ESIA OF LAGOS AND OGUN STATES TRANSMISSION LINES AND ASSOCIATED SUBSTATIONS PROJECT (LOT 3)

FINAL REPORT

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT OF LAGOS AND OGUN STATES TRANSMISSION LINES AND ASSOCIATED SUBSTATIONS PROJECT (LOT3)

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LIST OF ABBREVIATIONS AND ACRONYMS

%	Percentage
(T)	Threatened species
°C	Degree centigrade
°F	Degree Fahrenheit
AAS	Atomic Absorption Spectrometer
Ag	Silver
AIDS	Acquired Immuno-Deficiency Syndrome
AIS	Invasive species
ALARP	As Low As Reasonably Practicable
AM	Ante meridian
ANFO	Ammonium Nitrate fuel Oil
APHA	American Public Health Association
AQN	Air Quality and Noise
ARD	Acid rock drainage
ASTM	American Standard and Testing Methods
ATR	Africa Traditional Religion
Ba	Barium
BAP	Biodiversity Action Plan
BAT	Best Available Technology
BCG	Bacillus Chalmette-Guerin
BMI	Body Mass Index
BOD	Biological Oxygen Demand
BREF	Best available technical Reference document
Ca	Calcium
CBO	Community Based Organization
CCP	Cement Closure Plan
Cd	Cadmium
CDM	Clean Development Mechanism
CEMPS	Construction Environmental Management Plan
CEO	Chief Executive Officer
Cfm	Cubic feet per minute
Cfu/ml	Colony forming unit per millilitre
CHMP	Cultural heritage management plan
CHSP	Community Health and Safety Plan
CITES	Convention on International Trade in Endangered Species
Cm	Centimetres
CMP	Construction Management Plan
CNS	Central nervous system
CO	Carbon monoxide
CO_2	Carbon dioxide

COD	Chemical Oxygen Demand
CPKO	Crude Palm Kennel Oil
Cr	Chromium
Cu	Copper
D	Menhinick's Index (D).
D	Margalef's Richness Index (d)
dB	Decibels
DBH	Diameter Breast Height
DCS	Distributed Control System
DD	Data Deficient
DNA	Deoxyribonucleic Acid
DO	Dissolved Oxygen
DPT	Diphtheria pertussis tetanus
E	EASTINGs
EBRD	European Bank for Reconstruction and Development
EC	Electrical conductivity
Ef	Emission Factor
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EL	Exploratory License
EMP	Environmental Management Plan
EMP	Environmental Monitoring Plan
EMPRITP	Environmental Monitoring Programme and Resources Implementation and Training Program
EMS	Environmental Management System
EN	Endangered
END	Environmental Noise Directive
EPA	Environment Protection Act
EPFI	Equator Principle Financial Institution
EPRP	Emergency Preparedness and Response Plan
ESIA	Environmental and Social Impact Assessment
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and social management plan
ESPS	Environmental and Social Policy Statement
EU	European Union
FAS	Ferrous Ammonium Sulphate
Fe	IRON
FEPA	Federal Environmental Protection Agency
FGDs	Focus groups Discussions
FLS	FL Smidth

FM	Frequency modulation
FMEA	Failure Mode and Effects Analysis
FMEnv	Federal Ministry of Environment
G	Grams
GDP	Gross Domestic Product
GHG	Green House Gases
GHS	Globally Harmonized System
GIIP	Good Industry International Practice
GIS	Geographic information system
GIT	Gastro-intestinal Tract
GM	General Manager
GPS	Global Positioning System
H_2S	Hydrogen sulphide
Ha	Hectare
HAZID	Hazard Identification
HAZMATS	Hazardous materials
HAZOP	Hazard and Operability
HBV	Hepatitis B Virus
HEMM	Heavy Earth Moving Machinery
HFO	Heavy Fuel Oil
HGL	Honeywell Group Limited
HIA	Health Impact Assessment
HIV	Human Immuno-deficiency virus
HPLC	High Performance Liquid Chromatograph
HRRP	Habitat removal and re-instatement plan
Hs	Shannon and Weiner diversity index
HSD	High speed diesel
HSE	Health, Environment and Safety
i.e.	That is
IAA	International Atomic Agency
IEC	Information Education and Communication
IFC	International Finance Corporation
IFF	Intergovernmental Forum on Forests
ILO	International Labour Organisation
IMCO	Inter-governmental Maritime Consultative Organization
IPF	Intergovernmental Panel in Forests
IPIECA	The international petroleum industry environmental conservation association
IPPC	Integrated Pollution Prevention and Control
IQ	Intelligence quotient
ISO	International Organization for Standardization

ISQG	International Quality Sediment Guidelines
ISWMS	Integrated Solid Waste Management Scheme
ITCZ	Inter-tropical convergence zone
ITD	Inter-tropical discontinuity
IUCN	International Union for Conservation of Nature
J	Species Equitability
JICA	Japanese International Cooperation Agency
K	Potassium
kg/yr	Kilogram per year
KW	Kilowatt
LASEPA	Lagos State Environmental Protection Agency
LAWMA	Lagos State Waste Management Agency
LC	Least concerns
LCD	Liquid Crystal Detector
LCP	Large Combustion Plants
LFN	Laws of the Federation of Nigeria
LGA	Local Government Area
LIDAR	Light detection and ranging
Log	Logarithm
LPFO	Low Pour Fuel Oil
LSG	Lagos State Government
m^3/hr	Metre cubic per hour
MC	Mifor Consult
MCC	Manual classified Count
MCTC	Manual Classified Turning Count
MDA	Ministries, Department and Agencies
Mg	Magnesium
MG	Milligram
mg/kg	Milligram per kilogram
mg/l	Milligram per litres
MGW	Mega watts
Ml	Millilitres
ML	Metals leaching
MLA	Mining Lease Area
mm	Millimetre
mm/sec	Millimetre per seconds
MMSD	Ministry of Mines and Steel Development
Mn	Manganese
MoU	Memorandum of Understanding
mS/cm	Micro Siemens per centimetre
MSDSs	Material Safety Data Sheets

mT	Tropical Maritime
MTPA	Million Tonnes Per Annum
MW	Mega Watts
N	NORTHINGS
NA	Not Available
Na	Sodium
NBAP	National Biodiversity Strategy and Action Plan
NBS	The National Bureau of Statistics
ND	Not Detected
NE	Not evaluated
NEEDS	National Economic Empowerment and Development Strategy
NEITI	Nigerian Extractive Industry Transparency Initiative
NERP	National Emission Reduction Plan
NES	Nigeria Environmental Society
NESREA	National Environmental Standards and Regulations Enforcement Agency
NG	Nitro-glycerine
NGOs	Non-Governmental Organizations
Ni	Nickel
NIMET	Nigerian Meteorological Agency
NO	Nitrogen oxides
NO_3	Nitrates
NPC	National Population Commission
NT	Not- Threatened
NTU	Nephelometric Turbidity Unit
OGEPA	Ogun State Environmental Protection Agency
OHSAS	Occupational Health and Safety Assessment Series
OPIC	Overseas Private Investment Corporation
OSG	Ogun State Government
PAG	Management of potentially acid generating
PAH	Polycyclic aromatic hydrocarbons
Pb	Lead
PCB	Polychlorinated Biphenyl
PCBs	Polychlorinated biphenyls
PH	Power of hydrogen (hydrogen ion)
PM	Post meridian
PM	Particulate Matter
PNS	Peripheral nervous system
PO_4	Phosphates
PPE	Personal Protective Equipment
PPE	Personal protective equipment

ppm	Parts per million
PSD	Particulate Size Distribution
PTDF	Petroleum Trust Development Fund
PVC	Polyvinyl chloride
QA	Quality Assurance
QC	Quality Check
QHSE	Quality Health Safety and Environment
RBDPKO	Refined Bleached Deodorized Palm Kernel Oil
RBDPO	Refined Bleached Deodorized Palm Oil
RL	Reduced Level
RP	Regeneration potential
RTI	Respiratory Tract Infection
SDOS	Sustainable development organizational structure
SDP	Sustainable Development Plan
SEMA	State Emergency Management Agency
SEPA	State Environmental Protection Agency
SIA	Social Impact Assessment
SMCL	Secondary Maximum Contaminant Level
SNCR	Selective Non-catalytic Reduction
SO_4	Sulphates
SoI	Sphere of influence
SOPs	Standard Operating Procedures
SPL	Sound pressure level
SPM	Suspended particulate matter
SPO	Special Palm Oil
SPSS	Statistical package for the social sciences
Sqm^2	Square meter
STDs	Sexually Transmitted Diseases
SUVs	Sport Utility Vehicles
T	Turbidity
TBA	Traditional Birth Attendants
TC	Tropical Continental
TC	Total Coli form
TCN	Transmission Company of Nigeria
TDS	Total Dissolved Solids
TFR	Total Fertility Rate
THB	Total Heterotrophic Bacteria
THC	Total hydrocarbon content
THF	Total Heterotrophic Fungi
THUB	Total Heterotrophic Utilizing Bacteria
THUF	Total Heterotrophic Utilizing Fungi

TL	Transmission line
TLV	Threshold Limit Value
TOC	Total Organic Carbon
ToR	Terms of Reference
TPM	Total particulate matter
TSC	Time Species Count
TSS	Total Suspended Solid
TT	Tetanus toxoid
UDHR	Universal Declaration of Human Rights
UN	United Nations
UNCBD	United Nations Convention on Biological Diversity
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
USD	United States Dollar
USDA	United States Department of Agriculture
USEPA	United States Environmental protection Agency
UV	Ultra-Violet
V	Vanadium
VOCs	Volatile Organic Compounds
VU	Vulnerables
WB	World Bank
WCMC	World conservation Monitoring Centre
WHO	World Health Organizations
WMF	Waste Management Facility
WRC	Watersheds Regulation Committee
YF	Yellow Fever
Zn	Zinc
µg/L	Microgram per litre
µS/cm	Micro Siemens per centimetre

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EXECUTIVE SUMMARY

Project Background

Nigeria has realized strong economic growth, until 2016 when the economy went into recession. However, stronger growth is projected for the future due the new anti-corruption posture of the Government as well as economic policies targeted at reducing capital flight. Meanwhile, power supply capacity is overwhelmingly insufficient. As a countermeasure of serious power shortage, Transmission Company of Nigeria (TCN) planned a project geared to achieving transmission capacity of 20,000 MW by 2020 in accordance with growth of generation capacity.

Presently, the transmission lines to the largest demand centre of Lagos are in a bottleneck situation so the generating capacities being built across the country cannot be fully utilized. Moreover, there are no detour routes for use when equipment failure occurs, and the system reliability is low.

The Lagos and Ogun States is targeted at improving power supply to Lagos and Ogun States, in line with the Transmission Lines network capacity development of achieving transmission capacity of 20,000 MW by 2020.This project in Lagos and Ogun States (“Lagos and Ogun States Transmission Project” or “ the entire project”) is to be financed through a loan (Japanese ODA loan) from Japan International Cooperation Agency (JICA). The Transmission Company of Nigeria (TCN) is the implementing agency and owners of the project when completed. This entire project plans reinforcement of transmission capacity, improvement of credibility of electricity supply and reduced electricity loss by installing transmission systems in southwest area Nigeria. It contributes acceleration of economy and development of the communities.

The entire project consists of about 203km high voltage transmission lines and 5 high voltage substations. For the purpose of ESIA and RAP study, the entire project is divided into 3 sections, Lot1, Lot2 and Lot3. Transmission Company of Nigeria (TCN) has mandated the EEMS Limited to conduct Line Route Study, Environmental and Social Impact Assessment (ESIA), Environmental and Social Management Plan (ESMP) and Resettlement Action Plan for Lot 3 of the project consisting of the following components, with total length of 87.7km

- 330kV D/C Transmission Line from Ejio to Ajegunle, with estimated length of 29.5km.
- 132kv D/C Transmission Line from Ajegunle to Agbara, with estimated length of 21.7km.
- 132kv D/C Transmission Line from Ajegunle to Badagry, with estimated length of 36.5km.
- New substation at Ejio (2x150MVA, 330/132kV + 2x60MVA 132/33kV)
- New substation at Ajegunle (2x150MVA, 330/132kV + 2x60MVA 132/33kV)
- New substation at Badagry (2x60MVA, 132/33kV).

This type of project must undergo an environmental and social impact assessment as required by the EIA Act No. 86 of 1992. And in conformance with Nigerian legislations, JICA guidelines for environmental and social considerations, the World Bank environmental and social safeguard policies and International best practices, the project is subjected to a complete environmental study, along with RAP and an Environmental and Social Management Plan (ESMP). The present document is the ESIA report of the Lagos and Ogun States Transmission Projects (LOT3).

The Proponent

Transmission Company of Nigeria (TCN), wholly owned by the Federal Government of Nigeria 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.

TCN has eight Transmission Regions and a National Control Centre, NCC. Each of these is headed by a General Manager (Transmission), who is responsible for the running and maintenance of transmission and transformation facilities in their areas of operation. The Transmission Regions are Lagos, Osogbo, Kaduna, Bauchi, Benin. Shiroro, Enugu and Port Harcourt and the National Control Centre (NCC) located at Osogbo.

Being one of the 18 unbundled Business Units under the Power Holding Company of Nigeria (PHCN), TCN was issued a transmission license on 1st July 2006 by the Nigerian Electricity Regulatory Commission (NERC) to carry out electricity transmission, system operation and electricity trading which is ring fenced.

Policy, Legal and Institutional Framework

Section 20 of the constitution of Nigeria (1999), makes it an objective of the Nigerian State to improve and protect the air, land, water, forest and wildlife of Nigeria. And Section 12 establishes, though impliedly, that international treaties (including environmental treaties) ratified by the National Assembly should be implemented as law in Nigeria. Furthermore, 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.

The national policies relevant to this project are as follows;

- National Environmental Policy
- National Energy Policy
- National Land Policy
- National Social Protection Policy
- National Gender Policy

The laws and regulations relevant to the project include the following;

- The Environmental Impact Assessment (EIA) Act Cap E12 LFN, 2004
- Land Use Act of 1978
- Electric Power Sector Reform Act No. 6, 2005
- National Environmental Standards & Regulations Enforcement Agency (NESREA) Act, 2007
- The Nigerian Urban and Regional Planning Act CAP N138, LFN 2004; contain requirements for development planning
- Harmful Waste (Special Criminal Provisions) ACT CAP H1, LFN 2004; prohibits dumping of harmful wastes within Nigeria
- The Endangered Species Act, CAP E9, LFN 2004; protects endangered species.
- The Factories Act, 1987 (Factory Act cap 126, LFN, 1990); contain labour requirements, including occupational health, and similar matters.
- Labour Act - CAP. L1 L.F.N. 2004; specify requirements relevant to labour issues, including wages, recruitment, discipline, employee welfare, employment of women and child labour.
- Wages Board and Industrial Council Act, 1974; established the National Wages Board and Area Minimum Wages Committee for States and for Joint Industrial Councils for particular industries, which determines minimum wages.
- Workers' Compensation Act, 1987; provisions for the payment of compensation to workmen for injuries suffered in the course of their employment and compulsory insurance covers employees of all categories
- National Environmental Regulations established by NESREA based on Section 34 of the NESREA Act, 2007. Those relevant to this project include Effluent Limitations, management of Solid and Hazardous Waste and Pollution Abatement in Industries Generating Wastes.
- Ogun State Environmental Protection Agency (OGEPA) Law of 1995
- Ogun State of Urban and Regional Planning Law No 20 of 2005
- Environmental Management (Miscellaneous) Provisions Law, 2004
- Lagos State Environmental Management Protection Law, 2017 ("EMPL 2017")

The international conventions, to which Nigeria is a signatory, relevant to this project are as follows:

- African Convention on the Conservation of Nature and Natural Resources
- Convention on Biological Diversity
- Endangered Species (Control of International Trade and Traffic)
- Conservation of Migratory Species of Wild Animals (1973)
- Convention to Combat Desertification (1994)

- United Nation Framework Convention on Climate Change (UNFCCC) 1992.
- International Union for Conservation of Nature and National Resources (IUCN) Guideline, 1996.
- The African Convention on the Conservation of Nature and Natural Resources, 1968.
- Convention on the Elimination of All Forms of Discrimination against Women (CEDAW)
- Human and Peoples' Rights on the Rights of Women in Africa in 2005
- Civil and Political Rights Covenant
- Economic, Social and Cultural Rights Covenant
- Convention on the Elimination of All Forms of Violence Against Women
- Convention on the Rights of the Child
- ILO Occupational Safety and Health Convention, 1981
- ILO Conventions and Core Labour Standards
- World Bank Safeguard Policies
- JICA Guidelines for Environmental and Social Considerations
- IFC Performance Standards for Investment

Gap Analysis: Nigerian EIA Act. 86 vs World Bank OP 4.01

Regarding legislative and institutional arrangement for EIA in general there is no difference in categorization, details of EIA study and EIA report, public participation, and information disclosure between the JICA Guidelines and Nigerian laws and regulations. On the other hand, the difference to be considered is that environmental items of social environment such as gender, children's right, local conflict of interests, misdistribution of benefit and damage are not included in laws and regulations related to public participation and information disclosure.

ESIA Terms of Reference

In line with the Nigeria's EIA procedural guidelines (FEPA, 1995), the Terms of Reference (ToR) for the ESIA of the proposed project approved by the FMEnv's had the following objectives:

- 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.
- 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.

Project Justification

Lagos and Ogun State to a certain extent are industrial nerve centers of Nigeria. Hence, account for significant proportion of load demand from the national grid. The new power plants in the South normally transmits to the North through the areas of highest demand (Lagos). And presently the transmission system around the area has limited capacity as a result they constitute bottlenecks. Hence, the need to expand the network to improve stability and reliability.

The sustainability of the project has been considered on three premises – technical, economic and environmental and social. Technically, the technologies, materials and equipment and personnel are available. On the economic premise, the funds for its execution are available and the project output is awaiting uptake by the consumers through Ikeja, Eko and Ibadan DISCOs in return for tariff payments. Environmental and social sustainability stem from the complete acceptance of the project by host communities, the careful identification and mitigation of project negative impacts and TCN’s commitment to the implementation of all developed project’s management plans.

Analysis of Project Alternatives

Three options were considered - the do-nothing option which would result in the continuation of reliance on the present insufficient and unreliable transmission network around Lagos, further resulting to the use of domestic and industrial generators which would lead to increase gaseous emissions with its associated health effects.

The second option was to delay the execution of the proposed project while the third option was to execute the proposed project now to bring its benefits to bear on the economy positively. The first two options were therefore rejected in favour of the third. The chosen option was subsequently subjected to various project alternatives, principally based on substation sites and technology; and transmission line routes and capacity selection and technology. For substation sites, availability of land, distance and corridor for the associated transmission line were considered.

Multi-criteria analyses were used to analyse the alternative line routes, which took into consideration of the economic, technical, environmental and social criteria to arrive at the optimal alternative.

Considering technology, two alternatives were analysed for the substations. The Air-insulated Substations (AIS) was chosen for all the substations because it is easier to operate and maintain as well as less expensive compared to the Gas-insulated Substation (GIS).

Project Description

The proposed Lagos and Ogun States transmission project is a power transmission project that connects three proposed new substations at Ejio, Ajegunle and Badagry as well as the existing Agbara substation.

Project Phases and Activities

The project activity order for the proposed PTLs and substations is given below. It is anticipated process for selection of contractors to commence in 3rd quarter in 2019, and actual construction works of the transmission line will commence in last quarter 2020 and take between 24 to 36 months to complete. The project will be implemented according to the following phases.

1) Phase I: Pre-construction
2) Phase II: Construction Phase
3) Phase III: Operations and Maintenance Phase
4) Phase IV: Decommissioning/Closure

This last phase comes at the end of project's lifespan and will involve in the minimum, decommissioning audit, dismantling and removal of structures, site restoration.

The Line Route

A 50m width clearance for 330kV line and 30m width of right of way for 132kV line projects is allow for Nigeria standard. The transmission line ROW acquired for this project is:

- **i.** For 330kV Line (Ejio-Ajegunle): $29.1 \times 1000 \times 50 = 1{,}455{,}000\ m^2$ (145.5 ha)
- **ii.** For 132kV Line (Ajegunle-Agbara): $22.5\ 1000 \times 30 = 675{,}000 m^2$ (67.5 ha)
- **iii.** For 132kV Line (Ajegunle-Badagry): $34.6\ 1000 \times 30 = 1{,}038{,}000 m^2$ (103.8 ha)
- **iv.** Less shared common tower for the 132Kv: $6 \times 1000 \times 30 = -180{,}000\ m^2$ (18.0 ha)

Giving a total of $2{,}988{,}000\ m^2$ = 298.8 hectares

The Substations

The proposed project in LOT3 comprises of four substations, three are new and one existing (Agbara susbatation). Each of the new proposed substation sites are 25.2 ha, while no additional land take is needed for Agabara, giving a total of 57.6 ha.

Main functions of the proposed substations:

- For Voltage control mechanism through the transformers to step-up or step-down the system voltage as case might be, thereby lowering transmission losses.
- For Correction of power factor in the circuits when the reactive loads are there to protect the generating plants and increase efficiency.
- For load shedding purposes on the distribution network there maintaining system balance.

Main facilities to be installed at the substations:

- All transformers of different sizes and ratings as capture in 3.3 above.
- All breakers and isolators.
- All auxiliary transformers – Voltage, current, reactor, instrument etc.
- Line Bays as required.
- Cable trenches, oil sumps and drainage channels.

The Conductors, Insulators and Fittings

The following types of insulators were considered for this project:

- Porcelain Discs, Porcelain Longrod, and Polymeric Longrod

The fitting line design for this project will be in accordance with standard fittings assembly. The design will include armour grip suspension units, spacers and dampers. The tension insulators assemblies will include grading rings to reduce the effects of corona.

Transmission line system protection has both electrical and mechanical aspects.

- For mechanical protection, Buchholz, high temperature, oil level relays including no-load time changer protection and all will be incorporated.
- The electrical aspect on the other hand shall consist of numerical low impedance differential protection, high impedance restricted earth fault for each star connected transformer winding.

Communication/Control System

Radio communication between the technical crew in the Substation with the other Substations in the Transmission network, or between the control room officer and other field officers is considered very important for effective system operations. Hence highly sophisticated equipment shall be employed in this project.

Campsites / Logistics Bases

Campsites / logistics bases will be located at and adjacent to the substation locations at Ejio and Ajegunle as well as at Agbara Industrial Estate. No construction of residences will be needed for these base camps as there good hotels around the areas can accommodate workers close to all the worksites. However, storage facilities for equipment and materials will be needed.

Access Track Repair / Upgrade / Construction

Access to each structure location will be required for a crane, elevated platform, trucks transporting the materials and construction equipment, materials, and vehicles. Access will also be required to temporary sites needed for storing conductor drums, winching and braking equipment during the overhead earth wire stringing.

Workforce and Hours of Operation

Labour requirements for this project will generally be a maximum of 32, comprising approximately 10 on access track and foundation work, 10 on structure erection and 12 on stringing work, with a number of others engaged on miscellaneous other activities.

Due to the nature of activities to be undertaken, most of the construction program will include work that will be done at night time and weekend periods as required.

Operations and Maintenance of the Transmission Line

TCN shall be responsible for the maintenance of the proposed PTL. The maintenance process shall include:

Structure and Conductor Maintenance: upon completion of the transmission line, maintenance patrols will make periodic inspections of the structures, the easement and the conductor as well as line hardware, taking particular note of clearance conditions, damage to components or evidence of vandalism.

Easement Maintenance: As outlined in TCN Easement and Access Track Maintenance Policy maintenance of the transmission line easement is necessary to ensure that the safe electrical clearances are not infringed due to growth of vegetation.

Rehabilitation Program

Rehabilitation of work sites will be carried out as work proceeds and as soon as possible after the completion of work on each site. However, a rehabilitation plan shall be included in the project's ESMP.

Wastes Generation and Management

The list of envisaged project wastes and their potential sources:

- **i.** Leaves, branches, trunks, grasses from the clearing of the vegetation along ROW and Substation spaces.
- **ii.** Kitchen wastes from human feeding and activities involving many workforces.
- **iii.** Scrap metals – from cuttings, fittings, pylon member, nuts, bolts, and welding etc.
- **iv.** Concrete waste – from foundations and plinths, including housing complex and control room construction.
- **v.** Nylons/Plastics – from human activities wrappings, water sachet, food etc.
- **vi.** Oil spills from heavy duty machinery and equipment, transformers, breakers, and vehicle engines, either during normal runs of old machines or maintenance work.
- **vii.** Human wastes – from activities of personnel involved in the work or secondary business group.
- **viii.** Operational activities – nylons, paper materials/office, human waste etc.

Waste disposal methods will include:

a. solid waste (composting of biodegradables, selling metal, wood, and plastic scraps to buyers, reuse of materials e.g., packages, concrete, etc, dumping of remaining wastes at approved sites)

b. liquid waste (sewage from site camps will be vacuum-sucked into septic tanked trucks and taken to sites approved by OGEPA or LASEPA.

c. spent oils generated during transformer fillings, retrofitting and maintenance work will be stored in oil trench and oil sump at the substations preparatory to evacuation by contractors licensed by the FMEnv for that purpose.

Project Schedule

The proposed project execution schedule indicates construction commencement in Q3 2019 and commissioning scheduled for Q4, 2021.

ENVIRONMENTAL AND SOCIAL IMPACTS

The summary of impact analysis as described in the environmental and social impact assessment report is presented here. The impact analysis considers the various phases of the project:

- pre-construction phase
- construction phases
- operation phase, and
- decommissioning phase

This analysis is based on a cause/effect matrix between project-related impact sources and valued environmental and social components. Impacts are defined by their intensity (low, medium, major), their extent (regional, local, limited) and their duration (long, medium, short). The method used to identify, analyze and mitigate environmental and social impacts, or to improve positive impacts, places the project in a sustainable development perspective. The mitigation of anticipated negative impacts and the enhancement of positive impacts allow its environmental and social acceptability by stakeholders. Impact intensity as well as impact probability of occurrence, based on the ESIA report of the Abuja Power Feeding Transmission Scheme.

Anticipated Socio-Economic Benefits

The potential socio-economic benefits that will arise due to the commencement of the project includes

- Increased earning to local labourers from vegetation clearing and site preparation
- Provision of social amenities like portable water supply, electricity, and asphalt road
- Direct employment to qualified Nigerians and local inhabitants

- Increased revenue to state and through payment of electrical bills
- Increased foreign and local investments in the area and in the country, leading to wealth creation, employment generation, infrastructural development, and economic empowerment
- Availability of land for alternative use, after project decommissioning

Potential Negative Impacts

Environmental issues identified may involve negative impacts includes;

- The use of energy and non-renewable resources;
- Depletion of ecosystem resources and potential soil and water pollution
- More burden on local infrastructures
- Emissions to air (in particular dust); discharge of effluent/waste water to the aquatic environment and potential water pollution
- Occupational health and safety
- Public health issues involving waste management and community health.

ENVIRONMENTAL AND SOCIAL MANAGEMENT MEASURES

Mitigation impact hierarchy has been applied for the identified significant (adverse and beneficial) impacts, by considering prevention/avoidance, reduction, and control of adverse impacts in that order and enhancement for the beneficial impacts. Measures proposed are as follows, with the PIU being the responsible implementing entity during construction and TCN HSE Unit during operations phase. However, these can be included in contracts for third parties to implement but does not absolve TCN from the overall responsibility of ownership.

Mitigation Measures During Pre-construction and Construction Phases

- Implement the resettlement action plan (RAP), and pay fair compensation to PAPs
- The grievance mechanism in the RAP report to address complaints at the local level needs to be implemented by TCN and the action parties.
- Develop and implement stakeholder engagement plan for each phase of the project. EPC contractors are responsible during construction, while HSE Dept of TCN during operations
- Engage actively and activate the grievance resolution mechanism.

- Undertake revegetation planting agro-forestry trees that increase availability of fodder or fruit trees, to maximize livelihood benefits for local population.
- Carefully select the landing area of falling trees to minimize damages to crops.
- Locate access roads and lay down areas away from residences to the possible extent.
- Notify landowners along the line route about the construction schedule and activities.
- Secure equipment and demarcate any excavation work areas.
- Design and build the transmission line as to ensure that EMF levels are well below accepted guidelines for occupational and human health exposure limits.
- Maintain equipment and machinery in good running condition, including brakes, mufflers and silencers, and catalysers.
- Restrict transport and circulation activities on public roads to the period between 6 a.m. and 6 p.m.
- Require the Contractor to adopt policies and procedures that comply with national legislation and address all aspects of labor standards relevant to the project as specified by World Bank policies.
- Comply with TCN Corporate Policy on Occupational Health and Safety.
- Require all contractors and sub-contractors to comply with relevant World Bank (WB) health and safety requirements,
- Supply drinking water and maintain its quality and ensure sanitation at the construction sites.
- Develop and Implement an H&S management plan to protect every worker involved in construction activities, even temporary workers.
- Prepare and implement an HIV/AIDS prevention program.
- Screen health of potential employees as part of the recruitment process.
- Maintain construction camps in a clean and healthy condition as prescribed by international worker health standards.
- Communicate with communities effectively and involve their representatives.
- Employ non-skilled and semi-skilled labour, where available and provide training in relevant skills needed by the project to enable community members participate.

- Encourage the recruitment of female workers.
- Apply the Physical Cultural Resources Management Plan, waste management plan, vegetation management plan, etc.
- Provide development projects to affected communities along the route and around the substation.

Mitigation Measures During Operations Phase

- Provide all internal combustion equipment with properly functioning silencers or mufflers.
- Prepare and implement an Emergency Response Plan.
- Keep Spill Containment Kits readily accessible in the event of an accidental spill and ensure on-site staff is trained in spill response.
- Contain any spills and clean up spills as soon as possible.
- Grade ground surface at each tower site to provide drainage away from tower base.
- Maintain all work inside the footprint of access road and ROW to reduce encroachment on natural habitats.
- Clearly mark the extent of vegetation control in the ROW. Identify and mark the vegetation to be preserved along sections of the ROW.
- Undertake selective control of the vegetation to keep low scrubby and herbaceous species that do not represent a risk for the powerline (species that cannot grow more than 4m in height).
- Dispose of organic material removed from the ROW properly and in line with waste management regulation and in collaboration with local communities.
- Use mechanical method for vegetation control inside the ROW. Forbid use of chemical pesticides to control vegetation in the ROW.
- Develop specific mitigation measures for species that are involved in bird mortality.
- Schedule ROW maintenance activities to avoid breeding and nesting seasons of bird species with special statuses.
- Undertake monitoring of natural resources exploitation and implement a sensitization program in order to educate and increase local communities' awareness on natural resources protection.

- Only excavate the lower third of ditches during drainage ditch maintenance in order to maintain ditch slope stability.
- Plan for maintenance activities to be conducted outside of the planting and grazing seasons.
- Apply human resources policies favouring local labour from communities traversed by the line.
- Implement training programs to build local capacity.
- Compensate PAPs for any damaged crops during maintenance works.
- Maintain a minimum working distance of 2.13 m to the energized components during maintenance work.
- Keep residences and other permanent structures such as schools, shops, or offices out of the wayleave to minimize exposure to EMFs.
- Educate local populations to safe behavior in the presence of a high voltage power line.
- Undertake awareness campaign to reduce bushfire and slash and burn practices under and close to the powerline.
- Install warning signs and anti-climbing device pylons.
- Ensure the development of local and regional emergency plans in case of infrastructure breakdowns, especially near roads or residential areas.
- Monitor and control illegal encroachments on ROW and educate the local population on EMF risks.
- Communicate with communities effectively and involve their leaders.

Specific Management Plans

Specific management plans have been developed for the project as follows;

- Resettlement Action Plan
- Waste Management Plan
- Vegetation Management Plan
- Physical Cultural Resources Management Plan
- Emergency Management Plan

- ✓ storage and use of petroleum products and hazardous substances
- ✓ petroleum product spills
- ✓ fire / explosion involving petroleum products or other hazardous substances
- ✓ spills of oils and grease
- ✓ use of electric transformers
- ✓ spills of dielectric oil
- ✓ fire / explosion involving an electric transformer

Training

The operating staff benefits from continuous training to guarantee a certain level of knowledge and adequate competence. The operating staff must fully understand the emergency response plan's procedures. Each worker will be trained to know the warning and intervention procedures in the event of an emergency.

Performance Monitoring and Surveillance

Performance monitoring are carried out to ensure that the required ESMP activities are being implemented and that the desired targets and outcomes are being achieved.

Performance monitoring involves three components:

- Monitoring of the implementation of identified management measures and plans, during pre-construction and construction phases.
- Monitoring of selected environmental and social indicators associated with expected impact sources, and changes on environmental and social components associated with project implementation, during operation phase.
- Audits assessing the strengths and weaknesses of the ESMP.

Internal monitoring is carried out by the PIU through the ESIA/ESMP Consultants, while regulatory monitoring and oversight is conducted by the Federal Ministry of Environment in conjunction with Regulators of other tiers of Government [state and LGAs]. The monitoring plan consist of environmental components/parameters to be monitored, objectives/targets, frequency, methods, responsibilities and locations. Reports of internal monitoring results are submitted to FMEnv at defined intervals, who will then take steps to review and verify.

In summary, the activities related to environmental monitoring will allow:

- → Overseeing the application of management or enhancement measures contained in the ESIA and in plans and specifications.
- → Conducting on-site work inspections, reporting all non-conformities, new issues or impacts not previously identified to the contractor.
- → Supervising higher impact activities or activities occurring in sensitive zones (deforestation, work in aquatic environments such as floodplains or banks or near cultural or collective sites etc.) to constrain impacts.
- → Recording all complaints and concerns raised by affected communities.
- → Evaluating the efficiency and the quality of management procedures and identifying, in consultation with the environment committee of the project management unit, alternative measures to put in place to resolve any unforeseen problems that may occur during the work.
- → Ensure that the work is performed in accordance with national environmental requirements and international best practices adopted by the funders.

The cost of these environmental and social surveillance measures cannot be specified at this point since they will be borne out by the PIU from their operating budgets. The surveillance of the job site and associated costs are included in the terms of the contractor's agreement but managed by the PIU to ensure independence of the Consultants.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

1.1.1 The Project

The Transmission Company of Nigeria (TCN) is one of the companies unbundled from the defunct Power Holding Company of Nigeria (PHCN), and the only one wholly owned by the Government. TCN is charged with the responsibility of transmitting electric power from the various power stations to the load centres across the country and beyond, ensuring efficient and cost-effective transmission, system operation, and improved service delivery. TCN is also responsible for the management of assets of the High Voltage Transmission System Operations, generation dispatch functions, as well as the development of the network through the construction of new transmission lines and substations for efficient transmission and system operations.

Nigeria has realized strong economic growth, until 2016 when the economy went into recession. However, stronger growth is projected for the future due the new anti-corruption posture of the Government as well as economic policies targeted at reducing capital flight. Meanwhile, power supply capacity is overwhelmingly insufficient. As a countermeasure of serious power shortage, Transmission Company of Nigeria (TCN) planned a project geared to achieving transmission capacity of 20,000 MW by 2020 in accordance with growth of generation capacity.

Presently, the transmission lines to the largest demand centre of Lagos are in a bottleneck situation so the generating capacities being built across the country cannot be fully utilized. Moreover, there are no detour routes for use when equipment failure occurs and the system reliability is low.

The Lagos and Ogun States is targeted at improving power supply to Lagos and Ogun States, in line with the Transmission Lines network capacity development of achieving transmission capacity of 20,000 MW by 2020.This transmission line project in Lagos and Ogun States ("Lagos and Ogun States Transmission Project" or "the entire project") is to be financed through a loan (Japanese ODA loan) from Japan International Cooperation Agency (JICA). The Transmission Company of Nigeria (TCN) is the implementing agency and owners of the project when completed. This entire project plans reinforcement of transmission capacity, improvement of credibility of electricity supply and reduced electricity loss by installing transmission systems in southwest area Nigeria. It contributes acceleration of economy and development of the communities.

The entire project consists of about 203km high voltage transmission lines and 5 high voltage substations. For the purpose of ESIA and RAP study, the entire project is divided into 3 sections, Lot1, Lot 2 and Lot 3. Transmission Company of Nigeria (TCN) has mandated the EEMS Limited to conduct Line Route Study, Environmental and Social Impact Assessment

(ESIA), Environmental and Social Management Plan (ESMP) and Resettlement Action Plan for Lot 3 of the project (hereinafter "the project" or "proposed project") consisting of the following components;

- 330kV D/C Transmission Line from Ejio to Ajegunle, with estimated length of 29.5km.
- 132kv D/C Transmission Line from Ajegunle to Agbara, with estimated length of 21.7km.
- 132kv D/C Transmission Line from Ajegunle to Badagry, with estimated length of 36.5km.
- New substation at Ejio (2x150MVA, 330/132kV + 2x60MVA 132/33kV)
- New substation at Ajegunle (2x150MVA, 330/132kV + 2x60MVA 132/33kV)
- New substation at Badagry (2x60MVA, 132/33kV).

Specifically, following studies shall be conducted.

- Carry out the Line Route Study (LRS), to determine the optimum route for the lines.
- Conduct the ESIA to identify and assess the potential environmental and social impacts and recommend appropriate mitigation strategies and prepare ESMP.
- Prepare out the Resettlement Action Plans (RAP), based on the international standards and principles presented in the Resettlement Policy Framework.

The project is financed through a loan from Japan International Cooperation Agency (JICA), as part of the development of power transmission infrastructure in the South-Western Region of Nigeria.

This type of project must undergo an environmental and social impact assessment as required by the EIA Act No. 86 of 1992. And in conformance with Nigerian legislations, JICA guidelines for environmental and social considerations, the World Bank environmental and social safeguard policies and International best practices, the project is subjected to a complete environmental study, along with RAP and an Environmental and Social Management Plan (ESMP).

1.1.2 The Proponent

Transmission Company of Nigeria (TCN), wholly owned by the Federal Government of Nigeria and having its headquarters at 14, Zambezi Crescent, Maitama, Abuja, is the project proponent. The company 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.

TCN has eight Transmission Regions and a National Control Centre, NCC. Each of these is headed by a General Manager (Transmission), who is responsible for the running and maintenance of transmission and transformation facilities in their areas of operation. The Transmission Regions are Lagos, Osogbo, Kaduna, Bauchi, Benin. Shiroro, Enugu and Port Harcourt and the National Control Centre (NCC) located at Osogbo.

Being one of the 18 unbundled Business Units under the Power Holding Company of Nigeria (PHCN), TCN was issued a transmission license on 1st July 2006 by the Nigerian Electricity Regulatory Commission (NERC) to carry out electricity transmission, system operation and electricity trading which is ring fenced.

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, hence all stakeholders should observe the Grid Code, Distribution Code and Market rules.

TCN has a Health Safety and Environment (HSE) Department, headed by a General Manager. The department is responsible for environmental and social safeguards of the company's activities and operations. The department also facilitates liaisons with communities as well as government agencies and local government departments to facilitate stakeholder consultations, as well as interfaces with the Federal Ministry of Environment for the approval of the ESIA.

1.1.3 Project Location

The entire project consists of about 203km high voltage transmission lines and 5 high voltage substations located in Lagos and Ogun State, as shown in Figure 1.1 and 1.2. The entire project is divided into three (3) Lots and the proposed project subject to this ESIA is Lot 3, which is a linear project crossing three LGAs of Ogun State (Ewekoro, Ifo and Ado Odo/Ota) and Badagry LGA of Lagos State. The transmission line has a total length of 87.7 km, consisting of 29.5km from Ejio (Arigbajo) to Ajegunle (New Agbara), 21.7 km from Ajegunle to Agbara and 36.5 km from Ajegunle to Badagary. The Ajegunle to Agbara and Ajegunle to Badagry lines share a common multi-circuit tower for 6.7 km. The three substations within the scope of Lot 3 are located at Ejio Village in Ewekoro LGA, Ajegunle in Ado Odo/Ota LGA and Yafin Village in Badagry LGA. See Figures 1.3.

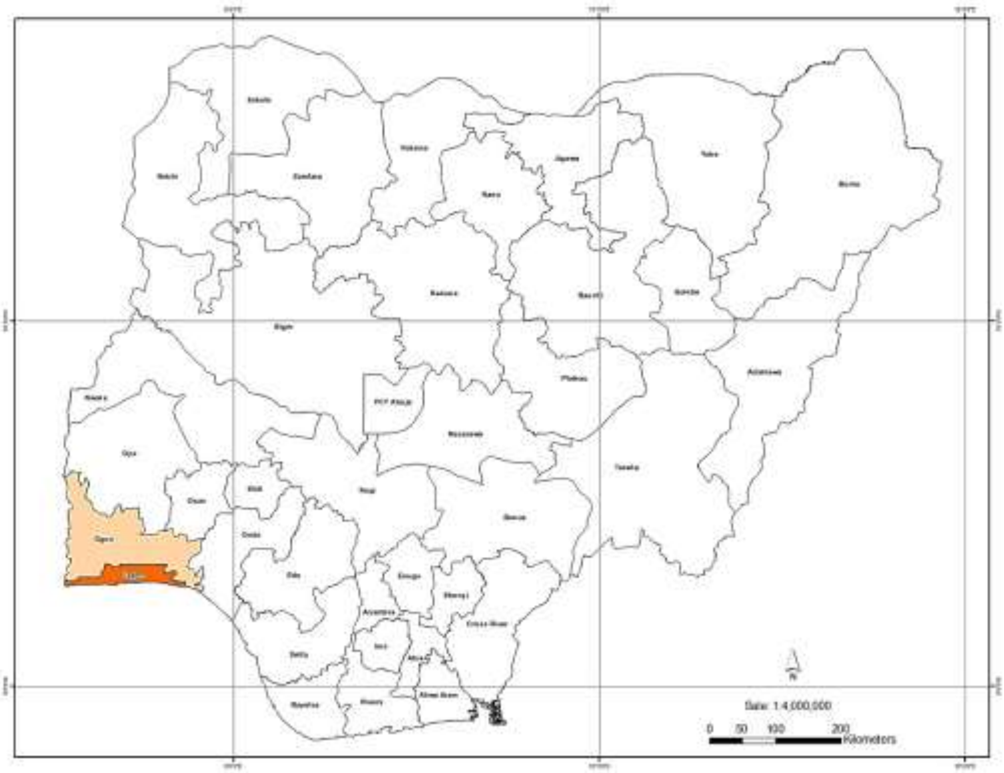


Figure 1.1 Map of Nigeria showing Location of Ogun and Lagos States

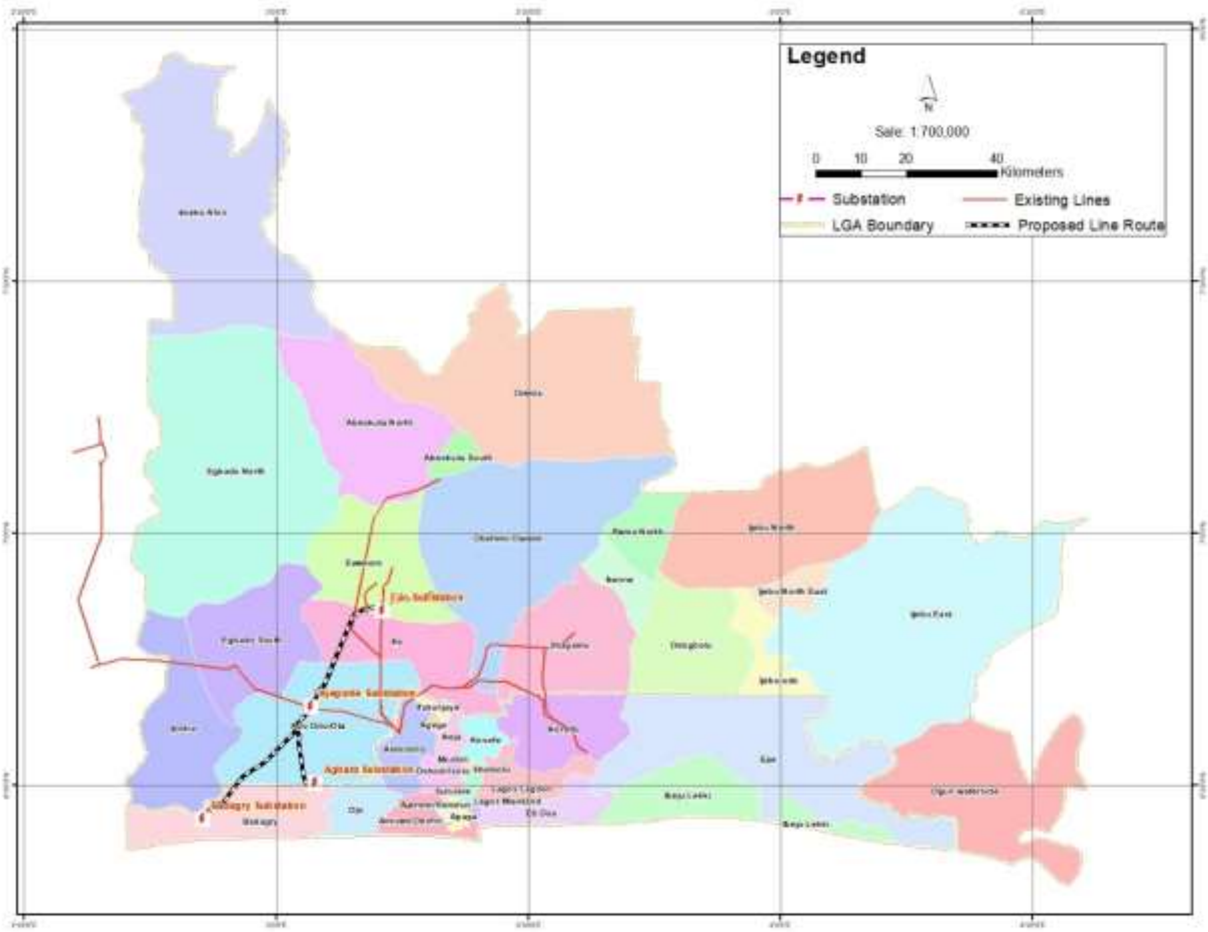


Figure 1.2 Map of Lagos and Ogun States Showing the Proposed Project (Lot-3) Route

1.2 Objectives of the ESIA

The objectives of the ESIA are as follows:

1. Ensure compliance with national environmental regulations and policies, JICA guidelines for environmental and social considerations, World Bank Safeguard Policies, and industry best practice and standards;
2. Generate baseline data to characterize existing environment as well as socio-economic and health conditions and for subsequent monitoring and evaluation of how well the mitigation measures have been implemented during the project life cycle;
3. Identify and analyze alternatives to the proposed projects, including sites, technology, layout, etc;
4. Identify and assess the anticipated environmental and social impacts of the proposed projects – both positive and negative;
5. Propose mitigation measures for negative impacts and enhancement measures for positive impacts to be undertaken during and after the implementation of the proposed projects;
6. Recommend cost effective measures to be used to mitigate against the anticipated negative impacts;
7. Consultation to seek the views of affected persons and stakeholders;

8. Prepare an Environmental and Social Management Plan (ESMP), include budget for implementation;

1.3 ESIA Scope of Work

The ESIA will inform the Government of Nigeria, TCN as project developer and as project sponsor as well as interested and affected parties and other stakeholders about potential environmental and social impacts associated with the development of the project components.

The ESIA should be prepared under meaningful consideration of information gathered from stakeholders, relevant government agencies, and with the active participation of and consultation with all groups of potentially affected people.

The Environmental and Social Impact Assessments (ESIA) will cover at minimum, but will not be limited to the following aspects:

- Description of the entire Project and detailed Project Description.
- Analysis of the National Legal Framework.
- Analysis of applicable international policies, guidelines and standards (Japan International Cooperation Agency (JICA) environmental guidelines as well as International Conventions/Guidelines/Agreements to which Nigeria is a signatory, WB social and environmental safeguards, relevant IFC social and environmental safeguards).
- Baseline Description: environmental and social baseline conditions (identification / census of the economic/person affected to be compensated)
- Assessment of project impacts, disaggregated to construction, operation and decommissioning; disaggregated into temporary and permanent impacts.
- Identification of Project Affected People and of severity of impacts; assessment of adverse as well as of beneficial impacts
- Analysis of alternatives, with an overall description of related impacts
- Assessment of the cumulative potential impacts
- Overview on environmental and social measures for mitigation of adverse impacts and enhancement of beneficial impacts including an outline for monitoring and evaluation procedures
- Institutional arrangements for environmental and social management, including staffing and capacity building plan
- Stakeholder Engagement Provisions, including planning for public information, consultation, participation and disclosure, a transparent and accessible grievance mechanism, monitoring provisions and reference to institutional set ups and responsibilities for the different activities under stakeholder engagement
- Projects Registration with Federal Ministry of Environment (FMENV) and payment of all required statutory fees for certification.

Scope of project component for Lot 3 are as follows; –

- Ejio – Ajegunle 330kV D/C Transmission Line
- Ajegunle – Agbara 132kv D/C Transmission Line
- Ajegunle – Badagry 132kv D/C Transmission Line

- 2x150MVA, 330/132kV + 2x60MVA 132/33kV Substation at Ejio
- 2x150MVA, 330/132kV + 2x60MVA 132/33kV Substation at Ajegunle
- 2x60MVA, 132/33kV substation at Badagry.

1.4 Policy, Legal and Institutional Framework

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

- Section 20 makes it an objective of the Nigerian State to improve and protect the air, land, water, forest and wildlife of Nigeria.
- Section 12 establishes, though impliedly, that international treaties (including environmental treaties) ratified by the National Assembly should be implemented as law in Nigeria.
- Sections 33 and 34 which guarantee fundamental human rights to life and human dignity, respectively, have also been argued to be linked to the need for a healthy and safe environment to give these rights effect.

1.4.1 Policy Framework

A. National Environmental Policy

Launched by Government in November 1989, this document prescribed guidelines for achieving sustainable development in fourteen vital sectors of the nation's economy, namely: Human Population; Land Use and Soil Conservation; Water Resources Management; Forestry, Wildlife and Protected Natural Areas; Marine and Coastal Area Resources; Sanitation and Waste Management; Toxic and Hazardous Substances; Mining and Mineral Resources; Agricultural Chemicals; Energy Production; Air Pollution; Noise in the Working Environment; Settlements; Recreational Spaces, Green Belts, Monuments, and Cultural Property.

It also contains Nigeria’s commitment to ensure that the country’s natural and built environment is safeguarded for the use of present and future generations. This commitment demands that efficient resource management and minimization of environmental impacts be the core requirements of all development activities. Accordingly, this Policy seeks to promote good environmental practices through environmental awareness and education. The project will have effects on biophysical and human environment, as a result it shall comply with the relevant provisions of this policy.

B. National Energy Policy

The National Energy Policy approved by the Executive Council of the Federation in 2003 and launched in 2005 has the following objectives:

- To ensure the development of the nation's energy resources, with diversified energy resources options, for the achievement of national energy security and an efficient energy delivery system with an optimal energy resource mix.
- To guarantee increased contribution of energy productive activities to national income.
- To guarantee adequate, reliable, and sustainable supply of energy at appropriate costs and in an environmentally friendly manner, to the various sectors of the economy, for national development.

The policy dealt with five focal areas.

- Energy Sources: Oil and Gas and Other Conventional (Coal & Tar Sands) Energy Sources such as Nuclear Renewable Energy.
- Energy Utilization: electricity, industry, agriculture, and transport.
- Energy Issues: Environment, Energy Efficiency and Conservation, Research, Development and Training, Energy Manpower Development; Bilateral, Regional and International Cooperation, Energy Databank.
- Energy Financing: Indigenous participation. Financing.
- Planning and Policy Implementation: energy planning, policy implementation, prioritization of strategies into short, medium, and long term, monitoring and evaluation.

The project is about improving energy supply, as a result it shall comply with the relevant provisions of this policy.

C. National Land Policy

The legal basis for land acquisition and resettlement in Nigeria is the Land Use Act of 1978, modified in 1990. According to the act, 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 Area.

The Governor had the right to grant statutory rights of occupancy to land. Local Government has the right to grant customary rights of occupancy.

The Land Act gives government the right to revoke statutory and customary rights to land for the overriding public interest. The act 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, the act specifies that the state or local government should pay compensation to the current holder or occupier with equal value. The act also requires the state or local government to provide alternative land for affected people who will lose farmlands and alternative residential plots for people who will lose their house.

The need for an integrated approach towards land use planning is highlighted. The coordination of activities of all stakeholders in land use planning is emphasized. In particular, the involvement of land owners, community groups, women, youth and the less privileged in making land use related decisions that affect them is regarded as being critical in the successful implementation of the policy.

The project will involve land take for the line route and the new substation sites. Hence, the process for the land acquisition shall comply with the national land policy.

D. Social Protection Policies

Social protection policy has been on the agenda since 2004, when the National Planning Commission, supported by the international community, drafted a social protection strategy. More recently, the National Social Insurance Trust Fund drafted a social security strategy. The social protection policy approached social protection using a life-cycle and gender lens, recognizing both economic and social risks, including, for example, job discrimination and harmful traditional practices. The policy was organized around four main themes: social assistance, social insurance, child protection and the labour market.

However, only a few of the instruments of this approach were adopted in the national implementation plan, most notably the provision of specific and limited social assistance, social insurance (such as expanding national health insurance to the informal sector) and labour market programmes (such as developing labor-intensive programmes). Moreover, in practice, programmes to date have been focused largely on conditional cash transfers and two health financing mechanisms driven by the federal government with little inter-sectoral or state-federal coordination. A significant number of actors are involved in funding and implementing social protection, including those from government, donors, international non-governmental organizations and civil society. Federal government-led social protection includes three main programmes:

- the conditional cash transfer In Care of the People (COPE) (funded initially through the DRG fund) targeted at households with specific social categories (those with children of school-going age that are female-headed or contain members who are elderly, physically challenged, or are fistula or HIV/ AIDS patients
- the health fee waiver for pregnant women and children under five (financed through the DRG fund)
- the community-based health insurance scheme, which was redesigned in 2011 because the previous scheme had design challenges Other social assistance programmes are implemented in an ad hoc manner by various government ministries, departments, and agencies at state level, and some are funded by international donors. These include conditional cash transfer programmes for girls’ education (in three states), child savings accounts, disability grants, health waivers, education support (such as free uniforms) and nutrition support. HIV and AIDS programming at state level also include social protection sub-components (although not as the primary objective), including nutrition, health and education support. Labour market programmes include

federal-and state-level youth skills and employment programmes, and Nigeria also has agricultural subsidies/inputs.

The project will have effects on the social aspects of the people around the area, as a result it shall comply with the relevant provisions of this policy.

1.4.2 Legal Framework

NATIONAL LEGISLATIONS

i. The Environmental Impact Assessment (EIA) Act Cap E12 LFN, 2004

The EIA Act 86 makes it mandatory for any person, authority, corporate body private or public, to conduct EIA prior to the commencement of any new major development or expansion that may likely have significant effect on the environment. The Act sets the EIA objectives and the procedures for consideration of EIA of certain public or private projects.

The project is a major development, which is expected to have some impacts on the environment. Hence, full compliance with the EIA Act is required. The EIA guidelines (procedural and sectoral) issued by the FMEnv derived from this Act and the project proponent (TCN) shall conduct its activities for the development of this project in conformance with these guidelines.

ii. Land Use Act of 1978

The Land Use Act (Cap 202, 1990), now Cap L5 Laws of the Federation of Nigeria 2004, is the key legislation that has direct relevance to this project. Relevant sections of these laws that may relate to this project with respect to land ownership and property rights, resettlement and compensation are summarized in this section.

The Land Use Act is the applicable law regarding ownership, transfer, acquisition and all such dealings on Land. The provisions of the Act vest every parcel of Land, in every State of the Federation, in the Executive Governor of the State. He holds such parcels of land in trust for the people and government of the State.

The Act categorized the land in a State to urban and non-urban or local areas. The administration of the urban land is vested in the Governor, while the latter is vested in the Local Government Councils. At any rate, all land 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”.

The concept of ownership of land as known in the western context is varied by the Act. The Governor administers the land for the common good and benefits of all Nigerians. The law 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 Statutory Rights of Occupancy are for a definite time (the limit is 99 years) and may be granted subject to the terms of any contract made between the state Governor and the Holder.

The Local Government Councils may grant customary rights of Occupancy for agricultural (including grazing and ancillary activities), residential and other purposes. But the limit of such grants is 500 hectares for agricultural purposes and 5,000 for grazing except with the consent of the Governor. The local Government, under the Act is allowed to 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.

The State is required to establish an administrative system for the revocation of the rights of occupancy, and payment of compensation for the affected parties. So, the Land Use Act provides for the establishment of a Land Use and Allocation Committee in each State that determines disputes as to compensation payable for improvements on the land (**Section 2 (2) (c)**).

In addition, each Local Government is required to set up a Land Allocation Advisory Committee, to advise the Local Government on matters related to the management of land. The holder or occupier of such revoked land is to be entitled to the value of the unexhausted development as at the date of revocation. (**Section 6**) (5). Where land subject to customary rights of Occupancy and used for agricultural purposes is revoked under the Land Use Act, the local government can allocate alternative land for the same purposes (**section 6**) (6).

If Local Government refuses or neglects within a reasonable time to pay compensation to a holder or occupier, the Governor may proceed to effect assessment under section 29 and direct the Local Government to pay the amount of such compensation to the holder or occupier. (Section 6) (7).

Where a right of occupancy is revoked on the ground either that the land is required by the Local, State or Federal Government for public purpose or for the extraction of building materials, the holder and the occupier shall be entitled to compensation for the value at the date of revocation of their unexhausted improvements. Unexhausted improvement has been defined by the Act as:

anything of any quality permanently attached to the land directly resulting from the expenditure of capital or labour by any occupier or any person acting on his behalf, and increasing the productive capacity the utility or the amenity thereof and includes buildings plantations of long-lived crops or trees, fencing walls, roads and irrigation or reclamation works, but does not include the result of ordinary cultivation other than growing produce.

Developed Land is also defined in the generous manner under **Section 50(1)** as follows: land where there exists any physical improvement in the nature of road development services, water, electricity, drainage, building, structure or such improvements that may enhance the value of the land for industrial, agricultural or residential purposes.

It follows from the foregoing that compensation is not payable on vacant land on which there exist no physical improvements resulting from the expenditure of capital or labour. The compensation payable is the estimated value of the unexhausted improvements at the date of revocation.

Payment of such compensation to the holder and the occupier as suggested by the Act may appear confusing as it raises the following question: Does it refer to holder in physical occupation of the land or two different parties entitled to compensation perhaps in equal shares? The correct view appears to follow from the general tenor of the Act.

First, the presumption is more likely to be the owner of such unexhausted improvements. Secondly, the provision of **section 6(5)** of the Act, which makes compensation payable to the holder and the occupier according to their respective interests, gives a pre-emptory directive as to who shall be entitled to what.

Again, the Act provides in **section 30** that where there arises any dispute as to the amount of compensation calculated in accordance with the provisions of **section 29,** such disputes shall be referred to the appropriate Land Use and Allocation Committee. It is clear from **section 47 (2)** of the Act that no further appeal will lie from the decision of such a committee. If this is so, then the provision is not only retrospective but also conflicts with the fundamental principle of natural justice, which requires that a person shall not be a judge in his own cause.

The Act must, in making this provision, have proceeded on the basis that the committee is a distinct body quite different from the Governor or the Local Government. It is submitted, however, that it will be difficult to persuade the public that this is so since the members of the committee are all appointees of the Governor.

Where a right of occupancy is revoked for public purposes within the state of the Federation; or on the ground of requirement of the land for the extraction of building materials, the quantum of compensation shall be as follows:

- In respect of the land, an amount equal to the rent, if any, paid by the occupier during the year in which the right of occupancy was revoked.

- In respect of the building, installation, or improvements therein, for the amount of the replacement cost of the building, installation or improvements to be assessed on the basis of prescribed method of assessment as determined by the appropriate officer less any depreciation, together with interest at the bank rate for delayed payment of compensation. With regards to reclamation works, the quantum of compensation is such cost as may be substantiated by documentary evidence and proof to the satisfaction of the appropriate officer.

- In respect of crops on land, the quantum of compensation is an amount equal to the value as prescribed and determined by the appropriate officer.

Where the right of occupancy revoked is in respect of a part of a larger portion of land, compensation shall be computed in respect of the whole land for an amount equal in rent, if any, paid by the occupier during the year in which the right of occupancy was revoked less a proportionate amount calculated in relation to the area not affected by the revocation; and any interest payable shall be assessed and computed in the like manner.

Where there is any building installation or improvement or crops on the portion revoked, the quantum of compensation shall follow that outlined in paragraph (ii) above and any interest payable shall be computed in like manner.

This project will require acquisitions of land for the substation sites and ROW for the transmission lines. Hence, will comply with the requirements of this law.

iii. Electric Power Sector Reform Act No. 6, 2005

The Act established the Nigerian Electricity Regulatory Commission (NERC) as an independent regulatory agency. NERC was inaugurated in October 2005, and is mandated to carry out:

- The monitoring and regulation of the electricity industry
- Issuance of licenses to market participants, and
- Ensure compliance with market rules and operating guidelines.

This Act also deals with acquisition of land and access rights. Section 77 of the Act empowers the NERC to make a declaration that land is required by a license for purpose of generation or distribution of electricity. Section 77 (9) states: “where the President issues a notice under sub-section 6, the Governor shall in accordance with the provisions of section 28(4) of the Land Use Act, revoke the existing right of occupancy respecting the land and grant a certificate of occupancy in favour of the concerned licensee in respect of the land identified by the commission in such notice who shall be entitled to claim compensation in accordance with the provisions of the Land Use Act”.

iv. National Environmental Standards & Regulations Enforcement Agency (NESREA) Act, 2007

Administered by the Ministry of Environment, the National Environment Standards and Regulations Enforcement Agency (NESREA) Act of 2007, repealed the Federal Environmental Protection Agency (FEPA) Act. It is the embodiment of laws and regulations focused on the protection and sustainable development of the environment and its natural resources. The following sections are worth noting:

- Section 7 provides authority to ensure compliance with environmental laws, local and international, on environmental sanitation and pollution prevention and control through monitory and regulatory measures.
- Section 8 (1)(K) empowers the Agency to make and review regulations on air and water quality, effluent limitations, control of harmful substances and other forms of environmental pollution and sanitation.

- Section 27 prohibits, without lawful authority, the discharge of hazardous substances into the environment. This offence is punishable under this section, with a fine not exceeding, N1, 000,000 (One Million Naira) and an imprisonment term of 5 years. In the case of a company, there is an additional fine of N 50,000, for every day the offence persists.

This project will comply with NESREA regulations, including conducting ESIA, environmental audit every three years after commissioning, obtain permit before disposing hazardous wastes, etc.

v. The Nigerian Urban and Regional Planning Act CAP N138, LFN 2004

The Urban and Regional Planning Act is aimed at overseeing a realistic, purposeful planning of the country to avoid overcrowding and poor environmental conditions. In this regard, the following sections become instructive:

- Section 30 (3) requires a building plan to be drawn by a registered architect or town planner.
- Section 39 (7) establishes that an application for land development would be rejected if such development would harm the environment or constitute a nuisance to the community.
- Section 59 makes it an offence to disobey a stop-work order. The punishment under this section, is a fine not exceeding N10, 000 (Ten thousand naira) and in the case of a company, a fine not exceeding N50, 000.
- Section 72 provides for the preservation and planting of trees for environmental conservation.

The project shall be implemented in line with requirements of this Act, including obtaining development permit from Ogun and Lagos State Governments.

vi. Harmful Waste (Special Criminal Provisions) ACT CAP H1, LFN 2004

The Harmful Waste Act prohibits, without lawful authority, the carrying, dumping or depositing of harmful waste in the air, land or waters of Nigeria. The following sections are notable:

- Section 6 provides for a punishment of life imprisonment for offenders as well as the forfeiture of land or anything used to commit the offence.
- Section 7 makes provision for the punishment accordingly, of any conniving, consenting or negligent officer where the offence is committed by a company.
- Section 12 defines the civil liability of any offender. He would be liable to persons who have suffered injury as a result of his offending act.

The project will generate wastes including construction wastes and transformer oils at substations and other harmful wastes. These wastes shall be handled, treated, and disposed of in accordance with the relevant requirements of this Act.

vii. The Endangered Species Act, CAP E9, LFN 2004

This Act focuses on the protection and management of Nigeria's wildlife and some of their species in danger of extinction as a result of over exploitation. These sections are noteworthy:

- Section 1 prohibits, except under a valid license, the hunting, capture or trade in animal species, either presently or likely, in danger of extinction.
- Section 5 defines the liability of any offender under this Act.
- Section 7 provides for regulations to be made necessary for environmental prevention and control as regards the purposes of this Act.

Certain sections of the line route of this project will pass through natural areas that serve as wildlife habitats which will be impacted by the project. Hence, the project activities shall be carried out to comply with relevant provisions of this Act.

viii. The Factories Act, 1987 (Factory Act cap 126, LFN, 1990)

The factories Act, as contained in the Laws of the Federation of Nigeria 1990, seeks to legislate, and regulate the conduct of health and safety in the Nigerian workplaces. It was enacted in June1987 with the desire to protect the workers and other professionals against exposure to occupational hazards. The director of factories at the Federal Ministry of Employment, labor and productivity is responsible for the administration of the provisions or requirements of this Act. Section 13 allows an inspector to take emergency measures or request that emergency measures be taken by a person qualified to do so, in cases of pollution or nuisances.

This Act deals with working conditions at work sites, including construction sites, such as the type to be undertaken under the Project. Hence, the occupational health and safety requirements applicable to construction sites, as well as other work sites to be used by the project shall be subjected to the provisions of this Act.

ix. Labour Act - CAP. L1 L.F.N. 2004

This Act deals with labour issues, including payment of wages, recruitment, discipline, employee welfare, employment of women and child labour. Sections **54 to 58** which deal with employment of women, prescribed period of absence from work for nursing mothers and allows her half an hour twice a day during her working hours to attend to the baby for a period of up to six months after she resumes work. Section 55 also exempted women from night work, except when they are employed as nurses. Sections 59-64 deal with employment of young people.

x. Wages Board and Industrial Council Act, 1974

The Act provides for the establishment of a National Wages Board and Area Minimum Wages Committee for States and for Joint Industrial Councils for particular industries. It empowers the Minister to order or direct that an industrial wages board be established to perform, in relation to the workers described in the order and their employers, the functions specified in the provisions of this Act, including minimum wage. The minimum wage is currently NGN 18,000.00 per month, and all workers employed for this project shall not earn less than the minimum wage. Hence, all workers engaged by the project shall be paid a minimum of N18,000 per month.

xi. Workers' Compensation Act, 1987

The Act to make provisions for the payment of compensation to workmen for injuries suffered in the course of their employment. The compulsory insurance covers employees for injury or death resulting in the course of work or in work places. All types of workers are covered including working under a contract of service or apprenticeship with an employer, whether by way of manual labour, clerical work or otherwise, and whether the contract is expressed or implied, is oral or in writing. The project will employ both skilled and non-skilled labour and shall be subject to this law as applicable.

National Regulations

National Environmental Regulations

In exercise of this power, the minster issued the national environmental regulations covering all sectors of development. The regulations relevant to the project are as follows:

- National Environmental (Sanitation and Wastes Control) Regulations, S.I.28 of 2009,
- National Environmental (Noise Standards and Control) Regulations, S.I.35 of 2009;
- National Environmental (Surface and Groundwater Quality) Regulations, S.I.22 of 2011;
- National Environmental (Electrical/Electronic Sector) Regulations, S.I.23 of 2011;
- National Environmental (Control of Bush/Forest Fire and Open Burning) Regulations, S.I.15 of 2011; and
- National Environmental (Soil Erosion and Flood Control) Regulations, S.I.12 of 2011

xii. EIA Procedural Guidelines

This procedure prescribes the steps to be followed in the EIA process from project conception to commissioning and post commissioning impact mitigation, to ensure that the project is implemented with maximum consideration for environment. This EIA study was conducted in compliance with this guideline.

The EIA Process in Nigeria: The Federal Ministry of Environment (FMEnv) developed guidelines to be used by project proponents in conducting EIA, in compliance with the EIA Act. Accordingly, the EIA process, illustrated in Figure 1.3, shall follow the following steps sequentially as outlined in the procedural guideline.

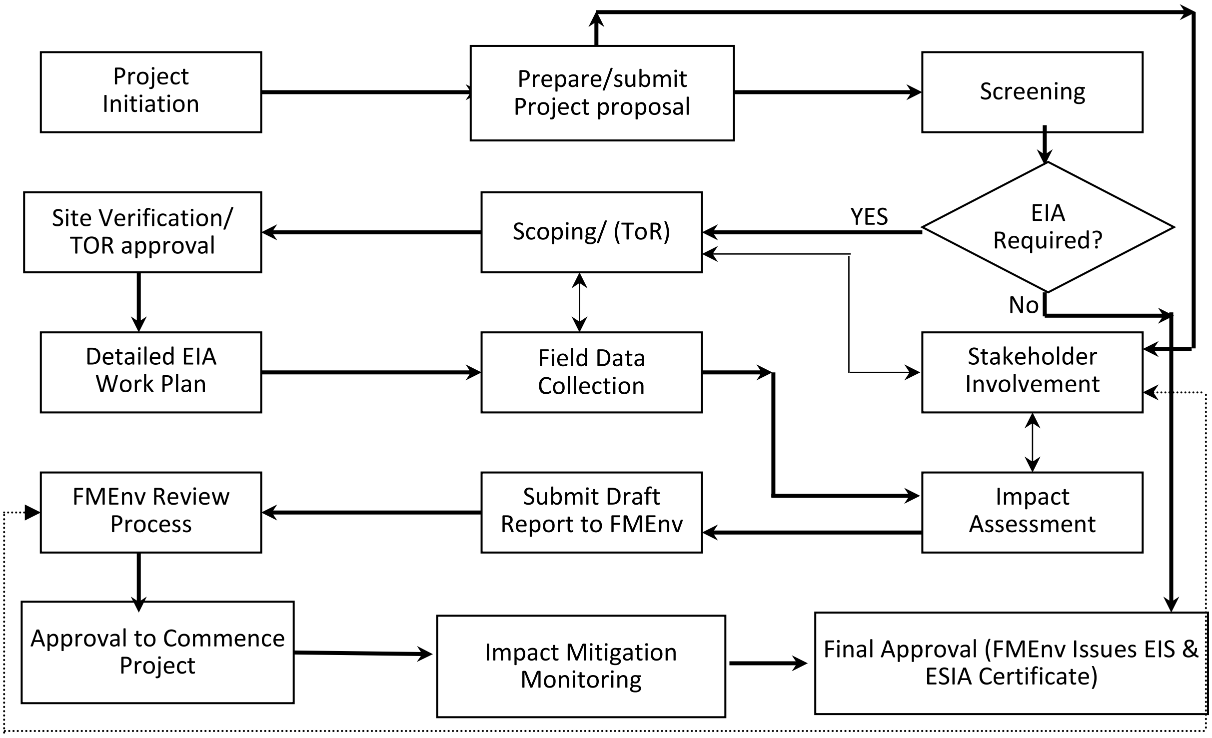


Figure 1.3 The EIA Process of FMEnv

xiii. EIA Sectoral Guidelines (Infrastructures)

This provides general guidelines for EIA of projects in infrastructure sectors of Nigeria, with specific details for sub-sectors. The Electrical transmission sub-sector applies to this project.

B) OGUN STATE LAWS

Ogun State Environmental Protection Agency (OGEPA) Law of 1995: This law established Ogun State Environmental Protection Agency as a parastatal under ministry of environment with the responsibility to protect the environment in the state.

Ogun State of Urban and Regional Planning Law No 20 of 2005: Established **t**he Ogun State Urban and Regional Planning Board as the agency responsible for development control in the state. The substation sites as well as the ROW in Ogun State needs to be approved by the board as part of the process for granting right of occupancy by the Governor. The State Ministry of Urban and Physical Planning also derives its statutory functions from section 3 line 246 of this law as the policy arm of the government related to physical planning in the State.

C. LAGOS STATE GOVERNMENT LAWS

Lagos State Environmental Management Protection Law, 2017 ("EMPL 2017"): This Law consolidates all the Laws and Regulations applicable to the management, protection and sustainable development of the environment in Lagos State. It deals with modern cosmopolitan environmental issues like waste management, litter, dumping of untreated toxic and or radioactive material into public drains; sanitation, street trading and hawking;

obstruction to drainage systems, water generation, effluents, noise, signage, advertisement, gardens and parks, etc. Key requirements related to this project are as follows;

- It is mandatory for all waste collection, transportation, recycling, sorting, treatment and disposal businesses to only operate in Lagos State under a Licence issued, by the Lagos Waste Management Authority (“LAWMA”). Therefore, the EPC contractor during construction shall engage a LAWMA licensed agent to manage its waste. The same applies to relevant TCN department during operation phase.
- All Residents are required to keep their premises and surrounding environment, forty-five (45) metres from all public sidewalks of a street, clean and devoid of litter and waste. As part of this requirement, all generated during construction and operation of the project shall be kept in securely tied and fastened plastic bags or leak proof dustbins, or covered litter bins.
- Prohibition of objectionable loud noises, except where a Licence is obtained prior to the commencement of a noise generating activity.
- Prohibition of street trading, for which both buyer and seller becomes liable. Hence, workers employed by the project (both temporary and permanent) shall not engage in street buyer or patronizing hawkers.
- Any person engaged in any form of commercial activity is required to pay, not later than the 1st day of January of every calendar year, an Environmental Development Levy to the Lagos State Environmental Protection Agency (“LASEPA”).
- The dumping and burying of any untreated, injurious gases, toxic or radioactive waste or substances, without a government issued Permit is expressly prohibited.
- Waste Management Facilities, Abattoirs and Livestock establishments, Housing Estates, Hotels, Hospitals and other commercial facilities shall not discharge any trade or industrial waste or effluents into the public drains without first treating such waste and effluent and retaining possession of a prior issued Permit from LASEPA.
- Residents in residential premises are allowed, without a licence from the Lagos State Water Corporation (“LWC”), to construct, dig or extend in their premises, any well, borehole or other works for the supply of water for domestic use only. Such water supply systems must however be sited in hygienically conducive environment, protected from any kind or form of pollution. The quality of the water must also meet the World Health Organisation (“WHO”) recommended standards for water consumed.
- Where a borehole or well is for commercial purposes, a Licence for groundwater abstraction must be obtained from LWC.
- No person shall erect any building or structure over, across or adjacent to any drainage, channel, sewer or sewerage system without first obtaining a Clearance Certificate from the Lagos State Wastewater Management Office (“LSWMO”); for drains and channels, the permit is from the Lagos State Office of Drainage Services. Therefore, public drains or water channels shall not be blocked by the project, even if it is temporary without permit.

- It is an offence for any person to discharge, cause or permit to be discharge any kind of untreated trade effluent into any public sewer or drain-line without a Permit. Penalties include fines.
- Construction of any structure that will accommodate or serve 50 or more people must obtain a Wastewater Clearance License from the LSWMO.
- Erection of any structure or signage for advertisement purposes require Permit by the Lagos State Signage and Advertisement Agency ("LASAA").
- It is not permitted to fall or trim trees in Lagos State without a prior Permit obtained for such a purpose from the Lagos State Parks and Gardens Agency ("LASPAR).

Others relevant to the project include Lagos State Properties Protection Law, 2016 and Physical Planning and Urban Development Law, 2010

1.4.3 International Conventions

The international conventions, to which Nigeria is a signatory, relevant to this project are as follows:

- African Convention on the Conservation of Nature and Natural Resources
- Convention on Biological Diversity
- Endangered Species (Control of International Trade and Traffic)
- Conservation of Migratory Species of Wild Animals (1973)
- Convention to Combat Desertification (1994)
- United Nation Framework Convention on Climate Change (UNFCCC) 1992.
- International Union for Conservation of Nature and National Resources (IUCN) Guideline, 1996.
- The "Equator Principle"
- World Bank Operational Policies.
- Public Health Legislations and Regulations.
- The Rio Declaration on Environment and Development
- The Kyoto protocol, Montreal Protocol on Substances that Deplete the Ozone Layer, 1987.
- The African Convention on the Conservation of Nature and Natural Resources, 1968.
- Convention on the Elimination of All Forms of Discrimination against Women (CEDAW)
- Human and Peoples' Rights on the Rights of Women in Africa in 2005
- Civil and Political Rights Covenant
- Economic, Social and Cultural Rights Covenant
- Convention on the Elimination of All Forms of Violence Against Women
- Convention on the Rights of the Child
- ILO Occupational Safety and Health Convention, 1981

ILO Conventions and Core Labour Standards

The International Labour Organisation (ILO) is a tripartite organisation consisting of trade unions, governments and companies, and is part of the United Nations system. In 1998, the ILO produced the Declaration on Fundamental Principles and Rights at Work. In the Declaration, ILO member states including Nigeria agreed that they should all respect, promote, and realise core labour standards (whether they have been ratified or not).

- The core labour standards consist of five standards, laid out in eight conventions:
- Freedom of association and the effective recognition of the right to collective bargaining (Convention No. 87 & No. 98)
- The elimination of all forms of forced and compulsory labour (Convention No. 29 & No. 105)
- The effective abolition of child labour (Convention No. 138 & No. 182)
- The elimination of discrimination in respect of employment and occupation (Convention No. 100 & No. 111)

TCN as well as its contractors shall comply with these requirements, as well as the following internationally recognized labour rights: the right to a living wage based on a regular working week that does not exceed 48 hours; humane working hours with no forced overtime; a safe and healthy workplace free from harassment; and a recognised employment relationship with labour and social protection.

1.4.4 JICA Guidelines for Environmental and Social Considerations

The objectives of the guidelines are to encourage Project proponents etc. to have appropriate consideration for environmental and social impacts, as well as to ensure that JICA's support for and examination of environmental and social considerations are conducted accordingly. The guidelines outline JICA's responsibilities and procedures, along with its requirements for project proponents etc., in order to facilitate the achievement of these objectives. In doing so, JICA endeavors to ensure transparency, predictability, and accountability in its support for and examination of environmental and social considerations.

1.4.5 World Bank Safeguard Policies

The World Bank environmental and social safeguard policies include both Operational Policies (OP) and Bank Procedures (BP). Safeguard policies are designed to protect environment and society against potential negative effects of projects, plans, programs and policies.

1.4.6 IFC Performance Standards for Investment

The Eight Performance Standards established by IFC for the life of an investment include:

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts
- Performance Standard 2: Labour and Working Conditions
- Performance Standard 3: Resource Efficiency and Pollution Prevention
- Performance Standard 4: Community Health, Safety, and Security

- Performance Standard 5: Land Acquisition and Involuntary Resettlement
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- Performance Standard 7: Indigenous Peoples
- Performance Standard 8: Cultural Heritage

1.4.7 TCN's HSEQ Policy

TCN 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.

Particular consideration shall be given to the Safety, Health, Environment, Security (SHE&S) and Regulatory (SHES&R) of all project personnel at all stages of planning, execution and management of the project. The following sections identify how the project shall be planned to achieve SHE&S objectives, through the implementation of procedures relating to SHE&S Planning and Execution. SHE&S is the project's highest priorities and the responsibility of every individual associated with the project. The SHE&S Philosophy is:

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

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

- OHSAS18001:2007 Occupational Health and Safety Management Systems Requirements;
- ISO9001:2008 Quality management systems: Requirements
- ISO14001:2004 Environmental management systems: Requirements with guidance for use;
- Local Norms, Rules and Regulations for Health, Safety and Environmental Protection;
- Workmen's Compensation Decree/1987;
- Electrical Regulations/1988.

The objectives and strategies for the construction phase of the Project are aligned with the overall Project Objectives and Strategies (POS). Construction Objectives are:

- Improve Project Safety, health, security, environmental protection/performance, particularly during construction
- Assure Project Quality
- Reduce Project Life-Cycle Costs
- Reduce Project Schedules

- Properly plan logistics to ensure minimum rework caused by poor engineering/construction coordination
- Properly plan the contracting and procurement activities while supporting field construction requirements to ensure the reduced schedule and cost impacts are realized.
- Enhance Management of Risk
- Involve local communities in the construction process
- Foster an effective relationship with communities.

1.4.8 Gap Analysis against JICA guideline

Regarding legislative and institutional arrangement for EIA, in general there is no difference in categorization, details of EIA study and EIA report, public participation, and information disclosure between the JICA Guidelines (same as World Bank OP 4.01) and Nigerian laws and regulations as shown in Table 1.2

Table 1.1 Gap Analysis Between Nigerian Laws and World Bank E & S Policies

Item	Outline of EIA Legislation in Nigeria	Differences/Measures
Category	According to the EIA Decree and EIA Procedural Guidelines 1992, all the proposed projects are classified into three categories considering extent, nature and location of the projects. (a) Category I for which EIA is mandatory; the project is likely to significantly affect the environment (almost same as the category A of JICA Guidelines) (b) Category II for which a partial EIA will be required; the project is likely to not significantly but somewhat affect the environment (almost same as the category B of the JICA Guidelines).and, (c) Category III for which EIA is not required; the project is unlikely to affect the environment (almost same as the category C of the JICA Guidelines) In addition, the proposed projects in Sensitive Areas as shown in 3.1.1.3 2) are also classified as category I.	No difference in general
Screening	Screening should be conducted by FME after site survey.	No difference in general
Scoping and preparation of TOR	Proponent should make environmental scoping and TOR for EIA study and submit to FME.	No difference in general
Environmental Items	Environmental items, on which impacts due to the project to be identified and evaluated are not described in the EIA Decree. However, items of major negative impacts due to power transmission line project are indicated to such items as land acquisition/resettlement and way-leave, landscape, ecological system, noise and vibration are indicated as major negative impacts due to power transmission line project according to EIA Sectoral Guidelines for Transmission Line.	No difference in general
Contents of EIA report	Mentioned in Article 4 of the EIA Decree - An Environmental Impact Assessment shall include at least the following minimum matters: (a) Proposed activities	No difference in general

Item	Outline of EIA Legislation in Nigeria	Differences/Measures
	(b) Potential affected environment including specific information necessary to identify and assess the environmental effects of the proposed activities (c) Practical activities, as appropriate (d) An assessment of the likely or potential environmental impacts on the proposed activity and the alternatives, including the direct or indirect cumulative, short-term and long-term effects (e) An identification and description of measures available to mitigate adverse environmental impacts of proposed activity and assessment of those measures (f) An indication of gaps in knowledge and uncertainly which may be encountered in computing the required information (g) An indication of whether the environment of any other State, Local Government Area or areas outside Nigeria is likely to be affected by the proposed activity or its alternatives (h) A brief and non-technical summary of the information provided under paragraph (a) to (g).	
Environmental Management Plan (EMP) and Environmental Monitoring Plan	Although the term of "environmental management plan" is not found in the EIA Decree, it is used in the EIA Sectoral Guidelines (Transmission Line). Although the term of "environmental monitoring" is not found in the EIA Decree, the term of "follow-up program" is used as follows: (a) Article 16 - the design and implementation of a follow-up program, (b) Article 17 –mandatory study must include a discussion of the need for and the requirements of any follow-up program.	No difference in general
Information disclosure and public participation	Term of "stakeholder" or "public participation" is not found in the EIA Decree. However, subjects relating to public involvement are described from screening process to reviewing draft final report of EIA study for EIA approval in the EIA Decree. In general: Article 7 - FME shall give opportunity to government agencies, members of the public, experts in any relevant discipline and interested groups to make comment. (b) Screening process. (c) Public hearing. (d) Public comments. However, it is not mentioned about public involvement conducted by the proponent itself during scoping phase and EIA study phase.	In the transmission line project (2012) by World Bank stakeholder meetings were held for communities and villages. In the proposed project stakeholder meetings will be held at the scoping phase and at the stage of preparing draft final report of EIA study.
Comparison of alternatives	Mentioned in the EIA Decree. For example: (a) Article 4 - an EIA shall include an assessment of the likely or potential environmental impacts on the proposed activity and the alternatives, including the direct or indirect cumulative, short-term and tong-term effects. (b) Article 17 - every mandatory study of a project by review panel shall include a consideration of alternative means of carrying out the project.	No difference in general

1.4.9 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
- Transmission Company of Nigeria (TCN)
- JICA Project Implementation Unit (PIU)
- Ikeja Electricity Distribution Company
- Eko Electricity Distribution Company
- Ogun State Ministry of Environment
- Ogun State Environmental Protection Agency ("OGEPA")
- Ogun State Bureau for Lands and Survey
- Ogun State Power Unit, Office of Governor
- Lagos Waste Management Authority ("LAWMA")
- Lagos State Environmental Protection Agency ("LASEPA")
- Lagos State Bureau for Lands
- Surveyor General Lagos State
- Local Government Authority (LGA):
    - ✓ Ewekoro Local Government Area
    - ✓ Ifo Local Government Area
    - ✓ Ado Odo/Ota Local Government Area
    - ✓ Badagry Local Government Area
- The Customary District Councils headed by Obas of each Kingdom affected
- Village Chiefs (Baale) of Affected Communities

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

1.4.9.1 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.

1.4.9.2 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. 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.

1.4.9.3 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.

Project Implementation Unit

Is a unit established by TCN with responsibility for the end to end delivery of all JICA funded projects, including planning, feasibility, ESIA and RAP, engineering, procurement and construction (EPC). PIU is headed by a substantive Project Manager.

Furthermore, the PIU shall ensure:

- The ESIA and RAP studies are conducted in line with legal requirements as well as requirements of the lender
- Proper implementation of the ESMP
- Supervise the EPC contractor in conjunction with the Owner Engineers in Project Department to ensure implementation of management measures.
- Provision of information on activities and consultations with the PAPs.
- Maintain an inventory of the assets to be resettled and a detailed valuation of the compensations.
- Ensure proper information and participation of PAPs and affected communities.
- Management of compensation payments.
- Monitoring the resettlement work.
- Implementation of community-approved projects financed through the EPC contractors.
- Production of monitoring reports to appropriate government authorities, TCN and the contractor in charge of the line construction and the Lender.

1.4.9.4 Electricity Distribution Companies (Ibadan, Ikeja and Eko)

These three electricity distributions companies are part of the thirteen distribution companies unbundled from defunct PHCN during electricity reform in 2004. They are responsible for distributing electricity to homes and other consumers within the Lagos and Ogun State 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.

1.4.9.5 Ogun State Ministry of Environment

The Ministry of Environment was established in July 2003 with the aim of creating better living and conducive environment for the entire people of Ogun State. The Ministry has five (5) departments and two (2) sister Agencies namely, Ogun Environmental Protection Agency (OGEPA) and Ogun State Emergency Management Agency (SEMA).

- Department of Administration & Supplies: is 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.

1.4.9.6 Ogun State Bureau for Lands and Survey

This bureau 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 Ogun 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 in Ogun State.
- Provision of Geospatial information infrastructure.
- Textual and graphic data on Ogun State, including land record, aerial photographs, satellite images, engineering drawing, and scanned pictures of building.
- Property search and verification of land record.
- Land application processing and administration.

1.4.9.7 Ogun State Ministry for Physical Planning

The Ministry is the apex body of Physical Planning in Ogun State. It is responsible for the formulation of Physical Planning policies and the coordination of physical development within the State. It derives its statutory functions from section 3 line 246 of the State Urban and Regional Planning Law No.20 of 2005. Though the Ministry is the policy making body, it has the Urban and Regional Planning Board as its parastatal.

1.4.9.8 The Ogun State Urban and Regional Planning Board:

This Board is a parastatal of the Ministry of Urban and Physical Planning established the enactment of Ogun State Urban and Regional Planning law No.20 of 2005. The Board, which have 20 Zonal Town Planning Offices spread across the State is responsible for:

- Controlling all various physical developments be it Residential, Commercial, Industrial, Public, and Institutional uses.
- Monitoring all the development in order to control the growth of Urban Sprawl in Ogun State.

1.4.9.9 Ogun State Ministry of Women Affairs and Social Development:

has the responsibility

- 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 Organisations, Professional Institutions and other MDAs on issues affecting women, children/vulnerable ones.

1.4.9.10 Ogun State Ministry of Agriculture

This Ministry is the organ of Government responsible for formulating policies on food and agriculture for the State. The ministry is to enhance self-sufficiency in food production, provide raw materials for agro-based industries, generate employment opportunities and obtain desirable levels of export in order to improve the country's foreign exchange earnings.

Ogun State has 1.2million hectares of arable land which is 74% of the State's total land area. Only 30% of this arable land or 35,000 hectares is under cultivation. The major crops grown or cultivated in the State include: Cassava, Rice, Maize, Oil-Palm, Cocoa, Rubber, Citrus, Cotton, Soya-Bean, Vegetable, Pine apple, Sugar-Cane, among others. Livestock and fish farming are strong and viable in the State.

The mandate of the ministry includes;

- Formulating and implementing agricultural policies and programmes for Ogun State.
- Regulation of farm practice and certification of farm produce.
- Ensuring food safety and food security.
- Promotion of mechanized agriculture.
- Ensuring availability and provision of quality agricultural inputs
- Coordinating agricultural cooperative societies and commodity groups
- Promoting and managing Irrigation Schemes
- Delivery of agricultural research proven technologies to farmers for adoption through effective Extension Services

- Promoting the development of the Livestock and Fishery industries in the State.

1.4.9.11 Lagos 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, 2017 (“EMPL 2017”). These include LASEPA and LAWMA.

LASEPA is responsible for regulations, establishing discharge limits, and issuance of permits among others.

1.4.9.12 Lagos State Bureau for Lands and Survey

This bureau 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 Lagos 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 in Lagos State.
- Provision of Geospatial information infrastructure.
- Textual and graphic data on Lagos State, including land record, aerial photographs, satellite images, engineering drawing, and scanned pictures of building.
- Property search and verification of land record.
- Land application processing and administration.

1.4.9.13 Lagos State Ministry for Physical Planning and Urban Development

The Ministry is the apex body of Physical Planning in Lagos State. It is responsible for the formulation of Physical Planning policies and the coordination of physical development within the State. It derives its statutory functions from section 3 line 246 of the State Urban and Regional Planning Law No.20 of 2005. Though the Ministry is the policy making body, it has the Urban and Regional Planning Board as its parastatal.

1.4.9.14 Lagos State Ministry of Women Affairs and Social Development:

has the responsibility

- To promote Gender Equality and provide Empowerment facilities for Socio-economic Development for people displaced by the project in Lagos State
- 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 Organisations, Professional Institutions and other MDAs on issues affecting women, children/vulnerable ones.

1.4.9.15 Local Government Areas (LGAs)

The project will pass through four LGAs, three in Ogun State -Ewekoro, Ifo and Ado Odo/Ota as well as Badagry LGA in Lagos 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 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.

1.4.9.16 The Customary District Councils

The line route will pass through the Chiefdoms as several villages under them. The Obas (traditional head of chiefdom) and Village Heads (Baales) 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

1.4.9.17 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[1].

This NGO will revise reports of compensation payment process, meet with PAPs, check implementation of the measures, reconstruction, etc. in the field, and provide comments and recommendations. All PAPs will be informed of the NGO role and function and need to have access to its representatives, in a confidential manner if necessary, to explain and discuss their difficulties of grievances.

1.4.9.18 Contractors

Each contractor shall appoint a qualified environmental manager who, after approval by the PIU will be responsible for daily management on-site and for the respect of 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.

1.4.9.19 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, preparation of periodic reports required by regulations.

1.5 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 was submitted to the FMEnv on 24/05/2017 and the approval letter is in Appendix 1.

1.6 STRUCTURE OF THE ESIA REPORT

The ESIA Report is presented in eight chapters.

- **CHAPTER ONE** is an introduction containing relevant background information and the legal and administrative framework for ESIA in Nigeria among other information, international conventions ratified by Nigeria and the World Bank environmental and social sustainability policies.
- The **CHAPTER TWO** presents the project justification, the need/value and its envisaged sustainability as well as the project development and site/route options considered.
- **CHAPTER THREE** contains detailed description of the proposed project including its location, overall layout, basis for design, type and specifications of equipment/facilities to be installed and operation/maintenance of the proposed power project.
- In **CHAPTER FOUR** the baseline, ecological and socio-economic status of the study area respectively is described. Information on consultation with stakeholders is presented in this chapter.
- **CHAPTER FIVE** discusses the identified potential and associated environmental impacts of the proposed project.
- **CHAPTER SIX** presents the various mitigation measures TCN is committed implement against the identified significant impacts.
- **CHAPTER SEVEN** provides a cost-effective environmental and social managemental plan that would be adopted throughout the project's lifecycle. It also enumerates the environmental monitoring programme, the waste management programme
- **CHAPTER EIGHT** contains project's decommissioning/remediation plan.

- **CHAPTER NINE** concludes the report and requests approval for project implementation.

The preliminary sections of the report include status page, the table of contents, list of tables, list of figures, list of plates, list of abbreviations and acronyms, list of ESIA preparers, acknowledgement page and the executive summary. The concluding sections include the references and various appendices.

CHAPTER TWO

2.0 PROJECT JUSTIFICATION

2.1 Need for the Project

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 Nigerian National Integrated Power Project (NIPP) become operational, the installed generation capacity will become above 10,000 MW by the end of 2018 and it will be expected to increase greatly. The existing and proposed transmission line system in Nigeria is shown in Figure 2.1.

The transmission lines that run from the Niger Delta in the south to the north via the largest demand center of Lagos are in a bottleneck situation so the generating capacity in the south cannot be fully utilized. Moreover, there are no detour routes for use when equipment accidents occur, and the system reliability is low.

Furthermore, as was mentioned above, the capacity of generating equipment is expected to increase greatly in the coming years, however, because transmission capacity is unable to keep up with generating capacity, there is an urgent need to strengthen the transmission infrastructure. As a countermeasure of serious power shortage, Transmission Company of Nigeria (TCN) planned a project geared to achieving transmission capacity of 20,000 MW by 2020 in accordance with growth of generation capacity.

Nigeria has the largest population among African countries. After coming out of recession last year, the economy of the country is expected to grow steadily in in the coming years. However, social infrastructure is far behind the economic development. In particular, electricity supply is extremely in short, being serious impediment to economic development.

Therefore, it is most urgent and essential to secure sufficient and stable supply of electricity as the platform for the economic development.

According to a report “preparatory survey for power transmission project in the Federal Republic of Nigeria” by JICA published in 2016, the implicit peak demand for the national grid is estimated at 11.0GW in 2014, and will increase to 16.4GW in 2020 and 23.6GW in 2025. The report also projected High Case with revised assumptions. Under the High Case projection, the implicit peak demand for the national grid will grow from 11.0GW in 2014 to 17.3GW in 2020 and 26.3GW in 2025. The electricity demand for the grid is projected to grow at annual 7.2% between 2014 and 2025 for the Base Case and 8.5% for the High Case.

Furthermore, according to the Lagos State Electricity Board, the electricity demand in the Lagos Region is presently 1,250MW, however, the average supply capacity is 650MW, resulting in an absolutely short supply.

Power supply is seriously in short even in the central part of Lagos State, and supply rotation is implemented almost daily. Because of this situation, everybody keeps generator at home and office. Large users of electricity such as large factories and hotels fully depend on their own generators, without depending on the grid, in consideration of the quality of electricity. As result of this it increases cost of living as well as air pollution due emissions from generators.

Since the central part of Lagos State is already fully developed with commercial and industrial facilities, the megalopolis is now expanding to the periphery under a policy of "Decentralize the Large City," to the east, Lekki, to the west towards Badagry, and to the north towards Ogun and Oyo States.

2.2 Benefits of the Project

Energy is the raw material needed to fuel any country's economy growth. *"Energy is the golden thread that connects economic growth, increased social equity and a healthy environment. Sustainable development is not possible without sustainable energy,"* -UN Secretary-General Ban Ki-moon.

The benefits of this project for the people of Lagos and Ogun State 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 through overall reduction of the used of personal power generating sets.
- General improvement of the standard of living for the populace.

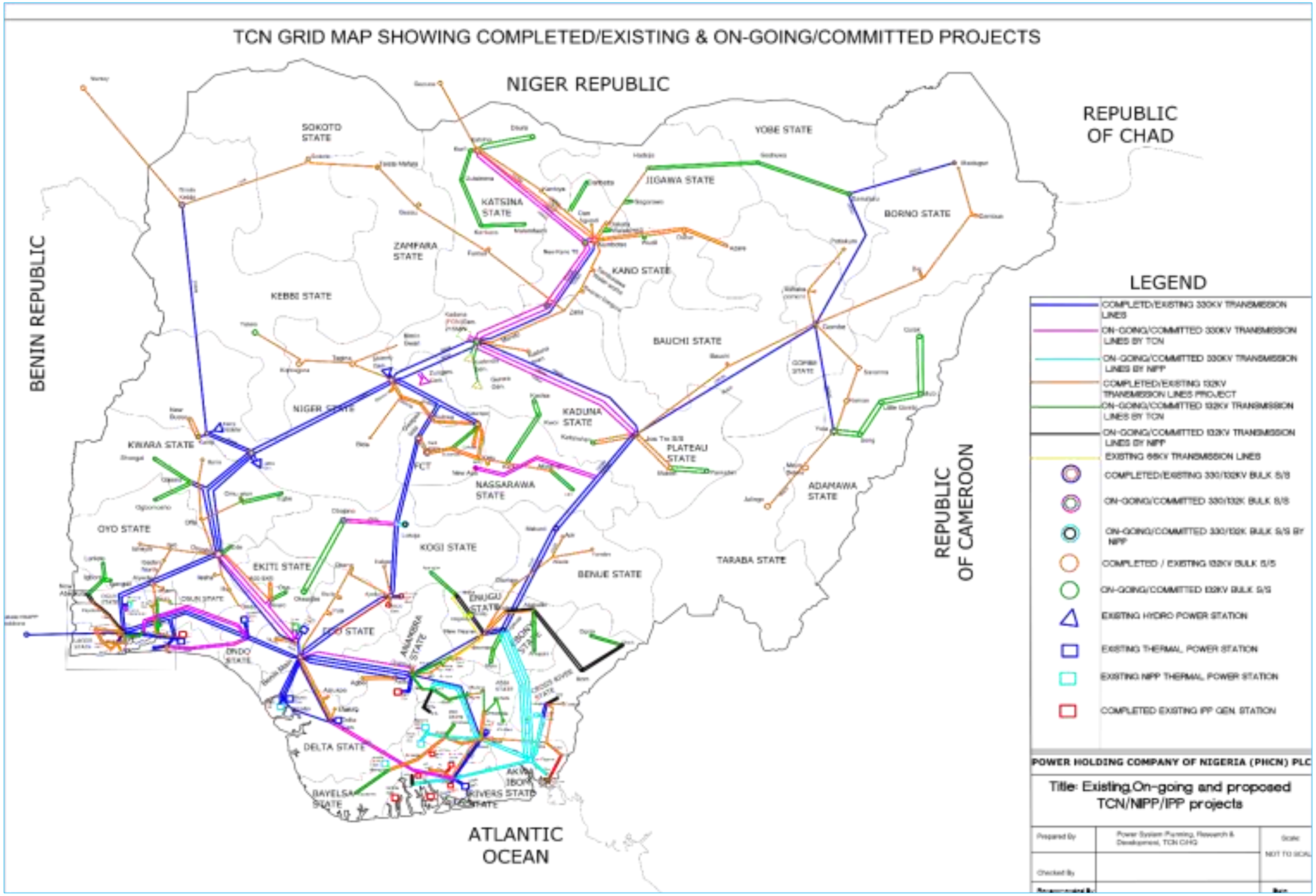


Figure 2.1 National Transmission and System Operation Infrastructure

Source: TCN, 2016

2.3 Envisaged sustainability

Some factors are important to consider to reaching project sustainability. They are related to practical aspects related to economic profitability, technical resources, and all, with an efficient management. With the growth in electricity demand that has occurred over the last decades, adequate and reliable energy supplies are important to economic development. Additional energy resources, including electricity generation and share, as well as infrastructure improvements, are key. Consequently, the investments which will be carried out should be useful primarily economically speaking, for the supply of the local load.

2.3.1 Technical Sustainability

The proposed project shall be technically viable because, 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. TCN also have qualified and experienced personnel to handle the construction, operation and maintenance of the project. Moreover, where additional personnel are needed, they can be recruited among qualified Nigerians.

2.3.2 Economic Sustainability

The proposed transmission line project shall be economically sustainable because the proponent is seeking to finance the project through a loan by JICA. Talks has reached advanced stage. Also, there is high demand of the power and the Return on Investment (ROI) is long term but surely high, to ensure effective pay back of the loan in line with loan agreement.

2.3.3 Environmental Sustainability

The line routes and the substation sites has been carefully selected by considering sensitive ecosystems along the proposed PTL route 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 proposed PTL project and TCN is fully committed to comply with the relevant applicable national environmental laws, applicable international conventions and world bank environmental safeguard policies. 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 a General Manager who reports directly to the CEO. Significant number of ESIAs and environmental audits have 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.

2.3.4 Social Sustainability

The project has secured its first social license – the host communities' acceptance of the proposed project their eagerness to see it succeed. The proposed transmission line project shall create job opportunities for unemployed indigenes and Nigerians.

In addition, TCN is committed to effective and continuous stakeholders' engagements and consultations and effective implementation of the RAP.

TCN is committed to comply with applicable national social laws, relevant international conventions and world bank social safeguard policies. Furthermore, TCN has a Social Specialist as a member of the PIU, but will require training on World Bank involuntary resettlement policy as well as the new environmental and social management framework

2.4 Project Alternatives

2.4.1 Project Options

a. Do-Nothing' Option

The first project option considered was the 'do-nothing' option. This option would result in 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.

b. 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 favourable, given available mitigation options. This would mean that all planning and development activities would be stalled until conditions are more favourable.

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.

c. Project Implementation Option

The third option considered was the execution of the proposed project as planned. This option was accepted because it will de-bottleneck the grid around the largest demand center of Lagos, provide a more secure and reliable energy supply with all the benefits listed under Section 2.2.

2.4.2 Analyses of Design/ Technology Alternatives

Substations

a. Gas-insulated Substation (GIS)

A Gas Insulated Substation is a compact and modular design multi component assembly that utilizes the components of traditional SF_6 Gas-Insulated Switchgear technology and encompasses several different functions in one module. SF6 gas has superior dielectric properties used at moderate pressure for phase to phase and phase to ground insulation.

It occupies less space (1/10th) compared to AIS substations, hence its preference for areas where substation space is small. It has the advantage of needing a little space, where land availability poses a challenge but much more expensive than the AIS and the use of SF6 is a great environmental concern. See Figure 2.2.

Figure 2.2 Gas Insulated Substation with Double Bus Arrangement

b. Air-insulated Substations (AIS)

The AIS technology uses air as the primary dielectric from phase to phase, and phase to ground insulation. They have been in use for years before the introduction of GIS. Most substations across all regions are AIS. They are in extensive use in areas where space, weather conditions, seismic occurrences, and environmental concerns are not an issue such as rural areas, and favourable offsite terrain. The indoor AIS version is only used in highly polluted areas, and saline conditions, as the air quality is compromised.

It has the advantage of being less expensive than the GIS although needing more space. This is the more economical alternative, where land is available.

Figure 2.3 A Typical AIS Substation (with transformers zoomed in)

c. Hybrid

This technology combines the advantages of being less expensive than the GIS with needing less space than the AIS.

The option to be used for the project is the air insulated technology because the size of land for the substations can contain it with land still available for future expansion.

2.4.2.1 Lines

a. Number of Circuits Alternatives

This presents the alternatives of using the single-, double-, or multi-circuit transmission lines.

- The single-circuit (SC) TL combines the immediate advantage of low construction cost with maintenance convenience, although it becomes more expensive on the long run, requiring more land take for corridors. This alternative was rejected entirely.
- The multi-circuits (MC) TL requires the least space for corridor per unit power transmitted than the SC and DC TLs. It is the highest initial capital outlay, although eventually, the most economical. However, in the event of need for maintenance, power outage has farther reaching impacts on consumers than both SC and DC TLs.
- The double-circuits TL minimizes land take per unit power transmitted than the SC, requires more initial cost than the SC but it is more economical, eventually.
- Furthermore, multicircut tower is utilised for a length of about 7km on the 330kV line. This is from Ejio substation to the crossing of the single circuit Osogbo to Ikeja West at Sojuolu Town. This is necessary because it is difficult to cross lines of the same voltage, hence, the Osogbo to Ikeja West line will be looped in and out of the Ejio substation utilising the same towers with the Ejio to Ajegunle line.
- In addition, the 132kV Ajegunle to Agbara and Ajegunle to Badagry lines will utilise the same tower (multicircuit) for upto 6km from the Ajegunle substation. This is to minimise footprint, reduce displacement of people and other impacts, because the area around the Ajegunle is heavily built up.

b. Towers Types (Tubular / Lattice) Alternatives

There are two basic tower types, namely the tubular and the lattice steel towers. The choice of tower type was based on considerations of available corridor width and cost. The tubular towers are more compact than the lattice type, requiring shorter width but shorter spans and therefore a greater number of towers. Against this background, therefore, the lattice type will be used for both the 330kV DC and 132kV lines.

c. Underground vs surface transmission Alternatives

The underground transmission is very expensive and is often necessary where there is not enough land for the required corridor for the surface tower infrastructure. It is also aesthetically wholesome and reduces environmental risks and impacts. On the other hand, the surface transmission alternative is cheaper, easier to construct and maintain and equally sustainable when all identified impacts and risks are eliminated or minimized. Hence surface transmission was selected.

Figure 2.4 Types of Lattice Tower

2.4.3 Site and Line Route Alternatives

The general characteristics of the line route considered are:

- short, to minimize cost and the impact on the environment,
- rectilinear, to minimize the angles and the footprint,
- accessible, near roads, to facilitate maintenance,
- surrounding towns and villages, to facilitate electrification, and
- bypassing towns and villages, to minimize the demolition of the built environment and relocation of populations.

The factors to avoid are:

- exclusion zones of airports and airfields
- soils with low load-bearing capacity, thus, far from wetlands and floodplains
- hills and ridges
- protected areas, forest reserves, classified forests, Ramsar sites and other sites, which aim to protect natural areas and species
- Physical cultural resources (PCR), archaeological, paleontological, historical, architectural, religious (including graveyards and burial sites) and aesthetic or other cultural significance.
- Bird migration corridors, feeding, rest areas and nesting grounds.

2.4.3.1 Initial Route Analyses

There was an initial analyses of line route alternatives by the feasibility study team conducted in 2015. This analysis was done based Google Map, which resulted in the recommendation of Option 3 in Table 2.1.

Table 2.1 Preliminary Analysis of Alternative Routes Conducted in 2015

	Route 1	Route 2	Route 3
Description	Straight route with the lowest construction cost	It avoids build-up areas and settlement to minimize land acquisition.	It avoids build-up areas and settlement to minimize land acquisition. It also shares 3km of its Way Leave with Component 32-2/3 Route1.

Distance (km)		26.4	28	26.6
Social Aspect	Number of Buildings in Way Leave (Estimated)	206	36	31 (Out of which, 21 is within the shared Way Leave)
Natural Aspect	Access Road	Many existing roads are present around Arigbajo Substation and New Agbara Substation. Construction of access roads is unnecessary most likely.	Many existing roads are present around Arigbajo Substation and New Agbara Substation. Construction of access roads is unnecessary most likely.	Many existing roads are present around Arigbajo Substation and New Agbara Substation. Construction of access roads is unnecessary most likely.
	Land Use	Built-up areas along the expressway, farmlands, vegetation	Residence, farmlands, vegetation	Residence, farmlands, Vegetation
	Impacts on Natural Environment	Some vegetation needs to be cleared. No difference from the other routes.	Some vegetation needs to be cleared. No difference from the other routes.	Some vegetation needs to be cleared. No difference from the other routes.
Geographical Conditions (Topography, ground stability, etc.)		None in particular	None in particular	None in particular
Natural Disaster Risk		None	None	None
Technical Aspect		No difference from the other alternatives	No difference from the other alternatives	No difference from the other alternatives
Cost		◎	○	○
Recommended Route				●

Source: JICA (2016): NOTE: Arigbajo=Ejio, New Agbara = Ajegunle

2.4.3.2 Detailed Alternative Line Routes Analyses

As a result of time lag, the Route 3 recommended in 2015 as presented in Table 2.1 was found to to seriously encumbered by settlements, because the region is developing very fast. Hence, there was a need to re-align further. Therefore, a more detailed analyses analyses based on information from GIS data interpretation and field missions were carried out. The design of the line route options as well as the mapping of the supporting biophysical and human environment were carried out simultaneously to maximize feedback between the two processes that allow exploring a maximum amount of solutions. In analysing the the alternatives, the following techno-economic, environmental and social criteria were applied in a multi-criteria modelling.

- **Technical and Economic Criteria** (Line Length, Angle Points (>15°), Inaccessibility (>5 km), Proximity to an airport (<2 km), Hilly areas, Crossing lines of similar voltage, Sections Without Multi-Circuit Tower)
- **Environmental Criteria** (Protected Areas, Full and partial wildlife reserves, Forest area without status, Floodplains, Wetland or Swamp)
- **Social Criteria** (Built Environment, residential/commercial buildings, Religious/cultural/ historic sites/ structure, Recognized pastoral zones, Plantations, Crops).

Summary of results are in Tables 2.2 to 2.4, while details of the analyses in Appendix 6.

Table 2.2 Summary of Analyses of the Ejio to Ajegunle Line Route Options

		Route 1 (JICA, 2016)	**Route 2**	**Route 3**
Description		Most straight route with the lowest construction cost	It avoids build-up areas and settlement to minimize land acquisition.	It avoids build-up areas and settlement to minimize land acquisition. It also shares 6km of its Way Leave with Component 32-2/3 Route1.
Distance (km)		30.6	32.3	30
Social Aspect	Number of Buildings in Way Leave (Estimated)	500	300	320 (Out of which, 150 is within the 7km shared Way Leave with Osogbo-Ikeja West turn in/turn out)

Natural Aspect	Access Road	Many existing roads are present along the route and Construction of access roads is unnecessary most likely.	Although existing roads are present along the route, construction of access roads may be necessary in more areas	Many existing roads are present along the route and Construction of access roads is unnecessary most likely.
	Land Use	Built-up areas along the expressway, farmlands, vegetation	Fewer built up areas, and more of farmlands, vegetation	Few built-up areas, farmlands, and vegetation.
	Impacts on Natural Environment	Some vegetation needs to be cleared. No difference from the other routes.	Some vegetation needs to be cleared. No difference from the other routes.	Some vegetation needs to be cleared. No difference from the other routes.
Geographical Conditions (Topography, ground stability, etc.)		None in particular	None in particular	None in particular
Natural Disaster Risk		None	None	None
Technical Aspect		No difference from the other alternatives	No difference from the other alternatives	No difference from the other alternatives
Cost		◎	○	○
Recommended Route				●

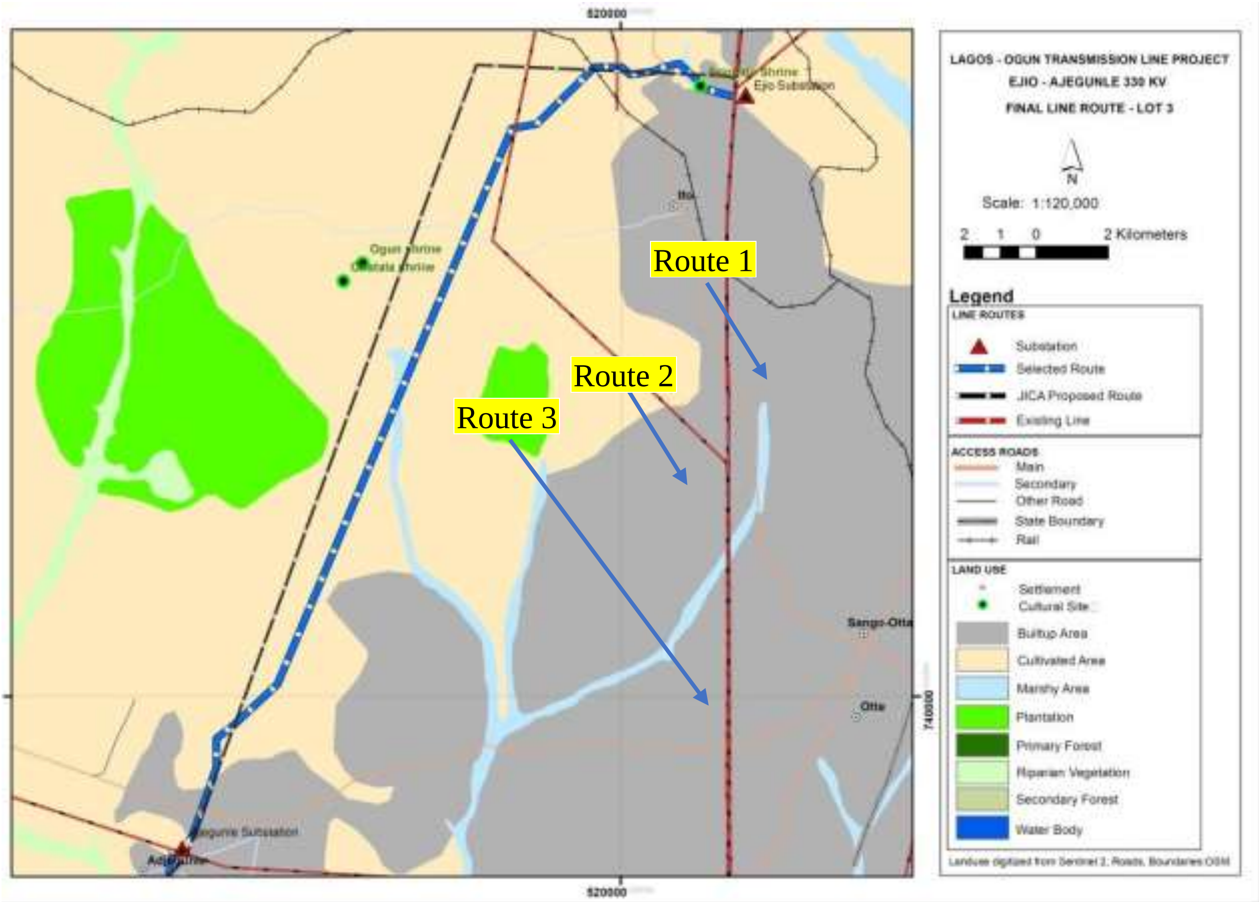


Figure 2.5 Alternative analysis for Ejio to Ajegunle Route

Table 2.3 Summary of Analyses of the Ajegunle to Agbara Line Route Options

		Route 1 (JICA, 2016)	**Route 2**	**Route 3**
Description		Most straight route with the lowest construction cost	It avoids build-up areas and settlement to minimize land acquisition.	It avoids build-up areas and settlement to minimize land acquisition. It also shares 6km of its Way Leave with Component 32-2/3 Route1.
Distance (km)		20.8	22.5	21
Social Aspect	Number of Buildings in Way Leave (Estimated)	400	280	300 (Out of which, 80 is within the shared Way Leave)

Natural Aspect	Access Road	Many existing roads are present along the route and Construction of access roads is unnecessary most likely.	Although existing roads are present along the route, construction of access roads may be necessary in more remote areas	Same as option 1
	Land Use	Built-up areas along the expressway, farmlands, vegetation	Fewer built up areas, and more of farmlands, vegetation	Few builtup areas, farmlands, and vegetation.
	Impacts on Natural Environment	Some vegetation needs to be cleared. No difference from the other routes.	Some vegetation needs to be cleared. No difference from the other routes.	Some vegetation needs to be cleared. No difference from the other routes.
Geographical Conditions (Topography, ground stability, etc.)		None in particular	None in particular	Very close to Badagry substation around Patedo and Ilupeju, the area is mashy
Natural Disaster Risk		None	None	None
Technical Aspect		Pile foundation may be necessary for a distance of about 2km	No difference from the other alternatives	No difference from the other alternatives
Cost		◎	○	○
Recommended Route				●

Table 2.4 Summary of Analyses of the Ajegunle to Badagry Line Route Options

	Route 1 (JICA, 2016)	Route 2	Route 3
Description	Most straight route with the lowest	It avoids build-up areas and settlement to	It avoids build-up areas and settlement to minimize land

		construction cost	minimize land acquisition.	acquisition. It also shares 6km of its Way Leave with Component 32-2/3 Route1.
Distance (km)		34.2	37.5	36
Social Aspect	Number of Buildings in Way Leave (Estimated)	250	150	120 (Out of which, 80 is within the shared Way Leave)
Natural Aspect	Access Road	Many existing roads are present along the route and Construction of access roads is unnecessary most likely.	Although existing roads are present along the route, construction of access roads may be necessary in more areas	Although existing roads are present along the route, construction of access roads may be necessary in few areas, mostly towards the Badagry substation
	Land Use	Built-up areas along the expressway, farmlands, vegetation	Fewer built up areas, and more of farmlands, vegetation	Few builtup areas, farmlands, and vegetation.
	Impacts on Natural Environment	Some vegetation needs to be cleared. No difference from the other routes.	Some vegetation needs to be cleared. No difference from the other routes.	Some vegetation needs to be cleared. No difference from the other routes.
Geographical Conditions (Topography, ground stability, etc.)		None in particular	None in particular	Along a stretch of about 5 to 10km close to Badagry substation
Natural Disaster Risk		None	None	None
Technical Aspect		No difference from the other alternatives	No difference from the other alternatives	Pile foundation may be necessary for few towers

Cost	◎	○	○

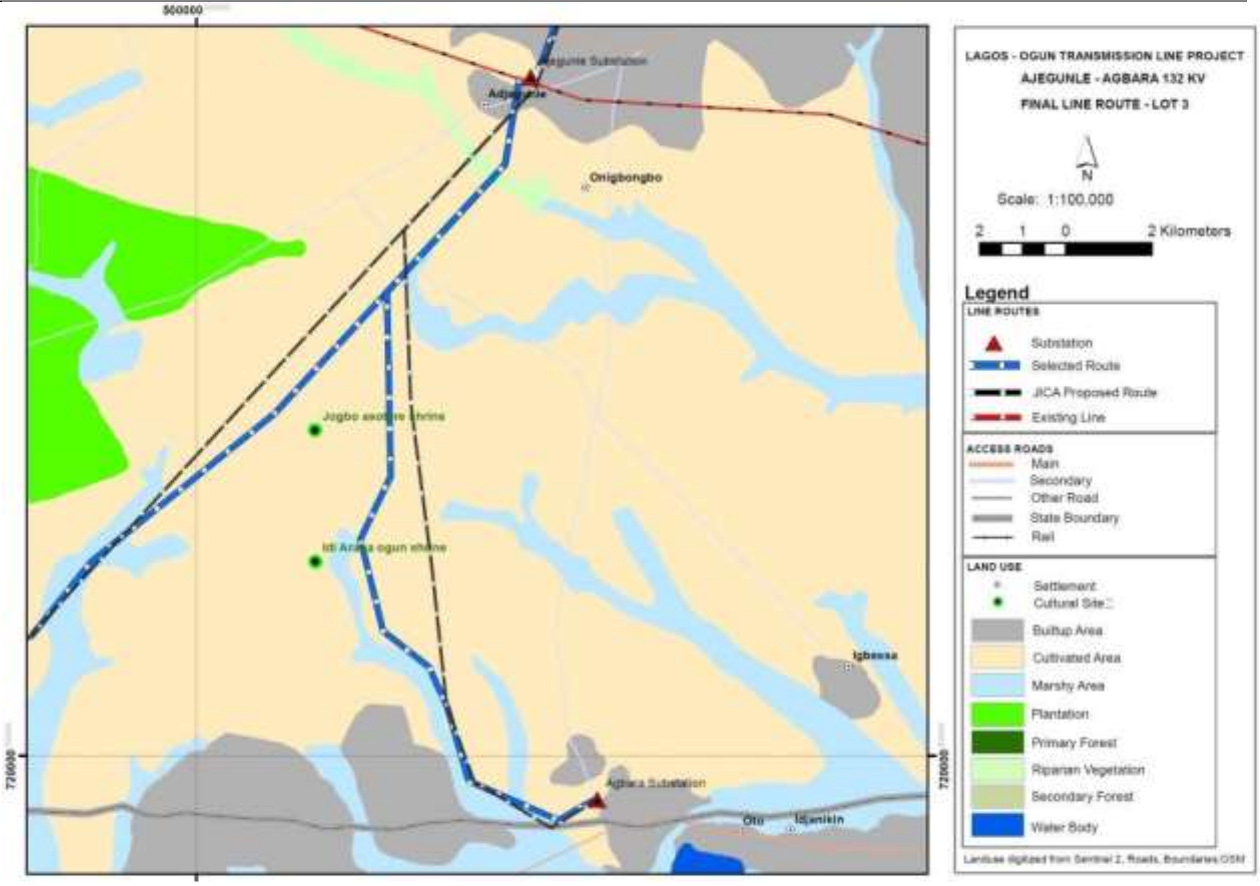


Figure 2.6 Alternative analysis for Ajegunle to Agbara Route

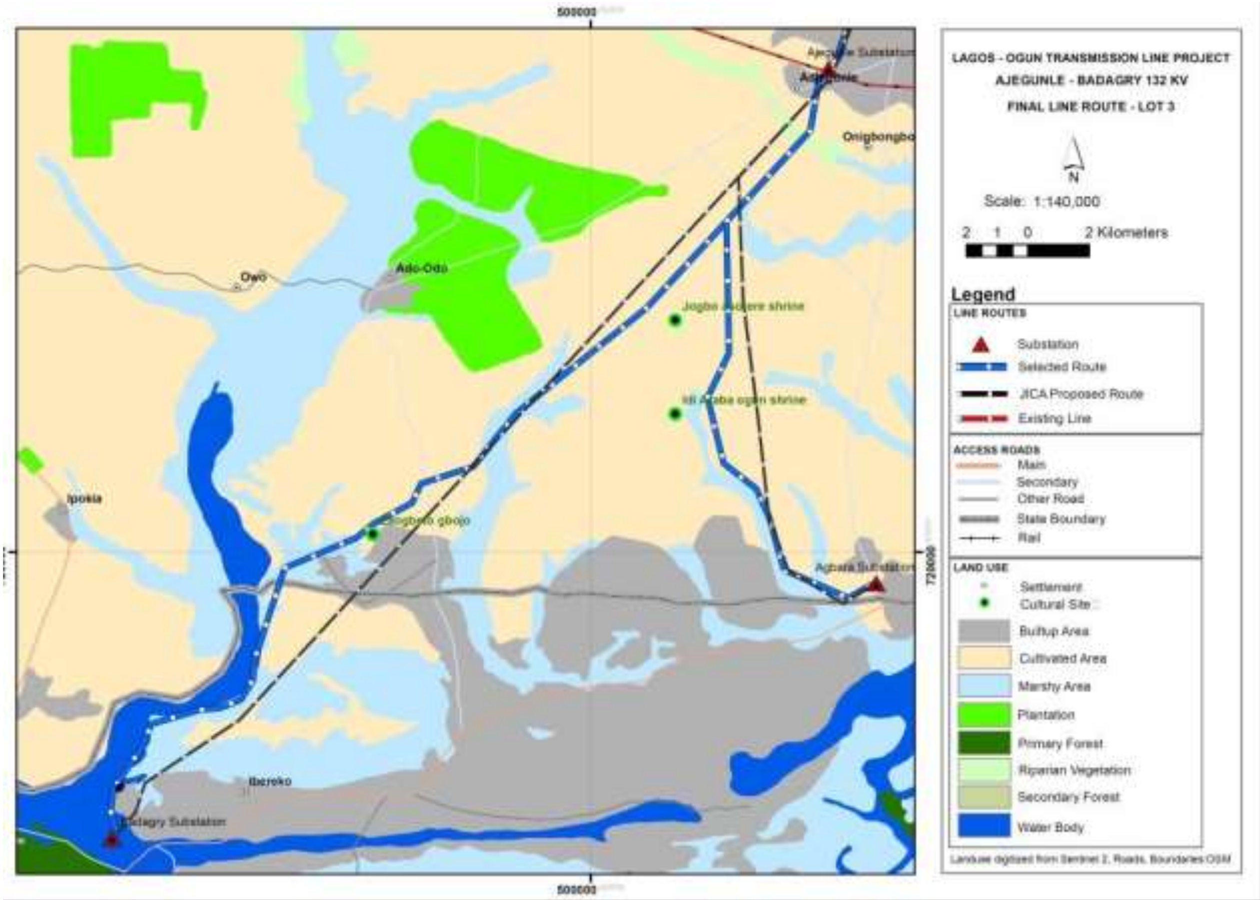


Figure 2.7 Alternative analysis for Ajegunle to Badagry Route

CHAPTER THREE

PROJECT DESCRIPTION

3.1 Introduction

The proposed Lagos and Ogun States Transmission Project is aimed at strengthening the national grid around the country for a more reliable electricity supply. The project is divided into three lots, and this description cover only lot 3 components. This consist of 330 kV DC line from proposed Ejio substation to Ajegunle (29.5km) in Ogun State, 132 kV DC line from Ajegunle to Agbara (21.7 km) and another 132 kV DC from Ajegunle to Badagry (36.5km). Three new substations at Ejio (Ewekoro LGA), Ajegunle (Ado Odo/Ota LGA) both in Ogun State and Badagry in Lagos State.

3.2 Project Phases and Activities

The project implementation scheme has 4 distinct phase, pre-constructio, construction, operation and maintenance and decommissioning.

Phase I: Pre-construction

Feasibility studies

Line-route studies

Environmental and Social Impact Assessment (ESIA)

Resettlement and Compensation

Front End Engineering Design

EPC contract award

Mobilization

Check survey of EPC contractor

Impact Mitigation Monitoring

Transmission line and Substation detail design

Material production (transformers and accessories, tower members, conductors, insulators, line hardware)

Material testing

Material shipment

Phase II: Construction Phase

Clear and grub site at substations and along transmission lines corridor

Impact Mitigation Monitoring

Foundations for tower installation and substation construction

Tower erection

Substation construction and installations

Conductor stringing

Impact Mitigation Monitoring

Commissioning and testing

Reinstating and clean up

Demobilization

Impact Mitigation Monitoring

Ready for handing over

Phase III: Operations and Maintenance Phase

Power Transmission

Maintenance of TL

Maintenance of SS

Compliance Monitoring

Period Environmental Audit

Periodic Systems Audit

Phase IV: Decommissioning/Closure

Decommissioning Audit

Dismantling and removal of Structures

Site restoration

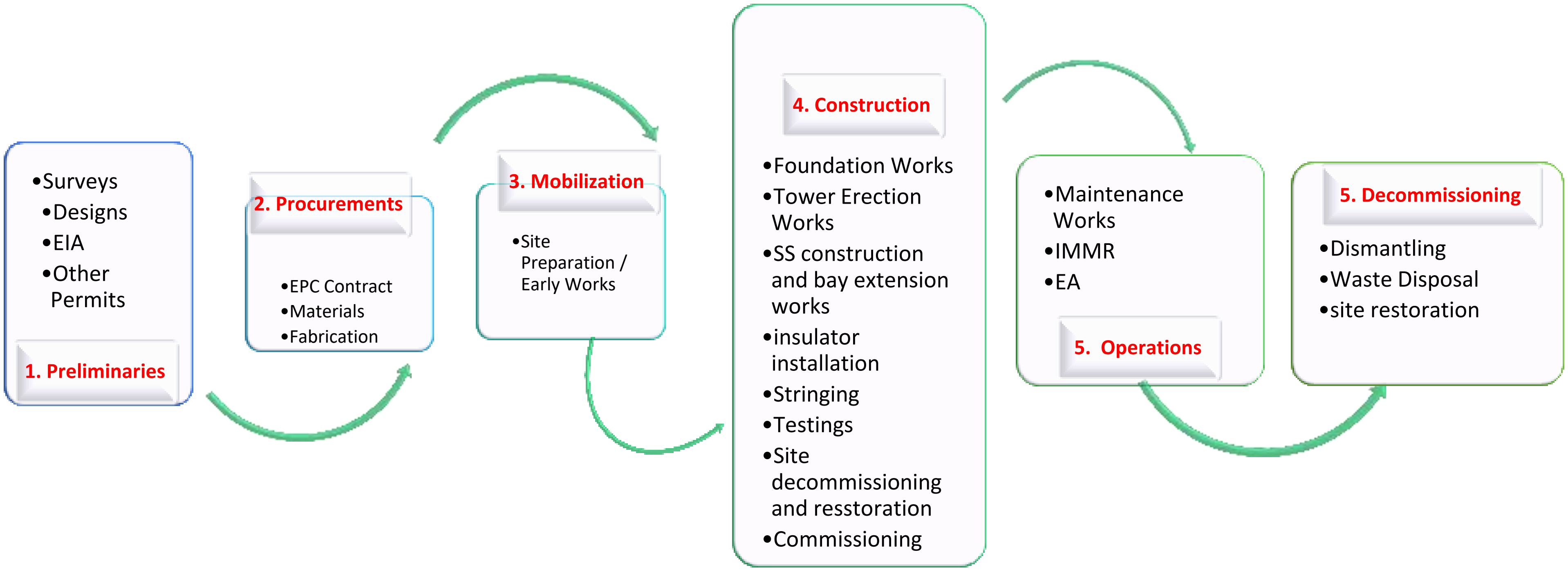


Figure 3.1 Proposed Work Flow Chart

3.3 Pre-Construction Engineering Studies and ROW Acquisition Programme

During Feasibility studies, several site studies have been performed to be used as indicators and basis for engineering works. These studies are considered as preliminary studies and no claim on completeness of these documents can be raised. For detailed engineering, information given herein and described in the reports will be considered during detail design and construction works.

- FEED
- Topographic Survey
- Crossing Study
- Conceptual Design of Transmission Line

3.3.1 Centre - Line and Topographical Survey

Topographical survey has been performed on site. The site is generally flat, with a gentle elevation toward the substation. According to the results of the topographic survey the TL route and ROW are determined. Road crossings, TL crossing and determination of structures in the TL have been performed according to topographic survey results. All topographical survey works included the establishment of any survey control, needed in addition to the existing survey control.

The complete topographic information for the survey areas use a maximum point interval / grid spacing of 25 m to describe the current local conditions in acceptable accuracy. The locations and elevations of the following minimum scope of data have been determined:

- All topographic surface information and features (high / low points, break lines, streams, river banks, swamps, vegetation, etc.);
- All man-made, civil structures (roads, tracks, buildings, foundations, walls, fences, etc.);
- All existing third party facilities (piping, cabling, process installations, telecom, power lines, utility markers etc.);
- All geotechnical points to be set out / surveyed;
- Temporary access roads, camp sites, fabrication-/storage yards, as required.

A routing team consisting of environmental, a geotechnical engineer, and ROW experts has explored the area of the presently foreseen route. Upon their identification of the area’s suitability, navigational positioning marked a preliminary route.

Referring to the evaluation results, the final route has been confirmed on site during a second routing campaign. The centre-line got marked. However, in sections, where the centre-line approximates any constraints, the required minimum clearances have been assured. The route maps have been updated, now showing the confirmed route and being reference for the subsequent route clearance from vegetation.

Upon confirmation of the final TL route the following were performed:

- Clearance of the route from vegetation over a corridor width of 1.5m to 3.0m;
- Establish required survey control along the TL route;
- Set-out and permanently mark the centre-line at an accuracy specified for the TL;
- Survey a longitudinal profile of the centre-line, with specific focus on high / low points, start / end of swamps, road, and water crossings;
- Survey all special points not limited to structures, buildings and obstacles 30m (for 132kV) and 50m (for 330kV) either side of centre-line to meet TCN standards for horizontal clearances;
- Capture additional topographic data at tower locations (15m x 15m), dedicated for towers (and definition of leg extensions);
- Update and finalize the route maps by adding all the above survey data.

3.3.2 Width of ROW

TCN typically use 30m as ROW width for 132Kv lines and 50m for 330kV overhead transmission lines. Factors considered include space to accommodate the lattice tower (wire zone) and safety buffer zone to provide safe limits for electromagnetic radiation as well as tower collapse.

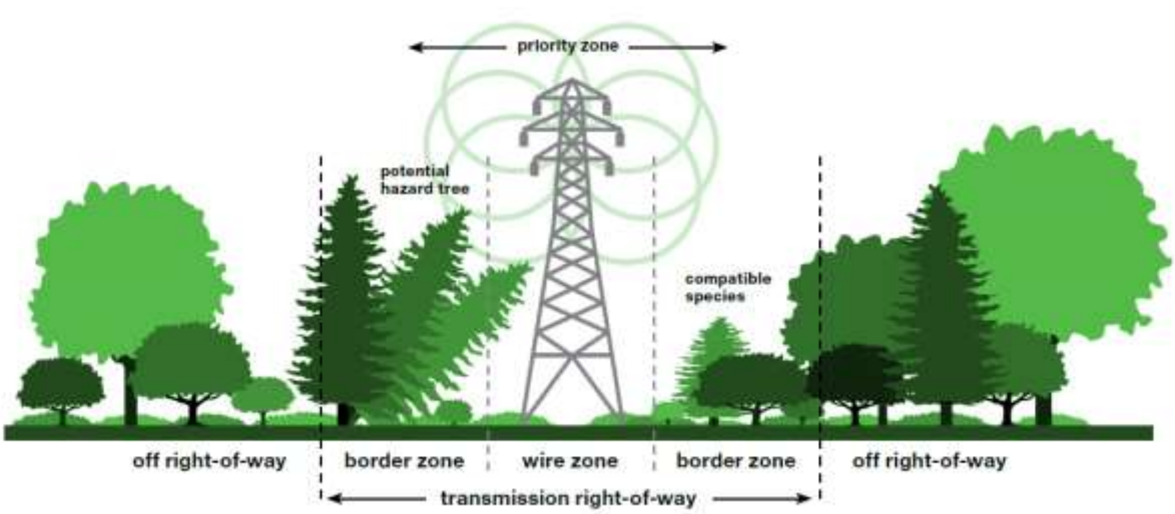


Figure 3.2 Transmission Right of Way

3.4 Construction Activities

The construction program will have several discrete activities and these are described below. The specific pattern of construction activities will generally follow this sequence although some activities may be carried on concurrently.

3.4.1 Campsites / Logistics Bases

Campsites / logistics bases will be located at and adjacent to the substation locations at Ejio, Ajegunle and Badagry. Material storage during the construction of the lines will be restricted within the acquired ROW. The campsites / logistics bases at these locations will be reuired only for storage and fabrication, while workers shall be accommodated in existing hotels around the area.

3.4.2 Access Track Repair / Upgrade / Construction

Access to each structure location will be required for a crane, elevated platform, trucks transporting the materials and construction equipment, materials, and vehicles. Access will also be required to temporary sites needed for storing conductor drums, winching and braking equipment during the overhead earth wire stringing.

Apart from the existing community tracks (where they exist) which none in current condition will accommodate larger equipment necessary for the construction activities, several access tracks for the construction work will be require repair and existing ones upgraded. There are several specific locations where tracks and swamp crossings will require upgrading or access re-evaluated. These upgrades will be identified during detailed design and form part of the construction contractor’s responsibility. Recommendations have been made where significant or important vegetation communities exist will be re-grown. These recommendations form part of the development project, as described in the ESMP.

The entire line route corridor has adequate existing roads and tracks that can used to access it. Hence, new tracks will be constructed only where necessary. Any new access road to be constructed upgraded will be limited to 5m, while tracks to be constructed under the line is limited to 3m. These will be used during construction and maintained for maintenance purpose. The proposed new access road required for the project is shown Figure 3.3. However, final route of access road will be determined in consultation with the landowner, giving consideration to environmental impacts. Where new tracks are required, road plant may be used to construct the track and for final trimming and construction of drains.

Some tracks will need to be constructed in soft or swampy ground and additional foundations may be required to accommodate the expected vehicle movements. This is required particularly for the Badagry substation site as well as the lines approaching Badagry and Agbara.

There is no specific need for continuous access along the entire route of the transmission line, although continuous access generally provides the simplest and least extensive method of access to individual structures and the proposed easement area. Access tracks will be upgraded progressively as construction works progress.

Erosion and Sediment Control measures for all works will be implemented, in accordance with the respective regulatory standards. EPC contractors shall prepare an Erosion and Sediment Control Plan (ESCP) in accordance with regulatory standards and submit to FMEnv as part of impact mitigation implementation monitoring report. Measures may include installation of silt fences, straw bales, and drains. It is TCN's policy that the tracks be maintained in a condition suitable for the construction work until the completion of the works. The tracks are then maintained to ensure maintenance and inspection works can be undertaken during operation of the transmission line.

Figure 3.3 show existing roads, which will be assessed to determine, where upgrade will be required. There will be no need to construct new access roads, except around Badagry where the line passes through swampy area, where a temporary access of not more than 500m will be required to access tower location. These temporary access roads, which will be removed after construction is completed, is not visible in Figure 3.3 because of the scale of the map, but area is circled in red in the figure.

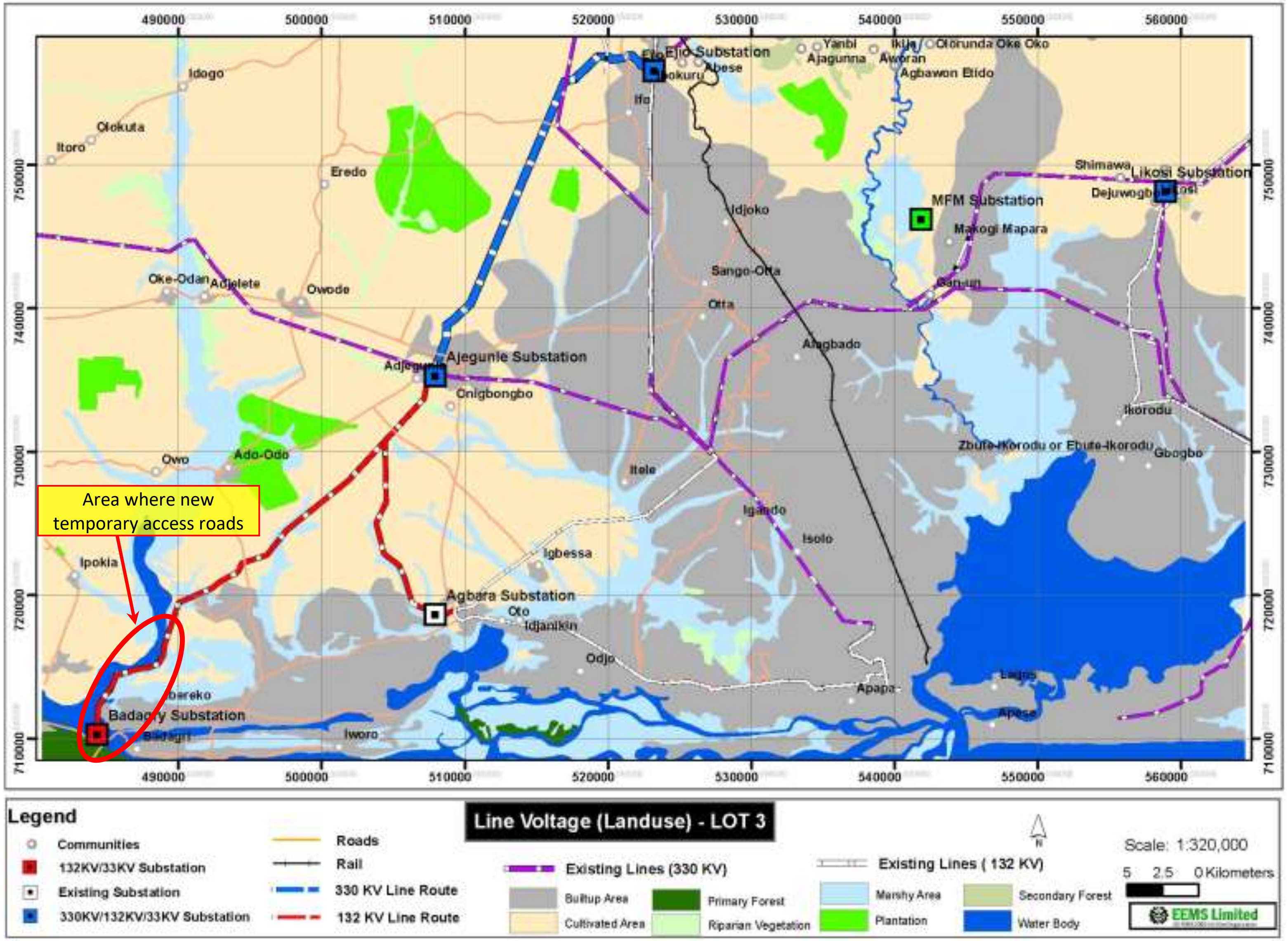


Figure 3.3 Existing Roads and where Proposed New Access Roads are Needed

3.4.3 Foundation Construction and Erection

The construction of structure foundations generally involves boring or excavating a hole for each leg or pole, installing steel reinforcing and the stub leg, and then pouring concrete. All surplus soils from excavations and boring would be used in filling low lying areas of the access roads, provided that this soil is not polluted. Where the soils are contaminated, this should be reported to Ogun State Ministry of Environment and/or Lagos State Waste Management Authority (LAWMA) for guidance on the most appropriate disposal depending n the nature and extent of contamination.

In poor ground conditions and for the heavier tension towers, more substantial foundations are required involving open excavation, the installation of formwork, pouring of concrete, and subsequent backfilling of the excavation. These foundations take longer to install and will cause more disturbance than the construction of bored tower foundations. In steeper terrain, it may be necessary to create a level bench at some tower sites to provide a working area for construction crew and equipment.

The construction of tower and pole foundations will require a workforce of approximately eight (8) persons, an auger type borer or backhoe excavator and arrangements for supply of premixed concrete, by truck. The construction of foundations for a typical tower or pole might take up to three days, although the time could be a week or more where difficult foundation conditions are encountered. Foundations will be under construction at several sites at any one time.

At each new tower sites, the crane and drill rig will require a flat platform to work on. Although the new tower sites are generally flat, there may be a need for the construction of a level pad. The pad will need to be cut into the slope close to the foundation site and access for concrete trucks will be necessary along the access tracks to each structure.

Erosion and sediment control measures will be implemented, and the level area will be retained and vegetation cover rehabilitated following completion of construction works.

3.4.4 Tower Construction

For this project the lattice tower type shall be used. The conductors are vertically arranged, and the earthing conductors are above conductors. Towers of overhead power lines consist of tower body, earth wire peaks and cross-arms. The transmission voltage, the number of circuits, the height of the towers and other aspects determine the tower design and material, whereby galvanized steel is used. The towers dominate the aesthetic impact of an overhead line, govern the operational reliability. They need to withstand reliably the conductor forces and external loads.

3.4.5 Conductor and Earth Wire Stringing

Following erection of the new structures at either end of the line, stringing of the conductors and earth wires will occur. A process known as "tension stringing" is normally used. This ensures that the conductors remain above ground at all locations in each stringing section.

This requires specialized truck mounted equipment. This process will be undertaken gradually along the line as construction progresses.

The process of stringing starts with a light wire, called the draw wire, being fed through "sheaves", or pulleys, supported from the ends of the insulators. Where possible, the draw wire will be run along the ground between structures and through the sheave attached to each structure. The draw wire is then tightened and pulled into the air. Where it is not possible to run the draw wire along the ground, because of terrain difficulties, water bodies, roads or disturbance to vegetation, a nylon draw wire will be fed between two structures using a hurdle and catch cradle arrangement to support the draw wire above ground. The nylon rope will be held at tension above the ground and is "pulled through" the sheaves to draw the normal steel draw wire into the sheaves.

The draw wire will be attached to the end of the conductor and the conductor will be pulled through the sheaves. The conductors will be drawn from the drums and a braking machine applies tension to the conductor as it is pulled out. The tension keeps the conductor from touching the ground, or trees and other obstacles.

At the completion of the "pull", the tension in the conductors will be adjusted to ensure that correct ground clearance is obtained. The conductor will then be fixed in position at each structure and the sheaves recovered and moved along the line to be used again. Stringing requires specialized truck mounted equipment, known as the "winch" and the "brake", to pull out the conductor and to maintain and adjust the tension in the conductors. These two pieces of plant are normally positioned to allow up to 7 km of the transmission line to be strung in a single "pull". For this project the pull distance will be less due to shorter distances between tension structures and the need to minimize outage length. The conductor and earth wire are stored on reels, called "drums", approximately 2 m in diameter. Each drum holds about 3.5 km of conductor so several drums will be stored at each brake site. Plant required at each site includes the winch and/or brake equipment, trucks for delivery of conductor drums, and concrete anchor blocks. Winch and brake sites are normally located adjacent to tensions towers but can also be in the centre of a span. Sites that are relatively level and flat will be required to allow the drums to be maneuvererd easily and safely.

The stringing operations will involve approximately 15 to 20 persons, spread over the section being strung. It is expected that each section of line will take several months to string with the actual "pulling out" of the conductors taking only two days. The rest of the time will be spent on preparation and final tensioning in between outage periods.

The stringing and tensioning equipment is normally truck mounted and does not require any specific earthworks or establishment activities. However, the stringing and tensioning activities will involve truck and vehicle access along the section being strung which may result in some surface disturbance. No specific erosion or sedimentation controls will be required however any incidental soil disturbance will be rehabilitated on completion of the construction program.

3.4.6 Substation Construction

The chart for the substations is shown in **Figure 3.4.**

Construction activities for the substations will involve the following:

- Construction of the substation access road to the substations, in the case of Ejio the existing untarred road will be upgraded and Ajegunle may not need construction of access road because it exists very close to the Atan-Ado Odo road, while Badagry substation will require the construction of about 500m access road through a swampy area.
- Removal of vegetation within substation footprint.
- Terracing and levelling of the sites.
- Installation of foundations for infrastructure such as transformers, control room and radio tower: - The project area is made up of different types of soils and varying geological conditions which will require geotechnical studies. Excavations will be conducted to create holes for erecting or installing the pylons. After excavation, foundations will be constructed for supporting the pylons. The excavation and construction of the foundations shall involve the use of hand tools like crow bars, mixers, vibrators, trappers, etc. But in case of rocky areas compressors and drills will be used. The equipment to be used in project construction will require various forms of energy which will include manpower, charged battery or fossil fuel. The manual equipment to be used in the development project include crow bars, spanners and ropes. About 75% of materials for the substation construction is expected to be imported from outside Nigeria while 25% will be sourced locally.

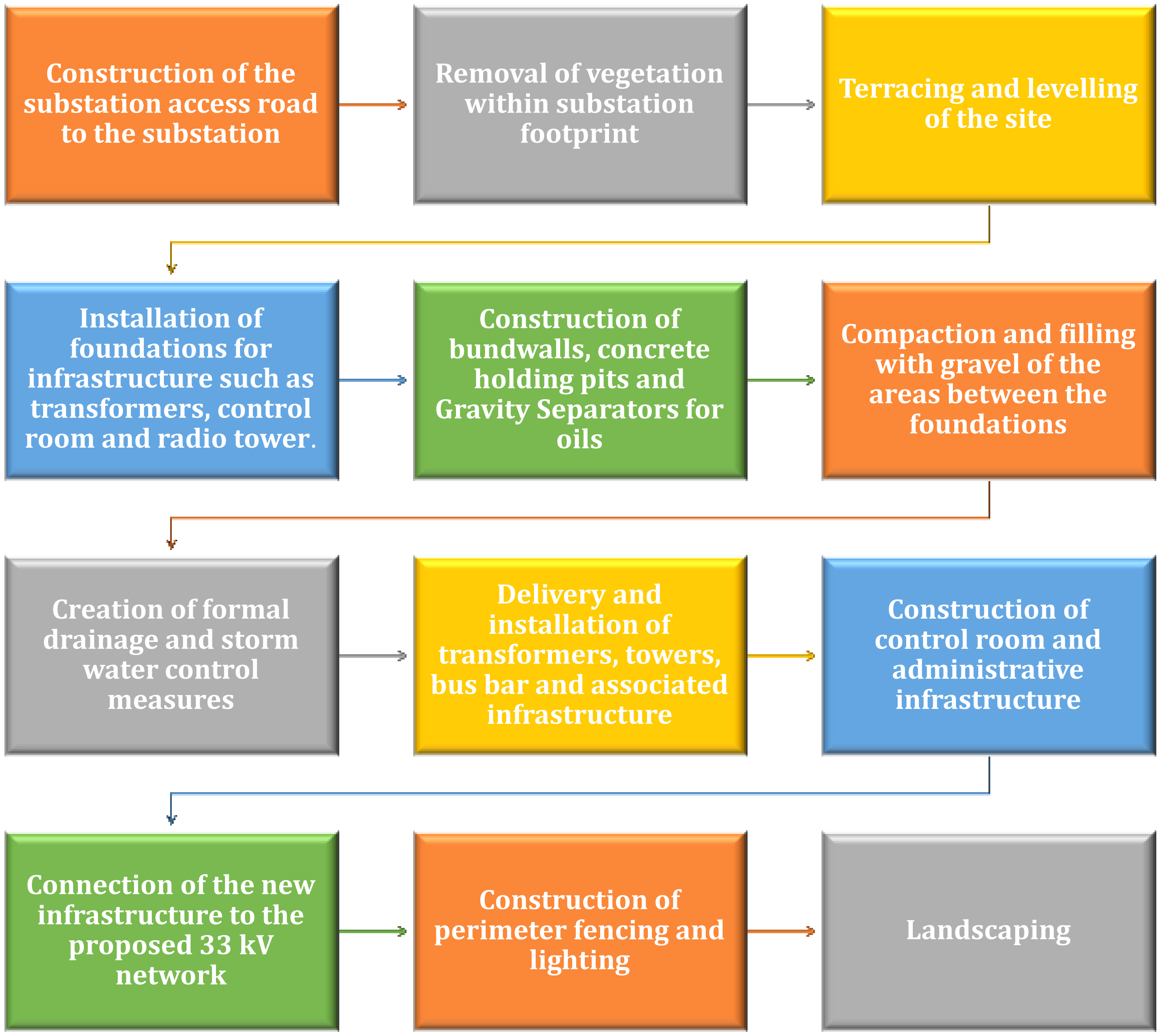


Figure 3.4 Construction Activities of The Substations

Fuel based equipment to be used will include mixer, vibrators, compressors, and drills. The construction of the foundations will involve masonry work and related activities. General masonry and related activities to be undertaken will include concrete mixing, construction of foundations, erection of steel tower and curing of fresh concrete surfaces. These activities shall utilize labour from the neighbourhood to supplement some machinery works such as that by the concrete mixers. Thus, creating employment for the local population.

- Construction of bunds and oil holding dams (for emergency holding of transformer oil in the event of a spill) and wall safety walls
- Compaction and filling with gravel of the areas between the foundations
- Creation of formal drainage and storm water control measures

- Delivery and installation of transformers, towers, bus bar and associated infrastructure
- Construction of control room and administrative infrastructure
- Connection of the new infrastructure to the proposed 33 kV network
- Construction of perimeter fencing and lighting
- Landscaping: - After successful completion of the project construction work, the project contractor will rehabilitate the project sites that had been subjected to clearing by planting indigenous plant species.

3.4.7 Transportation

Transportation requirements during the construction period will vary per the work required at each tower site. For new structures, the vehicles likely to be used are as follows:

- articulated truck for steel sections and transformers delivery from Lagos (Tin Can or Apapa port where these imported components of the required materials will be shipped will be transported through Apapa-Oworonsoki and Lagos -Abeokuta Express way for the Ogun State area and through Lagos-Badagry Expressway for construction activities around Agbara and Badagry area.
- non-articulated flatbed truck;
- concrete truck;
- track or 4WD mounted drill rig;
- crane;
- bulldozer/grader/excavator/backhoe;
- 4WD vehicles;
- elevated work platform; and
- brake and winch truck

The nomination above for the main earthmoving equipment will vary between the structure sites and will likely be transported to several sites at different times. For example, some foundation sites will require an excavator for the foundation work while others will only need a backhoe. It is not anticipated that earthworks requiring the use of a dozer would be required.

Each site would require an elevated platform or similar for connection of the conductor pulleys. For the stringing operations, two heavier brake and winch trucks and one truck delivering conductor wire, earth wire, and temporary anchor blocks will need access to specific sites along the route.

The EPC contractor shall prepare a Traffic Management Plan (TMP), as a part of the CEMP. TMP is to focus on the 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.

3.4.8 Workforce and Hours of Operation

Workforce

The workforce engaged on the project will vary during the construction program and will be dependent on the specific activities underway. Labour requirements will generally be a maximum of 32, comprising approximately 10 on access track and foundation work, 10 on structure erection and 12 on stringing work, with several others engaged on miscellaneous other activities. As outlined above, it is anticipated that most activities will be undertaken gradually in accordance with the requirement to keep the existing line in service during peak demand periods.

Hours of Operation

Given the need to undertake most of the work in planned system outages, the construction program will include work outside normal construction hours and will include night time and weekend periods as required. Construction activities that are likely to cause system outages may extend to night time, to minimise outages. Apart from this no construction activities is expected to be carried out at night time.

Regulatory Requirements

The contractors shall ensure compliance with the following laws and regulatons

- The Factories Act, 1987
- Wages Board and Industrial Council Act, 1974
- Workers' Compensation Act, 1987
- IFC Performance Standard 2: Labor and Working Conditions
- International Labour Organisations (ILO) requirements

These are elaborated in Section 1.4

3.4.9 Clean-Up and Final Inspection

The following steps will be taken to clean up the construction sites and conduct final inspection, preparatory to commissioning:

- On completion of works, the concrete shall be thoroughly cleaned.

- All packing and surplus materials from site and all rubbish and waste shall be removed as well as trees from transmission line right of way and access roads.
- Required burning permits shall be obtained, to comply with government regulations.
- There shall be no disposal of rubbish, waste or any debris in rivers and do not pile such materials in stream beds, river terraces, or any unauthorized place.
- Natural drainage in areas where temporary facilities have been made for construction purposes shall be restored.
- Access roads shall be restored to their original conditions.

Towers shall be inspected to ensure proper installation of all items including signs and accessories, hardware, dampers and spacer dampers, insulators and to ensure that bolts are tightened, no members and bolts are missing, conductors and overhead shield wires are properly sagged with specified clearances maintained, ground leads are removed and towers and foundations are installed within the specified tolerance. Inspection shall be carried out along the transmission line to ensure that rubbish and waste are disposed, fences are mended, holes and over-excavations are filled, drainage is restored, damages to property are made good and the transmission line right-of-way is reinstated.

3.5 Operation and Maintenance of the Transmission Line

The proposed PTL maintenance will be the responsibility of TCN. The maintenance is described in the following sections.

3.5.1 Structure and Conductor Maintenance

Once the transmission line construction is completed, maintenance patrols will make periodic inspections of the structures, the easement and the conductor and line hardware, taking note of clearance conditions, damage to components or evidence of vandalism.

3.5.2 Easement Maintenance

As outlined in TCN Easement and Access Track Maintenance Policy maintenance of the transmission line easement is necessary to ensure that the safe electrical clearances are not infringed due to growth of vegetation.

Generally, the easement will be inspected in conjunction with the inspections of the structures. If necessary, vegetation control activities will be carried out. Two basic types of control will be employed:

- Hand clearing: In sensitive areas or in areas too steep for mechanical control, hand clearing of re-growth is used. Only a portion of the re-growth is removed to keep the disturbance to a minimum. A team of up to 4 people could be used on this work; and
- Mechanical control: Tractor driven brush cutting equipment capable of clearing small trees are commonly used to maintain access tracks and where heavy re-growth is occurring within the easement. A work team of up to 3 persons could be involved.

In any section of the transmission line the easement does not contain any vegetation, but buildings and other infrastructure instead, it will be important to govern or restrict further development that impinges on the safe electrical clearances required for the 132/330 kV easements.

Nigeria Security and Civil Defence Corps (NSCDC) has the lagal responsibility for safeguarding national assets such as power lines, railway lines, pipelines and other public utilities. Therefore, it is NSCDC's responsibility to prevent encroachment on transmission lines. However, TCN being the owner of these lines, shall facilitate and provide logistics support.

3.5.3 Rehabilitation Program

Disturbed areas (e.g., construction pads, winch sites and tracks) that are not required for future use or access will be shaped and seeded in consultation with each landowner. Rehabilitation of work sites will be carried out as work proceeds and as soon as possible after the completion of work on each site. A rehabilitation plan shall be included in the project's ESMP.

Erosion control measures, in accordance with the Blue Book will be implemented at each work site during the work period and following the completion of work at the site, measures to restore the pre-existing ground condition will be implemented and are further discussed in Chapter 5.

Re-vegetation techniques such as loosening of ground compacted by construction equipment, improving soil quality of excavated material spread around structure sites, spreading of fertilizer and grass seeding will be implemented as required.

Special re-vegetation techniques will be necessary if acid sulphate soils are encountered. These areas may also require follow up maintenance to ensure that vegetation cover is successful.

In some areas, specialized rehabilitation works will be required or otherwise agreed with the landowners. As such, the ESMP that will need to be developed on a site-by-site basis to reflect the prevailing conditions and the level of rehabilitation required. Farmlands for example may prefer to leave the disturbed area tilled but not sown as they will be returned to vegetable production. Other areas, which may involve tree clearing, will require replanting of trees in areas located outside the easement and the agreement of respective land owners.

These trees will be replaced at a ratio of four to one and planted within the riparian corridor outside the easement. This work will be undertaken in consultation with all affected Local Government Councils.

3.5.4 Project Decommissioning/ Closure

This is the last phase of this project. Decommissioning of the substations and TLs will be effected when the active life of the substation has expired. The project will involve removing the substation apparatus and reclaiming the land where necessary. Equipment to be removed include:

- The transformers;
- Associated substation equipment; and,
- The substation fence.

The aim is to return the disturbed site to equivalent land capability following the substation decommissioning. The guidelines outlined under FMEnv and NESREA's Environmental Protection Guidelines for Transmission Lines for the reclamation of decommissioned substation sites will be applied in for the SS of two project areas. These include:

- Assessing soil conditions;
- Protecting the environment during the decommissioning activities; and,
- Ensuring the site is reclaimed to the pre-disturbance land capability and is compatible with current adjacent land use.

Generally, if a decision is made to decommission the lines and SS, the following steps will be taken towards the process in the two study areas:

- Dismantling of the towers and condition
- Dismantling of tower foundations
- Removal of all material from transmission line
- Dismantling and all material and equipment within the substations.
- Restoration of land to its original situation as much as possible

3.6 Project Wastes

A lot of wastes of different kinds are expected and generated during construction, decommissioning/dismantling, operation, and maintenance. Table 3.1 shows estimated quantity, sources, disposal method, place of disposal and the responsible party.

3.6.1 Waste Generation

Below is a list of envisaged project wastes and their potential sources:

- Leaves, branches, trunks, grasses from the clearing of the vegetation along ROW and Substation spaces.
- Kitchen wastes from human feeding and activities involving many workforces.
- Scrap metals – from cuttings, fittings, pylon member, nuts, bolts, and welding etc.
- Concrete waste – from foundations and plinths, including housing complex and control room construction.
- Nylons/Plastics – from human activities wrappings, water sachet, food etc.

- Oil spills from heavy duty machinery and equipment, transformers, breakers, and vehicle engines, either during normal runs of old machines or maintenance work.
- Human wastes – from activities of personnel involved in the work or secondary business group.
- Operational activities – nylons, paper materials/office, human waste etc.
- PCB is a toxic substance contained in certain transformer oil, which shall not be used in this project. Nevertheless, to control an accidental spill, provision shall be included in the project design for an API gravity oil separator as well as a bundwall or underground chamber as an integral part of transformer foundation is required to control PCB spillage.
- SF 6 is an inert gas which possesses very high insulation resistance to high voltage and acts as a very good medium for high voltage arc quenching. It is therefore deployed in high voltage switchgear operations

3.6.2 Waste Disposal

Waste disposal methods will include:

  - Composting of biodegradables
  - Selling metal, wood, and plastic scraps to buyers
  - Reuse of materials e.g., packages, concrete, etc
  - Dumping of remaining wastes at approved sites
- Sewage from site camps will be vacuum-sucked into septic tanked trucks and taken to facilities approved by either OGEPA or LAWMA. The EPC contractor shall contact these agencies during mobilisation stage to arrange the modalities.
- Spent oils generated during transformer fillings, retrofitting and maintenance work will be stored in oil trench and oil sump at the substations and in line with requirements of the Basel Convention.
- It is recommended to use mobile toilets at construction sites, and soak-a-way pits at camp sites.

Table 3.1 Proposed Transmission Project Waste Estimates and Disposal Plan

Project Phase	Type of waste	Form of Waste	Source of Waste	Estimated Quantity	Colour	Disposal company	Disposal method/use	Disposal location
Site preparation/ clearing	Degradable	Vegetation, kitchen waste	Camp, TLROW	3200 m^3	Green	Community members	Timber, fuelwood, compost	-
Construction	Degradable	Kitchen waste	Camp, TLROW	30 m^3	Green	OGEPA/LAWMA approved Waste Contractor	Compost	OGEPA/LAWMA approved site
	Mixed	Metal scrap, wood, Nylon/plastics, spilled concrete	Camp, TLROW	180 tons	Brown /black	OGEPA/LAWMA approved Waste Contractor	Reuse, recycle	Scrap buyers/ reuse location
	Sewage	Camp sites	Personnel		black	OGEPA/LAWMA approved Waste Contractor	Vacuum-sucked into septic tanked trucks	OGEPA sewage treatment facility, or disposal site
Maintenance	Degradable	Vegetation	TLROW	360 m^3 per year	Green	Community members	Fuelwood, compost	-
	Hazardous	Spent oils	Substations		Brown/ black	FMEnv/OGEPA approved Waste Contractor	reuse	
		SF6 gas	substations circuit breakers	N/A	Colorless and odourless green house gas	Not to be disposed, but contained and monitored		
Decommissioning & Dismantling	Mixed	Demolished concrete	TLROW	200m^3	Brown/black	OGEPA/LAWMA approved Waste Contractor	Backfill	OGEPA/LAWMA approved site
	Mixed	Pylon members, strings, insulators	TLROW	1000 tons	Brown/black	TCN for reusable PTL members	Reuse, recycle	Scrap buyers/ reuse location

Source: EEMS Survey, 2017

Note: OGEPA and LAWMA shall be contacted for disposal facility nearest to sites, since works will not be located on a fixed site.

3.7 Descriptions of the Transmission Lines

The description of the coordinates used in this report is based on the UTM WGS84 DATUM ZONE31. Furthermore, angle points and turning points are described in number of degrees it turns away from its rectilinear direction.

3.7.1 330kv DC line: Ejio to Ajegunle

This transmission line is 330kV double circuit which connects between the Ejio S/S and Ajegunle S/S, with a length of 29.5km. It commences from the Ejio substation at point (523223.522 mE, 756723.323 mN) and move towards the East along a bearing of 285.5^{O} for about one kilometre, where it took a right turn of 30.62^{O} from its rectilinear direction, in order to avoid the densely populated Arigbajo Town. Furthermore, to void a Shrine in the Arigbajo Forest, an able point of 15.34^{O} to the left was introduced at point AP-002. About 700 m from this point another angle point of 65^{O} to the left, to avoid crossing over a Mobil Petrol Station and the Lafarge Housing Estate.

This transmission line crosses the Lagos-Abeokuta Expressway (Trunk A5) at 6.853224^{O}N, 3.192264^{O}E, after about 2.3km from the Ejio substation. It also has a crossing point with the existing 330kV single circuit transmission line between Osogbo S/S and Ikeja West S/S after about 7km from Ejio substation. The existing single circuit transmission line is to be cut at the point of crossing. The Osogbo-Ikeja West line will be looped in and out of the Ejio substation. The transmission line from Ejio SS to the crossing point is four circuit; double circuit x 2 (consist of two circuit going to Ajegunle, two circuits from Osogbo-Ikeja West going in and out of Ejio). From the crossing to Ajegunle S/S is two circuits as shown in Figure 3.5. The crossing point is located at Latitude 6.838162° N, Longitude 3.154384° E and about 7km from the Ejio substation. The terminal tower at Ajegunle substation is 6.65854^{O}N, 3.07254^{O}E.

The altitude of Arigbajo (Ejio) S/S site is approximately 80m and the altitude of the distance of 5km Westward is approximately 110m, transmission line is gradually upslope from Ejio S/S to the Westward. The altitude of Ajegunle S/S is about 32m, the transmission line is gradually downslope by the Ajegunle SS. The route map is shown in Figure 3.5.

Figure 3.5 Intersection Point with the Existing Osogbo-Ikeja West Line

3.7.2 132kv DC line: Ajegunle to Existing Agbara Substation

This transmission line is 132kV double circuit from the proposed Ajegunle Substation to the existing Agbara Substation, with a length of 21.7 km. This line shares the same tower with the Ajegunle to Badagry line for upto about 6 km. Which means that the multi-circuit tower section will have four circuits with the advantage of reducing footprint, because only 30 m corridor will be required, instead of 60m if the lines were to run separately (See Figure 3.6).

Figure 3.6 The 132kV Lines Showing Multi-Circuit Sections

The areas around Ajegunle for upto 2km and 5km radius from Agbara substation is dense residential area, in addition to factories around Agbara, (see Figures 3.7 and 3.8).

Figure 3.7 Dense Residential Area Around Ajegunle Substation

Figure 3.8 Dense Industrial Area of Agbara

3.7.3 132kv DC line: Ajegunle to Badagry

This transmission line is 132kV double circuit connecting the proposed Ajegunle substation to Badagry S/S, and it is 36.5km in length. It will also require a ROW of 30m width. As mentioned in Section 3.8.2, four-circuit tower will be used to accommodate both the Ajegunle to Badagry and Ajegunle to Agbara lines for upto a distance of 6km.

The key challenge for this line is to negotiate riverine residential communities and the swampy nature of the uninhabited areas from about 15km from the Badagry substation. Many rivers and swamps are crossed by this route. Hence, the need for strict implementation of the ESMP.

3.7.4 PTL Engineering Characteristics

i Terminologies

In the process of implementation of the project, the following terminologies shall be used:

a. Structure: It shall be taken to be synonymous with the word “tower”, “transmission structure” or “transmission tower”.

b. Span Length: It shall be taken to mean the horizontal distance between the centre-lines of adjacent towers.

c. Standard Span Length: It shall be the span length assuming level ground, which is considered to be the most economic average span.

d. Standard Tower Height: It shall be the tower height required to provide minimum ground clearance over open land, based on level ground, standard span length and the final unloaded conductor sag at 75^0 C.

e. Wind Span; It shall be on half (1/2) the sum of the lengths of the immediately adjoining spans.

f. Weight Span: It shall be the horizontal distance measured between the lowest points of the sags in the spans immediately adjacent to the structure. This distance is to be the most critical measured at any conductor or ground wire temperature during initial or final sag.

g. Tower Height: It shall be the height of the lowest conductor at the tower above the natural ground at the centre of the structure.

h. Right-of-way width: The distance from the centre-line of the transmission lines to the edge of the right-to-way shall be 15 meters. For a single or double circuit transmission line on its own right-of-way, the total width of the right-of-way shall be 30 meters for the 132kV and 50 meters 330kV.

Tower centreline to tower centreline clearance for parallel transmission lines

The distance between the transmission line centre lines of any voltage to be the larger of Y1 or Y2. Y1 = 50 meters

Where:

Y1 = Distance from centre line of transmission line (A) to Line (B) and

Y2 = (X + 1) + F + G

Where:

Y2 = Distance from centre line of transmission line A to centre line of transmission line based on the criteria that transmission tower of line A falls towards line B or tower of line B falls towards A, whichever is critical.

X = Distance from centre line of line A (or line B) to the end of its lower cross arm (m).

F = Total height of maximum height tower of line (or line A) where maximum height tower is defined as required tower height for a level span length of 1.2 times the design suspension tower wind span (m) or for existing lines, the actual total highest structure.

G = One-half the ground line spread of the maximum height tower of line B (or Line A) (m).

3.7.5 Line Design Inputs

Network Requirements

The network requirements quoted in Table 3.2 underpin the designs recommended for the proposed power transmission lines.

Table 3.2 Network Requirements

Factor	Value	Source
Network nominal voltages	330/132 kV	TCN Criteria
Normal operating range	±10%	
Equipment highest voltage	362 kV	
Minimum required lightning/surge impulse withstand	1175 kVp	
Short time withstand: • OPGW • Overhead earth wires • Phase conductors	 56kA for 270 ms 56kA for 200 ms 56kA for 270 ms	

Physical Environment

Line designs have been based on the following physical environmental conditions as presented in Table 3.3.

Table 3.3 Rated Physical Environment

Factor	Value	Source
Conductor rating: Maximum ambient temperature	40^0C	TCN
Solar radiation	18.2 – 20.0$Wm^{-2}day^{-1}$	Nimet
Wind speed	(4.1 – 6.74) knots	Nimet
Keraunic level (Ave. annul thunder days)	11	Nimet
Everyday temperature	(28 – 32) ^{0}C	Nimet

Maintenance Provisions

The transmission lines are high security lines. As such, future planned outages for maintenance or new load/generator cut-ins will be very difficult to obtain.

Aligned with standard industry practice, TCN allows live line maintenance for 330kV transmission lines. The maintenance policy is to use the live bare hand methodology, with a minimum safe approach distance of 2,030mm (for the live line maintenance clearance requirements).

Design Life and Reliability Requirement

TCN is adopting the industry standard design working life of 50 years for transmission lines and their components. Reliability level 3 (LR=3) is selected which is applicable to the 330/132kv transmission lines. These factors correspond to wind return period of 200 years.

Applicable Codes and Standards

All known and agreed internationally accepted code and system regulations have been reflected in the codes and standards deployed in the manufacture and installation of 330/132kV DC transmission lines network components. A typical code and standard include.

System Parameters for the transmission line:

Electrical:

- 50m (for 330Kv) and 30m (for 132kv) ROW
- 400m - 450m (for 330Kv) and 325 – 350m (for 132kv) span between line towers
- 42m -57m (for 330Kv) and 28m - 32m (for 132kv) height for 330kV DC suspension tower (see Figs 3.7 and 3.8)
- 4.5 tonnes (for 330Kv) and 2.8 tonnes (for 132kv) weight suspension towers (See Table 3.7 for cumulative total weights).
- Normal Voltage 330kVrms (for 330Kv) and 132kVrms (for 132kv)
- Highest Voltage – 362kVrms
- Frequency – 50Hz
- System grounding effectively earthed system
- Basic insulation level 1135Vp switching impulse level 950kVp
- Power frequency withstand voltage (wet) 450kVrms
- Short circuit level for Isec 31.5kA
- Corona extinction voltage 230kVrms
- RIV at 230Vrms (uv at 1MHz) 1000

Table 3.4 Tower Span and Weight

S/N	Line	Length of Line (km)	Average Span (km)	Estimated No of Towers	Weight of Each Tower (tons)	Cumulative Total Weight of Towers
I	Ejio to Ajegunle	30	0.425	71	4.5	319.5
II	Ajegunle to Agbara	23	0.337	68	2.8	190.4
III	Ajegunle to Badagry	35	0.337	104	2.8	291.2

3.7.6 Structure Plotting

A plot of the proposed locations shall be on the plan and profiles such that the following criteria are satisfied:

- The wind span and weight spans shall both be within the design limits for the tower for both the conductor and overhead ground wire. The ratio of weight span to wind span for the conductor at maximum temperature unloaded, initial condition shall not be less than 0.5 for suspension structures. The ratio of ruling spans on each side of strain towers shall be within design limits of the tower.
- For strain towers, the maximum weight span on any side of a tower shall not exceed the span used to calculate the design vertical load on that side of the tower. The weight to wind span ratio on suspension structures shall be such that insulator strings do not swing beyond their design limits. Counterweights may be used to limit side swing. The conductor overhead ground wire and OPGW shall not be tensioned beyond the limits specified in sections 10, 12 and 14. Maintain the minimum clearances. When plotting, add not less than 0.5m to the minimum ground clearances to account for minor errors in profile, etc.
- Leg extensions shall be used as required to compensate for sloping ground at the structure site. The final span to the substation line entry structures shall be “slack spans”. When crossing over communication lines, distribution lines, or pin insulated power lines, maintain the specified clearances assuming the top wire(s) of the line being crossed over is a straight line extending from support to support. When crossing over major highways, dual carriage ways and railways, adjacent suspension type structures with square cross arms and a complete suspension insulator assembly shall be provided at each corner of the cross arm. Structure spotting using Autocad software shall be done using the optimization routine in order to achieve the lowest total cost taking into account towers and foundation.
- Minimum Clearances in metres at 750C (conductor temperature) 330kV.
  a) Vertical Distance: Normal ground 8.0 6.7, road crossings 9.0 8.3, buildings, pole structures, walls and cradle guards 5.2, 5.0, limited access motorways and dual carriageways 10.0, 10.0, navigable waterways (at high water level) 15.0 15.0, pipelines (oil, gas, water) 10.0 10.0 communication and power line wires 4.6 3.6 and cradle guard to top of railway track 9.0 8.3.
  b) Horizontal Distances: Nearest steel of transmission tower, to edge of navigable waterways, pipelines, bridges, highway pavement, railway (nearest rail), buildings on right-of-way and at crossings, to structure of line being crossed 50.0, 50.0.
- Route Selection: The routes shown on the Route Plan represents the preferred routes, taking into account such aspects as soil conditions, access, right-of-way acquisition costs, and avoidance of built-up areas. Distances between paralleling transmission lines shall be as determined herein.

- Right-of-way Clearing and Access Roads: Clearing transmission line right-of-way shall mean cutting, removing and disposing of all trees, brush, fallen timber and debris from the transmission line right-of-way.
- Work Involved: The work of this section consists of the clearing of the right-of-way for transmission lines and shall include all measures and materials to clear the right-of-way as specified. Work also includes the preparation of the permanent access roads.
- Anger Trees: This shall mean any tree outside the right-of-way which, when falling towards the line will pass within 1.5 metres from either the tower steel or the conductor at its vertical position. At the maximum or minimum sag, access road and access to the line right-of-way from existing roads/tracks shall also be shown.

Tower Foundations: Tower foundation shall mean the tower footing and footing and the supporting soil, which together resist the applied tower loads. Tower footings are the structural element (piles, grillages, pad and chimneys, etc.) that transmit the load to the soil. The soil types and soil engineering parameters shall be adequate and properly taken into account.

For this project, the determination of type and size of a tower foundation, soil details from geotechnical investigations shall be used and complemented with additional investigations where required. All foundations shall make adequate provision for horizontal shear forces at the ground line. The foundation types chosen for the proposed TL project shall be constructed using concrete and reinforcement as major materials. Due to the possibility of the corrosion of foundation materials by underground water, surface water and soil, the following shall be used: The foundation protection thickness shall be enlarged to over 50mm while the top of the foundation shall be minimum 500mm above ground level.

- High strength concrete shall be used.
- Antiseptic such as bitumen shall be applied on the area that shall have direct contact with the soil.
- Specific high-grade cement shall be used in the concrete mixture.

Standard Foundations

Standard foundations for towers shall be concrete pad and chimney. The height of the chimney shall be determined according to expected buoyancy (e.g. floods, tidal water level changes). The use of displacement method for calculating bearing pressure in pad and chimney foundation, reducing the unit weight of concrete in account of excavated earth overburden shall not be accepted.

Special Foundations

In areas of low soil bearing capacity, special foundations will be required for the set-up of TL towers. Special foundations comprise but are not restricted to:

- Pad and chimney with enlarged pad (soil bearing capacity!)
- Raft foundations (soil bearing capacity!)

- Pile foundations,
- Combined pile and raft foundations

For design of these foundations, special considerations shall be made concerning water levels, buoyancy, concrete quality, etc.

Transmission Lines Design for Actual Conditions:

The design and foundation selection shall be done based on the actual ground conditions at each site, taking into account the differences in design methods applicable to granular and cohesive soils and considering the maximum and minimum ground water elevation at each site, whichever is critical, in the determination of the foundation and protective requirements. Initial identification of the soil type has been based on visual examination of the soils present throughout the length of the ROW. Soils have been identified as either granular or cohesive on the basis of the field identification procedures.
Loading on Foundation: The foundations are designed from the loads worked out from the tower design at the base of the tower and these loads are increased by 10% in case of suspension tower and 20% in case of tension tower. These loads are considered as working loads for the design of the foundation.

3.7.7 Fabrication and Manufacture

Reinforcing Steel

The EPC Contractor shall make bends in reinforcement to shapes shown on the drawings and bar schedules; make bends around mandrels to achieve the specified bending radii; discard bars with cracks or splits; and for concrete filled pile caissons, ensure that the reinforcing steel extends the full length of the pile element.

Structural Steel

All structural steel shall be fabricated in accordance with the tower supply specification applicable to this project.

Installation

Ground levels existing prior to the construction of foundation shall be considered in determining tower heights and individual single leg extensions. The material shall be disposed and the movement of equipment so regulated that disturbance of the original grade is kept to a minimum.

Protective Measures

Foundations shall be provided in seasonally dry riverbeds, or drainage channels, with appropriate erosion protection measures. Foundations shall be provided for steeply sloping ground or erosion sensitive sites with adequate support to prevent loss of backfill.

Excavation

The base of the foundations shall be set within the specified allowable tolerances, to the specified depth. Any over-excavations shall be filled with compacted suitable materials to bring the excavation to the required elevation.

Backfill

Backfill shall be excavated materials. It shall be clean from organic or other deleterious substance. Backfill from any other source shall be subject to the agreement of the engineer.

Compact backfill will be done by tamping in 150mm layers, before compaction, for the first 1000mm above the bottom surface of the excavation. The remainder of the backfill tamp in layers shall not be more than 200mm. After compaction, backfill shall have at least the minimum density used for uplift design of the foundation. Backfill in every location shall be built up to a minimum of 300mm above the surrounding ground surface to allow for settlement. Backfill shall be placed only in dry excavated holes or in holes kept dry by pumping out any water in the hole using a surface pump. Under no circumstances shall backfill be placed in an excavation where water is present.

Concrete

Concrete work shall conform to all requirements of the latest editions of ACI 301: Specifications for structural concrete building, except as modified by the supplemental requirements below:

The use of earth cuts for forms will be permitted, provided adequate cover is maintained for reinforcement. A 40mm x 40mm chamfer shall be provided on external corners and edges of concrete exposed to view. Testing will be carried out as specified in Field Quality Control.

Formwork shall not be disturbed until concrete has hardened adequately. Reference may be made to ACI 347 for recommended times of removal of forms. Welding of reinforcement will not be permitted. For concrete filed pile caissons, reinforcing steel shall extend the full length of the pile element. Placement of concrete underwater will not be permitted. Finishing of exposed formed surfaces shall be as specified in ACI 301 Chapter 10 for the following:

- Rough form finish;
- Smooth form finish;
- Finishes of exposed slabs shall be as specified in ACI 301 Chapter II for the following:
- Broom or belt finish;
- Trowelled finish.

The top of all concrete foundations shall extend at least 500mm above the ground.

The slope of the top of the foundations shall be away from the tower legs.

Steel Work

Bases of grillages will be set firmly on and in complete contact with undisturbed soil or backfill used to fill over excavations. Grillages shall not be set on organic material.

Piling

Piles shall be driven in such a sequence as to minimize the detrimental effects of vertical and lateral displacement of the ground. When a pile has risen as a result of adjacent piles having been driven, the defect shall be corrected. Driving shall not be carried out close to recently cast concrete which has not attained sufficient strength to withstand the vibration.

Casing of Piles

The inside surfaces of the casing to receive concrete shall be cleaned prior to placement of concrete.

Towers

EPC shall ensure that all concrete foundations or rock anchor grouting have cured for the minimum period specified (at least 21 days) and that all backfill is compacted to its approved level before placing or erecting tower steel on the foundations.

Tower height specified is the height of the bottom conductor above the natural ground at the centre of the structure. Towers shall be assembled in accordance with the approved TCN's guidelines (see 3.7.5 (i-iii) below).

Tower Erection/Accessories

Towers shall be erected at approved distances and all accessories shall be attached such as anti-climbing devices; cattle, birds and cradle guards; circuit plates (2 nos. for D/C towers), phase plates, danger plates, number plates aerial identification signs, step bolts and ladders, etc. Tower painting shall be ensured as prescribed. Specific requirements for painting, if required for the project, shall be provided by TCN. Stub templates above the base shall be provided as necessary to ensure correct position of the stubs during setting and concreting of foundations.

Tower Configuration/Extensions

The towers shall be self-supporting, latticed double circuit vertical configuration structures with one overhead ground wire and one OFGW for the lines. The 4-circuit towers shall be provided with 2nos OFGW instead of one OFGW and one ground wire. Opposite faces of the towers shall be identical but adjacent faces may be dissimilar. Each tower type is designed so that the tower height is compatible with and connect directly to the bottom of the common body. Individual leg extensions shall be interchangeable in any combinations and shall be compatible with and directly connected to any leg position of the common body or body extension of a particular tower type. The body extension shall be in the steps of 3m, 6m and 9m and leg extensions in the steps of 1.0m and 2m.

3.7.8 Line Insulation and Fittings

Insulators Type Analysis

Typically, 330kv tension / suspension composite insulator (injection molding technics), has the following specifications;

- mechanical load of 160-210 kN.
- Coupling length 2990mm.
- Min. Creepage distance (mm). 9075.
- Dry lightning impulse withstand voltage (kv). 1425 (positive).
- Dry power freqency with stand voltage (kv). 630kv.
- Approx. Weight. 15kg.

The following three types of insulators are considered.

Porcelain discs

Porcelain Longrod

Polymeric Longrod

Comparative Costs

Polymeric longrod has not had the same service history as porcelains and therefore its longevity has not been as well established as that of the latter type.

Manufacturers and users of polymeric insulators have indicated that the industry assessment, at this point in time, points to a lifetime of about 25 years.

Porcelain ceramic insulators, on the other hand, have a service history of over 50years.

It is evident from the cost analysis that although the porcelain disc insulator presents higher capital cost, porcelain disc insulators are the most economical insulators.

Line Fittings

The line fittings design will be in accordance with standard fittings assembly. The design will include armour grip suspension units, spacers and dampers. The tension insulators assemblies will include grading rings to reduce the effects of corona.

3.7.9 Structure Suite Selection

Functional Requirements

The objective of this section is to determine the most economical suite of structures that can cover all possible functional requirements of the PTL.
The high-level inputs to this process are as follows:

- wind strength and special wind conditions
- environmental and community engagement inputs
- line route and terrain
- visual impact issues

- special clearance requirements

The process of structure suite selection consisted of:

- Determining the possible combinations of tower types and functional requirements.
- Refining the tower suite to obtain the most optimal use of towers, i.e. taking into consideration cost of developing each different tower type and utilizing towers for multiple applications.
- Determining the actual angles for which the towers will be designed that optimizes their usage over the various angle requirements of the line route.

Structure Type Optimization

In determining a suite of structures for the transmission lines, the following tower types must be included:

- Suspension structures (designed for 0 or less than 5-degree deviation)
- Heavy suspension structures (to cater for 5 or more degree deviations). This option may be used where there are many small angles in the line route.
- In line strain structures (applicable only for line constructability on long transmission lines)
- Strain structures (designed for major line angle /deviations)
- Terminal structures (for terminating the transmission lines prior to entering the substation).

Table 3.5 displays all the initial tower type combinations available for the proposed TCN PTL route.

Table 3.5 Structure Types Selection for the proposed PTL project

Region Tower Types	Light Suspension	Heavy Suspension	In-line Tower	Strain Tower	Terminal Tower
Low – Medium Wind Area	✓	✓	✓	✓	✓
Strong Wind loads Area	X	X	X	N/A	N/A
Low Profile Tower Area	✓	N/A	N/A	N/A	N/A

Source: TCN

Lost Angle Optimization of Tower Types

The suite of towers identified above comprises a combination of suspension and angle tower types. To determine the angles for which towers should be designed that will be cost effective, a lost angle analysis was carried out. The lost angle analysis reviewed the nominated tower angle and compared its suitability against the actual deviation on the line route.

The difference in angle between the nominated tower angle and the deviation is considered a "lost angle". The average of this "lost angle" is compared with the total cost of the angle towers and the cost to develop and test a new tower.

The analysis considered various angle tower combinations and it shows that the most economical option is to design 4 angle towers that can be used to cover the following range of deviation angles:

- 0-0.4 degrees (0 deg suspension)
- 0.4-5 degrees (5 deg suspension also 0 deg in inline strain)
- 5-15 degrees (heavy suspension based on 45deg angle strain body)
- 15-45 degrees (strain)

Section Length Requirement

The structures are designed with longitudinal strength like the transversal direction and are fully capable of dissipating a shock load within the next two or three spans and to prevent the cascade failures. This eliminates any need for stop structures.

3.7.10 Tower Geometry

Phase Conductor Cross Arm Separation and Length

The line is designed for live line maintenance. As such, the power frequency and impulses do not only determine the geometry withstand clearances required, but also by live line maintenance approach and working distances. A minimum safe approach distance of 2,030mm for live bare hand work is required for 330/132kV line.

For low wind periods, the wind pressure used in calculating the swing angles is 0.1 kPa. For high wind periods, the wind pressure was calculated for a 200-year wind return period and converting the 3 second gust to a 5-minute gust. The 5-minute guest wind will provide a satisfactory operational performance with a probability of exceeding the calculated swing angle of 1%.

Lightning Protection and Earthing

The earth-wire cross-arm length is calculated to provide adequate shielding to prevent a shielding failure occurring in an area with a keraunic level of 10 as indicated in NiMET map of thunder days.

The earth-wire is placed above each top phase conductor at the same vertical distance of the vertical phase to phase separation of the line designed for de-energized maintenance as opposed to the live line design. This is due to the increase in length in phase to phase separation for a live line design. Industry practice has shown that de-energized maintenance distance for earth-wire to phase is adequate to avoid flashover.

3.7.11 Structure and Foundation Requirements

- Basis of Design: The structures have been designed to withstand minimum loading requirements.
- Structural Reliability: As mentioned earlier, the design life of the proposed PTL is 50 years with a reliability level of 3, which correspond to 200 - year wind return period.
- Design Actions
- Wind Loading

The site-specific wind parameters are based on the fact that the majority of the line is orientated west to east and passes through open terrain.

A detailed examination of topographical maps indicated that most the line did not have any issue with increased wind pressure due to local topographical features such as funneling or expansion in valleys, hills, and escarpments.

In addition, the design considers the seasonal change in wind strength.

The structures are designed to withstand the wind combinations as follows:

- Transversal wind;
- Oblique wind 22.5° inclination to transverse axis;
- Oblique wind 45.0° inclination to transverse axis;

Failure Containment Load

The structures are designed to withstand unbalanced longitudinal conductor tension due to failure of adjacent structure by considering the equivalent longitudinal loads resulting from not less than any one third of all phase conductors on the structure being broken with a nominal coincident wind velocity of 0.25 times the ultimate wind pressure.

Maintenance and Construction Loads

To minimize the structural loads on tower and provide suitable stringing methodology the maintenance loads are considered for each complete phase or overhead earth-wire being worked on in turn.

The conditions are based on the worst weather conditions under which maintenance will be carried out. The limiting wind velocity for maintenance work was taken as 10m/s (industry work practice).

3.7.12 Detailed Tower Design

The PLSCADD method for detailed tower designs is performed to the extent required to extract the tower properties necessary for line optimization analysis such as tower geometry, member sizes, and tower weight and tower models for PLSCADD optimum spotting and performance verification checks.

The tower models are designed using PLS-Tower software package and inserted in the PLSCADD line profile for optimal spotting (level 2 modeling). The structural and electrical performance verification was carried out by using level 4 models and finite element analysis (FEA). The FEA method calculates interactions between the tower members and attached conductor loads by including structure flexibility matrices and hence produces more realistic and more economical results compared with the traditional non-interactive model approach.

3.7.13 Material Selection

Towers shall be of steel material using hot rolled angle (90^0) 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.

Since the responsibility of costly and time-consuming production of steel fabrication drawings are with the contractor and can only start after the steel standard is approved, any change of steel standard is expected to have a limited influence on the project.

3.7.14 Tower Acceptance Testing

All tower types will be required to be full scale prototyped and then load tested prior to full production to demonstrate that the developed designs meet the quality requirements of TCN technical specification.

The load tests are required to verify the force distribution in the tower members and assess the efficiency of secondary bracing elements for each tower design.

All load tests will be in accordance with IEC 60652 with agreed test procedures to simulate design conditions as closely as practicable.

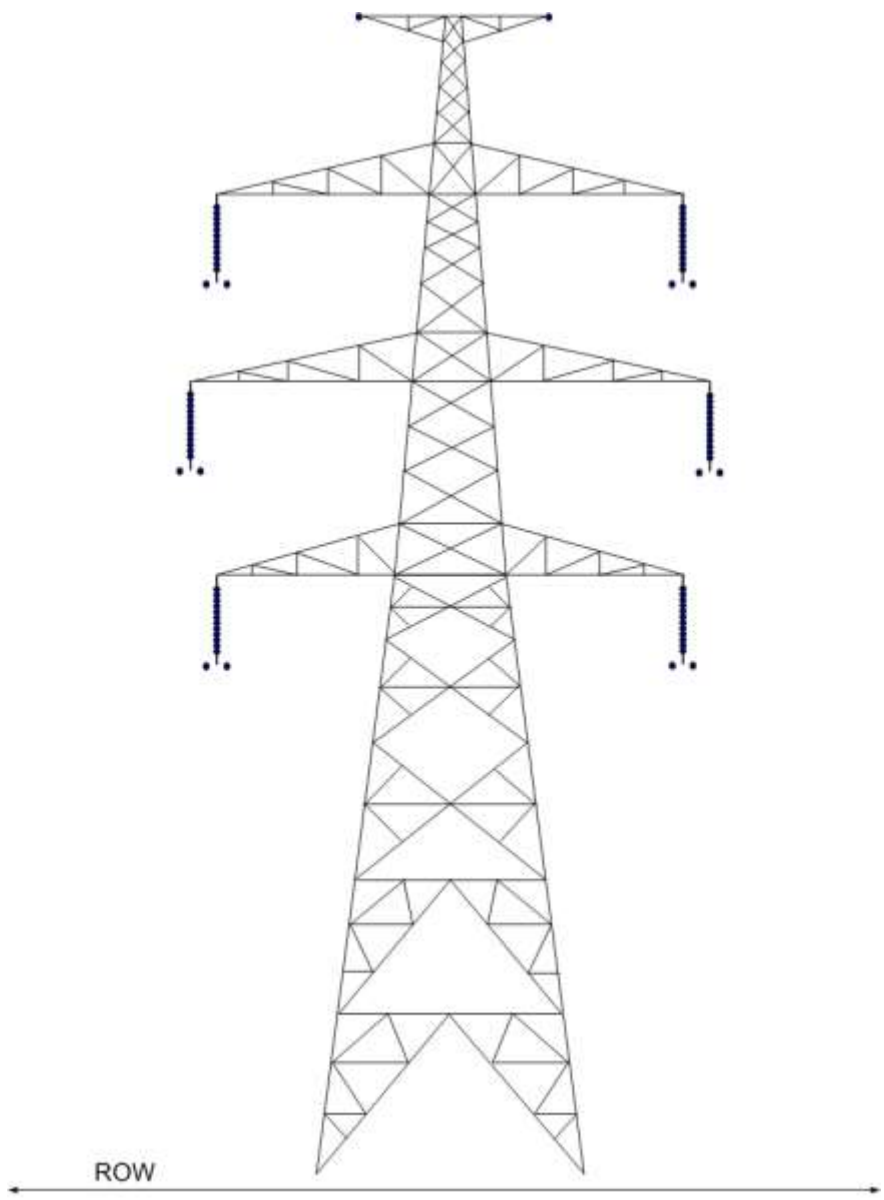


Figure 3.9 Typical Double Circuit Lattice Tower

3.7.15 Foundation Selection and Optimization

The following foundation types are considered on the basis of soil types encountered:

- Bored undercut foundation which is formed by augering a hole into soil and extending its base by forming a “bell”.
- Type “A” is for dry stable soil
- Type “D” is for wet stable soil.
- Bored socketed foundation, formed by augering a hole into rock; Type “B”

- Mass concrete or spread footings formed by excavation of square holes in soil or rock. The base may be straight sided or undercut depending on soil conditions and construction methods.
- Type “C” is for dry stable soil,
- Type “C1” for dry unstable soil,
- Type “E” is for wet stable soil,
- Type “E1” is for wet unstable soil.
- Type “F” is mass concrete foundation in rock.
- Piled, consisting of driven steel piles; Type “G”.

Further geotechnical investigations shall be carried out at a reduced intervals of 2km along the PTL length in order to achieve the required accuracy of soil parameters.

The cost of the foundations represents a significant part of the overall line cost. Three options are explored to reduce these costs without compromising the safety margin.

A. Minimum common parameters.

   This option is based on less extensive geotechnical investigation and adopts more conservative design parameters. The safety level is high. However, it will result in a higher foundation cost.

B. Full geotechnical testing at each tower location.

   This option will provide very accurate soil parameters at each tower location and prediction of foundation type distribution. However, in order to reduce construction cost the foundation design would be standardized and based on general optimized parameters that cover a reasonable amount of footings (target 90%). Therefore, the option 2 cannot realize the full benefit from the extensive geotechnical investigations.

C. Reasonably frequent geotechnical testing and design based on engineering soil parameters.

The geotechnical investigation will produce values and reasonably accurate distribution of soil parameters that will allow the determination of engineered soil parameters that cover the majority of foundations (target 90%). The engineering parameters will be used for foundation design. Construction personnel will be made aware of the assumed parameters and guidelines will be issued to allow recognition of soils not conforming to the adopted design parameters. The foundation in non-conforming soils will require special design however this is expected to be a small percentage resulting in this option producing the greatest cost/benefit.

The design of each type of footing is based on the following measures, to ensure that the soil conditions meet the assumed design criteria during construction:

- Foundation type testing;
- A geotechnical consultant will review the Contractor's foundation installation procedures;
- The geotechnical consultant will provide steel pile driving acceptance criteria charts (based on testing records); and
- The geotechnical consultant will train the Contractor's construction personnel to assess soil parameters. In addition, the geotechnical consultant will provide construction oversight of foundation installation to ensure correct selection by construction personnel.

Material Balance

Material balance recommended for the proposed project.

Concrete volume		
0.32. π.0.2	=0.056m3	
0.32. π.2.15	=0.607m3	
0.72. π. (1.02+0.32+1.0x0.3)	=1.018m3	
1.02 π. 0.05	0. 157m3.	
	=1.838m3	
Concrete weight		
1.838.2240= 4117kg	= 4.117t	
Each volume		
b =2.2.85 x tan200 + 2.0=4.07m3		
2.85. π (2.0352 +1.02+2.035 x 1.0)	=21.40m3	
-(0.607 + 1.018)	=-1.625m3	
	=19.775 m3	
Earth weight		
19.775 x 1600		31.640t
Total weight resisting uplift		<u>31.640t</u>
		<u>+ 35.757t</u>

3.7.16 Under Ground Transmission Cables

Although the preliminary design of the lines is based on overhead cables, in case the final design considers underground cable in any section. Hence, the relevance of this information. There are two main types of underground transmission lines currently in use. One is constructed in a pipe with fluid or gas pumped or circulated through and around the cable to manage heat and insulate the cables. The other is a solid dielectric cable which requires no fluids or gas and is a more recent technological advancement. The common types of underground cable construction include:

- High-pressure, fluid-filled pipe (HPFF)
- High-pressure, gas-filled pipe (HPGF)
- Self-contained fluid-filled (SCFF)
- Solid cable, cross-linked polyethylene (XLPE)

3.7.17 Earthing and Protection Systems

Transmission line system protection has both electrical and mechanical aspects. For mechanical protection, Buchholz, high temperature, oil level relays including no-load time changer protection will be incorporated. The electrical main protection scheme of the power transformer shall consist of numerical low impedance differential protection, high impedance restricted earth fault for each star connected transformer winding.

On the line, distance protection relays will be incorporated. Other protection devices will include:

- Over current and earth fault protection.
- Surge Arresters protection scheme.
- Reverse Power protection scheme.
- Differential protection scheme.
- Shunt reactor protection.
- Bus bar and breaker failure protection (numerical bus bar protection)
- General earth mat and earthing system.
- Safety and security.
- Fire hydrant system for the transformers.
- Under and over voltage relay system.
- High and under frequency relay’s operation.
- The towers and ground wire are major component of the line earthing, as they are electrically clamped to the towers.
- Lightening protection systems are installed as required to protect the lines and the towers.
- Isolators should be in place and used to knock-off supply finally during maintenance activities.
- All relays are in the relay room close to the control room for resetting when flagged and recording the fault accordingly.
- The control panel in the substation houses the switches, voltage meters, ammeters, indication lamps, alarm horns, metering system, fault signal equipment, synchroscope and the rest.

3.8 Communication/Control System

For effective system operations, radio communication between the technical crew in the Substation with the other Substations in the Transmission network, or between the control room officer and other field officers is imperative.

From inception frequency modulated (FM) radios was in vogue, in addition to use of walky-talky within an environment, but recent developments ushered in optical fibre ground wire (OPGW) and SCADA system. This also includes the use of computer and software application for even operational purposes, handsets and all inclusive. All known methods applicable will be employed in the project. There is normally a communication wire at the top of the Transmission line tower linkage to the radio room. Operational control panel showing various feeder areas, taking hourly meter readings, phase voltages and monitoring fault situations and load levels will be employed.

3.9 The Substations

A substation is part of an electrical generation, transmission, and distribution system. Substations transform voltage from high to low, or the reverse, or perform as a buffer to provide continuous power to the consumers even if there is a shortfall of power from the source. Electric power may flow through several substations between generating plant and consumer, and its voltage may change in several steps. A substation may include transformers to change voltage levels between high transmission voltages and lower distribution voltages, or at the interconnection of two different transmission voltages.

Substations are normally outdoors and are enclosed by a wire fence. However, in residential or high density areas, the substation may be indoors and even housed inside a building to restrict the humming noise of the large transformers. The elements of a substation are shown in **Fig 3.11**.

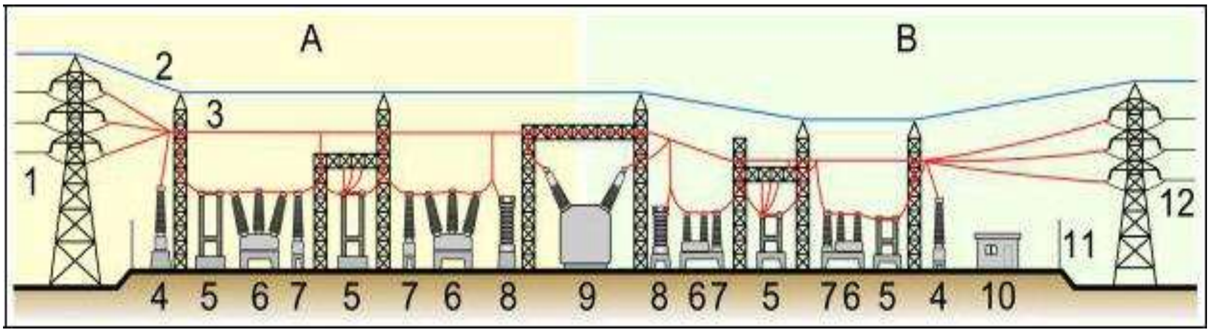


Figure 3.11 Elements of a substation

A: Primary power lines' side B: Secondary power lines' side

1. Primary power lines 2. Shield wire 3. Overhead lines 4. Transformer for measurement of electric voltage 5. Disconnect switch 6. Circuit breaker 7. Current transformer 8. Lightning arrester 9. Main transformer 10. Control building 11. Security fence 12. Secondary power lines

For this project, all the substations will use Air Insulated Substations.

The AIS (see Fig 3.12) uses air as the primary dielectric from phase to phase, and phase to ground insulation. They have been in use for years before the introduction of Gas Insulated Substation (GIS). Most substations across all regions are AIS, which are in extensive use in areas where space, weather conditions, seismic occurrences, and environmental concerns are not an issue such as rural areas, and favourable offsite terrain. The indoor AIS version is only used in highly polluted areas, and saline conditions, as the air quality is compromised.

Figure 3.12A Typical AIS Substation (with transformers zoomed in)

The following are some points to explain the features of AIS:

- The primary choice for areas with extensive space
- With quality design, the system is viable due to the low construction costs and cost of switchgear
- Less construction time, thereby more suited for expedited installations
- Easy maintenance as all the equipment is within view.
- It is easy to notice and attend to faults.

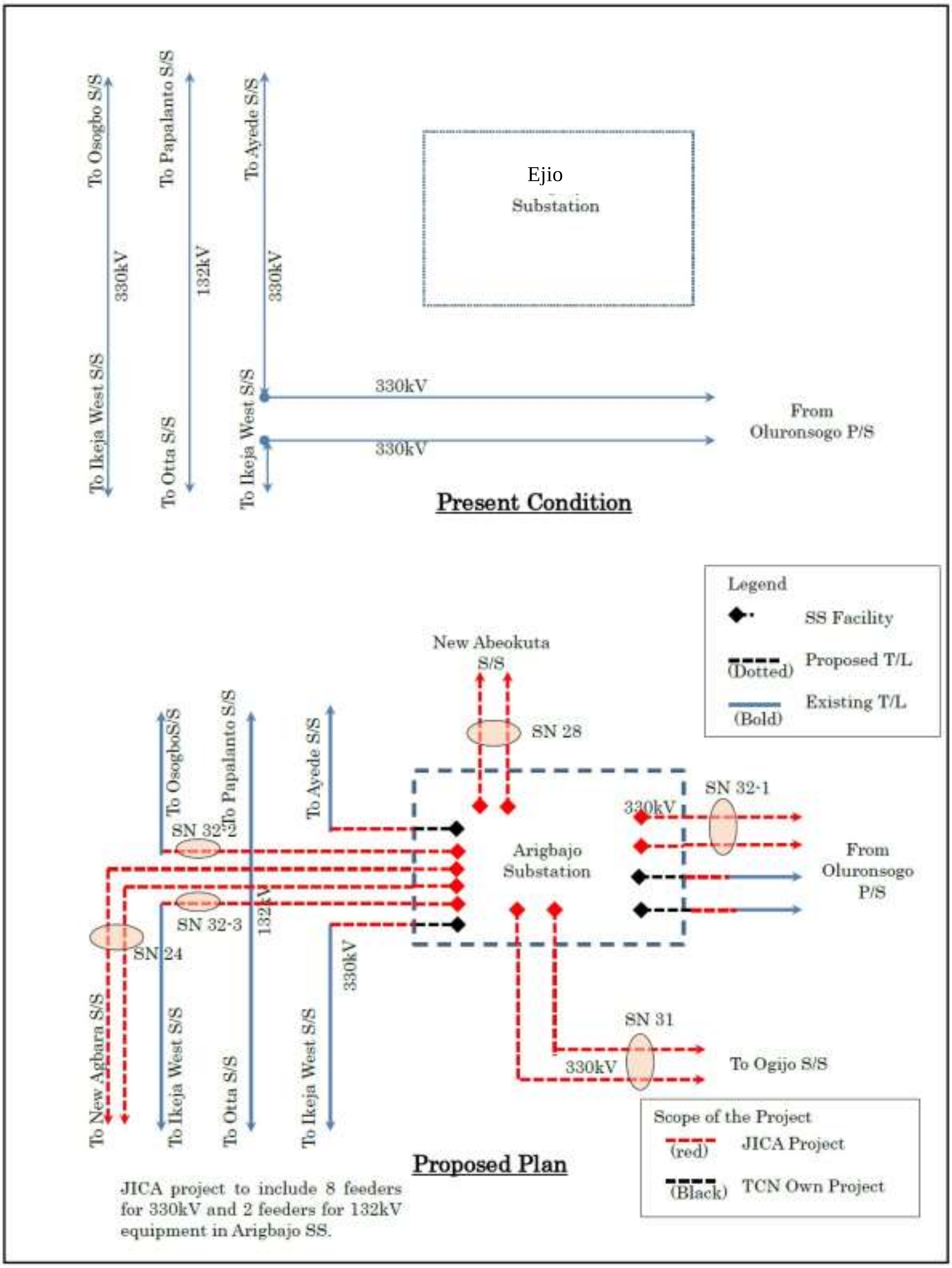
3.9.1 Configuration of the Substations

Four substations are within the scope of this ESIA for Lot 3 (3 green filed, while one brownfield). The greenfield substations are located at Ejio, Ajegunle, Badagry, while the existing Agbara will require an extension of the line bay to accommodate the new line from Ajegunle. The configuration of each of the substations as well as coordinates of location is in Table 3.6 and the layout plan in Figures 3.13 and 3.14.

Table 3.6 Location and Configuration of Substations

Substation Name	Location (UTM Zone: 31N)	LGA/State	Size of land (ha)	Voltage class	Incoming bay / for transmission line	Outgoing bay
Ejio Substation	523203.709mE 756989.301mN	Ewekoro LGA/ Ogun State	25.3	330/ 132/ 33kV	330kV DC from Olorunsogo PS 330kV SC from Osogbo 330kV SC from Ikeja West	330kV DC to Likosi 330kV DC to Ajegunle 132kV-DC to New Abeokuta
Ajegunle S/S	507769.196mE 735269.385mN	Ado Odo/Ota LGA, Ogun State	25.1	330/132/ 33kV	Incoming bay from 330kV DC Ejio 330kV SC from	330Kv SC to Sakete 132kV-DC to Agbara 132Kv dc to Badagry
*Agbara S/S - Existing	509275.967mE 718978.996mN	Ado Odo/Ota LGA, Ogun State	28.5	132/ 33kV	132kV-DC From Ajegunle	NIL
Badagry S/S	484303.490mE 710894.910mN	Badagry LGA, Lagos STate	25.2	132/33kV	132kV-DC From Ajegunle	NIL

*No new land take is needed in existing Agbara Substation



[Source] JICA Study Team

Figure 3.13 Layout Plan for Ejio Substation

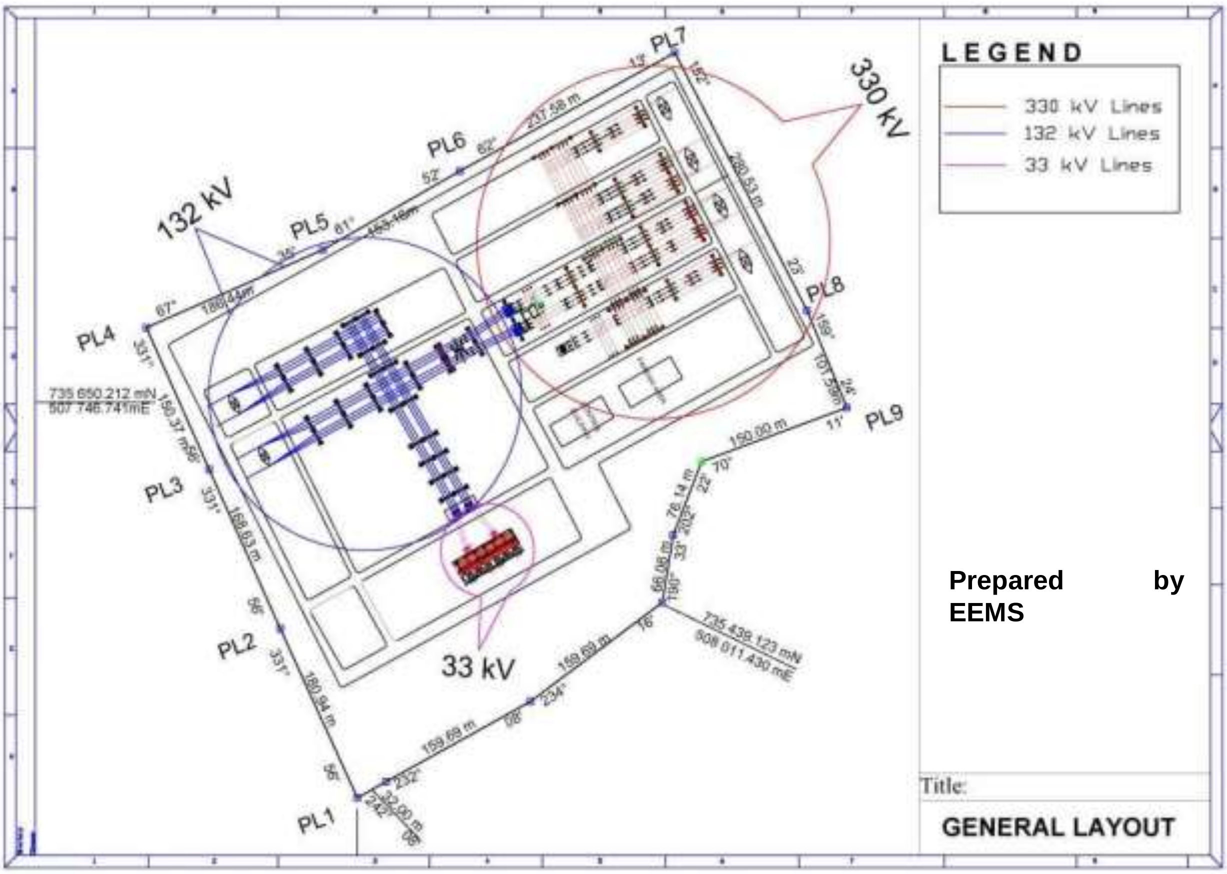


Figure 3.14 The Layout Plan for Ajegunle Substation

3.9.2 Functions of the Substations

The proposed substations are designed to function as follows:

- As voltage control mechanism through the transformers to step-up or step-down the system voltage as case might be, thereby lowering transmission losses.
- Correction of power factor in the circuits when the reactive loads are there to protect the generating plants and increase efficiency.
- For load shedding purposes on the distribution network there maintaining system balance.
- For the purposes of safety by switching and isolating the network during maintenance work, using circuit breakers and isolators including load demand sharing.
- Bus bar splitting for power distribution arrangement.

3.9.3 Substation Facilities

The spaces are meant to accommodate the following, in the minimum:

- All transformers of the following sizes and ratings.

  - Ejio (2x150MVA, 330/132kV + 2x60MVA 132/33kV)
  - Ajegunle (2x150MVA, 330/132kV + 2x60MVA 132/33kV)
  - Badagry (2x60MVA, 132/33kV).
  - Agbara (2x60MVA, 132/33kV).
- All breakers and isolators.
- All auxiliary transformers – Voltage, current, reactor, instrument etc.
- Line Bays as required.
- Cable trenches, oil sumps and drainage channels.
- Control room for system operations with offices, battery rooms, communication section, conveniences, clock rooms, parking slots, cable/junk yard etc.

The substations are highly earthed to take care of excessive current at fault condition. A robust environmental management system has been put in place to meet international standard and local environmental regulations.

In addition, the substations are to be graveled even after laying a nylon cover on the ground as a modern method to:

- Keep the weeds away from growth.
- Allow easy water run-off to drain channels.
- Improve the earthing system.
- Keep the environment clean and clear.

3.10 Project Schedule

TCN is strongly committed to the completion of the proposed PTLs and substations, which have estimated life span of 50 years, and every effort is geared towards actualizing this goal. The proposed project execution schedule is presented in Tables 3.7, 3.8 and 3.9 (Gantt Chart) and indicates that the process for selection of contractors to commence in Q4 2019 wich will take about 12 months to include pre-qualification, tendering and contract signing. The actual construction works of the transmission line will commence in last quarter 2020 and take between 24 to 36 months to complete.

The implementation schedule for the construction of the transmission lines and substations would follow the under-listed duration. It should be noted that some of the phases and activities will run concurrently to save time.

Table 3.7 Implementation schedule for construction of Transmission lines

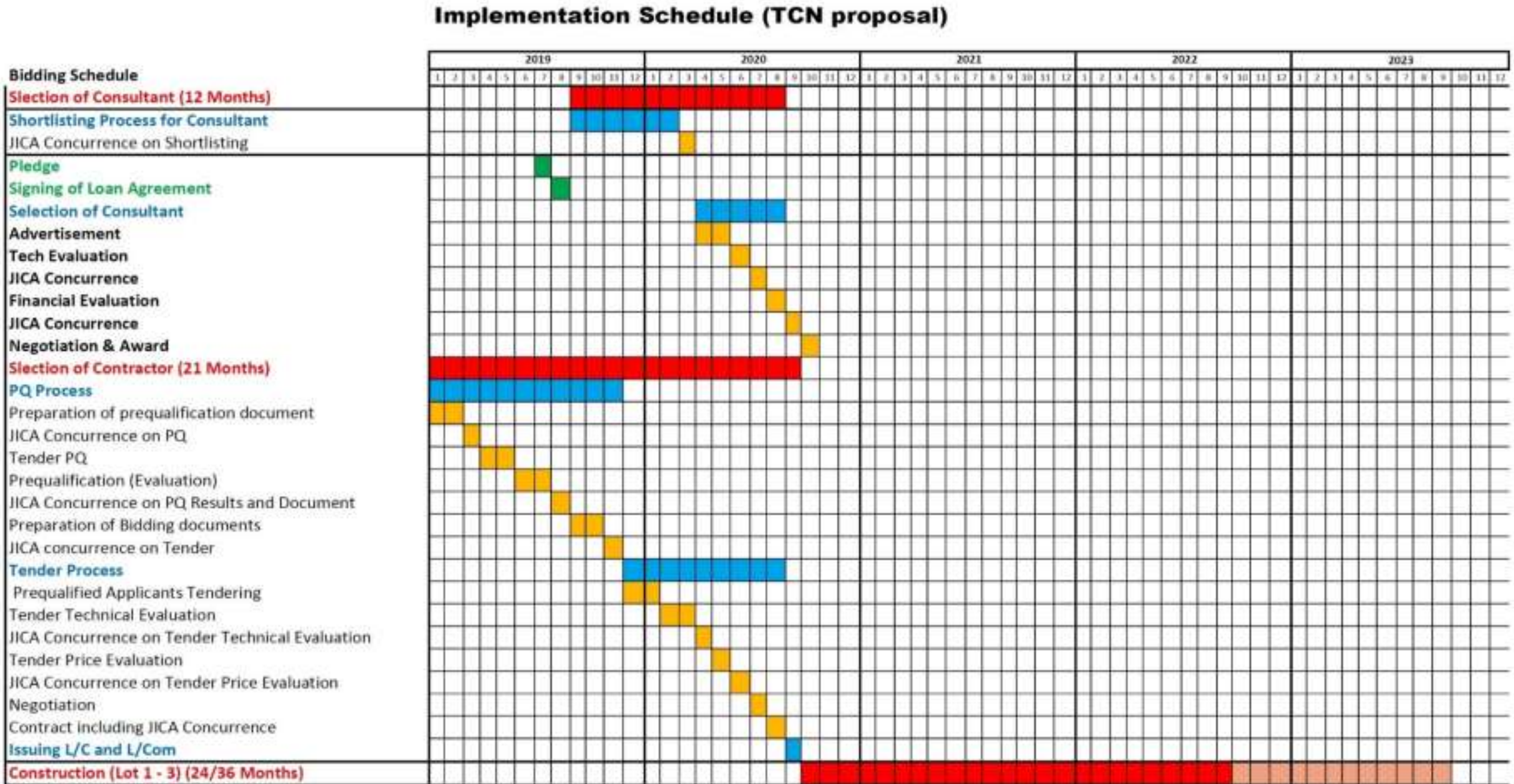
Transmission Lines		
Phase I	Phase II	Phase III
Pre-construction		
Line Route Studies ESIA RAP	Engineering Procurement and Construction (EPC) Final Acceptance Test (FAT)	Commissioning Project closure
12 months	24 months	3 months

Table 3.8 Implementation schedule for construction of Substations.

Substations			
Phase I	Phase II	Phase III	Phase IV
Design & Approval	Procurement & Manufacturing	Construction	Communication, Project closure
6 months	12 months	24 months (can run concurrently with part of phase 2)	6 months

Invariably, some percentage variation is allowed in the duration for contingencies. In that case, the average total duration for the entire project execution is put at 36months. Construction works shall be scheduled at time crops have been harvested.

Table 3.9 Proposed Project Implementation Schedule



Note: (1)Consultant requires only for supervision as owner Engineer. TCN Project team has the expertise to implement the procurement process for the selection of both Consultant and the Contractors for the project. This is similar to arrangement for other Donors funding projects undertaking by TCN.

(2)Shortlist process for Consultant begins after the signing of the loan and continue with the selection process later after signing. However, PQ process for the selection of contractor expected to starts January 2019 (6 months before the pledge while the actual tender process continue after the signing of the loan.

CHAPTER FOUR

4.0 DESCRIPTION OF EXISTING ENVIRONMENT

The prevailing ecological conditions of the environment within which the proposed project will be sited, as well as the socio-economic and health profiles of the affected settlements are presented in this chapter. Components described include the physico-chemical environment (meteorology, geology, sediment/soil type and distribution, surface/groundwater characteristics), biological environment (location and distribution of benthos, plankton, fisheries, flora and fauna characteristics), as well as socio-economic and health conditions describing the demographic structure, culture, heritage sites, social and health status of the people and their environment, including outcomes of consultations held.

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 (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.

4.1 Scope of Study

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 ground water
- Soil and sediment
- vegetation & fauna wildlife
- Hydrobiology, fisheries and
- Socio economics/health impact, demography and community characteristics

4.2 Baseline Data Acquisition Methods

The acquisition of data basically 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 (details are spelt out in Appendix 3.1). This approach assured that the required data and samples were collected in accordance with agreed requirements (scientific and regulatory) using the best available equipment, materials and personnel. Elements of this approach include:

- review of existing reports that contain environmental information on the study area;
- designing and development of field sampling strategies to meet work scope and regulatory requirements;
- pre-mobilization activities (assembling of field team, sampling equipment/materials calibrations/checks, review of work plan and schedule with team, and job hazard analysis);
- mobilization to field; fieldwork implementation - sample collection (including positioning and field observations), handling, documentation and storage protocols and procedures; and
- demobilization from field; transfer of sample custody to the laboratory for analyses.

4.2.1 Spatial Boundary and Size

A 700 m wide spatial boundary on each side of the transmission Right of Way (RoW) was taken. For the sub stations, a 3km^2 boundary was adopted.

4.2.2 Desktop Studies

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.

4.2.3 Field Sampling/Measurement

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 27th November through 4th December 2017. The specific objectives of the ecological field sampling were to determine:

- ambient air quality and noise level of the study area;
- physico-chemical 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.

Table 4.1 presents an inventory of the biophysical and socioeconomics/health details collected during field studies

Table 4.1 Inventory of Biophysical and Social Samples

S/N	Environmental Component	Parameter/Details	No of samples requested by FMEnv	Actual no of samples collected
1	Surface water &Sediments	Physico chemical & microbial	Three (3) at each stream/river crossings in line with best analytical methods + control sample.	15 points + 1 control
2	Ground water	Physico chemical & microbial	One (1) no at each substation + control.	8 points + 4 controls
3	Soil	Physico chemical & microbial	Thirty-three (33) Representative samples in line with best analytical methods at 5km intervals + three (3) control sample.	33 points + 3 controls
4	Ambient air quality	Criteria pollutants	3 Nos. At each substation (in-situ @ different elevations)	33 points + 3 controls
5	Noise	Sound/pressure level	3 Nos. At each substation (in-situ @ different elevations)	33 points + 3 controls
6	EMF	Electromotive force	At the edge of the RoW/regular intervals and around substations	10 points were collected
7	Meteorology	Pressure, Relative Humidity,	3 Nos. At each substation (in-situ @ different elevations)	33 points + 3 controls
8	Biodiversity	Taxa	-	10 transects each of 2ha totalling 20ha
9	Socio economics	Human and infrastructures	-	All 68 communities

4.3 Analytical Methods

Samples collected from the field were analysed in Mifor Consult Laboratory using the various methods shown in Table 4.2. Also shown on the Table are the equipment detection limits for the different parameters analysed.

Table 4.2 Laboratory Analytical Methods

Parameters	**Methods**	**Detection Limits**
Water Samples-		
Temperature (^oC)	APHA 2110B	-
pH	APHA 4500H^+B	-
Turbidity (NTU)	APHA 2130B	1.0
Salinity (mg/l)	APHA 2520B	0.01
TSS (mg/l)	APHA 2540D	1
TDS (mg/l)	APHA 2510A	-
Conductivity (µS/cm)	APHA 2510A	-
THC (mg/l)	ASTM D3921	1.0
DO (mg/l)	APHA 4500-O G	-
BOD (mg/l)	APHA 5210A	0.5
COD (mg/l)	APHA 5220D	0.8
Reactive Silica (mg/l)	APHA 4500-SiO_2	0.1
Nitrate (mg/l)	EPA 352.1	0.02
Phosphate (mg/l)	APHA4500-P D	0.002
Ammonium (mg/l)	APHA 4500-NH_3	0.02
Calcium (mg/l)	APHA 3111B/ASTM D3561	0. 1
Magnesium (mg/l)	APHA 3111B/ASTM D3561	0.1
Potassium (mg/l)	APHA 3111B/ASTM D3561	0. 1

Sodium (mg/l)	APHA 3111B/ASTM D3561	0.1
Lead (mg/l)	APHA 3111B	0.20
Total Iron (mg/l)	APHA 3111B	0.05
Copper (mg/l)	APHA 3111B	0.05
Polychlorinated biphenyls (PCBs)	EPA8082A	0.1
Zinc (mg/l)	APHA 3111B	0.05
Manganese (mg/l)	APHA 3111B	0.10
Cadmium (mg/l)	APHA 3111B	0.02
Total Chromium (mg/l)	APHA 3111B	0.10
Mercury (mg/l)	APHA 3112B	0.0002
Arsenic (mg/l)	APHA 3030B/3114B	0.001
Sediment / Soil samples		
pH (H_2O)	ASTM D4972	-
TOC/TOM (mg/kg)	BS 1377	-
Conductivity (mg/kg)	APHA 2510B	-
THC (mg/kg)	ASTM D3921	10.0
Nitrate (mg/kg)	EPA 352.1	0.02
Phosphate (mg/kg)	APHA 4500-P D/CAEM	0.002
PSD (mg/kg)	ASTM D422	-
Calcium (mg/kg)	APHA 3111D	0.1
Magnesium (mg/kg)	APHA 3111B/ASTM D3561	0.1
Potassium (mg/kg)	APHA 3111B/ASTM D3561	0.1
Sodium (mg/kg)	APHA 3111B/ASTM D3561	0.1
Zinc (mg/kg)	ASTM D5198/APHA 3111B	0.05
Lead (mg/kg)	ASTM D3111B /D5198	0.20
Mercury (mg/kg)	APHA 3112B/ASTM D 3223	0.0002

Arsenic (mg/kg)	APHA 3030F/3114B	0.001
Total Iron (mg/kg)	APHA 3111B/ASTM D5198	0.05
Copper (mg/kg)	APHA 3111B/ASTM D5198	0.05
Cadmium (mg/kg)	APHA 3111D/ASTM D5198	0.02
Polychlorinated biphenyls (PCBs)	EPA 9078	0.5
Total Chromium (mg/kg)	APHA 3111B/ASTM D5198	0.10

4.4 Climate and Meteorology.

Climate and Meteorology encompasses the statistics of temperature, humidity, atmospheric pressure, wind, rainfall, atmospheric particle count and other meteorological elements in a given region over long period (30-35 years) of time. The climate of a location is affected by its latitude, terrain, altitude, as well as nearby water body and their currents. Climates can be classified according to the average and typical ranges of different variables, most commonly temperature and rainfall. The climate of Nigeria is characterized by two regimes-the dry season and the wet season. These are dependent on two prevailing air-masses blowing over the country at different times of the year: the north-easterly air mass of Sahara origin (the tropical continental air mass) and the humid maritime air-mass blowing from the Atlantic (the tropical maritime air mass). The two air masses blowing from nearly opposite directions meet along a slanting surface (the Inter-Tropical Front). The area about this front, where the air masses to some extent mix, is called the Inter-Tropical Discontinuity (ITD) or the Inter-ropical Convergence Zone (ITCZ). The Data presented are for a period of thirty-one (31) years; from 1986 to 2016.

The studied areas in Lagos and Ogun States) which is in the Western region of Nigeria, is situated in the tropics and experiences a fluctuating climate which is characterised by two distinct conditions of wet and dry seasons. The wet season occurs between April and October with a brief break in August, while the dry season occurs between November and March.

4.4.1 Rainfall

The rainfall within the study area for the period measure, ranged from 24mm to 461mm with an annual mean of 185.8mm in Ogun state and 25mm to 460mm with an annual mean of 185.5mm in Lagos state. Rainfall distribution was observed to be highest in the month of July and Sept and lowest in January and December for both Ogun and Lagos state respectively (Figure 4.1).

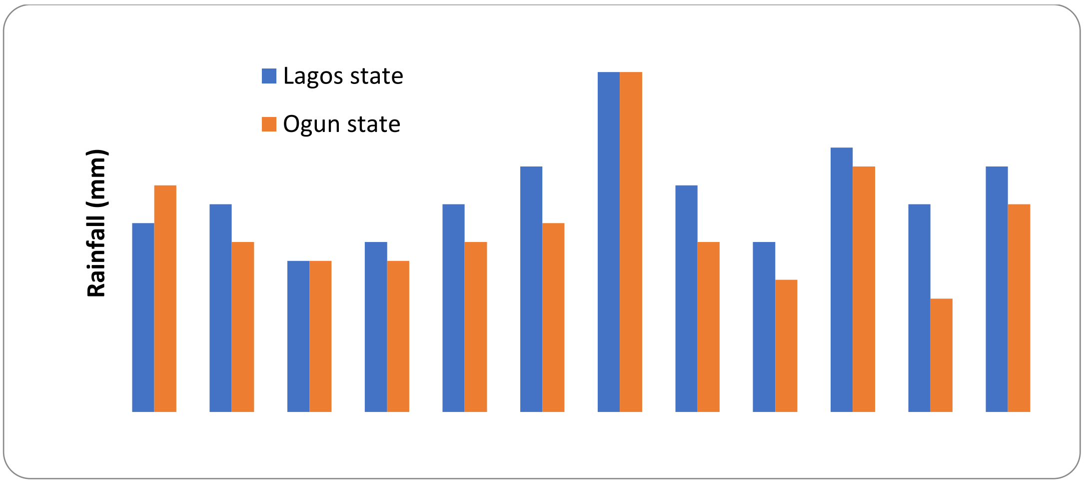


Figure 4.1 Average Rainfall for Lagos and Ogun state (NIMET, 1986-2016)

Source: Nigerian Meteorological Agency (NIMET), 2017

4.4.2 Temperature

The maximum and minimum temperatures recorded for Lagos and Ogun state by the Nigerian Meteorological Agency (NIMET) over same climatic period is shown in Figure 4.2a-b. From the data obtained the maximum temperature was highest in the month of March for both Lagos and Ogun state and lowest in July. Minimum temperature for Lagos and Ogun sate was highest in March, while the least temperature was also recorded in the month of July.

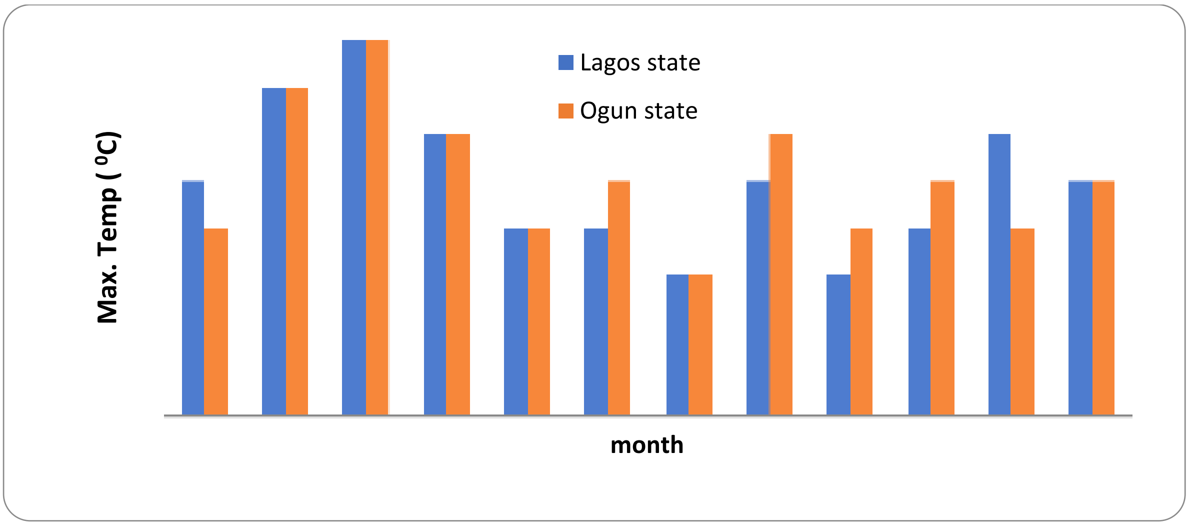


Figure 4.2a Mean Monthly Max. Temperatures for Lagos & Ogun state (1986 - 2016)

Source: Nigerian Meteorological Agency (NIMET), 2017

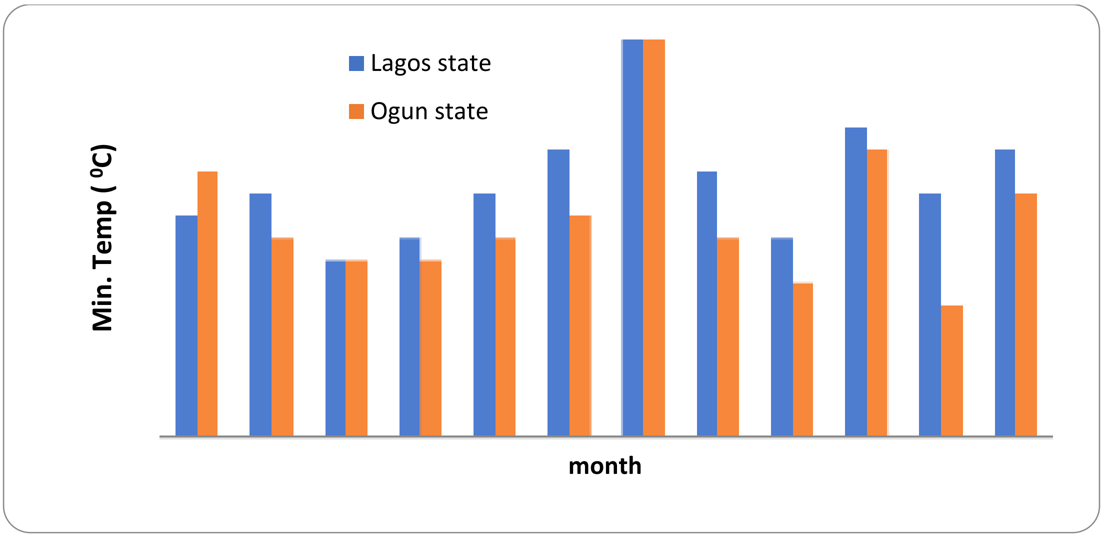


Figure 4.2b Mean Monthly Min. Temperatures for Lagos & Ogun state (1986-2016)

Source: Nigerian Meteorological Agency (NIMET), 2017

4.4.3 Sunlight

Data obtained from NIMET indicates that the proposed project area is most intense between the month of Nov and Feb for both Lagos and Ogun state. Lowest isolation was recorded between the month of July and Aug for Lagos state and Jun and August for Ogun state. Average sunlight hours for both states, ranged between 3 and 7 hours with an annual average of 5 hours (Figure 4.3).

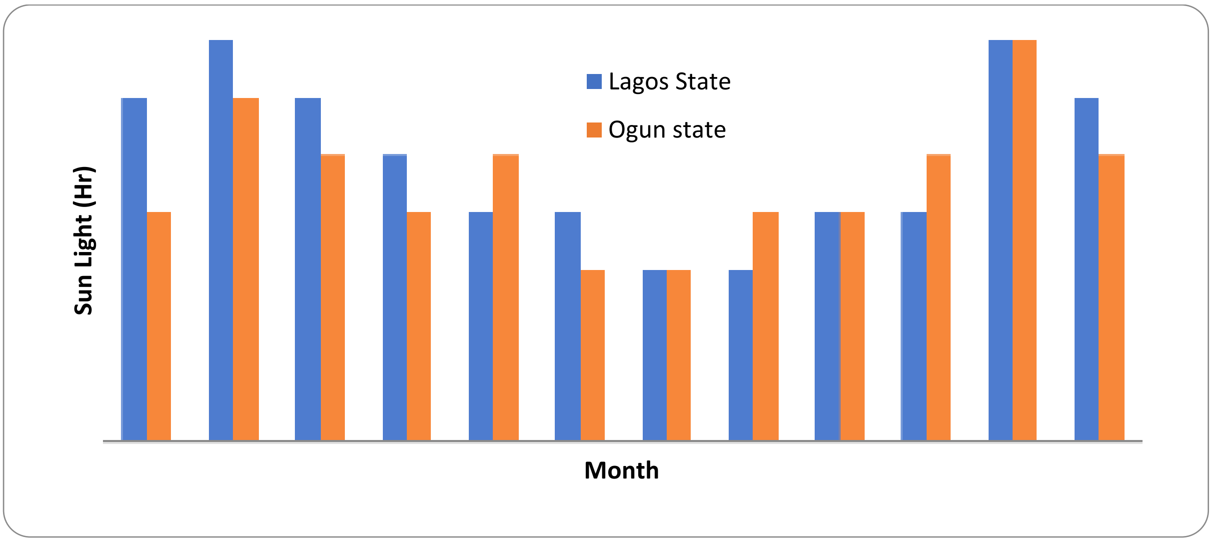


Figure 4.3 Mean Monthly sunlight for Lagos and Ogun state (1986 - 2016)

Source: Nigerian Meteorological Agency (NIMET), 2017

4.4.4 Wind speed

Wind speed for the proposed study area was observed to be highest in month of August for both Lagos and Ogun state respectively. The lowest speed was observed in November for Lagos state and in December for Ogun state (Figure 4.4).

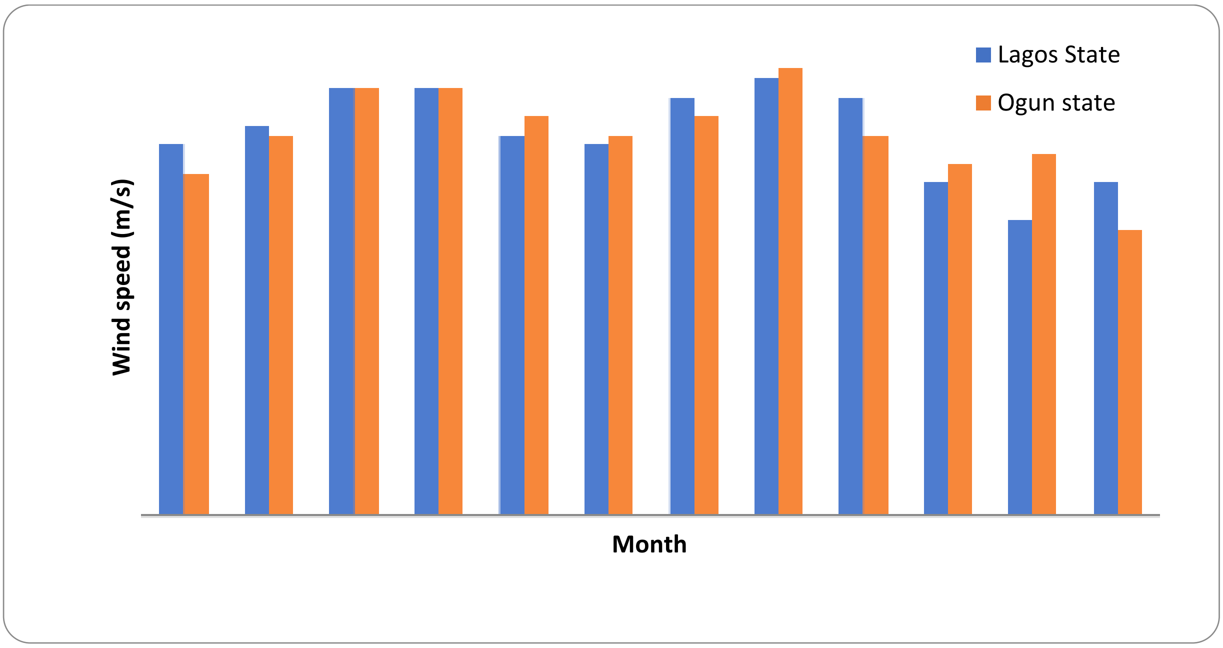


Figure 4.4 Mean Monthly wind speed for Lagos and Ogun state (1986 - 2016)

Source: Nigerian Meteorological Agency (NIMET), 2017

4.4.5 Wind Direction

Data obtained from NIMET revealed that south westerly wind direction is prevalent in the study area throughout the year (NIMET, 1986-2016). However, during dry season, winds are distributed in all directions, but predominantly South-Southwest direction during the raining season in both Lagos and Ogun State respectively.

4.4.6 Relative Humidity

Relative humidity is the ratio of the amount of water vapour in the air at a specific temperature to the maximum amount that the air could hold at that temperature, expressed as a percentage. For example, a reading of 100 percent relative humidity means that the air is totally saturated with water vapour and cannot hold any more, creating the possibility of rain. Relative humidity is usually higher in the wet season than the dry season because of rainfall caused by precipitation of vapour in the atmosphere. Relative humidity was highest in the month of July for Lagos and Ogun state. It was however, least in November for Ogun state and in September for Lagos state (Figure 4.5).

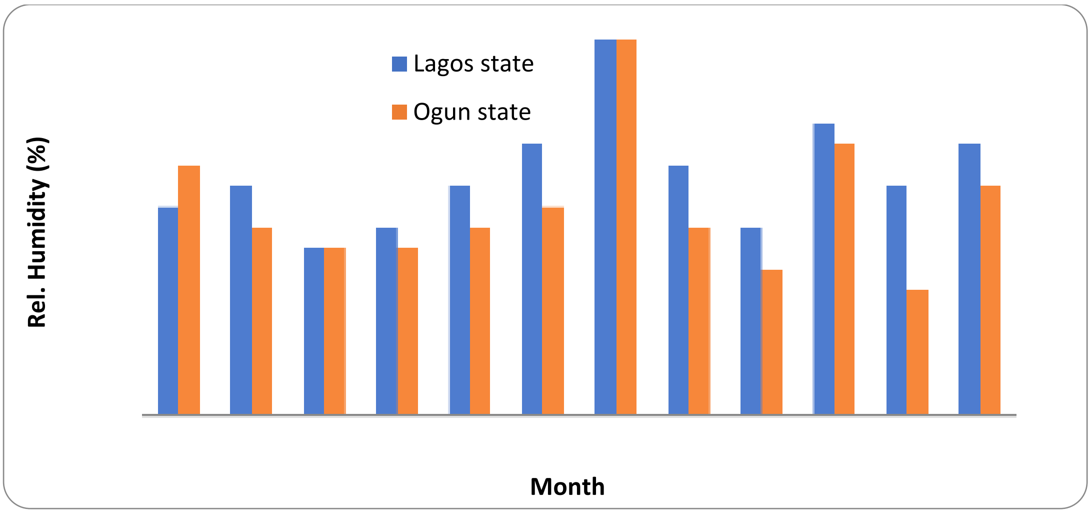


Figure 4.5 Annual Relative Humidity for Lagos and Ogun state (1986-2016)

Source: Nigerian Meteorological Agency, 2017

4.4.7 Cloud

Solar radiation, temperature and humidity have direct relationship with cloud development and thus precipitation. Cloud formation is preceded by upward movement of humid air, which leads to its expansion (against the diminishing resistance of the lowering pressure of the surrounding atmosphere), and cooling. This cooling will lead to immediate condensation in saturated air or to eventual condensation if the cooling is sufficiently prolonged. As the rainy season approaches, there is a trend towards increased cloudiness. Decline in sunshine hours (and radiation) becomes more intense as the rainy season progresses.

4.5 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.

4.5.1 Ambient Air Quality Measurement

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

Ambient air quality measurements wascarried out on site using *in situ* digital meters (Table 4.3 and Plate 4.1) at 36 locations with three of the locations as control points (control points were outside the spatial boundary). The sampling location is shown in Figure4.6.Noise quality measurement was also carried out at same locations of air quality sampling.

Table 4.3 List of Air and Noise Quality Equipment Used in the Study

Parameter	Equipment	Detection Limit
Total Suspended Matter	Casella Cel Micro Dust Pro 880nm	0-250mg/m3
Hydrogen sulphide	Gas Alert Extreme (BW Technologies) Model GAXT-H-DL	0-1000ppm
Carbon monoxide	Gas Alert Extreme (BW Technologies) Model GAXT-M-DL	0-1000ppm
Sulphur oxides	Gas Alert Extreme (BW Technologies) Model GAXT-S-DL	0-1000ppm
Ammonia	Gas Alert Extreme (BW Technologies) Model GAXT-A-DL	0-1000ppm
Nitric Oxide	Toxi RAE II PGM -1140	0-250ppm
Nitrogen iv oxide	Gas Alert Extreme (BW Technologies) Model GAXT-N-DL	0-250ppm
Carbon iv oxide	Alnor CF910	0-005ug/L
Total Hydrocarbon (THC)	Crowcon Multi Gas indicator	ND
Noise Level	Pulasa Sound Metre Model 14	35-130dB
Meteorology	Aeroqual aerocet series 531	0-1000ug/m3
Chlorine (Cl_2)	Cl_2 Crowcon Gasman S/N: 19812H	ND
Hydrogen Cyanide (HCN)	HCN Crowcon Gasman S/N: 19773H	ND

Source: EEMS survey, 2017

Plate 4.1 Air quality sampling and In-situ Measurements

Source: EEMS survey, 2017

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 are presented in Table 4.4 and sampling map in Figure 4.6.

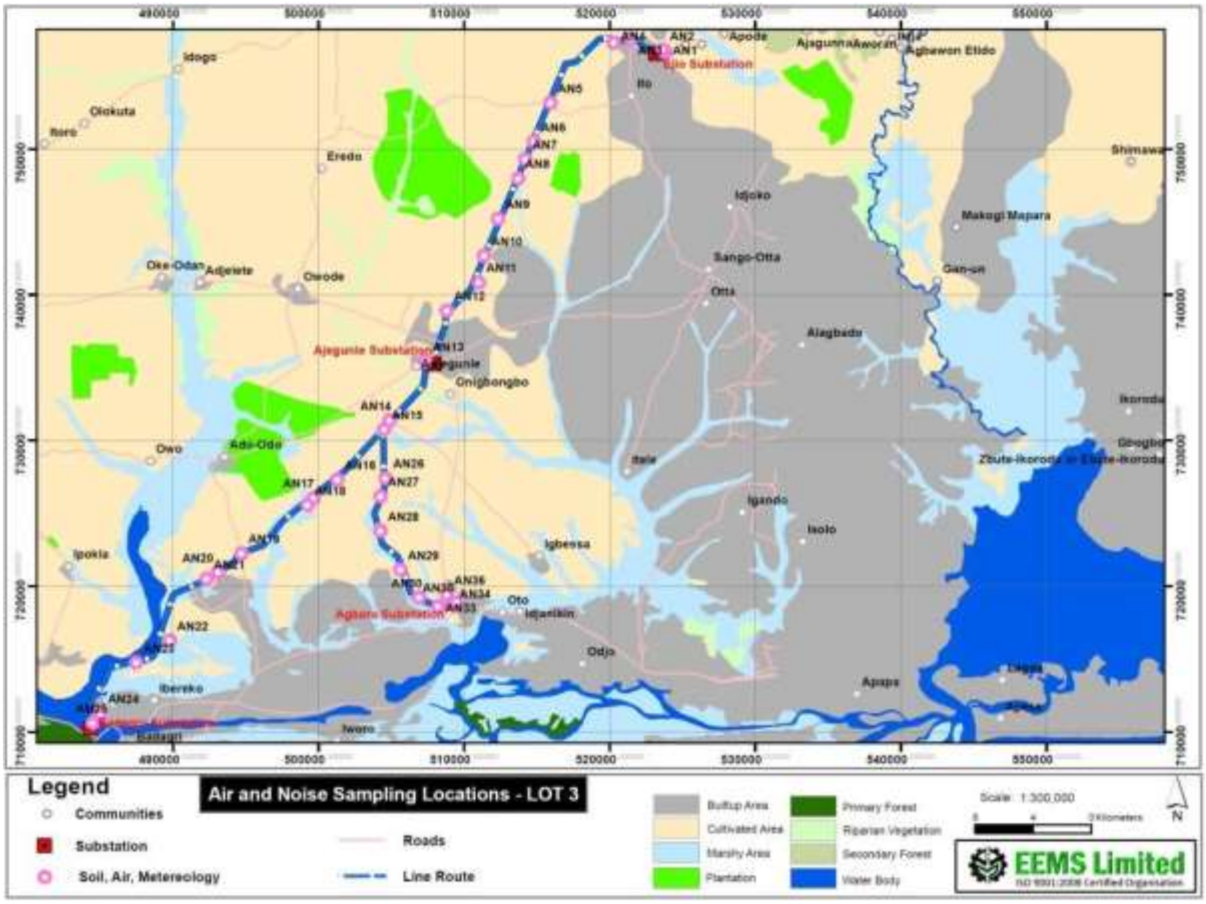


Figure 4.6 Sampling Map for Air Quality and Noise.

Table 4.4 AirQuality /Noise Sampling Locations

CODE	Latitude	Longitude	Elevation	TIME	Description
AN1	6.848333	3.212303	156	16:22	Ejio proposed substation; built-up environment mostly residential, a lot domestic activities, etc.
AN2	6.835194	3.215243	40	16:53	Ejio: Perennial water body; built up areas, mostly residential etc.
AN3	6.84818	3.19353	43	17:41	Apomu; Buildings and farmlands
AN4	6.82091	3.14915	347	18:18	Ekundayo; Secondary forest interspersed with farmlands, unpaved road.
AN5	6.79127	3.12773	769	11:45	Alakpako-Isale; built-up mostly residential, secondary forest, unpaved road, fire spots for commercial and domestic activities, etc
AN6	6.78117	3.12114	48	09:08	Ogunwede; sand mining activities, sparsely built up, secondary forest interspersed with farmlands, etc

CODE	Latitude	Longitude	Elevation	TIME	Description
AN7	6.76281	3.12012	76	10:29	Oke-Oji; residential area, partially paved road, etc.
AN8	6.74336	3.11125	77	15:32	Ijemo/Olori; built up, secondary forest interspersed with farmland, etc.
AN9	6.72053	3.11173	39	17:04	Adie-Owe; Farmlands and buildings
AN10	6.70468	3.09478	48	09:19	Leshi; residential, Track roads and farmlands
AN11	6.598534	3.050337	79	10:23	Iberese Buildings, secondary vegetation and track road
AN12	6.65396	3.07285	47	13:30	Ajegunle proposed substation; Buildings, river and track road
AN13	6.623711	3.044007	55	11:56	Apena; Buildings , swamp, sacred sites and farmlands
AN14	6.62757	3.06336	67	12:30	Ojuiroko; Buildings, secondary vegetation and track road
AN15	6.50876	3.08114	220	09:19	Agbara Buildings, factories swamp,
AN16	6.493144	3.085523	57	11.06	Olaoparun; built-up environment mostly residential, a lot domestic activities, etc.
AN17	6.493657	3.06941	55	14:53	Buildings, secondary vegetation and track road
AN18	6.50758	3.06592	67	16:00	Idoluba; Track road, buildings and farmlands
AN19	6.51776	3.05383	85	16:31	Kofelerin; Buildings, secondary vegetation and track road
AN20	6.52505	3.05039	112	16:56	Idayin Buildings, secondary vegetation and track road
AN21	6.54203	3.04022	68	17:26	Egudu; Buildings, secondary vegetation and track road
AN22	6.58203	3.02676	93	09:36	Buildings, secondary vegetation and track road
AN23	6.55845	3.03179	703	17:51	Ajogb-Akia; built-up mostly residential, and primary school, secondary forest, unpaved road, fire spots for commercial and domestic

CODE	Latitude	Longitude	Elevation	TIME	Description
					activities.
AN24	6.57327	3.00441	48	09:15	Whezume; residential area, Buildings, secondary vegetation and tracks.
AN25	6.55814	2.99707	207	09:45	Isunba; built-up environment mostly residential, domestic activities, etc.
AN26	6.857577	3.175392	44		Kooko Health Resort, builtup area, secondary vegetation
AN27	6.54501	2.97633	205	12:31	Onilogbo; sparsely built-up; unpaved road, etc.
AN28	6.43715	2.854784	94	15:21	Yafin/ Alakotomeji; Swamp , sacred site and secondary forest
AN29	6.454805	2.877052	88	16:05	OkushuIdolomo; sparsely built up, Gmalina and Shea plantation, secondary forest interspersed with farmlands,
AN30	6.52727	2.95207	79	16:22	Bandu; residential area, Swamp, secondary vegetation and farmlands
AN31	6.43063	2.866802	100	16:44	Buildings, secondary vegetation and track road
AN33	6.520993	2.926793	100	17:27	janvhe; Buildings, secondary vegetation and track road
AN34	6.472078	2.902143	77	08:54	Tohun, swamp
AN35	6.498304	2.915149	902	14:12	Erekiti/Iragbon axis, Swamp
AN36	6.411563	2.857518	44	09:36	Yafin/ Alakotomeji; Swamp , sacred site and secondary forest

SOURCE: EEMS survey, 2017.

4.5.2 Ambient Air Quality Result

Result of this study was presented according to the various sections of the study as presented in Table 4.5, while Appendix 3.2 contained detailed result. Particular attention was paid to the Greenhouse gases (GHG) like CO_2, N_2O and CH_4.

Table 4.5 Ambient Air Quality Result Measured in the study Area

SAMPLING PARAMETER	SO2 (ppm)	NO2 (ppm)	CO2 (ppm)	VOC (ppm)	HCl (ppm)	CO (ppm)	H_2S (ppm)	SPM_{10} (ppm)
EJIO - AJEGUNLE SECTION								
Mean	0.6	0	441.6	0.17	0	0.68	0.4	0.04380
Min	0	0	303	0.06	0	0	0	0.007
Max	3.5	0	676	0.41	0	3.7	2.7	0.1318
AJEGUNLE - AGBARA SECTION								
Mean	2.6	0	518.6	0.11	0	0.15	1.8	0.00692
Min	0	0	313	0.05	0	0	0	0
Max	6.7	0	847	0.17	0	1.4	3.4	0.0127
BERESE - BADAGRY SECTION								
Mean	3.2	0	414.7	0.14	0	0.5	1.2	0.01164
Min	0	0	297	0.04	0	0	0	0.0026
Max	5.9	0	491	0.65	0	2.8	3.1	0.0366
Overall mean for all areas	2.8	0	465.9	0.14	0	0.5	1.1	0.020925
Secondary data (ICCL 2015)	<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**	0.1		10-20	<10	0.15- 0.25

Source: EEMS survey 2017. *NA=not available

- Suspended Particulate Matter

These are finely divided particles (solid and liquid) of 0.01 to over 100 microns in diameter, suspended in ambient air (Larry and Loren, 1977). These particles when exist above tolerable limit in the atmosphere can initiate a variety of respiratory diseases (bronchitis, emphysema and cardiovascular diseases). Also, fine particles may cause cancer and aggravate morbidity and mortality from respiratory dysfunctions (CCDI, 2001).

The result showed that SPM10 concentrations were generally below WHO/FMEnv regulatory limits of 0.15-0.25ppm for the various section of the study area. This result indicated a non-contaminated air in the various sections of the study area. However, one control point in Idobarum community (outside the spatial boundary along Ajegunle –Agbara section), had concentration below equipment detection limit.

- Carbon Monoxide

Carbon monoxide (CO) is a colourless, odourless and tasteless gas produced by the incomplete combustion of carbonaceous materials or fossil fuels - gas, oil, coal and wood. Adverse health effect has been observed with carbon monoxide concentrations of 12 - 17ppm for 8 hours (Canter and Hill, 1977) while prolonged (45 minutes to 3 hours) exposure to concentrations of CO between 200ppm and 800ppm often results in severe headache, dizziness, nausea and convulsions (CCDI, 2001).

The result indicated concentrations below WHO/FMEnv regulatory limits, hence, no health or environmental concern shall be posed. However, increase in CO levels is projected during all phases of the project for which mitigation measures are proffered.

- Sulphur Dioxide

Sulphur dioxide (SO_2) is a colourless gas produced from biological decay and forest fire releases. It is also produced from the combustion of sulphur-containing fuels, smelting, manufacture of sulphuric acid and incineration of refuse and production of elemental sulphur.

SO_2 gas is known to be a harsh irritant, and is capable of aggravating asthma, bronchitis and emphysema (CCDI, 2001). Also, sulphuric acid aerosols (formed from dissolved sulphur dioxide) will readily attack building materials, especially those containing carbonates such as marble, limestone, and mortar.

From the result So_2 concentrations were observed to be above WHO/FMEnv limits in some sampling stations. Specifically, two sampling stations (Ejio village and at Ajegunle village) were observed to be high in concentration, while other points in Ejio-Ajegunle section recorded values below equipment detection limits. This increased SO_2 levels were observed in the afternoon among communities in Ajegunle-Agbara section and evenings for communities along Berese-Badagry section. This could be attributed to variations in fossil fuel emissions during times of the day. However, the SO_2 level is not projected to exceed the regulatory limits during all phases of the project life cycle.

- Nitrogen Dioxide

Nitrogen dioxide (NO_2) is a member of the family of highly reactive gases called nitrogen oxides or oxides of nitrogen, which are formed during combustion processes. NO_2 results when fuel is combusted at high temperatures and occurs mainly from motor exhaust and stationary sources such as electric utilities and industrial boilers (Canter and Hill, 1977, SIEP, 1995). It is the only oxide of nitrogen that has been shown to have significant human health effects, with exposure to concentrations higher than 0.5ppm (1mg/m_3) triggering changes in pulmonary function in healthy people (SIEP, 1995).

Concentration of NO_2 in the various study section was observed to be below equipment detection limit and thus below WHO/FMEnv regulatory limits. Hence it poses no health implication in the study area. However, corona effect is projected to increase NO_2 levels during the operation phasefor which mitigation measures have been proffered for in Chapter Six.

- Hydrogen chloride (HCL)

Hydrogen chloride is a gas at room temperature. Solution of hydrogen chloride in water forms hydrochloric acid. It is irritating and corrosive to any tissue it contacts. Brief exposure to low levels causes throat irritation. Exposure to higher levels can even result in rapid breathing, narrowing of the bronchioles, blue coloring of the skin, accumulation of fluid in the lungs, and even death.

Hydrogen chloride is formed in the air during the burning of plastics. Other releases of hydrogen chloride into the atmosphere are however removed by rainfall, limiting the chances of exposure to high levels of this compound by breathing ambient air (Hlavay and Guilbault, 1978). According to Hlavay and Guilbault (1978) air concentrations above 5ppm can cause irritation. However, concentrations recorded for the various sections of the study were below equipment detection limits and thus posed no health implication in the study area.

- Volatile Organic Compound

Volatile organic compounds (VOCs) are organic chemicals that have a high vapour pressure at ordinary, room-temperature conditions. VOCs are numerous, varied, and ubiquitous. They include both human-made and naturally occurring chemical compounds. VOCs play an important role in communication between plants. Some VOCs are dangerous to human health or cause harm to the environment. Anthropogenic VOCs are regulated by law, especially indoors, where concentrations are highest. Harmful VOCs are typically not acutely toxic, but instead have compounding long-term health effects. Because the concentrations are usually low and the symptoms slow to develop, research into VOCs and their effects is difficult. Volatile organic compounds are produced naturally through biological mechanisms such as metabolism. Industrial use of fossil fuels produces VOCs either directly as products (e.g. gasoline) or indirectly as by-products (e.g. automobile exhaust). In addition to their indirect impacts through photochemical ozone formation, some VOCs directly affect human senses through their odour; some others exert a narcotic effect while certain species are toxic with particular concern on cancer induction (Ajao, 1989).

Concentration of VOCs in the various study sections were within WHO/FMEnv regulatory limits, except for one sample point (AB0312SS/AQ/N34) in Berese-Badagry section.

Elevated concentrations of VOC in this area is presumably due to numerous perform wearing persons boarding the *Pontu.*

- Hydrogen Sulphide

Hydrogen sulphide (H_2S) is a toxic, odorous and corrosive gas, which is rapidly oxidized to SO_2 in the atmospheres. Its presence in the atmosphere could result from storage tanks and process vents. Exposure to concentrations in excess of 500ppm can be fatal (SIEP, 1995).

Generally, concentrations recorded for the various section of the study were within WHO/FMEnv permissible limit of <10ppm, hence poses no health and environmental concern in the study area.

- Carbon dioxide (CO2)

Carbon dioxide (CO_2) is the primary greenhouse gas emitted through human activitie. Themain human activity that emits CO2 is the combustion of fossil fuels (coal, natura l gas and oil)for energy and transportation, although certain industrial processes and la nd-use changes also emit CO_2.

CO_2 concentrations measured in the study area during field sampling were below WHO/FME nv permissible limits of 5000ppm. This result indicates no health/environmental concern in the study area.

4.6 Noise Quality and EMF (Electromagnetic fields)

4.6.1 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 limits shall be used to benchmark the ambient noise levels measured in the project area. Table 4.6 presents the WHO guidelines for community noise.

Noise measurements were conducted in accordance with IFC 2012 standard. The document implies measurement of noise with respect to the various micro-habitats present in a given area. In this study the micro-habitats present are houses, farmlands, religious grounds and hospitals.

The ambient noise level was measured in different stations (selection criteria was earlier explained) with the aid of a hand held Pulsar Sound Level Meter about 1.9 m high during the day and night. Night measurements were imperative since trucks are also expected to move at night time. This meter has a Liquid Crystal Detector (LCD) where readings are displayed for observation. The noise level was read off from the LCD after about 2 to 3 minutes of display. It is expected that the measured ambient noise levels and the regulatory guidelines will be the standards against which noise will be assessed during the course of constructing the transmission line. Plate 4.2 shows measurement of noise level.

Table 4.6 WHO Guidelines for Community Noise

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

	open (outdoor values).			
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 night time 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 tranquillity	#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.

Plate 4.2 Noise and EMF level Measurement at Ekundayo

4.6.2 Electromagnetic fields (EMF)

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

Exposure to EMF above 0.3 μT to 0.4 μT causes acute health issues such stimulation of peripheral nerves and muscles, shocks and burns; elevated tissue temperatures and childhood leukemia (ICNIRP, 2003). Tree Growth Regulator and Herbicide Control methods used in transmission line right of way have been reported to also pose adverse health effects (ICNIRP, 2003).

4.6.3 Noise Quality and EMF result

Table 4.7 shows the summarized result of noise and EMF measurement, while Appendix 3.3 presents detailed result for both noise level and EMF respectively.

Table 4.7 Noise and EMF Measurements in the Study Area

SAMPLING CODE	Noise dB(A)	LAF (dBA)	LMIN. (dBA)	LMAX. (dBA)	EMF (µT)
EJIO - AJEGUNLE SECTION					
Mean	60.3	66.7	34	61.4	0.34
Min.	52	57	29	54	0.32
Max.	75.6	88.2	43	70	0.37
AJEGUNLE - AGBARA SECTION					
Mean	63.2	67.9	28.3	60.1	0.33
Min.	53	57.7	23	47	-
Max.	74.7	84.5	42	78	-
BERESE - BADAGRY SECTION					
Mean	40.6	60.2	30.9	59.6	0.31
Min.	30.8	49.9	22	40	0.29
Max.	51	72.7	38	76	0.33
Ggggg					
Secondary data (ICCL)	**28.4 - 60**				NA
ICRNIP Limit for EMF					0.3-0.4
WHO/FMEnv Regulatory daily limit for Noise					
General Noise Level limit		**- 105 db(A) per hour or 90dB(A) per day for prolonged exposure**			
School		45 (day) 35 (night)			
Hospital		30 for day and Night			
Residential		45 for Day and 35 for Night time			
Farmlands		40 for Day and 45 for Night			

* EMF was measured at 50Hz

Source: EEMS survey, 2017

The results as presented in Table 4.7 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 Berese –Badagry section which recorded slight increment above the threshold for residential areas only in two of the stations (NQ33 and NQ36). 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 favourably well with the obatained secondary data.

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

4.7 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 Aeroqual aerocet 531. This equipment was calibrated and held at arm-length towards the direction of the prevailing wind. The value of the climatic elements was read off screen and data documented. The sampling locations for noise and air were same for meteorology. Result of this study for the various sections investigated is presented in Table 4.8, whereas, Appendix 3.4 contained detailed result.

Table 4.8 Summary Result of On-Site Meteorological Measurement

SAMPLING PARAMETER	Wind speed (m/s)	Wind direction (%)	TEMP. (^{0}C)	RH (%)
EJIO - AJEGUNLE SECTION				
Mean	2.1	-	32.8	64.9
Min.	1	-	28.1	43.7
Max.	4	-	37.6	91.8
AJEGUNLE - AGBARA SECTION				
Mean	2.9		35.9	52.2
Min.	1.5		30.1	40.3
Max.	4		38.3	78.5
BERESE - BADAGRY SECTION				
Mean	1.8		33.2	67.9
Min.	1		27.5	55.2
Max.	3		36.2	87.1

Source: EEMS Survey, 2017

Temperature

The temperature result presented in Table 4.8 during the study was within the recorded range obtained from NIMET for the entire study area.

However, Oluwajobi *et al.,* (2012) showed a linear relationship between temperature and conductor length. Expectedly, during construction and operation phases, as ambient temperature increases, the outstretched conductor length is expected to increased, resulting in sag increase and decrease in conductor tension. This phenomenon was factored in proffering mitigation measures in chapter six.

Relative humidity

The amount of atmospheric humidity in the various sections studied was observed to be within data obtained from NIMET for the entire study area. However, the highest value of 91.8% and 87% were recorded in Ajio-Ajegunle and Berese-Badagry section respectively. Qin *et al.,* (2014) showed a direct relation between increase in humidity levels and NO_2 concentrations. As stated earlier, this projected higher intensity in corona effect from this parameter and other sources were factored in during impact prediction in chapter 5.

Wind Direction and speed

The wind patterns follow the dynamic migratory movements of the inter-tropical front (ITF). The result indicated a predominant north-easterly or harmattan winds which is typical of dry season with a low south-westerly wind direction (Figure 4.7). The near-uniformity of result recorded in this study were within the range recorded by NIMET for the entire study area (1986-2016) and agreed with the findings in Oluwajobi *et al.*, 2012. The linear relationship shown between wind speed and elevated levels of tension in conductors during power transmission as a causal factor in power failure (Oluwajobi *et al.*, 2012) was considered (in chapter 5) when the project was superimposed on the the values obtained for this parameter.

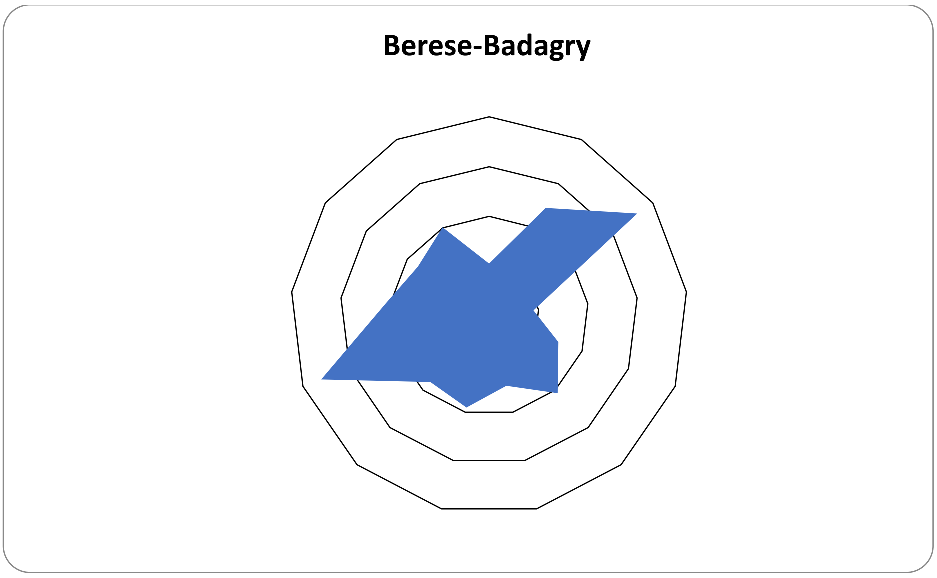


Figure 4.7 Wind Rose for Proposed Area Based on Microclimatic Data

Source: EEMS survey, 2017

4.8 Geology and Hydrogeology

4.8.1 Regional Geology

Lagos and Ogun state shares similar geologic settings. Lagos and Ogun state lies within the Dahomey Basin, an extensive sedimentary basin, spanning from southeastern Ghana in the west to the western flank of the Niger Delta. Only the eastern part of this basin is within Nigeria (Figure 4.8). Structurally, the basin is bounded to the west by fault and other tectonic structures associated with landward extension of fracture zones. The basin is separated from the Benue trough by the Okitipupa ridge (Adegoke, 1969), the western flank of which consists of horst and grabens structures (Omatosola and Adegoke 1981).

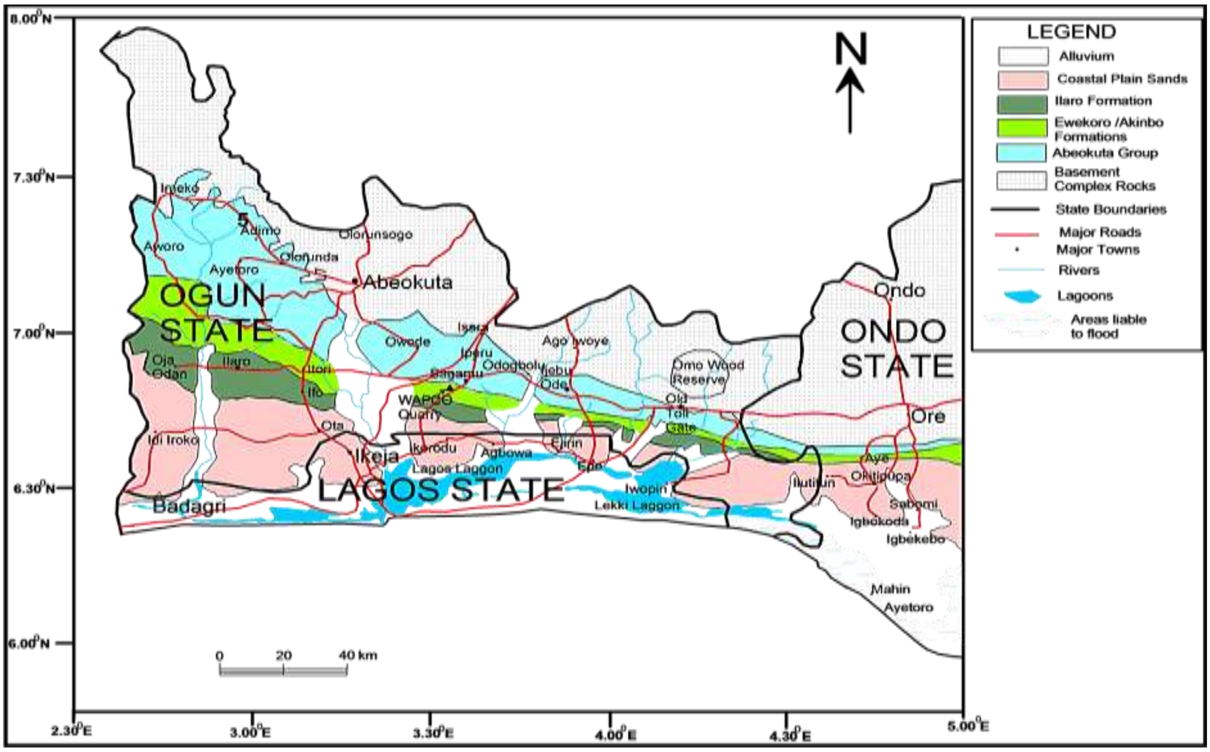


Figure 4.8 Stratigraphy of Eastern Dahomey Basin

The sediment outcrops in an actuate belt is roughly parallel to the ancient coastline. The oldest dated sediment onshore consists of lower cretaceous grits and sandstones interbedded with mudstone. The continental sediment was deposited in series of rapidly subsiding fault-controlled depression on the basement complex. They are progressively overlain by finer detrital sandstones, siltstones and shales of a transitional nature.

Different studies conducted by Adegoke in Kogbe, 1976 and Whiteman, 982 among others showed a stratigraphic succession (Table 4.8) that began with the mostly marine cretaceous Abeokuta formation at its base, lying uncomfortably on the Precambrian Basement complex. The Paleocene Ewekoro formation is deposited conformably the Abeokuta formation which is succeeded by the Eocene Ilaro formation. Quaternary alluvia deposits of unconsolidated and unsorted sands, clays and silts are the youngest sedimentation in the area.

Stratigraphy of Dahomey Basin

The stratigraphy of the basin (Table 4.9) as described by various workers is enumerated as Abeokuta group, Ewekoro formation, Oshosun formation, Ilaro formation and coastal plain sands and alluvium

Abeokuta group

Abeokuta group is the oldest unit of the eastern Dahomey basin (Jones and Hockey, 1964). It consists of poorly sorted ferruginous grits, conglomeratic sands, siltstones, clays and shale. The age of the group is neocomian to Maastrichtian (Adegoke and Omatsola, 1980, Agagu, 1985). Abeokuta group can be subdivided into three members based on Agagu (1985) and they are:

Ise member

Ise member is the oldest member of the formation and overlies the basement" complex. It consists of grits and siltones. The Precambrian basement complex is overlain by coarse to medium grained sandstones and grits with interbedded kaolinitic clays (Omatsola and Adegoke, 1981). Neocomian in age and more than 600m of this formation was penetrated in Ise-No2 well and similar sections are exposed near Ode-Remo.

Araromi member

Araromi member overlies the Afowo member. It is the youngest of the cretaceous sediments in the eastern Dahomey basin (Omatsola and Adegoke, (1981), it is also known as the Araromi Shale (Reyment, 1965). It consists of fine to medium grained sands at the base and overlain by shale and siltstone beds with thin interbedded lime stones and marls (Ogbee, 1972).

Table 4.9 Stratigraphic Succession in Dahomey Basin Area

Age	Adegoke (in Kogbe 1976)
Recent	Alluvium
Oligo-Pleistocene	Benin formation
Eocene	Ilaro Formation Oshosun Formation
Palaeocene –Lower Eocene	Akinbo formation
Cretaceous	Araromi formation Afowo formation Ise formation
Pre-Cambrian	Basement complex

Source: Omatsola & Adegoke, 1981

Afowo member

Afowo member overlies the Ise member and consists of coarse to medium grained sandstones with thick interbeds of shales, siltstones and clay stones. The shale component increases progressively from the base to the top. The lower part of the formation which deposited is transitional with mixed brackish to marine horizons that alternate with well sorted, sub-rounded clean loose fluviatile sands (Billman, 1976). This according to Omatsola and Adegoke (1981) indicates a littoral or estuarine near-shore environment in which water level fluctuates. Billman, (1992) assigned a Turonian age to the formation while the upper part grads into the Maastrichtian. They outcrop at the northern part of the basin and along the

Okiti pupa ride Sequence. The shales are very fossiliferous bearing abundant planktonic and benthic foraminifera and ostracodes (Billman, 1976). Towards the top the shales are mostly marine and generally rich in organic matter. Omatsola and adegoke, 1981 put the age of this formation between Maastrichtian and early Paleocene.

Ewekoro Formation

This is predominantly highly fossiliferous lime stones (Adegoke, 1969; Adegoke and Omatsola 1981) the formation consists of marl and its arenaceous content increases towards the base and grades into the underlying predominantly sandy Abeokuta group. The formation is extensive and traceable over a distance of about 32km continuously from Ghana eastwards, towards the eastern margin of Dahomey Basin. The thickness of the formation is about 30m at Ewekoro quarry. Ogbe (1972) further modified this and proposed a fourth unit. Strati graphically, the units are: Sandy biomicrosparite, shelly biomicrite, algal biosparite and red phosphatic biomicrite

The sandy biomicroparite is light to brownish gray. It is a sandy limestone with stratification accentuated by variations in the quantity and grain size of the interbedded quartz and glauconite. The shelly biomicrite consists mainly of pure shelly limestone and it grades into the biomicropharite. There is a sharp contact where the shelly biomicrite is overlain by biosparite. Little ferruginous material appeared in the limestone, which has a light-brown prey color. The algal biosparite limestone overlies the shelly biomicrite unit with the top of the unit been eroded. The red phosphatic biomicrite is red, very dense and rich in phosphate and bone fragments (Ogbe, 1972). Reyment (1965) suggested a Paleocene age and associated it with shallow marine Akinbo formation overlies the Ewekoro; consist of thick grey fossiferous shale, about 10m thick. The formation also comprises lower and upper units separated by loose shally glauconitic band of about 0.3m (Ogbe, 1972).

Oshosun Formation

This is characterized by a dull, red, siliceous sand mudstone with inclusions of phosphatic and glauconitic materials in the lower part of the formation. The upper part is made up of medium to coarse-grained silty sandstones (Adegoke, 1969) continental in character, lacking in fossils and Eocene in age. He concludes that the Oshosun formation consists of the lower part of a sequence of mostly pale greenish to grey laminated phosphitic Marla with light grey white-purple clay intercalations. Thin beds of limestone or marl are locally present in this formation.

Ilaro Formation

This formation consists of predominantly coarse-grained continental sands that display rapid lateral facies change (Slansky, 1962; jones and Hocckey, 1964). The sand is generally white and mineralogical composed of pure quartz grains. Textural analysis of the sand from the formation indicates beach, shoreline and near shore environments or deposition. The formation is poor in fossil but some benthic foraminifera have been described. The age of the formation is put at Eocene (Agagu, 1985) environment due to the abundance of corlline algae, gastropods, pelecypods, echinoid fragments and other skeletal debris (Nton, 2001).

Coastal Plain Sands and Alluvium

The coastal plain sands together with recent alluvium constitute the youngest sedimentary unit of the Dahomey basin. The coastal plain sands overlie the Ilaro formation but evidence of this is lacking (Jones and Hockey, 1964). The coastal plain sands are made up of soft, very poorly sorted clayey sands, pebbly sands, sandy clays and rare thin lignite. The age of the unit has been fixed at Oligocene to Pleistocene (Agagu, 1985).

4.8.2 Regional Hydrogeology

Review of regional hydrogeology is important for the understanding of the impacts the proposed project may have on ground water in the area. The summary is presented in Table 4.10.

Table 4.10 Summary of Hydrological Units in the proposed Project Area

Age	Formation
Recent	Alluvium
Oligo- Pleistocene	Benin
Eocene	Ilaro
Paleocene	Ewekoro
Cretaceous	Araromi, Afowo, Ise

Groundwater in the study area occurs in the soft overburden aquifer and fractured bedrock aquifer. Hand dug wells within the study area are shallow therefore they tap water only from soft overburden aquifer. It is only some boreholes that tap waters from fractured bedrock aquifer because they are drilled with mechanized equipment.

4.8.3 Groundwater Sources

4.8.3.1 Groundwater Analysis

Ground water samples were obtained from eight existing boreholes in close proximity to the proposed sub stations. Project activities around power transmission sub stations do impact negatively on ground water (IFC EHS 2007). For instance, fuel storage, fuel handling, refuelling activities and generation of spent oils during maintenance and servicing resulting in spillage and seepage of effluent is capable of polluting ground water.

The groundwater sampling location is shown in Figure 4.9 and Table 4.11. Obtaining a baseline data for the physico-chemical and microbial contents of the ground water of the project area do allow for future evaluation and monitoring of the impact. The proffered mitigation measures for the potential negative impacts on ground water are well documented in chapter six of this report.

4.8.3.2 Groundwater Sampling Methodology

The boreholes located within the study area were sampled using Nsikin bottle. The Nsikin bottle was flushed with distilled water before and after being used at every station. Plate 4.3 shows underground water sampling.

Plate 4.3 Ground Water Sampling in Yafin.

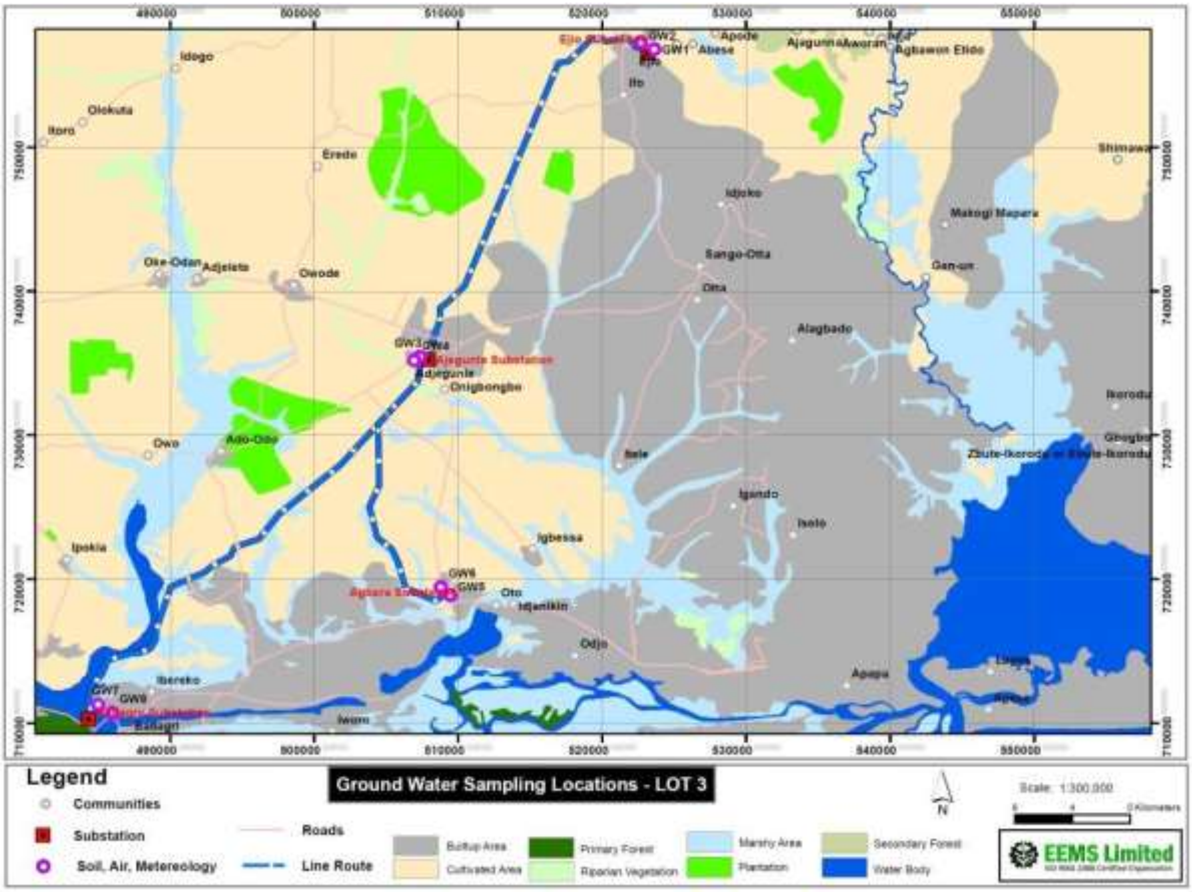


Figure 4.9 Sampling Map for Ground Water

Table 4.11   Groundwater Sampling Locations

CODE	LOCATION	LAT	LONG
GW1	Ejio Substation1	6.8467115	3.2136834
GW2	Ejio Substation2	6.8511216	3.2052827
GW3	Ajegunle Substation1	6.6535888	3.0664301
GW4	Ajegunle Substation2	6.6513829	3.0629164
GW5	Agbara Substation1	6.5039265	3.0854416
GW6	Agbara Substation2	6.508766	3.0795622
GW7	Badagry Substation1	6.4350596	2.8644276
GW8	Badagry Substation2	6.4297716	2.8730106

4.8.3.3 Groundwater Analytical Result

The summarized results of the physical and chemical characteristics of groundwater samples are presented in Table 4.12, while detailed results are presented in Appendix 3.5.

Table 4.12 Ground Water Physico-Chemical Parameters

Study section	Ejio substation		Ajegunle substation		Berese substation		Badagry substation		ICCL baseline data (2015)	FMEnv limits	WHO limits
Parameter	**GW1**	**GW2 Crtl1**	**GW3**	**GW4-Crtl2**	**GW5**	**GW6 Crtl3**	**GW7**	**GW8 Crtl4**			
Well Depth (m)	3.27	4.01	3.10	3.09	3.24	3.48	3.01	3.00	3-4	NA	NA
Water Level(m)	0.98	1.4	1.12	0.93	1.05	0.84	1.10	1.61	0.7-1.4	NA	NA
Colour	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear
BOD (mg/l)	1.48	1.23	2.66	2.16	4.74	3.23	3.01	2.45			10
DO(mg/l)	10.93	9.62	8.58	8.77	7.84	9.63	7.84	8.52		5	<5
COD(mg/l)	10.2	9.8	8.2	9.2	10.2	9.8	8.5	8.2			10
Hardness (mg/l)	14.2	13.6	20.6	19.9	15.4	13.9	9.73	10.1	200	150	-
PCB (ng/m^3)	ND	ND	ND	ND	ND	ND	ND	ND	NA		0.003
TSS (mg/l)	33.1	28.2	11.05	27.6	28.2	33.1	28.4	42.1	-	500	50
Salinity (g/l)	0.08	0.06	0.10	0.02	0.08	0.12	0.10	0.06			
pH	3.96	6.52	6.61	7.86	6.75	6.64	7.86	6.75	5.46 - 5.84	6.5-8.5	6.5-9.2
Temperature (^{0}C)	27.2	26.0	27.6	27.9	27.3	27.7	26.8	27.4	26.50-27.20		40^{o}c
Conductivity (mS/cm)	55.3	54.3	18.2	50.2	54.3	55.3	55.2	55.3	41.5-126.8	1000	250

Turbidity (NTU)	6.95	1.35	1.85	2.25	4.85	2.95	2.75	1.55	1.46-9.51	-	5
Nitrate (mg/l)	0.21	0.1	0.5	0.3	0.4	0.2	0.15	0.1	<0.1-0.21	50	10
Sulphate (mg/l)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	100	500
Phosphate (mg/L)	0.55	0.68	0.22	0.25	1.10	0.32	0.45	0.65	0.22-1.14	≤ 0.2	5
THC (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	NA	0.3	0.05
Potassium (mg/l)	0.39	0.30	0.35	0.36	0.39	0.37	0.34	0.31	NA		10
Lead (mg/l)	0.041	0.010	0.012	0.020	0.021	0.010	0.24	0.073	0.012-0.24	0.05	0.02
Copper (mg/l)	0.120	0.010	0.015	0.012	0.025	0.032	0.110	0.015	0.012-0.120	1.0	2.0
Total Iron (mg/l)	0.15	0.22	0.33	0.30	1.22	0.70	2.05	0.45	0.24-2.11	1.0	0.3
Barium (mg/l)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	NA	0.7	1.3
Total Coliform (cfu/100ml)	ND	ND	ND	ND	4.2x10^{1}	5.1x10^{1}	4.2x10^{1}	5.1x10^{1}	NA		0.00
Faecal Coliform (cfu/100ml)	ND	ND	ND	ND	11	19	ND	ND	NA		0.00
E-coli (cfu/100ml)	ND	ND	ND	ND	ND	ND	ND	ND	NA		0.00
Faecal Streptococci (cfu/100ml)	ND	ND	ND	ND	ND	ND	ND	ND	NA		0.00

Source: EEMS Survey, 2017. **ND = Not Detected; NA= Not Available**

Concentrations in red above FMEnv limits

Colour

Colour in drinking water can be caused by the presence of dissolved and suspended organic materials and compounds of calcium and iron. WHO therefore recommends that any water suitable for drinking must be colourless.

Results of all the samples indicated colourless water implying conformity to WHO standard for this parameter.

BOD and COD

BOD indicates the amount of putrescible organic matter present in water. Therefore, a low BOD is an indicator of good water quality (Shelton, 1991) while a high BOD indicates polluted water. Reduction in the availability of dissolved oxygen present in a water body represents the BOD while a measure of the oxygen equivalent of the organic matter content that represents potential consumption of oxygen within the receiving water body is COD. Both parameters are inversely linked to dissolved oxygen.

Result of all the samples revealed a BOD and COD level within the threshold established by WHO/FMEnv for drinking.

DO

The level of dissolved oxygen in water is used as an indication of pollution and its portability. According to WHO, groundwater with DO concentration less than 5mg/l indicates pollution and presence of micro-organism (WHO, 1993).

Results of all samples revealed DO level within WHO limits.

Total Hardness

It is the resistance of water in forming lather with soap. Hard water thus requires a considerable amount of soap to produce lather. The principal cause of hardness in groundwater is the presence of calcium and magnesium ions which however, indicates the level of groundwater pollution (Olumuyiwa *et al.,* 2012).

According to WHO, groundwater with concentration ranging from 0 to 60 mg/L is classified as soft; 61 to 120 mg/L as moderately hard; 121 to 180 mg/L as hard; and >180 mg/L as very hard.

The result for the present study is within the category Soft and hence conforms to WHO standard for this parameter.

PCBs

It is an organic chlorine compound which was once deployed as dielectric and coolant fluids in electrical apparatus, carbonless copy paper and in heat transfer fluids. When PCBs are spilled or abandoned underground, it contaminates groundwater (Dan (2003). Exposure above WHO permissible limits causes impaired memory and reduces intellectual development in children and adults. Result of the study however, indicated concentration below equipment detection limits across all samples.

Total suspended solids (TSS)

These are minerals and organic materials present in water. It enters groundwater through runoff from industrial, urban or agricultural areas. Elevated TSS causes rise in groundwater temperature which in turn supports growth of some microbial organisms.

Result of all samples revealed concentration within WHO/FMEnv exposure limits.

Salinity

Groundwater naturally contains salts and minerals. Saline water becomes unusable not only because of the bad taste but because excessive salt intake affects kidney function. Increase level of salt in groundwater, makes water harder, thus affecting its suitability for domestic use (WHO 2011). Corrosion of Pumps, metallic pipes and tanks as a result of increased level of salt in groundwater, causes health issues to human.

The result obtained indicates a low level of salinity in the sampled groundwater, suggesting a safe source of water for drinking.

pH

pH of water determines the solubility of chemical constituents such as nutrients (phosphorus, nitrogen, and carbon) and heavy metals. pH is therefore an index of groundwater pollution. Although pH has no direct health implication on humans, high pH encrusts water pipes and water-using appliances with deposits; and depresses the effectiveness of groundwater disinfectants. pH <6.5 or >9.2 would markedly impair the potability of drinking water (WHO 2011).

Result of all samples indicated pH level within WHO/FMEnv permissible limits for drinking water, and hence, suitable for drinking and for other domestic use.

Temperature

The rate of chemical reactions generally increases as temperature increases. Groundwater with higher temperatures tend to dissolves more minerals from the rocks in the aquifer and therefore have a higher electrical conductivity (EC). High temperature negatively impacts water quality by enhancing the growth of micro-organisms which may increase taste, odour, colour and corrosion problems (UNICEF, 2008). Temperature above ambient level is therefore an index of groundwater pollution.

Result of the study which is within WHO/FMEnv permissible limits indicated that groundwater samples obtained from the various sections is suitable for drinking and for other domestic uses.

Electrical Conductivity (EC)

Electrical conductivity gives an indication of the amount of total dissolved substitution in water. Pure water containing less or no organic salt is an excellent insulator which cannot conduct electricity, hence any water with EC concentration above WHO/FMEnv limits is said to be polluted (IFC EHS 2007).

Results of this study were within WHO/FMEnv limits, hence suitable for drinking.

Turbidity

Turbidity or cloudiness is caused by the presence of clay, silt, suspended matter, colloidal particles and other microorganisms. These particles of turbidity provide "shelter" for microbes by reducing their exposure to attack by disinfectants. High turbidity promotes re-growth of pathogens in the distribution system, leading to waterborne disease outbreaks, which have caused significant cases of gastroenteritis throughout the world.

Turbidity also affects other water quality parameters such as colour, when it is imparted by colloidal particles as well as rise in temperature.

The level of groundwater turbidity in all the samples were observed to be within WHO/FMEnv limits.

Nutrients (Nitrate, Sulphate and Phosphate)

Nutrients are essential for the growth of micro-organisms in groundwater. Excessive concentrations of nutrients in drinking water, however, promote bacterial growth, as well as imparting bitter taste (WHO 2011). High level of nutrients in groundwater is attributed to failing septic systems, excessive use of agriculture fertilizers, leachable from refuse dumps and industrial discharges.

Nutrients level above the maximum permissible limits in drinking water, indicates pollution, and thus poses some health challenges (WHO 2011).

Results of all samples revealed concentration within WHO/FMEnv limits except Phosphate.

THC

Pollution caused by petroleum is of great concern over the years since petroleum hydrocarbons are toxic to all forms of life. Damage caused by the toxicity of crude oil to organ systems may be immediate or it may take months or years. Consumption of water contaminated with petroleum hydrocarbons can damage any organ system in the human body like the nervous system, respiratory system, circulatory system, immune system, reproductive system, sensory system, endocrine system, liver, kidney, etc. and consequently can cause a wide range of diseases and disorders (Costello, 1979).

THC in groundwater is therefore the quantity of the measured hydrocarbon impurities present. Result of this study revealed hydrocarbon was not detected in all the samples.

Potassium

Potassium is an essential element in humans and it is hardly found in groundwater at levels that could be a concern for healthy humans. It occurs widely in the environment, including all-natural waters. It can also occur in drinking water as a consequence of the use of potassium permanganate as an oxidant in water treatment.

Although concentrations of potassium normally found in drinking water are generally low and do not pose health concerns, high solubility of potassium chloride and its use in treatment devices such as water softeners can lead to significantly increased exposure.

Result of this study therefore indicates that K level in all the samples were within WHO permissible limits.

Lead (Pb)

Lead is a cumulative poison; toxic in small concentrations. Pb level in groundwater above WHO/FMEnv limits can cause lethargy, loss of appetite, constipation, anaemia, abdominal pain, gradual paralysis in the muscles, and death.

Lead concentration was high only in borehole sampled within Badagry substations (6.4350596 N/2.8644276E and 6.4297716N/2.8730106E) perhaps due to pipe rust used in irrigating farms within the substation. All other samples had concentration within WHO/FMEnv permissible limits.

Copper (Cu)

Copper is both an essential nutrient and a drinking-water contaminant. Cu concentrations in groundwater vary widely as a result of variations in water characteristics, such as pH, hardness and copper availability in the distribution system. Copper is an essential nutrient, but at high doses it has been shown to cause stomach and intestinal distress, liver, kidney damage and anemia (WHO, 2006).

Result of all samples showed concentration within WHO/FMEnv permissible limits.

Total iron

Iron is the second most abundant metal in earth's crust. It is an essential element in human nutrition. The minimum daily requirement of iron ranged from about 10 to 50 mg/day

(FAO/WHO 1988). High concentration can also promote growth of certain kinds of bacteria that clog pipes and well openings of boreholes.

Result of the study showed increase concentration of groundwater obtained from Badagry substation. Possible sources of contamination in the affected borehole are mineral dissolution. In the light of this result, groundwater pollution by Total Iron is predicted for which mitigation measures are proffered.

Barium

Barium gets into groundwater through discharge of drilling wastes, from metal refineries; and erosion of natural deposits (Flaten, 1991). At concentrations above WHO/FMENv limits, barium causes vasoconstriction by its direct stimulation of arterial muscle, peristalsis as a result of the violent stimulation of smooth muscles and convulsions and paralysis following stimulation of the central nervous system (Flaten, 1991).

Result of all samples revealed low concentration and hence were within WHO/FMENv limits.

4.8.3.4 Ground Water Microbiology Analysis

Eight groundwater (GW) samples extracted from existing borehole were analyzed. The samples were obtained as recommended by FMEnv with key quality assurance and control (QA/QC) techniques observed during handling preservation and field test as outlined in ASTM and APHA standards and other standard methods. Analytical standard methods such as API-RP, ASTM and APHA were used for the microbiological analysis of groundwater samples collected. The methods include the Pour Plate and Most Probable Number (MPN) techniques. The protocol of the procedures is summarized in Figure 4.10. The modified Bacto Sulfate API medium (DIFCO) plus agar was adopted for the enumeration and isolation of sulphate reducing bacteria (SRB). The colonies were counted and recorded appropriately.

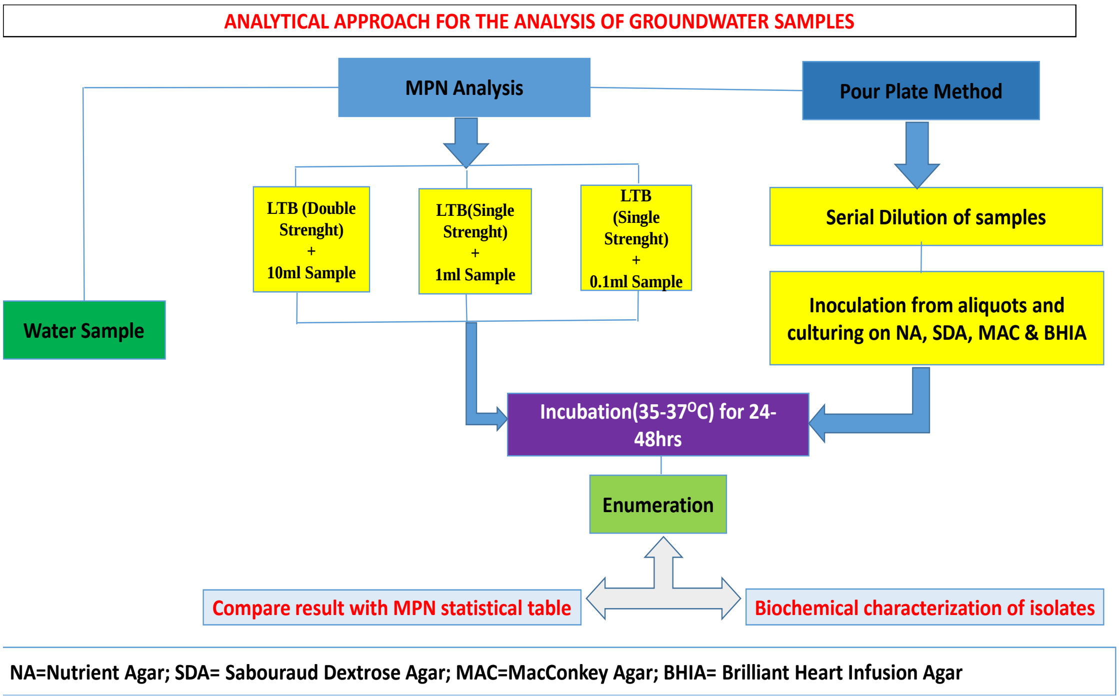


Figure 4.10 Groundwater Analysis Protocol

The presence of feacal and total coliform in borehole 7 and 8 (Berese – Badagry section) falls short of WHO standards for drinking water. However, possible source of contamination includes leacheate of faecal materials. When the concentrations of feacal coliform and that of E coli was evaluated, it was evident there were other groups of feacal coliform that were present in the samples. Other possible genera are Citrobacter, Enterobacter and Klebsiella. The low count of E. coil in the samples is indicative of prolong sewage contamination. Fortunately, since the counts are less than 200 colonies per 100 ml of water samples, there is a lower chance of pathogenic presence

4.9 Surface Water

Sixteen water bodies (found in Ejio, Sojuolu, Alapako, Iju, Igeemo, kooko, Ajegunle, Oke Egan, Agbara, Okuran Idolomo, Ikoge ile, Erekiti, Tohun, Isalu, Yafin and Alagomeje) were observed along the RoW and were subsequently sampled. The sampling location is shown in Table 4.13 and Figure 4.11. Plate 4.5 shows pictures of some of the water bodies that are found on the RoW.

Table 4.13 Surface Water Sample Locations

CODE	Location	LATITUDE	LONGITUDE
SW1	Ayepe	6.8474998	3.1686115
SW2C	sojuolu	6.8382535	3.158505
SW3	Sojuolu	6.8359526	3.1594491
SW4	Oji/AN8	6.7670468	3.1238723
SW5	Igbele Ajana	6.6744113	3.0763865
SW6	Kooko	6.6647994	3.0743051
SW7	AJEGUNLE	6.6548889	3.0724168
SW8	Ojuiroko	6.6360904	3.0623102
SW9	Agbara	6.4991936	3.0753136
SW10	Okaran Akinyele	6.54230	2.9672098
SW11	Ajobe Zebbe	6.5243503	2.9378128
SW12	Erekiti	6.4826491	2.8999615
SW13	Panko	6.4585991	2.8660583
SW14	YafinSS	6.4269144	2.8547287
SW15	YafinSS2	6.4214983	2.8622818
SW16C	YafinCtrl	6.4288121	2.8460598

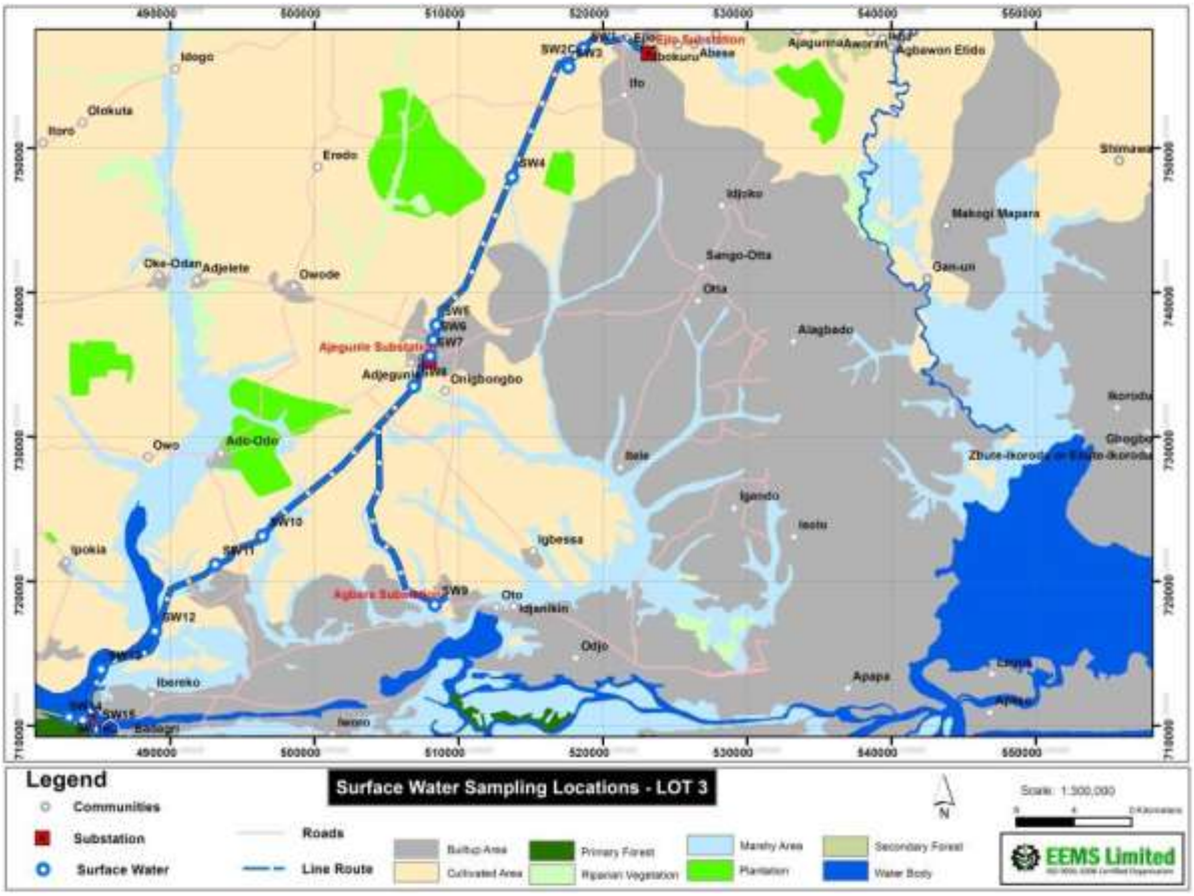


Figure 4.11 Sampling Map for Surface Water.

Igemo River **(Long:** 3.03179**; Lat:** 6.55845**)** kooko River **(Long: 2.97633; Lat:**6.54501**)**

Ajegunle Stream (**Long:**3.20661**; Lat:** 6.85106**)**

Plate 4.4 Some Water Bodies Observed and Sampled in the Project Area

The people depend on them for various activities ranging from drinking, cooking, washing and bathing. In view of the pivotal role the river plays in the day to day lives of the people coupled with the expected roles they will assume on the commencement of the project life cycle, the baseline physical, chemical and biological characteristics was conducted. Some of the parameters analysed insitu were pH, temperature, conductivity and dissolved oxygen. Others analysed in the laboratory were turbidity, nitrate, sulphate, BOD_5, COD_5, and various heavy metals species.

The fresh water bodies ranged in depth from few meters to tens of meters (observation and personal communication).

The rationale for surface water studies is to acquire baseline concentrations for the physico-chemical and microbial contents for which future evaluation and monitoring could be based.

Several activities of the project may impact negatively on the surface water within the proposed project RoW. Such activities include: waste water disposal from maintenance and servicing of the base stations, sewage disposal on surface water by camp workers and migrant food seller thus polluting the water bodies in the proposed project area. Although, the water bodies in the proposed project area are generally small they serve the residents as major sources of water. Pollution of these water bodies, shall impact negatively on the health and socioeconomic status of the residents. However, the mitigation measures of these impacts are presented in chapter six of this report.

4.9.1 Surface Water Sampling Methodology

The container for surface water sampling was lowered into the river in order to collect surface water samples. Water samples were collected directly into various ampoules for preservation and subsequent analysis. Plate 4.5 shows sampling of surface water.

Plate 4.5 Surface Water Sampling at Igeemo River

However, *In-situ* analyses were conducted immediately for pH, temperature, turbidity, conductivity, total dissolved solids and dissolved oxygen. These are parameters with short holding time. Water samples for heavy metal analysis were collected in 2ml plastic bottles and acidified with 10% HNO_3. Plate 4.6 shows surface water *in situ* instrument.

Plate 4.6 Operations of In- Situ Measurement of Surface Water Sample

4.9.2 Surface water Physico-Chemical Result

The physico-chemical characteristics of the surface water bodies within the proposed project areas are summarized in Table 4.14 (see Appendix 3.6 for detailed result).

Table 4.14 Summarized Surface Water Physico-chemical Characteristics

PARAMTERS	Ejio –Ajegunle			Ajegunle to Agbara			Berese to Badagry			Secondary Data (ICCL 2015)	FMENV/WHO (2011) limits for sustenance of Aquatic Lives
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean		
Colour	Cloudy			Cloudy			cloudy			NA	
Odour	Nil			Nil			Nil			NIL	Odourless
pH (H_2O) @24.2^oC	7.32	7.55	7.46	7.36	7.44	7.4	6.36	7.59	7.17	7.20 - 7.56	4.8-9.2
Temp (^oC)	25.8	27.4	23.2	26.7	27.3	27.0	32.8	27.7	26.79	24.4-28.1	40
Conductivity(µS/cm)	46.2	259	77.79	46.2	56.6	55.9	45.8	77.2	58.27	45.1- 287	
Salinity(mg/l)	0.03	0.09	0.04	0.03	0.06	0.05	0.03	0.06	0.04	0.04 -0.08	
DO(mg/l)	3.84	4.88	4.54	2.68	3.50	3.09	2.84	4.46	3.75	2.66 - 4.89	>4 < 9
Turbidity(NTU)	3	60	16	8.0	91.0	49.5	2.0	39.0	18.71	1-45	≤25
TSS(mg/l)	4	50	16.86	26.0	122	74.0	4.0	66.0	23.43	9 - 74	
TDS(mg/l)	27.2	155	46.61	27.7	39.4	33.55	27.5	46.3	31.0	29 - 43.2	
Oil and Grease(mg/l)	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.41	<0.40	<0.40	1- 4	
BOD(mg/l)	10	10	10	10.0	20.0	20	15.0	20.0	11.43	8 - 15.6	≤5
COD(mg/l)	19.8	59.4	39.6	49.5	49.5	49.5	19.9	39.7	29.7	20.6 - 51.3	20
Lead(mg/l)	<0.08	<0.08	<0.08	0.008	<0.008	<0.008	<0.008	<0.008	<0.08	2 - 16	25

Zinc(mg/l)	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	3-11	5000
Copper(mg/l)	<0.02	<0.02	<0.02	<0.02	<6.02	<0.02	<0.02	<0.6	<0.6	0.01 - 1.3	1500
Total Iron(mg/l)	0.24	1.47	0.47	0.22	3.17	1.695	1.22	3.29	0.85	2 – 6	300
Manganese (mg/l)	0.11	0.11	0.11	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	NA	0.18
PCB (ng/m^3)	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	0.03
Chromium (mg/l)	<0.01	<0.02	<0.01	<0.01	<0.01	<0.05	<0.01	<0.03	<0.01	NA	0.1
Cadmium (mg/l)	0.002	0.002	0.002	<0.01	<0.02	<0.01	<0.02	<0.02	<0.02	0.01	0.03
Mercury (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Nickel(mg/l)	0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	0.00 - 0.12	88
Vanadium(mg/l)	0.02	0.02	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.00 - 0.15	

Source: EEMS Survey, 2017

pH

The pH value recorded in-situ and presented in Table 4.14 indicated slightly alkaline media across all the water bodies except the swampy environment in Ikoge Ile which showed slight aciditic characteristics. The analysis compared well with the secondary data reviwed for this parameter and is within WHO limit for sustenance of aquatic lives. However, storm water containing cement-based stabilizers could increase the alkalinity beyond the WHO recommended limits during preconstructuion and constructuon phases.

Temperature

Temperature relates directly to habitat and breeding preferences by aquatic lives. The values indicated a colder temperature in Ejio to Ajegunle axis to hot in Tohan River near Badagry. Although, the baseline values were within tolerable limits to sustaining aquatic lives and within secondary data reviewed for this parameter, discharge of process water from the sub stations is predicted to raise the temperature profile of the adjoining water bodies.

Conductivity

Conductance of water bodies is an index of pollution (Oyem *et al.,* 2014). Apart from natural sources from underlying rocks which imposes a constant conductivity values to a water body, run offs, laden with clayey materials and sewage may be the contributory causal factors to the fairly high conductivity values recorded in the Ajegunle, Agbara and Badagry samples. The conductivity values in all points were within range of secondary data reviewed for this parameter. Watch Network (1997), reported a 150 – 500 µS/cm as ideal range for the sustenance of aquatic lives in a fresh water medium. Since this project is expected to have a construction management plan and waste management plan, the recorded baseline concentrations are not expected to be significantly raised.

Salinity

Salinity provides information on water quality and habitat preference for organisms. The recorded salinity values indicated the entire surface water resources as Fresh in line with the categorization of Vital signs (2017). Secondary salinization which could raise the salt levels of the water bodies resulting in ecological imbalance is not expected from this project. More so, irrigation and mining which are other activities in secondary salinization is virtually non-existent along the project corridor. Salinity values were within limits of secondary data reviewed for this parameter.

Dissolved oxygen

Increase in organic waste load into water bodies induce eutrophication and reduce available dissolved oxygen for aquatic lives. This was the case in all but two of the water bodies (Alapako stream and Iju River). The values obtained for all water samples in Berese – Badagry and Ajegunle – Agbara including those from from Ejio, Sojuolu, igeemo were close to being anoxic. Expectedly, diversity in fishery resources and hydrobiology for this study is low. Nonetheless, self-recovery of the water bodies is possible, if and when inputs ceases or reduces. Similar anoxic concentrations were recorded for this parameter in the report reviewed for secondary data.

Turbidity

Turbidity is an important indicator of potential pollution, suspended sediment and erosion levels. This can arise from inorganic materials or organic matter such as algae, planktons and decaying material. Ejio –Ajegunle and Berese to Badagry section fall within the recommended limits of WHO and secondary data. However, Ajegunle to Agbara section had a higher value above the acceptable limits. Implications are that light will not penetrate down the water and lower dissolved oxygen due to increase in temperature.

Total suspended solids

Results shown for this parameter indicated that samples recovered from Ejio, Sojuolu, igeemo water bodies were above regulatory limits. Probable sources are discharges by artisans and run offs of inorganic and organic matter including decaying materials. Storm water from construction activities and process water from substations during operation phase are predicted to add up to the recorded baseline concentrations. TCN have therefore put up mitigation measures to address this (see chapter six for mitigation measures).

Total dissolved solids

Anthropogenic discharges are the major source of dissolved solid inputs in water bodies. Mineral salts, metals, industrial waste, sewage, leaves lither, silt; pesticides and fertilizers from runoff are probable causal factors for the concentrations recorded across the three sections. Waste from metal scraps, vegetal litters and silt discharge are materials that would introduce more dissolved solids into the water bodies. With elevated baseline concentrations observed in the water body at Ejio (close to proposed substation) exceeding the values for the secondary data reviewed for this parameter, a construction management plan/ storm water management plan is planned for this project.

Oil and Grease

Oil and Grease concentrations were negligible and uniform in all the samples and sections indicating insignificant introductions of spent oils into the water bodies. Spent transformers oils that would be generated in the substations during operation phase is predicted not to add up to this baseline concentration as it would be properly bounded and disposed through legally accredited third parties. However, spent oil that may be accidentally discharged during construction is predicted to marginally influence the recorded concentrations for which a waste management plan would address.

Biological oxygen demand (BOD)

BOD as an index of dissolved oxygen available to decompose organic waste, the implication of the concentrations recorded in this study is that of heavily polluted water (BOD values greater than 5ppm - Slade *et al.,* 2011). Nutrients laden discharges from terrestrial environments is the most plausible causal factor in the study area. This project is not expected to add to the baseline levels as waste and construction plans are planned.

Chemical oxygen demand

It is the amount of dissolve oxygen available to decompose both organic and inorganic wastes. Expectedly, as in BOD, the recorded values of all samples, breached the regulatory limits. Sources of introductions into the water bodies and prediction levels are similar to those mentioned for BOD.

Lead

The uniform Concentrations observed in all samples across the three segments is possibly a reflection of the reduced activities of artisanal practise in the area. This position was deduced based on report by EPA (2017) on the sources of lead in surface water.

Zinc

The concentrations were negligible and uniform in all the samples and sections indicating insignificant introductions of zinc into the water bodies. However, this low concentration if anthropogenic, the likely sources are Battery, paints, leaded pipes, motor oil from zinc tank and car tires (Sharma, 2014).

Copper

Concentration of samples were within regulatory limits Copper – based conductors, welding and fabrication used during and after construction phase could add up to the baseline concentrations (EPA, 2017)

Total iron

All the concentrations were within regulatory limit. Corrosion of iron materials during and after construction will definitely increase the concentrations (SaskH20, 2017).

PCBs

PCBs are a group of persistent environmental chemicals which was once deployed as dielectric and coolant fluids in electrical apparatus, carbonless copy paper and in heat transfer fluids. PCBs according to Dan (2003) enters surface through leakages of PCBs containing transformer oils, waste disposals and by burning of some wastes in municipal and industrial incinerators via runoffs. Exposure above the permissible limits according to WHO causes impair memory and intellectual development in children and adults and to cause human liver disorders and; reproductive problems and possibly dead of aquatic organisms.

Result of this study for all samples revealed concentration below equipment detection limit across all samples and sections, hence, indicates no risk to aquatic and human lives.

Manganese (Mn)

Mn plays several roles in physiological processes in living organisms, including humans. It is a major component of enzymes (Bolarinwa and Okeowo, 2017). In domestic water, Mn can constitute a nuisance if present in a high concentration with a characteristic metallic taste and staining properties.

However, result of this study of all samples indicates concentration below WHO permissible limits, indicating no risk to both aquatic and human lives.

Cadmium (Cd)

Cadmium occurs naturally in rocks, soils, dusts, plants, animal tissue and metals such as zinc, lead and copper ores released during volcanic emission. It exists in the environment at different concentrations. Possible sources of contamination include agricultural runoff, where fertilizers, pesticides and other agro-chemical are used in addition to possible release of sediment bound metal (Muntau and Baudo, 1992). Chronic exposure to cadmium could leads to reduction in growth rate of aquatic organisms, thus reducing its population.

Results of the present study of all samples were observed to be within FMEnv/WHO exposure limits hence no impact on aquatic lives shall be recorded.

Nickel

The concentration of nickel across all samples was negligible, uniform and within the recommended limits implying reduced introduction into the water bodies. However, anthropogenic sources are fertilizers, batteries, metal factories and power plants. (Cempel and Nikel, 2005).

Mercury (Hg)

Concentration of mercury in the various sample stations, was below equipment detection limits, hence was not detected in all the samples and therefore poses no risk to aquatic organisms.

Chromium (Cr)

In aquatic environment, Cr is one of the bio-chemically active transition metals. Weathering of the earth crust is the primary and natural source of the chromium in the surface water. It could also be caused by municipal wastes, laundry chemicals; paints, leather, and road run off due to tire wear and brake wires. Cr, though an essential trace nutrient and a vital component for the glucose tolerance factor, chromium toxicity damages the liver, lungs and causes organ hemorrhages.

Result of the study revealed no traces of contamination by Cr across the various samples, since Cr concentration was below WHO permissible limit.

Vanadium

Vanadium concentrations were insignificantly low and uniform across all samples and compared well with secondary data. Heavy vehicular movements, corrosion of steel, iron and machinery parts, combustion of fossil fuels during and after construction is expected to increase the concentrations of this metal (SEPA, 2017). However, TCN have put up mitigation measures to address this (see chapter six for mitigation measures).

4.9.3 Surface Water Microbiology

The densities and taxa of microorganisms in the water bodies within the project environment are presented in Appendix 3.6.1, while summarized result is presented in Table 4.15.

Table 4.15 Summarized Surface Water Microbiology Result

Sample stations	Total Heterotrophic Bacteria (THB)	Count (ml)	Hydrocarbon utilizing Bacteria (HUB)	Count (ml)	Total Heterotrophic Fungi (THF)	Count (ml)	Hydrocarbon Utilizing Fungi (HUF)	Count (ml)
Ejio to ajegunle	*Bacillus sp* *Chromobacterium sp* *Micrococcus sp* *Pseudomonas sp* *Staphylococcus sp*	11666	*Bacillus sp* *Micrococcus sp*	373	*Aspergillus sp* *Candida sp* *Mucor sp* *Penicillum sp* *Rhizopus sp* *Rhodotorula sp*	736	*Mucor sp* *Rhizopus sp*	210
Ajegunle to Agbara	*Bacillus sp* *Chromobacterium sp* *Micrococcus sp* *Pseudomonas sp* *Staphylococcus sp*	6370	*Bacillus sp* *Micrococcus sp*	311	*Aspergillus sp* *Candida sp* *Geotrichum sp* *Mucor sp*	620	*Mucor sp* *Rhizopus sp*	150
Berese to Badagry	*Actinomyces sp* *Bacillus sp* *Klebsiella sp* *Chromobacterium sp* *Micrococcus sp* *Pseudomonas sp* *Staphylococcus sp*	14360	*Bacillus sp* *Micrococcus sp*	3183	*Aspergillus sp* *Candida sp* *Mucor sp* *Penicillum sp* *Rhodotprula sp*	243	*Mucor sp* *Rhizopus sp*	84

Source: EEMS Survey, 2017

Total Heterotrophic Bacteria (THB)

Surface water contaminated by waste from rice, meat, vegetables, tomatoes, pepper and bakery products are well documented in literatures (Banyko and Vyletelova (2009), Capurro *et a l.*, 2010) as growth media for the five microbial genera (*Bacillus sp, Chromobacterium sp, Micrococcus sp, Pseudomonas sp and Staphylococcus sp*) observed in samples recovered in the Ejio to Ajegunle and Ajegunle to agbara sections. Conversely the occurrence of *Klebsiellasp* and *Actinomyces* genera were observed only in sample obtained in Berese to Badagry sections. The presence of these genera in any water sample as suggested by Zadoks *et al.*, (2011) is indicative of waste mainly from animal-rich diet and less from plant based. In terms of cell abundance, there ought to be a direct relation between high number of species and high counts per ml. This was not the case in this group. A bacterial group exhibiting high abundance and low species diversity is suggestive of sudden or episodic organic enrichment which enhances replication rate leading to the well documented "boom" concept in microbial physiology. In this study as in all environments, the dominance of these opportunistic species is expected to 'crash' as the rate of the organic enrichment ceases or decline.

Hydrocarbon Utilizing Bacterial (HUB)

Bacillus and *Micrococcus* species were the two HUBs observed in all the water samples recovered from the sixteen sample stations. This uniform occurrence across all segments shows a common possible contamination source similar to those already discussed for the THB. Also, the presence of only two HUBs genera coupled with a low count per ml is indicative of an environment with reduced presence of hydrocarbon.

Total Heterotrophic Fungi (THF)

Aspergilus, Candida and *Mucor* species were the three fungi genera observed in all the samples across the three segments. The presence in any water body as reported by Loudon *et al.*, 1996 are possible contaminations from plant litter, fruits, carbohydrates, oil and mold in vegetable and peanuts. Also, the presence of *Rhodotorulasp* in Ejio to Ajegunle and Berese to Badagry samples is indicative of contaminated waters by milk, fruit juices and dairy products (Aksu and Tugbaeren, 2005).

Heterotrophic Utilizing Fungi (HUF)

The uniform occurrence of two fungi species (*Mucor sp* and *Rhizopus sp)* observed in samples recovered across the three segments depict ecosystem stability. Possible sources of contamination include domestic waste materials such as meat, strawberries, cereal grain and nuts mold in vegetables and peanuts as reported by Sridhara *et al. (1990).* A reduction in species count (ml) was however, observed in HUF with increasing counts from Ejio to Ajegunle, Ajegunle to Agbara and Berese to Badagry in that order.

4.10 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. Several activities of the transmission line project shall negatively impact the soil. Oil and fuel leak from construction machineries and vehicles for transport of construction materials equipment shall directly impact the soil. Also, the construction of access roads shall result in vegetation clearing thus exposing the underlining soil to erosion. More so, the disposal of solid wastes by camp workers and migrants may contaminate the soil. Though most of these impacts are short term, the effects may be severe. However, mitigations measures have been proffered for these impacts, and they are well documented in chapter six of this report.

4.10.1 Soil Sampling

Soil samples were collected at thirty-six (36) stations. At each station, soil samples were collected at two depths (0-15cm for top soil and 16-30cm for sub soil). This operation was carried out with hand auger as shown in Plate 4.7 and 4.8.

Plate 4.7 Soil Sampling by Augur at Omilende

Plate 4.8 Soil Samples Storage/Preservation

Each sample was collected in polyethylene bags, labelled appropriately, and stored in a cooler ready for transportation to the FMEnv accredited Mifor Consult laboratory. The soil sampling locations are shown in Figure 4.12 and Table 4.16.

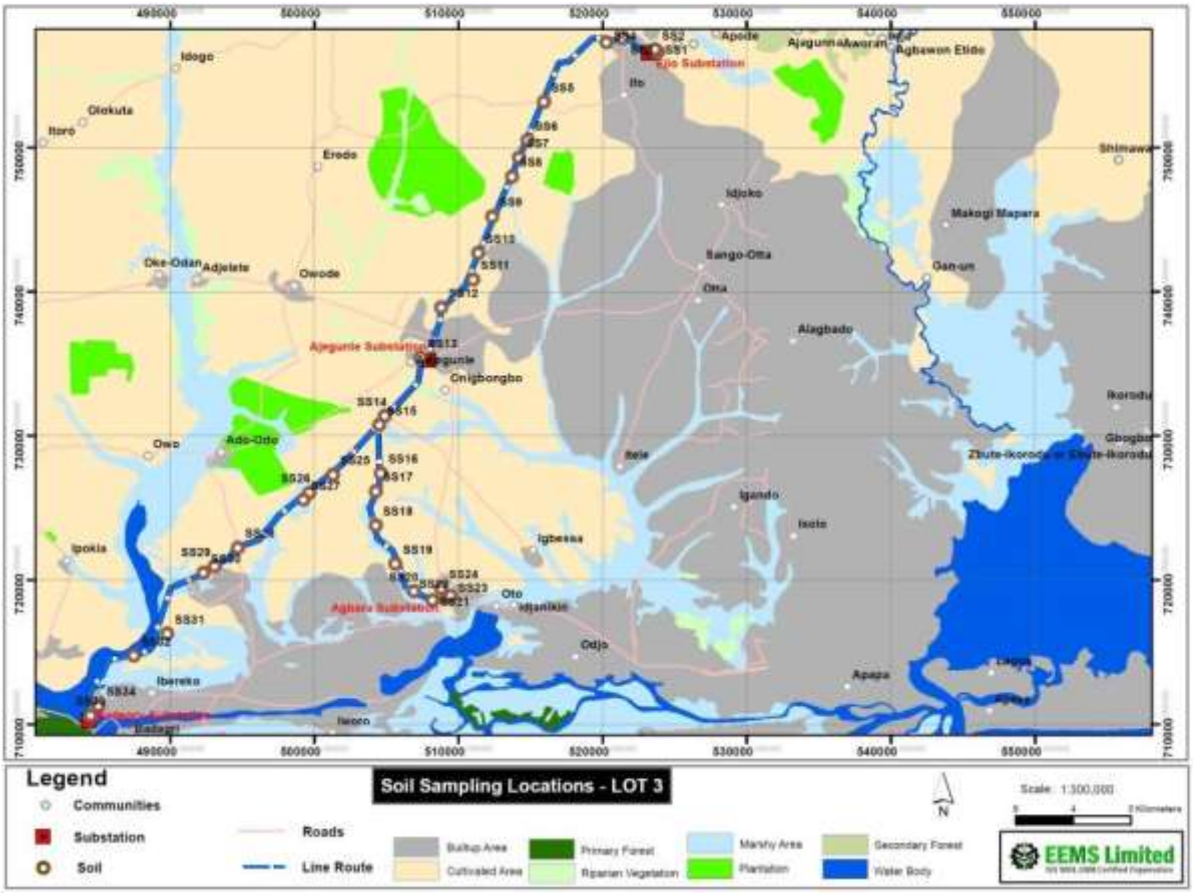


Figure 4.12 Sampling Map for Soil

CODE	LATITUDE	LONGITUDE	DESCRIPTION
SS1	6.8450498	3.2155609	Ejio proposed substation; built-up environment mostly residential, a lot of domestic activities, etc.
SS2	6.8467115	3.2136834	Ejio: Perennial water body; built up areas, mostly residential etc.
SS3	6.8536781	3.1938887	Arigbajo: residential buildings, highway (Lagos-Abeokuta Expressway)
SS4	6.8514305	3.1832242	Apomu; Buildings and farmlands
SS5	6.8139012	3.1439352	Ekundayo; Secondary forest interspersed with farmlands, unpaved road.
SS6	6.7897395	3.1337643	Alakpako-Isale; built-up mostly residential, secondary forest, unpaved road, fire spots for commercial and domestic activities, etc
SS7	6.7790645	3.1283462	Ogunwede; sand mining activities, sparsely built up, secondary forest interspersed with farmlands, etc
SS8	6.7670468	3.1238723	Oke-Oji; residential area, partially paved road, etc.
SS9	6.7420304	3.1114483	Ijemo/Olori; built up, secondary forest interspersed with farmland, etc.
SS10	6.7190105	3.1028438	Adie-Owe; Farmlands and buildings
SS11	6.7025853	3.0995178	Leshi; residential, Track roads and farmlands
SS12	6.6849607	3.0796051	Igbele Ajana: Residential, palm plantation, factory
SS13	6.6535888	3.0664301	Ajegunle: proposed substation, busy road partially paved, building buildings
SS14	6.6168222	3.0441999	Olakitan: Buildings, secondary vegetation and paved road
SS15	6.6112298	3.0407506	Iberese: Buildings, secondary vegetation and track road
SS16	6.5809269	3.0415177	Akpabiekun: secondary forest, track road
SS17	6.5697144	3.0384707	Ago-Iboro; Buildings, secondary vegetation and track road
SS18	6.5483119	3.0384064	Egudu; Buildings, secondary vegetation and track road
SS19	6.5240944	3.0507231	Idayin Ishaga: Buildings, secondary vegetation and track road
SS20	6.5070392	3.062396	Idayin Idah: Buildings, secondary vegetation and track road
SS21	6.5013255	3.073951	Idoluba; Track road, buildings and farmlands
SS22	6.5027859	3.0829096	Agbara: Buildings, factories, swamp,
SS23	6.5039265	3.0854416	Agbara: Buildings, factories, vehicular movements

SS24	6.508766	3.0795622	Agabara: substation site
SS25	6.5799677	3.0115843	Ajogb-Akia: built-up mostly residential, and primary school, secondary forest, unpaved road, fire spots for commercial and domestic activities.
SS26	6.5687125	2.9966497	Whezume; residential area, Buildings, secondary vegetation and tracks.
SS27	6.5640867	2.9928303	Isunba; built-up environment mostly residential, domestic activities, etc.
SS28	6.534242	2.9517817	Bandu; residential area, Swamp, secondary vegetation and farmlands
SS29	6.5226661	2.937448	Gbojo; Buildings, secondary vegetation and track road
SS30	6.5184236	2.9303026	Janvhe; Buildings, secondary vegetation and track road
SS31	6.4802186	2.9075575	Erekiti/Iragbon axis, Swamp
SS32	6.4665732	2.8865719	Tohun, swamp
SS33	6.4289827	2.8594923	Yafin: proposed substation, swamp, secondary forest
SS34	6.4350596	2.8644276	Yafin/ Alakotomeji; Swamp, sacred site and secondary forest

Table 4.16 Soil Sampling Location

4.10.2 Soil Physico-Chemical Parameters

Table 4.17 is a summarized physico chemical results for which detailed results is shown in Appendix 3.8.

Table 4.17 Soil physico-chemical characteristics

EJIO TO AJEGUNLE							AJEGUNLE TO AGBARA						BERESE TO BADAGRY						2^O (ICCL 2015)	WHO/ FMENV Limits (USDA 2017)
Parameters	Top soil			Sub soil			Top soil			Sub soil			Top soil			Sub soil				
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max		
pH (H_2O) @ 23.3°C	5.86	5.26	6.89	5.87	5.21	6.51	5.45	5.04	5.92	5.65	5.34	6.01	5.35	5.16	5.5	5.64	5.39	5.77	5.01 - 6.85	5.0-8.0
Moisture Content (%)	12.26	9.57	16	11.41	8.65	14.2	13.97	10.5	17.8	12.03	7.66	14.4	12.12	8.79	16.79	10.10	7.89	15.22	7.62 - 18.03	
THC (mg/kg)	.0.05	<.0.05	<.0.05	<.0.05	<.0.05	<.0.05	<.0.05	<.0.05	<.0.05	<.0.05	<.0.05	<.0.05	<.0.05	<.0.05	<.0.05	<.0.05	<.0.05	<.0.05	3 - 8	
PSD																				
Clay (%)	4.5	2	9	4.75	2	9	4.36	2	8	5.73	2	9	3.53	0	9	4.46	0.2	10	0 - 16	
Silt (%)	7.92	3	17	12.58	3	54	15.55	3	40	16.64	4	44	9.15	0.9	19	16.08	1.8	45	1-66	
Sand (%)	87.58	81	95	82.67	41	95	80.09	56	95	77.64	48	93	87.32	72	98.9	79.62	98	97.5	34 - 86	
Ext. Nitrate (mg/kg)	14.27	0.02	36.3	23.09	0.02	62.9	19.77	1.91	31	32.24	10.9	64.7	23.67	3.6	59.33	28.82	5.67	65.33	0.01 - 10	500
Ext. Sulphate	168.5	35	410	269.2	37.5	588	157.5	35	345	190.2	10	498	70.89	10.30	200	194.0	9.98	366	14 - 688	

(mg/kg)				5			3			5				6		8				
Ext. Phosphate (mg/kg)	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.86	0.001	6	0.69	0.001	6.4	0.01 - 26	5
Total Iron (mg/kg)	6,695	4,333	8,380	7,598	5,256	11,050	9,466	6,758	14,630	9,958	7,619	15,560	4,110	48	7,770	5,283	73	11,260	36 - 15.783	30,000
Copper (mg/kg)	31.12	0.5	97.6	21.45	0.5	76.9	13.441	5.2	41.5	33.74	4.34	93.6	34.30	0.5	90.3	34.06	0.5	99.1	1.0 - 120	36
Lead (mg/kg)	11.85	3.9	39.6	11.09	1	30.7	12.10	4.5	29.1	21.52	4.6	49	4.40	0.001	8.5	5.24	0.001	11.5	0.001 - 65	85
Nickel (mg/kg)	9.5	5.5	14.3	11.35	6	15.8	10.55	6.8	12.4	11.84	8.2	17.9	4.62	0.09	9	6.39	0.04	11.7	2- 21	35
Zinc (mg/kg)	26.66	18.3	35.6	28.13	19.8	35.8	30.95	20.7	41.9	34.55	22.7	41.9	16.06	0.211	29.6	18.25	0.12	31.4	10 - 138	140
Vanadium (mg/kg)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	9.00	1	45.5	11.4	1	53.9	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01 - 187	

Source: EEMS survey, 2017

pH

The entire sample reflected a fairly acidic medium indicating a humid environment and arable soil type. The sub soil was observed in its entirety to be less acidic than the corresponding top soil indicating insignificant leaching effects. The concentrations compared favourably with those of the secondary data and aligned with the limits set by WHO 2017.

Moisture Content

Soil moisture correlates strongly with precipitation and storm water runoff into areas with lower elevations such as water bodies. Percentage moisture content was shown to be generally higher among top soil samples than underlying sub soils indicting more abundant pore spaces and less compact soil type among top soils. However, results observed across samples from the two depths (0-15 cm and 15 - 30cm) around Igbovipe, Zenvie, Panko and Tohan were similar, signifying similar sandy soil and hence loose compaction that would require soil compaction prior to construction.

THC

The uniform concentration across all samples and sections investigated revealed low levels of spent oil within the proposed project area.

PSD

Presence of the three (sandy, clayey and silt) basic soil types across all sampled depths collected in Ejio - Ajegunle and Ajegunle agbara showed a graduation of a loose sandy top to a more compacted clayey sub soil. However, samples collected in Igbovipe and Tohan showed zero or insignificant percentage of clayey soil in the top and sub soil. In turn, they revealed a more unconsolidated sandy soil.

Exchangeable Nitrate

High concentrations of exchangeable nitrates indicate higher amounts of organic matter which was observed more in samples recovered in Badagry and Idanyin areas of the project area. Generally, areas with lower elevations and dense vegetal matter coincided with areas having concentrations of 30 mg/kg and above. Higher vegetal waste is therefore expected to be generated from these areas during pre-construction phase.

Exchangeable Sulphate

The results differentiated the study areas into sulphate rich (>50 mg/kg) and sulphate poor (<50. mg/kg). Samples with relatively high clayey content in the top soil and obtained from points with dense vegetation cover aligned to sulphate rich concentrations on analyzes. This corresponds to the Kooko, Igeemo, Alapako, Okuran Idolomo, Idanyin and Ikoka Ile axis of the study. Sulphate heave and seams are therefore expected to be formed across these areas of the project foot print during construction when aluminium-based compounds and/or calcium-based stabilizers such as cement is used. The obtained results fit that reviewed for the secondary data.

Exchangeable Phosphate

Phosphorous as a natural occurring element in the soil showed negligible concentrations across samples in the Ejio to Ajegunle through Agbara sections. Expectedly, fairly higher concentrations observed in sub soil samples obtained in Whezeme and Iragbo axis do influence phosphate uptake by crops (since soil is acidic) around the RoW, thus conferring higher soil fertility to these areas. This is reflected in part by larger number of farmlands in these areas that would be affected by this project.

Total Iron

Iron concentrations observed in this study correlate linearly and strongly with hydrogen ion concentrations (pH). Higher iron concentrations were revealed in areas with red lateritic soil type. Though poor for tuber production and most agricultural purposes, it confers excellent soil strength for construction purposes hence ideal for the project. The obtained values are in tandem with data reviewed for the secondary data and within regulatory limits.

Copper

About two- thirds of the concentrations across the various study sections were above regulatory limit. Naturally, Xing *et al.* (2016) reported higher copper concentrations from soils derived from igneous rocks and lower values in extreme acidic and alkaline soils. Agricultural activities, municipal and industrial solid waste (especially around the Agbara axis) are likely anthropogenic causal factors that led to copper concentrations above regulatory limits. In this study, Construction and operation phases of the sub stations are expected to add up to the copper levels, hence cumulative impact and waste management plan need be evaluated and developed.

Lead

Lead usually enters soil from anthropogenic sources which include; lead pipe presence, lead additives in vehicles, lead-based paint etc and spent batteries. The presence of lead in the samples indicated sources of income related to usage. Since, the project is not expected to displace artisans who introduce it into the soil by the two latter sources, effective waste management plan during construction and operation of the sub stations would maintain the lead levels to within the regulatory limit.

Nickel

Electroplating industries and combustion of fossil fuels are the two basic anthropogenic sources of nickel into the environment. The higher levels observed in samples obtained from urban or semi urban are Agbara, Bandu and Ikoge ile is associated with combustion of fossil fuels. Nickel is generally less than 100ppm in soils but it could be exceptionally high in some cases especially where ultra basic rocks are present. Plants appear to be more sensitive to nickel toxicity than animals.

4.10.3 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 soil the 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 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. About 1g of fertile soil should contain 1 x 10^6 to 1 x 10^8cfu/g bacteria and fungi (Odu *et al.*, 1985). Detailed analytical procedures are shown in Appendix 3.1.

Soil microbial result for the study area is summarized in Appendix 3.8.1. However, Table 4.18 shows a summary of the microbial population in the soil samples.

Table 4.18 Summarized Soil Microbial Result

	Ejio- Ajegunle		Ajegunle- Agbara		Berese- Badagry	
Groups	**Speies**	**Counts (Cfu/ml)**	**Species**	**Counts (Cfu/ml)**	**Species**	**Counts (Cfu/ml)**
THB	*Bacillus sp* *Pseudonomassp* *Staphylococcus sp* *Proteus sp* *Enterobacter sp* *Micrococcus sp* *Actinomyces* *Escherichia sp* *Klebsiellasp* *Serriatiasp* *Flavobacteriumsp*	470,000 - 134,000	*Bacillus sp* *Pseudonomassp* *Staphylococcus sp* *Proteus sp* *Chromobacterium msp* *Micrococcus sp* *Serriatiasp* *Klebsiellasp*	470,000- 120,000	*Bacillus sp* *Pseudonomassp* *Micrococcus sp* *Escherichia sp* *Klebsiellasp* *Protuessp* *Serriatiasp* *Staphylococcus sp* *Enterobacter sp* *Arthrobacter sp* *Actinomyces sp* *Flavobacterium sp* *Chromobacterium sp*	560,000- 130,000
HUB	*Bacillus sp* *Pseudonomassp* *Micrococcus sp* *Arthrobactersp* *Staphylococcus sp*	7,200- 1000	*Bacillus sp* *Pseudonomassp* *Staphylococcus sp* *Serriatiasp*	14,000- 1,500	*Bacillus sp* *Pseudonomassp* *Micrococcus sp* *ProtuesspStaphylococcus sp*	20,000- 1,200

	Ejio- Ajegunle		**Ajegunle- Agbara**		**Berese- Badagry**	
Groups	**Speies**	**Counts (Cfu/ml)**	**Species**	**Counts (Cfu/ml)**	**Species**	**Counts (Cfu/ml)**
			Micrococcus sp *Proteus sp* *Klebsiellasp*		*Escherichia sp* *Arthrobactersp* *Klebsiellasp* *Flavobacteriumsp* *Serriatiasp*	
THF	*Aspergillussp* *Penicilliumsp* *Cladosporiumsp* *Mucorsp* *Fusariumsp* *Rhizopussp* *Candida sp* *Trichoderma sp*	840-60	*Aspergillussp* *Penicilliumsp* *Fusariumsp* *Mucorsp* *Rhizopussp* *Trichoderma sp*	400-60	*Aspergillus* *Mucorsp* *Penicilliumsp* *Fusariumsp* *Rhizopussp* *Candida sp* *Trichoderma sp*	720-60
HUF	*Mucorsp* *Aspergillussp* *Fusarium sp* *Penicilliumsp* *Candida sp*	320-20	*Penicillium* *Mucor* *Aspergillussp* *Fusarium sp* *Rhizopussp*	360-20	*Aspergillus sp* *Mucorsp* *Fusarium* *Penicillum* *Candida*	320-20

Source: EEMS survey, 2017

Total Heterotrophic Bacteria (THB)

The microbial diversity along the three (3) segments of the study area was largely uniform indicating similar substrate for metabolic activities.

However, the introduction of *Arthrobacterspp* in Ejio-Ajegunle indicates discharge in herbicides, pesticides and manure into the environment. The finding observed in this study was corroborated by Luying *et al*. 1992 & Akindele *et al*. 2015 who in the study area recorded similar organisms, indicating ecosystem stability.

Also, the variation and quantity of substrates available to the microbes seem a determining factor in the abundance, count as there exist a linear relation between the number of species and abundance recorded in the three sections.

Hydrocarbon Utilizing Bacteria (HUB)

Differences in microbial diversity exist along the three (3) segments for the HUB possibly indicating multiple substrates for metabolic activities. For instance, the introduction of *Escherichia*, *Flavobacterium* and *Serriatia* species in Berese- Badagry section presumably indicates pesticides, manure and herbicides discharge into the environment. However, variation and quantity of substrates available to the microbes influences the count per cell.

Total Heterotrophic Fungi (THF)

Slight differences exist in the microbial species studied along the three (3) segments for the THF indicating uniform substrates. For instance, the intrusion of *Candida* and *Cladosporium* could be due to heavy metal occurrence and low concentration of hydrocarbons within the environment owing to their low abundance. Orji *et al*. 2016 recorded similar organisms in Ogun State soil around Ewekoro Local Government Area.

Hydrocarbon Utilizing Fungi (HUF)

The five (5) microbial genera assayed along each of the three (3) segments as could be seen in Table 4.17 and the relatively low count was indicative of a soil with reduced presence of hydrocarbon show.

4.11 Protected Areas

The protected areas in Ogun and Lagos States State are shown in Table 4.19 and none of them crossed by this project. The closest to the project site is the Ologe Lagoon Forest Reserve, which is about 3km South of the existing Agbara Substation.

Table 4.19 Protectected Areas in Ogun and Lagos State

S/N	Name	Location	State	Total Area (km^2)	Year Established	Remarks
1	Omo F/R Area J1 & J3 , Area J4, Area J6 & Ak, 16 Enclaves	Ijebu East and Ijebu North Local Government	Ogun	1305.5, 519.3, 565.8, 220.4, 65	1925	Productive
2	Olokemeji Forestry Reserve	Odeda LG (Olokemeji)	Ogun	58.88	1916	Degraded
3	Arakanga Forestry Reserve	Odeda LG (Olokemeji)	Ogun	2.39	1945	Protective
4	Ilaro Forestry Reserve	Yewa South LG (Ipake)	Ogun	46.08	1953	Degraded
5	Edun Stram Forestry Reserve	Yewa South LG (Ilaro)	Ogun	0.97	1953	Protective
6	Eggua Forestry Reserve	Yewa North LG (Eggua)	Ogun	41.47	1937	Degraded
7	Aworo Forestry Reserve	Yewa North LG (Aworo)	Ogun	212.99	1936	Degraded
8	Imeko Game Reserve	Imeko-Afon LG (Imeko)	Ogun	954.88	1933	Degraded
9	Ohumbe Forestry Reserve	Yewa North LG (Oja Odan)	Ogun	46.08	1936	Degraded
10	*Ologe Forest Reserve	Ologe, Badagry LGA	Lagos	4.43	2000	Protective
11	*Ogun River Forest	Erunkan Area, (between Kosofe	Lago	N/A	N/A	N/A

	Reserve	and Ikorodu)	s			

Source: Ogun State Forestry Operations; *Olufemi A. O. and Ameh, C. E (1999); N/A = not available

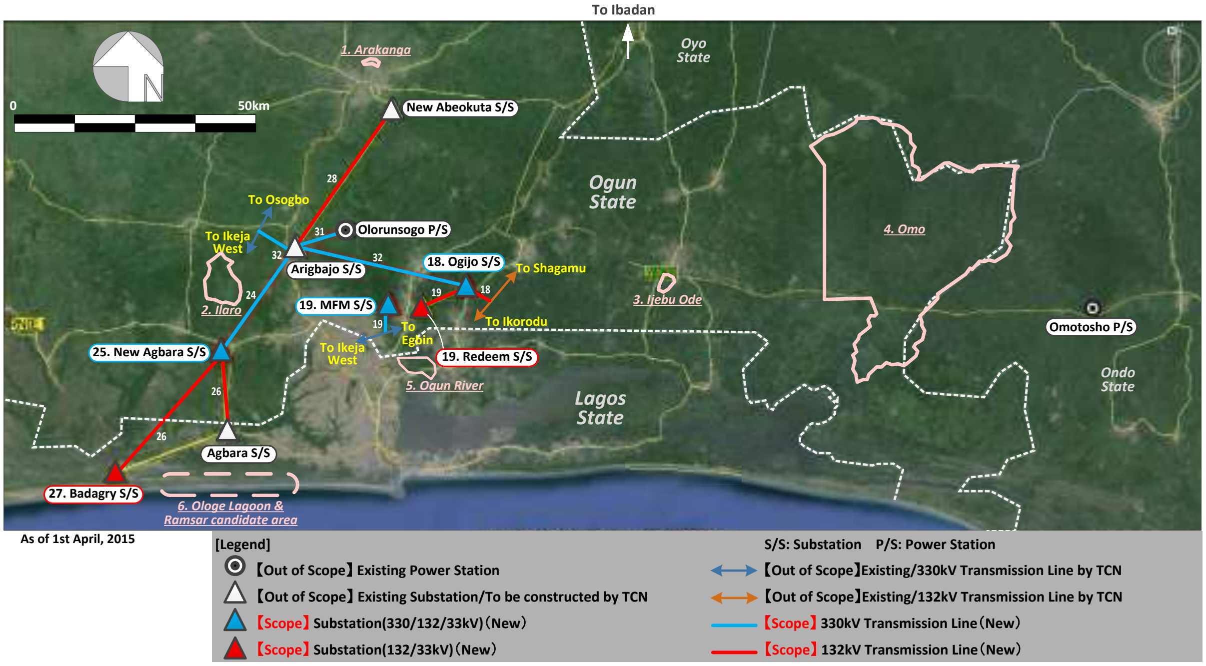


Figure 4.13 ProtectedAreasAround the Project Area

4.12 Biodiversity

4.12.1 Overview

Biological diversity (Biodiversity) has been defined as the variability among living organisms from all sources including *inter alia*, terrestrial, marine, other aquatic ecosystems (freshwater and brackish water) and ecological complexes of which they are part: this include diversity within species and between species of ecosystems. The Convention on Biodiversity is a legally binding agreement opened for signature at the Earth Summit in Rio de Janeiro (Brazil) in 1992. Over 145 countries, including Nigeria are now parties to the convention. The objectives of the convention are the conservation of biological diversity (biodiversity); the sustainable use of biodiversity's components and the equitable sharing of benefits derived from genetic resources. The Convention is one of the international legal frameworks guiding the execution of EIA/ESIA in Nigeria today. To that effect, the convention recognizes the importance of biodiversity for maintaining life sustaining system of the biosphere and acknowledge that the conservation and sustainable use of biological diversity is of critical importance for meeting the food, health and other needs of the growing World population. It has a wide range of intrinsic values including ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values.

Today, biodiversity has become an issue of worldwide interest and an integral part of all environmental studies. It is therefore not surprising that virtually all the agencies of the United Nations Organization (UNO) as well as many international Non-Governmental Organizations (NGO) have continued to show interest in biodiversity. The latest development in this global interest in biodiversity is the establishment of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) formed by many agencies of the United Nations UNEP, UNESCO, FAO and UNDP. The Government of Federal Republic of Nigeria is a signatory to the Biodiversity Convention, IPBES as well as many other related Conventions. Indeed, development activities, ways of life and means of livelihood in the country are strictly guided by these Conventions, in addition to many national and state legal and administrative framework.

In support of the Federal Ministry of Environment (FMEnv) which is the federal regulatory body on issues of environment in Nigeria, there are many established NGOs/ societies in the country with strong interest in Biodiversities. Foremost among these NGOs in the country are the Nigerian Field Society (NFS) and the Nigerian Conservation Foundation (NCF). The Nigerian Field Society, established in 1930 (now 87 years old) is the oldest NGO on the environment in West Africa, and its journal (The Nigerian Field) which has published since 1931, is a goldmine on the Nigerian biodiversity (flora, fauna and ecosystems). The Nigerian Conservation Foundation (NCF) established over 40 years ago (located along Lagos – Epe Expressway, Lagos) has co-operated with many international/national bodies and donors (notably the WWF, IUCN, WRI) on the conservation and development of biodiversity in the country. The foundation has worked closely with Government Institutions on development and /or management of the seven established National Parks as well as the numerous forest games reserves, protected areas, zoological gardens and arboretum all over the country. The foundation (NCF) has developed a Biodiversity Action Plan (BAP) for forest regeneration and the mitigation of the identified effects of Climate Change on the Nigerian forest cover which is very fast decreasing. The nearest forest reserve to the present project area is the Omo forest (Ogun State) and contiguous to it is the Shasha forest.

In the present study, the biodiversity of Lot 3 study area has been adequately covered in the following specific studies;

- <u>Terrestrial Vegetation (Flora):</u>

Vegetation cover and physiognomy, taxonomic composition of trees, shrubs, herbs, economic plants and crops

- <u>Wildlife (Fauna):</u>

Amphibians, Reptiles, birds, and mammals (taxonomic composition, etc)

- Phytoplankton Flora (Water)

Taxonomic composition, occurrence and distribution, abundance, community structure and biodiversity indices

- Zooplankton Fauna (Water)

Taxonomic composition, occurrence and distribution, abundance, community structure and biodiversity indices

- Macro-Invertebrates (Sediment)

Taxonomic composition, occurrence and distribution, abundance, community structure and biodiversity indices

- Microbiology (Water and Sediment)

Taxonomic composition, occurrence and distribution, abundance of heterotrophic bacteria and fungi (mould and yeasts).

4.12.2 Terrestrial Vegetation (Flora)

4.12.2.1 Methdology

Vegetation Sampling

This involved site selection, samples collection, and data analyses.

Location and Area Descriptions

The focal area of interest, termed the Terrestrial Biodiversity Study Area (hereafter 'Study Area') of about ten (10) plots (1000m x 2000m) was established. Each of the ten plots was considered as a sampling point. Also, twelve (12) sections were obtained from the plots based on the communities that fall within them.

Characterization Method

A combination of field surveys and desktop assessments was used to characterize the biodiversity resources present at the Study Area.

Survey Timing

A preliminary assessment of the Study Area was conducted by the Biodiversity Team Lead Novemeber 26, 2017. During this assessment, regular observations to assess changes in habitat and other points of interest were noted. This reconnaissance survey formed the basis for sampling size determination. Detailed biodiversity study was conducted between November 27th and December 4th, 2017 (Plate 4.9 and 4.10).

Plate 4.9 Biodiversity Sampling Activities at Igeemo Village

Plate 4.10 Biodiversity Sampling Activities at Ekundayo

Sampling site: Twelve sampling points were delineated using plant species physiognomic conditions and habitat types. Table 4.19 presents the sampling sites and their coordinates.

Sampling Size: An average of 2 hectare was adopted as sampling size per sampling point. This resulted in a total sampled area of 20 hectares.

Sampling Team: The team comprises a plant taxonomist/ecologist and an assistant, animal ecologist and an assistant and two local assistants.

4.12.2.2 Sampling Parameters and Methods (Flora)

Specific and standard methodology was adopted for specific parameter/flora taxon for which baseline information is required as contained in the Biodiversity Terms of Reference (TOR). Some of the floristic parameters to be determined as shown in Table 4.20 include species and family information (life forms, diversity richness, abundance, frequency, community/vegetation structure, alien species inventory, indigenous uses. Detailed flora and fauna methodologies are shown in Appendix 3.1.

Table 4.20 Habitats Sampling Sites

Sampling plot ID	Latitude (N)	Longitude (E)	Location	Habitat feature
Section 1: Ejio substation to Ajegunle Substion				
BD1 – BD2	6.85062 – 6.84421	3.20651 – 3.21697	Ejio substation	A derive savannah
BD3 - BD5	6.84569-6.82116	3.16911 - 3.14647	Shojuolu to Ekundayo	Derived Savannah
BD7-BD8	6.80117-6.73899	3.13786-3.11197	Alapako to Adelaja	Derived Savannah and Riparian forest
BD6-BD9	6.70931 - 6.68672	3.09547 - 3.08605	Igbili to kooko	Derived savanna and Riparian Forest
Section 2: Ajegunle Substation to Agbara Substation				
BD12	6.50696 - 6.49982	3.07688 - .08528	Agbara Substation	Derived Savannah
BD9-BD11	6.62953-6.62766	3.05071-3.04905	Ajegunle to Ojuroko	Derived savanna
BD10-BD17	6.57391 – 6.56295	3.02727 – 3.0638	Adaoduro to Onilogbo	Derived savanna
BD14-BD-16	6.54491-	3.02454-	Ijegemo Ishaga to	Derived savanna and

	6.53735	3.03186	Idanyi	Riparian forest
Section 3: Berese to Badagary substation				
BD10-BD19	6.57377-6.57319	3.00399-3.00457	Whezeme to Okuran Idolomo	Derived Savannah
BD19-BD20	6.54827 - 6.49869	2.97313-2.92160	Ikoga Ile to Iragbo	Derived Savannah and Riparian Forest
BD21-BD26	6.48000-6.46790	2.90358-2.89555	Igbo Fipe to Zenvie	Derived Savannah and Riparian Forest
BD24	6.42916-6.43609	2.85902-2.85681	Badagry sub Station	Derived savanna and Riparian

Source: EEMS survey, 2017

4.12.2.3 Habitats type

The results obtained were discussed under habitat type, species richness, species density, species diversity, species abundance, vegetation structure, conservation status, alien/invasive species evaluation, ecosystem services and protected areas.

The Study area consists of swampy area, riparian vegetation, cultivated area, fallow field and built-up area. Estimate (using GIS data supplemented by ground truthing and UAV survillance) of the cover by each habitat type obtained in respect to transect covered during field study is presented in Table 4.21. The pictures of each sampled area are shown in Plate 4.11 and 4.12.

Table 4.21 Habitat Types and Approximate Size

Land use type	Affected Area Within Substation Site (m^2)						
	Ejio S/S	Ajegunle S/S	Badagry S/S	Ejio-Ajegunle	Ajegunle-Agbara	Ajegunle-Badagry	**TOTAL**
AREA OF SS/LENGTH OF LINE	25.1ha	25.1ha	25.2ha	30km	21km	36km	
Primary Forest							**-**
Secondary Forest	41,500			175,500	127,800	216,000	**519,300**
Swampy area			251,957	-	7,200	183,600	**190,800**
Riparian vegetation		7,698		18,200	5,480	108,000	**131,680**
Water body				-	3,150	162,000	**165,150**
Cultivated area	52,650	45,837		409,110	171,700	177,120	**757,930**
Fallow field	146,135	187,691		729,500	306,400	216,000	**1,251,900**
Built-up area	12,670	8,872		145,300	10,200	17,226	**172,726**
Plantations				-	-	-	**-**
Others				22,100	-	-	**22,100**
TOTAL	**252,955**	**250,098**	**251,957**	**1,499,710**	**631,930**	**1,079,946**	**3,211,586**

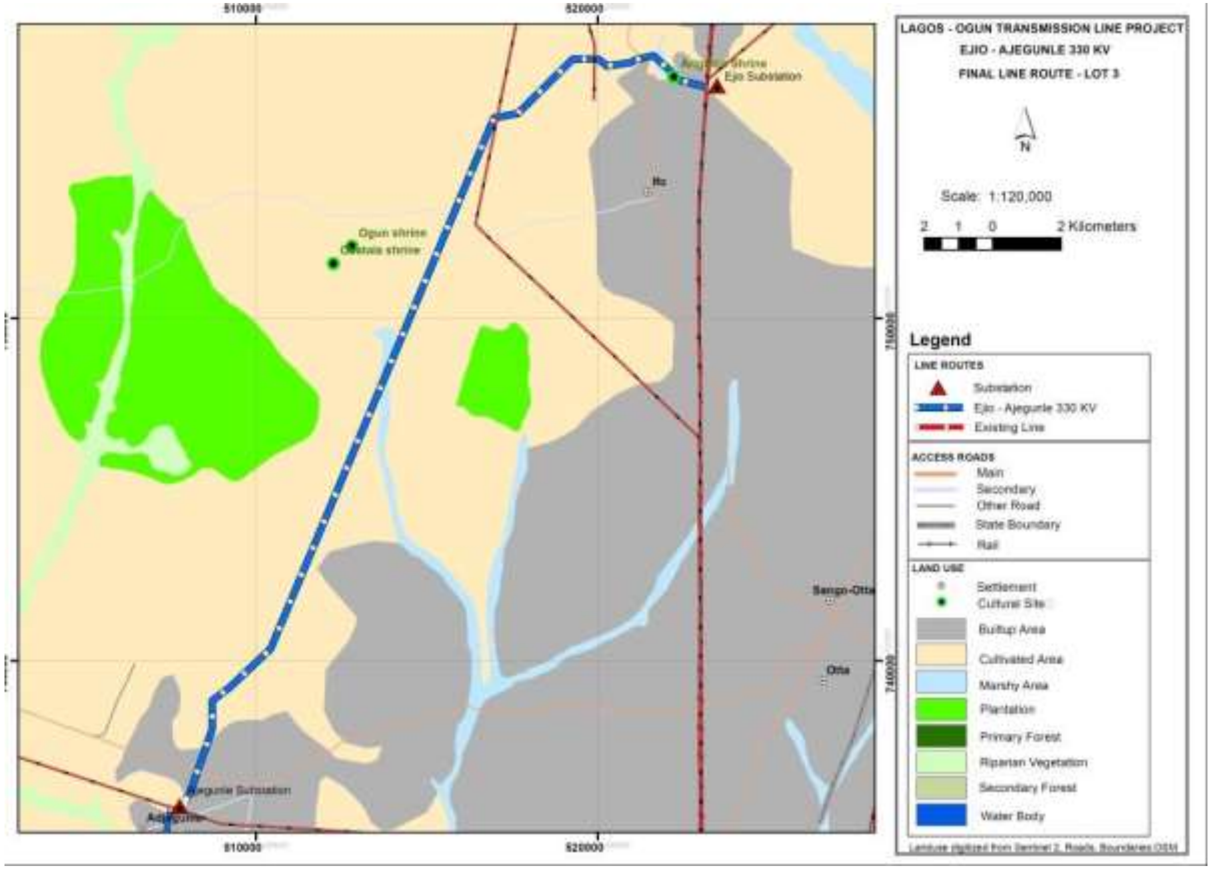


Figure 4.14a Land Use (Ejio-Ajegunle)

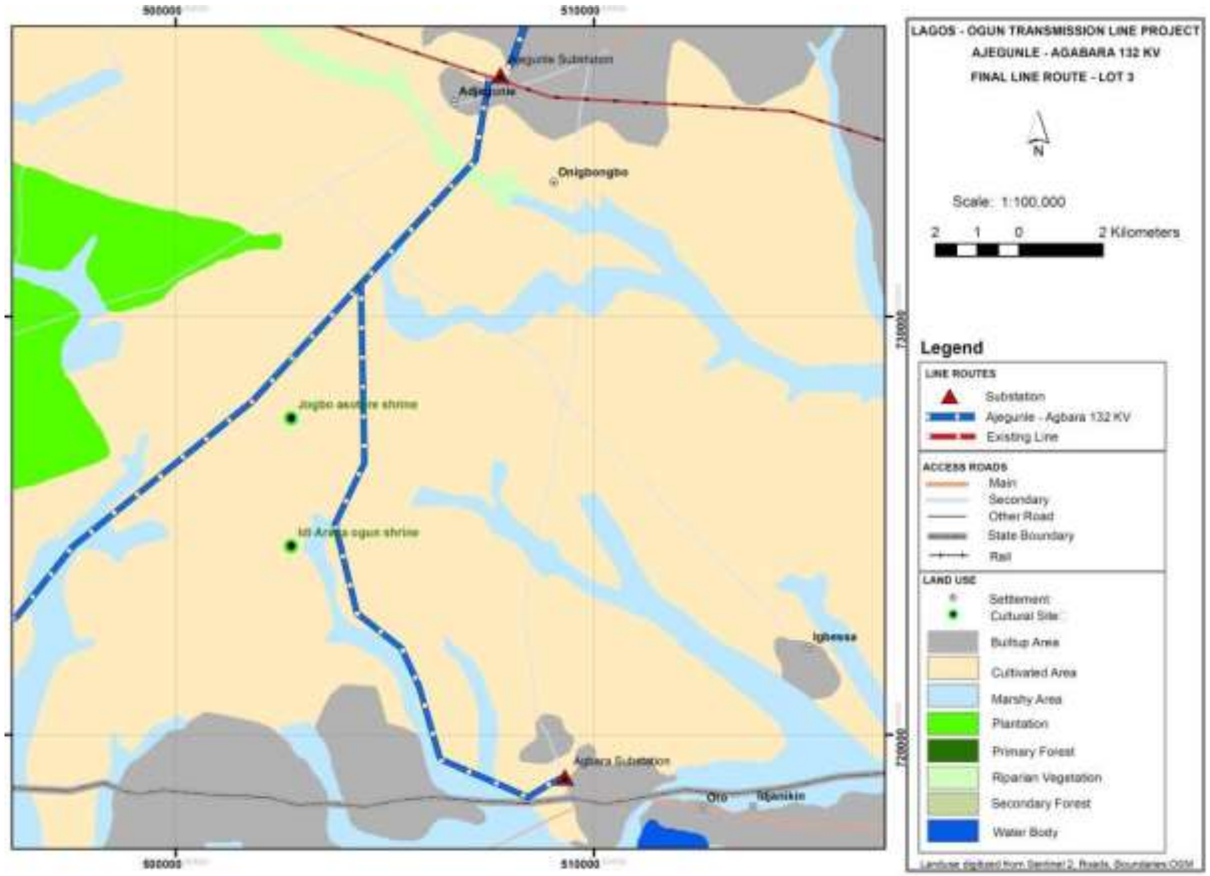


Figure 4.14b Land Use (Ajegunle-Agbara)

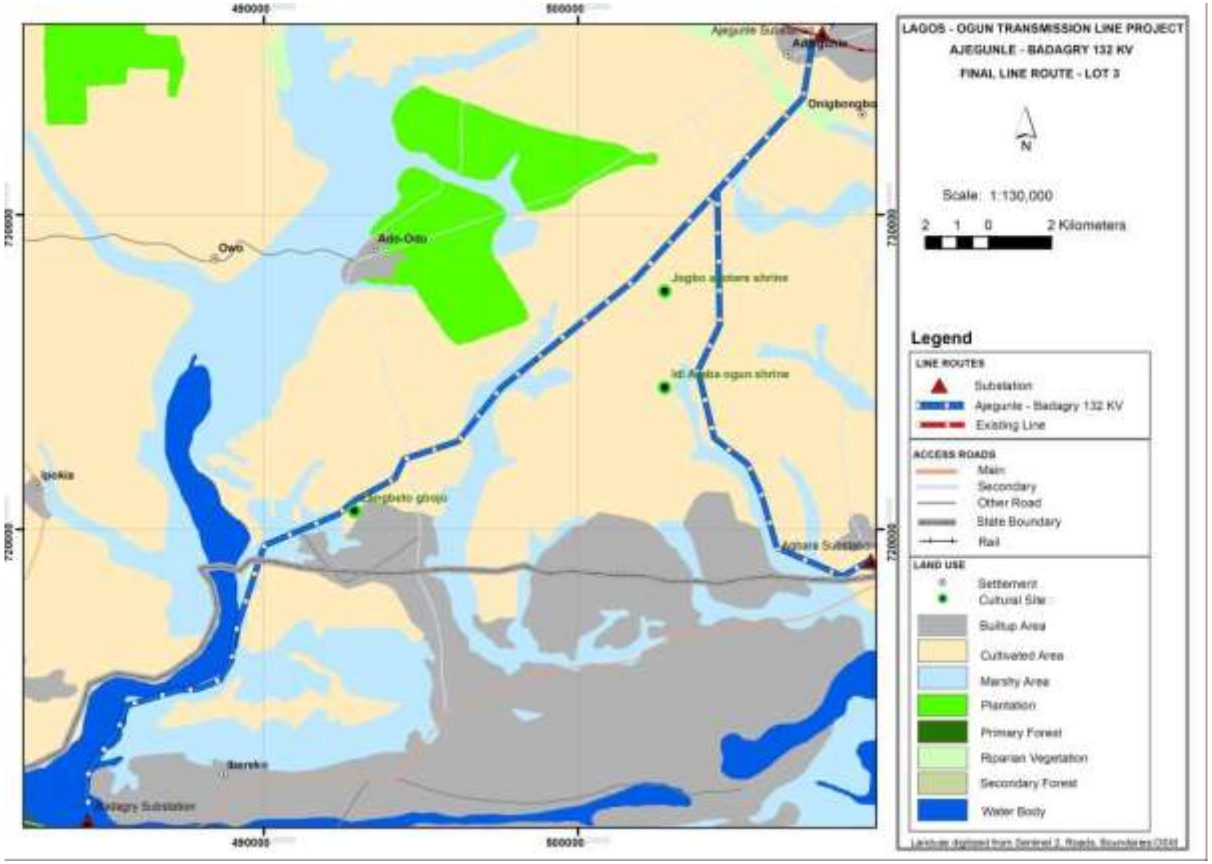


Figure 4.14c Land Use (Ajegunle-Badagry)


a) Alapako to Adelaja


b) Igbele to Kooko

c) Ijegemo Ishaga to Idanyi

(d Ikoga Ile to Iragbo


e) Igbo Fipe to Zhenvie


f) Yafin to Badagry Sub Station

Plate 4.11 Areas with Riparian Habitat


a) Ejio substation


b) Shojuolu to Ekundayo


c) Alapako to Adelaja


d) Igbele to Kooko

	
e) Agbara SubstationAjegunle to Ojuroko	
	
f) Ajegunle to Ojuroko	


g) Adaoduro to Onilogbo


h) Ijegemo Ishaga to Idanyi


i) Whezeme to Okuran Idolomo	
	
j) Ikoga Ile to Iragbo	
	
k) Igbo Fipe to Zhenvie	

l) Badagry sub Station to Yafin

Plate 4.12 Areas with Drived Habitat

4.12.2.4 Species Composition

A total of one hundred and twenty-two (122) flora species in forty-eight (48) taxonomic families were inventoried in the entire studies area. Appendix 3.9 shows the flora checklist.

- Species Richness

This is the total number of species censored in a defined area. It is often used as a criterion for disturbance or ecosystem stability. A comprehensive list of the censored flora species is presented in Appendix 3.9 while summarized result is presented in Table 4.22.

Table 4.22 Species Richness per sampled habitat and community in the study area

Species richness per sampled section		**Species richness per sampled plot**		
Sampled section	Species richness	**Plot**	**Location**	**Species richness**
Section 1 (Ejio to Ajegunle)	113	1	Ejio substation	68
		2	Shojuolu to Ekundayo	79
		3	Alapako to Adelaja	76
		4	Igbili to kioko	72
Section 2 (Ajegunle to Agbara)	91	5	Agbara Substation	50
		6	Ajegunle to Ojuroko	74
		7	Adaoduro to Onilogbo	72
		8	Ijegemo Ishaga to Idanyi	70
Section 3 (Iberese to Badagry)	87	9	Whezeme to Okuran Idolomo	68
		10	Ikoga Ile to Iragbo	61
		11	Igbo Fipe to Zenvie	65
		12	Badagry sub Station	63

Source: EEMS survey, 2017

A total of one hundred and thirteen (113) species belonging to forty five (45) taxonomic families were censored in section 1, ninety-one (91) species belonging to forty (40) taxonomic families in section 2 and eighty-seven (87) species belonging to forty-one (41) taxonomic families in section 3. Plot 2 recorded a total of seventy-nine (79) species as the richest followed by plot 3 with seventy-six (76) species.

Some species were observed to occur solely in riparian habitat. Some of these indicator species include *Lasimorpha senegalensis*, *Mitragyna ledermannii*, *Raphia hookeri* and *Nymphaea lotus.* Derived savanna habitats were generally richer in species than the riparian forest habitats. High species richness recorded in some of the sample areas is as a result of reduced anthropogenic actions and/or resistance to invasion and other disturbances.

4.12.2.5 Species Density (SD)

Density refers to the number of species per given area. Estimates of density are useful for monitoring plant responses to environmental perturbations. A density of 983.6m^2 per species was observed for the entire studied area (Table 4.23).

Table 4.23 Species Density in the Study Section

Study section	Species Richness	Species Density
Section 1 (Ejio to Ajegunle)	113	1/88.5m^2
Section 2 (Ajegunle to Agbara)	91	1/ 109.9m^2
Section 3 (Iberese to Badagry)	87	1/ 114.9m^2

Source: EEMS survey, 2017

The result showed that species density was higher in section 1 than in section 2 and section 3.

This high species density was however, observed to be recorded mostly in derived savanna habitat (Appendix 3.9).

It is however, anticipated that activities of the various phases of the proposed project will impact negatively on the numbers of individuals of species within the RoW. Mitigation measurews are provided for in Chapter Six.

4.12.2.6 Species Abundance

Species abundance is a record depicting the number of individuals of a species. It is an important concept in ecological study since it can be used to assess degree of impacts. A total of 25416 individuals were censored in the entire study area. Also, the study reveals the presence of more individuals of a single species. Table 4.24 shows plant species with the most and least abundant individuals in the entire study area

Table 4.24 Checklist of Five most Abundant and Five Least Abundant Plant Species

Most Abundant Species	**Abundance**	**Least Abundant species**	**Abundance**
Chromolaena odorata	1641	*Spondianthus preussii*	7
Asystasia vogeliana	1301	*Hoslundia opposite*	8
Alchornea cordifolia	1268	*Irvingia wombolu*	8
Lasimorpha senegalensis	1198	*Phyllanthus muellerianus*	8
Blepharis maderaspatensis	1017	*Tinospora cordifolia*	11

Source: EEMS survey, 2017

As could be seen in Table 4.24, *Chromolaena odorata*, *Asystasia vogeliana*, *Alchornea cordifolia*, *Lasimorpha senegalensis*and *Blepharis maderaspatensis* were the most abundant species while *Spondianthus preussii, Hoslundia opposite, Irvingia wombolu, Phyllanthus muellerianus* and *Tinospora cordifolia* were the least abundant. Plate 4.13 shows some of these species.



Chromolaena odorata *Lasimorpha senegalensis* *Alchornea cordifolia*

Some of the most abundant plant species in the studied area



Spondianthus preussii *Phyllanthus muellerianus* *Irvingia wombolu*

Plate 4.13: Pictorial evidence of some of the most and least abundant species

Abundance was equally evaluated for each of the sampled sections and communities as shown in Table 4.25. Results showed that section 1 has the highest number of individuals followed by section 3 while section 2 had the least number of individuals.

Table 4.25 Species Abundance per Habitat and Community

Habitat	Species Abundance			Most Abundant Species	Least Abundant Species
	Abundance	Plot	Abundance		
Ejio-Ajegunle (330kV)	10034	1	3072	Chromolaena odorata, Asystasia vogeliana, Bidens pilosa, Pennisetum purpureum	Spondianthus preussii, Mussaenda elegans, Malacantha alnifolia, Pentaclethra macrophylla
		2	2362		
		3	1604		
		4	2823		
Ajegunle to Agbara (132kV)	6926	5	1871	Chromolaena odorata, Asystasia vogeliana, Blepharis maderaspatensis, Alchornea cordifolia	Canarium schweinfurthii, Ouratea flava, Musanga cecropioides, Ficus sur, Holarrhena floribunda, Sterculia trigacanta
		6	1933		
		7	1675		
		8	1406		
Ajegunle to Badagry (132kV)	8456	9	2108	Lasimorpha senegalensis, Raphia hookeri, Costus afer, Commelina diffusa	Irvingia wombolu, Cola gigantean, Pentaclethra macrophylla, Spondianthus preussii
		10	1575		
		11	2710		
		12	2032		

Source: EEMS survey, 2017

As could be seen in Table 4.25, the most abundant species in section 1 and section 2 are *Chromolaena odorata* and *Asystasia vogeliana* as against *Lasimorpha senegalensis* and *Raphia hookeri recorded* for other sections. In the same vein, *Spondianthus preussii* and *Mussaenda elegans* (section 1), *Canarium schweinfurthii* and *Ouratea flava* (section 2) and *Irvingia wombolu* and *Cola gigantean* (section 3) were the least abundant genera in the entire sampled area. The occurrence of more individuals per species in section 3 was expected as the study reveals the presence of more individuals of a single species in section 3 than in section 1 and section 2.

Similarly, plot 1 with 12.2% individuals has the highest species abundance followed by plot 4 with 11.2% while plot 8 and plot 10 with 5.6% and 6.3% respectively had the least abundance. Also, sampled plots in derived savanna habitat were observed to be richer in species abundance than those in riparian forest. Forest with high species abundance is indicative of one either under disturbance and/or efficient dispersal mechanisms (Ebigwai *et al* 2014).

It is however, anticipated that activities of the various phases of the proposed project will impact negatively on the numbers of diversity of species within the RoW, especially during preconstruction and construction phase. TCN have therefore put up mitigation measures to prevent this occurrence (see chapter 5 and 6 for impact and mitigation measures).

4.12.2.7 Species Diversity Indices

Species diversity index is a quantitative measure that indicates the extent of diversity in a habitat. In the present study, Shannon's index for the entire sampled area was 4.081 while the equitability index was 0.8495. The diversity indices for each section are shown in Figure 4.15.

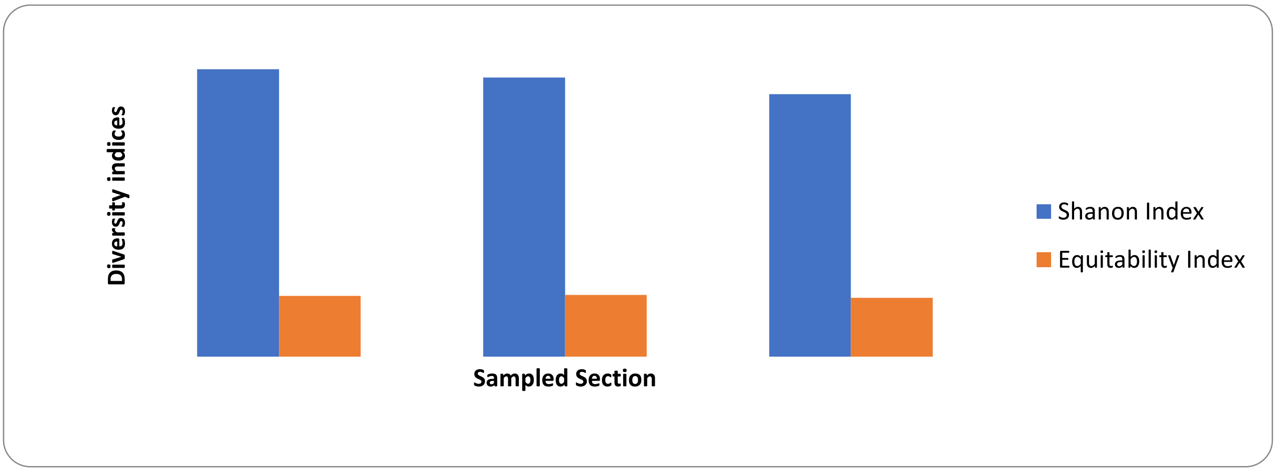


Figure 4.15 Diversity Indices Per Habitat in the Study Area

As could be seen in Figure 4.15, the Shannon index for Ejio-Ajegunle is highest for the study, followed by Ajegunle-Agbara and least for Ajegunle-Badagry. This was expected owing largely to the high number of species recorded in Ejio-Ajegunle.

Diversity indices were equally evaluated for each of the sampled habitats. Results as shown in Table 4.26 indicated that sampled plots in derived savanna habitat recorded the highest shannon and equitability indices.

Table 4.26 Diversity indices per sampled community

Sampled plot	Location	Diversity indices	
		Shannon index	Equitability index
1	Ejio substation	3.487	0.8264
2	Shojuolu to Ekundayo	3.739	0.8556
3	Alapako to Adelaja	3.758	0.8678
4	Igbili to kioko	3.472	0.8119
5	Agbara Substation	3.041	0.7772
6	Ajegunle to Ojuroko	3.752	0.8718
7	Adaoduro to Onilogbo	3.781	0.8842
8	Ijegemo Ishaga to Idanyi	3.709	0.8731
9	Whezeme to Okuran Idolomo	3.4	0.8058
10	Ikoga Ile to Iragbo	3.316	0.8067
11	Igbo Fipe to Zenvie	3.247	0.7778
12	Badagry sub Station	3.193	0.7707

As could be seen, the highest Shannon index was calculated for Adaoduro to Onilogbo Section followed by Alapako to Adelaja Section and Ajegunle to Ojuroko.The least Shannon index was recorded for SubstationSites at Agbara and Badagry respectively. Similarly, the Sections fromIjegemo Ishaga to Idanyi, Ajegunle to Ojuroko, and Adaoduro to Onilogbo recorded the highest equitability as against SubstationSites at Agbara and Badagry. This shows that Adaoduro to Onilogbo Section was the richest in flora diversity in the studied area and hence, would offer more ecosystem services value.

It is however, anticipated that activities of the various phases of the proposed project will impact negatively on the numbers of diversity of species within the RoW, especially during preconstruction and construction phase.

Species growth habit is the characteristic form in which a given species of plant grows. Species growth determines the vegetation structure and succession in an ecosystem. The result for the study revealed that trees (66.3%) formed the dominant vegetation type in the study area (Table 4.27).

Table 4.27 Distribution of plant habit across the Study Area

Plant habit	No of plant species	Percentage (%)
Trees	49	40.2
Shrubs	46	37.7
Herbs	12	9.8
Climbers	14	11.5
Floater	1	0.8
Total	122	100.0

Source: EEMS survey, 2017.

As could be seen in Table 4.27, trees were the dominant plant form in the study area. This was followed closely by shrubs, climber/ or creepers, Herbs and Floaters, in a decreasing order. This agrees with Durugbo *et al.* (2012) who reported similar trend in the region.

Some of the tree species censured include *Albizia adianthifolia, Albizia zygia, Anthocleista djalonensis, Eleaiseguineensis, Anthonotha macrophylla, Ceibapentandra.* While *Alchornealatifolia, Combretum racemosum*, *Baphia nitida*, were some of the shrubby species censured. Examples of herbal species censored include *Asystasia vogeliana, Blepharis maderaspatensis, Boerhavia diffusa*and *Cleome ciliate*

Eleais guineensis *Ceiba pentandra* *Anthocleista djalonensis*

Plate 4.14 Some woody species

In a similar way, distribution of species growth habits in the sampled sections was also determined (Table 4.28**).** Generally, the percentages of trees in all the sections were relatively higher compared to other growth forms. Ejio-Ajegunle Section had the highest proportion of tree species, followed by Ajegunle-Agbara Section while the Badagry line recorded the least proportion of tree species. (Table 4.28).

Table 4.28 Distribution of plant habit across study section

Study section	**Abundance in %**									
	T		S		C		H		F	
	No	%	No	%	No	%	No	%	No	%
Section 1 (Ejio-Ajegunle)	47	41.6	43	38.1	11	9.7	11	9.7	1	0.9
Section 2 (Ajegunle-Agbara)	38	41.8	35	38.5	10	11.0	9	9.9	0	0
Section 3 (Ajegunle-Badagry)	38	43.7	29	33.3	11	12.6	8	9.2	1	1.2

T =tree, H =herb, F =floater, S =shrub and C =climber/creeper

Source: EEMS survey, 2017

Finally, growth habit was determined according to habitat types. Accordingly, higher proportion of tree species was observed in riparian habitat as compared to derived savanna habitats. Woody shrubby species also followed similar trend as that of the woody trees (Appendix 3.9).

4.12.2.8 Vegetation Structure

Spatial orientation of species in space is termed vegetation structure. It is one of the components of ecosystem restoration processes. An ecosystem with an excellent vegetation structure is a measure of a healthy ecosystem integrity and high productivity. Vegetation structure also called community structure was measured in the study using Diameter at Breast Height (DBH). Table 4.29 shows diameter size class for the species. However, abundance of each species in these categories was considered in determining the vegetation structure.

Table 4.29 Vegetation Structure for the Study Section

Diameter size class (cm)	Section 1		Section 2		Section 3		Few Notable Genera
	No. of spp	%	No. of spp	%	No. of spp	%	
0-9	26	23.6	20	22.0	18	21.0	*Asystasia, Boerhavia, Mimosa, Lasimorpha*
10-19	14	12.7	10	11.0	10	11.6	*Abrus, Cayratia, Leptoderris, Maesobotrya*
20-29	18	16.4	15	16.5	14	16.3	*Feretia, Glyphaea, Icacina, Manniophyton*
30-39	18	16.4	17	18.7	13	15.1	*Hoslundia, Ficus, Mussaenda, Newbouldia*
40-49	10	9.1	9	9.9	10	11.6	*Dalbergia f, Musa, Bridelia, Combretum*
50-59	10	9.1	7	7.7	8	9.3	*Berlinia, Margaritaria, Morinda, Spondias*
60-69	8	7.3	4	4.4	6	7.0	*Musanga, Anthocleista, Canarium, Ceiba*
≥70	6	5.5	9	9.9	7	8.1	*Cola, Cleistopholis, Alstonia, Pycnanthus*

Source: EEMS survey, 2017

It was observed that species in section 1, 2 and 3 respectively had DBH between 4 -39cm. This is suggestive of a disturbed ecosystem. Harvesting of fuel woods for house hold energy, logging activities for house construction and clearing of bushes for farms and residential area are the main drivers of loss in large woody species. The species with DBH of 0 - 9cm had the highest record across the sections, followed by species with DBH 20-29cm. Section 3 recorded higher proportion of species with DBH above 50cm followed by section 2 with section 1 recording the least count (Table 4.29). More so, species with DBH 60-69cm had the least number of species followed by ≥70cm among others.

Similarly, more species with DBH 50cm and above were recorded in riparian forest than in derived savannas. This indicates that communities with riparian forest were the least disturbed as against communities with derived savannas.

4.12.2.9 IUCN Status of the censured flora

IUCN Red List is set as precise criteria to evaluate the extinction risk of species and subspecies. The aim is to convey the need for conservation to the public and policy makers, as well as help the international community reduce activities leading to species extinction. In addition, IUCN provide scientifically based guide and actions to conserve biological diversity (IUCN, 2007).

The IUCN status of the plant resources for the studied area was evaluated using IUCN version 2017 -3 criterion. The results showed that *Mitragyna ledermannii (*sampled in the riparian habitat*)* was the only Vulnerable (VU) species.

4.12.2.10 Alien species and Invasive species

Alien species are plant resources that are accidentally 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 **2**4 plant species that are alien to Nigeria while the global invasive database listed the occurrence of 29 invasive flora in Nigeria (Borokini 2011).

Lantana camara, Euphorbia heterophylla and *Chromolaena odorata* were the three species censored in this study listed as alien to Nigeria while *Bidens pilosa Chromolaena odorata, Mimosa pudica and Dalbergia sissoo* so listed as invasive to Nigeria was found in this study. As could be observed *Chromolaena odorata that was censored in this study was* listed as both alien and invasive species to Nigeria (See Plate 4.15).


Chromolaena odorata (Owolowo leaf) *Bidens pilosa*


Euphorbia heterophylla *Dalbergia sissoo*

Plate 4.15 Alien/invasive species in the study area

4.2.3 Terrestrial Wildlife Fauna

4.2.3.1 Methodology

Sampling transect used for flora studies was equally used for fauna wildlife. Two main method of fauna sampling was adopted. Direct evidence (sighting) and indirect evidences

Direct observations: Visual encounter survey during nocturnal and diurnal expeditions and recognizing evidence of wildlife species presence through vocalization was undertaken. The Capture-recapture method was used for small mammals and some invertebrate fauna.

Indirect Observations: Indirect signs such as footprints, scats/faeces, feeding activity, nests, tracks, holes/diggings or scratching, carcass. The recorded evidence was represented both bydirect (collections and observations) and indirect (tracks, footprints, scats/faeces, feeding activity, nests, tracks, holes/diggings or scratching, carcass and identification by residents).

Examination of road kills and meat markets*:* Interview of hunters, fishermen, farmers, etc to gain better insight into the habitat history (see questionnaires), faunal distribution pattern, seasonal migration, local names, conservation status, economic importance and threats to biodiversity. At their homes, the hunters were also urged to present for examination, animal remains or trophies including, horns, skins, skull/skeleton, shells, hoofs, etc in their bags as well as say the last time they sighted or killed each animal presented.

Night sampling was also done to listen to the vocalization of nocturnal animals. Raking quadrants (2m x 2m) for litter amphibians and reptiles were also employed. Inspection of broad-leaved hydrophytes e.g. *Cyrtosperma senegalensis* for tree frogs, lifting of stones, logs, plants, panels, plastics, etc for any hidingherpetofauna, use of appropriate field data sheets to capture information like date of sampling, block/plot number, weather condition, weather during theprevious 24/48 hours, species list with scientific, common and local names, biomass and abundance.

4.2.3.2 Fauna Composition

As shown in Appendix 3.10, a total of seventy-nine (79) fauna resources were inventoried in the study. This comprises of 61 fauna species that were sighted (direct evidence) and 18 fauna species that were obtained via indirect evidences. Table 4.30 shows a summary of the fauna resources.

Table 4.30 Summary of Fauna Resources of the Study Area

Fauna Group	Direct Evidence (Sighted)	Indirect Evidence (Not Sighted)
Mammal	12	2
Aves	40	11
Reptilian	4	5
Amphibian	5	0
Total	61	18

Source: EEMS Survey, 2017

The avi-fauna group recorded the highest number of species, followed by the mammalian group. The reptilian group recorded and amphibians however, recorded the least number of species. There were two major habitats in the censored area which are derived savannah and riparian/swamp habitat. Derived savanna was observed to record the highest number of species. This high number of species in savanna habitat is attributed to disturbed environment, since fast growing species (colonizers) dominate such habitat. Table 4.31, shows summarized number of species sighted in each habitat and sections of the censored area.

Table 4.31 Summary of Fauna species sighted per habitat and section

Fauna group	Number of species sighted per habitat		Number of species sighted per Section		
	Derived savannah	Riparian/Swamp	Section 1	Section 2	Section 3
Mammals	**11**	**3**	**9**	**5**	**10**
Aves	**38**	**13**	**36**	**16**	**26**
Reptiles	**5**	**4**	**3**	**3**	**7**
Amphibians	**5**	**5**	**4**	**5**	**5**

Source: EEMS Survey, 2017

- Species Diversity Indices

Shannon weiner and equitability indices were used to evaluate species diversity in the study. This index is used in accessing the degree of richness of any habitat. The diversity indices for the entire study area and sections were conducted across all faunal groups (Table 4.32).

Table 4.32 Diversity Indices for the Entire Study Area

Index	Mammals	Aves	Reptiles	Amphibians
Shannon index	**2.443**	**3.582**	**1.427**	**1.557**
Equitability index	**0.9258**	**0.9109**	**0.6494**	**0.9672**

Source: EEMS Survey, 2017

As presented in Table 4.31, the avian group had the highest Shannon index followed by the mammals and the amphibians. However, the reptile taxon is the most evenly distributed of them all with the highest equitability index.

- Diversity indices for each study section

The avian group recorded highest Shannon index across all the three sections. However, the avian, mammalian and amphibian group recorded the highest equitability index across the first, second and third sections respectively**.** Table 4.33 presents the result of diversity indices for each section.

Table 4.33 Diversity indices for each section

Sections	**Section 1**		**Section 2**		**Section 3**	
Diversity indices	**H**	**E**	**H**	**E**	**H**	**E**
Mammals	1.872	0.8132	1.516	0.9418	2.238	0.8182
Aves	**3.344**	**0.9064**	**2.813**	**0.9238**	**3.148**	**1.2138**
Reptiles	0.8627	0.7853	1.073	0.977	1.59	0.8278
Amphibians	**1.236**	**0.8914**	**1.237**	**0.8925**	**1.584**	**0.8925**

***H=Shannon index, *E=Equitability index**

Source: EEMS Survey, 2017

- Species Abundance

Species abundance is a record depicting the number of individuals of a particular species. It is an important concept in ecological study since it can be used to assess degree of impacts. This was conducted for the entire study area, habitat, and communities for each faunal group. A total of 1230 individual across all fauna groups where censored in the project area. Table 4.34 shows faunal species with the most and least abundant individuals in the entire study area.

Table 4.34 Checklist of the Most Abundant and Least Abundant Species Per Fauna Group

S/N	Most abundant	Abundance	Least Abundant	Abundance
Mammals				
1	*Rattus norvegicus*	32	*Chaerephon pumilus*	1
2	*Rattus fuscipes*	23	*Hypsignathus monstrosus*	4
3	*Rattus rattus*	17	*Epomophorus gambianus*	5
Aves				
4	*Bubulcus ibis*	57	*Columba iriditorques*	2
5	**Boissonneaua flavescens*	51	Western Bronze-naped Pigeon	2
6	*Ardea alba*	42	Laughing Dove	3
Reptiles				
7	*Agama agama*	58	*Dendroapis jamesonii*	1
8	*Mabuya sp*	36	*Naja melaoleuca*	1
9	*Grayia smythii*	9	*Python sebae*	1
Amphibians				
10	*Hylarana albolabris*	40	*Hyperolius concolor*	16
11	*Amietophrymus maculates*	37	*Haplobatrechus occipitalis*	23
12	*Hyperolius fusciventris burtoni*	24		

*A species of interest *Boissonaeua flavescens* was sighted directly during this study, weadvocate for further research as to the reasons for its appearance in the study area.The specie is native of Ecuador, Venezuela and Columbia and occur North and central America. (See *The IUCN Red List of Threatened Species: Boissonneaua flavescens – published in 2016. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22687868A93172791.en);http://www.birdwatchingdaily.com*http://www.berkeleydailyplanet.com/issue/2004-06-01/article/18989).

Bird list is increasing in Nigeria every year because of various studies(www.africabirdclub.org). Humming birds nesting grounds is fast expanding to new regions in Africa (https://www.google.com.ng/amp/s/www.mercurynews.com/2016/06/30/south-african-plant-attracts-hummingbirds/amp/). Nigerian sunbirds has similar nesting grounds and habitat preferences as *B.flavescens. (https://www.birdwatchingdaily.com/blog/2016/09/14/africas-hummingbird-like-sunbirds-find-nectar/)*

It is recognised majorly by its long beak larger than mean body weight and as only bird capable of flying backwards as was seen in this study (http://www.birdsofeden.co.za/humming-birds_article_op_view_id_201). Its presence is either casual, accidental or introduced, hence anyone/body with genuine interest is free to conduct more research to determine its status in Nigeria.

A breakdown for each fauna group revealed that avi-fauna group recorded the highest individuals, followed by the mammalian and amphibian group respectively. The reptilian taxon recorded the least abundance with individuals (Table 4.33). Details of the fauna abundance per fauna group are illustrated in Figure 4.16.

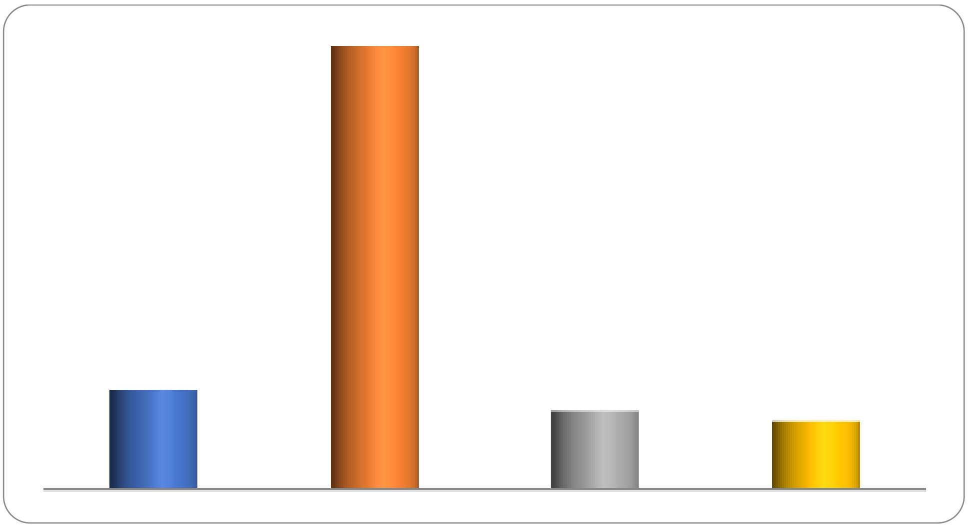


Figure 4.16 Species Abundance Per Fauna Group

Abundance per section

Abundance for the three sections and across all fauna groups revealed that section1recorded the highest. On the other hand, Derived savanna was also observed to record the highest number of individuals across the four fauna groups (Table 4.35).

Table 4.35 Abundance per section and habitat of the Study Area

Fauna Group	**Section 1: (Ejio - Ajegunle)**		**Section 2: (Ajegunle - Agbara)**		**Section 3: (Berese - Badagery)**	
	Derived savannah	swamp	Derived savannah	Swamp	Derived savannah	Swamp
Mammals	97		11	8	25	36
Aves	421	15	103	40	163	49
Reptilians	63		17		27	15
Amphibians	18	12	35	11	21	43
Total	599	27	166	59	236	143

Source: EEMS survey, 2017

Abundance per community

Analysis on abundance per communities was conducted across all fauna groups. Results obtained from the analysis are present in Table 4.36.

Table 4.36 Abundance per communities of the study area.

Fauna Group	**Ejio sub-station**	**Sojuolu To Ekundayo**	**Alapako To Adelaja**	**Araromi-orita To Igbele**	**Agbara Sub-station**	**Ajegunle To ojuroko**	**Adaoduro To Onilogbo**	**Jeseemo ishaga To Idanyii**	**Whezume To Okuran idolomo**	**Ikoga ile To Iragbo**	**Igb fipe To Zer**
Mammals	34	43	20	0	1	2	8	8	1	9	15
Aves	163	152	106	15	8	40	55	40	26	38	99
Reptile	31	19	13	0	2	5	10	0	1	6	20
Amphibians	3	9	6	12	7	13	15	11	0	4	17
Total	231	223	145	27	18	60	88	59	28	57	151

Source: EEMS survey, 2017

Similarly, as presented in Table 4.35, Ejio sub-station and Sojuolu - Ekundayo recorded the highest number of individuals, while Araromi-orita – Igbeli, Agbara Sub-station and Whezume - Okuran idolomo had the least individuals. This reduction in species individuals in most of the sample communities, habitat and sections indicates the level of disturbance.

From the aforementioned fact, it is anticipated that, during the different phases of the proposed project, fauna populations will be impacted.

4.2.3.3 Avian migration

Some avian species are known to migrate. Avian migration is either a regular or irregular (nomadism, irruption, or invasions) seasonal movement between north and south. In some species, the movement is one directional.

Whatever the movement is, avian migration is usually driven by food, habitat and changes in weather conditions. These movements are usually between breeding and wintering grounds (veen *et al.*, 2014).

In Nigeria as in other countries in the Northern hemisphere, migratory birds commence this movement between February, March and April to warmer areas and return between August, September and October to winter grounds. Migratory movement often results in high mortality and predation. In this study, a total of 4 migratory birds were inventoried (Table 4.37).

Table 4.37 Details of migratory birds censored in the project area

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

Source: EEMS Survey, 2017

The habitats of the species cut across the two identified habitats. The nesting grounds for these species ranges from rooftops, branches, bushes, protected sites, emergent vegetation to bushes over water. All the species are full migrants and majority of them have their breeding seasons from March to October. The IUCN status of the species is Least Concern.

4.12.3.4 Raptors

A diurnal predatory bird that hunts and feed on rodents, insects and small animals exerts strong biodiversity influences on the ecosystem. In such environments, they act as keystone 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 belonging to Acciptriformes, Apodidae and Falconiformes orders (Fowler *et al.*, 2009). In this study, a total of three (3) raptors were sighted. *Milvus milgrans* raptor is also a migratory species. Table 4.38 shows details of raptors sampled in the study area.

Table 4.38 Raptors of the Study Area

S/N	Species	Common Name	Prey
1	*Milvus migrans*	Black kite	Small live prey e.g. bats and rodents, fish, household refuse and carrion.
2	*Polybroides typhus*	African harrier hawk	Rodents, bats, birds, amphibians, lizards and insects
3	*Cypsiurus pavus*	African palm swift	Insects eg spiders, termites, beetles etc

Source: EEMS Survey, 2017

The raptors censored in the study were members of Accipitridae and Apodidae families only. The total species of raptors censored represents about 5.9% of the avian taxon but contributing about 3.7% of the total species abundance. The most abundant raptors for the study were *Milvus migrans* and *Polyboroides typhus.*

4.12.3.5 IUCN Status of fauna

Analysis for the conservation status of the species censored in the proposed project area was conducted using IUCN, 2017 Red List of Threatened species. Results revealed that none of the censored species were threatened. They were however, either not accessed or Least Concern (LC) as in the case of *Mabuya sp* (Appendix 3.10)

4.13 Hydrobiology

The productivity of any aquatic water body depends on the amount of plankton present in the said water body (Davies *et al.,* 2009). Three groups of hydrobiology parameters were evaluated. They are phytoplankton, zooplankton and benthos.

Ecosystem stability is a critical factor for aquatic lives. Species composition of a water body and their counts over a two-season period is one of the several indices for assessing stability in a water system. Since preconstruction and construction activities are likely to impact negatively on the water bodies, expected change in water quality would result in growth and count of opportunistic species. Therefore, a baseline study of the plankton population is imperative. Also, sediment deposition is also predicted to affect benthonic lives. See chapter five and six for impact analysis. These formed the basis for their study in this project.

4.13.1 Sampling Methods

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 0.5mm-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.

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 Field study team conducted zooplankton sampling exercise (Plate 4.16).

Plate 4.16 Zooplankton Sampling at Igeemo River

Source: EEMS Survey, 2017

Zooplankton samples were collected by pulling plankton net of mesh size of 0.063mm vertically on the surface of the river. A weight (iron rod) was attached to the cord holding the net, lowered into the water and then pulled back to the surface for collection of samples. After each tow, zooplankton were collected using labelled 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 at a speed of about 1.5knots per hour for 5 minutes. The phytoplankton samples were collected in clearly labelled containers and preserved in Lugol's iodine solution.

Plate 4.17 Phytoplankton Sampling at Panko

Source: EEMS Survey, 2017

4.13.2 Result of Hydrobiology

A total of sixty-three (63) species were observed in the study. The breakdown includes; thirty-six (36) phytoplankton, twenty (20) zooplankton and seven (7) macro benthos. Detail is provided in Appendix 3.11, while summarized result is provided in Table 4.39.

Study section	**Ejio- Ajegunle**		**Ajegunle- Agbara**		**Berese- Badagry**	
Parameter	**species**	**count**	**Species**	**count**	**Species**	**Count**
Phytoplankton	29	1835	17	748	15	536
Zooplankton	13	175	9	68	6	44
Macro-benthos	3	6	1	1	0	0

Table 4.39 Checklist of Plankton Species.

Note: Samples from SW4, SW5, SW6, SW7, SW8, SW10, and SW12 – SW16 were all barren

Source: EEMS survey, 2017

a) Phytoplankton Study

A total of ten (10) species were recorded in Ejio – Ajegunle section. The increased number of species in this section could be due to favourable environmental factors including warm water temperature, nutrients from agricultural runoff and cleaning fluids (Hoppenrath and Saldarriaga, 2012).

On the other hand, two species were recorded in the Ajegunle - Agbara section. Lee and Kim (2010) reported a correlation between high phytoplankton abundance and low *Tintinnid* abundance, suggesting a prey-predator relationship. As suggested by Thompson *et al.*, (1999, 2001) *Tintinnid* abundance in this study is seemingly affected by abiotic factor rather than food availability. This is reflected by the present of *Bacillaria paxillifera* which is an indicator species of warm water flow, possibly with Agbara substation acting as point source.

Four species on the other hand, were identified in Berese - Badagry section. The observed number of phytoplankton sems to vary with nutrient supply. Higher numbers and species types were noticeable with increased nutrient concentration in the water bodies and higher water transparency. The presence of diatoms in water samples from this section is indicative of possible pollution from anthropogenic sources such as fertilizers and nutrients runoff, leading to eutrophication (Blinn and Bailey, 2001) (Table 4.39).

b) Zooplankton Result

Result of the study revealed the presence of five pollutant sensitive species in the Ejio – Ajegunle section (Table 4.39). The presence of pollutant sensitive species indicates some level of pollution as a result of heavy metals accumulation and changes in nutrient level over time (EPA, 2016).

Samples from the Ajegunle- Agbara axis revealed the presence of four pollution sensitive species while only two were present in the Berese- Badagry section. In spite of the relative differences in species abundance across the various sections, two species (*Coscinodiscus eccentricus* and *Coscinodiscus marginatus*) were common across the three sections under study. The presence of these species is indicative of anthropogenic influence from sewage and agricultural practices (Echaniz *et al.*, 2012).

d) Benthic study

Four species were present in Ejio – Ajegunle section of which two were pollutant tolerant species (*Capitella sp.* and *Nereis sp*.). Their occurence suggests water bodies that are organically polluted (Balogun *et al*., 2011) from sources such as sewage, agricultural runoff and urban wastes. The highest abundance of *Capitella sp* is suggestive of species which is an excellent competitor for space and/or food (Young and Young, 1982).

On the other hand, only one species was observed in the Ajegunle- Agbara axis. Reduction in the abundance and number of pollutant sensitive species in any water body as exposed by Balogun *et al*., 2011) is indicative of fairly polluted water or one with excellent self-recovery abilities. However, water bodies with these species are often enriched with pesticides accumulation via runoffs (Balogun *et al*., 2011).

4.13.3 Sediment study

a. Sediment Physico-Chemical Analyses

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) species of heavy metals. 3.7 shows the various parameters and their concentrations across spatial and temporal gradients. Similarly, the regulatory limits and ranges of some of the parameters (where they exist) were used as the benchmark for determining existing status. Also, the results of the baseline study were compared with those observed and reported for contiguous areas. The sampling points were same as that of the surface water (16).

Table 4.40 Summarized Sediment Physico-chemical Results

EJIO – AJEGUNLE SECTION				AJEGUNLE – AGBARA SECTION			BERESE – BADAGRY SECTION			Secondary data (ICCL 2015)	WHO /FMEnv Limits
Sample Stations Parameters	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max		
pH (H_2O) @24.2^{o}C	5.42	5.16	6.49	5.33	5.31	5.35	5.50	5.25	5.69	5.50-5.80	6.0-9.0
Temperature ($_0$C)	5.50	5.36	6.26	5.58	5.39	6.29	5.44	5.27	6.18	5.33 – 6.43	40
Colour	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Dark Grey	Light Grey	NA	
THC (mg/kg)	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	0.50-1.40	
Ext. Nitrate (mg/kg)	16.97	3.39	24.40	30.45	10.50	50.40	12.61	6.62	16.80	0.10-0.18	
Ext. Sulphate (mg/kg)	169.43	70.00	250.00	276.50	128.00	425.00	155.00	11.40	195.00	0.12-0.15	
Ext. Phosphate (mg/kg)	143.28	3.44	551.00	12.30	12.30	12.30	9.34	3.86	13.40	0.25-2.45	
Total Iron (mg/kg)	8,787	6,797	18,700	6,403	5,561	7,244	6,063	4,070	9,745	55.00-95.80	
Copper (mg/kg)	10.00	6.70	17.90	30.10	10.20	50	66.73	9.50	103	2.35-9.35	35.7
Lead (mg/kg)	31.37	5.30	68.90	20.15	9.90	30.40	7.40	3.80	11.80	0.01-0.05	35-170
Nickel (mg/kg)	12.74	7.00	14.90	9.85	5.10	14.60	6.27	4.40	9.40	0.42-0.50	18-61

Zinc (mg/kg)	35.50	35.20	35.60	33.00	30.40	35.60	25.74	18.40	33.30	0.20-1.56	123-540
Manganese (mg/l)	31	16	50	31	26	22	28.71	12	49		30
PCB (ng/m^3)	24.6	10.1	39.6	24.6	21.5	10	18.37	10	24.5		
Chromium (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND		0.006
Cadmium (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		0.025
Mercury (mg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND		
Vanadium (mg/kg)	2.80	2.20	3.40	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	0.10-0.65	

Colour

The sediment colour varies from dark to light grey. This colour type is indicative of samples obtained from an oxidized unsaturated environment. Benthonic lives in such sediments were shown to be poor remediators of pollutants (Dalsgaard and Thamdrup 2002).

pH

The result shown across the three sections reflect a slightly acidic nature. This result was observed to be within WHO/FMENv permissible limits. Aremu, (2010) showed that sediment with slightly acidic and alkaline properties as best suited for sustenance of benthonic lives. About 75% of the sampled points had concentrations below the lower rank of the regulatory limits, implying non-optimal conditions for the benthonic lives. In this study, this perhaps acted as a limiting criterion for species diversity and abundance.

Temperature

The result shown across the three sections indicates similarities in tempetature and in line with the secondary data range as against WHO limit. The temperatures values in this study are perhaps driven by atmospheric radiation, convection and evaporation. The temperature is not optimum for benthonic lives.

Total Hydrocarbon Content

The concentration suggests low or no hydrocarbon presence in the sediment, signifying that these environment is free from Hydrocarbon pollution.

Extractable Nitrate

High nitrate concentration showed a linear relationship with high organic matter decomposition across all samples in the three sections. A water body capable of degrading high amount of organic pollutants exhibit high self purification tendencies (Ekeanyanwu *et al.,* 2010). Hence, these water bodies could self remediate the expected waste stream though a waste management plan would be developed.

Extractable Sulphate

Sulphate concentrations were higher among samples recovered along Ajegunle - Agbara sections than those from Ejio-Ajegunle and Berese-Badagry axis. Sulphate concentration is known not to pose problems generally for structures except when treated with calcium-based stabilizers and subjected to moistures (Tack *et al.,* 2007).

Extractable Phosphate

Phosphate concentration in sediment samples is often due to storm water run off. While low levels (observed mainly in samples obtained from Ajegunle to Agbara and Berese to Badagry) may be related to removal of top layer of sediments by the storm water, high concentratiions (observed mainly in deeper water bodies) in Badagry could be related to perrenial locked up inputs from terrestial environments.

Heavy Metal

Total Iron

The high concentrations of Total Iron in the sediment samples across the three studied sections could be due to waste water discharges from domestic and industrial sources and storm water. Inputs from the cement factory at Iwekoro could be a factor in the excessive concentrations observed along the Ejio – Ajegunle axis. High concentration of iron in sediment samples relative to other metals has been reported in various studies confirming that natural sediments contain significant levels of iron (Dara, 1993; Ademoroti, 1996; Aluko and Oluwande, 2003).

Copper (Cu)

Cu concentration range from Bersere- Badagry and Ejio-Ajegunle was greater than that from Ejio- Ajegunle. Major source may be from repeated use of fungicides that contain copper in the regions with high concentartion. High exposure can result in number of adverse health effects. Its toxicity may induce diarrhea, vomitting and sporadic fever.

Lead (Pb)

Pb concentration range result from Ejio-Ajegunle and Ajegunle-Agbara was comparable to WHO limit. High concentration of lead in sediments is likely to be derived from vehicles exhust fumes containig some rich aerosols (Zalir *et al.*, 2014). Purefoy, (2010) reported several deaths in a village in Zamfara State, Nigeria as a result of lead poisoning.

Nickel (Ni)

Ni concentration in the study showed uniformity in each of the study sections from Ejio-Ajegunle, Ajegunle- Agbara and Berese- Badagry. Continuous release in sediments could result its accumulation in the environment. Exposure to intake of large amount of Nickel from plants grown on Nickel rich sediments leads to higher chances of developing cancer and lungs, nose, larnyx and postrate as well as respiratory failures, birth defects and heart disorders (Duda-Chodale and Blaszezyk, 2008; Lentech, 2009).

PCBs

PCBs are a group of persistent environmental chemicals which was once deployed as dielectric and coolant fluids in electrical apparatus, carbonless copy paper and in heat transfer fluids. PCBs according to Dan (2003) enters surface through leakages of PCBs containing transformer oils, waste disposals and by burning of some wastes in municipal and industrial incinerators via runoffs. Exposure above the permissible limits according to WHO, causes reproductive problems and possibly dead of aquatic organisms.

Result of this study revealed concentration below equipment detection limit across all sample stations and sections, hence, indicates no risk to aquatic and human lives.

Zinc (Zn)

Zn concentration range result from Ejio- Ajegunle was comparable to Ajegunle - Agbara as against that from Besere-Badagry. High level of zinc in these regions could be attributed to the wear and tear of vehicle bodies with galvanized steel surface, roofing and leaching of sidewalls (Zakir *et al.*, 2014). Zinc, if present even in low concentration are toxic to living organisms including humans as well as microbial population.

Cadmium (Cd)

Cadmium occurs naturally in rocks, soils, dusts, plants, animal tissue and metals such as zinc, lead and copper ores released during volcanic emission. It exists in the environment at different concentrations. Possible sources of contamination include agricultural runoff, where fertilizers, pesticides and other agro-chemical are used in addition to possible release of sediment bound metal (Muntau and Baudo, 1992). Concentration above the threshold limits could leads to reduction in fish population.

Results of the present study across the various sample stations were observed to be within FMEnv/WHO permissible limits hence no impact on aquatic lives shall be recorded.

Manganese (Mn)

Mn plays an important role in physiological processes in aquatic organisms. It is a major component of enzymes (Bolarinwa and Okeowo, 2017). However, result of this study across the various sections indicates concentration above WHO permissible limits, for which mitigation measure have been proffered in chapter six.

Chromium (Cr)

In aquatic environment, Cr is one of the bio-chemically active transition metals. Weathering of the earth crust is the primary and natural source of the chromium in the surface water. It could also be caused by municipal wastes, laundry chemicals; paints, leather, and road run off due to tire wear and brake wires. Cr, though an essential trace nutrient and a vital component for the glucose tolerance factor, elevated concentration damages the liver, lungs and causes organ hemorrhages to fishes.

Result of the study which was observed to be below WHO permissible limit, however, revealed no traces of contamination by Cr across the various sample stations.

Mercury (Hg)

Concentration of mercury in the various sample stations, was below equipment detection limits, hence was not detected in all the sample stations and therefore poses no risk to aquatic organisms.

Vanadium

Vanadium concentration result from Ejio- Ajegunle was increased as against that of Ajegunle- Agbara and Berese-Badagry. Increased concentration may be due to Rock weathering, wet and dry deposition and soil leaching. However, when the uptake is too high, vanadium can have a numer of effects on human health such as severe eye, nose and throat irritation.

a) *Sediment Microbiology*

Sediment samples were also analysed for microbial content. 3.7.1 shows detailed result, while Table 4.41 presents summarized result.

Table 4.41 Summary of Sediment Microbiology

Study Section	Ejio- Ajegunle		Ajegunle- Agbara		Berese- Badagry	
	Speies	**Counts (Cfu/ml)**	**Species**	**Counts**	**Species**	**Counts**
THB	*Pseudonomas sp* *Bacillus sp* *Staphylococcus sp* *Micrococcus sp* *Actinomyces* *Proteus*	2,001,000	*Pseudonomas sp* *Bacillus sp* *Staphylococcus sp* *Micrococcus sp* *Actinomyces*	239000	*Pseudonomas sp* *Bacillus sp* *Staphylococcus sp* *Micrococcus sp* *Actinomyces* *Protues sp*	1,305,200
HUB	*Pseudonomas sp* *Bacillus sp* *Staphylococcus sp* *Micrococcus sp*	7,600	*Pseudonomas sp* *Bacillus sp*	1,500	*Pseudonomas sp* *Bacillus sp* *Micrococcus sp* *Actinomyces* *Protues sp*	14,100
THF	*Aspergillus sp*	1,420	*Penicillium sp*	300	*Aspergillus*	1,740

	Candida sp *Rhodotorula sp* *Penicillium sp* *Mucor sp* *Fusarium sp*		*Mucor sp*		*Candida sp* *Rhodotorula sp* *Penicillium* *Mucor* Fusarium	
HUF	*Aspergillus sp* *Candida sp* *Fusarium sp* *Penicillium sp* *Mucor sp*	780	*Penicillium sp* *Mucor sp*	210	*Aspergillus sp* *Fusarium* *Mucor* *Penicillum* *Candida*	760

Source: EEMS Survey, 2017

Total Heterotrophic Bacteria (THB)

The Microbial species recorded from the samples indicated that similar food sources were responsible for their introduction across these segments. The likely food substances discharged into the water bodies that induced the presence of these organisms include Corn – meal, dairy products, sewage, meat, dust, tomatoes, pepper and alcoholic beverages. The absence of these organisms in Idu Igeemo River is owed largely to the relatively low inputs of organic matter since it is a saprophytic bacterium.

The level of organic waste load is further explained by the count per cell of the THB. The higher abundance of cells showed in the water bodies in Ejio-Ajegunle section relates directly to the eutrophic nature of the water in stark comparison to those observed in the sediments of the other two sections.

Hydrocarbon Utilizing Bacterial (HUB)

The occurrence of four (4) genera (*Pseudomonas sp*, *Bacillus sp*, *Staphylococcus sp* and *Micrococcus sp*) of HUB is indicative of an environment with negligible concentrations of hydrocarbons (Okpokwasili, 2003). For example, Okpokwasili (2003) reported about 200 species of HUB in the degradation of a consortium of hydrocarbon. This assertion is further buttressed by the reduced number of cells per individual.

Evaluation of several published reports on the minimum count of bacteria required to degrade a hydrocarbon enrich sediment was put at 0.44 x 10^{-7} to 10.2 x 10^{7}g^{-}1 by kostla *et al. (*2011).

Total Heterotrophic Fungi (THF)

The uniform occurrence of *Mucor* and *Pennicillim sp* across the samples indicated common sources of introduction. Also, same genera were observed across all samples along Ejio-Ajegunle and Berese-Badagry. However, the presence of *Aspergillus, Candida*, *Rhodotorula* and *Fusarium* species in Ejio-Ajegunle and Berese-Badagry sections may possibly be due to contamination from nuts, baked flours, tobacco, dairy products and vegetal matter.

Evaluation of abundance data however, showed more counts/cell in Berese-Badagry waters indicating higher contamination index.

Heterotrophic Utilizing Fungi (HUF)

Mucor and *Penicillum sp* were observed to be common among all the samples indicating common sources of contamination. However, the presence of Aspergillus, Candida and Fusarium in Ejio-Ajegunle and Berese-Badagry betrayed other sources of contamination. These contaminants could possibly have been introduced through sources already described in THF

4.13.4 Fishery Study

Study on fish composition was conducted for some rivers, specifically, in Ogun state using fish landings in Tohun, Panko and Yafin river shores.

Fish observed and identified from these locations were photographed as part of the primary data source, while secondary data source involves literature review of past fish studies conducted within the area.

A fisherman (Mr David Oluwatobi) and fishmongers were accosted within the area as shown in the plate below. These individuals were interviewed to gather information about fishes caught. Pictures were taken and fish types recorded. The fish caught were subsequently sold to people around the village.

Plate 4.18 A fisherman at Badagry

Generally, fishing activities are well known and a common practice among inhabitants of Badagryarea. The type of fishing here is mainly artisanal, in terms of scale, where the catch is usually for family consumption with little for sale. Fishing gears commonly used for fishing in the area include, hook and line, hand pole, fence, seine nets, cast nets, gill nets, bamboo traps, lift- nets, long line and basket traps. These gears are typical for use by artisanal fishermen and like the ones reported byJenyo-Oni *et al*, (2014).

Fishes observed and recorded during the field visit are presented below in Table 4.42. Also presented are common, biological and local names as well as the 2017 International Union for the Conservation of Nature (IUCN) Red List ranking of each fish species. Pictorial evidence of these fishes from the study area is further presented in Plate 4.19.

Table 4.42 Fish Composition Within the Study Area

Common Name	**Biological Name**	**Local Name**	**2017 IUCN R anking**
Bagrid catfish	*Chrysicthys nigrodigitatu s*	Obokun, Ojan	Not Evaluated
Trunkfish	*Gnathonemus senegalens es*	Aba	Not Evaluated
Elephant fish	*Gnathonemus cyprinoide s*	Ayo	Least Concern
	Marcusenius psittacus	Ugbala	Not Evaluated
Cat fish	*Synodontis nigrita*	Okokoniko	Least Concern
Electric eel	*Electrophorus electricus*	-	Least Concern
Nile tilapia	*Oreochromis niloticus*	Epia, Ukuobu	Not Evaluated
Elongate tigerfish	*Hydrocynus forskahlii*	Akoko	Least Concern
African pike Characin	*Hepsetus odoe*	Ija	Least Concern
Sharptooth Catfish	*Clarias gariepinus*	Igungun	Least Concern
North African Catfish	*Clarias camerunensis*	-	Least Concern
Freshwater rat-tail	*Gymnarchus niloticus*	Aba	Least Concern
Bony Tongue	*Heterotis niloticus*	Arowana, Sla pwater	Least Concern
Red belly Tilapia	*Tilapia zilli*	Epia, Owe	Not Evaluated

Source: EEMS Study, 2017.

Plate 4.19: Fish Species Observed within the Rivers along the Way Leave

According to Lawson and Olusanya (2010), fisheries resources are on the decline in Nigeria due to over exploitation and inadequate management of her inland waters. For sustainability of these resources, an adequate knowledge of species composition of her water bodies must be understood and vigorously pursued.

The water bodies have been studied extensively, and over the years some fishes have been mentioned and observed to be reoccurring in most articles. The fishes recorded by researchers have been complied and presented in Table 4.43. Also presented are the common, biological and local names as well as the 2017 IUCN ranking.

Table 4.43 Fish Composition Reviewed for the Area

Common Name	Biological Name	Local Name	2017 IUCN Ranking
African Electric Fish	*Malapterurus electricus*	Electric fish	Least Concern
Cornish jack	*Mormyrops deliciosus*	-	Least Concern
Nile catfish	*Bagrus docmac*	-	Least Concern
Nile perch	*Lates niloticus*	-	Least Concern
Jewel fish	*Hemichromis fasciatus*	-	Least Concern
African butter catfish	*Schilbe mystus*	Dibawe	Least Concern
Schilbe	*Eutropius niloticus*	-	Not Evaluated
Vundu catfish	*Heterobranchus longifilis*	Aso	Least Concern
Obscure snakehead	*Channa obscura*	-	Not Evaluated
Eel-like fattyfin catfish	*Heterobranchus bidorsalis*	Aso	Least Concern
African Lungfish	*Protopterus annectens*	-	Least Concern
Whiptailed catfish	*Phractura clauseni*	-	Least Concern
True Big-scale Tetra	*Brycinus macrolepidotus*	Elei	Least Concern
-	*Tilapia dageti*	Epia	Least Concern
African pike characin	*Phago loricatus*	-	Least Concern
Silversides	*Alestes nurse*	Paraffin	Least Concern
Moon fish	*Citharinus citharus*	Osu	Not Evaluated
Eel catfish	*Clarias anguillaris*	Aro	Least Concern
African Jewelfish	*Hemichromis bimachulatus*	Epia	Not Evaluated
Elephant fish	*Marcusenius senegalensis*	Akoko	Least Concern

Source: Bolarinwa & Okeowo 2017, Soyinka & Ebigbo 2012, Adeosun (2012)

Adeosun (2012) studied the fin fish assemblage of lower Ogun River which comprise d a total of 34 species belonging to 13 families.

Chrysicthys nigrodigitatus was recorded to be the mostabundant and highest in biomas s (55,491.21kg) accounting for 27.6% of the catch. *Gnatonemus senegalenses,* *Gnatonemus cyprinoides, Synodontis nigrita, Marcusenius psittacus and Malapterurus electricus* were the least in number, while Phago loricatus was least in biomass (32.03kg) accounting for 0.02%.

Species of Concern for Conservation

All the fishes observed during the study and those previousely reported in the river were either ranked as least concern or not evaluated in the 2017 IUCN Red List of Threatened animals.

4.14 Ecosystem Services

IFC 2012 recognizes that maintaining ecosystem services are fundamental to sustainable development. Ecosystem services are the benefits people including businesses derive from plant resources (IFC 2012). Ecosystem services are organized into four types namely provisioning services (food, medicine and raw materials), regulating services (Carbon sequestration and storage, Local climate regulation (air quality), Waste water treatment and detoxification, Regulation of water flow, Biological control, Erosion prevention and maintenance of soil fertility and Moderation of extreme events such as storm and shorelines), supporting services (Soil Formation, Nutrient Cycling, Primary Productivity and Habitat Mediation& space) and cultural services (Spiritual and religious values, Knowledge systems and Educational values, Inspiration, Aesthetic Values, Social Relations, Sense of Place, Cultural diversity, Cultural Heritage Values and Recreation and Ecotourism). Impacts on biodiversity often adversely affect the delivery of ecosystem services. The functional ecosystem services played by the censored plant species in the study area was evaluated via desk top review. The uses of ecosystem services in the project area are in Table 4.44

Table 4.44 Indigenous Uses of Ecosystem Services in the Communities

Provisional Services	**Average Percentage Usage**	**Frequency of Harvesting/Usage (%)**			**Relative Importance**		
		Often	**Weekly**	**Occasionally**	**Very Important**	**Important**	**Not Available**
Collection of woods for Fuel wood in the wild	20	64	30	6	50	30	20
Collection of woods for Charcoal in the wild	17	50	35	15	42	33	15
Harvesting of	14	23	30	57	22	29	59

Provisional Services	Average Percentage Usage	Frequency of Harvesting/Usage (%)			Relative Importance		
		Often	Weekly	Occasionally	Very Important	Important	Not Available
Medicinal plants in the wild							
Collection of Wild fruits	11	7	12	81	10	15	75
Sand Mining for sale & construction	4	4	8	88	4	6	90
Fishing	2	1	3	96	2	6	92
Hunting	8	3	8	89	6	10	84
Grazing	8	3	9	88	15	21	64
Basket Weaving	3	1	5	96	3	9	88
Broom making	4	2	6	92	3	9	88
Production of alcoholic beverages	4	3	7	90	6	9	85
Collection of Grass for Thatching	3	1	4	95	5	11	84
Collection of Clay for Building	2	1	4	95	1	6	93

F=frequency, Wk=weekly, OF=often, VIM=very important, NA=not available, IM=important, OC=occasionally.

Source: EEM survey, 2017

According table 4.43, the most exploited ecosystem services are Collection of woods for Fuel wood in the wild (20%), Collection of woods for Charcoal in the wild (7%), Harvesting of Medicinal plants in the wild (14%), and Collection of Wild fruits (11%), while the least exploited ecosystem services are Hunting (2%), Fishing (2%), Basket weaving (3%) and Collection of Grass for Thatching (3%).

4.14.1 Provisioning Services

Services that describe the material or energy outputs from ecosystems are termed provisional services. Provisional services offered by the floristic resources of the study area are organized into three groups namely; food/fibre/energy**,** medicinal attributes and Raw Materials.

3.9 showed that a total of twenty-six (26) species censored in the study offers Provisioning Services. Among these, nine (9) species were recorded to providing food/fibre/energy, eleven (11) as sources of raw materials while twenty (20) provides medicinal services. Some of the species include *Albizia adianthifolia, Albizia zygia, Abuliton mauritiana, Asystasia vogeliana, Annona senegalensis, Bambusa vulgaris, Ceiba pentandra* and *Eleaise guineensis.*

4.14.2 Regulatory Services

As could be seen in 3.9, *Chromoleana, Euphorbia, Nymphea, Lasimorphia, Ficus* and *Ceiba* are six genera used for regulatory services in the study area. They are applied to addressing carbon sequestration and storage, regulation of water flow, local climate regulation, erosion prevention and maintenance of soil fertility, and biological control.

4.14.3 Supporting Services

Appendix 3.9showed that*Irvingiawombulu*is used for habitat mediation by the people, while *Chromolaena odorata* and *Irvingiawombulu*act as nutrient recycling.

4.14.4 Cultural Services

These are the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences (Sarukhán and Whyte 2005). IFC 2012 grouped these services into Cultural diversity, Spiritual and religious values, Knowledge systems, Educational values, Inspiration, Aesthetic values, Social relations, Sense of place, Cultural heritage values and Recreation and ecotourism.

As evident in Appendix 3.9**,** *Raphia hookeri, Blighia sapida, Bombax vulgaris, Ceiba pentandra, Albizia adianthifolia, and Combretum racemosa* are six (6) species censored in the project area that serves cultural values. They are applied to addressing spiritual/religious values, and aesthetic values

4.14.5 Ecosystem services of faunal groups

Analysis on the ecosystem services provided by the fauna species across the fauna group was conducted. The ecosystem services reviewed are provisional services (food and energy, medicine, raw material), regulatory services (biological control, pollination), supportive services and cultural services. Details of the ecosystem services are presented in Appendix 3.10.1, while Table 4.45 presents the summary fish consumed in the area.

A total of 41 fauna species were reviewed as offering ecosystem services. A breakdown of the number of species with respect to fauna group revealed that the Avian taxon with 29 species was the group with the highest number of species offering ecosystem services, this was followed by Mammals with10 species, reptiles with 4 species, while the amphibians with 2 species recorded the least number of species with ecosystem services. However, the total may exceed 41 as some species provides two or more ecosystem services. A checklist of these species and their ecosystem services are provided in Appendix 3.10.1.

Table 4.45 Ecosystem Services of Faunal Groups

	Mammals	Aves	Reptiles	Amphibians
Provisional services	-	3	4	2
Regulatory services	8	22	-	-
Supportive services	2	2	-	-
Cultural services		2	2	-
Total	**10**	**29**	**6**	**2**

Source: EEMS Survey, 2017

4.15 Human Environment

4.15.1 Introduction

4.15.1.1 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. Nigeria experienced the first military coup in 1966, and a thirty-month civil war from 1967 to 1970. The military government created 12 states from the four regions in 1967. Between 1967 and 1996, the 12 states were further divided into 19, then 21 and finally 36 states. Ogun State was created in 1976 out of the then Western State. Lagos state was created on the 27th May 1967 by virtue of the state creation and Transitional Provisions Decree No.14 of 1967. Lagos state is known as the financial hub of Nigeria.

4.15.1.2 Country Location and Administrative structure

Nigeria lies between latitudes 4o and 14o north of the equator and longitudes 3o and 15o east of the Greenwich meridian on the west coast of Africa. It covers a total area of 923,766 square kilometres consisting of 910,768 square kilometres of land and 13,000 square kilometres of water with the coast line stretching up to 853 kilometres. The entire country is divided into 36 states and federal capital territory. These are further sub-divided into 770 local government areas which form the third tier of government while the central and state governments form the first and second tier respectively. The third tier consists of the Local Government Areas. The country practices a presidential system of government consisting three arms of government: the executive, the legislature and the judiciary (Nigerian 1999 Constitution). The executive consists of both elected and appointed members, while members of legislature, both at federal and state levels are elected. This pattern is similar to what obtains at the Local Government level, except that there is no third arm (the judiciary) at the LGA level. Another major difference between the central government structure and that of the state is the presence of two legislative chambers at the center (i.e. the Senate and the House of Representatives), while the states have just one.

The LGA administration is run by an elected Executive Chairman and appointees of the Chairman representing the executive arm of local government administration. There is also the legislature made up of ten Counselors elected from the wards in the LGA. The Chairman is the chief security officer of the LGA and the office is important in the operations of the proposed project.

The communities have a well-defined hierarchical political structure with traditional leadership through Kings (Oba) or Baale, chiefs and community Heads. The traditional authority structures are similar in all the communities. This governance structure is graphically represented in Section 4.15.2.3

At the community level, the traditional authority structure hardly varies from one community to another with the traditional head (King or Baale) and chiefs jointly administering their political, economic and social affairs. Authority in each community is at two levels. The first is the traditional ruling council composed of the village chiefs and headed by the village head (the "Baale"). The second is the Community Development Association (CDA) comprising of an elected Chairman and some Executive Members. All CDAs operate under the leadership of one Community Development Secretary (CDS) who is coordinates the activities of all CDAs in the area. The Community Development Association (CDA) mobilizes the different sections and interest groups in the Community for development purposes. The CDA reports to the CDS who takes issues to Council of Elders. There is also a Youth Organization with elected Chairman and members in each community.

Three broad groups are identifiable in each of the communities – male elders, youths and women. The role of male elders is traditional governance of the communities. They dominate the political arena and the decision-making positions, while the youth leaders are usually at the bottom rungs of the ladder of authority. The traditional role of the youths includes constituting a labour force in development projects, security of the community and to enforce law and order.

4.15.2 Socio-Economic Baseline

4.15.2.1 Overview of project area

Following the 2006 census, the National Population Commission (NPC) published the population of Nigeria as 140,431,790 comprising 71,345,488 males and 69,086,302 females.

The NPC estimated annual population growth at 3.2% (NDHS, 2008). The current population, projected at 3.2% annual growth and using the exponential model is 180,735,714, with a density is 198.6 per square kilometer. A higher male population and sex ratio of 103 was recorded for the country. Children (age 0-14) constituted 41.8% of the population while those less than 20 years were 52.3% and those less than 25 years 61.9%. The elderly (65 years and above) were 3.2% of the population. The age dependency ratio was 82.0. Given these proportions, the population of Nigeria is quite young. Average household size in Nigeria is 4.9 (NBS 2012).

According to the 2006 census, Lagos State has a population of 10,694,915 (NBS, 2012), with a projected population of 12,130,986.7 for the year 2015 (NBS, 2012). The population of Ogun State according to the 2006 census is 4,424,096, with a projected population of 5,037,594.173 for the year 2015 (NBS, 2012). The density of Lagos state and Ogun State are 3304.55 and 307.17 square kilometers respectively. In Lagos State, children aged (0-14 years) constituted 30.3% of the population, those from (15-44 years) constitute 49.3%, (45-64 years) constitute 15.28% while 2.8% of the population are 65 years and above. The age dependency ratio of the population in the state is 70.9%. Similarly, children (age 0-14 years) in Ogun state constituted 38.3%, those within (15-44 years) are 39.9%, those within (45-64years) are 15.3%, while the elderly (65years and above) occupy 3.6% of the population. The age dependency ratio of the population in the state is 88.5%.

Table 4.46 Relevant livelihood indices in the project states

Livelihood Indices	Ogun state		Lagos state	
Population	4,424,096		10,694,915	
Literacy	78.8		80.5	
Youth Literacy in any language	Male	Female	Male	Female
	98.2	88.1	99.4	99.3
Adult literacy in English language	Male	Female	Male	Female
	80.3	77.2	95.8	92.3
Infant Mortality	67		45	
Life expectancy	53years		51years	

Source: NBS (2012)

4.15.2.2 Host Communities and Local Government Areas

The affected Local Government Areas are Ewekoro, Ifo, and Ado Odo Ota local Government Areas (LGA) in Ogun state, and Badagry LGA in Lagos state.

Thereare77 communities within the spacial boundary of the proposed project (700 m wide each of RoW). The LGAs and the communities affected in are shown in Table 4.47, Figure

4.17 and Figure4.18 respectively, while comprehensive list of the communities is in Appendix 4.

Table 4.47 Affected LGAs and Communities in the Project Area

STATE	LGA	NUMBER OF COMMUNITIES	TOTAL
Ogun	Ewekoro	8	68
	Ifo	16	
	Ado Odo Ota	44	
Lagos	Badagry	9	**9**
TOTAL		**77**	**77**

Source: EEMS Field Survey 2017

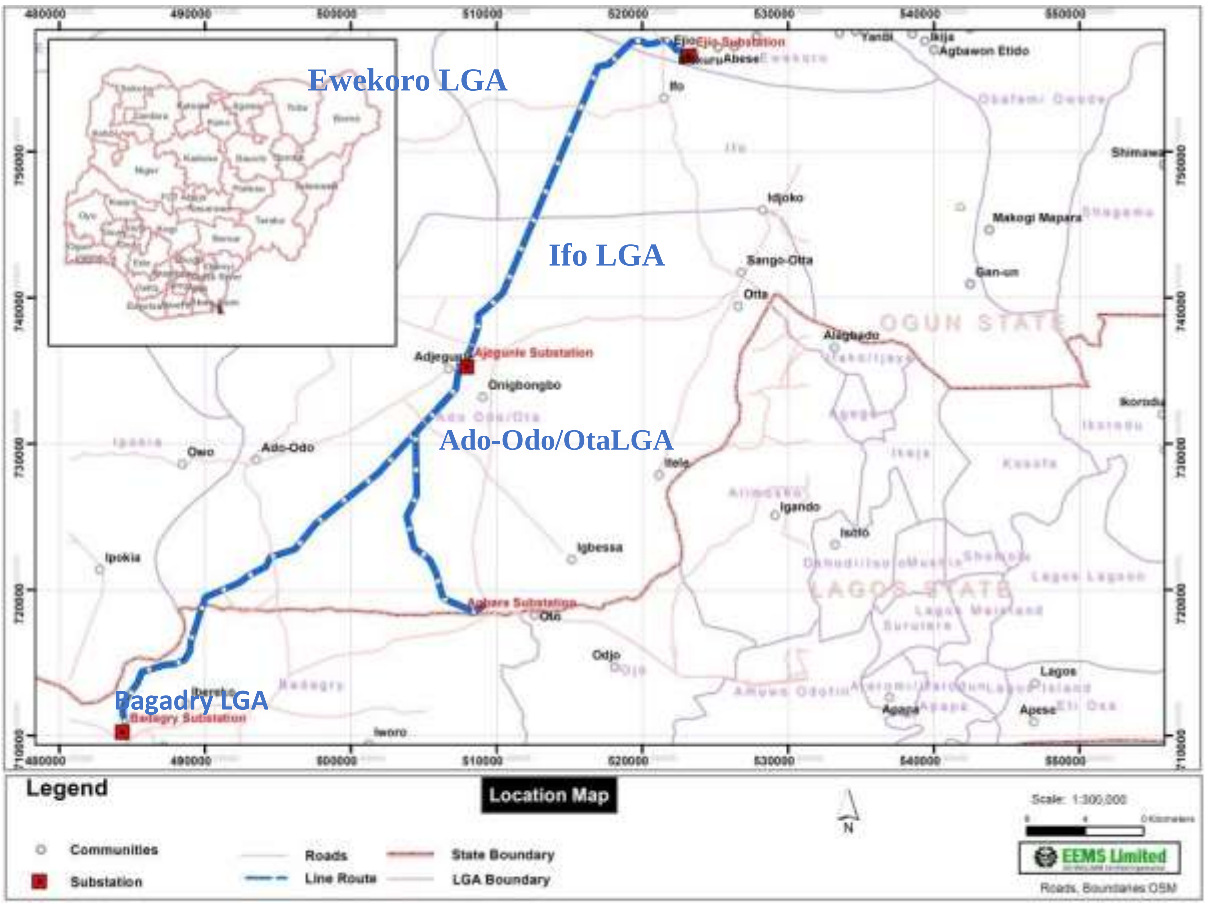


Figure 4.17 Map of Lagos Ogun State Showing Affecetd LGAs

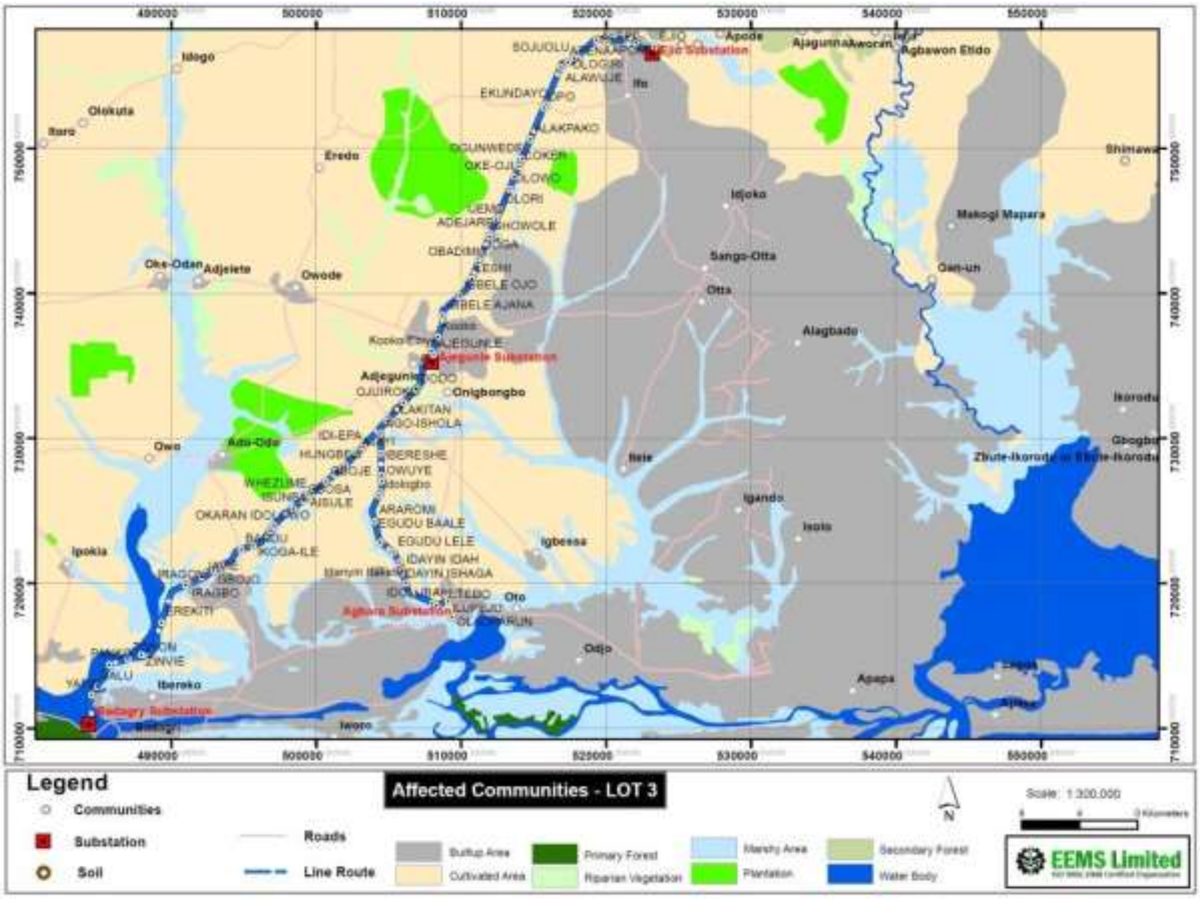


Figure 4.18 Map showing Communities Around the Proposed Project

4.15.2.3 Traditional / Political Governance & Community Organization

Three broad groups are identifiable in each of the communities – male elders, youths and women. The role of male elders is traditional governance of the communities. They dominate the political arena and the decision-making positions, while the youth leaders are usually at the bottom rungs of the ladder of authority. The traditional role of the youths includes constituting a labour force in development projects, security of the community and to enforce law and order.

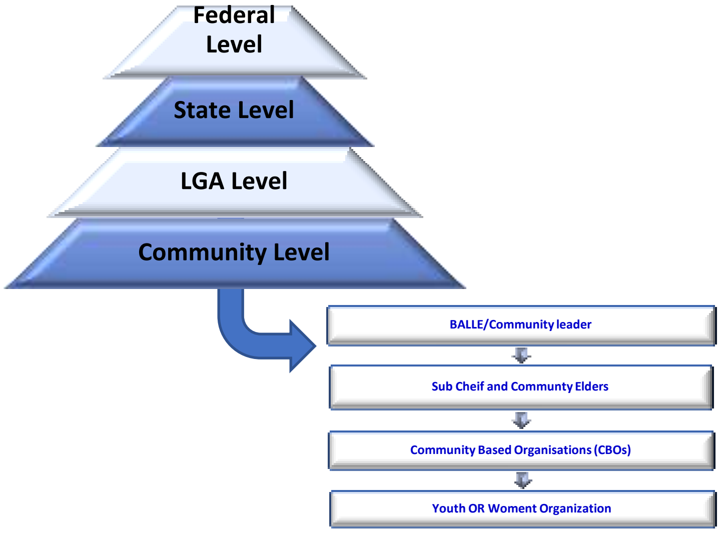


Figure 4.19 Traditional Governance Structure at Community Level

4.15.3 Methodology

Data accumulation for the baseline information starts with some reviews and desktop studies of various reports on Nigeria. This provides the context within which the baseline information about Ogun State, the affected Local Government Areas (LGAs) and the immediate settlements around the project site will be appreciated. Finally, mostly data in statistical representation and charts, reflected in this ESIA, were obtained from structured consultations with the traditional rulers, community heads, and officials of the LGAs as well as members of the affected communities.

Human environmental baseline data was gathered using a combination of desktop studies and field surveys. It covers the following social components: demography, land uses, land ownership, administrative and socio-cultural institutions, infrastructures, economics and livelihood, cultural heritage and health.

The baseline socio-economic and health status of the project area was assessed using structured questionnaires, with 100% coverage of all the affected households. A total of 3,479 households are affected by the projectas shown in Table 4.48 andall were interviewed on site using structured questionnaire (Appendix 4), during census of projected affected person (PAP). The data was supplemented by interview of randomly selected adults and youths in each community representing between 15% to 20% of the affected people as a control group.

Table 4.48 Number of Households Affected

Local Government Areas (LGAs)	Number of Affected Communities	Estimated Length of ROW across LGAs (km)	Number of Households	Number of PAPs	Baseline Census Dates
Ewekoro	9	15	953	5,909	16/01/2018 to 22/01/2018
Ifo	17	5	539	3,342	23-01-18
Ado Odo Ota	49	50	1921	11,910	24/01/2018 to 10/02/2018
Badagry	7	11	66	409	11/02/2018 to 15/02/2018
0	**82**	**81**	**3479**	**21,570**	

Table 4.49 Household Size of Affected Households

Lot #	Local Government Areas (LGAs)	Household Size					
		1 to 2	3 to 5	6 to 10	11 to 15	>15	Total
	Ewekoro	60	518	277	58	40	953
	Ifo	34	293	157	33	23	539
	Ado Odo Ota	121	1043	558	116	80	1920
	Badagry	4	36	19	4	3	66
Total		**219**	**1889**	**1011**	**211**	**147**	**3478**
		6.3%	**54.3%**	**29.1%**	**6.1%**	**4.2 %**	**100%**

[Data source] EEMS Household Survey

4.15.4 Demographics of affected people

4.15.4.1 Age and Sex Structure

Table 4.50 Population Data in Project Affected Area (2016)

LOT #	LGA	TOTAL	MALE	FEMALE
3	Ewekoro	76,600	51%	49%
	Ifo	750,000	51%	49%
	Ado Odo Ota	733,400	51%	49%
	Badagry	327,400	51%	49%

[Data source] National Population Commission projection from 2006 census

The total number of households affected by the is 3,479 with Ado Odo LGA having the highest with 1,921 (55%) and Badagry LGA the least with 66 households (1.9%). Female heads of households constitute 12.7% of the total households (see Table 4.51).

Table 4.51 Project Affected Households

Lot #	Local Government Areas (LGAs)	Gender of Head of Households		Total (Project Affected Households: PAHs)
		Male	Female	
3	Ewekoro	823	130	953
	Ifo	486	53	539
	Ado Odo Ota	1667	254	1921
	Badagry	61	5	66
Total		**3037**	**441**	**3479**
		87.3%	**12.7%**	**100%**

[Data source] EEMS Household Survey

Table 4.52 Marital Status of Heads of Households

Lot #	Local Government Areas (LGAs)	Marital Status				
		Single	Married	Widowed	Divorced/ Separated	Total
	Ewekoro	202	601	76	74	953
	Ifo	114	339	43	42	539
	Ado Odo Ota	407	1210	154	150	1921
	Badagry	14	41	5	5	66
Total		**737**	**2192**	**278**	**271**	**3478**
		21.2%	**63.0%**	**8.0%**	**7.8%**	**100.0%**

[Data source] EEMS Household Survey

Table 4.53 Nature of Marriage in Households

Natuture of marriage	Ado-Odo/Ota	Ewekoro	Ifo	Badagry	TOTAL	PERCENT (%)
Monogamous	37	99	3	14	153	86%
Polygamous	7	10	0	7	24	14%
TOTAL	44	109	3	21	177	100%

Source: EEMS, 2017

As could be seen in Table 4.53, monogamy constitutes over 86% of the marriagesacross all communities in the project area while polygamy accounts for 14%. There are more monogamous marriages (99) in Ewekoro and Ado Odo Otaproject communities compared to the two other LGAs

4.15.5 Dependency Rate

The total dependency ratio is the proportion of the population not in the work-force who are ‘dependent’ on those of working-age, it’s a calculation which groups those aged under 15 with those over 65 years as the ‘dependants’ and classifying those aged 15-65 years as the working-age population.

You can calculate the ratio by adding together the number of children (aged under 15 years), and the older population (aged 65+), dividing that percentage by the working-age population (aged 15-65 years), multiplying that percentage by 100 so the ratio is expressed as the number of ‘dependents’ per 100 people aged 15-64 years. The higher the dependency ratio, the more people who are not of working age, and fewer who are in the labour force (and paying taxes). The age group distribution of the total population affected is shown in Table 4.54

Table 4.54 Dependency Rate Among Affected Population

Age Bracket (years**)**	**Ewekoro**	**Ifo**	**Ado Odo Ota**	**Badagry**	**TOTAL**
01-14	2,056	1,288	4,368	155	7,867
15-39	1,659	925	3,393	115	6,092
40-65	1,531	901	2,954	106	5,492
>65	663	228	1,195	33	2,119
TOTAL	**5,909**	**3,342**	**11,910**	**409**	**21,570**
Dependency Ratio	85.24%	83.02%	87.65%	85.16%	86.21%

[Data source] EEMS Household Survey

Using the method described, the national average for Nigeria 88.2% in 2015, up from 87.9% in 2010 (NBS, 2016). However, one of the obvious limitations of dependency ratios is the assumption that people under 15 years and over 65 years are outside of the labour force, as well as the assumption that those aged 15-64 are participating in the labour force. Although the retirement age in Nigeria is 65 years, it is rarely applied particularly in the private sector. Furthermore, people that retire at that always get engaged either being self employed or contract jobs.

4.15.6 Education and Literacy

UNESCO defines literate person as one who can with understanding both read and write a short simple statement on his(her) everyday life in any language, and an illiterate person as one who cannot with understanding both read and write a short simple statement on his (her) everyday life.

The Education attainment status of Heads of Households (HofH) affected by the project is in Table 4.55, while the literacy rate is in Table 4.56.

Table 4.55 Educational Status OF Hofh

Lot #	**Local Government Areas (LGAs)**	**# of Household**	**No Formal Education**	**Primary Education**	**Secondary Education**	**CoE and Polytechnic**	**University Degree or above**
			Percent (%)				
LOT3	**Ewekoro**	953	2.2	7.9	45.6	22.7	21.6
	Ifo	539	3.8	15.8	35.1	24.8	20.5
	Ado-Odo/Ota	1921	2.0	17.4	48.5	15.3	16.8
	Badagry	66	1.7	15.5	22.4	20.7	39.7
	Average (%)		2.4	14.2	37.9	20.9	24.7

[Data source] EEMS Field Survey

Table 4.56 Literacy Rate of PAPs

Lot #	Local Government Areas (LGAs)	Literacy Rate (%)		
		Male	Female	Total
3	Ewekoro	98.7	88.9	97.0
	Ifo	98.4	88.5	97.2
	Ado-Odo/Ota	97.8	85.9	95.8
	Badagry	92.8	92.5	92.8
***Ogun State**		98.2	88.1	93.5
***Lagos State**		99.4	99.3	99.3
***Nigeria (Average)**		86	79	82.6
Total PAPs		18,147	3,422	21,570
		84.1%	15.9%	100%

[Data source] EEMS Field Survey

*NBS (2016) and

According available data published in July 2017 by National Bureau for Statistics (NBS) National summary for the year 2016 shows that 86 % of men are literate and 79% of women among youths. The youth's literacy levels in Ogun State are 98.2% and 88.1% among men and women respectively. For Lagos State youth literacy are 99.4% (men) and 99.3% women (NBS, 2017).

4.15.7 Economics

The economic life of the communities revolves mainly around multiple sources of income. Some people that work in the organised private and public sectors also practice agriculture or other means of earning livelihood.

4.15.7.1 Occupation of Affected Heads of Household

Table 4.57 presents the general occupation of the heads of affected households. The percentages do not add up to 100, because many of them declared multiple occupation and were not sure which they can consider the major one.

Table 4.57 Occupation in the Project Area

Lot #	Local Government Areas (LGAs)	Occupation of Head of Household (%)							
		Farmer	Pastoralist	Self-employed/ Business Person	Private employee	Public Employee	Trading	Hunter / Fisherman	Others
	Ewekoro	72.3	1.7	24.2	8.9	17.3	6.2	0.0	1.2
	Ifo	78.3	0.5	17.3	2.8	24.7	3.1	0.2	0.8
	Ado-Odo/Ota	81.2	2.8	19.9	4.7	18.6	3.2	0.4	0.7
	Badagry	62.3	0.4	18.4	3.3	20.7	2.9	18.3	0.2
Average		**73.5**	**1.4**	**20.0**	**4.9**	**20.3**	**3.9**	**4.7**	**0.7**

[Data source] EEMS Field Survey

NOTE: The percentages do not add up to 100, because many households earn income from more than one occupation.

4.15.7.2 Incomeand Livelihoods of Household

Income analyses presented in Table 4.57 contain proportion of affected households in each LGA that practices the vocations and other means of livelihoods in the project area. Distinction is made between occupations that generates income and those that do not. The distinction is necessary because agriculture generally in Nigeria is subsistence in nature and only excess is sold to generate income. The heads of household were asked to list all livelihood supporting activities they engage, and then mention if they generated income from them in the past one year.

The proportion of households “having practiced” is obtained by dividing the number of households that engage in the livelihood activity in the LGA by the total number of households in that LGA. While those that declared it as having received income from it within the past 12 months is obtained by dividing the number by the number of people that practiced that same occupation.

It is observed that most households engage in more than one job to boost income, varying work activity with the seasons, and level of acquired skills and relative size of household farmland holding.

As Table 4.56 show, farming attracts the highest proportion of the respondents up to 72.2% and 71.8% in Ifo and Ado Odo Ota respectively practice farming and generate substantial income from it 87.3% and 78.3%. The people of Badagry practice farming the least but practice hunting or fishing the highest.

The proportion that earn income from other sources such as Business, Pension, Money transfer from family and friends, Salary, Odd or casual work, etc are also included in Table 4.58

Table 4.58 Income Analysis of Households

Activity		**LOCAL GOVERNMENT AREA**			
		EWEKORO	**IFO**	**ADO ODO OTA**	**BADAGRY**
Number of Households		953	539	1921	66
Cultivation Farming	Household having practiced	60.80%	72.20%	71.80%	47.10%
	Household having declared a source of income	85.30%	87.30%	78.30%	77.50%
Tree Cropping /Plantation	Household having practiced	11.50%	6.10%	9.40%	15.20%
	Household having declared a source of income	7.10%	38.10%	18.20%	23.90%
Livestock	Household having practiced	9.40%	13.80%	11.00%	3.70%
	Household having declared a source of income	65.30%	88.20%	34.50%	56.30%
Fishing or Hunting	Household having practiced	0.00%	0.20%	0.40%	18.30%
	Household having declared a source of income	10.00%	58.60%	50.20%	52.30%
Charcoal	Household having produce	2.30%	12.60%	13.30%	15.70%
	Household having declared a source of income	0.50%	50.00%	50.00%	44.40%
Fuel Wood	Household having	32.30%	49.20%	40.20%	40.80%

	collected				
	Household having declared a source of income	30.00%	46.90%	23.40%	36.50%
	Business	24.20%	17.30%	19.90%	18.40%
	Pension	2.70%	4.10%	2.60%	3.20%
	Money transfer (family)	8.60%	13.30%	14.60%	14.30%
	Renting (land, house, etc.)	2.20%	11.80%	8.50%	7.40%
	Salary (official)	26.20%	27.50%	23.30%	24.00%
	Odd or casual contract work	23.40%	18.80%	24.80%	12.20%
	Other sources	2.70%	11.80%	14.50%	9.00%

[Data source] EEMS Field Survey

Table 4.59 show the income from all sources. The people that are living in the abject poverty line (on less than N10,00/month equivalent to less than USD 1/day) has highest proportion in Badagry LGA (19.7%), while Ewekoro has the lowest (15.7%).

Table 4.59 TOTAL MONTHLY INCOME OF HOUSEHOLDS

Lot #	Local Government Areas (LGAs)	Estimated Monthly Income (Percent -%)					
		<10,000	10,001-50,000	50,000-100,000	100,001 - 500,000	>500,000	TOTAL
LOT 3	**Ewekoro**	15.7	34.5	24.80	14.7	10.3	100%
	Ifo	17.8	36.7	24.5	12.3	8.7	100%
	Ado-Odo/Ota	18.1	40.7	26.5	12.5	2.2	100%
	Badagry	19.7	45.8	22.9	10.8	0.8	100%
Average		**17.8**	**39.4**	**24.7**	**12.6**	**5.5**	**100%**

[Data source] EEMS Field Survey

4.15.8 Existing Infrastructures

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 1 tertiary institution in the project area. In addition, Ado Odo Ota LGA accounts for about 35% of these schools. About 90% 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 Ifo, Badagry and Ewekoro LGAs only have access to government owned secondary schools. The pupils in these communities often walk distances of 3 – 4 km to bigger communities such as Atan, Badagry, Bandu and Agbara to access government owned secondary schools. Information on the educational facilities in the project area is presented in Table 4.60.

Table 4.60 Educational Facilities in the Project Area

	Ewekoro LGA		**Ifo LGA**		**Ado-Odo/Ota LGA**		**Badagry LGA**	
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**
Primary	133	133	33	23	505	465	84	78
Secondary	12	12	11	4	148	145	10	8
Tertiary	2	2	0	0	2	2	0	0

* N.G= National grid; Source: EEMS 2017

The manpower in virtually all the schools is inadequate with high teacher/student ratio of over 1:40. About 65% of the existing schools lack basic facilities like water supply, electricity 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, only one tertiary educational institute (Shepard University) in Ajibawo community of Ado Odo Ota LGA is present in the project area. In addition, there is no adult literacy school in any of these communities which could have helped stem the high rate of illiteracy among adults.

Plate 4.20 A teacher (Mrs. Kayode) in Alapako oke

Plate 4.21 Local Government Primary School, Coker

Plate 4.23 United Primary school Ajegunle

Potable Water Supply: About 62.2% of communities in Ado Odo Ota LGA have access to water supply as against about 59.5% inEwekoro, 50.6% in Ifo and 53.2% in Badagry LGA. Most of the water schemes in the area are privately owned boreholes and wells. Some communities in Ijegemo and Sowole depend almost exclusively on water sourced from rivers and streams. Information on the number of boreholes as well as protected streams in each of the project LGA is presented in Table 4.61

Table 4.61 Number of water source across the project area

	Ewekoro LGA		Ifo LGA		Ado-Odo/Ota LGA		Badagry LGA	
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**
Communal	16	155	6		15		10	
Private	162		317	202	5407	3269	819	510
Protected spring (wells)	7		19		27		7	

Source: EEMS, 2017

As could be seen in Table 4.61, the number of privately-owned boreholes is higher compared to communally owned ones. About 60% of the boreholes in Ado Odo Ota are powered from light source provided by the National grid as against 57% in Ewekoro, 59% in Ifo and 61% in

Badagry. 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 85% of the communally owned boreholes (40 boreholes) and 35.4% of the privately owned ones have obsolete pipes and fittings.

Plate 4.25: Galloons on the Bank of Ijegemo Stream for Fetching drinking water

Plate 4.24: Borehole Facility in Ekundayo

Electricity: Forty–one communities representing about 62%are linked to the national grid line for electricity supply. This information is presented in Table 4.62

Table 4.62 Number of Communities in the LGAs connected to the National Grid

	Ewekoro	Ifo	Ado-Odo/Ota	Badagry
Communities connected to the N.G	1	5	25	10
Communities not connected to the N.G	1	4	20	0

Source: EEMS, 2017

The breakdown indicated that all ten communities within the RoW in Badagry LGA are connected to the national grid as against 25 (53%) within the Ado-Odo/Ota Local LGAthat is connected to the national grid. In Ewekoro LGA, Ejio community is connected while Sojuolu is not connected. Five (5) of the 9 communities in Ifo LGA are connected.

HealthFacilities: The health facilities in the area comprise of nine (9) Primary Health Centres (PHC) and fifty-eight (58) hospitals (Table 4.63). The grossly inadequate health facilities provide both out-patient and in-patient services.

Table 4.63 Number of Health Facilities in the Project Area

	Ewekoro LGA		**Ifo LGA**		**Ado-Odo/Ota LGA**		**Badagry LGA**	
	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	2	2	0	0	3	3	4	4
Hospital	20	20	6	6	31	29	1	1

Source: EEMS, 2017

The ratio of public to private hospitals in the project area is about 3:2. All of the LGAs have PHCs, except the eight project affected communities in Ifo LGA. Interestingly, about 95% of the health facilities are connected to the national grid. Plate 4.26 is a picture of a health facility in Ajegunle community (Ado Odo Ota LGA)

Plate 4.26: A Primary Health Centre in Ajegunle (Ado Odo Ota LGA)

Source: EEMS, 2017

Household Facilities: Several facilities were surveyed to be present in the households of the project area. The household sample taken per LGA was arrived at by taking into consideration the length of the line that pass through the LGA, the number of communities affected and the population. These include power generators, televisions, cars/trucks, refrigerators, etc. (Table 4.64). Most of these facilities are meant to improve the livelihood of the households while others are income generating. Result on the survey of these facilities revealed that gas stove/kerosene, TV and radioare the most common facility among households in the project area, where almost all households have them.

Table 4.64 Household Facilities

FACILITIES	Ewekoro	Ifo	Ado-Odo/Ota	Badagry
Number of Households Surveyed	**638**	**217**	**309**	**57**
Power generator	68.5%	66.7%	64.1%	63.8%
Gas stove/Kerosene	99.1%	94.0%	96.4%	96.6%
Refrigerator	85.9%	82.9%	90.0%	90.8%
Television	100.0%	94.0%	97.1%	95.7%
Radio/cassette/music system	98.7%	95.7%	98.1%	98.6%
Car/Truck	13.6%	8.5%	8.1%	8.2%
Motor Cycle	3.6%	15.4%	5.8%	9.7%
Bicycle	8.2%	21.4%	12.3%	16.9%
Plow	0.3%	0.0%	2.3%	0.0%
Cart	0.6%	0.0%	1.6%	0.5%
House in town	4.5%	5.1%	3.2%	3.4%
Land in town	0.5%	0.9%	1.9%	2.4%

Source: EEMS 2017

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

- The Lagos – Abeokuta express way
- Sango-Idi-Iroko Road
- The Sokoto road in Egbele Village
- Ado road
- The Coker – Atan road
- Smaller feeder roads linking the major roads with the impacted communities, and
- Unpaved roads connecting small villages and settlements.

Plate 4.27: Sokoto Road

Plate 4.28: The Coker – Atan road

Plate 4.29: Gboje - Iragbo road

Plate 4.30: Erekiti road

Apart from the tarred Lagos-Abeokuta express way and the Sokoto road, the Ado road and others are either partially tarred or not tarred

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 such as Agbara, Atan, Ifo and Badagry while motorcycle transport is used for shorter distances and unpaved roads.

4.15.9 Housing Types

Field survey was conducted to identify quality of housing used by the PAPs. The materials used in construction surveyed and presented in Tables 4.65 to 4.66 and sample pictures in Plates 4.31 and 4.32.

House Roofing Materials: Results on the roofing materials are presented in Tables 4.66

Table 4.65 Roofing Materials (%)

Material	Ewekoro	Ifo	Ado Odo Ota	Badagry	Average (%)
Corrugated Iron Sheets	25	43	20	34	30.4
Thatch	2	21	1	9	8.2
Asbestos	39	11	36	23	27.2
Bamboo/reed	0	5	1	3	2.2
Aluminum roofing	33	17	40	29	29.7
Nil / No roof / Not completed	1	3	3	2	2.2

Source: EEMS Survey, 2017

The use of iron sheets, asbestos and aluminum accounted for about 87% of the roofing materials. The least used roofing material is bamboo and thatch, accounting for about 2.2% and 8.2% respectively.



Aluminum roofing in Bandu |Corrugated iron sheet in Olaoparun | Asbestos in Igbele

Plate 4.31: Roofing materials for household dwellings

House Walling Materials: Results of household walling materials are presented in Table 4.66.

Table 4.66 Walling Materials of Houses in the Project Area

	Ewekoro	Ifo	Ado Odo Ota	Badagry	Average (%)
Mud	2	9	5	7	5.7
Mud bricks	13	20	12	16	15.2
Wood	3	5	3	6	4.2
thatch	0	15	4	5	6
Compacted (combine)	1	1	1	1	1
Concrete (blocks)	75	50	70	60	56
Others	6	2	5	5	4.5

Source: EEMS Survey 2017

On the average, the use of bricks as walling materials is predominant. However, the use of mud bricks is most pronounced among communities in Ifo and Badagry LGAs. It was also observed that walling materials for a house could be mud, bricks and woods. Also, some houses are walled exclusively of bamboo, tarpaulin and zinc.



Zinc in Alapako Mud in Olowo concrete in Berese

Plate 4.32: Walling Materials for Household Dwellings

House Flooring Material: Table 4.67 is the results of flooring material from the study.

Table 4.67 Flooring Materials of Houses in the Project Area

Material type	Ewekoro	Ifo	Ado Odo Ota	Badagry	Average (%)
Earth/sand/dirt/straw	7	23	12	18	15
Smoothed mud	2	19	3	15	9.8
Smooth cement	63	35	59	42	49.8
Wood/planks	3	8	5	8	6
Ceramic tiles	25	15	21	17	19.5

Source: EEMS Survey 2017

Five flooring materials were observed to be in use. While smooth cement (49.8%), ceramic tiles (19.5%) and sand (15%) are the most used flooring materials across all the communities and LGAs, the use of woods/planks and smoothen mud were observed more among households in Ifo and Badagry LGAs.

4.15.10 Community 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.

Waste Management: Open dumping and burning are the two waste methods practiced by the communities. Open dumping is the prevalent refuse disposal method in the area followed by refuse incineration. However, some households practice both methods.

Sewage disposal by households were either by pit latrine, bush or by water closet. About 60% of households in Ado Odo Ota, Ewekoro and Badagry use the Water Closet (WC) system except in Ifo (where only about 30% of the household use the WC). About 39% of households in the project area used the pit latrine while about 10% of the households, except in Ewekoro LGA (0%) use the bush.

Prevalence of Diseases in in the study area: The commonest and most prevalent diseases affecting all age groups in the communitiesas shown in Table 4.67 are Malaria Fever (32.8%), Upper Respiratory Tract Infection (21.8%), Typhoid Fever (11.7%), Diarrhea/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.

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 4.68 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: EEMS, 2017

The practice of traditional medicine was common in almost all the communities, especially those within the Badagry 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.

Infectious diseases: 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**.**

Table 4.69 Sexual Practices among Inhabitants

No o Sexual Partner	Percentage (%)				Average %
	Ado Odo Ota	Ewekoro	Ifo	Badagry	
1	37.5	42.3	49.3	50.3	44.85
2	58.6	34.1	30.1	29.5	38.075
3	17.4	10.4	9.3	10.5	11.9
4	12	8.1	7.1	7.7	8.725
5	8.5	3.8	3.2	2.0	4.375
Above 6	3.5	1.3	1	0	1.45

Source: EEMS 2017

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.

Housing Condition: 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.

The use of iron sheets, asbestos and aluminum accounted for about 87% of the roofing materials. The least used roofing material is bamboo and thatch, accounting for about 2.2% and 8.2% respectively. On the average, the use of bricks as walling materials is predominant. However, the use of mud bricks is most pronounced among communities in Ifo and Badagry LGAs. It was also observed that walling materials for a house could be mud, bricks and woods. Also, some houses are walled exclusively of bamboo, tarpaulin and zinc. Five flooring materials were observed to be in use. While smooth cement (49.8%), ceramic tiles (19.5%) and sand (15%) are the most used flooring materials across all the communities and LGAs, the use of woods/planks and smoothen mud were observed more in Ifo and Badagry LGAs.

4.15.11 Indigenous People

IFC Performance Standard 7 recognizes Indigenous Peoples as social groups with identities that are distinct from mainstream groups in national societies. Indigenous people are not applicable in Nigeria. However, the Federal Government recognises ethnicity. Nigeria has three largest ethnic groups that include the Yoruba, Hausa–Fulani and Igbo, representing 71 percent of the population. The project is located in South-west Nigeria and the people living in this region are mainly the Yoruba ethnicity.

4.15.12 Land Use

The proposed transmission line's wayleave lies within the south western zone of the country. Derived savanna and riparian forest were the two identified habitats. Farming constitutes the major land use activity in Ado Odo Ota, Ewekoro and Ifo LGA, while fishing and farming both constitute the major land use inBadagry LGA. Oil palm (Elaeis guineensis) plantation, Banana plantation and crop farming. Other notable land uses include fishing. Building of residential houses and cottage industries are some of the apparent changes in land use pattern observed around the study area.

4.15.13 Cultural Heritage

The cultural heritage resources present in the project area are cemeteries, shrines, sacred grooves, sacred streams and few isolated graves. A total of 5 cultural heritage resources were found to fall directly under the centerline of the transmission line. Plate 4.33 shows the pictures and locations of these resources. The location of identified cultural sites is in Figure 4.20.

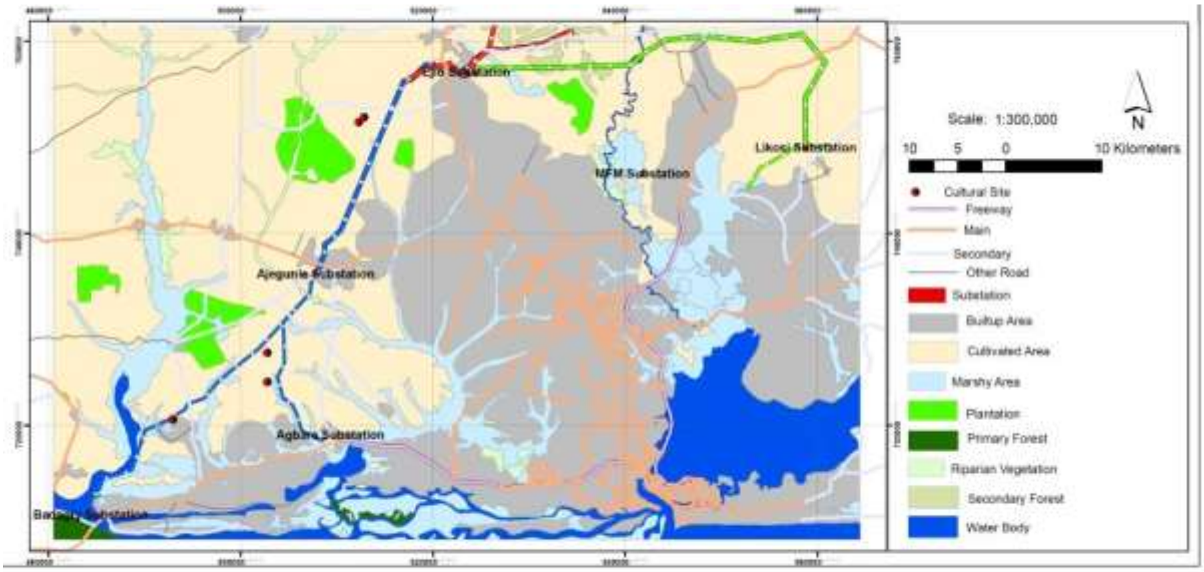


Figure 4.20 Location of Cultural Heritage Sites

Jogbo asotere shrine (6°34'55.88"N, 3° 1'44.81"E)

Idi Araba ogun shrine (6°33'16.65"N, 3° 1'29.81"E)

Obatala shrine6°47'58.39"N, 3° 6'39.53"E

Zangbeto (gbojo 6°31'8.56"N, 2°56'8.31"E)

Ogun shrine 6°48'14.81"N, 3° 6'57.24"E

Plate 4.33 pictures and locations of cultural heritage resources affected

Ajogbo Akia shrine (6°35'29.59"N, 3° 1'13.22"E)

Ancient well (6°35'12.50"N, 3° 0'54.47"E)

Hobo shrine (6°35'14.64"N, 3° 0'56.60"E)

Olowo cemetery (6°45'31.34"N, 3° 6'38.67"E)

Alapako Oke shrine 6°48'10.06"N, 3° 7'16.73"E

Shinto shrine (6°35'13.69"N, 3° 0'56.60"E)

Ogun shrine (6°35'14.64"N, 3° 0'56.60"E)

Dahon (Obatala) shrine 6°35'13.69"N, 3° 0'56.36"E

Sacred groove 6°50'41.31"N. 3°12'36.14"E

Ejio stream 6°53'42.91"N, 3°13'27.54"E

Yoho temple (6°35'13.69"N, 3° 0'56.60"E)

Church cemetery 6°49'32.63"N, 3° 7'24.17"E

Plate 4.34 Cultural Heritage Resources within 700m of the Transmission Line

The project will impact negatively on these heritage resources, as any cultural heritage site surveyed along the wayleave will be removed. However, interviews with some of the Baales revealed that they are willing to relocate these heritage resources peradventure any of them fall under the way leave. They also informed that sacrificial rights are necessary for such relocation. Plates 4.33 through 4.34 are pictures of some of these cultural heritage resources.

4.16 Consultation of Stakeholders

This chapter outlines the public information and consultation process that has been designed and implemented in order to facilitate the informed participation of the project affected persons (PAPs), communities and other stakeholders affected by or with interest in the project. As such, consultation objectives, activities and outcomes are reported.

4.16.1 General Objectives

General stakeholder engagement objectives of this study were to:

- → Inform stakeholders on the proposed infrastructures and activities and seek their informed opinion about the socio-environmental risks and opportunities potentially associated with the project as well as take the measures and actions in order to manage the anticipated impacts;
- → Obtain feedback from stakeholders on issues of concern and expectations in order to optimize the project
- → Generate a social and institutional dialogue in order to assess and strengthen the project's social acceptability;
- → Help to consolidate, through the ESIA process, the efforts made by the TCN in order to establish lasting relationships with affected communities and other stakeholders.

4.16.2 Stakeholder Information and Consultation Stages

Three stakeholder information and consultation stages were planned, and two has been implemented through the development of the line route survey, the ESIA/ESMP study and RAP of this project. They were planned according to key stages, or decision moments, throughout the study where the informed participation of stakeholders were likely to make the most significant contribution to the on-going analysis.

These included the scoping stage (1st stage), the preliminary route assessment and the documentation of the affected communities and displaced households stage (2nd stage). The third round of consultatons is scheduled for the disclosure of the Final Line Route, ESIA, ESMP and RAP preliminary results (3rd stage).

Table 4.70 outlines the studies' stakeholder engagement process and presents, for each consultation stage, the specific engagement objectives, target groups and implementation periods.

Table 4.70 Stakeholder Consultation Implementation

ROUND	Objectives	target groups	implementation Period
STAGE 1: Environmental and Social Scoping	• Present the project and the ESIA process to key authorities; • Identify key issues, concerns and expectations related to the project and study area; • Complete the stakeholders' list and validate the general approach for consultations.	• Transmission Company of Nigeria (TCN) • Concerned ministries • State and LGA Administration • Customary Chief's of areas affected by the line	May/Jun 2017
STAGE 2: Line Route Study	• Involve key stakeholders in the analysis of the « hot spots » identified along with the provisional line route. • Inform affected communities and involve them in environmental and social optimization of the line route; • Identify the concerns and expectations of affected communities, displaced households and women; • Inform affected households of their rights and options for resettlement.	• Transmission Company of Nigeria (TCN) • Concerned ministries • Local authorities • State-level and LGA-level authorities and technical services. • Affected people and their leaders. • Women representatives. • Customary chiefs.	Oct./Nov. 2017
STAGE 3: Disclosure of Preliminary Results (ESIA, ESMP and RAP)	• Present, validate and enhance preliminary ESIA and RAP results. • Ensure compliance of the proposed measures with the requirements of regulatory authorities; • Evaluate the social acceptability of the project and its proposed measures.	• Transmission Company of Nigeria (TCN) • Concerned ministries at national and state levels. • Local authorities and community leaders from affected LGAs. • NGOs.	To be determined

4.16.3 Stake Holder Identification and Mapping

Target stakeholder groups for the stakeholder engagement process include:

- → Concerned agencies and organisations at State and National levels;
- → State-level (Ogun and Lagos) agencies;
- → Customary authorities in communities affected by the line; -Obas, Ba'ales and Village Heads crossed by the line route.
- → Industrial and commercial actors affected by the line, including relevant TCN departments, and JICA.
- → Security agencies, national civil security and defence corps, department of security service and the Nigerian Police

In the case of the project, the scenario is such that the land is acquired from the leaders and members of the affected communities who have consented. These communities have been informed and have agreed to release the portions covered by the transmission line and substations based on adequate compensation. However, it should be noted that land in Likosi substation had already been acquired by TCN since 2008 and it is expected that no compensation will be paid on Likosi land. This historical fact may influence the list of stakeholders. Hence, the next few paragraphs will discuss the identified stakeholders for the transmission lines and substations as well as indication of their stake in the project.

a) Government Authorities

Federal and State governments as well as Local government constitute important stakeholders within the project's engagement framework. Some are regulators who issue the necessary permits while others may provide information on demography, climatic conditions, etc. Engagement with these agencies must live throughout the project life span. During this scoping phase of this project, the following stakeholders were identified.

- Federal Ministry of Environment (FMEnv), Abuja;
- The Federal Ministry of Power, Abuja;
- The Nigerian Electricity Regulatory Commission (NERC), Abuja;
- The Ogun State Team;
- The Lagos State Team

The Project falls within four LGAs located within Ogun and Lagos States. These are Ewekoro, Ifo and Ado Odo/Ota LGAs in Ogun State and Badagry in Lagos State. TCN together with the consultants engaged with the relevant council departments of the LGAs and asked them to consider the project activities in the wider planning for the LGAs. In addition, the following Ministries and Ministerial Agencies within the two States and Federal Government will be engaged throughout the project lifecycle to ensure that they are kept informed and are given an opportunity to provide input in their respective planning areas

b) Communities and Traditional Institutions

Traditional institutions, their councils and the leaders of the social groups in the community (such as women, youths, market women and local farmers) is engaged on a continuous basis in a discussion of all aspects. Meetings with these groups follow local practices and norms and is held prior to any wider communication in the villages in order to respect the traditional structures.

c) Vulnerable Groups

Women have been identified as vulnerable group for the project, due to their economic vulnerability and inability to participate in decision-making processes within the traditional context. Women in the project area are not always able to attend or speak freely at open meetings and/or may have household restrictions on when they are able to attend such meetings. The project holds women’s meeting at times and places convenient to the women in each community. These meetings is held by a female member of the project team, where possible.

Other potential vulnerable groups identified as part of the ESIA include the elderly, youth and migrant farmers. Vulnerability of these groups is also based on reduced opportunities to participate in local decision-making, as well as their economic vulnerability, particularly with regard to employment.

300 Naira x 30 days per person of special grant for AP household to improve living standards of vulnerable APs (such as linking to national poverty reduction programs conducted by various government institutions) and assistance to in finding suitable land for relocation and shifting.All women that are part of the resettled households will be informed of the compensation benefits offered to them specifically.Special help will be given such as opening a bank account, budget management, etc.

d) Non-Governmental Organizations (NGOs)

Nigerian Conservation Foundation (NCF) an NGO participated in the scoping of the project, and was also consulted at later stage preparatory to field data collection as well as participating in reviewing the reports and feedback obtained that improved the quality of the study (see Table 4.71)

Table 4.71 List of identified stakeholders

Stakeholder Groups	Primary Stakeholders	Secondary Stakeholders
Neighbouring/Host Communities **(See Appendix 4 for the list of communities)**	• Communities living along the Transmission Lines and close to the substations site; • Other communities within the project area of influence; • Vulnerable groups within these communities; and • Workforce recruited from the communities.	• Village Head ('Baale'); • Community Development Association; • Religious leaders; • Village elders; and • Sagamu, Ewekoro, Obafemi Owode and Ifo LGAs
Institutional Stakeholders	• Social infrastructure, like schools, health facilities and emergency services.	• Electricity distribution companies, Lagos and Ogun States Government; and • Project investors (TCN, JICA).
Regulatory Authorities		• Federal Ministry of Environment; • The Federal Ministry of Power, Works and Housing, Abuja; • The Transmission Company of Nigeria (TCN), Abuja; • Lagos and Ogun State Ministry of Environment • Land Administration and Physical Planning -Ogun and Lagos State
Other Groups		• NGOs and Civil Society; • Media; • Other projects in the area; and • Universities and other institutions doing research in the area.

Table 4.72 below gives an overview of the stakeholder groups and their concerns, expectations and influence on the Project.

Table 4.72 Stakeholder Mapping

Stakeholder Category	Relevant Stakeholders	Profile/Status	Concerns surrounding the Project	Expectations from the project	Nature of influence on Project
Primary	Communities living along the Transmission Lines and close to the substations site	These communities may directly be impacted by the project and may experience cumulative impacts	Additional impacts and risks to existing situation.	Support in social infrastructure and employment at the site.	Protest and/or causing delays.
Primary	Other communities within the Project area of influence.	Directly impacted by cumulative impacts and risks from Lafarge's site with past impacts and risks.	Additional impacts and risks to existing situation.	Support in social infrastructure and employment at the site.	Protest and/or causing delays.
Primary	Construction labour force recruited from the communities.	Temporary employment and income from construction activities.	Labour and Working Standard risks and employment opportunities.	Employment and good wages.	Protests if employment opportunities are disappointing.
Secondary	Community.	- Discussion of community concern; - Discussion with the vulnerable groups, women and youths; - Discussion on TCN workers integration into the community; and	- Youth empowerment; - Provision of basic social amenities and infrastructure; and - Influx of workers.	- Youth empowerment; - Provision of basic social amenities and infrastructure; and - Compensation.	Protest and/or causing delays.

Stakeholder Category	Relevant Stakeholders	Profile/Status	Concerns surrounding the Project	Expectations from the project	Nature of influence on Project
		- The need for a grievance mechanism throughout the project.			
Secondary	Federal Ministry of Environment.	- Registration of the Project; - Scope of data collection and ToR approval; - Issues concerning site visits; - ESIA process and scope of the ESIA - Approval for one season waiver.	No concerns on the status of the project.	Submission of Draft Report and processing fee payment.	ESIA Permit.
Secondary	Transmission Company of Nigeria.	National Grid Connection Approval.	- Transmission Line (TL) and Substation operation; - MOU between TCN and JICA; and - Preliminary Route and Substation Map Approval.	- Agreed MOU; - Approved TL design; and - Approved Preliminary Route Map - Approved Substation site	Permit and Execution of the project.

Stakeholder Category	**Relevant Stakeholders**	**Profile/Status**	**Concerns surrounding the Project**	**Expectations from the project**	**Nature of influence on Project**
Secondary	Federal Ministry of Works, Power and Housing.	Moderation of parties involved.	MOU between TCN and JICA	- Agreed MOU; and - Electricity supply.	Permit and Execution of the project.
Secondary	Nigerian Gas Company.	Meeting with TCN on the RoW acquisition.	Transmission line alignment design.	Notification on transmission line construction.	Project execution.
Secondary	Ogun State Ministry of Environment; and Ogun State Environmental Protection Agency (OGEPA).	Compliance monitoring of approved EMP.	Environmental degradation.	Compliance with approved EMP.	Project execution.
Secondary	National Environmental Standards and Regulations Enforcement Agency (NESREA).	Compliance monitoring of approved EMP.	Environmental degradation.	Compliance with approved EMP.	Project execution.
Secondary	Local Council Development Authority (LCDA)	- Engagement with affected communities; - Potential positive impacts (employment opportunities	Environmental degradation and community development programme implementation.	Compliance with approved EMP and implementation of community projects.	Project Execution.

Stakeholder Category	Relevant Stakeholders	Profile/Status	Concerns surrounding the Project	Expectations from the project	Nature of influence on Project
		for local people and provision of electricity); and - Community Development.			

The host Local Government Areas are: Ifo, Ewekoro, Ado Odo/Ota and Badagry and the host communities include those listed in Appendix 4. Pre-entry consultations were held with the Executive Councils, Elders and Youths of the host communities between December 15 and 16 at Local Government Secretariat. During these periods discussions and consultations enabled the stakeholders to be informed of the intent of the proponent and a collection of the views of the people about the proposed project.

4.16.4 Consultation Activities

The summary of consultation activity conducted to date are summarized in Table 4.73. The details are provided in Appendix4.

Table 4.73 Stakeholder Engagement Activities to Date

Stakeholder Engagement	Engagement Activity	Stakeholders	Number of Participants	Venue	Date/Time	Specific Discussion Areas
STAGE 1 : SCOPING						
Government Agencies – Federal, State and Local Government Authority Regulatory Authorities.	Meeting with State and Local Council Officials.	Federal Ministry of Environment and othe Federal Agencies. Lagos state agencies Badagry LGA	42	Lagos	May 10, 2017 July 11, 2017	ration of the Project; of data collection and ToR approval; concerning site visitation; ocess and scope of the EIA; val for one season waiver; and val for the substation and the lines.
		Ogun State Agencies Ewekoro LGA Ifo LGA Ado Odo/Ota LGA	21	Abeokuta		
		Affected communities	52	Baale's Palaces in respective communities	24 to 27 Mar 2017	
STAGE 2: Line Route survey/ESIA Study						
Baseline Data Collection: Community	Meeting with Traditional Rulers and	The head and chiefs of host communities. (Please add number of	67	Baale's Palaces in respective communities and	December 18 -23, 2017	l presentation of the project; ssion of community concern; and

Engagement, engagement with local groups and traditional leaders.	Youths.	communities engaged)		hot spots in the communitisand substations		need for a grievance mechanism hout the project life.
Government Agencies – Federal, State and Local Government Authority Regulatory Authorities.	Meeting with Local Government Officials.	Ewekoro, Igbogun/Coker, Ado/Odo and Badagry LGAs	27	LGA Secretariate and Hot spots along the line and substations	September 15-16, 2017	ement with affected communities; ial positive impacts (provision of city and employment of opportunities al people; and unity development in general.
		Federal Ministry of Environment, Abuja.	7	along the line and substations	December 18 – 23, 2017	pertaining to appropriate location of bstations
		Federal Ministry of Environment, Abuja.	XX	XX		ement with Redeem Officials to take on on the appropriate substation on

4.15.4.1 First Stage Consultations

The first consultation stage took the combined format of individual semi-structured interviews with community members and customary chiefs as well as group meetings with institutional stakeholders (organisations at national, state and LGA level). This approach has proved to be useful to better define the scope and framework of the RAP study.

The objectives of these meetings are as follows;

- Present the project and the ESIA process to the communities and relevant agencies;
- Identify key issues, concerns and expectations of the communities and agencies related to the project and study area;
- Identify current practices and requirements of each agency related to the project;
- Complete the stakeholders' list and validate the general approach for consultations;
- Identify relevant information sources and collect available data and reports.

Activities Performed in Ogun State

The activities carried out as part of the first-round stakeholders' engagement in Ogun Stateare:

- Meeting between TCN top management headed by the MD/CEO and the Governor of Ogun State and other Senior Government Officials at Government House Abeokuta.
- Meetings at State level in Abeokuta with relevant State Ministries, Agencies and affected LGAs in Ogun States.
- Meetings at community level, held in each community within the project area in Ogun States.

Table 4.74 show list of the stakeholders met in Ogun State during the first round of consultations.

Table 4.74 Ogun State Stakeholder Groups Consulted

Stakeholder Group	Type of Stakeholder	Location of Meeting	Date
Ejio (Arigbajo) Communities	PAPs/ Customary Chiefs	Palace of the Kabiyesi of Ejio	25-03-2017
Korogboji Community, Agbara	PAPs/ Customary Chiefs	Baale of Korogboji's Palace	26-03-2017
Ajegunle(New Agbara) Communities	PAPs/ Customary Chiefs	Baale of Ajegunle's Palace	25-03-2017
Ogun State Bureau of Lands	Institutional	Dept of Energy Office, Ogun State	11-05-2017
Ogun State Ministry of Rural Development	Institutional	Dept of Energy Office, Ogun State Secretariat	11-05-2017
Ogun State Ministry of Communication, Development and Cooperation	Institutional	Dept of Energy Office, Ogun State Secretariat	11-05-2017
Ogun State Bureau Of Electrical	Institutional	Dept of Energy Office, Ogun State	11-05-2017
Ogun State Ministry Of Housing	Institutional	Dept of Energy Office, Ogun State	11-05-2017
Ogun Governor's Office	Institutional	Dept of Energy Office, Ogun State	11-05-2017
Transmission Company of Nigeria	Promoter	Dept of Energy Office, Ogun State	11-05-2017

Plate 4.35: Scoping Meeting with Ejio Community   Plate 4.36: Scoping Meeting with Ogun State

Activities Performed in Lagos State

The activities carried out as part of the first-round stakeholders' engagement are:

- Meeting between TCN top management headed by the MD/CEO and the representative of the Governor of Lagos State in Abuja.
- Meetings at State level in Ikeja with relevant Federal and State Ministries, Agencies and affected LGAs
- Meetings at community level, held in each community within the project area in Lagos State.

Table 4.75 show lists the stakeholders met during the first consultation round.

Table 4.75 Lagos State Stakeholder Groups Consulted

Stakeholder Group	Type of Stakeholder	Location of Meeting	Date
Yafin Community, Badagry	Community	Baale's Palace	26/03/2017
Badagry Local Government Council	Institutional	Primal Hotel Hall, Ikeja, Lagos	22-06-2017
NBET	Institutional	Primal Hotel Hall, Ikeja, Lagos	22-06-2017
NSCDC	Institutional	Primal Hotel Hall, Ikeja, Lagos	22-06-2017
Office of the	Institutional	Primal Hotel Hall, Ikeja,	22-06-2017

Stakeholder Group	Type of Stakeholder	Location of Meeting	Date
Surveyor General		Lagos	
Federal Road Safety Corp	Institutional	Primal Hotel Hall, Ikeja, Lagos	22-06-2017
Ministry of Water Front Infrastructure	Institutional	Primal Hotel Hall, Ikeja, Lagos	22-06-2017
LASIMRA	Institutional	Primal Hotel Hall, Ikeja, Lagos	22-06-2017
Lagos State Ministry of Transport	Institutional	Primal Hotel Hall, Ikeja, Lagos	22-06-2017
Ministry of Physical Planning and Urban Development	Institutional	Primal Hotel Hall, Ikeja, Lagos	22-06-2017
Lagos State Ministry of Environment	Institutional	Primal Hotel Hall, Ikeja, Lagos	22-06-2017
JICA	Financier	Primal Hotel Hall, Ikeja, Lagos	22-06-2017
Transmission Company of Nigeria	Promoter	Primal Hotel Hall, Ikeja, Lagos	22-06-2017
LASEPA	Institutional	Primal Hotel Hall, Ikeja, Lagos	22-06-2017
Tripod Limited	Observer	Primal Hotel Hall, Ikeja, Lagos	22-06-2017
Ikeja Electric Distribution Company	Institutional	Primal Hotel Hall, Ikeja, Lagos	22-06-2017
Nigerian Inland Waterways Agency	Institutional	Primal Hotel Hall, Ikeja, Lagos	22-06-2017
National Conservation Foundation	Institutional	Primal Hotel Hall, Ikeja, Lagos	22-06-2017

Stakeholder Group	Type of Stakeholder	Location of Meeting	Date
Lagos State Electricity Board	Institutional	Primal Hotel Hall, Ikeja, Lagos	22-06-2017
NEMSA	Institutional	Primal Hotel Hall, Ikeja, Lagos	22-06-2017
Eko Electricity Distribution	Institutional	Primal Hotel Hall, Ikeja, Lagos	22-06-2017
Lands Bureau	Institutional	Primal Hotel Hall, Ikeja, Lagos	22-06-2017
Department of State Services	Institutional	Primal Hotel Hall, Ikeja, Lagos	22-06-2017

Plate 4.37 Scoping Meeting in Lagos State

4.16.4.2 Second Stage Consultations

The second stage of stakeholder information and consultation to present the preliminary line route, as well methodology and approach for ESIA and RAP study. At the same obtain feedback to refine the approach and the methodology and include concerns expressed in the study.

The activities carried out as part of the second stakeholder engagement round are:

→ Meetings in Abuja, Abeokuta and in the communities with relevant ministries and agencies.

→ Meetings with PAPs in each community affected by the line route

→ Field trip to show to stakeholders where the line will pass.

→ Printed and digital line route map as well as images illustrating examples of the type of proposed infrastructure (pylons and lines) were also exhibited. A project background information document, in a poster form was produced and distributed by the consultant to the authorities and representatives prior to meetings for public advertising.

→ PAPs were invited to attend the village level meetings with the Village Chief or District Head in their communities. The meetings included women as well as youths in each village.

Table 4.76 Stakeholder Groups MetDuring Second Stage Consultations

Stakeholder Group	**Type of Stakeholder**	**Location of Meeting**	**Date**
Transmission Company of Nigeria	Promoter	TCN Office, Abuja	31-08-17
Field Visit with TCN and Relevant Agencies in Lagos and Ogun States	Institutional	Various Hotspots along the proposed line route	05-09-17 & 06-09-17
Affected Communities	Community leaders and PAPs	Apomu	19-11-17
		Leshi	20-11-17
		Joga Owode	
		Sowole	
		Oke Oji	
		Atan Iju Ilogbo	
		Alapako	
		Coker Ibogun	21-11-17
		Gbeko	26-11-17
		Idolehin	

		Ijegemo	
		Onilogbo	
		Iberese	
		Abisoye	
		Asokere	
		Bandu	
		Adigbon	
		Igbele Ajana	01-12-17
		Ajegunle	
		Ejio	02-12-17
		Erekiti	08-12-17
		Tohon	
		Yafin	

Plate 4.38 Presentation of the Line Route to Baale of Ajegunle, Ado Odo/Ota LGA

Plate 4.39 Presentation of the Line Route to Institutional Stakeholders in Abeokuta

4.16.5 Outcomes of the Consultations

4.16.5.1 Outcomes and Results Obtained in Stage 1

The following results were achieved from the consultations

- The communities understood the objectives and requirements of the project and pledged support and cooperation
- The relevant agencies are aware of the project and the ESIA process (team, objectives and schedules);
- The requirements of Ogun State and Lagos State Laws and Regulations relevant to the project were highlighted by the agencies and understood by TCN and its consultants.
- The main stakeholders' concerns and expectations were documented and have been considered for inclusion in the scope of the studies;
- A preliminary list of stakeholders was completed and the orientations of the Stakeholder Engagement Framework was enhanced;
- The Ogun State Governor established a committee in the State to provide support for the project.

Table 4.77 provides a summary of the main comments and recommendations made by stakeholders in Ogun State on different social and environmental issues of concern to them with respect to the project. Responses provided on the spot, where applicable were also provided.

Table 4.77 Comments by Stakeholders in Ogun State during Stage 1

Topic	Concerns, Comments and Recommendations	Stakeholders having made the comment / recommendation	Actions to Address Concerns
Location of Proposed Sites	Some sites are under acquisition while others are free. The ones that are free, Government will acquire for the project in the interest of the public but the project will be responsible for the processing charges.	OGSG/ Bureau of Lands and Survey	The lands needed will be compiled and sent to OGSG
	The Governor mentioned need to raise the lines where crossing rail lines eg. Lagos – Ewekoro (Lafarge Cement) rail line at Apomu village	Bureau of Lands and Survey	This shall be included in the EPC contract
Project Components	Requested additional substation as follows In Ijebu Area, which will be in Obere to feed Ogun East. Aiyetoro to feed the communities along Benin Border. Idi-Iroko, Waasimi axis. The State Government will provide land and fast track approval of the substation sites and ROW acquisition, while TCN will pay for the processing only.	Department Power/Energy, Governor's Office	TCN explained that there will be no need for building substations as the proposed substations will be sufficient for the areas mentioned. All that is needed is to invest in distribution infrastructure
Substations Sites	**Ejio** – Under Government acquisition. TCN needs to apply for de-acquire and re-acquire	Bureau for Lands and Survey	Application along with supporting documents will be prepared and submitted
Line corridor	**Ajegunle (New Agbara)** – Free, Government will acquire on behalf of TCN and issue C of O	Bureau for Lands	
	Arigbajo (Ejio) – New Agbara (Ajegunle) – Within Government acquisition and some are free **New Agabara- Badagry** – Partly free and within Government acquisition	Bureau for Lands and Survey	

Table 4.78 provides a summary of the main comments and recommendations made by stakeholders in Lagos State on different social and environmental issues of concern to them

with respect to the project. Response to these inputs from stakeholders are also provided, where applicable.

Table 4.78 Comments by Stakeholders in Lagos State during Stage 1

Topic	**Concerns, Comments and Recommendations**	**Stakeholders having made the comment / recommendation**	**Actions to Address Concerns**
Security	Give warning signals where challenges from host communities may arise, provide real time security	DSS	Schedule of field acitivities will be shared with security agencies
	Where security issues ocuur, there should be a formal request to the Commandant General requesting for man power/ motorised patrols and aerial surveillance. Collaboration with other security agencies	NSCDC	
Compensation/ RAP	Who is responsible for compensation	Lands Bureau	TCN is responsible for payment
Lines Crossing Water Ways	Seek for permission before it crosses any major water ways and obtain permit. Any line of construction between 100m of the shore line will need permit	NIWA	There is no Section of the line that crosses navigable or major waterway.
Survey	Is it the office of the Surveyor General that will do the survey? Provide preliminary line route to see how it will affect the development in that area. What informed the choice of Yafin community as location for substation? There is plan for a deep sea port in Badagry area. Supply maps to the Surveyor General's office, to check against other plans.	Office of the Surveyor General	TCN has hired consultants to do the line survey, ESIA and RAP. Surveyor General will be consulted
Environment	Consult Lagos State Environment Protection Amendment Law 2017		These will be included in the scope

Topic	Concerns, Comments and Recommendations	Stakeholders having made the comment / recommendation	Actions to Address Concerns
	Asses Alternative Routes? Ensure safety of workers and community You need a forest permit from LASPARK before any tree can be cut. Do not permit use of herbicide protec birds and biodiversity areas Waste Management issue	LASEPA	of the studies. Requirement for forest permit will be included in the ESMP
	Biodiversity Management should be developed and included in the ESMP. Stick to faithful implementation of the report	NCF	These will be included in the scope of the studies
Traffic	How do we handle traffic generated from movement of equipment during the construction phase	Ministry of Transport and FRSC	Traffic study will be carried out at major road crossings
Line route/ ESIA	Would like to know the scope of work, duration of the project and advised to consult Ministry of Local Government Community Affairs	LSEB	Scope of the project was further clarified
Cultural heritage	Respect Historical Heritage sites. Local Government is the coordinator for CDC's	Badagry LGA	Physical cultural properties including heritage sites is in the scope of the ESIA (see physical cultural resources management plan). Physical cultural resources was also one of the criteria for line route.
Line	ROW in that area has been given to NIPP	Ministry of	The NIPP project is

Topic	Concerns, Comments and Recommendations	Stakeholders having made the comment / recommendation	Actions to Address Concerns
route	so if additional ROW is needed, TCN should check with the Ministry to see if it can be accommodated within the gazetted ROW Respect physical planning regulations 2005 with emphases on setbacks, substations	Physical Planning	not in the same area. The line covered by this project is from Ajegunle to Yafin Village. Setback distance by NERC is 15m and is respected by this project
Encroachment	How do we intend to stop construction under ROW/ transmission line	IKEDC	Periodic monitoring and involvement of NSCDC
Support for the project	Will like to collaborate with TCN/Consultants to ensure hitch free process	EKEDC	EKEDC is a critical partner in the project
Support for the project	Want to be part of the project from commencement to decommissioning	NEMSA	NEMSA has been involved in the project along with other key stakeholders

4.16.5.2 Outcomes and Results Obtained in Stage 2

Issues raised by stakeholders during second round consultations are in Table 4.79

Table 4.79 Comments by Stakeholders During Stage2 Consultations

Sections of the Line	Comments and Recommendations	Stakeholders Having Made the Comment / Recommendation	Actions that addresses comments
Ejio-Arigbajo-Apomu axis	**Option C: c**onsider running parallel to the Lagos-Ibadan Expressway on the left hand side of the road (Northwards) before	TCN	This was not possible, because of the need to avoid a shrine (6.848790°N,

Sections of the Line	Comments and Recommendations	Stakeholders Having Made the Comment / Recommendation	Actions that addresses comments
	going left.		3.201160°E) in Arigbajo Forest as well as Mobile Petrol Station (6.854169°N, 3.191616°E) along the road
	OPTION B: Try to avoid the structures around Lat 6.835046, Long 3.138859.	TCN	The line route has been amended to avoid the structures indicated
	Option B: Try to avoid a ware house around Lat 6.612138 and Long 3.013081	TCN	The warehouse has been avoided
	Option C: Try to reduce the number of angle greater than 15^0	TCN	The multi-criteria modelling used in analyses of route alternatives took into account the number of angle points.
330kv Line Crossing Lagos-Abeokuta Expressway at Apomu Village	Take the line to avoid Mobil filling station at Apomu village, to minimise compensation costs.	TCN	The Mobile Petrol station has been avoided completely.
330kv line at Ibogun-Olaogun Village	**Option B:** Realign the line to avoid the police station opposite Obasanjo's House Also avoid the telecommunication mast Shift, with at least 10m clearance from the corridor	Ogun State Ministry of Environment	The final line route avoided the Police Stations well as all telecommunication towers along the route.
132kv line at OPIC Estate Agbara	Shift the Line to avoid palm oil mills and houses as much as possible.	Ogun State Lands Bureau/Ministry of Environment	All large palm plantations along the route including those in

Sections of the Line	Comments and Recommendations	Stakeholders Having Made the Comment / Recommendation	Actions that addresses comments
Industrial Estate			Aiyepe, Igbele, Agbara, etc has been avoided
Yafin Community Jetty	**Option B:** passing by the shoreline, but shift the line, such that the corridor is least 10m from nearest residence and completely avoiding crossing over the jetty at Yafin Village	Lands Bureau and LASIMRA	The center line is more than 50m from the Yafin Jetty against 15m setback recommended by NERC.
General	Optimise, and do a cost benefit analysis to ascertain the best line route	MPP & UD	The three-line route alternatives subjected to multi-criteria analyses involving, economic, social and environmental issues (see Section 2.5).
General Comments by Community leaders	Compensation should be paid directly to PAPs and not through any third party. PAPs request that they be paid in cash instead of building houses for them. They argue that they want to decide the new location by themselves and control the cost and quality to avoid trust issues	Communities	Although the OP 4.12 discourages cash for land, the Land Use Act allows it. TCN also prefer cash compensation as a policy. Hence, cash payment will be adopted for this project in line with the land use Act, TCN policy and to respect request of the affected people.
Yafin Village	The corridor crossed two shrines, which cannot be moved and also proposed site for Baale's Palace. Need to avoid them	Baale of Yafin	The line has been re-aligned and the sacred sites were avoided
Tohun Village	The corridor crossed the middle of the small community of Tohun	Baale of Tohun	The line was adjusted, to pass at the Southern side of the community,

Sections of the Line	Comments and Recommendations	Stakeholders Having Made the Comment / Recommendation	Actions that addresses comments
			therby minimising houses affected
Igbele Village	The corridor affects palm oil factory and its plantations, which should be avoided considering people driving livelihood from the factory as workers	Community members	The line was adjusted to avoid the factory and its palm plantations.

4.16.5.3 Outcomes and Results Obtained in Stage 3

The Nigerian Conservation Foundation (NCF) is an NGO dedicated to nature conservation and sustainable development in Nigeria, established in 1980 and was registered in 1982 as a Charitable Trust under the Land (Perpetual Succession) Act of 1961 - a policy that was replaced by the Company and Allied Matters Act of 1990.

NCF was invited to participate in the scoping meeting held in Lagos on 22nd June 2017. A meeting of stakeholders also took place on March 07 2018 with the participation of TCN and JICA, where the results of ESIA and RAP was discussed.

After presentation of the project and results achieved the following discussions took place.

- NCF is currently working on IWC (International Water bird Census), which is organized by Wetlands International, to monitor the migratory birds in Badagry area. IWC was also conducted in December 2017- January 2018 at Badagry area. The IWC report in 2017 is available and can be shared with the team.
- Some of the bird species listed as migratory bird is not migratory species, therefore, further review may be necessary. It is agreed that TCN will share the draft ESIA report to NCF to provide their feedback for the potential impact on ecosystem from the proposed project.
- There is no fact that the presence of transmission line causes bird strike around the project area. However, since no bird strike survey has been conducted, NCF has been planning to carry out such a survey to understand actual situation of bird strike.
- Migration route is not main concern for NCF since bird can fly over transmission lines; however, NCF concerns place to stay in winter.

- December is a good timing for bird survey since many species of bird visit the area since the migratory birds fly from outside of Nigeria, e.g. Europe from December to February in general (the biodiversity survey in this ESIA study was conducted in December 2017).
- NCF has been working on several projects for local community to enhance their way of livelihood in sustainable manner. For example, NCF is educating local people to find alternative livelihood resource such as chicken farming, instead of hunting.
- NCF accommodates about 90 staffs and there are several project offices throughout Nigeria. The staff of NCF works as project officer for the community support project.
- NCF shows their interest for the collaboration of TCN`s project if there is any opportunity

As a follow up to the meeting the ESIA repot was shared with NCF and the comments received as well as responses generated are in Table 4.80. furthermore, NCF also sent a report of bird survey they conducted in the Mangrove Swamp area around Badagry (See Appendix 3A).

Table 4.80 NCF Comments and Response

<table>
<tr><td>COMMENT FROM NCF MINUTES OF MEETING</td><td colspan="2">Some species listed are not migratory</td></tr>
<tr><td>RESPONSE</td><td>Four (4) species were listed as migratory in the ESIA. These species are;
• Ardea alba,
• Ardea cinerea,
• Egreta garzetta, and
• Milvus migrans
All were either full migrants or partial.</td><td>References;
• Habitat/Ecology section of IUCN RED LIST 2017 version 3
• Ringim, A. S., Magige, F. J. & Jasson, R. M. (2017). ‘A comparative study of species Diversity of Migrant Birds Between Protected and Unprotected Areas of the Hadejia-Nguru Wetlands, Nigeria’
• Checklist of Western Paleartic bird’s species migrating within Africa 2004</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3">RESPONSE TO NCF REQUEST TO INCOPORATE RESULT OF THEIR STUDY (see Appendix xx) INTO THE ESIA REPORT</td></tr>
<tr><td colspan="3">It is believed that the essence of adding the document ‘2016 coastal flyway counts for</td></tr>
</table>

Nigeria: A water birds count along the coastal creeks and Estuaries in Badagry and Calabar' is to possibly incorporate the Avian species inventory of Badagry area into the draft ESIA report. It would not be proper to add inventory of species obtained from a mangrove wetland (see page 2 of PDF document sent by NCF) to the LAGUN report which do not cut across (see project RoW and habitat classification in the EIA report). The Badagry SS where the ROW terminates is a Riparian Swamp.

CHAPTER FIVE

5.0 ASSOCIATED AND POTENTIAL IMPACT

INTRODUCTION

This chapter provides information on the assessment of the associated and potential environmental and socio-economic impacts from the proposed Project. The impacts from both short-term construction phase and the long-term operational phase are being considered. A description of the assessment methodology used to assess the significance of impacts, taking into account impact magnitude and sensitivity of receptors and resources affected, is provided below.

The assessment considered project activities in the following phases of the project development. The detailed description of the activities in each phase is provided in Chapter 3.

- Pre-Construction Phase
- Construction Phase
- Operation and Maintenance Phase
- Decommissioning and Closure

The following environmental indicators, receptors or resources affected by potential impacts were also considered:

Biophysical Environment:

- Air quality;
- Noise, vibration & EMF;
- Soils and geology;
- Water resources;
- Terrestrial 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 with the potential impacts of Project activities are identified and evaluated of the significance of the impacts. A summary table of all potential impacts with their significance is presented in Tables 5.9 and 5.10.

5.1 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.

5.1.1 Nature/Type of impacts

There are number of ways that impacts may be described and quantified. The definitions adopted for this ESIA are described in Table 5.1.

Table 5.1 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 stack emissions and the ambient air quality). **Secondary** – impacts that result from the primary interaction between the Project and its environment as a result of subsequent interactions within the environment. **Indirect** – impacts that result from other activities that are encouraged to happen as a consequence 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 as a result 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. 20 years). 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 (i.e Ogun State). **National** - impacts that affect nationally important environmental resources; affect an area that is nationally important/protected; or have macro-economic consequences (ie 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.

5.1.2 Assessment of Significance

There is no statutory definition of 'significance' and its determination is therefore necessarily partially subjective. For the purposes of this ESIA, the following definition of significance has been adopted:

"An impact is significant if, in isolation or in combination with other impacts, it should, in the judgment of the ESIA team, be taken into account in the decision-making process, including the identification of mitigation measures (by the Project) and consenting conditions (from Regulators and Stakeholders)."

Criteria for assessing the significance of impacts stem from the following key elements:

- Status of **compliance** with relevant Nigerian legislation, policies and plans and any relevant Nigerian or industry policies, standards or guidelines;
- The **magnitude** (including nature, scale and duration) of the change to the natural or socio-economic environment (e.g. an increase in noise, an increase in employment opportunities), expressed, wherever practicable, in quantitative terms. The magnitude of all impacts is viewed from the perspective of those affected by taking into account the likely perceived importance as understood through stakeholder engagement;
- The nature and **sensitivity** of the impact receptor (physical, biological, or human). Where the receptor is physical, the assessment considers the quality, sensitivity to change and importance of the receptor. For a human receptor, the sensitivity of the household, community or wider societal group is considered along with their ability to adapt to and manage the effects of the impact; and
- The **likelihood** (probability) that the identified impact will occur. This is estimated based upon experience and/or evidence that such an outcome has previously occurred.

For this assessment, significance has been defined based on five levels described below

Positive impacts provide resources or receptors, most often people, with positive benefits. It is noted that concepts of equity need to be considered in assessing the overall positive nature of some impacts such as economic benefits, or opportunities for employment.
Negligible impacts (or Insignificant impacts) are where a resource or receptor (including people) will not be affected in any way by a particular activity or the predicted effect is deemed to be ‘negligible’ or ‘imperceptible’ or is indistinguishable from natural background variations.
An impact of minor significance (‘Minor impact’) is one where an effect will be experienced, but the impact magnitude is sufficiently small (with or without mitigation) and well within accepted standards, and/or the receptor is of low sensitivity/value.
An impact of moderate significance (‘Moderate impact’) is one within accepted limits and standards. Moderate impacts may cover a broad range, from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly to design an activity so that its effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is ALARP. This does not necessarily mean that ‘Moderate’ impacts have to be reduced to ‘Minor’ impacts, but that moderate impacts are being managed effectively and efficiently.
An impact of major significance (‘Major impact’) is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of ESIA is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (ie ALARP has been applied). It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones

such as employment, in coming to a decision on the Project.

For environmental impacts the significance criteria used in this ESIA is shown in

Table 5.

Table 5.2 Overall Significance Criteria for Environmental Impacts

Receptor sensitivity (or resource value)	Impact magnitude		
	Low	Medium	High
Low	Minor	Minor	Moderate
Medium	Minor	Moderate	**Major**
High	Moderate	**Major**	**Major**

For social impact assessment, the perceptions of stakeholders, expressed as opinions around certain issues, can be as important as actual impacts. Consequently, the concept of perception is explicitly brought into the evaluation of significance after an impact is evaluated. When an impact is of significant stakeholder concern, this may be cause to raise the significance rating. This prompts the formulation of more rigorous and appropriate mitigation measures which focus on the source of the impact and also address stakeholder perceptions. The risk of not addressing stakeholder perceptions is that reputational damage could arise, resulting in the loss of a 'social license to operate'.

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 (ie 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 5.1.

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 5.3

Table 5.3 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
	As far as one-time events (e.g. air emissions) or slowly developing effects are concerned (e.g. impacts on local life style)	As far as possibly recurring impacts are concerned, such as accident or unplanned events (e.g. traffic accident, fire)

5.2 AIR QUALITY

5.2.1 Construction Phase

Emissions from vehicles and equipment (SO_2, CO, NOx, CO_2, PM)

The movement of vehicles for the construction will result in PM, SO_2, CO, NO_x, 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 HC and CO emissions decrease, while NO_x and CO_2 emissions increase. Emissions from diesel-fuelled vehicles include particulate matter, NO_x, SO_2, CO and HC, 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 to be **minor** due to the relatively low number of vehicles and equipment compared to the already existing traffic load on the roads and relatively short duration of the construction phase.

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 vehicle 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 stock piles. 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 temporary nature of construction differentiates it from other fugitive dust sources as to estimation and control of emissions. Construction consists of a series of different operations, each with its own duration and potential for dust generation. In other words, emissions from any single construction site can be expected (1) to have a definable beginning and an end and (2) to vary substantially over different phases of the construction process. This is in contrast to most other fugitive dust sources, where emissions are either relatively steady or follow a discernible annual cycle. Furthermore, there is often a need to estimate area wide construction emissions, without regard to the actual plans of any individual construction project. For these reasons, either area wide or site-specific emissions are not directly calculated and modelled.

The impact of this phase on air quality is of **minor** significance and consequence because of the relatively short duration of the construction, the limited earthworks required on the site and the involvement of a limited number of construction vehicles.

Climate change impact due to construction activity

A series of stages are involved in estimating the climate change impact of an electricity transmission network. During the construction stage, following activities are considered for climate change impact.

a. 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. Below is 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 tonnes (for 330 kV) and 2.8 tonnes (for 132 kV). Normal Voltage 330 kVrms (for 330 kV) and while 132 kVrms (for 132kv). The average distance between each 330 kV tower is 400 m – 450 m and 325 – 350 m (for 132 kV). Right of way for 330 kV TL is 50m while that of 132 kV TL is 30 m. It is estimated that the height of towers will range between 42m -57m (for 330 kV) and 28 m – 32 m (for 132 kV). The principal materials and their Embodied CO_2 are presented in Table 5.4.

The Team confirmed specification of the conductor on 132 kV and 330 kV transmission lines using TCN standard, the specification are as follows:

i. 132 kV Transmission Line Type of Conductor Aluminum Alloy Conductor Steel Reinforced (ACSR) Size： Code named : Bear (British standard)

ii. 330 kV Transmission Line Type of Conductor Aluminum Alloy Conductor Steel Reinforced (ACSR) Size： Code named : Bison (British standard)

Table 5.4 Principal Materials and their Embodied CO_2

S/No.	Material	Embodied CO_2 ($kgCO_2/kg$)
1	Aluminium	8.24
2.	Copper	3.88
3.	Steel	2.82
4.	Ceramics (fittings)	1.05
5.	HPDE	1.60
6.	Concrete	0.13
7.	Concrete (2% reinforced)	0.13

Source: World Bank (2010)

→ **Energy use in the construction activity**

There is on-site energy use in the actual construction of electricity transmission project, primarily in the form of transport fuel for construction vehicles and the shipping of components. This energy use could be considered a component of direct non-generation emissions, because it is at the project site, even though it occurs before the actual operation of the transmission project. This source of emissions is likely to be very small compared to the lifetime energy and emissions impacts of the project.

The methodological approach to construction emissions is straightforward, but calculating this source is only possible if the underlying data are readily available, particularly data on the quantities of fuel consumed by construction vehicles. Data for fuel calorific values and emission factors are available from IPCC and GHG Protocol, but the quantity of fuel normally come from the project documents. This information is not something that is evaluated even during the detailed design phase of transmission and distribution projects World Bank (2010). Hence, it was not possible to provide estimates.

→ **Land Clearing**

Construction of transmission lines and substations, affects carbon stored in biomass and soil. An obvious example would be clearing forest for a long-distance transmission line, which would result in a one-time release of the carbon stored in the vegetation. Carbon loss from forest clearance is estimated by multiplying aboveground biomass in project area and carbon fraction value to convert dry matter to carbon based on emission factors provided in Harmon *et al*, (2001) and summarised in Table 5.5.

$$\mathbf{C_{LB} = B_{AG} \text{ x } A \times CF \text{ x } 44/12}$$

C_{LB} =Carbon stocks in living biomass in forest (t-CO_2e/y)

B_{AG} = aboveground biomass, (t-dm/ha)

A = land area of organic soils, (ha)

CF = carbon fraction of dry matter (t-C/t-dm) (default = 0.5, IPCC GPG-LULUCF)

R = root-to-shoot ratio

Table 5.5 GHG Computations for Biomass Clearing

	Description		Value	Unit	Source
A	land area of Forest		114.3	ha	JICA team
B_{AG}	Aboveground biomass	Evergreen Forest	43.4	t-dm/ha	Table 3.2.2, IPCC GPG-LULUCF
CF	Carbon fraction of dry matter	Default value	0.5	t-C/t-dm	IPCC GPG-LULUCF

Primary and secondary forests, swampy area, riparian vegetation and plantations are the land covers to be cleared. From Table 4.20, the total area affected on this basis is 114.3 ha.

Therefore, carbon loss from clearing of vegetation for construction

$$C_{LB} = 43.4\text{t-dm/ha} \times 114.3\text{ha} \times 0.5 \text{ t-C/t-dm} \times 44/12 = 9{,}094 \text{ t-CO2e.}$$

The total GHG Emission (tCO_2e) from all project activities is summarized in Table 5.6.

Table 5.6 Total GHG Emission from Activities Related to the Project

Activity		Estimated Weights (tons) - from Table 3.7	Associated GHG Emission (tCO_2e)
a. Material Production	Towers	801.1	2,259.1
	Overhead Ground Wire	14.3265	118.1
	Conductors and OPGW	792	6,526.1
	Insulators and Fittings	4860	5,103.0

b. Energy use in construction activity	* Insufficient data	xx
c. Forest clearing	See Section 5.3.1.3c above	9094
Total		**23,100**

* Estimate methods rely of fuel consumption by construction vehicles and materials shipping, which is not available

GHG will be emitted from material production as well as energy use in construction activity. In addition, there will be carbon loss due to the forest clearance. Total 23,100 tons of CO_2 equivalent of GHG emission will be emitted due to the construction activity. The large portion of GHG emission is due to manufacture of construction materials, which is an indirect impact and accounts for 97% of the total. Since the transmission line route was selected to avoid and minimize the forest area as reasonably practical as well as the fact that the GHG emission during construction stage is short and temporally, the impact on climate change is **minor.**

5.2.2 Operation phase

The operation of the transmission line will not contribute to any atmospheric emissions directly while substation operation will emit SF_6 and contribute to greenhouse gases effect and hence the predicted impacts are **minor**.

5.2.2.1 Climate change impact during operational stage

Sulfur hexafluoride is used in insulation and current interruption applications in transmission network systems and in gas-insulated switch. Sulphur hexafluoride is an extremely potent greenhouse gas that is used for several purposes when transmitting electricity through the power grid. Several factors affect SF_6 emissions from electric power systems, such as the type and age of the SF_6-containing equipment and the handling and maintenance procedures practiced by electric utilities. Because of its long-life span and high global warming potential (GWP), even a relatively small amount of SF_6 can impact the climate. The electric power industry uses roughly 80 percent of all SF_6 produced worldwide. Ideally, none of this gas would be emitted into the atmosphere. In reality, significant leaks occur from aging equipment, and gas losses occur during equipment maintenance and servicing. With a GWP 22,800 times greater than carbon dioxide (CO_2) and an atmospheric life of 3,200, one pound of SF_6 has the same global warming impact of 11 tons of CO_2 (USEPA, 2017). Results are presented in Table 5.7.

Table 5.7 Estimated Greenhouse Gases Emissions for Each Substation

Parameter	Energy Data Input (kWh)	ton CO_2/kWh	kg SF_6/kWh as CO_2 equivalent
EJIO SUBSTATION			
150MVATransformer	120,000	98.4	487
150MVATransformer	120,000	98.4	487
60MVA Transformer	48,000	78.8	390
60MVA Transformer	48,000	78.8	390
Total		**354.4**	**1754**
AJEGUNLE SUBSTATION			
150MVATransformer	120,000	98.4	487

150MVATransformer	120,000	98.4	487
60MVA Transformer	48,000	78.8	390
60MVA Transformer	48,000	78.8	390
Total	**-**	**354.4**	**1754**
BADAGRY SUBSTATION			
60MVA Transformer	48,000	78.8	390
60MVA Transformer	48,000	78.8	390
Total		**157.6**	**780**
AGBARA SUBSTATION			
60MVA Transformer	48,000	78.8	390
60MVA Transformer	48,000	78.8	390
Total	**-**	**157.6**	**780**
TOTAL FOR ALL SUBSTATIONS		**1024**	**5068**

When there are significant leaks from aging equipment, and gas losses occur during equipment maintenance and servicing, the project will have a significant contribution of the emission of GHG emissions with estimated total emissions of 1,754kg SF_6 /kWh as CO_2 equivalent at Ejio and Ajegunle Substations, both of which are 330/132/33 kV and 780kg SF_6 /kWh as CO_2 equivalent at the 132/33kV substations at Badagry and Agbara each. Additional carbon emissions will also be generated by transport vehicles during operations and inspections. The amounts to be generated by this means is likely to be insignificant, since line inspection is not done frequently and the transmission lines will be fitted with SCADA system for communication, monitoring and controls as well as other operational activities, which minimizes travelling.

As discussed above, a certain amount of GHG will be emitted during the operational stage. However, the improvement of electricity grid would contribute to mitigate the GHG emission and identified as the key action plan for climate change Nigeria`s nationally determined contribution (NDC) implementation.

Therefore, the climate change impact during the operational stage is positive. minor, if the maintenance will be conducted appropriately. However, since the GHG will be emitted during the maintenance and under the as a result of uncommon condition, the rating of greenhouse gases emission during operation necessary mitigation measure is required is moderate.

However, the proposed project is improvement of transmission line system in Nigeria, which is in line with Nigeria`s nationally determined contribution (NDC) implementation."

Therefore, the climate change impact during the operational stage is **beneficial**, assuming that the maintenance will be conducted appropriately.

5.2.3 NOISE, VIBRATIONS AND EMF

5.2.3.1 Construction Phase

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 neighbouring communities and local fauna. Communities likely to be affected include Ejio, Arigbajo, Apomu, Egbele, Kooko, Ajegunle, Apena, Ikoga-Ele, Bandu, Idayin and Agbara neighbourhood.

The detailed breakdown of activities is not available at this stage, and as the Contractor has not yet been appointed, no construction plant inventory is available at the time of assessment. Therefore, an assumed plant inventory is provided in Table 5.8. Assumptions have made regarding the type of construction plant, based on experience with similar projects. The noise levels present are data provided on standard noise levels of a wide variety of construction equipment (OSHA, 2003). It has been assumed that only one of each type of plant will be on used on each site during any day or night period.

Table 5.8 Assumed Construction Equipment Sound Pressure Level Inventory

Construction Equipment	SPL, dB(A)
Bulldozer	115
Backhoe	96
Impact pile driver	101
Loaders	108
Vibratory roller	102
Fuel truck	104
Welding machine	101
Cranes	106
Dump truck	105
Grader	114
Fork lifts	112
Compressors	104
Generators	93

Source: OSHA (2003)

Noise impacts will be more predominant within 500 m of the activity areas. People live within few meters of the substation perimeter in Ejio and Ajegunle, and hence will be disturbed during construction. The baseline noise levels around these two areas are similar, ranging between 75.6 and 60.3dBA with a mean of 55.2 dBA. The area is may be considered noisey due to vehicular traffic, music/video CD vendors, churches, vegetable grinders, etc. hence, the need to minimise additional noise discharge, considering the baseline noise levels has exceeded the WHO guideline for community noise of 50-55dBA for outdoor living. The proposed construction timeframes for this project estimates that all construction will take place over a period of 9 months. The construction activity will be undertaken during daytime. Construction activities will be concentrated and done sequentially so that no area is prone to extensive 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 **Moderate** significance, especially at where residential area is close to the construction area.

5.2.3.2 Operation Phase

Noise during the operation phase, maintenance activities conducted near pylons, substations, 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. Management measures proposed to reduce noise impacts during the construction phase will also be helpful in reducing noise impacts through the operation phase.

Moreover, operating transmission lines and substations emit a permanent background sound which is audible, and which may also disturb communities in the vicinity to the line or substations. Noise produced by transmission lines, can be experienced as a buzz or a crackle, whether noise produced by substations comes mainly from power transformers. In general, noise produced by substations is higher than that produced by transmission lines.

The audible noise emitted from high-voltage lines is caused by the discharge of energy that occurs when the electrical field strength on the conductor surface is greater than the 'breakdown strength' (the field intensity necessary to start a flow of electric current) of the air surrounding the conductor. This discharge is also responsible for radio noise, a visible glow of light near the conductor, an energy loss known as corona loss and other phenomena associated with high-voltage lines.

The degree or intensity of the corona discharge and the resulting audible noise are affected by the transmission voltage and weather conditions such as humidity, air density, wind, rain, drizzle and fog. 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 (Robert Dent, IEEE). Also, noise may be especially noticeable during night time 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 Ejio, Arigbajo, Apomu, Bandu, Kooko, Ajegunle, Idayin, Agbara, Apena, Eberese, Ikoga-Elle, Itire, Opo, Wezhume, Gboje, Gbosa, and Hungbeji, Gboje.

Overall, noise-related impacts during the operation phase are expected to be **minor**, with implementation of mitigation measures.

5.2.4 GEOLOGY AND SOILS

5.2.4.1 Pre-construction and Construction Phase

Impact on Geology and Soil Structure

During the construction phase, construction of access roads, digging of foundation pits for the towers and removal of vegetation (for foundation purposes) are the main activities likely to affect soil structure and quality. Foundations will be dug up to variable depths, depending upon the tower type and soil characteristics. At the tower sites, all vegetation within the footprint of the tower base will be cleared to ground level.

Excavation works and removal of vegetation, especially on steep slopes, would render soils unstable and more vulnerable to erosion. Soil quality may also deteriorate as a result removal of vegetation.

Although existing roads and tracks will be used to access the corridor, access roads along the corridor will be constructed and vehicle movement around the project area can lead to soil compaction in those areas where soils are clayey or highly saturated. These areas include swamps around Erekiti, Tohun and Yafin. 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 will help reduce adverse effects resulting from soil compaction in areas covered by this soil type.

Considering the that only small areas are exposed and impact localised and very few ground water sources, duration short, sensitivity of the receptor medium and its magnitude will be **Moderate**, during the construction period.

Potential contamination of soil from inadvertent release of hazardous or contaminating material

Finally, 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. This impact is likely to occur only in densely built up areas like Ejio, Arigbajo and Ajegunle. Avoiding storage of materials within these areas as well as implementation of an Emergency Response Plan will help manage accidental spills properly. Considering the medium magnitude of this activity and medium receptor sensitivity, the impact is **moderate.**

5.2.4.2 Operation Phase

Impact on Geology and Soil Structure

During maintenance, vehicular movement along unpaved access roads, could cause soil compaction which will affect soil organisms. This effect is likely to affect soils in swampy areas of Badagry around Erekiti, Tohun and Yafin. Considering the that only small areas are exposed and also the low frequency of routine inspection of the lines, the impact will be **minor**.

Potential contamination of soil from inadvertent release of hazardous or contaminating material

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.

However, the application of management measures listed above will help reducing this risk significantly. In the event of accidental leaks and/or spills, the impact significance will depend on the volume of leaks and/or spills and the nature of pollutants. Implementation of an Emergency Response Plan will help manage accidental spills/leaks properly. Overall, the potential impact on soil quality during operation is considered **negligible**

5.2.5 WATER RESOURCES

5.2.5.1 Construction Phase

Impact on hydrogeology due to exploitation of water for construction of tower foundation and access road

Sources of impacts to watercourses are removal of vegetation, construction of access roads, vehicle movement along the ROW and construction sites and excavation/piling for tower installations.

The proposed line route crosses a permanent watercourse at three points along the 330kV line at Sojuolu, Olowu and Ajegunle. The 132kV crosses four -at Iju-iroko and Idayin/Agbara axis as well as Ikoga-Elle and the Badagry Creek. Vegetation removal in riparian areas can increase soil erosion in erosion prone areas, causing sediment to be deposited into the waterbodies, especially during rain events. Construction of access routes under the line as well as vehicle movement along the construction sites can result into changes in hydrology of watercourses. Depending on the level of disturbance, watercourses can be temporarily or permanently impaired. However, mitigation measures such as using existing roads instead of constructing new ones and limiting construction-related traffic (vehicles, machinery) to work areas will allow reducing impacts on water resources.

Erection of pylons within watercourses could also potentially modify watercourse dynamics, reducing water flow and ultimately converting a lotic system into a lentic system. However, with a pylon spacing of an average of 300- 400m, no pylons will be installed in any of the riverbeds, since all are less than 50m in with. Therefore, the, hydrodynamics of these watercourse are not expected to be affected significantly. Therefore, the impact on hydrogeology is **minor.**

Potential contamination on water resource
In addition, unsound waste management practices are likely to have an effect on water quality (e.g. improper waste disposal in surface waters). Development and implementation of a waste management plan by the contractor and sub-contractors will allow mitigating that risk.

Finally, the risk of accidental oil spills from heavy machinery is present during the construction phase and could result into both surface water and groundwater contamination. The contamination level resulting from accidental spills will depend on their magnitude. However, implementation of an Emergency Response Plan will help managing them properly.

Moreover, groundwater could be contaminated during digging of foundation pits for the towers or substations, particularly near watercourses or the swampy area around Badagry. Proper management of excavation work will allow avoiding these potential impacts. Given the fact that the local community uses Oke-Oji River and the Ajegunle River for bathing and washing and the Badagry Canal is used for water transport by the Communities of Yafin, Tohun, Irgbon and Erekiti these water bodies have high sensitivity. This coupled with the magnitude of the potential consequences of an uncontrolled spill, impact is rated as **moderate**.

5.2.5.2 Operation Phase

No impact on the surface water and hydrogeology of the area is anticipated from the operation of the transmission line and the substations and therefore considered **negligible**.

5.2.6 TERRESTRIAL ECOLOGY

5.2.6.1 Construction Phase

Impact on Terrestrial flora and Fauna
Power line construction will require clearing vegetation taller than 4 m along a 29.5 km long and 50 m wide corridor for 330kV as well as 52.2 km long and 30 m wide for 132kV (excluding 6km shared corridor on multi circuit towers). The total land area needed for the project is 379.7 ha (304.1 ha for the lines and 75.6 ha for the three new substations). However, only 114.3 ha are covered by the vegetation that must be cleared. Vegetation clearing will lead to a permanent loss of woody species in terrestrial habitats found along the corridor.

Most of the power line right-of-way consists of agricultural areas including Agricultural-Shrubby vegetation Mozaic, fallow agricultural lands, Cultivated Land and Intensive Cultivation which cover together upto half of the affected land, i.e 150 ha of the right of way. However terrestrial agricultural dedicated areas still host trees and shrubs species. This habitat which supports woody species, will experience more significant disturbances. Other habitats, which are sparsely vegetated and consist mostly of herbaceous vegetation, will experience fewer losses due to clearing, but remain vulnerable to disturbances that could occur during the construction phase, in particular to vehicles and machinery. The flora present in the power line right-of-way does not include any species identified in the IUCN Red List of threatened species or in a national list (Isichei 2010). There are no known endemic species in the study area.

Bidens pilosa Chromolaena odorata, Mimosa pudica and Dalbergia sissoo so listed as invasive to Nigeria was found in this study. A total of seventy-nine (79) fauna resources were inventoried in the study, including Mammals, Aves, Reptiles, and Amphibians (See Section 4.13.8.3 and Appendix 3.10). However, it is the avifauna that are likely to be affected more as a result of noise generated during construction activities and failing of trees within the right of way.

Vegetation losses represent habitat loss for local fauna and flora. Even if local fauna consists mostly of common species, terrestrial habitats impacted are susceptible to host some threatened wildlife species. Small fauna species are more susceptible to be impacted by habitat loss. Mortality could occur during vegetation clearing operations.

Management measures, such as targeted clearing measures and compensation for area and field tree loss, will limit the impacts. In certain cases, vegetation clearing operations will consist of only cutting a few scattered trees and other woody vegetation. Compensation will be developed for sensitive habitats and this will be monitored to ensure no net loss of critical/endangered species.

Vegetation clearing for the construction of the power line and access roads will cause habitat disturbances that could create suitable conditions for the establishment of invasive species. The spread of invasive species can have negative impacts on local species, by modifying plant community composition. Alien invasive species have the potential to substantially modify wildlife habitat which can impact associated fauna populations.

Many use-value species will need to be cleared, reducing their availability for local communities. Moreover, creation of access roads can expose forest areas to increased human activities. This may have impacts on existing flora and fauna that may be of use to the local communities.

Although local in nature, this may have long-term effects, thus the magnitude of the impact is high. Since there are sensitive ecosystem along the river banks and the swampy Badagry area, the receptor sensitivity is high. Therefore, the impact significance is **Moderate**

Impact due to the introduction of Alien species

Vegetation clearing for the construction of the power line and access roads will cause habitat disturbances that could create suitable conditions for the establishment of invasive species. The spread of invasive species can have negative impacts on local species, by modifying plant community composition. Alien invasive species have the potential to substantially modify wildlife habitat which can impact associated fauna populations *Bidens pilosa*

Chromolaena odorata, Mimosa pudica and Dalbergia sissoo so listed as invasive to Nigeria was found in this study (See Appendix 3.10). Considering the small area to be cleared and non-observance of invasive species in the area of influence, this impact is **minor.**

Impact on Ecosystem Service

There is a total of twenty-six (26) species censored in the study offers Provisioning Services (see Appendix 3.9). Some provide food/fibre/energy, others are sources of raw materials and medicinal services. Some of the species include *Albizia adianthifolia, Albizia zygia, Abuliton mauritiana, Asystasia vogeliana, Annona senegalensis, Bambusa vulgaris, Ceiba pentandra* and *Eleaise guineensis.*

Furthermore, *Chromoleana, Euphorbia, Nymphea, Lasimorphia, Ficus* and *Ceiba* are six genera found in the study area, that are applied to addressing carbon sequestration and storage, regulation of water flow, local climate regulation, erosion prevention and maintenance of soil fertility, and biological control.

Many of these species will be cleared along the ROW, particularly between Ijuiroko and Eberese and Ajobo-Akia to Ikoga-Elle. In addition, raffia palm and palm trees around grow in the wild in the communities between Javie and Yafin along the Badagry route will also be affected. Due to the medium receptor sensitivity and low medium sensitivity, this impact is **moderate**

5.2.6.2 Operation Phase

Impact on terrestrial flora and fauna

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 and wetlands. The presence of the power line can affect birds 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 (BirdLife, nd).
- → Electrocution: Due to contact with live components.

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. Along the line route, collisions may be more frequent within the rural areas between Apena and Badagry mainly. 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 (cranes and waterfowl). There are no bird routes in the area that may be affected by the lines.

Aquatic birds, including shorebirds, waterfowl, cranes, and herons, are known as the most common victims of power transmission lines (Rioux et al. 2013). Collision risks are higher for species with small binocular fields of vision and large blind areas. Thus, visual field topographies, which have evolved primarily to meet visual challenges associated with foraging, may render certain bird species particularly vulnerable to collisions that extend into the otherwise open airspace above their preferred habitats. The concentration of water birds inside wetlands could increase the impacts on their populations.

Proposed mitigation measures will help reduce the risk of collision and electrocution. However, the success of mitigation measures could be highly variable from species to species. A proper bird mortality monitoring program should then be developed and implemented to identify areas and species that are more impacted. Collisions are thought to be more common during migratory movements (Morkill and Anderson 1991), which suggests that a better understanding of impacts during migration as well as other critical periods is needed.

Overall, the significance of the potential impact on avifauna is considered **moderate**, with the implementation of mitigation measures.

Impact on terrestrial ecology of operations and maintenance is also considered **negligible** as localised and in an already degraded ecosystem.

Impact of introduction of invasive species
This impact is not likely during operation.

Impact on Ecosystem Service
Plant species within ROW will not be allowed to grow above 4m in order to avoid short circuiting of the line and other safety issues. The species that offer provisioning services in the area would have been cleared during construction, will now be allowed to grow upto 4m along the ROW. However, since the affected area would be limited to the proposed ROW (30m width or 50 m width) and these local species will regenerate again as sufficient area with similar habitat is available around the affected area, the impact will be considered as minor. Therefore, this impact is considered **negligible**.

5.2.7 Aquatic ecology

5.2.7.1 Construction Phase

The construction of the roads, vegetation clearing, and pylon construction may cause wetland and riparian habitat loss. Due to their soft and spongy soils, wetlands around Yafin, Tohun, Erekiti and other swampy areas near the Badagry substation cannot support heavy loads, such as vehicles and machinery, and can become greatly damaged. Hence, there may be need to construct temporary access road to each tower spot.

Some species observed to occur solely in riparian habitat, include *Lasimorpha senegalensis*, *Mitragyna ledermannii*, *Raphia hookeri* and *Nymphaea lotus.* These mainly are found around Alapako to Adelaja, Egbele to Kooko, Ikoga Ile to Iragbo, Igbo Fipe to Zenvie and the Badagry sub Station. All along the 132kV lines. *Mitragyna ledermannii* is the only Vulnerable (VU) species.

Construction activities can influence water quality or modify flooding patterns and surface water flow over a certain period. The project may not avoid access road construction on wetlands/swamp.

Construction activities could also cause an increase in suspended solids in wetlands and aquatic environments, which could result in siltation of feeding sites and breeding grounds of some species, particularly for fish species. Furthermore, an increase of organic matter in aquatic environments could lead to an increase in biochemical oxygen demand (BOD) and a decrease in dissolved oxygen that could be locally harmful for aquatic fauna species. Water could also become contaminated by accidental oil and hydrocarbon spills. In lentic or stagnant aquatic environments, the contamination could exacerbate the impacts of the spills because contaminants could become locally concentrated. Rapid response measures in case of a spill will reduce associated impacts.

Impact on aquatic and semi-aquatic habitats will be limited in areas where there will be direct construction of pylons and substations [*i.e. tower foundation*]. Impacts will be local and the magnitude will be low. Since these areas are highly sensitive, the impact significance is **moderate**.

5.1.7.2 Operational Phase

Hydrological condition modifications that could potentially be caused by the presence of pylons in the rivers and perennial streams and of access roads could impact aquatic environments' ecological characteristics. The proposed line route crosses a watercourse at three points along the 330kV line at Sojuolu, Olowu and Ajegunle. The 132kV crosses at four -at Iju-iroko and Idayin/Agbara axis as well as Ikog-Elle and the Badagry Creek

These disturbances could also influence habitat availability and presence of some fauna species. It is not recommended to build permanent access roads in wetlands or in floodplains.

During the operation phase, workers and vehicles travelling along the ROW and the access road, especially for infrastructure maintenance and repair, could cause the spread of invasive alien species. Rigorous monitoring of invasive species will be implemented.

Upon construction of the pylons and other structures, impact on acquatic and semi-aquatic habitats and fauna will be limited. Since the sensitive of these habitats are **Low**, the impact significance is considered **minor**.

5.2.8 VISUAL AMENITIES

5.2.8.1 Construction Phase

Site clearance and site development

Aesthetic impacts during the construction phase will be limited to work zones. Deforestation of the ROW will change the landscape in rural areas, which is very limited since it is mainly crossing an agricultural area. 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. To minimize the impacts of the construction activities on the landscape, the existing access roads will be used whenever possible. Finally, all temporary work zones will be restored after construction**.**

Construction Derived Waste

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 OGEPA or LASEPA as applicable.

Such impact is likely to be experienced by the villagers inhabiting near the construction area. The duration of the construction activity is short term in nature and sensitivity of the area is also low, considering the number of existing high voltage in area. The potential impact on Visual and aesthetics is **minor** significance.

5.2.8.2 Operation Phase

The overall aesthetic effect of a transmission line is likely to be negative for some people, especially in rural areas along the Ajegunle to Badagry Sections. The other areas already have 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.

Research and experience show that the reaction to the aesthetics of transmission lines varies. Some residents do not notice nor oppose to it from an aesthetic point of view. For others, transmission lines or other utilities can be considered part of the infrastructures necessary to sustain life and everyday activities and are therefore acceptable. Moreover, for some, new transmission lines can be seen in a positive way since they are associated with economic development. The consultations conducted with the local populations and other stakeholders (see Section 4.15) have not raised any concern with respect to visual aspect. However, due to the change in landscape with introduction of new landscape element , especially in an area where transmission line will pass into the forest /swampy area in the Badagry axis, overall impact is considered to be **moderate**.

5.2.9 Land Planning and Use

5.2.9.1 Construction Phase

Agricultural activities will be affected during the construction because of the restriction of farming within the wayleave. 2,171 households will loose certain portions of their crop land within the ROW and substation sites. Loss of land and crops will have to be compensated before the beginning of the construction. These aspects are detailed in the RAP.

Impacts of land acquisition and changes in land use can lead to moderate magnitude with long-term effects. The impact significance is still considered **major** because it has to do with means of livelihood as well as the high number of people affected.

5.2.9.2 Operation Phase

Enhancement of local economy as a result of stabilization of electric power may change the land use in the project area. The degree and nature of the impact would be varied, and it is difficult to predict the impact. However, stabilization of the electricity would mainly contribute to improve the condition of existing development area and no significant land conversion from natural environmental area (forest, swampy area) is likely. Therefore, the impact on land use during the operational stage is considered to be generally **positive**.

5.2.10 Stakeholder and Community Relations Management

5.2.10.1 Construction Phase

The construction activities for the Transmission Lines and Substations may cause community concerns linked to impacts associated with issues like air and dust emissions, traffic, influx and community safety/security, noise/vibrations and the adverse impacts and inconveniences experienced from these issues.

In addition to the above, community/stakeholder perceptions are related to the cumulative impacts resulting from existing Ikeja-West Transmission, Omotosho Transmission Line, Egbin Transmission Line, Ogijo Iron Smelting Company and Olorunsogo Power Station operations. There are legacy issues present on account of environmental impacts from existing Transmission Lines reported stakeholder concerns around it, which will potentially reflect on the proposed Transmission Line and Substations project. Especially some people living around Ejio, Ajegunle and Agbara axis, along RoW of feel concerned about the additional activities of the transmission line construction and potential impacts on their health, safety and/or security. Although the number of people may be considered as limited and the construction activities are only temporary, the impact can be very serious for some people, especially for people with reduced resilience. The potential impact is considered **moderate**.

5.2.10.2 Operation Phase

Community concerns about cumulative impacts of the existing activities along proposed Transmission Lines and Substations will continue from the construction phase into the operation phase.

The operation and maintenance of the proposed projects may cause community concerns linked to impacts associated with issues like nuisance of noise and concerns of potential electrocution, bush fires and electromagnetic fields and interference of radio/TV transmission.

Noise can be generated by transmission lines, by the so-called Corona effect. This is a limited breakdown of electricity in the air. Conductors are designed to reduce this effect. However, at certain times a ‘hissing’ sound can be heard, sometimes with a low frequency ‘hum’. Other noise emissions in the operation phase maybe experienced in times of maintenance at the towers or lines. This will only be temporary and with limited frequency.

Further, the people living close to the RoW have concerns about electromagnetic fields imposing health impacts. A wide safety zone within which no human habitation or activity is allowed (25m for 330kV and 15m for 132kV lines) will ensure that such effects are reduced below the minimum acceptable level established by ICNIRP. Exposure stays within the limits set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP).

Another nuisance people near the RoW of the transmission lines are concerned about is an interference of the high voltage transmission lines with radio and TV transmission. No negative impact on houses and secondary structures is expected during the Operation Phase since these structures have been moved before construction. Moreover, transmission lines do not usually interfere with television and radio signals. In some cases, interference can occur very close to the ROW due to mild broadcast signals or poor reception equipment. [*Edvard, 2011)]*

Overall, there will be no direct impact on existing structures during operation phase, but there may be low impact in terms of interference with television and radio signals.

Households living near the RoW, who have currently erratic power supply and who will not get connected to the transmission line, may feel disappointed by not benefiting from the Project, while experiencing adverse impacts. They may feel that '*the power goes over their heads, leaving them in the dark'.* This will count for the communities affected by the RoW.

This is considered a **moderate** impact, because there may be some accumulation of disappointment over time, as already for some period reliable electricity supply is not provided, while industrial activity, power distribution and transmission are increasing in the area. However, the number of people living in these communities is relatively limited.

5.2.11 COMMUNITY HEALTH, SAFETY AND SECURITY

5.2.11.1 Construction Phase

Safety risk due to transportation

The increase in traffic in the villages and the roads could also be a source of accidents. The contractor will develop appropriate strategies to minimize the need for transportation of supplies and will ensure compliance with all applicable laws, such as maximum load restriction and speed limits. An awareness program for truck drivers to speed limits and other precautionary measures will be implemented. Sign indications (inhabited area, school, pedestrian crossings, etc.) and speed limits will be in place where appropriate. These measures will minimize the risk of accidents that could be caused by the project related traffic. As this is a temporary activity with limited transportation movements, this risk is considered **minor**.

Health risk due to influx of construction workers

During the construction phase, the working population in the project area may increase temporarily, increasing the pressure on local health systems. The influx of foreign workers in local communities can increase the risk of communicable diseases such as the transmission of HIV/AIDS. To avoid this impact, the contractor in charge of work will implement a prevention program for communicable diseases among workers and local communities. However, this impact remains low since the passage of these workers will be only short duration.

Also, workers' camp(s) can be a source of pollution and various disturbances of the surrounding environment: waste, septage, and wastewater, if not properly managed. The following management measures will be implemented in each set up camp: waste and wastewater management, latrines, containment of machinery in appropriate areas, etc.

Accidents may occur during construction. Construction sites have potential risks for workers and nearby communities because they can generate curiosity, especially among children. To prevent accidents, the contractor will ensure the proper use of equipment and implementation of all appropriate security measures. Employees will be trained properly regarding occupational health and safety (safety equipment port, etc.). The site and the equipment and material storage area will be fenced temporarily, prohibiting access to unauthorized people. In addition, warning signs will be posted for public safety. Finally, educational programs in schools and communities may be implemented to educate people about the dangers and safe practices when playing or working near a high voltage transmission line.

Moreover, disturbances (noise, dust, air pollution and risk of accidents) may cause stress in generally calm rural areas. Appropriate mitigation and containment of construction activities during normal working hours will reduce these drawbacks for the local population. Proper communication and stakeholder engagement activities and grievance mechanism will be implemented to obtain community concerns. Therefore, the impact is considered **Minor.**

5.2.11.2 Operational Phase

The presence of power lines is a potential security risk for the people living nearby, where people sometimes try to make illegal connections. Pylon steel and conductor theft can also pose significant security risks in the case of the collapse of the tower. The towers will be designed according to best practices and standards, which will ensure the safe and reliable operation of the transmission line while also ensuring the safety of neighbouring communities. The pylons will also be constructed with devices that prevent climbing beyond safe heights

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).

Electrocution and related fires can have severe impacts to the people experiencing this. However, the likelihood is low, the lines are not crossing areas that are densely used, so that these impacts are considered **moderate**.

5.2.12 RESETTLEMENT

The land in the RoW for the Transmission Lines need to be acquired by TCN according to the Nigerian and International legislation. It is not allowed to keep structures, like houses or sheds or tall trees in the RoW. Also cropping is not allowed. Ewekoro the line pass through 77 villages, 8 in Ewekoro LGA, 16 Ifo LGA, 43 in Ado Odo/Ota LGA and 10 in Badagry LGA.

324 residential structures that are occupied would be removed from the ROW, in addition to 864 structures that are either unoccupied or under construction. Furthermore, about 2,000 households will loss their farmlands. Both residential structures and farmlands will be compensated in line with the land use act. The basis for valuation of the assets is the cost of replacement method.

A separate Resettlement Action Plan has been prepared for the Proposed Transmission Line and Substation projects, providing all details of the land take and related impacts. (see RAP Report)

5.2.13 LABOUR AND WORKING CONDITIONS

The workforce engaged on the project will vary during the construction program and will be dependent on the specific activities underway. Labour requirements will generally be a maximum of 32, comprising approximately 10 on access track and foundation work, 10 on structure erection and 12 on stringing work, with few others engaged on miscellaneous other activities. Working hours will include work outside normal construction hours and will include night time and weekend periods as required. All construction activities that are likely to generate noise shall not be undertaken during night time. The contractors shall ensure compliance with the following laws and regulations to minimize impacts arising from labour and working conditions.

- The Factories Act, 1987
- Wages Board and Industrial Council Act, 1974
- Workers' Compensation Act, 1987
- IFC Performance Standard 2: Labor and Working Conditions
- International Labour Organisations (ILO) requirements

These are elaborated in Section 1.4

5.2.13.1 Construction Phase

Occupational accident risk

In the construction phase there will be job opportunities for construction workers for the preparation of the RoW and the installation of the towers, conductors and transmission lines. At this moment in time the number of workers required has not been assessed yet. Also, the construction period is not known yet.

It is expected that the majority of the workers can probably be sourced locally, from within 30 km of the construction location. The majority of the employees required during construction will be unskilled and semi-skilled labourers. Worker's accommodation camp will not be needed, because there are adequate hotels as well as good houses in the area that could be rented. unskilled workers recruited from the communities can stay with their households. To manage construction traffic and parking needs, transport will be provided. Since there is quite some unemployment among the people, and especially the youth, living in the communities near the proposed RoW, there will be quite some eagerness to find temporary employment in the construction of the project. This creates the risk that the EPC Contractor may get tempted to recruit labour force against insufficient labour and working conditions to save costs.

In the construction, occupational accidents may occur particularly among unskilled labour force, ranging between minor incidents such as cuts and major incidents related with working at height, tower collapse and the risk of electrocution. Also, around the undeveloped areas there would be possible hazards, like snake bite and scorpion sting in the clearance of the vegetation. In view of the number of construction workers, the use of quite some unskilled labour, albeit internationally managed, the risk of occupational accidents is considered **moderate**

Security risk

With the construction activities, valuable materials and equipment and the presence of a labour force will come to the construction site. Opportunistic people (possibly local youth) or organised crime may be tempted to steal materials from the site, to raid construction workers or force to obtain some benefits from the Project in another way. These security risks may threaten all staff working at the construction site.

The construction yard will be secured by a permanent fence at an early stage of construction. Security guards will be employed to patrol the site and control access 24 hours a day. All vehicles entering and leaving the site will be searched. All personnel will be required to display personal identification and all visitors will be required to sign in. The EPC Contractor will be responsible for site security during construction. Since these works do not take place in a remote area, security guards on site, security forces in the area are in place from the Government and from TCN, the risk is considered **minor.**

5.2.13.2 Operation Phase

Operation and maintenance of the transmission line will involve regular surveillance and clearing of transmission line RoW to avoid interference of activities in the RoW with the transmission lines. All tall vegetation and trees (including potential economic trees) within 10 meters of the conductor wires on the line will be cut. Safety audits and repairs will be implemented in the operation phase. In case of snapped lines or collapsed towers emergency repairs will have to be done.

Similar to the construction phase, potentially workers may be exploited and occupational health & safety risks may occur in the regular and emergency maintenance and repair works.

The likelihood of these risks is lower, as there will be less labour hired and fewer activities, compared to the construction phase. This risk of exploitation is considered **minor** and the health and safety risks **moderate**.

5.2.14 Employment and Economy

5.2.14.1 Construction Phase

There will be no significant adverse impacts on local and regional economy during the line construction. On the other hand, the project could generate some temporary jobs during construction of the power lines and substations.

The impacts to the villages and communities located along the line will be relatively small due to the limited duration of the project, to population resettlement along the corridor and the limited number of workers involved. However, it is crucial that local and regional people are informed in advance of the onset and duration of the construction work to enable them to adjust their supplies accordingly and avoid bottlenecks resulting in strong increases of price.

Moreover, livelihoods of the affected households may be affected with the acquisition of their lands. Appropriate compensation will be provided to replace economic loss. This risk is quite low since firstly, despite the land use density, it is possible to find alternative plots including through family and village solidarity. About 2000 families will loose a piece of cropland or house. These will be compensated by cash based on replacement cost (See RAP). In this context, the risk of loss will be greatly reduced. Overall, the impact on economic activities and livelihood is a **positive** impact.

5.2.14.2 Operation Phase

The most important benefit generated by the project will certainly be the improved availability and reliability of electricity supply to Lagos and Ogun States. This can increase access to electricity, which can improve economic activities and added convenience to people's lives. The project could also generate jobs for the operation and maintenance of the power lines and substations.

Improving the availability and reliability of energy in the region will serve as catalyst for micro, small and medium scale enterprises to develop.

Overall, the project will bring **positive impacts** to the local economy and livelihoods of people both directly (new employment) or indirectly (increased access to reliable electricity).

5.2.15 Infrastructure

5.2.15.1 Construction Phase

Concerning public infrastructures, roads, electricity and telecommunication infrastructures were studied. There will be no significant impact on the operation of nearby telecommunication antennas during construction, except perhaps temporarily limiting their access. Also, to the extent possible, existing roads will be used as access roads to the ROW.

Transport of construction materials and equipment using existing roads can increase traffic and may increase risks to road damage.

New access roads will only be built if highly needed. Currently, new access road will need to be developed only around Badagry. Access roads are restricted to 3m for a total distance of less than 10km across the entire 330kv and 132kV lines. This will result in about 30 ha of land. These new access roads will be built while minimizing environmental impacts through.

Impacts on existing infrastructures will have low magnitude due to low intensity of the activities. And with the low receptor sensitivity the impact significance is **negligible**

5.2.15.2 Operation Phase

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 captive power generating plants.

Furthermore, the new access roads constructed, and the existing ones upgraded during construction will now be available for use by the communities.

Hence, the impact on infrastructure during operation and maintenance is **positive.**

5.2.16 CULTURAL HERITAGE

5.2.16.1 Construction Phase

Consultation with local and regional authorities revealed the presence of a sites in Yafin, Ajobo-Akia, Arigbajo and Itire Villages linked to the cultural heritage in the project area. These sites were circumvented as requested by the communities. Other cultural sites agreed by the communities to be moved, include a grave in Ajegunle and individual Shrines in two communities. The project will assume responsibility for the cost associated with the relocations.

In addition, during the construction activities, unknown archaeological sites or objects can be discovered and partially destroyed by the machinery used. If archaeological or historic remains are discovered, the construction works will immediately stop along this section of line, the National Commission for Museums and Monuments (NCMM) and the LGA authorities where the discovery took place and the State Ministry responsible for culture in Ogun and/or Lagos State should be informed.

Even though all major cultural heritage sites known have been avoided by the lines, some shrines will still have to be relocated. Therefore, the impact is considered **moderate**, since worship can continue at the new site.

5.2.16.2 Operation Phase

Like for the construction phase, potentially the maintenance works generating additional traffic, noise and dust may interact with these cultural festivals, affecting the experience and value of these festivals. Considering the low frequency of the maintenance work and low magnitude -involving mainly trimming tree branches, the impact is **negligible** impact.

5.2.17 CUMULATIVE IMPACTS

5.2.17.1 Defining Cumulative Impacts

In theory, any development such as the proposed Project may be taking place at the same time as other developments, causing impacts affecting the same resources or receptors, such that the impacts on these resources and receptors from all potential development will be cumulative. According to the Performance Standard, cumulative impacts can be defined as impacts that:

> **"*result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted.*"**

Generally, Cumulative Impacts are considered to be impacts that act with impacts from other projects such that:

- The sum of the impacts is greater than the parts; or
- The sum of the impacts reaches a threshold level such that the impact becomes significant.
- The types of cumulative impacts that may be of relevance are detailed below:
  - ✓ **Accumulative**: the overall effect of different types of impacts at the same location. An example would be fugitive dust emissions, construction noise and construction traffic all impacting the local communities as a nuisance/ disturbance.
  - ✓ **Interactive**: where two different types of impacts (which may not singly be important) react with each other to create a new impact (that might be important) (e.g. water abstraction from a watercourse might exacerbate the impacts caused by increased sediment loading).
  - ✓ **Additive or In-combination**: where impacts from the primary activity (i.e. the construction and operation of the Project) are added to impacts from third party activities e.g. other major projects in the vicinity of the Project which are already occurring, planned or may happen in the foreseeable future).
- Performance Standard suggests that in identifying cumulative impacts, "cumulative impacts are limited to those impacts generally recognized as important on the basis of scientific concerns and/or concerns from Affected Communities".

5.2.17.2 Identification of Relevant Development(s)

The focus of the cumulative impact assessment is on the combination effects of the Project with potential future development in the immediate area around the Project site. Our assessment cumulative impacts regarding the potential project in view, depends on the status of other projects and the level of data available to characterize the magnitude of the impacts.

In view of the paucity of available information regarding such future developments, this assessment follows a generic pattern and focuses on key issues and sensitivities for this project and how these might be influenced by cumulative impacts with a combination of other developments. Consultations with local and state authorities and identification of relevant and significant developments via searches of relevant documents provided invaluable assistant in this assessment. The main developments identified are;

- Cumulative impacts from other projects within 10 km square radius
- Those likely to arise from other transmission line projects

The following projects within 10 km square radius are expected to exert cumulative impacts.

Existing projects:

- ➢ Ewekoro cement Plant Line 1- An operating 1.3million tonnes per annum clinker cement plant
- ➢ Ewekoro cement Plant Line 2–An Operating 2.7 million tonnes per annum clinker cement plant
- ➢ Olorunsogo Gas Fired Power Plants Phase I and II (333MW open cycle and 750MW- combined cycle respectively)
- ➢ 132kv transmission line – An existing transmission line linking Ota to Abeokuta.
- ➢ 330kv transmission line – An existing transmission line linking Olorunsogo Power Plant to Ikeja West
- ➢ 330kV single circuit linking Osogbo to Ikeja West
- ➢ 132 kV line from Ikeja West to Agbara and to Ojo

Proposed projects

- ➢ The following proposed Abeokuta Independent Power Project (Energy Culture)- A 147megawatt gas powered power plant with a 500m transmission line
- ➢ Railway system from Lagos to Abeokuta

5.2.18 Cumulative impact

Air Quality and Noise: Given the findings of impact assessment and distance of the Ewekoro cement plant (line 1 and 2) from the project area, it appears unlikely that the cumulative impact on noise and air quality will not be significant. Also, the cumulative impact of Olorunsogo Power Plant Phase I & II 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 Abeokuta IPP and ongoing construction of railway line project will use similar transport routes (Lagos – Abeokuta express way) 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.

Others: Other impacts already existing in the area that increase as a result of this project include Corona effect and EMF radiation, due to the existing power lines in the area.

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.

5.2.19 SUMMARY OF IMPACTS

Tables 5.9 and 5.10 presents the summary of various activities involved in the project development and the significant impacts associated with each of them on the environment and social.

Table 5.9 Summary of Potential Impacts During Site Preparation and Construction

Indicator	Potential impact	Receptor	Significance
Air quality	Localized impairment of air quality by exhaust emissions from vehicles and equipment engines (SO_2, CO, NOx, CO_2, PM)	Affected communities in area of influence	Minor
	Elevated dust 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

Indicator	Potential impact	Receptor	Significance
Climate Change	GHG will be emitted from construction material production, energy use in construction activity, carbon loss due to the forest clearance and SF_6 is used in circuit breakers. Total estimate is 14,486 tons of CO2 equivalent. 97% of this is due to material production which is indirect impact	Global warming	Minor
Noise, vibration & EMF	Nuisance noise and vibration from construction activities and EMF from high voltage conductors	Affected communities in area of influence Construction workers	Moderate
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 around Badagry substation	Moderate
	Potential contamination of soil from inadvertent release of hazardous or contaminating material (liquid fuel, solvents, lubricants, aluminium oxide paint, etc)	Soil on construction site, especially by construction camp and each tower	Moderate
Water resources	Potential surface and groundwater contamination from accidental spills and improper disposal of waste and wastewater	Local groundwater and River crossing points at Sojuolu, Olowu, Ajegunle, Iju-iroko, Idoluba, Ikoga-Elle and Badagry	Moderate
	Exploitation of water resources (e.g. casting of foundations) sourced from nearby water bodies through tanks	Local surface water resources	Minor
Terrestrial ecology	Disturbance to habitats, fauna and flora arising from dust, air emissions, light, noise and vibration, traffic, accidental spillages and sediment run-off	Flora and fauna and habitat in the area of influence	Moderate
	Vegetation clearing will cause habitat disturbances that could create suitable conditions for invasive species to spread	Flora and fauna within the RoW and Substation	Minor
	Loss of vegetation due ROW clearing for the construction of the power line and access roads will cause habitat disturbances.	Along the RoW and Substation	Major
Aquatic ecology	Degradation of aquatic species due to construction activities around surface water bodies	River crossings along the ROW	Moderate
Ecosystem Services	Species that provide services to the communities will be cleared along the ROW	Livelihoods	Moderate
Visual amenities	Temporary presence of an active construction site with storage of materials and equipment within the RoW and/or the site for the substation.	People living close to the construction sites.	Minor
Land use	Land use changes that converted agricultural and secondary forest areas to the line route ROW	Communities along the ROW	Major
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/stakeholder perceptions around cumulative impacts linked to the new plant and transmission lines and substations operations. Management of legacy issues on account of environmental pollution from the stakeholder concerns around existing transmission lines.	Affected communities in area of influence	Moderate
Community Health, Safety and Security	Increased risks of traffic safety incidents on public roads	People living close to access roads and road users	Minor
	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
	Potential for increase in prevalence of sexually transmitted diseases in local communities and other communicable diseases.	Affected communities in area of influence	Minor
	Risk of erosion into creeks, which are used as source of domestic water for the communities	Affected communities in area of influence	Minor
Resettlement	Households in the RoW need to be relocated and assets in the RoW will be lost	Affected properties and livelihood	High
Labour and working conditions	Exploitation of workers	Labour force	Minor
	Activities and staff at site may create security risks	All staff working at the construction site	Minor
	Risk of health & safety incidents amongst labour force, including minor incident's such as cuts and major incidents such as loss of life	Construction labour force	Moderate
Employment and economy	Creation of temporary jobs for locals residents and Nigerian nationals with skilled trades	Local residents of affected communities and Nigerian nationals	Positive
	Supply chain opportunities for Nigerian companies that can provide goods and services needed by the company	Nigerian companies and local SMEs	Positive
Infrastructure	Influx of outside workers may pose additional pressure on social infrastructure, like medical posts, emergency services, water supply, solid waste management	Affected communities in area of influence	Negligible
Cultural heritage	shrines are located within the RoW along the transmission line and need to be relocated.	Affected communities-	Minor
	Potential interactions between construction works and cultural festivals due to traffic, noise and/or vibration impacts	Affected communities along the RoW	Minor

Table 5.10 Summary of Potential Impacts during Operation and Maintenance

Aspect	Potential impact	Receptor	Significance (pre-mitigation)
Air quality	Exposure to emissions from vehicles (PM, NO_2/NOx) very limited as very little traffic	Workers on site, communities in area of influence	minor
	Accidental leak of SF_6 gas (a GHG) from aging equipment, and operational losses occur during equipment maintenance and servicing	Global warming	Minor
Climate Change	The proposed project is improvement of transmission line system in Nigeria, which is in line with Nigeria`s nationally determined contribution (NDC) implementation." Therefore, the climate change impact during the operational stage is considered to be beneficial, assuming that the maintenance will be conducted appropriately.	Global warming	Positive
Noise, vibration & EMF	Noise from overhead line due to Corona effect end EMF effect	Affected communities along the RoW and around substations	Minor
Soils, geology and land-use	Compaction effects on soil structure due to vehicular movement in swampy areas during line maintenance	Ecologically sensitive areas, particularly around Badagry	Minor
	Potential contamination of soil from inadvertent release of hazardous or contaminating material	Soil in the RoW and substation sites at Ejio, Ajegunle, Badagry and Agbara	Negligible
Water resources	No water resources will be affected by the Project	Surface water and Local groundwater	Negligible
Terrestrial ecology	Avian collision	Birds in the area of influence	Moderate
	Impact due to alien species	Flora and fauna	Negligible
	Loss of vegetation due to routine clearance of vegetation	Flora and fauna within the ROW	Negligible
Aquatic ecology	Degradation of aquatic species due to maintenance of the ROW	River crossings along the ROW	Minor
Ecosystem Services	Loss of species that provide ecosystem services	Along ROW	Negligible
Visual amenities	Transmission lines and towers will be visible from far and become an extrinsic element in the landscape. Cumulative with the other power lines this may result in a loss of the visual amenity.	communities near RoW	Moderate
Land use	Land use changes resulting from improved electricity supply and enhanced ability to plan and control developments in the area	Communities along the ROW	Positive
Stakeholder and Community expectation/relations Management	Management of Community concerns linked to impacts associated with operation phase issues (like air and dust emissions, traffic, and community safety/security, noise/vibration, etc) and adverse impact/inconveniencies resulting from it. Dealing with community/stakeholder perceptions around cumulative impacts linked to the new plant and existing cement plant operations. Disappointment about electricity supplied to national grid, while locally electricity supply has reduced reliability	Affected communities in the area of influence	Moderate
Community Health, Safety and Security	External safety risks of electrocutions, bush fires, line snapping, tower collapses	Affected communities along the RoW	Minor
Labour and working conditions	Exploitation of workers	Labour force for maintenance work	Minor
	Occupational H&S risks in operation and maintenance	Labour force	Moderate
Employment and	Improved electricity supply for the national grid, creating opportunities for businesses and economic development in	National level Nigeria	Positive

Aspect	**Potential impact**	**Receptor**	**Significance (pre-mitigation)**
Economy	the country.		
Cultural heritage	Potential interactions between maintenance works and cultural festivals due to traffic, noise and/or vibration impacts	Affected communities in the RoW	Negligible

CHAPTER SIX

6.0 MITIGATION MEASURE

6.1 INTRODUCTION

As presented in Chapter 5, the proposed Lagos and Ogun Transmission Lines and Associated Substations Projects has the potential to impact the various components of the biophysical, health and social environment of the project area. The identified negative impacts have been ranked variously as low, medium and high. To preserve the environment, a number of steps have been taken to mitigate the significant, high and medium ranking negative impacts, as well as enhance those impacts identified as positive. The mitigation measures proffered for the predicted impacts of the proposed project activities took cognizance of the following, which were elaborated in Section 1.4.

- Environmental laws and regulations in Nigeria, with emphasis on permissible limits for waste streams (FMEnv (formerly FEPA), 1991);
- JICA and World Bank Requirements and other relevant international requirements
- 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.

The residual effects that may remain after the application of the impact mitigation measures have also been discussed for further reduction of residual impacts to as low level as possible.

6.2 MITIGATION METHODOLOGY

6.2.1 Definition of Mitigation Measures

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 (eg changing the development approach);
- engineering controls and other physical measures applied (eg waste water treatment facilities);
- operational plans and procedures (eg waste management plans); and
- the provision of like-for-like replacement, restoration or compensation.

For impacts that are assessed to be of **Major** significance, a change in design or layout is usually required to avoid or reduce these. For impacts assessed to be of **Moderate** significance, specific mitigation measures such as engineering controls are usually required to reduce these impacts to 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. And **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 minimise impacts through the design and management of the Project rather than on reinstatement and compensation measures.

6.2.2 Assessing Residual Impacts

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 impacts are described in terms of their significance in accordance with the categories identified in Chapter 5.

Social, economic and biophysical impacts are inherently and inextricably interconnected. Change in any of these domains will lead to changes in the other domains. This section looks at how the local way of life might change as a result of the proposed project. Potential changes to local culture, livelihoods, health and well-being, personal and communal property rights are examined.

6.3 AIR QUALITY

6.3.1 Construction Phase

Air Pollutant Emission

Regarding impacts of emissions from vehicles and equipment engines the following mitigation measures are recommended:

- Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations;
- Stationary generators to be located to facilitate dispersion;
- 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 build-up of dirt;
- Spray surfaces prior to excavation;
- 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.

With the implementation of the above measures the residual air quality impacts can be expected to be **negligible**.

Green House Gas Emission

In consideration of the Climate Change under the construction phase, the impact of vegetation clearing, resulting to reduction of carbon sink ability of the environment and the use of equipment and vehicles during the construction resulting to the release of GHG gases shall be mitigated through the use of good international practice, including maintaining and operating all vehicles and equipment engines in accordance with manufacturers recommendations, location of stationary generators to facilitate dispersion, restriction of vegetation clearing to only the required area and the use of experienced drivers and fuel efficient equipment, vehicles and machineries during construction activities. Even the implementation of above mitigation measure, GHG emission cannot be avoided. Therefore, the impact on climate change can be reduced to **minor**.

6.3.2 Operation Phase

For climate change, the impact of SF_6 shall be mitigated through the improvements in the leak rate of new equipment, refurbishing older equipment, and the use of more efficient operation and maintenance techniques. These measures are expected to reduce the impact to negligible significance.

6.4 NOISE, VIBRATION AND EMF

6.4.1 Construction Phase

The following recommendations for mitigation measures are outlined below:

- 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 in accordance with manufacturers recommendations;
- Avoid mobile plant clustering near residences and other sensitive land uses;
- Ensure periods of respite are provided in the case of unavoidable maximum noise level events;
- 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 TCN Community Relation Officer;
- Noisy activities (activities that can be heard in nearby communities) restricted to day-time working hours.

With the implementation of the above measures the residual air quality impacts can be expected to be reduced to **minor**.

6.4.2 Operation Phase

The minor impact of noise emissions during operation can be reduced by choosing conductors designed and constructed to minimise corona effects and avoid overloading of transmission lines because of EMF effect. Also, installation of mesh at strategic areas will reduce EMF effect to the minimal level. In addition, ROW will be secured where no residential structure is allowed to be built. However, the noise emission cannot be completely blocked, because it also depends on weather conditions. Therefore, the residual impact will still be **minor** but reduced**.**

6.5 SOIL AND GEOLOGY

6.5.1 Construction Phase

Impact on Geology and Soil Structure

The highly unstable soils around Badagry axis (from Erekiti to the Yafin) may require access road to each pylon location, sighted within the swamp. The distances of these roads may not exceed 500m as the line is not too far from the communities (dry land).

The following mitigation measures to reduce impacts on soil structure from compaction and erosion are recommended:

- 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; and
- Use of existing track for transport of man and material to the extent possible;

With the implementation of the above measures the residual impacts can be expected to reduce to **minor**

Potential Soil Contamination

With regards to soil contamination impacts, the following measures will be implemented:

- Implement effective site drainage on the construction camp 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;
- Minimise bare ground and stockpiles to avoid silt runoff;
- Bunding of areas where hazardous substances are stored (eg fuel, waste areas);
- Remove all water accumulation within bunds using manually controlled positive lift pumps not gravity drains;
- Regular checking and maintenance of all plant and equipment to minimize the risk of fuel or lubricant leakages;
- Training of relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques;
- 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; and
- Spread sheet underneath the tower structure prior to start any painting activity.

With the implementation of the above measures the residual soil and geology quality impacts can be expected to reduce to **negligible**.

6.5.2 Operation Phase

Since impact is considered **negligible**, no additional measures have been identified.

6.6 WATER RESOURCES

6.6.1 Construction Phase

Impact on Hydrogeology

The potential contamination of groundwater and surface water from release of hazardous or contaminating material (liquid fuel, solvents, lubricants, aluminium oxide paint, etc), can be mitigating by the following actions

- The construction of drainage around the substations fitted with an API gravity separator for oil removal.
- Development of access road within swamp area around Badagry area
- Avoiding storage of materials that are likely to leach into soil in the open
- Construction of bund wall around fuel and oil storage areas

With the implementation of these actions, the impact is expected to be reduced to **Negligible.**

Potential contamination on water resource

Same as in section Soil and Geology for on the prevention of spills and leakage of hazardous substances to surface and ground water. The residual impacts on surface and groundwater can be expected to be **negligible**.

6.6.2 Operation Phase

Since impact is considered **negligible**, no additional measures have been identified.

6.7 TERRESTRIAL ECOLOGY

6.7.1 Construction Phase

Impact on Terrestrial flora and Fauna

The following recommendations for mitigation measures are outlined below:

- Limit lightening on site;
- Sensitivity training to staff and anti-poaching policy; and
- Site clearance activities to be restricted to the minimum required area.

The residual impacts on terrestrial ecology can be expected to be **minor**.

Impact due to the introduction of alien species

The right-of-way of an electric line is a disturbed zone, with the potential of being colonized by invasive species. Such species could use the line corridor as a spreading area and consequently reach adjacent habitats. The implementation of the following measures will result in a reduced **Minor** impact with the implementation of the following actions.

- Herbicides should not be used for vegetation clearing
- Revegetation 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 7.
- Retention of native species where possible along the line route.
- Clearing should be minimised 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.

Impact on Ecosystem Service

Impacts of ecosystem services is expected to be reduced to **minor** after implementing the following actions.

- Preserve species that provide services as much is possible
- Allow species that do not grow above 4m within the ROW

6.7.2 Operation Phase

Aviation Collision

In order to reduce risk of avian collusion, place "bird diverters" on the top (ground) wire to make the lines more visible to birds, particular in the swampy areas of Badagry. Typical installation if bird diverters requires:

- 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

With these measures, bird collision impacts is expected to be reduced to **minor**

Impact on Ecosystem Service

Although the impacts of operation phase on ecosystem services is negligible, in order to maintain this, plants shall be trimmed during ROW maintenance instead of cutting them down completely.

Impact on Terrestrial flora and Fauna and Impact due to the introduction of alien species

These impacts are negligible during operation phase

6.7 AQUATIC ECOLOGY

6.7.1 Construction Phase

The following measures shall be implemented during construction in order to minimize impacts on aquatic ecology during construction.

- Natural flow of a River shall not be blocked
- Conduct activities during the dry season to minimize 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 river banks, 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.
- 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

Implementing these measures is expected to reduce the impact to **minor.**

6.7.2 Operation Phase

The following measures shall be implemented during construction in order to minimize impacts on aquatic ecology during operation and maintenance phase.

- Natural water courses shall not be obstructed.

- Vegetation wastes or other types of 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. 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.

These measures are expected to reduce the impacts to **negligible**.

6.8 VISUAL AMENITIES

6.8.1 Construction Phase

The minor impact of the change in visual amenities can be reduced by maintaining the construction site in orderly condition and do not distribute material over many sites before usage. Following mitigation measure will be implemented.

- Provision of education to construction workers for waste management
- Construction waste will be appropriated managed at the site and treated and disposed by licensed company

The residual impact will be **negligible**.

6.8.2 Operation Phase

To reduce the permanent impact on the visual amenities of the landscape, smaller trees and vegetation (<4m) shall be kept, so that there is still green scenery present. The towers have quite an open structure which will not hamper the view very much. However, since the presence of transmission tower and line, changed the landscape in the area, especially forest area, the residual impact is still considered **minor**.

6.9 LAND PLANNING AND USE

6.9.1 Construction Phase

Cropland and residential housing will be converted to ROW and substation infrastructure. This is a permanent change, because TCN does not allow farming or any structure in the ROW for safety reasons. This cannot be mitigated hence Resettlement action plan (RAP) has been prepared as compensatory measures, which shall be implemented in line with requirements of the land use act and the world bank safeguard policy OP 4.18 on involuntary resettlement, which shall include;

- Livelihood restoration strategies
- Valuation and budget for replacement of assets lost as a result of the project
- Institutional framework for effective implementation
- Grievance redress mechanism

- Compensation shall be paid and key aspects of the RAP implemented before construction commences.
- Chopped woody resources and residues shall be made available to local population in order to reduce additional pressures on natural resources.

These will reduce impacts to **minor**

6.9.2 Operational Phase

Impacts of the project on land planning and use during operations has been assessed to be **positive** (see Section 5.10.2). nevertheless, the following actions will enhance the beneficial effects.

- Plan for maintenance activities to be conducted outside of the growing and grazing seasons
- Allow grazing in the ROW and wayleave, if plantations do not exceed 4 m in height.

6.10 STAKEHOLDER AND COMMUNITY EXPECTATION/RELATIONS MANAGEMENT

6.10.1 Construction Phase

The concerns of the close-by communities of cumulative effects of environmental and safety/security impacts and inconveniences of the transmission lines in combination with the existing activities within 5km radius of the project site shall need serious attention.

By implementing a package of mitigation and enhancement measures, the concerns can be reduced to a manageable level for the majority of the community members. However, there may be vulnerable people, who need special attention to reduce the effects to an acceptable level.

The following package of measures shall be implemented:

- Follow mitigation for construction phase air quality, noise and traffic;
- 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 (see Section 4.15);
- Set-up, manage and effectively manage construction phase grievance mechanism system (see Section 4.15);
- Sharing of independent monitoring reports of all monitoring actions during construction as mentioned in the ESMP;
- Engage communities in the monitoring activities to 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, implement SEP; and
- Ongoing reporting to stakeholders on the overall environmental performance of the plant and the steps taken to mitigate any adverse environmental impacts.

With a proper, continuous and serious implementation of the above-mentioned measures the experience of cumulative impacts can be reduced to a **moderate** level, since there many people affected.

6.10.2 Operation Phase

In the operation phase the same package of mitigation and enhancement measures should be continued from the construction phase as described above. This package, when implemented rigorously, continuously and with participation of the affected communities, can support the project in bringing the community impact to a **minor** from **moderate** level. However, potentially certain community members may not be satisfied with the mitigation and enhancement measures and may still provide resistance, also to negotiate better benefit sharing mechanisms.

The follow measures apply in the operation phase:

- Follow mitigation for operation phase air quality, noise and traffic;
- Inform communities about details of operation activities (e.g., employment opportunities by billboards, posters and plant visit
- Set-up, manage and manage grievance mechanism
- Sharing of independent monitoring reports of all monitoring actions as mentioned in this ESMP;
- Engage communities in the monitoring activities to 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. Create Broad Community Support;
- Ongoing reporting to stakeholders on the overall environmental performance of the plant and the steps taken to mitigate any adverse environmental impacts;
- Explain effects of electromagnetic fields to communities to limit concerns. Keep fields within limits of International Commission on Non-Ionizing Radiation Protection (ICNIRP); and
- Interference with radio/TC transmission during rain needs to be explained to the communities.

6.11 COMMUNITY HEALTH, SAFETY AND SECURITY

6.11.1 Construction Phase

To reduce the potential adverse impacts and risks of the construction works on the community health, safety and security, the following mitigation measures should be implemented.

To reduce traffic accident risks the Contractor should 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. If this plan is thoroughly implemented, this residual risk can be **negligible**.

A Local Content Plan should be prepared to facilitate involvement of local labour as much as possible. The implementation of the plan will enhance ability to locate local hires and Nigerian nationals. This plan should include provisions for hiring women 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. Further a code of behaviours for workers should be developed, which should be trained and periodically refreshed, as needed based on community liaison/grievance mechanism feedback. This will help in reducing the potential for frictions between outside labour and local community members to a **minor** level.

To reduce the risk of an increase in STD prevalence, awareness raising material and condoms should be provided to all workers. Herewith the risk can be mitigated to a **negligible** level.

The construction site should be managed to eliminate potential mosquito breeding sites. This includes the prevention of surface water ponding and an avoidance of outside storage of tires. For unavoidable ponding monitor for mosquito larvae and treat with a US-EPA (or similar) approved mosquito larvicide as needed. These measures can bring this risk to a **negligible** level.

Erosion prevention measures are required to prevent soil entering nearby fields and creeks. Especially in locations close to creeks and cropped fields construction sites should be kept flat, clearing lose soil from the site and covering with geo-textile if needed. These measures can bring this impact to a **negligible** level.

6.11.2 Operation Phase

To reduce the external safety risks for the people living close to the operational transmission line the following measures should be implemented by TCN, as operator of the lines:

- To prevent as much as possible emergencies and to manage the response to emergencies when they occur in the operation phase of the Project an emergency response plan should be developed and implemented following TCN’s standards and international best practice including provisions for prevention and response to electrocution, bush fires, repair of snapped lines and collapsed towers, roles and responsibilities and emergency response. This plan should be coordinated with TCN and the Local Government;
- Annually a safety audit of substations transmission lines, towers and RoW should be performed to identify potential safety risks in an early stage and keep maintenance at high standards, so that snapping of lines or collapsing of towers is prevented as much as possible; and

- The affected communities in the area of influence of the transmission lines should be informed about the safety risks related to the high voltage electricity, the do's and don'ts in the RoW and the response measures in place, when an incident happens (from the emergency response plan). Sign boards will be placed on the towers to warn about the electrocution risk.

With the serious implementation of the above measures the residual safety risks can be expected to be reduced to a **minor** level.

6.12 RESETTLEMENT

A separate resettlement framework has been prepared, describing the land take, resettlement process, compensation eligibility, way forward, grievance mechanism and foreseen monitoring. For the affected households, which need to be physically resettled micro-plans will be developed to secure their livelihood, legal rights and proper compensation.

The owners of the assets in the RoW will receive compensation for their lost assets. These affected people experience economic impacts by losing their cropping plots, valuable trees, (unfinished) structures and various kinds of businesses. However, in majority these people are not highly dependent on these assets for their livelihood. Compensation of the value of these assets will off-set these economic impacts.

The shrines located in the RoW will be relocated just outside the RoW in consultation with the affected communities through compensation process. This impact is expected to be reduced to **minor**

6.13 LABOUR AND WORKING CONDITIONS

6.13.1 Construction Phase

To prevent the exploitation of the workforce, the Contractor should comply with the provisions in the Labour Act of Nigeria and the international ILO conventions. The following items apply specifically for this Project:

- Develop transparent human resources policies and procedures for recruitment process, working conditions, terms of employment wages, worker-employer relations, non-discrimination policy, monitoring, roles and responsibilities;
- Provide reasonable, and if applicable negotiated, working terms and conditions;
- Establish worker's grievance mechanism, so that potential conflicts can be dealt with in an early and proper way;
- No use of child labour (workers under age 18) or forced labour is allowed;
- Provisions to ensure compliance with labour standards by supply chain and subcontracts, including training if required;
- Provide proper work place facilities for water/sanitation/rest rooms;
- If case of retrenchment needs first viable alternatives are analysed and then adverse impacts of retrenchment on workers are reduced as much as possible. A transparent retrenchment plan will be prepared;

- No hiring of short-term labour to be made at the site gate; and
- A worker's grievance mechanism will be in place.

If indeed the Contractor implements their human resources procedures in line with the Nigerian Labour Act and ILO Conventions and his held by these through their construction contract, the risk of exploitation of the labour force can be kept to a **negligible** level.

Security risks can be mitigated by preparing and implementing a security and emergency response plan in close cooperation with Lafarge security and local security forces. If security measures are well implemented these risks can be reduced to a **negligible** level.

To prevent and respond effectively to occupational health & safety incidents a project specific health and safety procedures needs to be developed and implemented, based on TCN's HSE guidelines, 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. Consult with local health facilities to be prepared in case of incidents that need medical help.

To prevent and manage occupational health & safety risks the following measures need to be implemented:

- ensure proper design, construction and installation of towers and associated facilities;
- train staff regularly and thoroughly in prevention and response of electrocution incidents, monitor and keep record;
- special focus on slip-trip, fall from height and electrocution in maintenance and repair works;
- audit management of electrocution incidents;
- emergency prevention and management;
- provide and maintain first aid facilities at all places where electrocution risks exist and train staff to use these; and
- provide and use personal protection equipment.

When all measures mentioned above are well implemented, the risk of occupational health & safety incidents can be kept to an acceptable level, to a **minor** level. However, these incidents cannot be prevented at all times.

6.13.2 Operation Phase

The same mitigation measures apply for the operation as for the construction phase to reduce the risks of labour force exploitation, to a **negligible** level and the risks of occupational health & safety, to a **minor** level. However, TCN is the responsible organisation for the implementation of these measures, following their TCN procedures for the management of these risks.

The following main items apply to reduce risks of labour exploitation to an acceptable level:

- 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 conflicts can be dealt with in an early and proper way;
- No use of child labour (workers under age 18) or forced labour;
- Provisions to ensure compliance with labour standards by supply chain and subcontracts, including training if required; and
- A worker's grievance mechanism will be in place.

TCN should follow their Occupational HSE plan following Nigerian and international requirements:

- train staff regularly and thoroughly in prevention and response of electrocution incidents, monitor and keep record;
- special focus on slip-trip, fall from height and electrocution in maintenance and repair works;
- audit management of electrocution incidents;
- emergency prevention and management;
- provide and maintain first aid facilities at all places where electrocution risks exist and train staff to use these; and
- provide and use personal protection equipment.

6.14 EMPLOYMENT AND INCOME

6.14.1 Construction Phase

To enhance the **positive** impact of employment opportunities for local residents a local content plan needs to be prepared to enhance the ability to locate local hires and Nigerian nationals. This plan should 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.

To enhance the positive impact of opportunities for local businesses and entrepreneurs the local content plan should also facilitate identification and selection of qualified local and Nigerian companies to provide needed supplies and services. This plan should include provisions for advance notice to local companies, along with selection criteria including health and safety, to allow them to prepare for upcoming opportunities.

6.14.2 Operation Phase

The **positive** impact of an important contribution to the national grid, enhancing socio-economic development in the country, can only be reached when the transmission lines are kept in good order ensuring reliable electricity supply, without power cuts and at a stable frequency and voltage.

6.15 INFRASTRUCTURE

6.15.1 Construction Phase

In the preparation and execution of the construction works the Contractor (together TCN) should coordinate with medical posts and emergency services about the potential of an increase demand of these services. Preparedness can be raised for temporary water supply to the communities, additional waste management and an increase in demand for medical services.

Proper and independent facilities for water supply, sanitation, solid and liquid waste need to be installed at the construction site, so that pressure on community infrastructure in limited.

New access roads shall be constructed only where it becomes necessary, otherwise existing roads shall be used. Temporary access created in swampy areas and othe sentitive areas shall be removed, when no longer needed.

By implementing both measures the impact of construction activities of the Project can be managed to a **negligible** level.

6.15.2 Operation Phase

The effect of the operation phase of the project on infrastructure is **positive** due to improved electricity supply.

6.16 CULTURAL HERITAGE

6.16.1 Construction Phase

The shrines, that are now present in the RoW, will be relocated to a location outside the RoW and agreed with the local communities through compensation process, where the worshippers can continue to use them. The exact location and ceremony for relocation will be managed by the communities. The residual impact will be **negligible**.

When the timing of construction activities is coordinated with the local cultural festivals, the potential of undesired interaction can be avoided, making this impact **negligible**.

6.16.2 Operation Phase

Also, in the operation phase the timing of maintenance activities should be coordinated with the Communities to avoid interference between maintenance and the festivals. The residual impact is **negligible.**

6.17 CONSTRUCTION OF ACCESS ROADS

Existing roads and tracks will be used to access the corridor as much as possible. Access roads along the corridor, which has already been acquired will be constructed for movements during construction and inspection and maintenances purposes during operation phase.

Construction of access roads in swampy area around Erekiti, Tohun and Yafin done as temporary measure, by piling soft areas to enable equipment and personnel access pylon spot during construction. The materials imported for this piling shall be removed at the end of the construction period and the area returned to its natural state. Furthermore, long spa towers shall be used in the swampy areas in order to minimize the need for new access.

With the application of these measures, the impact can be reduced from Moderate to Minor. during the construction period.

6.18 SUMMARY OF MITIGATION MEASURES

Tables 6.1 and 6.2 presents the summary of mitigation measures on various activities involved in the project development and the significant impacts associated with each of them on the environment and social.

Table 6.1 Summary of Mitigation Measures During Construction

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)
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
	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 • Speed limits on-site of 15kph on unhardened roads and surfaces	Negligible
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
Noise, vibration & EMF	Nuisance noise from construction activities	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 • Avoid mobile plant clustering near residences and other sensitive	Minor

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)
				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. • 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.	Minor
	Potential contamination of soil from inadvertent release of hazardous or contaminating material (liquid fuel, solvents, lubricants, aluminium oxide paint, etc)	Soil on construction site, especially by construction camp and 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. • Minimise bare ground and stockpiles to avoid silt runoff. • Bunding of areas where hazardous substances are stored (eg fuel, waste areas).	Negligible

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)
				• Remove all water accumulation within bunds using manually controlled positive lift pumps not gravity drains. • Regular checking and maintenance of all plant and equipment to minimize the risk of fuel or lubricant leakages. • Training of relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques. • Set-up and apply procedure regarding dealing with contaminated soils. • Development and implementation of a Waste Management Plan (as part of the ESMP) to ensure that waste is disposed of correctly. • Spread sheet underneath the tower structure prior to start any painting activity.	
Water resources	Potential surface and groundwater contamination from accidental spills and improper disposal of waste and wastewater	Local groundwater-well and bore hole	Moderate	See above measures to mitigate 'Potential contamination of soil' impact	Negligible
	Exploitation of water resources (e.g. casting of foundations) sourced from nearby water bodies through tanks	Rivers and streams crossed	Minor	Rivers and streams shall not be dammed for the purpose of water abstraction	Negligible
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 • Revegetation should use species locally native to the site and	moderate
	Vegetation clearing will cause habitat disturbances that could create suitable conditions for invasive species to spread		minor		Negligible

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)
				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 7. • Retention of native species where possible along the line route. • Clearing should be minimised 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 OGMENV and LAMENV	
	Loss of species that offer Provisioning Services		minor	• Site clearance activities to be restricted to the minimum required area.	Minor
Aquatic ecology	Loss/disturbance of aquatic species	Rivers/streams crossed	moderate	• Natural flow of a River shall not be blocked • Conduct activities during the dry season to minimize disturbance of sensitive shoreline and wetland areas • 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 river	minor

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)
				banks, 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. • 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 the ROW and/or the site for the substation.	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
Land planning and use	Change in land use cause by land take for towers, vegetation clearance, and access restriction	Land on the RoW	Moderate	• Site clearance activities to be restricted to the minimum required area. • Provision of predefined route, barriers or boundary markings to prevent incursion of machinery and workers into neighbouring areas See below measures under 'Resettlement'	Minor
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	Affected communities in area of influence	Moderate	Follow mitigation for construction phase air quality, noise and traffic. 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 Set-up and effectively monitor construction grievance mechanism	Moderate

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)
	impact/inconveniencies resulting from it. In addition dealing with community/stakeholder perceptions around cumulative impacts linked to the new plant and transmission lines and substations operations. Management of legacy issues on account of environmental pollution from stakeholder concerns around existing transmission lines..			Sharing of independent monitoring reports of all monitoring actions during construction as mentioned in this ESMP. Engage communities in the monitoring activities to 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 Ongoing reporting to stakeholders on the overall environmental performance of the plant and the steps taken to mitigate any adverse environmental impacts.	
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 people living close to the construction site.	Negligible
	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 labour to be made at the site gate. Develop a code of behaviours for workers. All workers to receive training on community relations and code of behaviour. Periodic refreshing as needed based on community liaison/grievance mechanism feedback.	Minor
	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
Resettlement	Households living in the RoW	Affected	Major	Follow principles and procedures of Resettlement Action Plan	Minor

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)
	need to be relocated and assets in the RoW will be lost	properties and livelihood		(RAP), including way forward, micro-plans per affected household.	
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 labour (workers under age 18) or forced labour. • Provisions to ensure compliance with labour standards by supply chain and subcontracts, including training if required. • Provide proper work place facilities for water/sanitation/rest rooms. • If case of retrenchment needs first viable alternatives are analysed 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.	Negligible
	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
	Risk of health & safety incidents amongst labour force, including minor incident's such as cuts and major incidents such as loss of life	Construction labour force	Moderate	Develop project specific health and safety procedures based on Wärtsilä's standard health and safety procedures, including provisions for training and certifications to be followed by all workers including subcontractors. Especially slip-trip and fall hazards with tower erection and electrocution need attention.	Minor

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)
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
	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
Infrastructure	Influx of outside workers may pose additional pressure on social infrastructure, like medical posts, emergency services, water supply, solid waste management	Affected communities in area of influence	Minor	Coordinate with medical posts and emergency services to prepare for water supply, waste management and incidents. Install proper and independent facilities at construction site for water supply, sanitation, solid and liquid waste, so that pressure on community infrastructure is limited.	Negligible
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
	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

Table 6.2 Summary of Mitigation Measures During Operation and Maintenance

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)
Air quality	Exposure to emissions from vehicles (PM10, NO2/NOx, SOx) very limited as very little traffic	Workers on site, communities in area of influence	Negligible	NA	Negligible
	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
Climate Change:	Accidental significant leaks of SF_6 from aging equipment, and gas losses occur during equipment maintenance and servicing	Ejio, Ajegunle, Badagry and Agbara Substations	Minor	Impact of SF_6 shall be mitigated through the improvements in the leak rate of new equipment, refurbishing older equipment, and the use of more efficient operation and maintenance techniques.	Minor
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. • Use of conductors conforming to IS standard to minimize corona effect during rainy weather conditions • Avoiding over loading Transmission Lines • Installation of mesh at strategic places	Minor
Soils, geology and land-use	Potential contamination of soil from inadvertent release of hazardous or contaminating material	Soil along RoW of TL and Substation	Negligible	NA	Negligible
Water resources	Contamination of surface water	Ajegunle River, Ijuiroko stream and BAdagry Lagoon	Negligible	NA	Negligible
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, particular in the swampy areas of Badagry • 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**
	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	Negligible

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)
				ROW. • 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	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.	Ejio, Ajegunle, Badagry and Agbara Substations	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
Stakeholder and Community expectation/relations Management	Management of Community concerns linked to impacts associated with operation phase issues (like air and dust emissions, traffic, and community safety/security, noise/vibration, etc) and adverse impact/inconveniencies resulting from it. Dealing with community/stakeholder perceptions around cumulative impacts linked to the new plant and existing cement plant operations. Disappointment about electricity supplied to national grid, while locally electricity supply has reduced reliability	Affected communities in the area of influence	Moderate	Follow mitigation for operation phase air quality, noise and traffic. Inform communities about details of operation activities (e.g., employment opportunities) by by billboards, posters and plant visit Set-up, manage and manage grievance mechanism Sharing of independent monitoring reports of all monitoring actions during construction as mentioned in this ESMP. Engage communities in the monitoring activities to 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 Explain effects of electromagnetic fields to communities to limit concerns. Keep fields within limits of International Commission on Non-Ionizing Radiation Protection (ICNIRP). Interference with radio/TC transmission during rain needs to be explained to the communities	Minor
Community Health, Safety and Security	External safety risks of electrocutions, bush fires, line snapping, tower collapses	Affected communities along the RoW	Moderate	Develop an emergency response plan following TCN and international best practice including provisions for prevention and response to electrocution, bush fires, repair of snapped lines and collapsed towers, roles and responsibilities. Coordinate with emergency services of LGAs	Minor

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)
				Annual safety audit of the transmission lines and poles and maintenance of the RoW to keep free of higher vegetation and structures. Communicate to communities in RoW the safety risks of the transmission lines and 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 conflicts can be dealt with in an early and proper way. • No use of child labour (workers under age 18) or forced labour. • Provisions to ensure compliance with labour standards by supply chain and subcontracts, including training if required. • A worker's grievance mechanism will be in place.	Negligible
	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
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
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
Access roads	Temporary access roads construction in swampy area of Erekiti, Tohun and Yafin will cause compaction, interfere with hydrological pattern and affect aquatic	Aquatic flora and fauna	Moderate	Use long span towers in swampy areas Remove imported materials used to construct temporary access and decomact the soils Undertake construction during dry season	Minor

Indicator	Potential impact	Receptor	Significance (pre-mitigation)	Mitigation or enhancement measures	Significance (post-mitigation)
	flora and fauna				

CHAPTER SEVEN

7.0 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

INTRODUCTION

This chapter provides the ESMP for the Lagos and Ogun Transmission Line and Associated Substations 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. Please note that this ESMP is designed for and will be applied to all 3 Lots (Lot1, Lot2 and Lot3) for the Project, as the integrated ESMP for the Project.

This ESMP is a delivery mechanism for environmental and social mitigation and enhancement measures made in the ESIA Report. 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 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 World Bank, IFC and JICA Guidelines. The ESMP is intended to cover those activities described in Chapter 3 of this EIA report. It covers project activities during construction and operation and will be subject to thorough reviews prior to the commencement of activities to ensure completeness. The ESMP does not include measures for activities related to equipment and facility fabrication being done offsite. It should be noted that this provides the outline requirements for environmental management. Provision will be made for updating the outline ESMP once the detailed project design is complete and for adapting the ESMP to relevant project stages as part of the overall ESMS.

The plan details the mitigation and enhancement measures TCN have 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. TCN will have principal responsibility for all measures outlined in the ESMP for the construction phase. TCN is responsible for the implementation of the measures in the operation phase. Both may delegate responsibility to its contractors, where appropriate. In cases where other individuals or organisations have responsibility for mitigation or enhancement measures, this is clearly indicated in Tables 7.2a and 7.2b. Capacity building and training requirements are also described, where these relate to specific skills required to deliver the ESMP action in question.

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 described in chapter seven;

prepare and maintain records of project environmental performance for monitoring and evaluating performance.

7.1 Institutional Framework for Implementation

7.1.1 Pre-Construction and Construction stage

7.1.1.1 Responsibility

Responsibilities in the implementation and monitoring of the Environmental and Social Management Plan (ESMP) during pre-construction and construction stage are shared between multiple stakeholders, including the TCN, the EPC contractors and regulators. TCN has set up a Project Implementation Unit (PIU), who will be responsible for the project execution during this stage.

In the PIU, Environmental and Social Unit will be a responsible administrator to manage environmental and social aspect including the implementation of ESMP. PIU will coordinate with TCN Management and TCN Lagos Regional Office for the necessary support for the preparation and implementation of ESMP. Figure 7-1 illustrates the structure of the institutional arrangements.

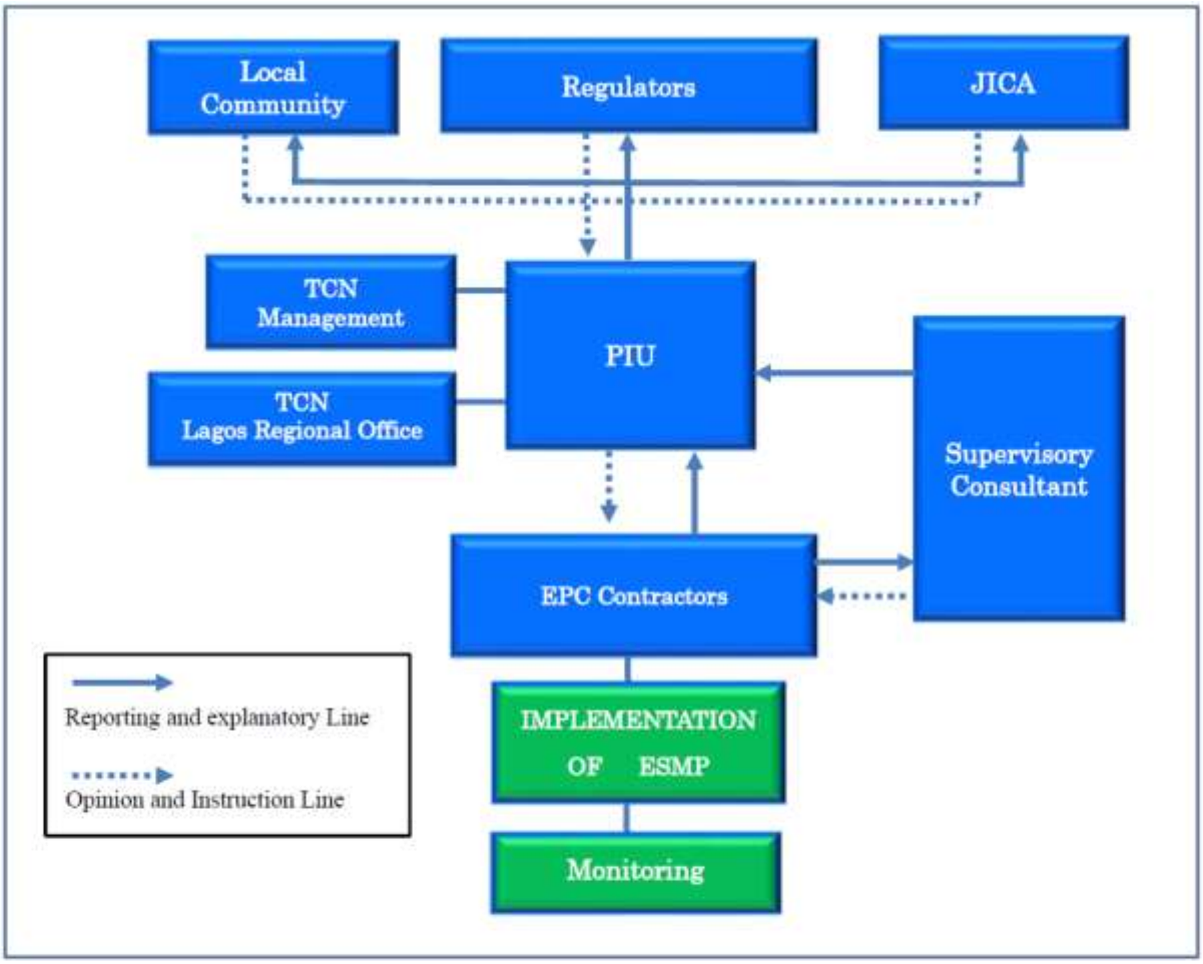


Figure 7.1 Institutional Arrangements for ESMP Implementation

7.1.1.2 Project Implementation Unit (PIU)

The PIU for JICA financed projects has been set up for the project implementation. It is headed by a Project Manager who reports to the CEO of TCN. Members of the PIU consist of technical experts and officers of Environmental Resettlement and Social Unit (ERSU) drawn from Environmental and Social Management Organization of TCN. Figure 7.2 illustrate the organizational structure of PIU.

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. These include ensure proper implementation of the environmental and social management measures contained in the ESMP, the RAP and their surveillance and monitoring. ESRU will be a main responsible unit for the implementation of ESMP and RAP.

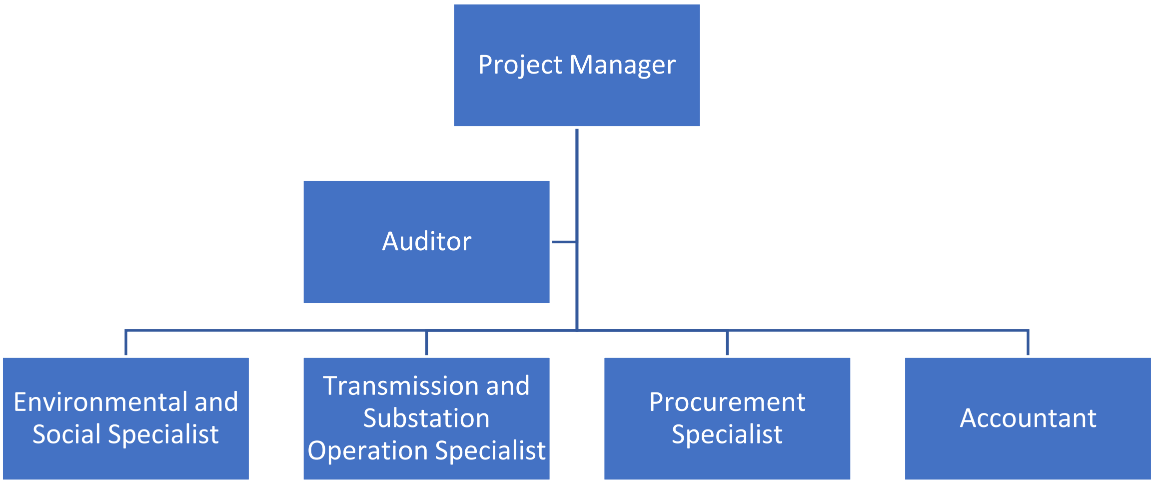


Figure 7.2 PIU Organisation Chart

Oversee the proper application of mitigation and enhancement measures presented in the ESMP (including those relating to the RAP) that are the responsibility of the Contractor

Implement management measure of the ESMP

Coordinate with TCN Management, including TCN HSE Sub sectors (in Head Quarter) and TCN Lagos regional office for the necessary support for the preparation and implementation of ESMP including RAP.

Monitor the environmental and social performance of the project in accordance with the programs presented in the ESMP

Do internal coordination within PIU for supervising the contractor in charge of the project construction.

Establish mechanism for handling compliants and distributes with the communities and relevant authorities.

Oversee compensation and resettlement activities of the project

7.1.1.3 TCN Management

TCN HSE Sub-sector

The HSE sub- sector was created in TCN in August 2014. It was the bringing up of two divisions together namely the Chemical Resettlement and Environment Division (CR&E) and the Occupational Health and Safety Division (OH&S). The TCN Sub-sector shall be responsible for ensuring implementation of management measures during operation phase (post-commissioning), including audits, compliance monitoring, preparation of periodic reports required by regulations. The function of HSE subsector includes;

Developing and maintaining of the Environmental Management Plan (EMP) and associated plan for material management, waste management, accident preparedness and response, inspection and monitoring.

Conducting and organising period environment and safety audits.

Preparing and managing documentations related to environmental performance

Regular and incidental reporting to the TCN management

Liasing and reporting to the appropriate environmental regulatory authorities

In addition, HSE sub-sector, mainly CR&E division shall be responsible for the land acquisition of the TCN project, which includes;

Support to liaise with the TCN Way-lease/ROW department on ROW acquisition process

Support to verify the compensation rates/budget and schedule as used in RAP to ensure proper implementation and provide recommendations to PIU for improvement/approval.

Support to carry out internal monitoring and evaluation of RAP activities

TCN Lagos regional office

Lagos regional office of TCN will involve the management and monitoring of Environmental and social performance of the project, including constriction and operational stage. TCN Lagos regional office has Environment unit, OHS (Occupational Health safety) unit and Wayleave unit. These unit will support for the implementation and monitoring of ESMP and RAP at site level.

7.1.1.4 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 (Lagos and Ogun States) and affected LGAs of Ewekoro, Ifo, Ado Odo/Ota and Badagry have certain oversight roles, which they perform under coordination of the FMEnv. Other agencies concerned about the project, which shall be involved in the implementation include;

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

Transmission Company of Nigeria (TCN)

JICA Project Implementation Unit (PIU)

Ikeja Electricity Distribution Company

Eko Electricity Distribution Company

Ogun State Ministry of Environment

Ogun State Environmental Protection Agency (“OGEPA”)

Ogun State Bureau for Lands and Survey

Ogun State Power Unit, Office of Governor

Lagos Waste Management Authority (“LAWMA”)

Lagos State Environmental Protection Agency (“LASEPA”)

Lagos State Bureau for Lands

Surveyor General Lagos State

Local Government Authority (LGA):

Ewekoro Local Government Area

Ifo Local Government Area

Ado Odo/Ota Local Government Area

Badagry Local Government Area

The Customary District Councils headed by Obas of each Kingdom affected

Village Chiefs (Baale) 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.

Electricity Distribution Companies (Ibadan, Ikeja and Eko)

These three 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 Lagos and Ogun State 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.

Ogun State Ministry of Environment

The Ministry of Environment was established in July 2003 with the aim of creating better living and conducive environment for the entire people of Ogun State. The Ministry has five (5) departments and two (2) sister Agencies namely, Ogun Environmental Protection Agency (OGEPA) and Ogun State Emergency Management Agency (SEMA).

Department of Administration & Supplies: is involved in the management, co-ordination and facilitation of the activities of other Departments.

Department of Environmental Conservation & Resources Management: is responsible for eenvironmental 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.

Ogun State Bureau for Lands and Survey

This bureau 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 Ogun 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 in Ogun State.

Provision of Geospatial information infrastructure.

Textual and graphic data on Ogun State, including land record, aerial photographs, satellite images, engineering drawing, and scanned pictures of building.

Property search and verification of land record.

Land application processing and administration.

Ogun State Ministry for Physical Planning

The Ministry is the apex body of Physical Planning in Ogun State. It is responsible for the formulation of Physical Planning policies and the coordination of physical development within the State. It derives its statutory functions from section 3 line 246 of the State Urban and Regional Planning Law No.20 of 2005. Though the Ministry is the policy making body, it has the Urban and Regional Planning Board as its parastatal.

The Ogun State Urban and Regional Planning Board:

This Boad is a parastatal of the Ministry of Urban and Physical Planning established the enactment of Ogun State Urban and Regional Planning law No.20 of 2005. The Board, which have 20 Zonal Town Planning Offices spread across the State is responsible for:

Controlling all various physical developments be it Residential, Commercial, Industrial, Public, and Institutional uses.

Monitoring all the development in order to control the growth of Urban Sprawl in Ogun State.

Ogun State Ministry of Women Affairs and Social Development: has the responsibility

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 Organisations, Professional Institutions and other MDAs on issues affecting women, children/vulnerable ones.

Ogun State Ministry of Agriculture

This Ministry is the organ of Government responsible for formulating policies on food and agriculture for the State. The ministry is to enhance self-sufficiency in food production, provide raw materials for agro-based industries, generate employment opportunities and obtain desirable levels of export in order to improve the country's foreign exchange earnings.

Ogun State has 1.2million hectares of arable land which is 74% of the State's total land area. Only 30% of this arable land or 35,000 hectares is under cultivation. The major crops grown or cultivated in the State include: Cassava, Rice, Maize, Oil-Palm, Cocoa, Rubber, Citrus, Cotton, Soya-Bean, Vegetable, Pine apple, Sugar-Cane, among others. Livestock and fish farming are strong and viable in the State.

The mandate of the ministry includes;

Formulating and implementing agricultural policies and programmes for Ogun State.

Regulation of farm practice and certification of farm produce.

Ensuring food safety and food security.

Promotion of mechanized agriculture.

Ensuring availability and provision of quality agricultural inputs

Coordinating agricultural cooperative societies and commodity groups

Promoting and managing Irrigation Schemes

Delivery of agricultural research proven technologies to farmers for adoption through effective Extension Services

Promoting the development of the Livestock and Fishery industries in the State.

Lagos 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, 2017 ("EMPL 2017"). These include LASEPA and LAWMA.

LASEPA is responsible for regulations, establishing discharge limits, and issuance of permits among others.

Lagos State Bureau for Lands and Survey

This bureau 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 Lagos 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 in Lagos State.

Provision of Geospatial information infrastructure.

Textual and graphic data on Lagos State, including land record, aerial photographs, satellite images, engineering drawing, and scanned pictures of building.

Property search and verification of land record.

Land application processing and administration.

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Lagos State Ministry of Women Affairs and Social Development:

has the responsibility

To promote Gender Equality and provide Empowerment facilities for Socio-economic Development for people displaced by the project in Lagos State

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 Organisations, Professional Institutions and other MDAs on issues affecting women, children/vulnerable ones.

Local Government Areas (LGAs)

The project will pass through four LGAs, three in Ogun State -Ewekoro, Ifo and Ado Odo/Ota as well as Badagry LGA in Lagos 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 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.

The Customary District Councils

The line route will pass through the Chiefdoms as several villages under them. The Obas (traditional head of chiefdom) and Village Heads (Baales) 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

7.1.1.6 Contractors

Each contractor shall appoint a qualified environmental manager who, after approval by the PIU, will be responsible for daily management on-site and for the respect of management measures from the ESMP. This manager will report regularly to the environment and social expert 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 to the PIU all of the required legal documents, among which the signed agreements with owners, authorizations for borrow pits and for temporary storage sites, etc.

7.1.1.7 Communities

Leaders and traditional institutions of the potentially affected communities will assist in public sensitization effort to advance implementation of ESMP. Training and awareness

TCN will identify, plan, monitor, and record training needs for personnel whose work may have a significant adverse impact upon the environment or social conditions. The Project recognises that it is important that employees at each relevant function and level are aware of the Project's environmental and social policy; potential impacts of their activities; and roles and responsibilities in achieving conformance with the policy and procedures.

This will be achieved through a formal training process. Employee training will include awareness and competency with respect to:

environmental and social impacts that could potentially arise from their activities (including dust, biodiversity and soil/water contamination);

necessity of conforming to the requirements of the ESIA and ESMP, in order to avoid or reduce those impacts; and

roles and responsibilities to achieve that conformity, including those in respect of change management and emergency response.

The HSE Coordinator is responsible for coordinating training, maintaining employee-training records, and ensuring that these are monitored and reviewed on a regular basis. The HSE Coordinator will also periodically verify that staff are performing competently through discussion and observation.

Employees responsible for performing site inspections will receive training by drawing on external resources as necessary. Training will be coordinated by the HSE coordinator prior to commissioning of the facilities. Upon completion of training and once deemed competent by management, staff will be ready to train other people.

Similarly, the Project will require that each of the sub-contractor's institute training programmes for its personnel. Each subcontractor is responsible for site HSE awareness training for personnel working on the job sites. The subcontractors are also responsible for identification of any additional training requirements to maintain required competency levels.

The subcontractor training program will be subject to approval by TCN and it will be audited to ensure that:

training programs are adequate;

all personnel requiring training have been trained; and

competency is being verified.

TCN's training programme will be followed to make permanent staff, contractor staff and temporarily hired staff aware of the ESIA and ESMP contents, their roles and responsibilities in the implementation of the ESMP and the additional requirements related to international standards.

7.1.2 Operational stage

7.1.2.1 Responsibility

TCN after the transfer of operation will take a responsibility for the implementation of ESMP during operational stage. The HSE coordinator of TCN will be the responsible for all environmental and issue, including;

Communicate with the regulatory authorities and communities.

Communicate with communities

Prepare relevant HSE documents,

Implement the necessary mitigation emasures as described in ESMO

Carry out monitoring and prepare monitoring report

Conduct internal audit

7.5 OPERATIONAL CONTROL PROCEDURES

Each potentially significant impact identified in the ESIA will have an operational control associated with it that specifies appropriate procedures, work instructions, best management practices, roles, responsibilities, authorities, monitoring, measurement and record keeping for avoiding or reducing impacts. Operational controls are monitored for compliance and effectiveness on a regular basis through a monitoring and auditing procedure described in the ESMP.

Operational control procedures will be reviewed and, where appropriate, amended to include instructions for planning and minimising impacts, or to at least reference relevant documents that address impact avoidance and mitigation.

7.5.1 Managing Changes to Project Activities

Changes in the Project may occur due to unanticipated situations. Adaptive changes may also occur during the course of final design, commissioning or even operations. The Project will implement a formal procedure to manage changes in the Project that will apply to all project activities.

The objective of the procedure is to ensure that the impact of changes on the health and safety of personnel, the environment, plant and equipment are identified and assessed prior to changes being implemented.

The management of change procedure will ensure that:

proposed changes have a sound technical, safety, environmental, and commercial justification;

changes are reviewed by competent personnel and the impact of changes is reflected in documentation, including operating procedures and drawings;

hazards resulting from changes that alter the conditions assessed in the ESIA have been identified and assessed and the impact(s) of changes do not adversely affect the management of health, safety or the environment;

changes are communicated to personnel who are provided with the necessary skills, via training, to effectively implement changes; and the appropriate TCN person accepts the responsibility for the change.

As information regarding the uncertainties becomes available, the Project ESMP will be updated to include that information in subsequent revisions. Environmental and social, as well as engineering feasibility and cost, considerations will be taken into account when choosing between possible alternatives.

7.5.2 Emergency Preparedness and Response

TCN will prepare plans and procedures to identify the potential for, and response to, environmental accidents and health and safety emergency situations and for preventing and mitigating potentially adverse environmental and social impacts that may be associated with them.

Emergency preparedness and response will be reviewed by TCN on at least an annual basis and after the occurrence of any accidents or emergency situations to ensure that lessons learnt inform continuous improvement.

Emergency exercises will be undertaken on a regular basis to confirm adequacy of response strategies. Investigations of accidents or incidents will follow formal documented procedures.

7.5.3 Checking and Corrective Actions

Checking includes inspections and monitoring as well as audit activities to confirm proper implementation of checking systems as well as effectiveness of mitigations. Corrective actions include response to out-of-control situations, non-compliances, and non-conformances. Actions also include those intended to improve performance.

7.5.4 Monitoring

Monitoring will be conducted to ensure compliance with regulatory requirements as well as to evaluate the effectiveness of operational controls and other measures intended to mitigate potential impacts. Monitoring parameters are included in the ESMP table provided in Tables 7.4.1a and 7.4.1b.

Monitoring methodologies or processes must be put in place in order to ensure the efficacy of the mitigation measures identified in the ESIA. Monitoring methodologies should be established to address the following:

Alteration to the biological, chemical, physical, social and health characteristics of the recipient environment;

Alterations in the interactions between project activities and environmental and social sensitivities, and interactions among the various sensitivities;

Monitor the effectiveness of the mitigation and enhancement measures;

Determination of long term and residual effects;

Identification of Project specific cumulative environmental and social effects, if applicable;

Social monitoring is focused on following the community relations of TCN. The quarterly FMEnv monitoring shall be performed with involvement of the communities. This joint monitoring will support good community relations, by creating trust and involvement;

At the construction site inspections should be performed on human resources procedures, occupational health, safety and security risks management, emergency planning and the open water on malaria larvae; and

The recruitment, human resources procedures, HSE training and awareness of the labour force in the construction as well as the operation phase should be monitored to know their origin in line with the local content plant and the level of knowledge and awareness on the code of conduct, STD prevention and occupational H&S measures.

The FMEnv guidelines require an environmental monitoring plan as part of an ESIA. The aim of the monitoring programme is to ensure that the negative environmental and social impacts identified in this ESIA are effectively mitigated in the construction and operation stages of the proposed Project.

7.5.5 Auditing

Beyond the routine inspection and monitoring activities conducted, audits will be carried out by TCN to ensure compliance with regulatory requirements as well as their own HSE standards and policies. Audits to be conducted will also cover the subcontractor self-reported monitoring and inspection activities. The audit shall be performed by qualified staff and the results shall be reported to TCN to be addressed.

The audit will include a review of compliance with the requirements of the ESIA and ESMP and include, at a minimum, the following:

completeness of HSE documentation, including planning documents and inspection records;

conformance with monitoring requirements;

efficacy of activities to address any non-conformance with monitoring requirements; and

training activities and record keeping.

There will be a cycle of audits into specific areas of the Project. The frequency of audits will be risk based and will vary with the stage of the Project and will depend on the results of previous audits.

Regulatory compliance audit is a mandatory requirement to be carried out by independent accredited consultant every three years during operation phase and the reports submitted to Federal Ministry of Environment.

7.5.6 Corrective action

Investigating a 'near-miss' or actual incident after it occurs can be used to obtain valuable lessons and information that can be used to prevent similar or more serious occurrences in the future.

TCN will implement a formal non-compliance and corrective action tracking procedure for investigating the causes of, and identifying corrective actions to, accidents or environmental or social non-compliances. This will ensure coordinated action EPC Contractor and its subcontractors. The HSE coordinator will be responsible for keeping records of corrective actions and for overseeing the modification of environmental or social protection procedures and/or training programs to avoid repetition of non- conformances and non-compliances.

7.5.7 Reporting

Throughout the Project, TCN will keep the regulatory authorities informed of the Project performance with respect to HSE matters by way of written status reports and face-to-face meetings. TCN will prepare a report on environmental and social performance and submit it to FMEnv. The frequency of this reporting will be determined by FMEnv, in a letter of approval of the project. These reports are prepared as part of requirements for impact mitigation monitoring to be carried by FMENV, OGMENV and LAMENV.

If required, TCN will provide appropriate documentation of HSE related activities, including internal inspection records, training records, and reports to the relevant authorities. Subcontractors are also required to provide HSE performance reporting to TCN on a regular basis through weekly and monthly reports. These will be used as inputs to the above.

7.6 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.

7.6.1 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.

7.6.2 Regulatory Agencies

Lagos and Ogun 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 judgement 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 settlement, he/she can then proceed to the official legal procedures.

7.6.3 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.

7.6.4 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 7.3 illustrates the procedure for grievance resolution.

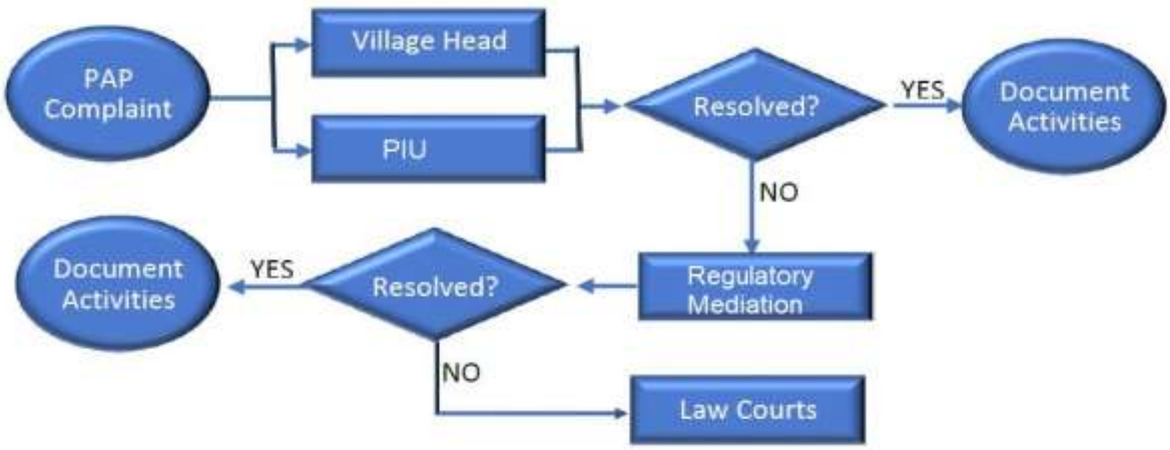

Figure 7.3 Grievance Resolution Procedure

7.7 PROPOSED MANAGEMENT PLAN

The Environmental and Social mitigation/enhancement measures, and the responsibilities for implementation are in Tables 7.1 and 7.2 respectively. The EPC contractor has responsibility for implementing the mitigation actions during construction phase. The budget for implementation shall be included in the EPC contract as part of the overall construction cost.

The monitoring plan in Tables 7.3 and 7.4 contain details of responsibilities, parameters to be monitored. Monitoring methods and standards/targets as well as locations and monitoring frequency. The cost estimates cover costs of analyses of samples (where required), travelling expenses and regulatory costs. The budget for environmental and social monitoring during construction (Table 7.3) shall be added to the EPC contract budget, and the EPC Contractor shall be required to disburse when needed, as directed by the Project Manager.

The budget for the monitoring during operations shall be provided by TCN management in its annual budgeting process and administered directly by the GM HSE, who has responsibility for ensuring mitigation actions are implemented effectively. These measures shall be adopted by TCN and imposed as conditions of contract on the sub-contractors hired for the Project (See Appendix A of the ESMP Report).

Additional detailed policies and specific plans have been developed to support the implementation which are included in the standalone ESMP report. The list of the management plans for this project is provided below and details is in the ESMP Report:

Waste Management Plan;

Vegetation Management Plan

Local Content Plan

Traffic Management Plan;

Occupational Health and Safety Management Plan.

Table 7.1 Environmental and Social Management and Mitigation Measure (Construction Phase)

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
Air quality	Localized impairment of air quality by exhaust emissions from vehicles and equipment engines (SO_2, CO, NOx, CO_2, PM)	Affected communities in area of influence	×	×	Maintain and operate all vehicles and equipment engines in accordance with manufacturers recommendations Stationary generators to be located to facilitate dispersion	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV
	Elevated dust levels due to vehicle movements, wind, and handling of dusty material	Affected communities in area of influence	×	×	Cover properly loose materials and keep top layers moist Regular cleaning of equipment, drains and roads to avoid excessive buildup	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					of dirt Spray surfaces prior to excavation Use covered trucks for the transportation of materials that release dust emissions Speed limits on-site of 15kph on unhardened roads and surfaces			
Climate change	GHG emissions that could add to climate change effects	Global warming	×	×	Maintain and operate all vehicles and equipment engines in accordance with manufacturers	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					specifications, location of stationary generators to facilitate dispersion, restriction of vegetation clearing to only the required area			
Noise, vibration	Nuisance noise from construction activities	Affected communities in area of influence Construction workers	×	×	Select 'low noise' equipment or methods of work Use temporary noise barriers for equipment (e.g. sound proofing walls around stationary power generating sources). Maintain and	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					operate all vehicles and equipment's in accordance with manufacturers recommendations 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			

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					the responsible person. Noisy activities (activities that can be heard in nearby communities) restricted to day-time working hours Provide appropriate PPE to construction workers and visitors			
Soils, geology and land-use	Change to soil structure (erosion and compaction) as a result of excavation and backfilling and removal of vegetation	Soil on construction site	×	×	Construction of foundations to be undertaken in the dry period as reasonable as possible. Protect excavated soil materials from	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					erosion (e.g. Ensure that the land is physically restored (include revegetation where possible) before leaving to next tower location and before the next rainy season. Use of existing road for transport of man and material to the extent possible.			
	Potential contamination of soil from inadvertent release of hazardous or	Soil on construction site, especially by each tower	×	×	Implement effective site drainage on the construction yard to allow for the	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
	contaminating material (liquid fuel, solvents, lubricants, aluminium oxide paint, etc)				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. Minimise bare ground and stockpiles to avoid silt runoff. Bunding of areas where hazardous substances are stored (eg fuel,	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					waste areas). Regular checking and maintenance of all plant and equipment to minimize the risk of fuel or lubricant leakages. Training of relevant staff in safe storage and handling practices, and rapid spill response and clean-up techniques. Set-up and apply procedure regarding dealing with contaminated soils. Development and			

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					implementation of a Waste Management Plan to ensure that waste is disposed of correctly. Spread sheet underneath the tower structure prior to start any painting activity.			
Water resources	Potential surface and groundwater contamination from accidental spills and improper disposal of waste and wastewater	Local groundwater-well and bore hole	×	×	See above measures to mitigate 'Potential contamination of soil' impact	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV
	Potential impact on hydrological condition due to the construction activities including the	Rivers and streams crossed	×		Natural flow of a River shall not be blocked	EPC Contractor	PIU Supervision	FMENV, OGMENV and

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
	construction of foundation as well as the access road within the swampy area.				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 river banks, in swamps or in areas where soils are saturated Consider and Select		Consultant	LAMENV

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					the engineering design for construction work, including construction of foundation as well as access road, which would minimize the impact on hydrological condition.			
Terrestrial ecology	Vegetation loss and disturbance to habitats, fauna and flora by construction activities	Flora and fauna and habitat in the area of influence Flora and fauna and habitat in the area of influence	×	×	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	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					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 Clearing should be minimised and restricted to the area required for construction purposes only and disturbance to adjacent vegetation communities and/or			

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					remnant trees within the corridor should be strictly controlled.			
					Revegetation will be carried out, as necessary. Revegetation will use species locally native to the site. The site of revegetation shall be identified and provided by the relevant government agency.	TCN 100,000USD	PIU Supervision Consultant	FMENV, OGMENV and LAMENV
	Vegetation clearing will cause habitat disturbances that could create suitable	Flora and fauna and habitat in the area of influence	×		Implementation of the invasive species management plan as part of the	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
	conditions for invasive species to spread				Vegetation Management Plan.			
	Potential avian collision	Birds in the area of influence	×	×	Consult with relevant agency (e.g local NGO) to seek any advice for mitigation measures to be considered for the design and construction of the transmission line. "Bird diverters" on the top (ground) wire to make the lines more visible to birds shall be installed, particular in the swampy areas	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					of Badagry Complete tree and/or brush cutting prior to or after the core nesting season			
	Loss of species that offer Provisioning Services	Local communities who rely on provisioning service, especially around swampy area.	×		Site clearance activities to be restricted to the minimum required area	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV
					Provide a training/education for the sustainable livelihood practice to local communities, as necessary, with cooperation of	PIU 50,000USD	TCN	FMENV, OGMENV and LAMENV

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					relevant agency.			
Aquatic ecology	Loss/disturbance of aquatic species	Rivers/streams/Swampy area crossed	×		Natural flow of a River shall not be blocked Conduct activities during the dry period to minimize 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	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					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			

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					permanent access roads along river banks, in swamps or in areas where soils are saturated 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			

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					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			
Waste management	Potential contamination of soil from inadvertent release of hazardous or contaminating material (liquid fuel, solvents, lubricants, aluminium	Surrounding environment and communities	×	×	Prepare and implement the waste management plan	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
	oxide paint, etc)							
Visual amenities	Temporary presence of an active construction site with storage of materials and equipment within the ROW and/or the site for the substation.	People living close to the construction sites.	×	×	Maintain construction site in orderly condition and do not distribute material over many sites before usage.	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV
Land planning and use	Change in land use cause by land take for towers, vegetation clearance, and access restriction	Land on the RoW	×		Site clearance activities to be restricted to the minimum required area. Provision of predefined route, barriers or boundary markings to prevent incursion of machinery and workers into	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					neighboring areas See below measures under 'Resettlement'			
Stakeholder and Community expectation/ relations Management	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.	Affected communities in area of influence	×	×	Follow mitigation for construction phase air quality, water quality, noise and traffic. Inform communities about details of construction activities (e.g., employment opportunities, schedule, timing of noise activities, traffic including movements of oversized loads) by	PIU RIC	TCN	FMENV, OGMENV and LAMENV

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					billboards, posters and community meeting Set-up and effectively monitor construction grievance redress mechanism Engage communities in the monitoring activities to enhance transparency and involvement.			
Community Health, Safety and Security	Increased risks of traffic safety incidents on public roads Risk of erosion into creeks, which are used	People living close to access roads and road users People who use the river water as source of	×	×	Implement a traffic management plan including design of access point, signalization, speed limits, training of	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
	as source of domestic water for the communities	domestic water			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. Follow mitigation for construction phase water quality.			
	Temporary influx of outside workers in the communities, risking tensions between outside (partly possibly	Affected communities in area of influence	×	×	Priority of employment shall be given to locals. A Local Content Plan should be	EPC Contractor	PIU Supervision Consultant	FMENV, OGMENV and LAMENV

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
	expatriate) labour and local population, due to differences in wealth and culture.				prepared to facilitate involvement of local labour. Develop a code of behaviours for workers. All workers to receive training on community relations and code of behaviour. Periodic refreshing as needed based on community liaison/grievance mechanism feedback.			
	Potential for increase in prevalence of sexually transmitted	Affected communities in area of influence	×	×	Do sensitization and awareness to all EPC workers	EPC Contractor	PIU Supervision	National Agency for Control of

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
	diseases in local communities and other diseases				regarding sexually transmitted diseases Provide Sexually transmitted disease awareness material to all EPC workers and host communities		Consultant	AIDS (NACA)
Resettlement	Land acquisition	Affected properties and livelihood	×	×	Follow principles and procedures of Resettlement Action Plan (RAP), including way forward, micro-plans per affected household.	PIU RIC	TCN	Witness NGO
Labour and working conditions	Exploitation of workers	Labour force	×	×	Develop transparent human resources policies and procedures for	EPC Contractor	PIU Supervision	TCN

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					recruitment process, working conditions and Terms of Employment wages, worker-employer relations, Grievance Redress 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 redress		Consultant	

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					mechanism, so that potential conflicts can be dealt with in an early and proper way. No use of child labour (workers under age 18) or forced labour Provisions to ensure compliance with labour standards by supply chain and subcontracts, including training if required. Provide proper work place facilities for water/sanitation/rest			

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					rooms etc. A worker's grievance redress mechanism will be in place.			
	Activities and staff at site may create security risk (e.g. infiltration of criminal)	Workers and local communities	×	×	Liaise with community security structure Provision of security during the construction work Make security plan and emergency response and contacts with security forces. Coordinate if applicable with TCN security measures	EPC Contractor	PIU Supervision Consultant Nigerian Security and Civil Defense (NSCDC)	Nigerian Police Force

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					for their site. Provide the identification tag for all workers and visitors.			
	Creation of tension between security personel and local communities	Local communities	×	×	Provide the training and awareness to security personnel Establish the communication with local communities and awareness	EPC Contractor	PIU Supervision Consultant Nigerian Security and Civil Defense (NSCDC)	Nigerian Police Force
	Risk of health & safety incidents amongst labour force, including minor incident’s such as cuts and major	Construction labour force	×	×	Develop project specific health and safety procedure, including provisions for training and	EPC Contractor	PIU	TCN

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
	incidents such as loss of life				certifications to be followed by all workers including subcontractors.			
Employment and economy	Creation of temporary jobs for locals residents and Nigerian nationals with skilled trades	Local residents of affected communities and Nigerian nationals	×	×	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,	EPC Contractor	PIU	TCN

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					receive applications, and provide guidance to applicants.			
	Supply chain opportunities for Nigerian companies that can provide goods and services needed by the company	Nigerian companies and local shops	×	×	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	EPC Contractor	PIU	TCN

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
					prepare for upcoming opportunities.			
Infrastructure	Influx of outside workers may pose additional pressure on social infrastructure, like medical posts, emergency services, water supply, solid waste management	Affected communities in area of influence	×	×	Coordinate with medical posts and emergency services to prepare for water supply and waste management. Install proper and independent facilities at construction site for water supply, sanitation, solid and liquid waste, so that pressure on community infrastructure is limited.	EPC Contractor	PIU	TCN

Indicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub-station		Mitigation Action/Cost	Supervision	Monitoring
Cultural heritage	shrines are located within the RoW along the transmission line and need to be relocated.	Affected cultural heritage	×		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	RIC	PIU	Witness NGO
	Potential interactions between construction works and cultural festivals due to traffic, noise and/or vibration impacts	Affected communities along the RoW and substation	×	×	Consult with local communities on festivals and potentials for interaction with construction works. If required cease works on the specific dates.	RIC	PIU	Witness NGO

Table 7.2 Environmental and Social Management and Mitigation Measure (Operations Phase)

ndicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub station		Mitigation Action	Supervision	Monitoring
Air pollution / Climate Change:	Accidental significant leaks of SF6 from aging equipment, and gas losses occur during equipment maintenance and servicing	Air quality	×	×	Impact of SF6 shall be mitigated through the improvements in the leak rate of new equipment, refurbishing older equipment, and the use of more efficient operation and maintenance techniques.	TCN	TCN HSE Dept	FMENV,
Noise, vibration & EMF	Noise & EMF from overhead line due to Corona effect and EMF effect	Affected communities along the RoW and Substations	×	×	Avoiding over loading Transmission Lines Keep residences and other permanent structures such as schools, shops or offices out of the RoW to minimize exposure to Noise and EMFs.	TCN	TCN HSE Dept	FMENV,
Terrestrial ecology	Impairments of natural habitats and associated	Flora and fauna around the ROW	×		Maintain all maintenance work inside the footprint of RoW to reduce encroachment on natural habitats Clearly mark the extent of vegetation control in the	TCN	TCN HSE Dept	FMENV, OGMENV and

ndicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub station		Mitigation Action	Supervision	Monitoring
	flora communities				ROW. Identify and mark the vegetation to be preserved along sections of the ROW Undertake selective control of the vegetation in order to keep low scrubby and herbaceous species that do not represent a risk for the powerline (species that cannot grow more than 4m in height) Use mechanical method for vegetation control inside the ROW. Forbid use of chemical pesticides to control vegetation in the ROW			LAMENV
		Bats and Birds in the area of influence	×		Schedule RoW maintenance activities to avoid breeding and nesting seasons of bird species with special status Develop and implement a mortality monitoring program, as necessary, with cooperation of local NGO.	TCN	TCN HSE Dept	FMENV, OGMENV and LAMENV

ndicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub station		Mitigation Action	Supervision	Monitoring
	Potential Impact due to introduction of alien species	Flora and fauna around the ROW	×		Develop and implement vegetation management plan to control the introduction of alien species A monitoring program of invasive species propagation within the right-of-way should be instituted and, if present, shall be removed.	TCN	TCN HSE Dept	FMENV, OGMENV and LAMENV
	Loss of species that offer Provisioning Services	Local communities who rely on provisioning service, especially around swampy area.	×		Undertake monitoring of natural resources exploitation and implement a sensitization program in order to educate and increase local communities' awareness on natural resources protection	TCN	TCN HSE Dept	FMENV, OGMENV and LAMENV
Aquatic ecology	Degradation of aquatic species	River crossings along the	×		Wastes shall not be disposed along water courses or sensitive areas.	TCN	TCN HSE	FMENV, OGMENV and

ndicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub station		Mitigation Action	Supervision	Monitoring
		ROW			Existing access roads shall be utilized during maintenance of the ROW. Avoid equipment and vehicle movements in rivers, floodplains and wetland areas as reasonable as practicable. Forbid use of chemical pesticides to control vegetation in the ROW		Dept	LAMENV
Waste management	Wastes such as waste oil, general waste will be generated from maintenance activities and substations	Surrounding environment and communities	×	×	Prepare and implement the waste management plan	TCN	TCN HSE Dept	FMENV, OGMENV and LAMENV
Visual amenities	Transmission lines and towers will be visible	Communities around the	×		Vegetation will be felled, but if possible, smaller trees can be kept.	TCN	TCN HSE	FMENV, OGMENV and

ndicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub station		Mitigation Action	Supervision	Monitoring
	from far and become an extrinsic element in the landscape.	project area			.		Dept	LAMENV
Stakeholder and Community expectation/ relations Management	Management of Community concerns linked to impacts associated with operation phase issues	Affected communities in the area of influence	×	×	Set-up, manage and manage grievance redress mechanism Engage communities in the monitoring activities to enhance transparency and involvement. Prepare and implement Stakeholder Engagement Plan(SEP). Enhance ongoing consultations with local communities by TCN to create continuous dialogue, trust and planning of community development activities according to SEP. Explain effects of electromagnetic fields to communities to limit concerns. Keep fields within limits of International Commission on Non-Ionizing	TCN	TCN HSE Dept	FMENV, OGMENV and LAMENV

ndicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub station		Mitigation Action	Supervision	Monitoring
					Radiation Protection (ICNIRP).			
Community Health, Safety and Security	External safety risks of electrocutions, bush fires, line snapping, tower collapses	Affected communities along the RoW and substations	×	×	Develop an emergency response plan following TCN and international best practice including provisions for prevention and response to electrocution, fires, repair of snapped lines and collapsed towers, roles and responsibilities. Coordinate with emergency services of LGAs Keep residences and other permanent structures such as schools, shops or offices out of the wayleave to minimize exposure to EMFs Communicate to communities in RoW the safety risks of the transmission lines and provide response measures. Put sign boards on towers about electrocution risk. Implement the anti-climbing device for on the	TCN	TCN HSE Dept	FMENV, OGMENV and LAMENV

ndicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub station		Mitigation Action	Supervision	Monitoring
					Transmission Tower.			
Labour and working conditions	Exploitation of workers	Labour force for maintenance work	×	×	Develop transparent human resources policies and procedures for recruitment process, working conditions and Terms of Employment wages, worker-employer relations, Grievance Redress 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 labour (workers under age 18) or forced labour.	TCN	TCN HSE Dept	FMENV, OGMENV and LAMENV

ndicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub station		Mitigation Action	Supervision	Monitoring
					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.			
	Occupational H&S risks in operation and maintenance	Labour force	×	×	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.	TCN	TCN HSE Dept	FMENV, OGMENV and LAMENV
Employment and Economy	Improved electricity supply for the national	National level Nigeria	×	×	Regular maintenance of the project to ensure reliable production of power	TCN	TCN HSE Dept	FMENV, OGMENV and

ndicator	Potential impact	Receptor	Project Component		Mitigation or enhancement measures	Responsibilities		
			Transmission Line	Sub station		Mitigation Action	Supervision	Monitoring
	grid, creating opportunities for businesses and economic development in the country.							LAMENV
Cultural heritage	Potential interactions between maintenance works and cultural festivals due to traffic, noise and/or vibration impacts	Affected communities in the RoW	×		Consult with local communities on festivals and potentials for interaction with maintenance works. I f required cease works on the specific dates.	TCN	TCN HSE Dept	FMENV, OGMENV and LAMENV

Table 7.3 Environmental and Social Monitoring Plan (Operational Phase)

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates (NGN)
Air quality	Dust	Visual inspection of construction sites, access roads; verification of equipment and machinery	Avoid significant degradation of baseline conditions.	Along ROW, access roads and work areas	daily	EPC Contractor	Included in EPC Contractor Fee
	SO2, NOx, CO, PM10, PM2.5, TSP	Ambient air quality measurements	IFC and National ambient air quality standards (FMENV)	Around substations (6)	quarterly	PIU	8,000,000/ year
Noise, vibration	Noise Levels,	Noise level measurements	IFC and FMENV noise standards	Along ROW and around substations (20)	quarterly	PIU	19,200,000/ year
Soils integrity	Visual signs of contamination Status of drainages, bundwalls, stockpiles, etc	Visual inspection of construction sites and access roads	Avoid the use of erosive processes or control them Reduce soil compaction Avoid soil profile structure	Along ROW, access roads and work areas	daily	EPC Contractor	Included in EPC Contractor Fee

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates (NGN)
			destruction Avoid any soil contaminations				
	Soil biological, physical and chemical properties	Sampling and analyses of soils	Compare with Baseline condition	Around substations (6)	Once the construction completed	PIU	10,800,000/ year
Water quality	Water physico-chemical and microbiological -pH, temperature, TSS, turbidity, phosphorus, metals, sulphate, BOD, COD, coliform, fungi, etc.	Analysis of surface and ground water samples Visual detection of pollution signs (presence of oil, waste, etc.)	Avoid significant degradation of baseline conditions WHO and FMENV water quality standards	Groundwater: Around substations (max 8) Surface water: Rivers and Surface water (50)	Twice a year	PIU	50,400,000/year
Aquatic ecology	Degradation on aquatic ecology	Visual inspection of rivers and streams	Avoid equipment and vehicle movements in rivers and swamps.	The construction area around rivers and swamps	Daily	EPC Contractor	Included in EPC Contractor Fee

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates (NGN)
Vegetation integrity and Fauna protection	Vegetation cover Pictorial comparison (before and after)	Visual inspection of construction sites	Avoid significant degradation outside the ROW. Protection of flora species with conservation status	ROW	Once during vegetation removal in the ROW	EPC Contractor	Included in EPC Contractor Fee
Waste management	Type and amount of waste generated Disposal of wastes	Keep the record	All waste are appropriately treated and disposed according with applicable regulation	ROE and substation sites	Daily	EPC Contractor	Included in EPC Contractor Fee
Visual amenities Land planning and use	Orderliness and cleanliness of sites disturbance outside ROW	Visual inspection of construction sites and access roads	Good housekeeping practice Site clearance activities to be restricted to the minimum required area. Provision of predefined route, barriers or	ROW and substation sites	Daily	EPC Contractor	Included in EPC Contractor Fee

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates (NGN)
			boundary markings to prevent incursion of machinery and workers into neighboring areas				
Stakeholder relations Management	No of complaints / concerns received Status of grievance resolutions	Interview neighboring communities Stakeholder meetings Inspection of complaints/grievance log book	As per Resettlement Action Plan	Neighboring communities	Continuous	PIU	Included in RAP cost
Health, Safety and Security	Incidences	Inspection and review of incidence log	ILO requirements and Factories Act minimum labour standards	All work sites and base camps	Daily	EPC Contractor	Included in EPC Contractor Fee
Employment and economy	Proportion of employees from local community materials procured	Inspect employee records Random interview with workers on site	Semi-skilled and non-skilled labour employed from local community Materials	Work sites and base camps	Daily	EPC Contractor	Included in EPC Contractor Fee

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates (NGN)
	from local community made in Nigeria materials used	Inspection of procurement records Interview with suppliers and vendors	available in the communities are used Made in Nigeria products are utilized, except where not available				

Table 7.4 Environmental and Social Monitoring Plan (Construction Phase)

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates (NGN)
Air quality	SO2, NOx, CO, VOC, PM, SF6	Visual inspection of substations and access roads;	Avoid significant degradation of baseline conditions.	Substations (6)	Daily Weekly monthly	TCN-HSE Dept	1,500,000/3 years

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates (NGN)
		verification of equipment and machinery records Ambient air quality measurements	WHO and National ambient air quality standards (FMENV)				
Noise and EMF	Noise Levels, EMF Levels	Noise level measurements EMF measurement	Avoid significant degradation of baseline conditions. WHO and FMENV noise standards ICNIRP EMF exposure limits	Along ROW and around substations (20)	Daily Weekly monthly	TCN-HSE Dept	6,000,000/3 years
Soils integrity	Visual signs of contamination Status of drainages, bundwalls, stockpiles, etc	Visual inspection of substation sites	Avoid the use of erosive processes or control them Reduce soil compaction Avoid soil profile structure destruction Avoid any	Substations (6)	Every 3 years	TCN-HSE Dept	Included in TCN`s administrative cost

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates (NGN)
			soil contaminations				
	Soil biological, physical and chemical properties	Sampling and analyses of soils	Compare with baseline condition	3 locations/ substations(6) Total 18	Every 3 years	TCN-HSE Dept	6,500,000/3 years
Terrestrial ecology	Introduction of Alien species	Visual inspection of alien species within and around the ROW	Avoid the introduction of alien species	Around ROW	Every 3 years	TCN-HSE Dept	Included in TCN`s administrative cost
	Avian collision	Visual inspection of incident of bird strike around the transmission line	Avoid avian collision	Around ROW	Every 1 year for fist 3 Year	TCN-HSE Dept	Included in TCN`s administrative cost
	Natural resource exploitation	Visual inspection and interview with communities	Increase awareness on natural resource protection	Around ROW	Continuous	TCN-HSE Dept	Included in TCN`s administrative cost
Vegetation integrity and Fauna	Vegetation cover Pictorial comparison	Visual inspection of areas around substations and along the	Avoid significant degradation outside the ROW and	ROW	At the time of ROW maintenance	TCN-HSE Dept	Included in TCN`s administrative cost

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates (NGN)
protection	(before and after the maintenance)	ROW	undeveloped areas. Protection of flora species with conservation status Avoid habitat loss and disturbances for local fauna				
Waste management	Type and amount of waste generated Disposal of wastes	Keep the record	All waste are appropriately treated and disposed according with applicable regulation	ROW and substations	ROW At the time of ROW maintenance Substations Regularly	TCN-HSE Dept	Included in TCN`s administrative cost
Visual amenities Land planning and use	Orderliness and cleanliness of sites disturbance outside acquired	Visual inspection of areas around substations and along the ROW	Good housekeeping practice Site clearance activities to be restricted	ROW	Daily	TCN-HSE Dept	Included in TCN`s administrative cost

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates (NGN)
	sites		to the minimum required area. Provision of predefined route, barriers or boundary markings to prevent incursion of machinery and workers into neighboring areas				
Stakeholder relations Management	No of complaints/ concerns received Status of grievance resolutions	Interview neighboring communities Stakeholder meetings Inspection of complaints/grievance log book	Grievances are resolved effectively Complaints and issues are addressed timely	Neighboring communities	Every 3 years	TCN-HSE Dept	Included in TCN`s administrative cost
Health, Safety and Security	Incidences	Inspection and review of incidence log	ILO requirements and Factories Act minimum labour	Transmission Tower and Substations	Daily	TCN-HSE Dept	Included in TCN`s administrative cost

Component	Parameters to be Monitored	Method	Standards/Targets	Location	Frequency	Responsibility	Cost Estimates (NGN)
			standards				
Employment and economy	Proportion of employees from local community materials procured from local community made in Nigeria materials used	Inspect employee records Random interview with workers Inspection of procurement records Interview with suppliers and vendors	Semi-skilled and non-skilled labour employed from local community if requierd Made in Nigeria products are utilized, except where not available	Transmission and Substations	As required	TCN-HSE Dept	Included in TCN`s administrative cost

CHAPTER EIGHT

8.0 DECOMMISSIONING AND CLOSURE

8.1 INTRODUCTION

The proposed transmission line project with the facilities and their ancillary installations have a life span of 50 years after which the performance of the project scales to diminishing returns or the project is no more viable and then will be decommissioned. A decommissioning plan will be prepared at end of the project life and submitted to FMEnv and other relevant regulators for approval before it is implemented. This plan shall contain procedures, outcome of consultations, impacts and mitigation.

Nevertheless, as required in the Guidelines for the ESIA study, the decommissioning Plan for the proposed project is presented below. The incorporation of remediation plans into the overall project planning is essential because it allows proponents to understand the need for restoring the environment into its original, or near its original status when abandonment plans are being conceptualized. Operating projects beyond the designed lifespan makes it economically unproductive as returns from such investment become unattractive.

8.2 STAKEHOLDERS CONSULTATION FOR DECOMMISSIONING

The project-decommissioning plan will include consultation with various stakeholders including host communities, nearby facility owners, regulatory bodies and experts.

As the Project approaches the end of its economic viability, plans will be put in place to wind down operations and maintenance. This will allow for a carefully planned redeployment and, where necessary, disengagement of personnel as appropriate.

8.3 PRE-DECOMMISSIONING ACTIVITIES

Prior to engaging in decommissioning works, the Proponent will develop a decommissioning plan in accordance with regulatory requirements at the time of decommissioning. Decommissioning and restoration activities will be performed in accordance with all relevant statutes in place at the time of decommissioning.

8.4 DECOMMISSIONING ACTIVITIES

At the end of the facilities utility, all equipment will be decommissioned. In general, the activities to be carried out during the decommissioning phase shall include the following:

- Dismantling of towers including excavation
- Dismantling of all surface equipment including conductors and grounding wires
- Removal and disposal of concrete works
- Removal and disposal of conductors, etc

8.5 IMPACTS AND MITIGATION MEASURES

Impacts

The potential impacts that might result from the decommissioning phase of the proposed project include:

- physical disturbance of the environment arising from the removal of the towers and ancillary equipment,

- potential hazards/accidents associated with decommissioning activities, and
- waste management problems

The strategy to be adopted for site remediation shall depend on the prevailing biophysical and social environmental attributes and the attendant impacts that may result from such an action as discussed in Chapter 6. The following measures need to be planned for implementation after decommissioning:

• Facilities and ancillary equipment shall be dismantled completely

• All equipment and debris shall be removed from the environment

• Good waste management plan shall be implemented.

- **Acoustics (Noise)**: Sources of noise during decommissioning would be similar to those during construction and would be caused primarily by construction equipment and vehicular traffic
- **Air Quality:** Emissions generated by activities during the decommissioning include vehicle emissions; diesel emissions from large construction equipment and generators; and fugitive dust from many sources such as structure removal, backfilling, dumping, reclamation of disturbed areas (grading, seeding, planting), and truck and equipment traffic.
- **Ecological Resources:** Removal of aboveground structures would eliminate the impacts to wildlife that occur during operation (e.g., bird collisions with transmission lines and habitat fragmentation).
- **Environmental Justice:** Issues that could be of concern during decommissioning and site reclamation are noise, dust, and visual impacts, as well as possible restoration of fish and wildlife populations for subsistence users.
- **Hazardous Materials and Waste Management:** Impacts could result if these wastes were not properly handled and were released to the environment.
- **Human Health and Safety:** Potential impacts to worker and public health and safety during decommissioning and site reclamation would be similar to those during construction; and relate to earthmoving, use of large equipment, dismantling of industrial components, and transportation of overweight and oversized materials.
- **Land Use**: Upon decommissioning, land use impacts resulting from construction and operation of an energy transmission project could be largely reversed depending on the end use selected for the ROW. No permanent land use impacts would occur during this phase.
- **Socioeconomics:** Direct impacts would include the creation of new jobs for workers during decommissioning.
- **Soils and Geologic Resources:** Activities during decommissioning that would result in impacts to soils include removal of access roads, transmission line components, and other ancillary structures. Surface disturbance, heavy equipment traffic, and changes to

surface runoff patterns could cause soil erosion. Soil erosion impacts include soil nutrient loss and reduced water quality in nearby surface water bodies.

- **Transportation:** Short-term increases in the use of local roadways would occur during decommissioning and site reclamation. Overweight and oversized loads could cause temporary disruptions to local traffic.

- **Water Resources**: Water would be used for dust control for road traffic, dismantling of towers, pipelines, substations, and other buildings, and for consumptive use by the construction crew. It might be trucked in from off-site or obtained from local groundwater wells or nearby surface water bodies, depending on availability.

Mitigation Measures

The strategy to be adopted for site remediation shall depend on the prevailing biophysical and social environmental attributes and the attendant impacts that may result from such an action as discussed in Chapter 6. The following measures need to be planned for implementation after decommissioning:

- Facilities and ancillary equipment shall be dismantled completely
- All equipment and debris shall be removed from the environment
- Good waste management plan shall be implemented.

For abandonment, strict adherence to facilities abandonment policy of TCN, which includes restoring the project environment to its original status as much as possible, shall be encouraged. The procedure shall be in accordance with approved Environmental and Social Management Plan (ESMP) and international industry standards. It is expected that if these measures are implemented, an environmentally friendly site restoration after decommissioning will be achieved.

Decommissioning of the transmission line and the ancillary installations will result in potential for work-related injuries and fatality from the dismantling process but increase land available for agriculture and other land use from the restoration of land to its original situation as much as possible and hand over of the reclaimed land to the original community and landowners

All facility components that can be used or recycled will be identified and quantified. Vehicles for the operation and other facilities will be scrapped and / or moved to other locations. Cleared locations will be re- vegetated using fast growing native plant species.

8.6 REPORTING

As required by regulations, a post-decommissioning report will be prepared and submitted to the Nigerian Regulators. The report will provide the following details:

- Overview of decommissioning facilities
- Details of methods used for decommissioning

- Nature of decommissioning (partial or whole)
- Record of consultation meetings
- Details of recyclable/reusable materials/facility components
- Decontaminated facilities
- Decommissioning schedule
- State of the surrounding environment
- Waste management plan
- Plans for restoration/remediation where necessary

CHAPTER NINE

9.0 CONCLUSIONS

The Environmental and Social Impact Assessment (ESIA) of the proposed project has been carried out in line with statutory requirements for environmental management in Nigeria and as such ensures that potential environmental, social and health impacts of the project are fully appraised. This ESIA report has documented the existing environment of the area, potential and associated impacts of the proposed project, proffered cost-effective mitigation/ ameliorative measures for impacts and enhancement measures for the beneficial impacts. A management plan that would be effective throughout the project's life cycle has also been put in place to assure environmental sustainability of the project.

The environmental baseline condition of the project area 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; air pollution, soil, sediment, groundwater water and surface water contamination from accidental/ routine discharges of effluent, workplace accidents, improper waste management has been identified. Consequently, cost-effective mitigation/ amelioration measures have been designed to ensure that these impacts are prevented, reduced or controlled to as low as reasonably practicable in order to ensure conservation of biodiversity in the area and enhance continual compliance with environmental standards and requirements in Nigeria. It is understood that the project will result in substantial social and economic benefit for Nigeria. The EMP developed would ensure the plans/ procedures for managing the significant impacts of the project are maintained throughout the project implementation.

Socio economic consultations with the project host communities and other relevant stake holders were also carried out and shall continue throughout the life cycle of the project

It is therefore hoped that all data/evidence contained in this report is sufficient in the development of an environmental impact statement (EIS), and afterward in the acquiring of necessary permits for commencement of project.

In consideration of the above therefore, all the environmental issues identified can be mitigated and manged through the ESMP.

Therefore, we recommend that the *ESIA of Lagos and Ogun States Transmission Project* be approved and issued ESIA permit. The mitigation measures that have been proffered shall be adequately implemented in accordance with the ESMP and in compliance with the ESIA Act and the world bank environmental and social safeguard policies.