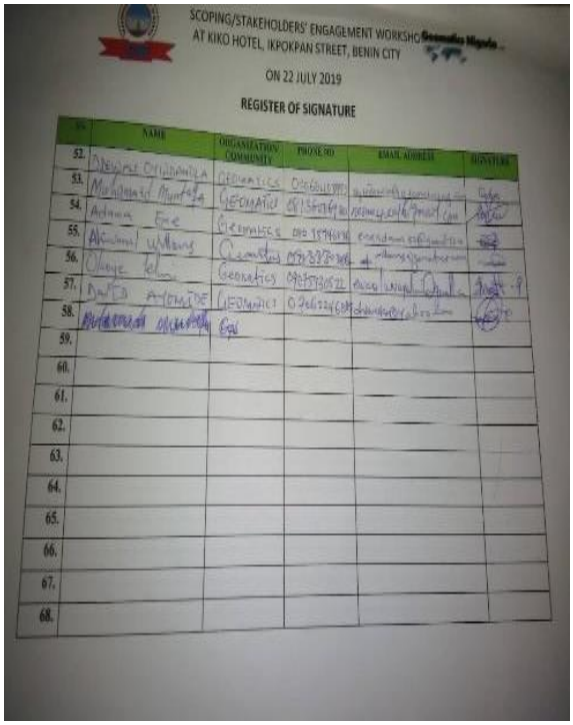
Plate 6.19 (A-U) presents some of the attendant register from stakeholder engagement meetings


SCOPING/STAKEHOLDERS' ENGAGEMENT WORKSHO
AT KIKO HOTEL, IKPOKPAN STREET, BENIN CITY
ON 22 JULY 2019
REGISTER OF SIGNATURE

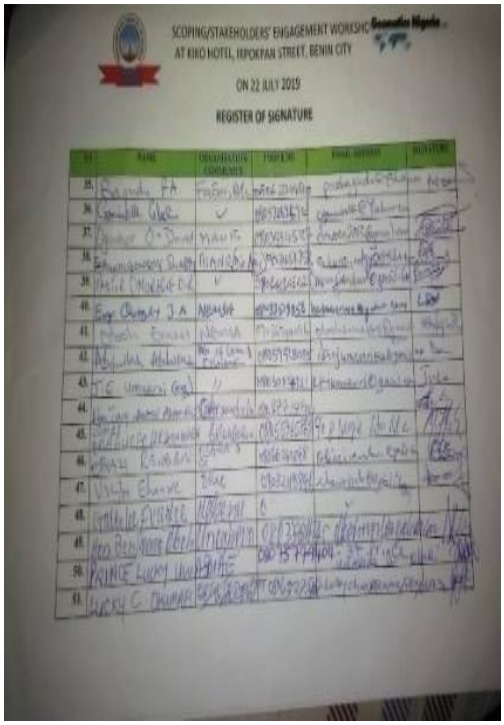
(A) DSS


SCOPING/STAKEHOLDERS' ENGAGEMENT WORKSHO
AT KIKO HOTEL, IKPOKPAN STREET, BENIN CITY
ON 22 JULY 2019
REGISTER OF SIGNATURE

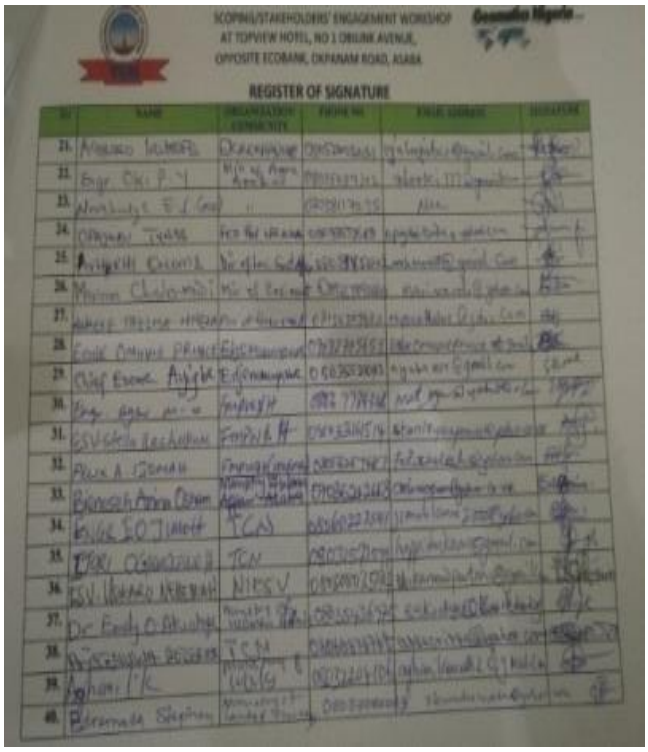
(B) NSCDC


SCOPING/STAKEHOLDERS' ENGAGEMENT WORKSHO
AT KIKO HOTEL, IKPOKPAN STREET, BENIN CITY
ON 22 JULY 2019
REGISTER OF SIGNATURE

(C) FMEnv

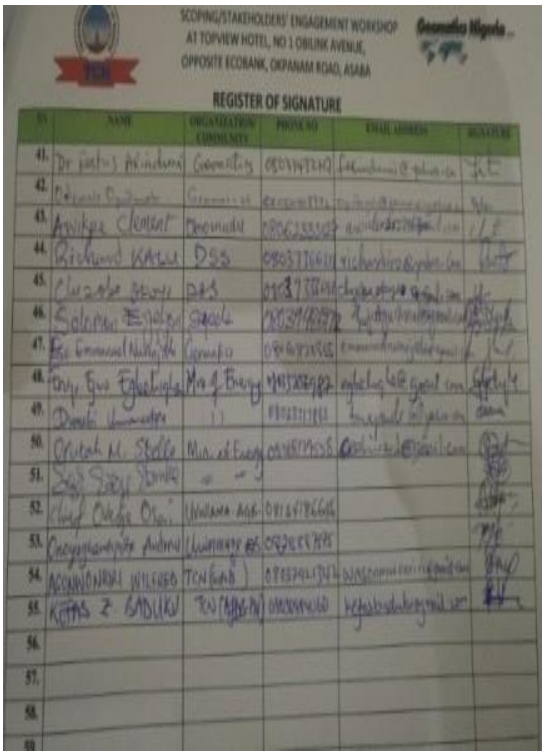

SCOPING/STAKEHOLDERS' ENGAGEMENT WORKSHO
AT KIKO HOTEL, IKPOKPAN STREET, BENIN CITY
ON 22 JULY 2019
REGISTER OF SIGNATURE

(D) NEMSA


SCOPING/STAKEHOLDERS' ENGAGEMENT WORKSHOP
AT TOPVIEW HOTEL, NO 1 OBIUNK AVENUE,
OPPOSITE ECOBANK, OKPANAM ROAD, ASABA

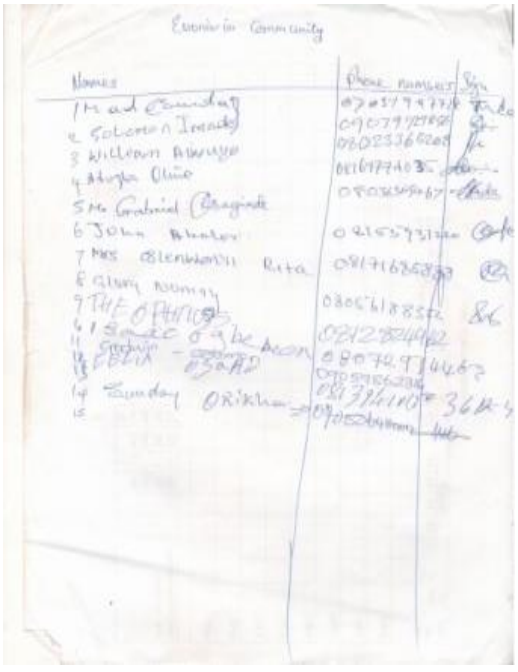
REGISTER OF SIGNATURE

(E) NIESV


SCOPING/STAKEHOLDERS' ENGAGEMENT WORKSHOP
AT TOPVIEW HOTEL, NO 1 OBIUNK AVENUE,
OPPOSITE ECOBANK, OKPANAM ROAD, ASABA

REGISTER OF SIGNATURE

(F) Ministry of Energy

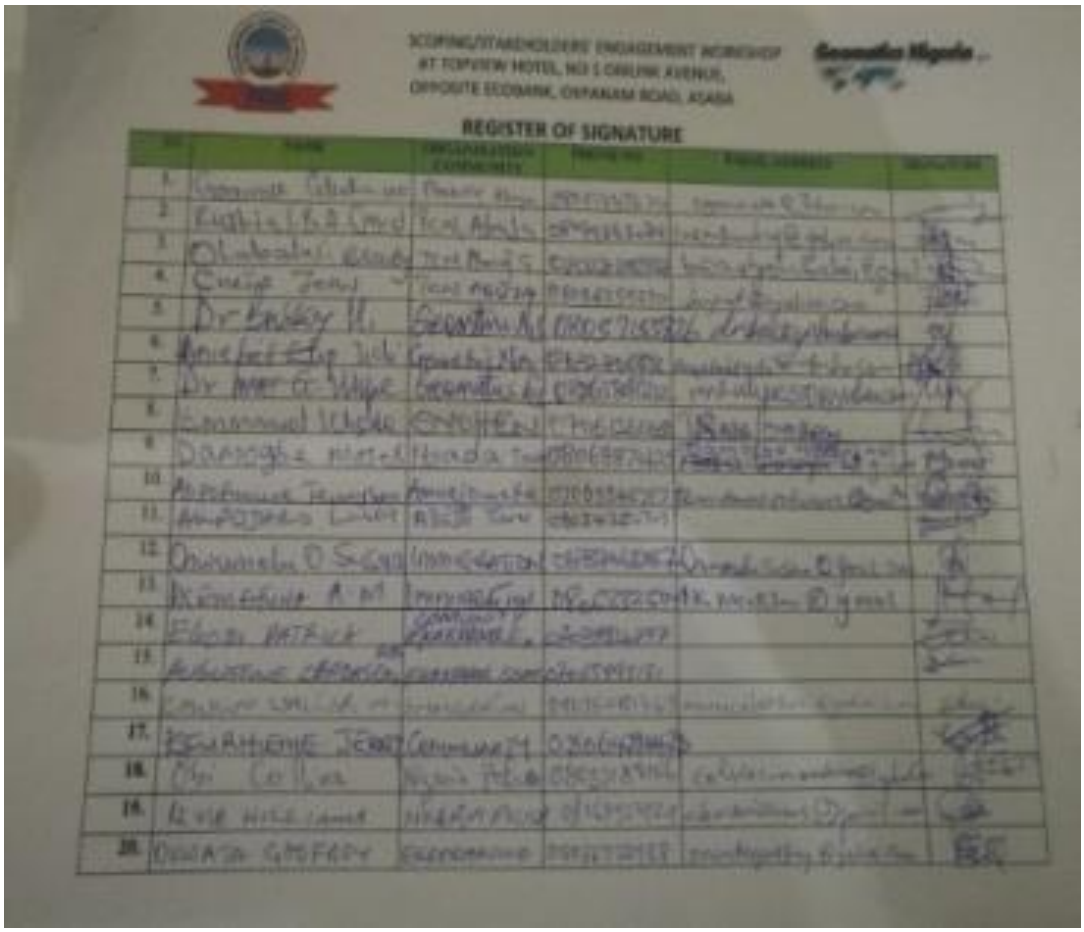

Evoriaria Community

Names | Phone numbers | Sign

(G) Evoriaria


TCN STAKEHOLDER MEETING FOR
JANUARY 2019
Wednesday 16

(H) EKPEKPE



(l) Ibada

Plate 6.20: Attendance registers of some communities and stakeholder engagements

6.16 Grievance Mechanisms

During implementation of the ESMP, it is possible that disputes/disagreements between the project developer and the PAPs will occur. There are great challenges associated with grievance redress especially in a linear project of this magnitude. A grievance procedure based on community grievance resolution channels, regulatory agencies and finally the law courts for resolution of the disputes and complaints.

6.17 Customary Mediation

All the communities affected by this project have internal mechanisms for resolution of disputes through the customary chiefdoms. Such customary avenues should provide a first culturally and amicable grievance procedure that will facilitate formal and/or informal grievance resolution.

A Customary Grievance Redress Committee shall be set up by the PIU in each LGA to address complaints. PAPs' complaints should first be lodged verbally or in writing through the customary chief, who in turn will invite the PIU. The PIU and the customary chiefs and other council in chief will try to resolve the issue amicably. If the complaint cannot be resolved at this level, or if the plaintiff is not satisfied with the settlement proposed, the matter should be reported to the regulatory agencies.

6.18 Regulatory Agencies

Edo and Delta States Ministry of Environment and the Federal Ministry of Environment have the statutory responsibility for an oversight and monitoring the implementation of the ESMP. The agencies shall pronounce judgment on any environmental complaint or dispute reported to them based on regulatory requirements. At this stage if the plaintiff is still not satisfied with the settlementhe/she can then proceed to the official legal procedures.

6.19 Courts of Law

The judicial process in accordance with applicable laws will be followed and the law courts will pass binding judgment on the matter.

6.20 Grievance Resolution Procedures

The first level is the Village Chief and the PIU: The aggrieved person shall first report the matter to the Village Chief for resolution. Issues that can be resolved at this level include, ownership tussle, management

of deceased property, boundary issues, etc. The type of issues to report to the PIU for possible include, perceived damage to property or means of livelihood, incorrect PAP data, inadequacy of compensation received, etc. If the issue is not resolved at this stage, it can then be escalated to customary mediation described in Section 7.6.1 and if still no acceptable resolution is achieved, the parties may choose to go to the regulatory agencies and thereafter to the court in accordance with laws of the Federal Republic of Nigeria. Figure 6.17 illustrates the procedure for grievance resolution.

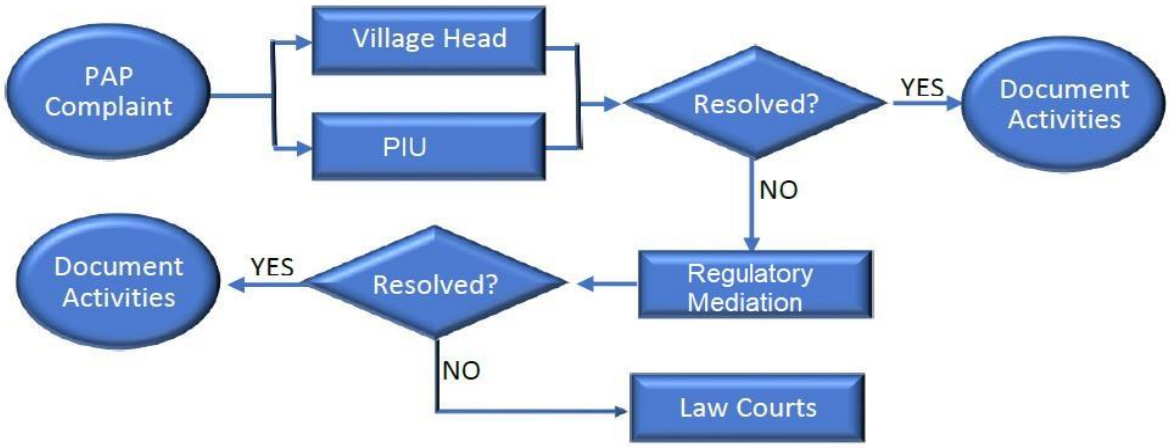


Figure 6.17 Grievance Resolution Procedure

CHAPTER SEVEN
IMPACT ASSESSMENT AND MITIGATION MEASURES

7.0 Introduction

This chapter provides information on the assessment of potential environmental and socio-economic impacts from the proposed Project. It also presents the approach adopted for the mitigation of identified impacts. The chapter also outlines the approach for predicting any residual impacts after application of mitigation measures. The impacts from both short-term (initial decommissioning, preconstruction, 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 7.1.

Table 7.1: Indicative project activities and environmental/social receptors assessed

	Phases	Activities
Indicative project activities	Decommissioning Phase of old towers and facilities that are on the ROW	• Tower unstringing • Tower dismantling • Dismantling of tower foundation • Waste management
	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 • 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). •
	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).
	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	**BiophysicalEnvironnent** • Airquality ; • Noise, vibration &EMF ; • Soils and geology; • Water resources; • Terrestrial and aquatic ecology. ***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 7.6 to 7.36.

7.1 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 iterative process involving the following four key elements:

1. **Prediction of potential** impacts and their magnitude (i.e., the consequences of the proposals on the natural and social environment);
2. Evaluation of the importance (or significance) of impacts taking the sensitivity of the environmental resources or human receptors into account;
3. Development of mitigation measures to avoid, reduce or manage the impacts or enhancement measures to increase positive impacts; and
4. Assessment 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.

7.2 Definition of Impact Terminologies

Nature/Type of impacts

There are a number of ways that impacts may be described and quantified. Table 7.2 provides definitions of terms used in this section.

Table 7.2 Definition of Impacts

1	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 loses 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 7.3.

Table 7.3 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 7.4: 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 reputationof 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 Tables 7.1 to7.4 above, the identified environmental impacts are categorized and scored according to Table 7.5aand the equation below.

Consequence (A+ B + C + D) X Likelihood (Z) = Significance evaluation score

Table 7.5 a: Significance Level Categories

Impact Significance	Score
Low Negative Significance	**1 - 25**
Medium Negative Significance	**26 - 50**
High Negative Significance	**> 50**
Positive Significance	**< -1**

7.3 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;
- View 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. TL maintenance facilities);

- Operational plans and procedures (e.g. Occupational Health Safety Plans); andthe provision of like-for-like replacement, restoration or compensation.

For negative 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.

7.4 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 the impact that is predicted to remain once mitigation measures have been designed into the intended activity. 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 7.5bis the criteria for residual impact determination. The calculations and formula were established with the assumption that the application of mitigation measures can reduce impact severity, consequence and perception to a lower risk.

Table 7.5 b: 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

7.5 Potential Impacts during initial decommissioningand pre-construction Phase

7.5.1 Impacts on Air Quality

The assessment of potential impacts on air quality, sources, rating criteria and mitigation measures are presented in Table 7.6.

Table 7.6: Impacts on Ambient Air Quality 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><td colspan="2">Impact on Ambient Air Quality</td></tr>
<tr><td rowspan="9">A1: Reduction in ambient air quality
A2: Contribution to global warming</td><td rowspan="9">site preparation (clearing and widening of existing access road to RoW)
transport of materials to site</td><td rowspan="9">▪ Use covered trucks for the transportation of materials that release dust emissions
▪ Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations</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>2</td></tr>
<tr><td>Scale</td><td>2</td></tr>
<tr><td>Frequency</td><td>4</td></tr>
<tr><td>Overall rating</td><td>40</td></tr>
<tr><td>Impact Significance</td><td>Medium</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="5">Mitigation measures</td></tr>
<tr><td colspan="5">• 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</td></tr>
</table>

• Provide and encourage use of PPEs. • Limit vegetal clearing to RoW footprint
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 7.6 will reduce the impact to a minor level.

A2: A small volume ofvegetal biomass shall be generated through widening of existing access roads linking the Old Benin – Sapele road to 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 greenhouse gases such as methane and CO. This impact is rated Medium and the implementation of the mitigation measures in Table 7.6 shall reduce the impact to a minor level.

7.5.2 Impacts on Ambient Noise Level

The assessment of potential impact on noise, sources, rating criteria and mitigation measures are presented in Table 7.7.

Table 7.7: Assessment of Impacts and mitigation measures on ambient Noise impact During Initial Decommissioning and Pre-construction Phases

Impact Statement	**Sources of Impact**	**Mitigation Measures Integrated in Project Design**	Impact on Noise	
NQ1: Increase in ambient noise level and Vibrations	Dismantling of tower foundation Towerdismantling and unstringing of conductors clearing and widening of	▪ Develop a detailed plan that relates to noise control for relevant work practices and discuss this with staff during health & safety briefings	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	1
			Severity	2
			Scale	1
			Frequency	4
			Overall rating	35
			Impact Significance	Medium

	existing access road to RoW Transport of materials to site			
Mitigation measures				
• Select 'low noise' equipment or methods of work • Avoid dropping materials from height, where practicable • Avoid metal-to-metal contact on equipment where possible • Limit work activities to daytime only • Ensure maintenance of vehicles and equipment • Provide and encourage use of PPEs such as earmuffs				
Residual Impact				
Negligible				

Baseline noise levels were within recommended threshold limit for specific receptors which include residential, schools and churches. However, Oviri and Oharhe communities showed levels above regulatory limits. The impact is rated Medium according to the rating criteria adopted and the severity of the receptors indicated in the baseline result. Implementation of the mitigation measures listed above shall reduce the impacts to a **Negligible** status.

7.5.3 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 7.8.

Table 7.8: 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	clearing and widening of existing access road to RoW	• Limit vegetation clearing only to the already existing RoW	Impact criteria	Rating
			Legislature	2
			Stakeholder concern	1
			Severity	3

SQ2: Exposure of soil to erosion	Dismantling of tower foundation Transport of materials to site		Scale	1
			Frequency	5
			Overall rating	35
			Impact Significance	Medium
Mitigation measures				
• Ensure that the land around tower sites is physically restored (include vegetation 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 soil exposed to the elements				
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. This impact is rated Medium according to the criteria in Table 7.8.

S2: Minimal widening of the existing access roads linking the Old Benin-Sapele 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 7.8 will reduce both impacts to Minor.

7.5.4 Impacts on Surface and Groundwater

The potential impact on water resources, sources, rating criteria and mitigation measures are presented in Table 7.9.

Table 7.9: Impacts on water Resources during Initial Decommission and Preconstruction Phase

<table>
<tr><td>Impact Statement</td><td>Sources of Impact</td><td>Mitigation Measures Integrated in Project Design</td><td colspan="2">Impact on water resources</td></tr>
<tr><td rowspan="9">W1: Potential surface and groundwater contamination
W2: Potential groundwater contamination
W3: Sedimentation of streams and Rivers</td><td rowspan="9">Dismantling of tower foundations

Widening of access roads to RoW

Operation and maintenance of preconstruction equipment/machines
Vegetation clearing of the RoW</td><td rowspan="9">• Accidental spills from machine maintenance shall be properly managed</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>4</td></tr>
<tr><td>Overall rating</td><td>32</td></tr>
<tr><td>Impact Significance</td><td>Medium</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="5">Mitigation measures</td></tr>
<tr><td colspan="5">• 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
• Laydown areas shall be designed to include erosion control
• Reclaim as practicable possible the topography of excavated or compacted upland areas uponcompletion of activities
• Install siltation traps within the drainage design to collect silt and sediments ensuringthat they do not end up in adjacent aquatic areas.
• Avoid crossing permanent waterways with machinery; if necessary, locate the crossingwhere the banks are stable and the waterway most narrowareas. .</td></tr>
<tr><td colspan="5">Residual Impact</td></tr>
<tr><td colspan="5">Negligible</td></tr>
</table>

IMPACT DESCRIPTION

W1: Baseline surface water turbidity levels were above regulatory limits at Ethiope River and Ologbo river. Earthworks during tower dismantling will 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. This shall add to the baseline surface water BOD levels at Ethiope and Ologbo rivers which are currently below threshold limits since hydrocarbon utilizing microbes are known to increase BOD levels in water.

W2: Depending on the magnitude of spill, huge accidental spill may seep into groundwater region and contaminate the water source. This shall render 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 6.9 shall reduce the impact to **negligible**

7.5.5 Impacts on Biodiversity

The potential impact on biodiversity, sources, rating criteria and mitigation measures are presented in Table 7.10.

Table 7.10: Biodiversity Impacts during Initial Decommission and PreconstructionPhase

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 optimizationto 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 animals) shall be minimized and restricted to the RoW • Preconstruction equipment shall be optimallymaintained 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 projectfor widening of existing access roads.

B1 (A): Baseline result showed two threatened flora species in the study area. *Cedrala odarata* censored in Evboraria and Okha*and Dalbergia latifolia*censored in Agbarho and Eruemokokowrainewith IUCN vulnerable status are the threatened species censored in the project area.

Similarly, there are thirty-six (36) 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 inthe small reduction in area of the secondary forest. The impact is rated low, 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.**

7.5.6 Impacts on land use

The potential impact on land use, sources, rating criteria and mitigation measures are presented in Table 7.11.

Table 7.11: Land Use Impacts during Initial Decommission and Preconstruction Phase

<table>
<tr><td>Impact Statement</td><td>Sources of Impact</td><td>Mitigation Measures Integrated in Project Design</td><td colspan="2">Impact on landuse</td></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. The existing line was constructed over 30 years ago when there was no awareness of the health and safety issues involving occupying and settling under an existing TL. 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. Some of the communities such as Etete in Benin still have issues in court against the government with this respect. There is need for these PAPs to be properly resettled according to principles and procedures spelt out in an efficient and robust RAP. About 46 households shall be displaced. 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.**

7.5.7 Impacts on Community Infrastructure, Socio-cultural and Health Status

The potential impact on biodiversity, sources, rating criteria are presented in Table 7.12.

Table 7.12: Impacts on Community Socio-cultural and Health Status

<table>
<tr><td>Impact Statement</td><td>Sources of Impact</td><td>Mitigation Measures Integrated in Project Design</td><td colspan="2">Impact on Community Socio-cultural and Health Status</td></tr>
<tr><td rowspan="9">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</td><td rowspan="9">(1) Employment of preconstruction workers
(2) Influx of workers and marketers
(3) Decommissioning works</td><td rowspan="9">Develop a code of behaviors for workers
Funding of local community projects to compensate impacts.</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>3</td></tr>
<tr><td>Overall rating</td><td>21</td></tr>
<tr><td>Impact Significance</td><td>Low</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="5">Mitigation measures</td></tr>
<tr><td colspan="5">• Develop a code of behaviors for workers
• All workers to receive training on community relations and code of behavior
• Employ workers (especially for activities not requiring high skills 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.
• Funding of local community projects to compensate for impacts.
• Carry out enlightenment and awareness campaign among workers on health matters especially on communicable diseases.</td></tr>
<tr><td colspan="5">Residual Impact</td></tr>
<tr><td colspan="5">Negligible</td></tr>
</table>

IMPACT DESCRIPTION

This impact speaks to the TL

SE1 (A), SE1 (B): TCN shall employ about 400decommissioning and 200 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** level.

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 Apapaport in Lagos State to the project laydown area. The major roads in the project area to be impacted include The Benin-Warri express way, the east-west express way, ogorode road and sapele road. 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. Thisimpact has been ranked **Minor**. Implementation of the impacts shall reduce these impacts to **Negligible.**

7.5.8 Impacts on Traffic and Safety

The potential impact on **Traffic and Safety**, sources, rating criteria and mitigation measures are presented in Table 7.13.

Table 7.13: Impacts on Traffic and Safety

<table>
<tr><th>Impact Statement</th><th>Sources of Impact</th><th>Mitigation Measures Integrated in Project Design</th><td colspan="2">Impact on Traffic and Safety</td></tr>
<tr><td rowspan="9">SE1 (E): Risk of Accidents to locals
SE1 (F): Traffic congestion</td><td rowspan="9">Transportation of materials on-site and wastes offsite
Transport of decommissioned materials offsite</td><td rowspan="9">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),</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>3</td></tr>
<tr><td>frequency</td><td>5</td></tr>
<tr><td>Overall rating</td><td>60</td></tr>
<tr><td>Impact Significance</td><td>High</td></tr>
<tr><td colspan="5">Mitigation measures</td></tr>
</table>

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. Prepare and implement a Journey Management Guide (JMG) for the project. An awareness program for truck drivers to speed limits and other precautionary
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 includes access road to Benson Idahosa University. This impact is with rated **Medium** significance, and implementation of the mitigation measures shall reduce the impact to a Minor Level.

7.5.9 Impacts on Employment and Opportunities

The potential **impact on Employment and opportunities**, sources, rating criteria and mitigation measures are presented in Tables 7.14.

Table 7.14: 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	Prepare a local content plan to facilitate identification and selection of qualified local and Nigerian companies to	Impact criteria	Rating
			Legislature	
			Stakeholder concern	

	Access road widening Tower dismantling and unstringing Dismantling of existing tower foundations Employment of workers	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	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 theentire 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 ofthe transmission line facilities. This is a positive impact and as such does not require mitigation. The enhancement measures are stipulated in Table 7.15.

7.6 Construction Phase Impacts and Mitigation Measures

7.6.1 Impacts on Ambient Air Quality

The potential impact on **Ambient Air Quality**, sources, rating criteria and mitigation measures are presented in Table 7.15.

Table 7.15: Impacts on Ambient Air Quality

<table>
<tr><th>Impact Statement</th><th>Sources of Impact</th><th>Mitigation Measures Integrated in Project Design</th><td colspan="2">Impact on Ambient air quality</td></tr>
<tr><td rowspan="9">AQ1 (A): Reduction in ambient air quality

AQ1 (B): Dust emission from land preparation and vehicle movements

AQ1 (C) Impact on climate change</td><td rowspan="9">Operation of construction equipment and machine

Transportation and traffic</td><td rowspan="9">Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations
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</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"></td></tr>
<tr><td colspan="5">Mitigation measures</td></tr>
<tr><td colspan="5">• 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</td></tr>
</table>

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 hydrocarbonand 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 Table7.15 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 tons (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 7.16.

Table 7.16: 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	**60.91**		**703,434.77**
Construction	955.8	Emissions in Table 4.16 and 4.17	104,539
	1016.71		807,973.8
Total **GHG Footprint**	**808,990.5**		
Project predicted to reduce GHG emissions by 4.8% in the project area	**4.8 x 1016.71/100**		**48.8**

Net **$MTCO_2$ Equivalence**	808,941.68	

See Chapter 4 for detailed calculation 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.

7.6.2 Impacts on Ambient Noise Level

The potential impact on **Ambient Noise Level**, sources, rating criteria and mitigation measures are presented in Table 7.17.

Table 7.17: Impacts on Ambient Noise Level

<table>
<tr><th>Impact Statement</th><th>Sources of Impact</th><th>Mitigation Measures Integrated in Project Design</th><td colspan="2">Impact on Ambient noise level</td></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>
</table>

Minor

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; Ethiope west, Okpe, Sapele, Ugheli north, Uvwie and Ikpoba okha 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.

7.6.3 Impacts on Soil and Geology

The potential impact on **Soil and Geology**, sources, rating criteria and mitigation measures are presented in Table 7.18.

Table 7.18: 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 from inadvertent release of hazardous or contaminating	Creation of tower foundation Erection of tower	Ensure that the land is physically restored (include re vegetation where possible) before leaving to next tower location	Impact criteria	Rating
			Legislature	2
			Stakeholder concern	1
			Severity	3
			Scale	1
			Frequency	5
			Overall rating	35

material (liquid fuel, solvents, lubricants, aluminum oxide paint, etc.			Impact Significance	Medium
Mitigation measures				
• 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 leaving to next tower location and before the next rainy season. • 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. • 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 forhandling and disposing of these wastes to be generated play an important role in thesignificance of impacts expected from wastes management. Waste handling and disposalhave 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.

7.6.4 Impacts on Water Resources

The potential impact on Water Resources, sources, rating criteria and mitigation measures are presented in Table 7.19.

Table 7.19: Impacts on Water Resources

<table>
<tr><th>Impact Statement</th><th>Sources of Impact</th><th>Mitigation Measures Integrated in Project Design</th><td colspan="2">Impact on Water Resources</td></tr>
<tr><td rowspan="9">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="9">Operation and maintenance of construction machines and equipment
Deepen foundations of transmission towers in areas prone to landslide</td><td rowspan="9">Rivers and streams shall not be dammed for the purpose of water abstraction</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">• Use of trained workers - for what purpose?
• Rivers and streams shall not be dammed for the purpose of water abstraction
• 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</td></tr>
</table>

• 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 waterresources 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 waterbodies, especially during rain events. This shall likely add to the baseline surface water Turbidity levels which are above threshold limits Baseline surface water turbidity levels were above regulatory limits at Ethiope river and Ologbo river. 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 BOD levels since hydrocarbon utilizing microbes are known to increase BOD 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. Baseline groundwater Iron and lead concentrations were below WHO regulatory limit at Benin, Ugheli and Sapele substations. 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 arerated **Medium** and implementation of the mitigation measures listed above shall reduce impacts to **Minor status.**

7.6.5 Impacts on Aquatic species

The potential impact on Aquatic species, sources, rating criteria and mitigation measures are presented in Table 7.20.

Table 7.20: Impacts on Aquatic species

<table>
<tr><th>Impact Statement</th><th>Sources of Impact</th><th>Mitigation Measures Integrated in Project Design</th><td colspan="2">Impact on Aquatic biota during construction</td></tr>
<tr><td rowspan="8">AS 1: Loss/disturbance of aquatic species</td><td rowspan="8">Tower erection
Transport and traffic</td><td rowspan="8">Natural flow of a River shall not be blocked</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>2</td></tr>
<tr><td>Frequency</td><td>5</td></tr>
<tr><td>Overall rating</td><td>45</td></tr>
<tr><td>Impact Significance</td><td>Medium</td></tr>
<tr><td colspan="5">Mitigation measures</td></tr>
<tr><td colspan="5">• 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 waterbodies, 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 waterbodies. 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</td></tr>
</table>

• Maintain vegetated buffer zones within and around rivers and along both sides of watercourse crossings. • Complete project timely to allow for speedy recovery of the ecosystem from the ipact
Residual Impact
Minor

This impact speaks to the TL

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 ofduration and is ranked at a medium significance level. Implementation of the mitigation measures is predicted to reduce the impact to Minor.

7.6.6 Impacts on Biodiversity

The potential impact on**Biodiversity**, sources, rating criteria and mitigation measures are presented in Table 7.21.

Table 7.21: Impacts on Biodiversity

<table>
<tr><td>Impact Statement</td><td>Sources of Impact</td><td>Recommendation Measures Integrated in Project Design</td><td colspan="2">Impact on Biodiversityduring construction</td></tr>
<tr><td rowspan="8">B2(A): Further migration of fauna species as a result of construction noise
B2 (B): Introduction of invasive and alien species</td><td rowspan="8">Construction of tower foundation
Transport and traffic</td><td rowspan="8">Re-vegetation shall be done using native species for erosion control</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>1</td></tr>
<tr><td>Scale</td><td>1</td></tr>
<tr><td>Frequency</td><td>2</td></tr>
<tr><td>Overall rating</td><td>14</td></tr>
<tr><td>Impact Significance</td><td>Low</td></tr>
<tr><td colspan="5">Mitigation measures</td></tr>
<tr><td colspan="5">• 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</td></tr>
</table>

• 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 befaunal 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. Thisimpact 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* 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.

7.6.7 Community Agitation

The potential impact on**Community Agitation**, sources, rating criteria and mitigation measures are presented in Table 7.22.

Table 7.22 Impacts on Community Agitation

<table>
<tr><th>Impact Statement</th><th>Sources of Impact</th><th>Mitigation Measures Integrated in Project Design</th><td colspan="2">Impact on community agitation during construction</td></tr>
<tr><td rowspan="8">CA1: Agitation by locals linked to compensation</td><td rowspan="8">Construction activities</td><td rowspan="8">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>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 is paid to identify 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</td></tr>
</table>

• 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 • Maintain consultation with relevant stakeholders throughout the life cycle of the project
Residual Impact
Minor

After ROW acquisition by the proponent, there is tendency for agitations by some groupsof people or individuals over non-satisfactory engagement and compensations over landand 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 neighboring 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** level

7.6.8 Impacts on Socio-economic

The potential impact on**Socio-economic**, sources, rating criteria and mitigation measures are presented in Tables 7.23, 7.24, 7.25 and 7.26.

Table 7.23: 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 behaviors 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 behaviors for workers • All workers to receive training on community relations and code of behavior • 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 is 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 managedis 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 ofHIV/AIDS. This impactif left unmanaged may result in long term health issues which may eventually lead tofatality. Impact arising from this is ranked as **High**. Application of the mitigation measures would reduce the impact to a **Minor** level.

Table 7.24 is an assessment of Socio-economic impacts on existing social infrastructure of the project are expected to occur during the construction phase.

Table 7.24: Impacts on Socio-infrastructure

<table>
<tr><th>Impact Statement</th><th>Sources of Impact</th><th>Mitigation Measures Integrated in Project Design</th><td colspan="2">Impact on Socio-infrastructure</td></tr>
<tr><td rowspan="8">SE2 (D): Pressure on existing social infrastructure</td><td rowspan="8">Influx of outside workers</td><td rowspan="8">Funding of local community projects to compensate for impacts</td><td>Impact criteria</td><td>Rating</td></tr>
<tr><td>Legislature</td><td>1</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>5</td></tr>
<tr><td>Overall rating</td><td>25</td></tr>
<tr><td>Impact Significance</td><td>Low</td></tr>
<tr><td colspan="5">Mitigation measures</td></tr>
<tr><td colspan="5">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 consultation with Community members</td></tr>
<tr><td colspan="5">Residual Impact</td></tr>
<tr><td colspan="5">Negligible</td></tr>
</table>

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 7.25 is anassessment of Socio-economic impacts on road accidents, kidnappings and traffic congestion.

Table 7.25: Impacts on accidents, kidnappings and traffic congestion

<table>
<tr><th>Impact Statement</th><th>Sources of Impact</th><th>Mitigation Measures Integrated in Project Design</th><td colspan="2">Impact on accidents, kidnappings banditry and traffic congestion</td></tr>
<tr><td rowspan="8">SE2 (E): Risk of road Accidents and Kidnapping
SE2 (F): Traffic Congestion</td><td rowspan="8">Transportation of materials on-site</td><td rowspan="8">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</td><td>Impact criteria</td><td>Rating</td></tr>
<tr><td>Legislature</td><td>1</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>5</td></tr>
<tr><td>Overall rating</td><td>25</td></tr>
<tr><td>Impact Significance</td><td>Low</td></tr>
<tr><td colspan="5">Mitigation measures</td></tr>
<tr><td colspan="5">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-upareas) and 10-30km/hr. (construction sites);
• Consultation and good public relation with the stakeholder communities.</td></tr>
</table>

• Ensure government approved security personnel is used on transport vehicles andboats 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 shortesttime 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 implement JMG for the trained drivers and supervisors
Residual Impact
Negligible

.

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 includes road to Benson Idahosa University on RoW and The Benin- Warri express way. This impact is rated **Medium** significance, and implementation of the mitigation measures listed shall reduce the impact to a Minor Level.

7.6.9 Impacts on Employment and Opportunities

The potential on **impact on Employment and opportunities**, sources, rating criteria and mitigation measures are presented in Tables 7.26.

Table 7.26: Impacts on Employment and Opportunities

Impact Statement	**Sources of Impact**	**Enhancement Measures Integrated in Project Design**	Impact on impact on Employment and opportunities	
			Impact criteria	Rating

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	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 willprovide an immediate positive impact on the employment and income situation at the levelof 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 ofthe 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 of employment**, sources, rating criteria and mitigation measures are presented in Tables 7.27.

Table 7.27: Impacts on loss of employment

<table>
<tr><td>Impact Statement</td><td>Sources of Impact</td><td>Mitigation Measures Integrated in Project Design</td><td colspan="2">Impact on loss of employment</td></tr>
<tr><td rowspan="8">SE2 (J): Loss of employment</td><td rowspan="8">Demobilization on completion of construction</td><td rowspan="8">Organize career development workshops, skills acquisition and enhancement</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>1</td></tr>
<tr><td>Scale</td><td>1</td></tr>
<tr><td>frequency</td><td>5</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">• 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</td></tr>
<tr><td colspan="5">Residual Impact</td></tr>
<tr><td colspan="5">Low</td></tr>
</table>

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

7.6.10 Visual Impacts

The potential on **Visual Impacts**, sources, rating criteria and mitigation measures are presented in Table 7.28.

Table 7.28: Assessment of Visual Impacts

<table>
<tr><th>Impact Statement</th><th>Sources of Impact</th><th>Mitigation Measures Integrated in Project Design</th><td colspan="2">Impact on Visual Impacts</td></tr>
<tr><td rowspan="8">VI 1: Visual effects</td><td rowspan="8">Installation of towers</td><td rowspan="8">Rehabilitate disturbed areas around pylons as soon as practically possible after construction. This should be done to restrict extended periods of exposed soil.</td><td>Impact criteria</td><td>Rating</td></tr>
<tr><td>Legislature</td><td>0</td></tr>
<tr><td>Stakeholder concern</td><td>1</td></tr>
<tr><td>Severity</td><td>1</td></tr>
<tr><td>Scale</td><td>3</td></tr>
<tr><td>frequency</td><td>5</td></tr>
<tr><td>Overall rating</td><td>60</td></tr>
<tr><td>Impact Significance</td><td>Low</td></tr>
<tr><td colspan="5">Mitigation measures</td></tr>
<tr><td colspan="5">• 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</td></tr>
<tr><td colspan="5">Residual Impact</td></tr>
<tr><td colspan="5">Negligible</td></tr>
</table>

VI 1: Aesthetic impacts during the construction phase will be limited to work zones. Deforestation of the ROW will change the landscape in rural areas. The area already has many existing transmission lines as well as many telecommunication towers adorn the skyline, the changes in the landscape is not likely produce significant impacts in most areas. These areas are not known to have special landscape values. Setting up of tower may create visual intrusion by altering the normal landform pattern along the ROW. Since no construction camp will be required, domestic waste will be limited to waste generated from construction workers. 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.

7.6.11 Impacts 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 7.29.

Table 7.29: Assessment of Impacts on workplace Health and Safety

<table>
<tr><th>Impact Statement</th><th>Sources of Impact</th><th>Mitigation Measures Integrated in Project Design</th><td colspan="2">Impact on workplace Health and Safety</td></tr>
<tr><td rowspan="9">HS1: Risk of workplace accidents and hazards</td><td rowspan="9">Tower erection
Earthwork
Tower stringing
Establishment of tower foundation</td><td rowspan="9">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.</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>Impact Significance</td><td>High</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="5">Mitigation measures</td></tr>
<tr><td colspan="5">• 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</td></tr>
</table>

• 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 • ·esign 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 seriousinjury or result in loss of lives and damage to properties and the environment. Flammablesubstances including diesel and motor oil may be stored or used on the project site forheavy-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.

7.7: Operation Phase Impacts and Mitigation Measures

7.7.1 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 7.30.

Table 7.30: 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. 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 such as Ikpoba okha, Itupe, Ugheli, Uvwie, Sapele, Ethiope-west, Okpe and Ugheli-north. Other communities likely to be affected are those whose baseline noise levels exceeded WHO regulatory limit.

Overall, noise-related impacts during the operation phase is ranked medium, with implementation of mitigation measures, impacts on noise shall reduce to **Negligible** Status.

7.7.2 Impacts on Soil and Geology

The Assessment of the potential impacts on **Soil and Geology**, sources, rating criteria and mitigation measures are presented in Tables 7.31.

Table 7.31: 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,	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, soilstructure etc.	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	1
			Severity	3
			Scale	1
			frequency	2
			Overall rating	16
			Impact Significance	Low

aluminum oxide paint, etc.				
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, though 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.

7.7.3 Impacts on Socio-economic

The Assessment **of** the potential impacts on **Socio-economic**, sources, rating criteria and mitigation measures are presented in Tables 7.32.

Table 7.32: 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.	Electric power transmission using the installed lines after	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	Impact criteria	Rating
			Legislature	
			Stakeholder concern	
			Severity	
			Scale	

SE3 (B): Development of new infrastructures or improvement to existing ones.	commissioning	laws on power transmission and distribution	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 Tables 7.33.

Table 7.33: Impacts on RoW Encroachment

Impact Statement	**Sources of Impact**	**Mitigation Measures Integrated in Project Design**	Impact on RoW Encroachment	
SE3 (C): Unchecked encroachment on the ROW, leading to land-use conflicts and accident	Electric power Transmission using the installed lines after commissioning.	consultations, sensitize stakeholders and members of the communities on government policies along established ROW	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	2
			Severity	3
			Scale	1
			frequency	3
			Overall rating	27

			Impact Significance	Medium
Mitigation measures				
Provide warning signs at access roads to warn against unauthorised entry Through consultations, sensitize stakeholders and members of the communities on government policies along established ROW				
Residual Impact				
Low				

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**

7.7.4 Impact on Biodiversity

The Assessment **of** the potential impacts on **Biodiversity**, sources, rating criteria and mitigation measures are presented in Tables 7.34.

Table7.34 Impacts on Biodiversity

Impact Statement	**Sources of Impact**	**Mitigation Measures Integrated in Project Design**	Impact on Biodiversity	
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	Electric power Transmission using the installed lines after commissioning Tower inspection and checks Line element replacements	Develop policies that prohibiting hunting by staffs	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	2
			Severity	3
			Scale	3
			frequency	2
			Overall rating	22
			Impact Significance	Low

	RoW maintenance			
Mitigation measures				
• TCN shall assure during transmission line component testing that national and international standard and limitsare 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 grassland during construction and operation should be kept to a minimum. • Develop policies that prohibiting hunting by staffs				
Residual Impact				
Negligible				

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 notto spend prolonged periods under the transmission lines due to the electric magnet fields. In the majority of situations, the faunal species will simply move into the large expanses ofnearby 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 25m to 50m 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.

Apus affinis was 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 are 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**.

7.7.5 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 Tables 7.35.

Table 7.35: 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><td colspan="2">Impact on Health, Safety and security</td></tr>
<tr><td rowspan="8">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="8">Operation of TL Transmission line maintenance</td><td rowspan="8">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>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</td></tr>
</table>

• Use trained Staff in TL maintenance
Residual Impact
Medium

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. T**he line route was selected to avoid dense areas, and implementation of the mitigation measures in the Table above shall reduce the impact to **Negligible.**

7.7.6 Impact on Surface Water Quality

The Assessment **of** the potential impacts on **Surface water quality**, sources, rating criteria and mitigation measures are presented in Tables 7.36.

Table 7.36: 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	Impact criteria	Rating
			Legislature	3
			Stakeholder concern	2
			Severity	3
			Scale	2
			Frequency	2
			Overall rating	20

		erosion due to steep slopes, soil structure etc.	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.

7.8 Decommissioning Phase Impacts and Mitigation Measures

The decommissioning phase refers to all the activities which relate to the proposedtransmission line when it is no longer in use. Potential issues that relate to thedecommissioning 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 similarimpacts on the environment as were identified for the construction phase. These includepotential impacts such as sedimentation, surface water, visual impact, dust and noisepollution, 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 withpractices 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 thetime of decommissioning.
- Ensure that excavated and stockpiled soil material is stored and bermed on the higherlying areas along the site and not in any run-off channels where it is likely to causeerosion.
- Decommissioning activities should preferably take place during the dry season monthsto 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, heavymachinery/trucks.
- The decommissioning contractor as at the time of decommissioning will have todevelop a decommissioning security plan and implement its use.
- Ensure effective waste management from cradle to grave for all wastes generatedduring 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 anddrivers
- Implementation of the above measures reduces the impacts from to negligible.

7.9 Cumulative Impacts

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).

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.

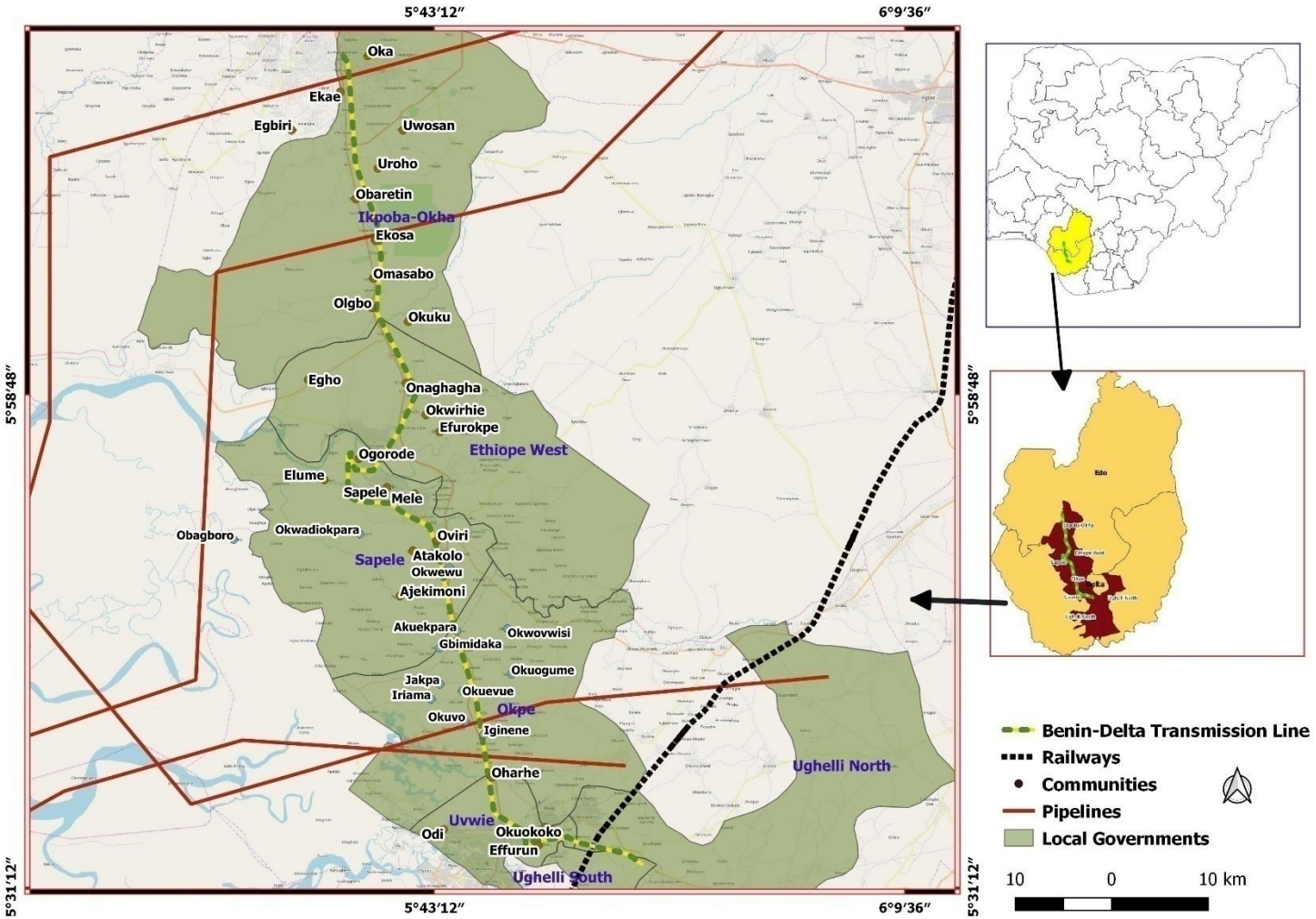


Figure 7.1: Existing projects within 5km either side of TL

The following proposed and existing projects within 5km on either side of the RoW are expected to exert cumulative impacts. They are;

- Construction activities at Benson Idahosa University at Okha
- Pan ocean oil field and company
- Seplat oil field and company
- Truck park at Effrun
- Construction activities at Federal university of petroleum resources at Ugbomoro

However, there are no known transmission project that is ongoing in the project area

Cumulative Impacts

Air Quality and Noise: Given the findings of impact assessment and distance of the TL from settlements, it appears unlikely that the cumulative impact on noise and air quality will not be significant. 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 EIGHT
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

8.0 Introduction

This chapter provides the ESMP for the Benin - Delta (Ugheli) 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 prepared 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 during construction and operation phases of the project 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, impact is found to be higher than initially predicted, additional mitigation measures shall be implemented to control, reduce or prevent an impact from occurring. Therefore, the ESMP is a 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.

8.1 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).

8.2 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-PIU, the TCN and the contractors. These are represented in Figure 8.1.

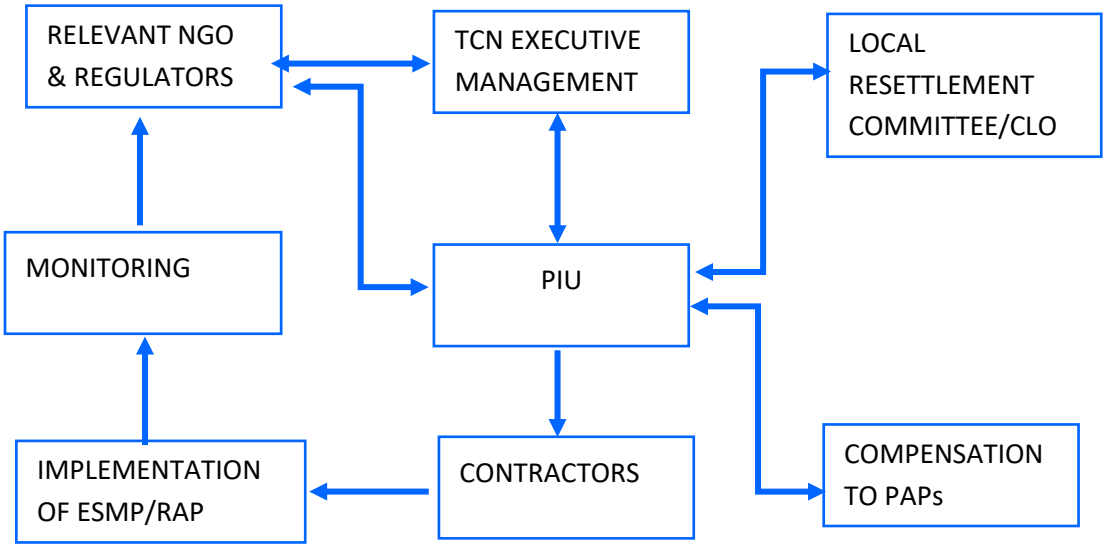


Figure 8.1 : Institutional Arrangements for the implementation of ESMP of the Benin - Delta (Ugheli) 330kV Transmission Line project

Figure 8.2 is the organogram for TCN-AfDB PIU.

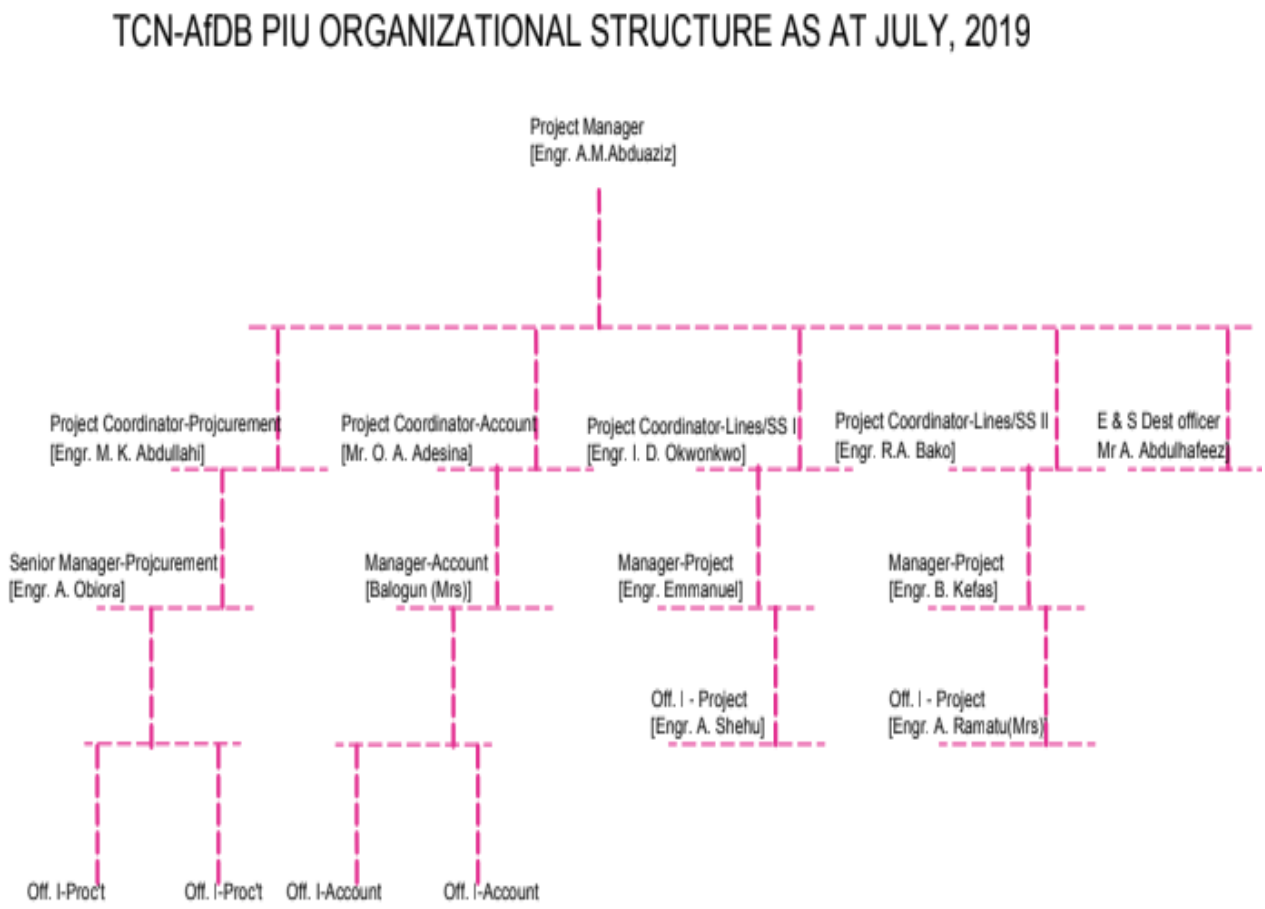


Figure 8.2 : TCN-AfDB PIU Organogram

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.
- TCN 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 8.2 and 8.3.

- 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.

8.2.1 Project Proponent (TCN)

TCN is the implementation agency for this project. Hence, has the overall responsibility for its success. The PIU for the AfDB projects has been established by the TCN Management to handle this responsibility. The PIU is headed by a Project Manager who reports the General Manager, Programs.

8.2.2 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, substation operations, procurement, planning, etc.

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.

8.2.3 TCN HSE Department

The HSE department 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.

8.2.4 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 (Edo and Delta States) and affected LGAs, Ethiope-west, Ikpoba-okha, Oredo, Sapele, Uvwie, Udu, Ugheli south, Ugheli north 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 8.1 below.

Table 8.1: Responsibilities of Agencies and Other Concerned Authorities

Concerned ministries	Competent authorities	Project implementation unit (PIU),	TCN and the contractors
Federal Ministry of Environment, Edo State Ministry of Environment and Public Utilities Edo state Ministry of Lands and Survey	Federal Government of Nigeria Edo State Ministry of Environment and Public Utilities Edo state Environmental and Waste Management Board (EEWMB)Edo State Ministry of Transport	AfDB Project Implementation Unit (PIU)	Transmission Company of Nigeria Local Government Area Representatives

Delta state Ministry of Environment	Edo State Ministry of Women Affairs and Social Development Edo state Ministry of Physical Planning and Urban Development Delta state Ministry of Environment Delta State Ministry of Land Survey and Urban Development Delta State Ministry of Women Affairs Delta State Ministry of Transport Delta state Waste Management Board (DWMP) Delta state Ministry of Works Local Government Authority (LGA) Village chiefs of affected Communities		

The responsibilities and roles of each of the institutions are discussed below.

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.

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 implementation and approval, 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.

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 Sub-stations.

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 Benin - Ugheli 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.

Edo State Ministry of Environment and Public Utilities

The Edo state Ministry of Environment (ESMEPU) executes programs relating to control of draughts, desertification, flood, erosion and management of forests estate in Edo State.

- Department of Administration & Supplies are involved in the management, co-ordination and facilitation of the activities of other Departments.
- Department of Environmental Conservation & Resources Management: is responsible for environmental Sanitation, landscaping and beautification, environmental and natural resources

conservation, meteorological services, water shed management and water quality monitoring, climate change, etc.

- Department of Planning, Research & Statistics: plan, undertake research and gather data or information which will allow the Ministry to grow and develop.
- Department of Finance & Accounts: responsible for budgeting and other financial management responsibilities.
- Department of Flood & Erosion Control: Management of flood and erosion issues, including planning, designing, and construction and maintenance of control structures.

Edo State Ministry of Physical Planning and Urban Development (EMPPUD)

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 centersin the state. The Bureau has Edo State Urban Planning and Development Authority (ENUPDA) 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
- Sub-division and private layout
- Merger of land titles
- Renewal of land ownership (Re-grant)
- Provision of search reports on request
- Conversion of land titles
- Non-urban services (planning recommendation, building plan approval)
- Geographical information services
- Project management of metropolitan and other Urban Roads
- Conflict management and arbitration.

Edo State Environmental and Waste Management Board/ Delta State Waste Management Board

The Boards of both statesare responsible for the public administrative duties related to waste management, such as deciding on the municipal waste tariff and the waste treatment system.

he authorities issue waste permits to smaller operations, including the storage of hazardous waste and end-of-life vehicles. They also accept notifications of professional waste carriers in the waste management register. As part of the ESMP, the ministry will be fully engaged in the monitoring process as regards to waste management especially during the construction phase of the project.

Edo State Ministry of Transport/Delta State ministry of transport

The ministries functions to perform the state management of road, rail, inland waterway, sea and air transport, and of public services according to law; including policies, regulations and standards in the transportation sector; perform state management of transport infrastructure, transport vehicles, training driver of vehicles, transport services management, traffic safety, environmental protection, international cooperation and science & technology in the field of transport. As part of the ESMP, the ministry will be fully engaged in the monitoring process as regards to traffic, especially during initial TL decommissioning and during the construction phases of the proposed project.

Delta State Ministry of Environment

Delta State Ministry of Environment is charged with the obligation of developing and creating environmental policies, environmental protection and control, environmental technology including efficient implementation of research and development.

Delta State Ministry of Women/Edo State Ministry of Women Affairs and Social Development

The responsibilitiesof the Ministries in both states are majorly:

- To promote Gender Equality and provide Empowerment facilities for Socio-economic Development
- To promote the survival, protection, participation and development of children
- To promote family harmony and reduce juvenile delinquency
- To provide care, support, rehabilitation and empowerment for the vulnerable groups (challenged persons, older persons, destitute and the likes)

- To collaborate and network with Non-Governmental Organizations, Professional Institutions and other MDAs on issues affecting women, children/vulnerable ones.

Delta State Ministry of Land Survey and Urban Development (DMLSUD)

The Ministryis vested with the authority of land administration in the state. It is an offshoot of Benin provisional land office which passed series of transformations. In 1963, the Ministry of Lands was established as a division in the ministry of works and survey. In 1968, the Commissioner empowered the division to approve applications for consent in cases of assignments, mortgages and sub-leases as well as sign certificates of occupancy. This division gave birth to the ministry of land and survey in 1975 as an autonomous entity. It became a directorate in 1983 under the office of the Governor. Finally, it attained its present status in July 1999.

Local Government Areas (LGAs)

The project will pass through twelve LGAs, two in Edo State –Oredo, Ikpoba-Okha and seven in Delta State-Uvwie, Ugheli-South, Ugheli-North, Sapele, Ethiope-West, Okpe, and Udu. 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 as several villages under them. The Oba's and Obi'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.

8.3 Responsibilities for Implementation and Monitoring of Mitigation Measures

Table 8.2 presents responsibilities for implementation and monitoring of mitigation measure during initial decommission, preconstruction and construction phases.

Table 8.2: Responsibilities for Implementation and Monitoring of Mitigation Measure during Initial Decommission, Preconstruction 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, 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, EDMEPU and DSMEnv
	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 • Spray surfaces prior to excavation • Use covered trucks for the transportation of materials that release dust emissions	Negligible	EPC Contractor	AfDB-PIU	FMENV, EDMEPU and DSMEnv

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				• 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	Minor	EPC Contractor	AfDB-PIU	FMENV, FMENV, EDMEPU and DSMEnv
Noise, vibration & EMF	Nuisance noise from construction activités	Affected communities in area of influence Construction workers	Moderate	Use good international practice: • 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 • 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	Minor	EPC Contractor	AfDB-PIU	FMENV, EDMEPU and DSMEnv

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				• 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 • 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 leaving to next tower location and before the next rainy season.	Minor	EPC Contractor	AfDB-PIU	FMENV, EDMEPU, EMPPUD and DSMEnv.DMLSUD

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				• 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, aluminum oxide paint, etc.)	Soil on construction site, especially by each tower	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. • Install oil/water separators and silt traps before effluent, leaves the site. • Minimize bare ground and stockpiles to avoid silt runoff.	Negligible	EPC Contractor	AfDB-PIU	FMENV, EDMEPU and DSMEnv
				• Bonding 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.		EPC Contractor	AfDB-PIU	FMENV, EDMEPU and DSMEnv

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				• 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 cleanup techniques. • 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 ground water-well and bore hole	Moderate	See above measures to mitigate 'Potential contamination of soil' impact	Negligible	EPC Contractor	AfDB-PIU	FMENV, EDMEPU and DSMEnv
	Exploitation of water resources	Rivers and stream	Minor	Rivers and streams shall not be dammed for the purpose of water abstraction	Negligible	EPC Contractor	AfDB-PIU	FMENV, EDMEP

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	(e.g. casting of foundations) sourced from nearby water bodies through tanks	s crossed						U and DSMEnv
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	• 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 • 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 • Implementation of the invasive species management plan as part of	minor	EPC Contractor	AfDB-PIU	FMENV, EDMEPU and DSMEnv

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				the Vegetation Management Plan presented in Chapter 7. • Retention of native species where possible along the line route. • Clearing should be minimized and restricted to the area required for construction purposes only and disturbance to adjacent vegetation communities and/or remnant trees within the corridor should be strictly controlled. • 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 EDME and EDME				
	Loss of species that offer Provisioning Services		minor	• Site clearance activities to be restricted to the minimum required area.	Minor	EPC Contractor	AfDB-PIU	FMENV, EDMEPU and DSMEnv
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	minor	EPC Contractor	AfDB-PIU	FMENV, EDMEPU and DSMEnv

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				disturbance of sensitive shoreline and wetland areas • 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. • Prohibit construction of permanent access roads along riverbanks, in swamps or in areas where soils are saturated • Maintain vegetated buffer zones within and around wetlands and along both sides of watercourse crossings. Restore as soon as possible any disturbed areas in the riparian buffer zone.				

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				• Dismantle temporary access roads built for construction phase in swamps and wetland areas. Perform this dismantlement during the dry season and dispose of materials outside wetland areas; • 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 lay down areas.	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, EDMEPU, EMPPU Dand DSMEnv.DMLSUD
Land planning and use	Change in land use cause by land take for towers,	Land on the RoW	Moderate	• Site clearance activities to be restricted to the minimum required area. • Provision of predefined route, barriers or boundary markings	Minor	EPC Contractor	AfDB-PIU	FMENV, EDMEPU, EMPPU D and

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	vegetation clearance, and access restriction			to prevent incursion of machinery and workers into neighboring areas See below measures under 'Resettlement'				DSMEnv .DMLSUD
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, noise/vibration, etc.) and adverse impact/inconveniencies resulting from it. In addition, dealing with community/st	Affected communities in area of influence	Moderate	Follow mitigation for construction phase air quality, noise and traffic.	Moderate	EPC Contractor	AfDB-PIU	FMENV, EDMEPU and DSMEnv, EMWASD, DMWA
				Inform communities about details of construction activities (e.g., employment opportunities, schedule, timing of noise activities, traffic including movements of oversized loads) by billboards, posters and community meeting		EPC Contractor	AfDB-PIU	FMENV, EDMEPU, EMT, DMT
				Set-up and effectively monitor construction grievance mechanism		EPC Contractor	AfDB-PIU	FMENV, EDMEPU and DSMEnv
				Sharing of independent monitoring reports of all monitoring actions during construction as mentioned in this ESMP.		EPC Contractor	AfDB-PIU	FMENV, EDMEPU and DSMEnv
				Engage communities in the monitoring activities to enhance transparency and involvement.		EPC Contractor	AfDB-PIU	FMENV, EDMEPU and DSMEnv

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	akeholder perceptions around cumulative impacts linked to the new plant and transmission lines operations.			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		EPC Contractor	AfDB-PIU	FMENV, EDMEPU and DSMEnv
	Management of legacy issues on account of environmental pollution from stakeholder concerns around existing transmission lines.			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, EDMEPU and DSMEnv
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 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	Negligible	EPC Contractor	AfDB-PIU	FMENV, EDMEPU and DSMEnv

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				people living close to the construction site.				
	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, EDMEPU and DSMEnv
				Develop a code of behaviors 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, EDMEPU and DSMEnv
	Potential for increase in prevalence of sexually transmitted diseases in local communities and other diseases	Affected communities in area of influence	Minor	Provide STD awareness material to all workers. Provide condoms to workers.	Negligible	EPC Contractor	AfDB-PIU	FMENV, EDMEPU and DSMEnv

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
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, EDMEPU and DSMEnv
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. • 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 labors (workers under age 18) or forced labour. • Provisions to ensure compliance with labour standards by supply chain	Negligible	EPC Contractor	AfDB-PIU	FMENV, EDMEPU and DSMEnv

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				and subcontracts, including training if required. • Provide proper workplace 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 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, EDMEPU and DSMEnv
	Risk of health & safety incidents amongst labour force, including minor incident's such as cuts and major incidents	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, EDMEPU and DSMEnv

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	such as loss of life							
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, EDMEPU and DSMEnv
	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, EDMEPU and DSMEnv
Infrastructure	Influx of outside workers may pose additional pressure on social infrastructure, like medical	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, EDMEPU and DSMEnv
				Install proper and independent facilities at construction site for water supply, sanitation, solid and liquid waste, so that		EPC Contractor	AfDB-PIU	FMENV, EDMEPU and DSMEnv

Indicator	Potential impact	Receptor	pre-mitigation Significance	Mitigation or enhancement measures	post-mitigation Significance	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	posts, emergency services, water supply, solid waste management			pressure on community infrastructure is limited.				
Cultural heritage	shrines are located within the RoW along the transmission line and need to be relocated.	Affected communities-	Minor	The shrines will be relocated to outside the RoW, where the local communities will continue to use them. The exact location and ceremony for relocation will be managed by the communities	Negligible	EPC Contractor	AfDB-PIU	FMENV, EDMEPU and DSMEnv
	Potential interactions between construction works and cultural festivals due to traffic, noise and/or vibration impacts	Affected communities along the RoW	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, EDMEPU and DSMEnv

Table 8.3: Responsibilities for Implementation and Monitoring of Mitigation Measure (Operations Phase)

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
Air quality	Exposure to emissions from vehicles (PM10, NO_2/NOx, Sox) very limited as very little traffic	Workers on site, communities in area of influence	Negligible	NA	Negligible	NA	NA	NA
	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	Negligible	NA	Negligible	NA	NA	NA
Climate Change:	Accidental significant leaks of SF_6 from aging equipment, and gas losses occur during	Affected communities in area of influence	Minor	Impact of SF_6 shall be mitigated through the improvements in the leak rate of new equipment, refurbishing older	Minor	TCN Lines Operations	AfDB -PIU	FMENV, EDMEPU and DSMEnv

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	equipment maintenance and servicing			equipment, and the use of more efficient operation and maintenance techniques.				
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 Lines Operations	AfDB -PIU	FMENV, EDMEPU and DSMEnv
Soils, geology and land-use	Potential contamination of soil from inadvertent release of hazardous or contaminating material	Soil along RoW of TL	Negligible	NA	Negligible			FMENV, EDMEPU and DSMEnv
Water resources	Contamination of surface water	Affected communities	Negligible	NA	Negligible			FMENV, EDMEPU and DSMEnv

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
		in area of influence						
Terrestrial ecology	Avian collision	Birds in the area of influence	**Moderate**	"Bird diverters" on the top (ground) wire to make the lines more visible to birds shall be installed. Installation on both 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	**Minor**	EPC Contractor	AfDB **-PIU**	FMENV, EDMEPU and DSMEnv

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	Loss of vegetation due to routine clearance of vegetation	Flora and fauna within the RoW	Negligible	NA	Negligible			
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 in rivers, floodplains and wetland areas.	Negligible	TCN Lines Operations	AfDB -PIU	FMENV, EDMEPU and DSMEnv

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
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 Lines Operations	AfDB -PIU	FMENV, EDMEPU and DSMEnv
Stakeholder and Community expectation/relations Management	Management of Community concerns linked to impacts associated with	Affected communities in the area of influence	Moderate	Follow mitigation for operation phase air quality, noise and traffic.	Minor	TCN Lines Operations	AfDB -PIU	FMENV, EDMEPU and DSMEnv

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	operation phase issues (like air and dust emissions, traffic, and community safety/security, noise/vibration, etc.) and adverse impact/inconveniencies resulting from it. Dealing with community/stakeholder perceptions around cumulative impacts linked to the new plant and existing cement plant operations.			Inform communities about details of operation activities (e.g., employment opportunities) by billboards, posters and plant visit		TCN Lines Operations	AfDB –PIU	FMENV, EDMEPUand DSMEnv
				Set-up, manage and manage grievance mechanism		TCN Lines Operations	AfDB –PIU	FMENV, EDMEPU and DSMEnv
				Sharing of independent monitoring reports of all monitoring actions during construction as mentioned in this ESMP.		TCN Lines Operations	AfDB -PIU	FMENV, EDMEPU and DSMEnv
				Engage communities in the monitoring activities to		TCN Lines Operations	AfDB –PIU	FMENV, EDMEPU and DSMEnv

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
	Disappointment about electricity supplied to national grid, while locally electricity supply has reduced reliability			enhance transparency and involvement.				
				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 Lines Operations	AfDB –PIU	FMENV, EDMEPU and DSMEnv

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				Explain effects of electromagnetic fields to communities to limit concerns. Keep fields within limits of International Commission on Non-Ionizing Radiation Protection (ICNIRP).		TCN Lines Operations	AfDB –PIU	FMENV, EDMEPU and DSMEnv
				Interference with radio/TC transmission during rain needs to be explained to the communities		TCN Lines Operations	AfDB -PIU	FMENV, EDMEPU and DSMEnv
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	Minor	TCN Lines Operations	AfDB –PIU	FMENV, EDMEPU and DSMEnv

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				and response to electrocution, bush fires, repair of snapped lines and collapsed towers, roles and responsibilities. Coordinate with 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 Lines Operations	AfDB –PIU	FMENV, EDMEPU and DSMEnv
				Communicate to communities in RoW the safety risks of the transmission lines and		TCN Lines Operations	AfDB –PIU	FMENV, EDMEPU and DSMEnv

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				provide response measures. Put sign boards on towers about electrocution risk.				
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. • Provide reasonable, and if applicable negotiated, working terms and conditions. • Establish worker's grievance mechanism, so that potential	Negligible	TCN Lines Operations	AfDB -PIU	FMENV, EDMEPU and DSMEnv

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
				conflicts can be dealt with in an early and proper way. • No use of child labors (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.				

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 Lines Operations	AfDB –PIU	FMENV, EDMEPU and DSMEnv

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)	Responsibilities		
						Mitigation Action	Supervision	Monitoring
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 Lines Operations	AfDB –PIU	FMENV, EDMEPU and DSMEnv V
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 Lines Operations	AfDB -PIU	FMENV, EDMEPU and DSMEnv

Table 8.4 provides details of monitoring.

Table 8.4: Environmental and Social Monitoring Plan

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)	4,500,000	Daily at Project site/ Monthly during OPS	18,000,000	Internal Monitoring environmenta 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		
Sanitation/wastes management				Health, Safety and Security	2,350,000
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, 587, 250	4 times a year	6, 349, 000		
Total per project phase			69,899,000		63,430,000
Overall estimate	133,329,000				

8.4 Management Subplans/Programs

The ESIA study did trigger development of specific management plans, including:

- Air Quality Management Plan;
- Waste ManagementPlan;
- Biodiversity ManagementProgram;
- Community Health and Safety Management Plan; and
- 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 Contractors required to develop and implement the following Construction triggered Management Plans:

- Access Roads Location and ManagementPlan;
- Soil and Erosion ManagementPlan;
- Update the Traffic ManagementPlan;
- Training and Skill TransferProgram;
- Worker's Health and Safety ManagementPlan;
- Rehabilitation and RevegetationPlan;
- Environmental and Social Code of Conduct;
- Contractors' GRM for Communities andWorkers;
- Method Statements, including, but not limited to erosion control, water crossing, work in heights, and others that may be required by the Conducted.

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.

8.4.1 Air Quality ManagementProgram

Justification andObjectives

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 2.4.

Actions and Implementation Schedule

Table 8.6 provides applicable control and action able mitigation measures during the initial decommissioning and construction phases (various applicable activities were spelt out in Table 8.5), 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 8.5: 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 I as much as possible. An allowable 0.2- 0.4 m space is left unloaded for any construction materials carrying trucks.			
	Trucks carrying dusty materials needed be adequately covered;			

Control emissions of dusts and pollutant gases	Stockpiles of granular materials need be water-proofed protected and/or sprinkled withwater constantly	Twice weekly in wet seasons and daily (in the dry season, during construction	Contractor	FMEnv
	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.			
	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 8.6 summarizes the follow-up and monitoring actions and the implementation schedule.

Table 8.6: 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.	Bi-weekly 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	When necessary

	(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.	

CorrectiveActions

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 8.2.

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 8.7 lists the performance indicators to be monitored for the Air Quality Management Program:

Table 8.7: 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 bi-weekly
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 8.8 summarizes 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 8.8: 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

8.4.2 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 chapter 4.

The actions and Implementation Schedule are summarized in Table 8.9 below.

Table 8.9: Summarry of Implementation Schedule for Waste Resources Management Plan

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	Initial	Contractor	PIU
Prevent water quality contamination/abstraction	Any river/dams affected accidently shall be rehabilitated as close to its pristine state as possible; Temporary stream diversions will be big enough to allow free flow of water without damming and submerging freshwater vegetation for long periods; Use of sandbags, use of 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 Fresh water vegetation. Clearing of freshwater vegetation shall be done in stages, as working	decommissioning /During construction	Contractor	PIU

	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			
	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, anyactivity requiring washing shall only be conductedin within lay down area; Prohibit workers to use natural waterways for recreational purposes, bathing orwashing.	Initial decommissioning During construction		

Table 8.10 lists the control and mitigation measures to be applied during construction, in order to minimize impacts on surface and groundwater resources.

Table 8.10: Description and implementation schedule for Water Resources Management Program

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 bonded wallsor 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- absolution of produced waste in the receptive environment through collecting and channeling to oil and grease separation pits	Initial decommissioning During construction	Contractor	PIU

Remedial Actions

Remedial actions are affected when and if deviations from the expected outcomes are observed during the follow-up and monitor actions. The extent, scale and pattern of the remedial actions or supplementary mitigation measures shall be case specific. Table 8.10 outlines the proposed remedial actions. Table 8.11 is a drawn –up follow up monitoring program for the WRM.

Table 8.11: Remedial actions, description and implementation schedule for Water Resources Management Program

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 decommissioningand 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 the erosion risk determination to shorelines.	Monthly during Initial decommissioningand construction (when working near water bodies)	contractor	PIU

Monitor occurrence of spillages in water resources	Conduct planned spillage assessment of parking lots, fuel supply areas, and other lay down areas for spilloccurrence; Conduct containment and clean - up operations if spills are observed. Document all assessment schedules including cleaningprotocols Record all accidental spillages occurring in water resources. Record the date, location, approximate volume of each spillage and implemented corrective measures.	During Initial decommissioni ngand Construction 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 isthe 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 suchas: Silt fences can be placed around affected areas to sifter dregs; Patterned weirs should be placedin the erosive pathsto 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 andReporting

Table 8.12 lists the performance indicators to be monitored for the Water Resources Management Program:

Table 8.12: 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 8.13 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 8.13: 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

8.4.3 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 construction sites.

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 DisposalFacilities

The development of this plan and its upgrade by the Contractor took/shall take into consideration availability of waste facilities in Edo and Delta States.

- Waste management in the project area is the responsibility of Edo state Environmental and Waste Management Board (EEWMB) and the Delta State Waste Management Board (DSWMB). No public landfills exist in the Project area, rather many municipal waste sites.
- As for hazardous waste, there is one licensed facility in the project area (Mawe Services Ltd, Warri, and Delta 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 8.14 below summarizes the proposed waste management actions.

Table 8.14: 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 questioning what concerns the availability of waste treatment and disposal facilities.	Initial decommission phase	Contractor	PIU
Reduce waste production	Workings 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 canbe 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 color-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 be identifying 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 alwaysclosed; 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

Waste management actions	Description	Implementation Schedule	Responsibility for Implementation	Supervision

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 pickup in an orderly fashion and with proper safety arrangements.	During construction	Contractor	PIU
	Prior to transport, an FMEnv certified laboratory shall confirm it to be nonhazardous. If confirmed as nonhazardous, a waste manifest detailing content, volume, the generating company should be 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	During construction	Contractor	PIU

Non-hazardous waste final destination	washable; Transfer operations of waste containers must be carried out safely: without compromising its segregation, and without causing leaks or spills and originatingdust; 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 theState 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 weeklybasis; 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.			

Waste management actions	Description	Implementation Schedule	Responsibility for Implementation	Supervision
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. 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 alwaysclosed; All produced waste will be sorted and placed in the corresponding container.	During construction	Contractor,	PIU
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. These are a 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,	During construction	Contractor,	PIU

	No naked light anddanger); 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 hazardmaterial; Hazardous waste must be transported (internal transportation) in containers. The transport must have steel clamps for securing the containers and guarantee safetransport; The transportation of hazardous waste transport outside the facilities of the Contractor can only be made by an entity licensed by DWMP and EEWMB. 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 kept by the waste transporting entity, the third copy is kept by the entity receiving the product and the fourth copy is sent to DWMP and EEWMB Provide the workers responsible for the handling of hazardous waste with adequate PPE (work wear, gloves, boots	During construction	Contractor,	PIU

	andmasks).			
Hazardous Waste Final Destination	The final disposal of hazardous waste will be made at an infrastructure licensed by REMASAB and KEPA for storage, treatment and/or final disposal of hazardous waste. The nearest such infrastructure is the Mawe Services Ltd, located in Warri, Delta state Whenever possible, enforcement of the buy-back policy with the suppliers should be invoked.	During construction	Contractor	PIU
Workers training	Workers must be briefed on the behavioral aspect of waste reduction. Theuse of disposable products (such as plates or plastic or paper cups, products with excessive packaging) will be limited as much as possible, and the use of reusable products will be promoted; Workers must be trained on the classification, correct sorting and handling ofwaste; Workers responsible for hazardous waste handling must be trained on the classification, correct sorting, handling and transport of hazardous waste. Workers must be briefed on the use of individual protection equipment	During construction	Contractor	PIU

Follow-up Actions

Table 8.15 summarizes the follow-up and/or systematic and/or periodic verification actions proposed for waste management.

Table 8.15: Follow-up Actions for Waste Management

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 8.16 summarizes the corrective actions and their implementation schedule.

Table 8.16: Corrective actions and implementation schedule for Waste Management Plan

Corrective Actions	Description	Implementation Schedule
Spill mitigation actions	Removal of substances accumulated in the spill containment trays sinks; Repair or change the damaged container thatleaks.	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 8.17 lists the performance indicators to be monitored for the Waste Management Plan.

Table 8.17 – 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 8.18: 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

8.4.4 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 *Polybroides typhus* (A raptor and migratory avian species). Baseline result showed two threatened flora (*Cedrala odorata* and *Dalbergia latifolia)* species in the study area. Invasive species (*Chromolaena odorata*) 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 8.19 lists:

- The scope of the BMP, which includes: (a) invasive species; (b) deforestation rate in riparian 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 8.20the 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 theirtriggers;
- Estimated costs / indicative budget; and
- Source of funding.

Details on the monitoring methodology are provided in the following sections.

Table 8.19: 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, lay down area 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 monitoringand management –including remedial actions of impacts on riparian habitat, on both flora andfauna	Establish the baseline for present deforestation rate sand wildlife poaching activities prior to the start of RoW clearing; Monitor the direct and indirect / induced impacts on natural and critical natural habitat (In this case, riparian habitat near Ologbo, Oghara and Ogorode), on both flora and fauna on a 2 km spatial boundary on both sides of the RoW. Establish deforestationand poaching monitoring and development of corrective actions; 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 accessed 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	Annually during construction and during the first five years of operation. Biannually during the next 5 years of operation.	Contractor, PIU (construction) PIU (operation) to be carried out by Independent Biodiversity Monitoring and Management Consultant financed by TCN	PIU

	measures such as targeted protection, reforestation and anti-poaching programs shall be developed and enforced			
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 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 borrowpit areas during maintenance, those will be monitored, and removed or controlled aswell.

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-trothing, 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 viaGPS;
- 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

Table 8.20 presents the main remedial actions.

Table 8.20: 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) are 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 8.21 lists the performance indicators to be monitored:

Table 8.21: 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 riparian 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	Fatality rate decreases in monitored segments, after application of additional corrective measures.

	particular species groups).	

The performance indicators results will be determined and compiled in quarterly reports, as indicated in the following section.

Reports

Table 8,22 summarizes the documental records that will be kept, to control the execution of this monitoring and management program.

Table 8.22: 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

8.4.5 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

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 8.23: 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 updatedTraffic Management Plan, detailing the management procedures and mitigation measures to minimize traffic related hazard risks to communities. The Plan will include the mitigation providedhere under: Movement of construction vehicles shall be limited to pre- approved construction routes. These will be defined in order to avoid 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.	Preconstruction Phase	Contractor	PIU

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 communities 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 birds. Provide for animal crossings and access to watering sites, ifneeded. 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; 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 employment including women and young workers and transfer technical skills to the local labour force; Forbid workers from hunting or buying bushmeat. 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;	Planning and During Construction	Contractor	PIU
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 the gate–establish local and regional recruitment centres 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

Minimize risks of social conflicts with workforce	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 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 projectareas); 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 breakingthem. The Contractor will further be expectedto: 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 leisure time in urban centres at reasonable intervals.	Preconstruction and During Construction	Contractor	PIU

	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 andAbuse/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 ofGBV/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;	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 theCoC; Referral Pathway: Identification of qualified GBV service providers (NGOs) and setting up a referral pathway so that 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 within put from the contractor, which will include at minimum: 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	Prior to mobilization of construction	Contractor	PIU / Third party auditor per Action Plan

	accountability procedures which will clearly lay out confidentiality requirements for dealing withcases; Mechanisms to hold accountable alleged perpetrators associated to theProject; 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 theproject; Reporting on the Framework implementation will be done on a monthly basis.			
Minimize community	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 compliant with AfDB operational safeguards (see chapter 2). This plan will include mandatory training for all security personnel, in what regards human rights, proportionate			

security hazards due to interaction with security personnel	force use and adherence to contractor's code ofconduct; Security will be supplied by NCSDC; PIU will make an effort to engage with the authorities, so that any engagement with the communities is in compliance with the Voluntary Principles on Security and Human Rights.	Planning / During Construction	Contractor	PIU

Actions	Description	Implementation Schedule	Responsibility	Supervision
Minimize workforce and community health risks	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 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 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

8.4.6 Traffic Management Program

Justification and Objectives

The Project is expected to generate relatively high volumes of traffic during the initial decommissioning and construction phasesof 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 program 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 1132 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). As a measure to reduce traffic volume on the Benin-Sapele road close to Benson Idahosa University, the Old Benin-Sapele road shall be used as an alternative route during material transport.

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 / HDT s 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
- Localised 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) utilisation 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 Old Benin Sapele Road. 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. 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 and safety requirements.

Emergency Procedures During Construction

The contractor shall ensure that unobstructed access is provided to all emergency vehicles along all routes and site accesses.

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

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 and delivering leaflets/flyers to houses in the affected areas. Sensitization shall be done in both Edo, Urhobo, pidgin and English. The flyers shall contain contact information for members of the public to obtain additional information and to provide additional knowledge such as local events, traditional festivals and religious celebrations which may conflict with proposed traffic management measures

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 NINE
CONCLUSION

9.0 Conclusion

The Environmental and Social Impact Assessment (ESIA) of the proposed Transmission Line 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 environmental and social conditions 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 and social sustainability of the project.

The environmental and social baseline condition of the project area which was carried out based on a one season (wet) data, supplemented with wet (dry) season secondary data (Azura, 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 and social standards requirements in Nigeria. It is understood that the project will result in substantial social and economic benefit for Nigeria. The ESMP 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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Appendix 1.1

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/5095/Vol. I/48
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 107KM BENIN-DELTA TRANSMISSION LINE TO 330Kv DOUBLE CIRCUIT QUAD CONDUCTORS

Please refer to your letter dated 13th May, 2018 and the Ministry's letter ref: **FMEnv/EA/EIA/5095/Vol. 1/28** dated 8thJuly, 2019 on the above subject.

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.

6. The following should be forwarded to the Federal Ministry of Environment before submission of the draft EIA report.

6. The following should be forwarded to the Federal Ministry of Environment before submission of the draft EIA report.

- 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, Aluminium tube, Part 2, Couplers, Specification for steel and aluminium 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 Aluminium-Clad Steel wires for Electrical Purposes.

• IEC 60121 Recommendation for commercial annealed aluminium electrical

conductor wire

• IEC 61089 Round wire concentric lay overhead electrical stranded

conductors.

• IEC 60889 Hard drawn aluminium wire for overhead line conductors

• IEC 61394 Characteristics of greases of aluminium, aluminium 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 Aluminium 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 Aluminium 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

	SAMPLING CODE	LATITUDE (N)	LONGITUDE (E)	TIME	SO_2	NO_2	CO_2	VOC	HCL	CO	H_2S	PM
Benin - Sapele	AQ1	6.266667	5.616667	13:30	0.021	0	416.74	0.21	0	1.19	0.22	0.0580
	AQ2	5.583333	5.583333	11:56	0.022	0	411.18	0.34	0	1.06	0.31	0.0441
	AQ3	6.283333	5.666667	12:30	0.024	0	426.57	0.27	0	2.25	0.31	0.0730
	AQ4	5.95	5.633333	9:19	0.018	0	432.53	0.22	0	1.29	0.25	0.0654
	AQ5	5.9	5.733333	11.06	0.021	0	385.38	0.23	0	1.18	0.43	0.0829
	AQ6	5.866667	5.75	10:23	0.023	0	400.45	0.13	0	0.53	0.35	0.0777
	AQ7	6.3	5.633333	10:29	0.023	0	385.63	0.47	0	0.13	0.35	0.0536
	AQ8	5.95	5.633333	15:32	0.021	0	418.22	0.15	0	1.91	0.20	0.0432
	AQ9	6.316667	5.6	17:04	0.021	0	400.93	0.22	0	2.49	0.47	0.0482
	AQ10	6.283333	5.633333	9:19	0.019	0	428.37	0.27	0	2.08	0.12	0.0450
	AQ11	6.183333	5.65	10:23	0.026	0	421.26	0.02	0	3.73	0.40	0.0456
	AQ12	5.9	5.7	13:30	0.022	0	406.81	0.46	0	1.21	0.29	0.0749
	Min				0.018	0	385.38	0.02	0	0.13	0.12	0.0432
	Max				0.026	0	432.53	0.47	0	3.73	0.47	0.0829
	Mean				0.022	0	411.17	0.25	0	1.59	0.31	0.0593
	SAMPLING CODE	LATITUDE (N)	LONGITUDE (E)	TIME	SO_2	NO_2	CO_2	VOC	HCL	CO	H_2S	PM
Sapele	AQ13	6.216667	5.683333	11:56	0.023	0	410.00	0.16	0	4.66	0.27	0.0397

	AQ14	5.85	5.716667	12:30	0.019	0	411.74	0.36	0	3.22	0.25	0.0513
	AQ15	5.566667	5.883333	9:19	0.023	0	405.27	0.15	0	1.63	0.37	0.0784
	AQ16	5.65	5.766667	11.06	0.023	0	405.31	0.20	0	2.70	0.03	0.0142
	AQ17	5.733333	5.733333	14:53	0.020	0	418.68	0.03	0	1.64	0.28	0.0424
	AQ18	6.3	5.666667	16:00	0.022	0	422.19	0.30	0	1.42	0.20	0.0713
	AQ19	6.133333	5.666667	16:31	0.020	0	416.54	0.21	0	1.73	0.25	0.0540
	AQ20	6.116667	5.666667	16:56	0.024	0	403.94	0.17	0	1.86	0.24	0.0613
	Min				0.019	0	403.94	0.03	0	1.42	0.03	0.0142
	Max				0.024	0	422.19	0.36	0	4.66	0.37	0.0784
	Mean				0.022	0	411.71	0.20	0	2.36	0.24	0.0516

Noise and EMF Quality Result

Appendix6.3 Detailed result for both noise level and EMF Level

Sections	SAMPLING CODE	LATITUDE (N)	LONGITUDE (E)	TIME	Decibels (A)	LAF (DbA)	LMIN(DbA)	LMAX(DbA)	EMF
Benin-Sapele	NQ1/EMF1	6.266667	5.616667	13:30	53.7	72.4	31.31	68.8	0.23
	NQ2	5.583333	5.583333	11:56	61.0	69.7	28.67	78.4	
	NQ3	6.283333	5.666667	12:30	60.6	80.4	32.28	68.9	
	NQ4	5.95	5.633333	9:19	61.1	60.7	26.20	57.3	
	NQ5/EMF2	5.9	5.733333	11.06	53.0	64.6	32.96	64.6	0.22
	NQ6	5.866667	5.75	10:23	57.6	63.9	24.46	53.6	
	NQ7	6.3	5.633333	10:29	63.7	63.2	23.17	52.2	
	NQ8	5.95	5.633333	15:32	60.6	74.3	24.84	50.7	
	NQ9	6.316667	5.6	17:04	56.8	68.7	28.33	55.6	
	NQ10/EMF3	6.283333	5.633333	9:19	63.8	65.9	31.08	55.7	0.23
	NQ11	6.183333	5.65	10:23	59.5	76.2	31.16	59.2	
	NQ12	5.9	5.7	13:30	50.2	59.4	29.82	62.2	
	MAX				63.8	80.4	32.96	78.4	0.23
	MIN				50.2	59.4	23.17	50.7	0.22
	MEAN				58.5	68.3	28.69	60.6	0.23
Sapele -Ughelli	NQ13	6.216667	5.683333	11:56	64.2	55.1	28.72	69.7	
	NQ14	5.85	5.716667	12:30	53.5	65.0	27.71	61.5	
	NQ15/EMF4	5.566667	5.883333	9:19	62.5	60.4	28.76	40.9	0.23
	NQ16	5.65	5.766667	11.06	69.5	64.2	35.22	57.7	
	NQ17	5.733333	5.733333	14:53	59.4	52.0	22.60	57.5	
	NQ18	6.3	5.666667	16:00	59.5	60.4	33.78	65.4	

	NQ19	6.133333	5.666667	16:31	54.2	58.8	27.41	61.6	
	NQ20/EMF5	6.116667	5.666667	16:56	64.1	63.4	27.34	64.6	0.21
	MAX				69.5	65.0	35.22	69.7	0.23
	MIN				53.5	52.0	22.60	40.9	0.21
	MEAN				60.9	59.9	28.94	59.9	0.22

Appendix 6.2

Soil Results

Soil Physico-chemical Result

		BENIN-SAPELE															
SOIL		**(0cm - 15cm)**															
SAMPLE STATIONS		SS1	SS2	SS3	SS4	SS5	SS6	SS7	SS8	SS9	SS10	SS11	SS12	SS13	Min	Max	Mean
PARAMETERS																	
PH		6.61	5.60	5.76	5.84	6.24	5.67	5.37	6.49	5.85	6.17	5.42	5.76	5.95	5.37	6.61	5.90
Elect. Conductivity (µS/cm)		85.00	90.68	89.70	85.39	85.06	89.67	86.40	87.17	94.20	87.76	92.14	84.68	84.03	84.03	94.20	87.84
Moisture Content (%)		6.7	11.1	7.3	11.3	10.3	12.6	13.3	7.6	10.2	8.0	8.6	7.8	11.1	6.7	13.3	9.7
PSD (%)	Clay	3.4	4.3	4.9	3.51	3.9	4	5.3	2	4.2	4	1	3.5	3.2	1	5.3	3.6
	Silt	8.2	8.2	9.0	9.5	10.5	10.2	7.8	7.3	11.6	12.7	9.9	4.7	11.4	4.7	12.7	9.2
	Sand	88.5	87.5	85.9	86.6	85.2	85.8	86.9	90.9	83.8	83.1	89.1	91.8	85.6	83.1	91.8	87.0
Ext. Nitrate		3.40	4.19	4.45	3.71	2.93	4.12	3.47	3.58	4.35	4.05	3.31	4.46	4.60	2.93	4.60	3.89
Ext. Sulphate		22.86	20.80	21.99	22.08	20.65	22.52	22.05	21.55	21.15	21.65	21.60	22.78	22.08	20.65	22.86	21.83
Ext. Phosphate		1.11	1.44	1.64	0.63	1.80	2.49	0.93	1.03	1.83	2.44	3.27	2.13	2.66	0.63	3.27	1.80
Phosphorous		12.68	16.85	19.02	19.71	16.97	17.31	18.58	15.65	7.56	12.48	14.45	11.53	12.92	7.56	19.71	15.05
Calcium		5.30	6.08	5.47	4.11	4.60	5.66	5.57	5.12	5.09	5.32	4.32	6.36	6.35	4.11	6.36	5.33
Magnesium		0.75	0.73	0.68	0.83	0.85	0.76	0.69	0.87	0.93	0.65	0.80	0.84	0.85	0.65	0.93	0.79
THC		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total chromium		0.90	0.88	0.79	0.29	0.71	0.77	0.82	0.60	0.79	0.59	0.68	0.89	0.68	0.29	0.90	0.72
Total iron		89.39	92.67	94.77	68.98	91.68	90.79	106.15	88.19	103.95	104.53	76.74	95.69	78.31	68.98	106.15	90.91
Copper		5.07	9.10	6.47	6.15	5.40	5.97	5.93	7.92	8.20	4.97	4.12	5.26	5.69	4.12	9.10	6.17
Lead		0.22	0.14	0.30	0.15	0.28	0.26	0.26	0.27	0.29	0.16	0.24	0.22	0.20	0.14	0.30	0.23
Manganese		5.95	5.92	5.61	7.00	5.25	5.98	5.86	5.76	5.76	6.02	4.67	5.24	5.99	4.67	7.00	5.77
Nickel		0.71	0.84	0.84	0.52	0.87	0.79	0.80	0.63	0.67	0.76	0.83	0.89	0.59	0.52	0.89	0.75

Zinc		1.11	1.09	1.25	1.11	1.04	1.20	1.13	1.10	1.10	1.12	1.05	1.11	1.00	1.00	1.25	1.11
Arsenic		0.20	0.30	0.26	0.32	0.21	0.27	0.25	0.29	0.26	0.34	0.25	0.29	0.29	0.20	0.34	0.27
Mercury		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium		0.21	0.28	0.19	0.20	0.22	0.27	0.26	0.26	0.23	0.21	0.18	0.18	0.21	0.18	0.28	0.22
Cadmium		0.65	0.40	0.71	0.65	0.53	0.63	0.51	0.54	0.47	0.31	0.72	0.74	0.40	0.31	0.74	0.56
Boron		1.29	1.41	1.15	1.65	1.52	1.63	1.54	1.62	1.65	1.34	1.68	1.53	1.75	1.15	1.75	1.52

		BENIN - SAPELE									
		(0cm - 15cm)									
SAMPLING STATIONS		SS14	SS15	SS16	SS17	SS18	SS19	SS20			
PARAMETERS									Min	Max	Mean
PH		5.56	5.59	5.15	5.20	5.86	6.24	5.16	5.15	6.24	5.54
Elect. Conductivity (µS/cm)		77.15	90.83	86.35	90.83	92.29	87.67	86.36	77.15	92.29	87.35
Moisture Content (%)		10.8	11.7	8.3	9.3	10.5	9.6	13.6	8.3	13.6	10.5
PSD	Clay	2.2	3.3	2.8	3.6	2.3	4.2	2.9	2.2	4.2	3.04
	Silt	10.2	9.8	17.3	11.3	10.8	11.9	11.8	9.8	17.3	11.9
	Sand	87.8	86.9	79.9	85.2	86.9	84.1	84.9	79.9	87.8	85.1
Ext. Nitrate		3.27	3.81	4.34	4.58	2.85	3.25	3.24	2.85	4.58	3.62
Ext. Sulphate		22.17	22.18	19.91	22.72	20.35	22.63	22.47	19.91	22.72	21.78
Ext. Phosphate		1.62	1.38	2.20	1.57	0.35	1.23	0.72	0.35	2.20	1.30
Phosphorous		18.55	17.53	19.09	12.31	6.20	13.88	17.09	6.20	19.09	14.95
Calcium		4.39	4.96	5.64	6.30	4.27	3.67	4.68	3.67	6.30	4.84
Magnesium		0.52	0.54	0.69	0.92	0.61	0.56	0.62	0.52	0.92	0.64
THC		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total chromium		0.83	0.69	0.85	0.73	0.57	0.70	0.64	0.57	0.85	0.72
Total iron		92.94	82.79	110.60	85.77	101.89	95.88	87.38	82.79	110.60	93.89

Copper	6.43	6.44	4.34	5.92	5.15	4.79	5.81	4.34	6.44	5.56
Lead	0.22	0.23	0.28	0.17	0.20	0.17	0.19	0.17	0.28	0.21
Manganese	6.41	6.23	6.08	6.46	6.71	6.19	6.91	6.08	6.91	6.43
Nickel	0.67	0.80	0.60	0.70	0.67	0.97	0.90	0.60	0.97	0.76
Zinc	1.16	1.23	1.09	1.18	1.06	1.23	1.16	1.06	1.23	1.16
Arsenic	0.20	0.28	0.28	0.24	0.31	0.30	0.27	0.20	0.31	0.27
Mercury	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	0.27	0.27	0.23	0.26	0.26	0.23	0.20	0.20	0.27	0.25
Cadmium	0.64	0.75	0.58	0.43	0.53	0.56	0.45	0.43	0.75	0.56
Boron	0.91	1.47	1.61	0.86	1.65	1.42	1.19	0.86	1.65	1.30

		SAPELE - UGHELLI														
		15cm - 30cm														
SAMPLING STATIONS		SS1	SS2	SS3	SS4	SS5	SS6	SS7	SS8	SS9	SS10	SS11	SS12	SS13	Min	Max	Mean
PARAMETERS																	
PH		5.77	5.45	5.83	5.57	5.45	5.86	6.42	4.83	5.38	4.85	4.71	6.22	4.10	4.10	6.42	5.42
Elect. Conductivity (µS/cm)		178.3	167.0	143.2	203.4	161.2	167.7	151.2	178.6	133.4	186.6	168.8	115.8	128.8	115.8	203.4	160.3
Moisture Content		16.58	14.98	11.20	16.71	12.85	13.98	14.54	15.09	13.85	13.20	14.04	18.07	15.96	11.20	18.07	14.70
PSD	Clay	4.4	6.3	8.9	11.51	10.9	12.2	7.3	12	9.2	10.6	11.2	12.5	9.2	4.40	12.50	9.71
	Silt	18.2	16.2	19.0	14.5	13.5	15.2	15.8	17.3	15.6	16.7	19.9	16.7	18.4	13.53	19.91	16.70
	Sand	77.5	77.5	71.9	73.6	75.2	72.8	76.9	70.9	74.8	73.1	69.1	70.8	72.6	69.12	77.51	73.60
Ext. Nitrate		5.20	4.75	4.65	6.31	7.13	6.25	5.89	6.39	6.18	6.07	6.16	5.82	5.29	4.65	7.13	5.85
Ext. Sulphate		21.79	22.21	21.77	21.71	21.77	21.83	22.20	22.85	21.11	22.59	22.48	23.04	21.65	21.11	23.04	22.08
Ext. Phosphate		0.85	2.09	1.18	2.05	2.75	0.65	1.42	1.60	1.54	1.54	1.49	0.12	0.25	0.12	2.75	1.35
Phosphorous		15.10	9.01	20.70	15.11	17.56	14.87	19.58	7.41	15.42	13.09	16.06	17.41	16.21	7.41	20.70	15.20
Calcium		6.05	4.74	4.73	4.05	6.15	7.02	6.78	3.90	4.55	5.35	3.90	5.34	4.60	3.90	7.02	5.17
Magnesium		1.05	0.64	0.93	0.87	0.84	0.92	0.98	1.14	1.14	0.91	0.82	0.65	1.04	0.64	1.14	0.92
THC		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Total chromium	2.25	1.54	1.69	1.41	1.26	1.30	1.18	1.25	1.73	1.65	1.28	1.05	1.42	1.05	2.25	1.46
Total iron	107.8	130.5	106.5	121.0	112.9	116.0	122.2	114.8	125.6	118.4	116.1	126.7	119.1	106.5	130.5	118.3
Copper	7.10	8.61	8.01	8.56	7.92	7.70	7.57	10.52	7.17	7.06	8.77	8.59	6.80	6.80	10.52	8.03
Lead	0.20	0.18	0.13	0.08	0.19	0.22	0.14	0.15	0.18	0.11	0.11	0.24	0.18	0.08	0.24	0.16
Manganese	7.08	7.60	8.27	8.34	8.42	8.11	8.82	8.09	7.43	7.37	7.62	8.36	8.39	7.08	8.82	7.99
Nickel	1.02	0.95	0.99	0.81	0.91	1.04	1.02	0.81	1.17	0.76	1.19	1.07	1.00	0.76	1.19	0.98
Zinc	1.59	0.52	0.49	1.30	1.26	1.04	1.26	1.26	1.61	0.97	0.97	0.92	1.01	0.49	1.61	1.09
Arsenic	0.25	0.36	0.24	0.34	0.53	0.33	0.25	0.27	0.40	0.33	0.22	0.29	0.28	0.22	0.53	0.31
Mercury	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	0.25	0.28	0.34	0.34	0.42	0.35	0.25	0.31	0.19	0.21	0.28	0.26	0.27	0.19	0.42	0.29
Cadmium	0.74	0.40	0.73	0.60	0.52	0.27	0.62	0.72	0.58	0.54	0.40	0.48	0.72	0.27	0.74	0.56
Boron	1.86	1.17	1.54	1.66	1.25	1.54	1.11	1.58	1.39	1.55	0.83	0.86	1.64	0.83	1.86	1.38

		SAPELE - UGHELLI									
		(0cm - 15cm)									
SAMPLING STATIONS		SS14	SS15	SS16	SS17	SS18	SS19	SS20			
PARAMETERS									Min	Max	Mean
PH		5.36	4.43	5.73	6.87	5.53	5.11	4.64	4.43	6.87	5.38
Elect. Conductivity (µS/cm)		193.0	175.9	151.2	133.3	167.3	152.8	116.0	116.0	193.0	155.7
Moisture Content (%)		15.10	17.08	12.45	15.49	13.36	12.72	16.56	12.45	17.08	14.68
PSD	12.2	7.3	12	7.6	6.3	10.2	8.3	6.30	12.20	9.13	
	15.2	15.8	17.3	18.3	13.8	15.9	14.8	13.77	18.30	15.86	
	72.8	76.9	70.9	74.2	79.9	74.1	76.9	70.86	79.91	75.10	
Ext. Nitrate		5.54	5.73	5.67	4.61	6.50	6.51	5.80	4.61	6.51	5.77
Ext. Sulphate		22.42	22.55	21.21	21.94	22.44	21.48	21.84	21.21	22.55	21.98

Ext. Phosphate	2.65	0.42	1.24	1.85	1.89	1.66	1.64	0.42	2.65	1.62
Phosphorous	9.55	14.74	14.34	10.80	15.43	10.91	15.43	9.55	15.43	13.03
Calcium	6.66	4.37	3.85	5.64	6.44	3.57	4.53	3.57	6.66	5.01
Magnesium	0.82	0.66	1.00	0.61	0.92	0.99	1.14	0.61	1.14	0.88
THC	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total chromium	0.81	1.38	1.43	1.72	1.03	1.36	1.67	0.81	1.72	1.34
Total iron	105.3	125.4	119.2	104.4	99.9	110.1	126.4	99.9	126.4	113.0
Copper	8.69	8.91	8.80	9.42	10.91	9.38	8.48	8.48	10.91	9.23
Lead	0.25	0.18	0.09	0.16	0.18	0.13	0.17	0.09	0.25	0.17
Manganese	6.76	7.51	7.17	8.69	8.85	6.94	7.04	6.76	8.85	7.56
Nickel	0.77	0.91	0.78	0.94	1.08	0.91	0.86	0.77	1.08	0.89
Zinc	0.74	0.92	0.79	1.64	1.45	1.68	1.24	0.74	1.68	1.21
Arsenic	0.40	0.37	0.37	0.30	0.37	0.33	0.27	0.27	0.40	0.34
Mercury	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	0.28	0.30	0.28	0.25	0.36	0.38	0.33	0.25	0.38	0.31
Cadmium	0.54	0.59	0.49	0.86	0.66	0.65	0.75	0.49	0.86	0.65
Boron	2.23	1.64	1.09	1.49	1.37	1.39	1.66	1.09	2.23	1.55

Appendix 6.3 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* *Proteus sp* *Arthrobacter sp*	1.1×10^3	*Bacillus sp* *Pseudonomas sp*	1.0×10^2	*Aspergillus sp* *Mucor sp* *Penicillium sp* *Fusarium sp*	1.2×10^4	*Mucorsp* *Aspergillussp*	1.2×10^2
SS1 (15-30cm)	*Bacillus sp* *Pseudonomassp* *Proteus sp* *Enterobacter sp* *Serriatiasp*	2.0×10^5	*Pseudonomassp* *Proteus sp* *Enterobacter sp*	1.6 x105	*Aspergillussp* *Mucorsp* *Candida sp* *Trichoderma sp*	1.41×10^2	*Mucorsp* *Candida sp*	1.37×10^2
SS2(0-15cm)	*Bacillus sp* *Pseudonomassp* *Staphylococcus sp* *Actinomycessp*	1.77×10^3	*Staphylococcus sp*	1.72×10^2	*Candida sp* *Aspergillussp* *Mucorsp* *Penicilliumsp* *Fusariumsp*	2.1×10^3	*Mucorsp* *Aspergillussp* *Candida sp*	2×10^3
SS2(15-30cm)	*Proteus sp* *Escherichia sp* *Klebsiellasp* *Serriatiasp* *Flavobacteriumbsp*	1.9×10^3	*Escherichia sp* *Klebsiellasp*	1.9×10^2	*Aspergillussp* *Mucorsp* *Penicilliumsp* *Fusariumsp*	1.9×10^5	*Mucorsp* *Aspergillussp* *Fusarium sp* *Penicilliumsp* *Candida sp*	1.8×10^2
SS3(0-15cm)	*Serriatiasp* *Staphylococcus sp* *Enterobacter sp* *Actinomyces sp* *Flavobacterium sp* *Chromobacterium sp*	2.5×10^2	*Actinomyces sp* *Flavobacterium sp* *Chromobacteriumsp*	2.1×10^2	*Aspergillussp* *Penicilliumsp* *Fusariumsp* *Mucorsp* *Rhizopussp* *Trichoderma sp*	1.9×10^3	*Penicillium* *Fusarium sp* *Rhizopussp*	1.5×10^3
SS3(15-30cm)	*Arthrobacter sp* *Enterobacter sp* *Micrococcus sp* *Actinomycessp*	1.2×10^3	*Enterobacter sp* *Micrococcus sp*	1.1×10^3	*Mucorsp* *Penicilliumsp* *FusariumspRhizopussp* *Candida sp*	2.5×10^2	*FusariumspRhizopussp* *Candida sp*	2.1×10^2
SS4(0-15cm)	*Bacillus sp* *Pseudonomassp*	1.7×10^2	*Escherichia sp* *Klebsiellasp*	1.5×10^2	*Penicilliumsp* *Fusariumsp*	1.2×10^3	*MucorspRhizopussp*	1.1 x 10

	Micrococcus sp *Escherichia sp* *Klebsiellasp* *Protuessp*		*Protuessp*		*MucorspRhizopus sp* *Candida sp*		*Candida sp*	
SS4(15-30cm)	*Bacillus sp* *Pseudonomassp* *Staphylococcus sp* *Flavobacterium sp* *Chromobacteriumsp*	1.9×10^2	*Bacillus sp* *Pseudonomassp* *Staphylococcus sp*	1.0×10^2	*Rhizopussp* *Candida sp* *Trichoderma sp*	1.7×10^2	*Rhizopussp* *Candida sp*	1.7 x 10
SS5(0-15cm)	*Arthrobacter sp* *Enterobacter sp* *Micrococcus sp* *Actinomycessp*	3.1×10^3	*Arthrobacter sp* *Enterobacter sp*	3.0×10^2	*FusariumspMucorspPenicilliumspRhizopussp* *Candida spAspergillussp*	1.9×10^2	*PenicilliumspRhizopussp* *Candida spAspergillussp*	1.9 x 10
SS5(15-30cm)	*Pseudonomassp* *Micrococcus sp* *Escherichia sp* *Klebsiellasp*	4.1×10^2	*Micrococcus sp* *Escherichia sp*	4×10^2	*Aspergillussp* *Mucorsp* *Penicilliumsp* *Fusariumsp*	3.1×10^3	*Mucorsp* *Penicilliumsp* *Fusariumsp*	3 x 10
SS6(0-15cm)	*Bacillus sp* *Pseudonomassp Proteus sp* *Escherichia sp* *Klebsiellasp*	3.5×10^2	*Pseudonomassp* *Proteus sp* *Escherichia sp*	3×10^2	*Penicilliumsp* *Fusariumsp* *MucorspRhizopus sp* *Candida sp*	4.1×10^2	*MucorspRhizopussp* *Candida sp*	4.1 x 10
SS6(15-30cm)	*Proteus sp* *Escherichia sp* *Klebsiellasp* *Serriatiasp* *Flavobacteriumbsp*	2.5×10^5	*Escherichia sp* *Klebsiellasp* *Serriatiasp*	2.3×10^3	*Aspergillussp* *Mucorsp* *Candida sp* *Trichoderma sp*	4×10^2	*Mucorsp* *Candida sp* *Trichoderma*	3.6×10^1
SS7(0-15cm)	*Serriatiasp* *Staphylococcus sp* *Enterobacter sp* *Actinomyces sp* *Flavobacterium sp* *Chromobacteriumsp*	4.4×10^3	*Staphylococcus sp* *Enterobacter sp* *Actinomyces sp*	4.1×10^1	*FusariumspMucorspRhizopussp* *Candida sp*	2.1×10^5	*MucorspRhizopussp* *Candida sp*	1.1×10^2
SS7(15-30cm)	*Proteus sp* *Arthrobacter sp* *Staphylococcus sp* *Flavobacterium sp* *Chromobacteriumsp*	4.1×10^5	*Staphylococcus sp* *Flavobacterium sp* *Chromobacteriumsp*	3.6×10^2	*Candida sp* *Aspergillussp* *Mucorsp* *Penicilliumsp* *Fusariumsp*	3.5×10^2	*Candida sp* *Aspergillussp* *Mucorsp*	2.3×10^2

SS8(0-15cm)	*Micrococcus sp Actinomycessp Arthrobacter sp Staphylococcus sp Flavobacterium sp*	3.1x 10^5	*Arthrobacter sp Staphylococcus sp*	2.5x 10	*Penicilliumsp Fusariumsp MucorspRhizopus sp Candida sp*	1.9x 10^2	*Penicilliumsp Fusariumsp Mucorsp*	1.1x 10^2
SS8(15-30cm)	*Bacillus sp Pseudonomassp Proteus sp Enterobacter sp Serriatiasp*	2.2x 10^5	*Bacillus sp Pseudonomassp Proteus sp*	1.2x 10^2	*Aspergillussp Mucorsp Penicilliumsp Fusariumsp*	2.6x 10^3	*Penicilliumsp*	1.6x 10^2
SS9(0-15cm)	*Pseudonomassp Proteus sp Escherichia sp Enterobacter sp Serriatiasp*	1.5x 10^5	*Enterobacter sp Serriatiasp*	1.1x 10^4	*Candida sp Aspergillussp Mucorsp Penicilliumsp Fusariumsp*	4.5x 10^4	*Candida sp Aspergillussp*	3.7x 10^4
SS9(15-30cm)	*Arthrobacter sp Enterobacter sp Micrococcus sp Actinomycessp*	3.1x 10^5	*Micrococcus sp*	2.1x 10^4	*FusariumspMucorspRhizopussp Candida sp*	4.7x 10^2	*Rhizopussp Candida sp*	3.2x 10^2
SS10(0-15cm)	*Bacillus sp Pseudonomassp Proteus sp Escherichia sp Klebsiellasp*	2.6x 10^4	*Pseudonomassp Proteus sp Escherichia sp*	1.6x 10^4	*Aspergillussp Mucorsp Candida sp Trichoderma sp*	2.9x 10^2	*Mucorsp Candida sp Trichoderma sp*	1.7x 10^2
SS10(15-30cm)	*Proteus sp Escherichia sp Klebsiellasp Serriatiasp Flavobacteriumbsp*	4.1x 10^3	*Proteus sp Escherichia sp Klebsiellasp*	3.9x 10^2	*Rhizopussp Candida sp Trichoderma sp*	3.0x 10^3	*Trichoderma sp*	2.5x 10^2
SS11(0-15cm)	*Pseudonomassp Micrococcus sp Escherichia sp Klebsiellasp*	3.1x 10^4	*Micrococcus sp Escherichia sp*	2.7x 10^4	*Candida sp Aspergillussp Mucorsp Penicilliumsp Fusariumsp*	4.2x 10^2	*Mucorsp Penicilliumsp Fusariumsp*	2.8x 10^2
SS11(15-30cm)	*Arthrobacter sp Enterobacter sp Micrococcus sp Actinomycessp*	2.1x 10^3	*Arthrobacter sp Enterobacter sp*	1.9x 10^2	*Mucorsp Penicilliumsp FusariumspRhizopussp Candida sp*	5.6x 10^3	*FusariumspRhizopussp Candida sp*	4.7x 10^2

SS12(0-15cm)	*Serriatiasp Staphylococcus sp Enterobacter sp Actinomyces sp Flavobacterium sp Chromobacteriumsp*	1.5x 10^4	*Staphylococcus sp Enterobacter sp Actinomyces sp Flavobacterium sp*	1.2x 10^4	*Mucorsp Penicilliumsp FusariumspRhizopussp Candida sp*	3.8x 10^4	*Rhizopussp Candida sp*	3.2x 10^4
SS12(15-30cm)	*Bacillus sp Pseudonomassp Micrococcus sp Escherichia sp Klebsiellasp*	3.2x 10^3	*Micrococcus sp Escherichia sp*	2.9x 10^2	*Aspergillussp Mucorsp Penicilliumsp Fusariumsp*	4.2x 10^4	*Aspergillussp Mucorsp Penicilliumsp*	3.5x 10^4
SS13(0-15cm)	*Micrococcus sp Actinomycessp Arthrobacter sp Staphylococcus sp Flavobacterium sp*	2.3x 10^4	*Arthrobacter sp Staphylococcus sp*	2x 10^4	*Aspergillussp Mucorsp Penicilliumsp Fusariumsp*	2.9x 10^3	*Penicilliumsp Fusariumsp*	2.1x 10^2
SS13(15-30cm)	*Bacillus sp Pseudonomassp Proteus sp Escherichia sp Klebsiellasp*	4.3x 10^2	*Proteus sp Escherichia sp*	3.8x 10^2	*Penicilliumsp Fusariumsp MucorspRhizopus sp Candida sp*	3.6x 10^4	*MucorspRhizopussp*	2.3x 10^4
SS14(0-15cm)	*Pseudonomassp Micrococcus sp Escherichia sp Klebsiellasp*	2.9x 10^3	*Escherichia sp Klebsiellasp*	2.4x 10^2	*Rhizopussp Candida sp Trichoderma sp*	1.5x 10^2	*Candida sp Trichoderma sp*	0.9x 10^2
SS14(15-30cm)	*Proteus sp Escherichia sp Klebsiellasp Serriatiasp Flavobacteriumbsp*	4.4x 10	*Escherichia sp Klebsiellasp Serriatiasp*	4.1x 10^2	*Aspergillussp Mucorsp Candida sp Trichoderma sp*	3.3x 10^2	*Aspergillussp Mucorsp Candida sp*	3x 10^2
SS15(0-15cm)	*Micrococcus sp Actinomycessp Arthrobacter sp Staphylococcus sp Flavobacterium sp*	5.1x 10^3	*Arthrobacter sp Staphylococcus sp Flavobacterium sp*	4.7x 10^2	*Mucorsp Penicilliumsp FusariumspRhizopussp Candida sp*	4.2x 10^4	*FusariumspRhizopussp Candida sp*	3.6x 10^4
SS15(15-30cm)	*Bacillus sp Pseudonomassp Proteus sp Enterobacter sp*	3.3x 10^2	*Pseudonomassp Proteus sp Enterobacter sp*	3.1x 10^2	*Aspergillussp Mucorsp Penicilliumsp Fusariumsp*	5.1x 10^2	*Mucorsp Penicilliumsp*	4.2x 10^2

	Serriatiasp							
SS16(0-15cm)	*Pseudonomassp Proteus sp Escherichia sp Enterobacter sp Serriatiasp*	2.1x 10^3	*Pseudonomassp Proteus sp Escherichia sp*	1.7x 10^2	*Candida sp Aspergillussp Mucorsp Penicilliumsp Fusariumsp*	3.6x 10^3	*Candida sp Aspergillussp Mucorsp*	2.1x 10^2
SS16(15-30cm)	*Bacillus sp Pseudonomassp Proteus sp Escherichia sp Klebsiellasp*	4.2x 10^2	*Pseudonomassp Proteus sp Escherichia sp Klebsiellasp*	3.6x 10^2	*FusariumspMucorspRhizopussp Candida sp*	3.9x 10^4	*MucorspRhizopussp Candida sp*	3x 10^4
SS17(0-15cm)	*Serriatiasp Staphylococcus sp Enterobacter sp Actinomyces sp Flavobacterium sp Chromobacteriumsp*	3.6x 10^4	*Serriatiasp Staphylococcus sp Enterobacter sp Actinomyces sp*	3.2x 10^4	*FusariumspMucorspPenicilliumspRhizopussp Candida spAspergillussp*	4.8x 10^2	*FusariumspMucorspPenicilliumspRhizopussp Candida sp*	4.3x 10
SS17(15-30cm)	*Bacillus sp Pseudonomassp Micrococcus sp Escherichia sp Klebsiellasp*	3.9x 10^2	*Pseudonomassp Micrococcus sp Escherichia sp*	3.4x 10^2	*Aspergillussp Mucorsp Penicilliumsp Fusariumsp*	3.7x 10^3	*Mucorsp Penicilliumsp*	3.1x 10
SS18(0-15cm)	*Pseudonomassp Micrococcus sp Escherichia sp Klebsiellasp*	3.7x 10^2	*Klebsiellasp*	2.9x 10^2	*Penicilliumsp Fusariumsp MucorspRhizopussp Candida sp*	4.3x 10^2	*Rhizopussp Candida sp*	3.2x 10^2
SS18(15-30cm)	*Bacillus sp Pseudonomassp Proteus sp Escherichia sp Klebsiellasp*	3.8x 10^3	*Proteus sp Escherichia sp Klebsiellasp*	1.5x 10^2	*Mucorsp Penicilliumsp FusariumspRhizopussp Candida sp*	2.7x 10^3	*Mucorsp Penicilliumsp*	2.1x 10^2
SS19(0-15cm)	*Bacillus sp Pseudonomassp Micrococcus sp Escherichia sp Klebsiellasp*	4.9x 10^4	*Micrococcus sp Escherichia sp*	3.5x 10^4	*Aspergillussp Mucorsp Candida sp Trichoderma sp*	1.3x 10^4	*Candida sp Trichoderma sp*	1x 10^4
SS19(15-30cm)	*Arthrobacter sp Enterobacter sp*	4.7x 10^3	*Enterobacter sp Micrococcus sp*	3.9x 10^2	*Aspergillussp Mucorsp*	3.7x 10	*Aspergillussp Mucorsp*	3.5x 10

	Micrococcus sp *Actinomycessp*				*Penicilliumsp* *Fusariumsp*			
SS20(0-15cm)	*Proteus sp* *Escherichia sp* *Klebsiellasp* *Serriatiasp* *Flavobacteriumbsp*	$4.8x\ 10^4$	*Escherichia sp* *Klebsiellasp* *Serriatiasp*	$4.5x\ 10^4$	*Rhizopussp* *Candida sp* *Trichoderma sp*	$4.9x\ 10^4$	*Candida sp* *Trichoderma sp*	$4.2x\ 10^4$
SS20(15-30cm)	*Bacillus sp* *Pseudonomassp* *Proteus sp* *Enterobacter sp* *Serriatiasp*	$2.5x\ 10^3$	*Pseudonomassp* *Proteus sp* *Enterobacter sp*	$2.1x\ 10^2$	*Aspergillussp* *Mucorsp* *Penicilliumsp* *Fusariumsp*	$2.3x\ 10^3$	*Mucorsp* *Penicilliumsp*	$2.2x\ 10^2$

Appendix 6.4

FLORA SPECIES CHECKLIST

S/No	SPECIES	FAMILY	Habit	DBH(CM)	IUCN	Sapele - Ughelli								Benin - Sapele			
						1	2	3	4	5	6	7	8	9	10	11	12
1	*Alchornea cordifolia*	Euphobiaceae	S	30	NE		56	116		38			15				
2	*Alstonia congensis*	Apocyanaceae	T	74	NE	44						9			10	11	
3	*Anogeissus leiocarpa*	Combretaceae	T	60	NE		63	16	19					16			
4	*Anthocleista procera*	Gentianaceae	T	73	NE		21		15	9		16			38	20	
5	*Bauhiinia tomentosa*	fabacea	S	48				21				18			15		8
6	*Berlinia grandifloria*	Casalpinioideae	S	18	NE			15				17					
7	*Borassus aethiopum*	Arecaceae	T	24	NE					23			19	38			15
8	*Boswellia papyrifera*	Burseraceae	T	100	NE	28					27		46			20	
9	*Bridelia micrantha*	Phyllanthaceae	S	13	NE							19		6		11	
10	*Burkea Africana*	Caesalpinioideae	T	48	NE		14		16	11	28		15		15		30
11	*Campylospermum flava*	Ochnaceae	T	128	NE							64	94				
12	*Canarium schweinfurthi*	Burseraceae	T	118	NE	19		17				53					
13	*Carapa procera*	Meliaceae	T	44	NE		16		15		38		10	24		19	
14	*Cedrala odorata*	Meliaceae	S	26	VU						17		19		25		33
15	*Chaetacme aristata*	Ulmaceae	S	18	NE			19		16				17		33	
16	*Clausena anisata*	Rutaceae	S	84				61			33				24		19
17	*Cleistopholis patens*	Annonaceae	T	166	NE					28		28		16		38	
18	*Combretum molle*	Combretaceae	T	63	NE	66						15	56				16
19	*Cordyla Africana*	fabaceae	T	93		51			32		28		19	38		52	12

20	*Crateva adansonii*	Capparaceae	S	20	NE			8							12		
21	*Dalbergia latifolia*	Caesalpinioideae	T	88	VU		12				33		28			18	
22	*Daniellia oliveri*	Caesalpinioideae	T	34	NE			19						43			19
23	*Diospyros elliotii*	Ebenaceae	T	92	NE				48	23			33		18		39
24	*Ekerbergia capensis*	Meliaceae	T	138	NE	49	38							54			28
25	*Elaeis guineensis*	Arecaceae	T	88	NE	94	38	91	38	38	39	57	45	48	19	34	68
26	*Ficus barteri*	Moraceae	T	106	NE	32		16			31				26		28
27	*Funtunia elastic*	Apocyanaceae	S	28	NE	21				33		29					
28	*Gardenia imperialis*	Rubiaceae	S	30	NE				38		21				18		19
29	*Gilbertiodendron dewevrei*	Caesalpinioideae	T	66	NE		33							54		20	
30	*Grewia mollis*	Malvaceae	S	39	NE								54				
31	*Rauvolfia caffra*	Apocyanaceae	S	38	NE	21						15			34		
32	*Rothmania hispida*	Rubiaceae	S	46	NE					18				21		38	
33	*Santeria trimera*	Burseraceae	S	27	NE							10					
34	*Tabernaemontana sp*	Apocyanaceae	S	43	-		18							47		21	
35	*Chromolina odorata*	Asteraceae	H	11	NE	96						54					21
36	*Mimosa pudica*	Mimosoideae	H	6	NE		37	84		71	1			83		46	