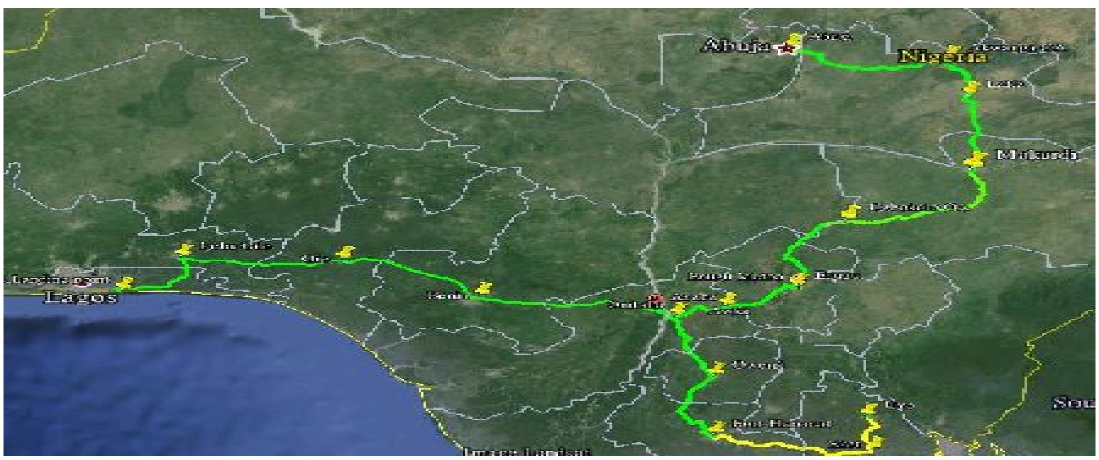
Environmental Impact Assessment
(EIA)

OF THE PROPOSED

NATIONAL INFORMATION AND COMMUNICATION TECHNOLOGY INFRASTRUCTURE BACKBONE (NICTIB) PROJECT



BY

HUAWEI TECHNOLOGIES CO., NIGERIA LIMITED

August, 2015

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LIST OF ACRONYMS AND ABBREVIATIONS

%o	-	Parts per Thousand
µg	-	Micro gram
µg/g	-	Micro gram per gram
$\mu g/m^3$	-	Micro gram per meter cube
µS/cm	-	Micro Siemens per Centimeter
^0C	-	Degree Celsius
^0F	-	Degree Fahrenheit
3G	-	3rd Generation
A/m	-	Ampere per meter
AAS	-	Atomic Absorption Spectrophotometer
ANSI	-	American National Standards Institute
API	-	American Petroleum Institute
ASTM	-	American Society for Testing Materials
AUC	-	Authentication Centre
Ave.	-	Average
BAT	-	Best Available Technology
BOD_5	-	5-day Biological Oxygen Demand
BSC	-	Base Station Controller
BSS	-	Base Station Subsystem
BTS	-	Base Transceiver Station
cm	-	Centimeter
CO	-	Carbon Monoxide
CO_2	-	Carbon dioxide
COD	-	Chemical Oxygen Demand
CS	-	Charging System
CSR	-	Corporate Social Responsibility
dB	-	Decibel
DCD	-	Development Control Department
DCP	-	Dry Chemical Powder
DO	-	Dissolved Oxygen
DPR	-	Department of Petroleum Resources
EA	-	Environmental Assessment
EAR	-	Environmental Audit Report
EHS	-	Environmental, Health and Safety
EIA	-	Environmental Impact Assessment
ELF	-	Extremely low frequency
EMF	-	Electromagnetic fields
EMP	-	Environmental Management Plan
EMS	-	Environmental Management System
ERP	-	Emergency Response Plan
ESA	-	Environmentally Sensitive Areas

ESI	-	Environmental Sensitivity Index
et. al	-	et. alli (and others)
E-Waste	-	Electronic Waste
FCT	-	Federal Capital Territory
Fe	-	Iron
FEED	-	Front End Engineering Design
FEPA	-	Federal Environmental Protection Agency
FMEnv	-	Federal Ministry of Environment
g	-	Gram
g/m^2	-	Gram per meter square
g/m^3	-	Gram Per Meter Cube
GHG	-	Green House Gases
GHK	-	General Housekeeping
GIS	-	Geographic Information System
GPS	-	Global Positioning System
GSM	-	Global System for Mobile Communications
H_2	-	Hydrogen
HDB	-	Hydrocarbon Degrading Bacteria
HES	-	Health, Environment and Safety
HIA	-	Health Impact Assessment
HLR	-	Home Location Register
HSA	-	Highly Sensitive Area
HSE	-	Health, Safety and Environment
HUB	-	Hydrocarbon Utilizing Bacteria
HUF	-	Hydrocarbon Utilizing Fungi
ICNIRP	-	International Commission on Non- Ionizing Radiation Protection
ICT	-	Information and Communication Technology
IEC	-	International Electric Code
IEE	-	Initial Environmental Examination
IF	-	Intermediate Frequency
IFC	-	International Finance Corporation
IMT	-	the International Mobile Telecommunications
ITCZ	-	Inter Tropical Convergence Zone
ITD	-	Inter Tropical Discontinuity
Kcal	-	Kilocalorie
kg	-	Kilogram
kg/cm^2	-	Kilogram per Centimeter Square
km^2	-	Kilometer square
Kr	-	Krypton
KVA	-	Kilovolt Ampere
l/d	-	Litre/day
LCA	-	Life Cycle Analysis
LCI	-	Life Cycle Inventory
LGA	-	Local Government Area

Long.	-	Longitude
LPS	-	Lightning Protection System
LSA	-	Low Sensitive Area
m	-	Meter
m/s	-	Meter per Seconds
m^2/d	-	Meter Square per Day
Max.	-	Maximum
mg	-	Milligram
mg/l	-	Milligram per Litre
MGW	-	Media Gateway
Min	-	Minimum
Min	-	Minimum
ml	-	Millilitre
mm	-	Millimeter
mS/cm	-	Meter Seimens per Centimeter
MSC	-	Mobile Switching Centre
₦	-	Naira
N.D	-	Not Detected
NAAQS	-	Nigerian Ambient Air Quality Standards
NCC	-	Nigerian Communications Commission
ND	-	Not Detected
NEC	-	National Electric Code
NEPA	-	National Electric Power Authority
NESREA	-	National Environmental Standards and Regulations Enforcement Agency
NGO	-	Non – Governmental Organizations
NH_3	-	Ammonia
NIMET	-	Nigerian Meteorological Agency
NIR	-	Non-Ionizing Radiation
NO_x	-	Nitrogen Oxides
NPC	-	National Population Commission
NSS	-	Network and Switching Subsystem
O_2	-	Oxygen
OAR	-	Operations Assurance Review
OE	-	Operational Excellence
ONC	-	Optical Network Control
OSHA	-	Occupational Safety and Health Administration
OSS	-	Operations Support system
PAH	-	Polycyclic Aromatic Hydrocarbons
Pb	-	Lead
pH	-	Potential of Hydrogen (Hydrogen ion Concentration)
PHCN	-	Power Holding Company of Nigeria
PLCS	-	Programmable Logic Controllers
PM	-	Particulate Matter

PPE	-	Personal Protective Equipment
ppm	-	Parts per Million
QC	-	Quality Control
QHSE	-	Quality, Health, Safety and Environment
RCA	-	Regulatory Compliance Audit
RF	-	Radio Frequency
RH	-	Relative Humidity
SEP	-	Stakeholder Engagement Plan
SEPA	-	State Environmental Protection Agency
SHE	-	Safety, Health and Environment
SHES	-	Security, Health, Environment and Safety
SLA	-	Service Level Agreement
SMEnv	-	State Ministry of Environment
SMS	-	Short Message Service
SOP	-	Standard Operating Procedures
SPM	-	Suspended Particulate Matter
Sqm	-	Square meter
TC	-	Tropical Continental
TDS	-	Total Dissolved Solids
TH	-	Total Hydrocarbon
THB	-	Total Heterotrophic Bacteria
THC	-	Total Hydrocarbon Contents
THF	-	Total Heterotrophic Fungi
THP	-	Tower Hold Point
TLC	-	Total Loss Control
TM	-	Tropical Maritime
TOC	-	Total Organic Carbon
ToR	-	Terms of Reference
TRX	-	Transceiver
TSP	-	Total Suspended Particulate
TSS	-	Total Suspended Solids
UES	-	Uniform Effluents Standards
UNEP	-	United Nations Environment Programme
UPS	-	Uninterrupted Power Supply
USEPA	-	United State Environmental Protection Agency
UTM	-	Universal Traverse Marcator
VOC	-	Volatile Organic Compounds
WHO	-	World Health Organization
WMP	-	Waste Management Plan
Yrs	-	Years
Zn	-	Zinc

EXECUTIVE SUMMARY

E.S- 1 INTRODUCTION

Information and Computer Technology (ICT) applications gives ability to individuals and the society at large to directly contribute to the efficiency of a country's economic development in this global information and knowledge exchange age. ICT technology plays a very important role in promoting sustainable development of each country in the 21st century.

In recent years, the Nigerian Government has incorporated the development of the ICT into national strategic planning and is positively promoting reforms aimed at opening up of the telecom industry. This is creating a favourable market environment for economic growth in Nigeria.

The organized private sector in Nigeria has also made significant strides in ICT infrastructure construction, under the active support of the Nigerian government. Good examples are the Glo-1 and Main One submarine fibre optics cable connecting Nigeria with the Europe.

The Nigeria Communications Commission (NCC) is also promoting ICT for the underserved through the following projects: (a) DAP project, aiming to encourage the middle and primary schools and higher education institutions to adopt the ICT. (b) ADAPT project, serving the teachers (mostly college teachers), to train them on their computer application ability and equip computers for some of them). (c) DBI project, mainly to train the mobile communication technicians. The institute has respectively 1 campus in Abuja, Lagos and Kano, with the teachers coming from all over the world.

E-governance is an important area of ICT application. The construction and development of e-government infrastructure has become an important factor for pushing social & economic development. Firstly, e-government can effectively improve work efficiency in government departments, and also provide high-quality service with lower and quicker speed. Secondly, the development of e-governance can create positive investment environment.

In order to ensure environmental sustainability vis-à-vis enhanced economic development, through projects of such magnitudes, an Environmental Impact Assessment (EIA) is mandatory in Nigeria as stipulated by the Environmental Impact Assessment Act, No. 86 of 1992. Similarly, the China Exim Bank as part of their conditions for project funding requires this report for their corporate business policy.

It is in compliance with the national and international regulations of minimizing impact on the environment that the Federal Ministry of Communications through National Information Communication Technology Backbone (NICTIB) and HUAWEI Technologies Limited planned to conduct this Environmental Impact Assessment (EIA) of the rehabilitation of the project area prior to the commencement of the project.

THE PROPONENT

1.1 Project proponent

Huawei Technologies Company Ltd signed a commercial contract in November 2006 to carry out the Nigeria National Information and Communication Technology Infrastructure Backbone (NICTIB) project.

REGULATORY FRAMEWORK

The work scope of this project involves development of fibre Optics and highways and related activities. The constitution of the Federal Republic of Nigeria confers jurisdiction on the Federal Government to regulate the operations and development activities in this sector. These, together with applicable International conventions provide a basis for an EIA of the project. The development will take account of the following Nigerian laws and regulations, and international conventions that apply to the subject development:

China Exim Bank's Environmental Protection Policy

China Ex-im Bank is paying a high level of attention to our funded projects' environmental impacts. We enhance environmental monitoring and management before, during and after the project implementation.

STRUCTURE OF THE REPORT

The EIA report is presented in nine chapters. Chapter 1 is the Introduction. It gives relevant background information on the project, HUAWEI (the EIA proponent), the Statutory Regulations and project objectives. In addition, it highlights the environmental assessment process. Chapter 2 discusses justification for the project and project alternatives. Chapter 3 describes the proposed project and processes, namely, type, input and output of raw materials and products, project operation and maintenance and schedule. Chapter describes the existing baseline environmental status of the study area and consultations and Chapter 5 describes potential and associated impact assessment. Chapter 6 gives the potential impacts and proffers mitigative and ameliorative measures for the adverse potential impacts identified. Chapter 7 presents the Environmental Management Plan that will be adopted throughout the project cycle. It also includes the Monitoring Plan that will ensure the effectiveness of the mitigation measures and the remediation plans after de-commissioning/closure. Chapter 8 contains the Conclusions.

E.S-2 PROJECT JUDTIFICATION

Need For the Project

The project is proposed to construct an Optical Fibre Cable Backbone network to cover the Federal Territory, including one Landing Station of for Submarine cables. This would provide government-owned increased capacity and lower cost allowing for faster and more reliable transmission for data and voice.

With this project, Galaxy Backbone Ltd, will be able to deliver connectivity and other Information and Communication Technology infrastructure to Ministries, Departments and Agencies (MDAs) of Government currently has up to 300MDAs connected to its ONEGOV.net network in over 3000 office locations nationwide, making it the largest single network ever developed in the public sector.

On the other hand, the direct-connected Internet gateway to Main One Fibre Optic cable system will be capable of transmitting and enabling access to bfibre Opticband Internet at a speed of almost 5 Terabytes per second – which is much faster than what is currently available in the Europe – and will deliver up to 10 times more capacity than what is currently available here in Nigeria

PROJECT ALTERNATIVES

Study alternatives that best suits the purpose and need for the Project were considered. Potential project alternatives include (1) taking no action; (2) consider alternative types of service modes; (3) Delayed option (4) Go-ahead option. In conceiving the development options and scenarios, the following main factors were also considered:

- availability of raw materials,
- process facilities,
- cost effectiveness and more effective utilization of resources.

PROJECT BENEFITS

This proposed project which is to construct an Optical Fibre Cable Backbone network will positively enhance the performance of the telecommunication industry in satisfying he expectations and demand of both the private and public sectors of the economy. This will undoubtedly increase returns on the investment. The benefits of the project include:

Technical Benefits

1. The Optical Fibre Cable Backbone network will provide reliable infrastructure for telecommunication operation.
2. The project will promote technology upgrade and provide dependable performance and superb reliability under high traffic load.
3. It has the ability to increase the businesses in the telecommunication industry.

Commercial and Economic Benefits

1. The project will improve the quality and efficiency of digital economy, data center enable organizations to conduct business around the clock and round the world.
2. It will ensure continuous business operations in the country.
3. Indirect economic benefits due to increased activities in the Information and Communication Technology7 (ICT) sector.
4. Provide employment opportunities and encourage Foreign Investment in the Telecommunication industry.

Social Benefits

1. Facilitate crime abatement through improved communications and timely access to emergency response services.
2. Also, from the social perspective, modern and prospering cultures are characterized by well functioning communication network.

E.S 3- PROJECT DESCRIPTION

Project Location

The 1, 482Km fiber backbone will be constructed from Abuja to Onitsha to Lagos, and Onitsha to Port Harcourt to Uyo. Other areas are Abuja – Akwanga – Lafia – Makurdi – Enugu – Awka – Onitisha – Asaba – Benin – ore – Ijebu Ode – Lagos and also its linking from Onitisha – oweri – PH – Uyo.

The Data Centers will be setup in Abuja, and some Metro access system located in cities like Abuja, Makurdi, Enugu and Lagos.

LAYOUT AND EXISTING CONDITIONS OF THE FIBRE OPTIC PROJECT

1. *Metro Access Network*

- Build fiber optics metro network in Abuja, the Federal Capital Territory (FCT) of Nigeria, using SDH and GPON technologies consisting of a 26-node metro core network with related metro access network.
- Deploy 9 eLTE sites and 800-nodes WiFi hotspot network, all within Abuja.

2. *Data Center*

- Build 2 new Data Centers. One new Data Center located in Abuja FCT and the other new backup Data Center in Enugu.

3. *Government Hotlines, Call Center, NOC, and Unified Communication*

- Install 25-seater Call Center facility in Abuja FCT.
- Provide 16000 IP phones, 2000 video phones and 5000 capacity PC client telephony in Abuja FCT.
- To build 30 sets Tele Presence and video conference solution.
- Build a Network Operation Center (NOC).

PROJECT OVERVIEW

1. CIVIL WORKS/ CONSTRUCTION

HDPE laying – HDPE / Duct is laid after the required depth is reached, the HDPE is the house built for the fiber, it protect the fiber, also note that as the case may be in in Metro (Urban) PVC is used before the HDPE to have a double protection on the fiber. But for the backbone (Suburban) HDPE is laid directly.

Laying of warning Tape – this is the stage of which after the HDPE is buried in the trench, the arranged according to the specification, half backfilling is done on the HDPE and warning (caution) tape is laid on the half backfilled soil ,this warning tape help to indicate to any person digging around the facility line that there is an existing sensitive facility along that route. Its of a very high advantage.

Backfilling – this is the final stage in the civil work aspect where the trench is finally backfilled with the excavated soil and compacted to avoid depression, which can lead to erosion along the trench path if not properly compacted.

HH installation – this is when the cast HH is deployed to site and installed accordingly to the marked location, this serves as a house for the joint closure, which is used to join two fiber together, and also this Hand hole is necessary because in time of maintenance it reduces the Waste of fiber cable as the fiber replacement can be shorten or the excesses stored in the Handhole called slag can cover the damaged section.

Fiber blowing – this is the telecom Aspect, this stage comes in after all the civil work is completed because if civil work is not properly done the telecommunication aspect is always difficult to deliver, thus the telecommunication aspect success depends on the civil work, in the FIBER blowing a blowing machine with compressor is used to blow the fiber cable through the HDPE buried in the trench, which there will be joint in different Handhole depends on the cable length.

Splicing/Termination – this is the method of joining two fiber cable at one end such that there will be continuity in the fiber link from one end to another, termination is the connection of the fiber to the ODF (optical distribution frame) which is connected to the DWDM or OSN as the case may be. After all this is done and OTDR and Light source and power Meter is used to check the link to confirm if the expected loss budget is not exceeded.

2. **Installation**
3. **Commissioning**

PROJECT SCHEDULE

The total duration from zero date to commissioning of the fibre Optic will be determined. The remaining phases required prior to construction include completion of the environmental impact assessment and screening, detailed field survey and geometric design, and acquisition of the required right of way especially for project areas. This is estimated to take thirteen months to complete. Construction thereafter will depend on the availability of funding. There is no specified date of decommissioning as the project is expected to be maintained and to remain in operation indefinitely.

E.S 4-ENVIRONMENTAL BASELINE CONDITIONS

This section is the description of the physical, chemical, biological, socio-economic and health characteristics of the route through which the proposed fibre optic project will traverse. It provides information on the features, quality and sensitivity of the proposed project environment. The studies was carried out in order to establish a reference platform against which environmental changes and impacts as a result of the fibre optic project could be judged and monitored during the operational phase.

Geographical Location.

Nigeria is currently divided into five ecological zones, namely:

Abuja – Akwanga – Lafia – Makurdi – Enugu – Awka – Onitisha – Asaba – Benin – ore – Ijebu Ode – Lagos and also its linking from Onitisha – Owerri – PH – Uyo.

This is zoned as follow:

- South-West Zone: Ore, Ijebu Ode, Lagos
- South-East Zone: Enugu, Awka, Onitsha, Owerri,
- South- South Zone: Uyo, Port Harcourt, Asaba, Benin
- North-Central Zone: Abuja, Markurdi, Laffia, Akwanga

Climatic Conditions

The climatic conditions of the area under study like many parts of Nigeria are influenced by the North-South movement of a zone or surface of discontinuity (SD) between Maritime (Atlantic) air masses and dry continental (Sahara) air masses. The regular movement of these air masses creates distinct climatic seasons in the area – the wet and dry seasons. Data on the following climatic elements were obtained from the Nigerian Meteorological Agency (NIMET) Lagos, for 1995-2015.

- **Rainfall**

The study area is influenced by two seasonal periods, namely the dry and rainy season. The raining season is characterized by the Southwest Monsoon wind (Southwest wind), which blows across the Atlantic Ocean. It brings cold and raining and it usually starts from May and ends in December.

Temperatures

The mean maximum temperature of the area varies between 24.9^{o}C and 33.1^{o}C while the mean minimum temperature varies between 12.2 and 26.1^{o}C. The months of August and September are the coolest with temperature of about 22^{o}C. The table 4.6 below shows the maximum and minimum temperature data of the area from year 2008 to 2015.

GEOLOGY/RELIEF, SOIL AND DRAINAGE

Geology and Relief: The southern landscape of the state forms part of the low plains of the Benue origin. Other parts of the state are composed of undulating lowlands and a network of hills developed on granites, migmatites, pegmatites and gneisses. Around the salt mining village of Awe are a number of worn volcanic cones.

Most parts of the state that lies within the Benue (valleys are composed of sandstones. However,) around the salt bearing districts of Awe, Keana and Akiri, are detached synclinal areas formed by localized folding. The brine springs of Awa, Azara and Bomanda are associated with anticline axes along which salt bearing beds within the synclines) approach the surface.

SOCIO ECONOMICS

Key stakeholders along the route were identified during the reconnaissance visit. The primary stakeholders of the projects identified are the important towns and settlements transacted by the fibre Optic or within 200m on both sides of the fibre Optic. Evidences and documents of these Consultations are presented in compliance with government regulation; a public forum was organized and conducted on the Projects in two different locations for the key communities located in Uyo, Eket, PHC, Owerri, Onitsha, Asaba, Awka, Benin, Ore, Ijebu Ode, Lagos, Enugu, Makurdi, Lafia, and Abuja. along the entire route. Stakeholders' forum was held between 10th and 14, August, 2015. Key socio-economic findings during the survey are presented below:

E.S- 5 POTENTIAL AND ASSOCIATED IMPACT

Environmental Issues

Direct impacts of fibre Optic development result from construction, maintenance and operation of the facility. The most significant project-related impacts are those related to site preparation activities, construction and commissioning and operation and maintenance. Some of the major project actions that will have potential impacts on the environment are discussed in the next section.

The project activities which may impact the environment include:

(I) Site Preparation Activities

These consist essentially of bush clearing and de-stumping activities involving mainly agricultural land which will not apply on the proposed fibre optic project in Uyo, Eket, PHC, Owerri, Onitsha, Asaba, Awka, Benin, Ore, Ijebu Ode, Lagos, Enugu, Makurdi, Lafia, and Abuja. However, in this circumstance, there will be site construction works. In addition, there will be some excavation activities and removal of spoils.

(ii) Construction/Civil Work and Commissioning

The project construction activities will involve civil engineering construction works, vegetation (bush) clearing, earth (soil) movement, topographic levelling, alignment and re-alignment of fibre Optic segments, creation of fibre Optic pavement, coal tarring and bridge and culvert works. The pavement will be mostly of lateritic materials (200mm) stabilized with cement.

(iii) Operation and Maintenance Activities

As soon as the commissioning ends then the running and maintenance of the project starts throughout the lifespan of the project.

Site Clearing and Construction/Civil Work

The impact of these activities on the environment will depend of the types of clearing and construction equipment used.

(i) Air quality

The primary air emissions during project construction will be from pug mills and airborne dust from construction truck movements and bush clearing and construction equipment. The Total Suspended Particles (TSP) was also within the set limit in all the locations measured and ranges between 0.21-0.26μg/m^3.

The emission levels SO_2 (0.00-0.5), CO_2 (0.00-0.3), CO (0.00-0.2), H_2S (0.00), NO_2 (-01.0 to -0.00), VOCs (0.00), RH (47.1-65.4), Temp. (^{0}C)(29.4-37.5).

Wind speed (W/S) ranges from 0.1 knots to 1.6 knots measured in the area during the study was lower in concentration than the acceptable limit of 250μg.m^{-3} in any given day stipulated by FMEnv.

(ii) Noise

The main noise sources during construction are construction machinery, which are known to generate noise at levels from 76 dB(A) to 98 dB(A) measured 5 m from running machines. At about 100 m, the noise levels are expected to reduce to levels within the daytime national noise standards of 70 dB(A). The noise will have an impact mostly on construction workers and residents living within 100 meters from the construction sites. Impacts during construction will arise from equipment noise, blasting and vibration and, during operation; those closest to the highway will hear vehicle movement. The existing ambient noise level (L_{A90}) in the nearby communities is within acceptable limits (31.6 -68.9dBA). The noise sources during site preparation and construction activities are the internal combustion diesel engines powering bush clearing and civil works.

(iii) Landuse, Agriculture and Soil

The proposed activity will be limited to the existing fibre Optic corridor. This means that no new land is expected to be acquired and hence land take is not an issue. However, in the course of the implementation of the project, third party property especially farm land may be affected through manuvouring of construction vehicle that require much space in the process of turning.

(iv) Ecology

Site clearing will destroy the plant community and wildlife habitat, leading to the death of plants and relatively immobile animals as well as the migration of the animals that are capable of escaping. This will lead to the reduction of biodiversity in the area and possible soil erosion by rain water due to soil exposure. This impact is considered insignificant as the proposed activity will be restricted to the existing route.

(v) Water Quality

During the bush clearing and construction stage, silt from disturbed soil and in-river construction activities may result in increased suspended solids (SS) in rivers immediately downstream from the expressway, and duck/fish ponds and water wells near the fibre Optics. Such impacts will be temporary and limited to small areas downstream, but can affect a large portion of an adjacent fish pond. Construction camps will generate domestic effluent of 60 L per person per day on average, and total wastewater in the largest camp may be up to 60,000 L per day. If discharged directly into natural water bodies, the domestic effluent from construction camps would raise COD concentrations by about 1.2 mg/L in large rivers and up to 34.7 mg/L in smaller streams.

(viii) Socio-Economics

The proposed Fibre Optic project will not directly impact several homes and is in close proximity to residential development at several locations. There will not be noise and air pollution levels. The proposed project will not lead to traffic disruption and possible road accident.

SOCIAL IMPACT ANALYSIS

Identified potential impacts include:

i. Positive Impacts

- Improved employment opportunities for indigenes and rural economy from phases of project implementation
- Better access to neighbouring towns and cities via internet.
- Employment in the construction sites
- Improved trading activities
- Better transport system for transporting farm products

ii. Negative Impacts

- Involuntary discomfort and disturbance of farmers and property owners
- loss of agricultural resource base
- Discomforting noise nuisance to workers and inhabitants from construction equipment and vehicle operation
- Interference with traffic and economic activities and increased road safety during construction.
- Increase in social vices (drug abuse, commercial sex workers, teenage pregnancies, etc) and increased pressure on existing infrastructure and health care facilities (housing, educational and recreational facilities) from influx of people (job seekers)
- Health impairment from equipment (air pollutants) gaseous emissions inhalation

iii. Natural Resources

In order to mitigate the impacts of the fibre optic project development on the natural resources, the following minimum term must be met:

- Rehabilitation aimed at restoring any portion of the impacted land and vegetation;
- All the wastes generated from the operation of the facilities must be disposed of in accordance with Federal Ministry of Environment (FMEnv) guidelines;

iv. Health and Safety

The existing health problems in the project area will be alleviated by the implementation of occupational health and safety of both the worker and the public. There should be measures in place for monitoring environmental parameters during the construction phase. Increased resources should be allocated for local occupational health and safety throughout the duration of the project. Provision of potable water supply for domestic use and proper disposal of human waste are mitigation measures that are most likely to reduce the incidence of water-borne diseases and improve the quality of health in the area.

E.S-6. MITIGATION OF POTENTIAL / ASSOCIATED IMPACTS

Site Clearing and Civil Work/Construction

The clearing and construction-related impacts such as equipment emission and noise impacts are short-term in duration. Their impact is not is not significant because equipment low risk levels to noise will be used to excavate the soil for this purpose.

To mitigate noise, no machines will be allowed to work at night. During the day, noisy stationary machines such as power generators, concrete mixers, pug mills, etc., will be located at least 300 m leeward to sensitive receptors..

Soil

During construction operations it will be ensured that surface water flows are controlled and if necessary channelled to temporary discharge points. Such points shall be located, designed and constructed in a manner that will minimize the potential threat of erosion in the receiving waters. Surface runoff within the worksite shall be drained into a suitable silt trap before its discharge into an outlet drain, ditch, stream or river. The silt trap shall be of adequate size and shall be regularly de-silted.

Water Quality

During the construction stage, silt from disturbed soil and in-river construction activities may result in increased suspended solids (SS) in rivers immediately downstream from the expressway, and fish ponds and water wells near the fibre Optics. Such impacts will be temporary and limited to small areas downstream, but can affect a large portion of an adjacent fish pond. Surface runoff to fish ponds and drinking water wells by the fibre Optics will be intercepted to prevent impact on these water bodies. The construction work has no effect on the

COD and Suspended solids in the project area.. Environmental management programs for the storage of hazardous materials, solid waste collection and disposal, and environmental contingency plans shall be in place.

Operations and Maintenace

Atmospheric Emissions

Vehicular emissions and noise constitute the main environmental impact of Highway traffic operation. Although areas adjacent to the expressway and that now have no emission sources will be adversely affected, air quality will be improved from a regional perspective; the upgrading of the existing fibre Optics will increase motor vehicle speeds and reduce acceleration/deceleration on the fibre Optics project area will reduce CO, HC and NOx emissions. Similarly, the new alignments will be made to bypass densely populated areas of two counties, townships, and several villages intersected by the present fibre Optics.

Noise Impact

The noise impact will be long term and increase over time as traffic volume on the project fibre Optics increases. Villages and other facilities beyond the 200-m range are however considered less sensitive to noise from expressway traffic because of the attenuation of noise intensity over distance. For the fibre Optics project some mitigation measures are planned based on the extent of noise levels above the national standards. Though noise levels will be reduce by engineering controls..

Nevertheless, the incremental increase of noise at sensitive receptors will be apparent — from rural baseline noise levels of around 50 dB(A) during daytime and 40 dB(A) or lower at night up to 70 to 75 dB(A) during daytime and 65 dB(A) at night. This will permanently expose some receptors to noise levels exceeding the national noise standards even after the preceding mitigation measures.

Socio-Economic

To mitigate the impact of loss of vegetation, trees and bushes will be planted on both sides of the expressway, and land will be seeded to grass the embankment in an expressway landscape plan. As the lost cultivated land economic crops, within the proposed ROW cannot be destroyed. The effect is minimal.

DECOMMISSIONING PLAN

The project Highway is generally expected to be maintained and to remain in operation indefinitely and the operation and maintenance procedure provide for monitoring the performance and the integrity of the system components. However, when the performance of the system scales to diminishing returns, or a new replacement fibre Optic is in place standard procedures for decommissioning shall be invoked. A decommissioning team is set up to plan and implement laid down guidelines on decommissioning. The following activities are involved in decommissioning/abandonment:

- Short down of facility
- Decommissioning of facility
- Disposal of Wastes;
- Rehabilitation of Site by re-vegetation etc.

At the end of decommissioning, various solid wastes are segregated according to their types and then disposed of according to FME waste disposal guidelines.

E.S-7. ENVIRONMENTAL MANAGEMENT PLAN

MONITORING SCHEDULE

The monitoring actions required and frequency will vary depending on the parameter to be determined and discharge type as summarized.

ENVIRONMENTAL AUDIT

The effectiveness of the EIA process relies on the availability and quality of information and data. In order to ensure that the EIA process remains valid and robust, the monitoring data must be reliable. Audit schemes aim at verifying the effectiveness of environmental control and highlights areas of weakness in environmental management. The audits are focused on areas of project perceived to be environmentally sensitive and having the highest environmental risk. The environmental audit process provides an assessment of the project, environmental management strategies and the effectiveness of the system in fulfilling the Company's environmental policy. Regular audit would be carried out for every major facility during construction and operations and maintenance, including on-site processing and storage facilities, waste disposal facility, maintenance facilities and emergency response facilities.

Contingency Planning

Despite all care and diligence exercised in project execution, accidents do occur. Accidents could occur from equipment failure or third party sabotage, all to the detriment of the environment. Consequently, Contingency Plans are usually made to handle such situations. Although serious incident is unlikely, HUAWEI Technologies Limited has in place a Contingency Plan which will be activated; regularly updated with periodic exercises conducted.

Project Organization and Responsibilities

HUAWEI Technologies Limited has to establish a policy and schedule for responsibilities and training on matters relating to the environment. There is a line responsibility for which all level of staff is accountable. Line management will take full responsibility for environmental issues.

E.S-8 ENVIRONMENTAL ACTION PLAN

This plan has been developed to meet the following specific short and long term objectives:

- To ensure compliance with legislation and company policy;
- To achieve, enhance and demonstrate sound environmental performance built around the principle of continuous improvement;

- To integrate environmental concerns fully into project operational philosophies;
- To rationalize and streamline existing environmental activities to add value to efficiency and effectiveness;
- To encourage and to achieve high performance and response from individual employees and contractors;
- To provide standards for overall planning, operation, audit and review;
- To enable management to establish environmental priorities;
- To ensure that all stated objectives are applicable throughout the rganization.

FOLLOW-UP ACTION PLAN

The FME is expected to conduct inspection from time to time to confirm the compliance with its standards.

- routes of any collected waste;
- Signs of poor housekeeping should be noted in the inspection of facility such fibre Optic failures in form of pitting, rutting and slipping;
- Procurement of the monitoring equipment to analyze traffic count, weighing bridge, emission, ambient air quality, noise and water quality;
- Provision of adequate personal protective equipment, particularly effective protection against inhalation of particulate matter and ear protectors;
- The age of process equipment and the presence of emission abatement technology;
- The means of transport to and from the site and the associated impacts;
- The boundary of the site should be walked to determine the adjacent properties/facilities and their sensitivity;
- Views of stakeholders on the operation at the fibre Optic facility;
- The disposal contact should be made with the local regulatory agencies to determine compliance record and whether complaints have been made by the public;
- Annual compilation of all the monitoring results and highlight of the activities related to facility safety and the environment of the quality control unit;

E.S- 9. CONCLUSIONS AND RECOMMENDATION

The consideration of health, safety and environmental (HSE) issues potentially arising from the proposed Optic Fibre project commenced as early as the project conceptualization stage, and will progress through project construction and operations.

A comprehensive EIA study of the project components and activities has been prepared in accordance with Nigerian regulations and contemporary international best practices in EIA studies.

This EIA Report has presented project plans and activities. The associated positive and potential negative effects of the project changes on the environmental (biophysical), socio-economic, and health characteristics of the project have been documented and as appropriate, evaluated in detail. Mitigation measures have also been prescribed for significant negative impacts.

In line with applicable Nigerian and international best practices, the EIA process incorporated extensive stakeholder consultation.

As currently planned, the Optic fibre project has the potential to positively impact the Nigerian economy at both the macro and micro scale.

All project-related potential negative impacts were mitigated through the design and process development stages by specific activities, commitments and action plans. Adherence to these measures and regulatory compliance requirements shall ensure that impacts assessed as having low significance subsequently remain at tolerable levels.

The effects of those impacts identified as having potentially moderate and high significance consequences will also be either eliminated or minimized through the implementation of appropriate mitigation measures as recommended in this report.

Suitable mitigation measures have been designed for each of the potential negative impacts. Similarly, a detailed waste management plan that assures responsible and environmentally acceptable handling of all wastes generated by Optic fibre project will also be implemented. Hazardous material spill contingency plans have been developed as indicated in the report.

This EIA Report also provides an Environmental Management Plan (EMP), which will be implemented with a number of action plans including:

- Waste Management Plan
- Journey Management Plan
- Influx Management Plan
- Emergency Response Plan
- Community Relations and Development Plan

HUAWEI TECHNOLOGIES is committed to executing the EMP and the entire project in a safe and environmentally responsible manner. The company also embraces the concept of Corporate Social Responsibility and will continue working with Government and other stakeholders towards the implementation of a participatory Community Relations and Development Plan as a process to ensure continuous stakeholder involvement and benefit from the project.

If implemented in adherence to applicable environmental and safety requirements, built-in design/process mitigation measures, and the additional mitigation measures as recommended in this EIA Report, the environmental sustainability of the Optic fibre project is indeed assured.

CHAPTER ONE

1.1 Background Information

Information and Computer Technology (ICT) applications gives ability to individuals and the society at large to directly contribute to the efficiency of a country's economic development in this global information and knowledge exchange age. ICT plays a very important role in promoting sustainable development of each country in the 21st century.

In recent years, the Nigerian Government has incorporated the development of the ICT into national strategic planning and is positively promoting reforms aimed at opening up the telecom industry. This is creating a favorable market environment for economic growth in Nigeria.

The organized private sector in Nigeria has also made significant strides in ICT infrastructure construction, under the active support of the Nigerian government. Good examples are the Glo-1 and Main One submarine fibre optics cable connecting Nigeria with Europe.

The Nigeria Communications Commission (NCC) is also promoting ICT for the under-served through the following projects:

(a) DAP project, aiming to encourage the middle and primary schools and higher education institutions to adopt the ICT.

(b) ADAPT project, serving the teachers (mostly college teachers), to train them on their computer application ability and equip computers for some of them.

(c) DBI project, mainly to train the mobile communication technicians. The institute has respectively 1 campus in Abuja, Lagos and Kano, with the teachers coming from all over the world.

E-governance is an important area of ICT application. The construction and development of e-government infrastructure has become an important factor for pushing social & economic development. Firstly, e-government can effectively improve work efficiency in government departments, and also provide high-quality service with lower and quicker speed. Secondly, the development of e-governance can create positive investment environment.

According to a report issued by World Bank, taking Singapore as the example, via the online processing system in e-government, the cost saved during the establishment of one new company taking the mode of attracting foreign investment is between 700 and 20,000 USD, and the time required is shortened from 2 days to 2 hours.

The Nigerian government having fully recognized the importance of e-government, taking cognizance of the fact that e-government infrastructure is the basic drive to realizing long-term planning, has worked out an e-government development strategy.

This involves the construction of unified platforms for the national e-government via various modes, plans and projects.

HUAWEI Technologies Company Limited is an integrated network developer and has been commissioned to build this National Information Communication Technology Backbone (NICTIB) project. The company is poised to meeting the increasing demand for Information and Communication Technology (ICT) infrastructure in Nigeria. The company is positioned to meet the growing high capacity transport and connectivity needs in the country. HUAWEI Technologies Company Limited intends to implement a world class quality Fiber Optic Backbone Network in the country.

This infrastructure is required to provide upload and download service points to the telecommunication industry in locations along Uyo, Eket, Portharcort, Owerri Onitsha, Asaba, Awka, Benin, Ijedu-Ode, Lagos, Enugu, Markurdi, Lafia and Abuja.

Therefore, in consonance with the relevant corporate policy of HUAWEI Technologies Company Limited on Environment, Health and Safety and (EHS) and the mandatory requirement of government regulatory bodies such as the Federal Ministry of Environment (FMEnv), National Environmental Standards and Regulatory Enforcement Agency (NESREA), the respective State Environmental Protection Agencies, HUAWEI Technologies Company Limited Commissioned Lawan Wurno Limited an accredited Energy and Environmental consulting company to carry out an Environmental Impact Assessment of the proposed Fiber Optic Backbone Network Infrastructure for the designated routes in the country.

An Environmental Impact Assessment (EIA) is a strategic and targeted means of identifying and quantifying the significant effects/impacts (positive and negative; short and long term; primary or secondary) of any prospective development activity. It serves as a decision-making tool employed in the management of industrial activities to foster sustainable development. In EIA studies, all actions that will result in physical, chemical, biological, economic, cultural and social modifications of the environment as a result of a particular new project are assessed. Mitigation measures are then developed and incorporated into the project to mitigate, minimize, or reduce adverse impacts, where practicable to benefits.

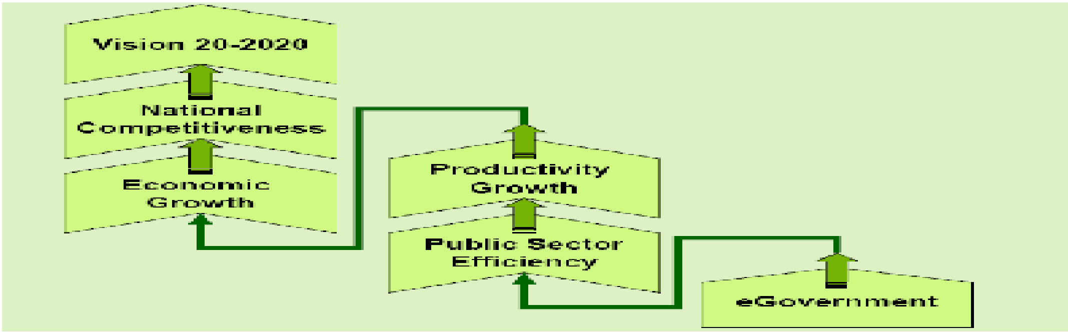
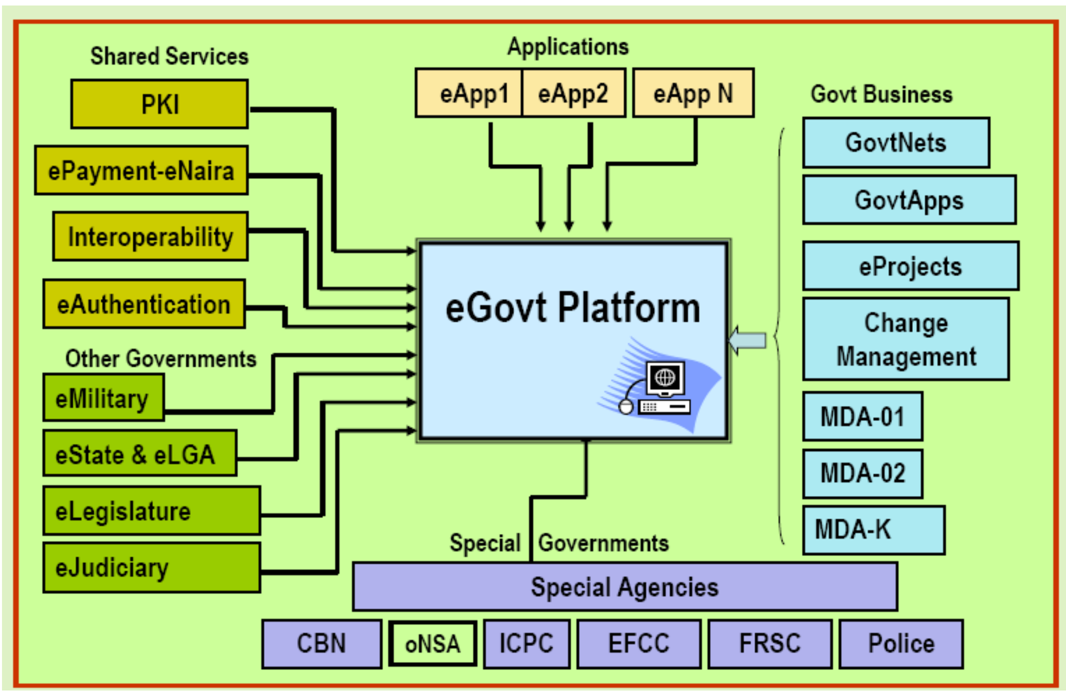


Fig 1.1: Strategic Idea for E-government in Nigeria

Fig. 1.2: Drive of e-government for realizing the long-term Planning.



1.2 Project proponent

Huawei Technologies Company Ltd signed a commercial contract in November 2006 to carry out the Nigeria National Information and Communication Technology Infrastructure Backbone (NICTIB) project.

1.3 Project Objectives

The project is proposed to construct an Optical Fibre Cable Backbone network to cover the Federal Capital Territory (FCT) and other parts of the country. This would provide improved Governance Capability by providing a strong and reliable information platform.

This project will be able to deliver connectivity and other Information and Communication Technology infrastructure to Ministries, Departments and Agencies (MDAs) of Government. Nigeria currently has up to 300MDAs connected to its ONEGOV.net network in over 3000 office locations nationwide, making it the largest single network ever developed in the public sector.

On completion, the project will greatly improve the modernization of ICT facilities of the Nigerian government, and strengthen the control capability of the central government of Nigeria over the politics, economy and society of the whole country. It will also create a nice investment environment for foreign investors and create the advantageous macro environment for the political stability and economic growth of the country.

1.3.1 Objectives of the EIA Study

The main objectives of the Environmental Impact Assessment study is to improve decision making; and to ensure that the design, construction, and expansion, of the National Information Communication Technology Infrastructure Backbone (NICTIB). To also ensure that infrastructures and other activities being considered under the proposed project are environmentally benign and sustainable. The secondary objective is to ensure that in-country capacity, regulatory framework; principles and procedures are established to provide a basis for environmental assessments of all sub-projects to be carried out under this additional financing.

Specifically, the objectives of the proposed will properly evaluate the potential environmental impacts and other associated impacts (including health and socio-economic impact) of the proposed facility. This is to ensure that the planned project activities exert minimal impacts on the environmental and nearby communities. The specific objectives of the EIA are to:

- Establish the existing state of the environment and identify sensitive components of the environment within the project area and its influence.
- Assist project design and planning by identifying and quantifying those aspects of location, construction, operation and decommissioning which may cause adverse environmental, social, health and economic effects.

- Recommend measures during construction, commissioning operation and decommissioning to avoid and ameliorate adverse effects and increase benefits.
- Recommend environmental management program for the life cycle of development activities including compliance monitoring, auditing and contingency planning.
- Identify the environmental issues and concerns which may in the future affect development of the area.
- Identify existing environmental regulations that will affect development and advise on standards, consents, and targets.
- Provide the basis for co-operation, consultation and compliance with regulatory authorities, stakeholders and the public.
- Prepare a detailed report, presenting clear and concise information on the environmental impacts of the proposed project.
- Obtain the necessary permits and approvals from all concerned government regulatory bodies.

1.4 EIA Terms of Reference

As statutorily required, a “Term of Reference” (ToR) was prepared by HUAWEI Technologies Company Limited and was submitted to FMEnv, Abuja for Approval. This provided a framework for achieving the overall objectives of the EIA. The summary of the ToR is as follows:

- Outline the general scope of the EIA study including the overall data requirement on the proposed National Information Communication Technology Infrastructure Backbone (NICTIB) project and affected environment.
- Define the procedures and protocols first for identification and assessment of associated and potential impacts and also for developing an effective Environmental Management Plan (EMP) for the proposed project.
- Define the framework for interaction and integration of views of a multidisciplinary EIA team with regulators, host communities and other stakeholders.
- Define the relevant framework of legal and administrative requirements of the proposed Project.
- Develop decommissioning and closure plan after project ends including site restoration plans.

1.5 Scope of the EIA

The scope of the EIA covers the following:

- Review of the national and international laws regulation and codes applicable to the study.
- Descriptions of actions/activities that will be carried out in the course of the proposed project.
- Review the existing literature on the project area and its influence, identifying the data gap as well as undertaking field survey and laboratory analysis to complement the existing data.
- Analysis of data obtained and description of the study area prior to the proposed project activities, with particular regard to the significant environmental components and/ or receptors.
- Identification and evaluation of adverse environmental impacts of the project on the nearby communities including impacts on cultural properties, social infrastructure and impacts on lifestyle/ values in the study area.
- Identification of health hazards that may result from the different phases of the project during execution including construction, operation and decommissioning and evaluation of local population exposure to these hazards.
- Recommendation of appropriate and cost effective mitigation measures and Environmental Management Plan (EMP).
- Preparation of EIA Report in conformity with the national and international guidelines and standards on EIA.
- Procurement of provisional or other relevant approvals and EIA certificate from FMEnv.

1.6 Legal and Administrative Framework

This section of the report provides the relevant Nigerian legislation and policy context as well as international legislations, good industry practices, standards and guidance that are applicable to the proposed project in general and EIA study in particular.

1.6.1 National Policy Guidelines and Regulations

- **Federal Ministry of Environment (FMEnv)**

In Nigeria the Federal Ministry of Environment is the nation's primary authority for the regulation and enforcement of environmental laws. The federal Government of Nigeria through the Act No, 58 of 1998 established the then Federal Environmental Protection Agency (FEPA) to protect, restore and preserve the ecosystem of the federal republic of Nigeria. In 1999, the FMEnv was created to oversee the functions of the defunct FEPA.

The Act establishing the Ministry places on it the responsibility of ensuring that all development and industry activity operations and emission are within the limits prescribed in the national Guidelines and Standards, and comply with the relevant regulations for environmental pollution management in Nigeria as may be released by the ministry.

In furtherance of her mandate to ensure the overall protection of the environment and conservation of natural resources, the FMEnv developed laws/guidelines on various sectors of national economy. The specific policies, acts, guidelines enforced by FMEnv that are applicable to protect the project include:

- **National Policy on the Environment (1999)**

Environmental management in Nigeria is based on the National Policy on the environment (1989), was revised in 1999. The goal of this policy is to achieve sustainable development and secure for all Nigerians a quality environment which is adequate for their health and wellbeing.

National Guidelines and Standards for Environmental Pollution Control in Nigeria (1991) This is the basic instrument for monitoring and controlling industrial and urban pollution.

- **EIA Act of No.86 of 1992**

EIA Act No. 86 of 1992 was the primary instrument for governing EIA in Nigeria. It was promulgated in order to enable the prior consideration of an EIA on specified public or private projects. The Act sets out the procedure to be followed and methods to be used in undertaking and EIA. Sections 2(2) of the Act requires that where the extent, nature or location of the proposed project or activity is such that it is likely to significantly affect the environment, an EIA must be undertaking in accordance with the provisions of the Act.

- **National Environmental Impact Assessment Procedures and Sectoral Guidelines**

In response to the promulgation of EIA Act of 2992, FMEnv developed a National EIA procedure in 1995. The procedure provides steps to be followed from the stage of project conception to commissioning in order to ensure that the project is implemented with maximum consideration for the environment. The FMEnv EIA process is shown in Figure 1.2a, while the FMEnv Flow Chart is presented in Figure 1.2b, below.

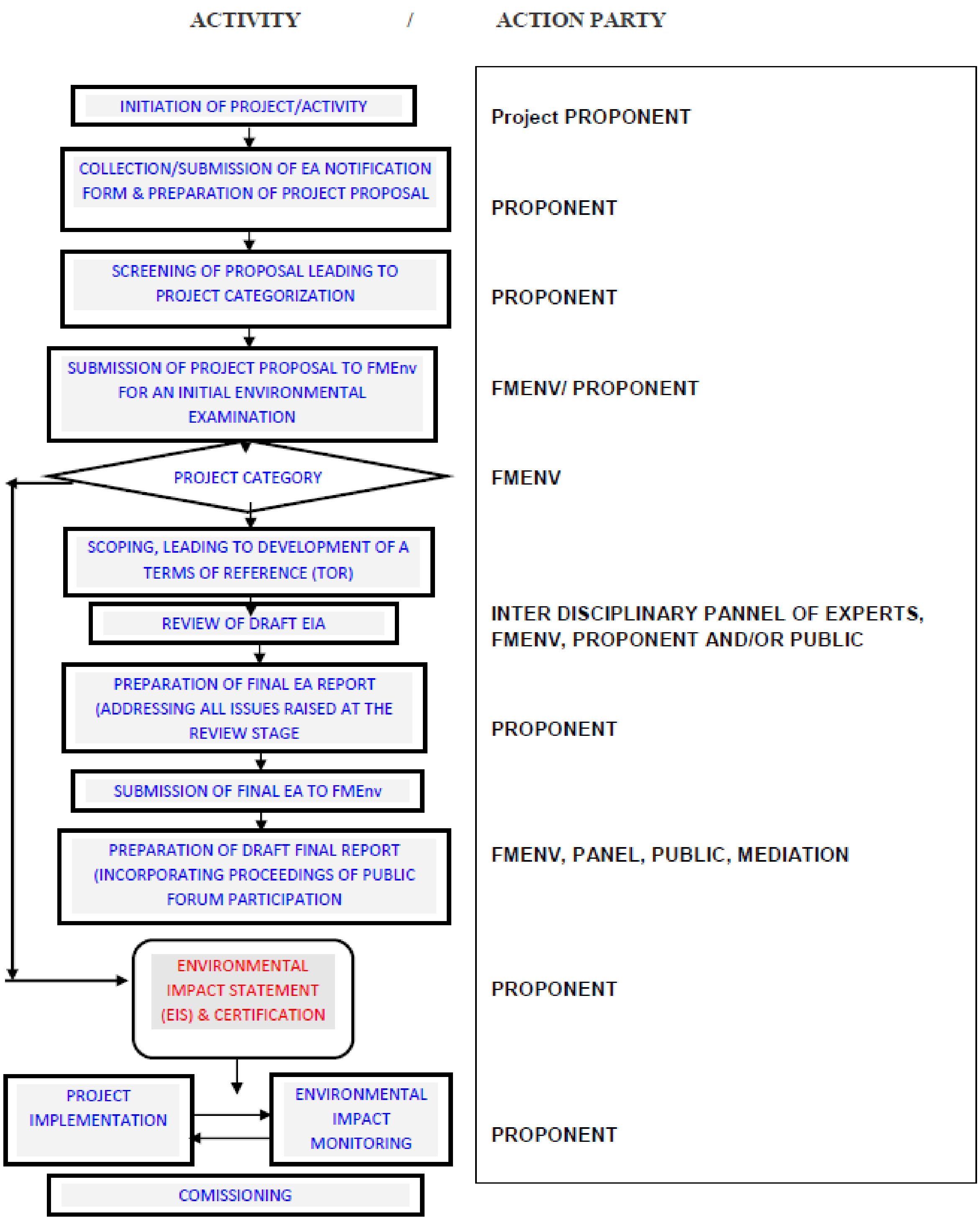


Fig. 1.3: Federal Ministry of Environment Environmental Impact Assessment process.

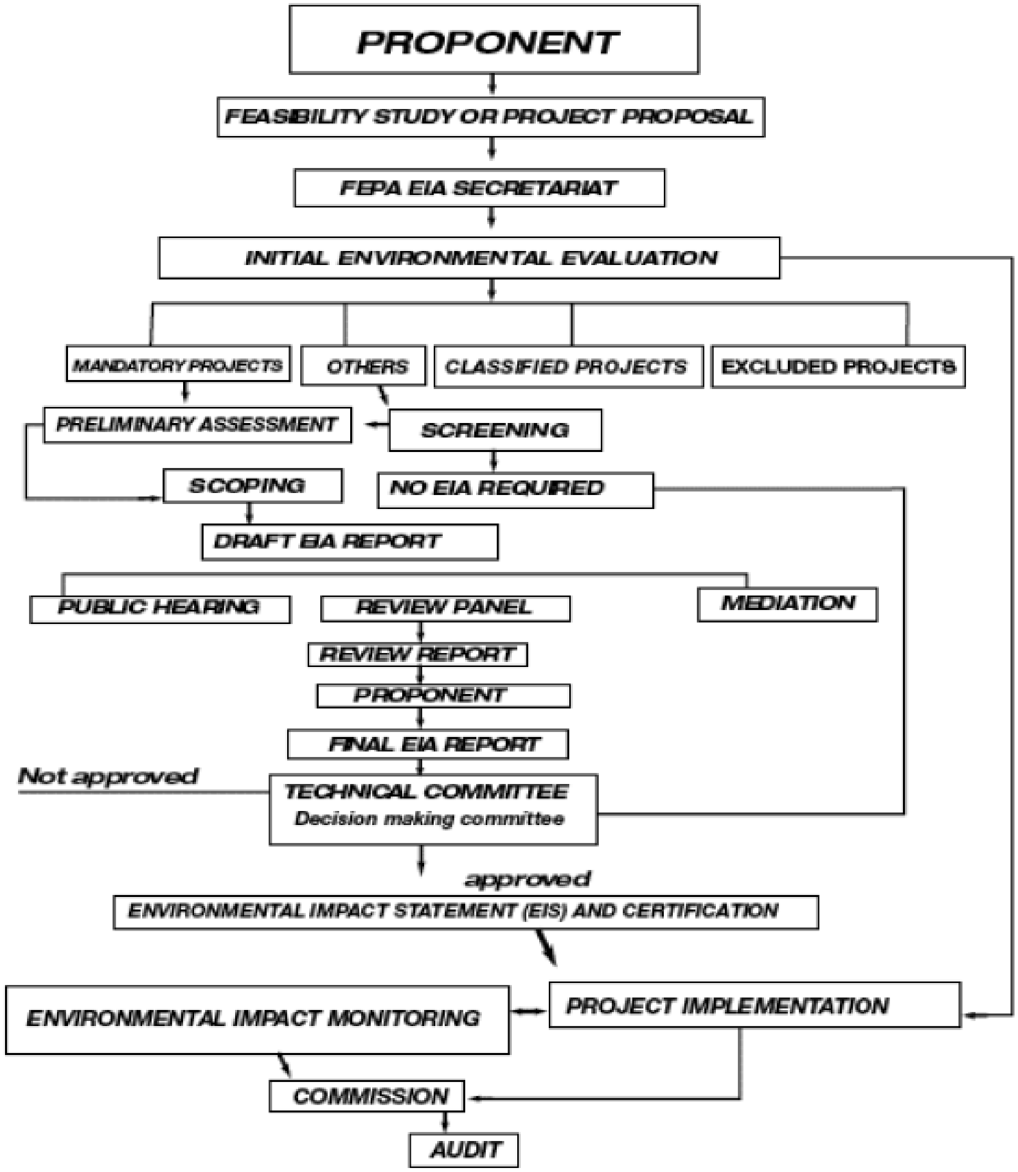


Fig. 1.4: Federal Ministry of Environment Environmental Impact Assessment Flow Chart.

- **National Environmental Standards and Regulation Enforcement Agency, 2007**

The National Environmental Standards and Regulations Enforcement Agency (NESREA) were established in 2007 by Federal Government of Nigeria as a parastatal of the Federal Ministry of Environment. The Agency is charged with the responsibility of enforcing all environmental laws, guidelines, policies, standards and regulations in Nigeria. It also has the responsibility to enforce compliance with provisions of international agreements, protocols, conventions and treaties on the environment. The vision of the agency is to ensure a cleaner and healthier environment for all Nigerians, while the mission is to inspire personal and collective responsibility in building an environmentally conscious society for the achievement of sustainable development in Nigeria.

- **Nigerian Communication Commission (NCC), 2003**

The Nigerian Communication Commission (NCC) is the nation's regulatory authority for telecommunication industry. The Nigerian Communications Act 2003 was signed into law to strengthen the capacity of NCC to properly carry out its regulatory activities.

- **Nuclear Safety and Radiation Protection Act, 1995**

The Safety and Radiation Protection Act No. 19 of 1995 established the Nigerian Nuclear Regulatory Authority. The Authority is charged with responsibility to ensure protection of life, health, property and the environment from harmful effects of ionizing radiation.

- **Land Use Act, 1978**

Land Use Act of 1978 protects the right of all Nigerians to use and enjoy land in Nigeria which must be protected and preserved. Land acquisition must follow the due process of law.

- **Land Urban and Regional Planning Act, 1992**

The Act 88 of 1992 established a Development Control Department (DCD) charged with the responsibility for matters relating to development control and implementation of physical development plans at Federal State and Local Government levels their respective jurisdiction.

- **Criminal Code**

The Nigerian Criminal Code of 1990 makes it an offensive punishment with up to six months imprisonment for any person who violates the atmosphere in any place so as to make it noxious to the health of persons in general dwelling, or carry on business in the neighbourhood, passing along a public way; or does any act which is and which he knows or has reason to believe to be, likely to spread that infection of any disease dangerous to life whether human or animal.

- **Endangered Species Act, 1985**

The Federal Government of Nigeria enacted the Endangered Species Act (Control of International Trade and Traffic) Act 11, 19785 which makes among others, provisions for conservation, management and protection of some of the country's endangered species. Section 1 of the Act prohibits the hunting capture and trade of endangered species.

- **The Factory Act, 1990**

The factories Act of 1990 is the primary law regulating health, safety and welfare of worker in factories in the country. The Acts seeks to make adequate provisions for the health and safety of workers and generally bring safety legislation in line with requirements of modern industrial setting.

- **Public Health Law**

In Nigeria the Public Health Law (L.N 47 of 1955, Cap 103) provides justification for the execution of development projects under guidelines that promotes health by protecting the environment and safeguarding the humans' health. The Public Health Laws empower Medical Officers of Health (operating at the local government council, under the supervision of the state and Federal Ministry) to ensure the promotion of good health (Subsection 6 and 7).

- **Akwa Ibom, Rivers, Imo, Anambra, Delta, Edo, Enugu, Ondo, Ogun Lagos, Benue, Nasarawa, Abuja, States Environmental Legislation**

This project traversed through all the states mentioned above and the Environment Protection Agencies in these states are saddled with the responsibilities of setting out procedures to minimize the impacts of physical developments on the ecosystem of their respective states; and to secure the quality of environment adequate for health and wellbeing of their residents.
The holistic overview of the functions of the SEPA's are follows:

- Liaising with the Federal Ministry of Environment, FMEnv to achieve National Policy on Environment.
- Co-operating with FMEnv and other National Directorates/ Agencies in the performance of environment functions including environment education/ awareness to the citizenry.
- Responsibility for general environmental matters in the states, and
- Monitoring the implementation of EIAs and other environmental studies for all development projects in the above mentioned states.

1.6.2 International Guidelines and Conventions

- **International Guidelines**

World Bank Guidelines on Environmental Assessment

The World Bank requires an Environmental Assessment on a proposed activity/ facility (i.e. project) from a borrower as a pre-requisite before granting any financial assistance in the form of loans. The EIA report usually forms part of the overall feasibility study or project preparation. The bank has categorization projects based on their EA requirements, which is very similar to that of FMEnv.

- *The Intentional Finance Corporation (IFC) Environment, Health and Safety Guidelines for Telecommunications*

The IFC and World Bank Group have developed a set of Sectoral Environmental Health and Safety (EHS) Guidelines which provides guidance to users on common EHS issues potentially application to all industry sectors including Telecommunication.

ICNIRP Guidelines on Human Exposure to Electromagnetic Field

To protect human health from possible impacts of electromagnetic radiation and in particular radiofrequencies (i.e. frequencies ranging between 0-300GHz, international standards have been adopted established exposure limits to electromagnetic fields. The guidelines most widely accepted in industry for the assessment of radiation compliance are set maintained by the international Commission on Non-Ionizing Radiation Protection (ICNIRP). The ICNIRP expose limits for mobile phone station frequency are provided.

- *China Export and Import (EXIM) Bank Guidelines on Environmental and Social Policies on Oversea Investment*

Adopting the policies of the International Finance Corporation (IFC) the EXIM bank put up environmental and social policies for proposed projects that it intend to finance or execute overseas.

These policies are effectively tailored towards identifying and mitigation not only unanticipated environmental and social harm, but also some investment risk that can undermine the long-term financial success of a project.

- *Equator Principle*

The Equator Principles are a voluntary set of guidelines developed by leading financial institutions for managing environmental and social issues in project finance lending. The guidelines are based on the environmental and social standards of the IFC, and apply globally to development projects with a capital cost of US dollars (US$) 10 million or more in all industry sectors. These principles are intended to serve as a common baseline and framework for the implementation of participating institutions' individual, internal environmental and social procedures and standards for project financing activities across all industry sectors globally. Additional detail can be found on their website *www.equator-principles.com.*

The first set of Equator Principles was launched in 2003 and was ultimately adopted by over 40 financial institutions during a three-year implementation period. A subsequent updating process took place in 2006 leading to a newly revised set of Equator Principles that were released in July 2006. The new, revised set of Equator Principles is fully consistent with recently revised IFC Performance Standards (see below).

The Equator Principles aim is to ensure that prior to agreeing to provide financing, (a) a project has been subject to an appropriate level of environmental and social assessment in accordance with the requirements of the IFC Performance Standards (2006) and (b) that the project will implement appropriate measures for the management of environmental, social and health issues during construction, operation and decommissioning phases. By adopting the Principles, financial institutions undertake to review carefully proposals for which their customers request project financing. They commit not to provide loans to projects where the borrower will not, or is unable to, comply with the requirements of the IFC Performance Standards.

- **International Conventions**

The Nigerian government is an important player in the international support the protection of the environment. As such, the country is a signatory to some international laws and conventions, which are targeted towards conservation and protection of the environment in order to ensure sustainable development. Some international conventions and regulations that are related to the present study and the protection of environment in Nigeria include:

- *African Convention on Conservation of Nature and Natural Resources*

The African Convention on Conservation of Nature and Natural Resources was adopted in Algiers, Algeria on September 15, 1968 and entered into force on June 16, 1969. The convention stipulates that the contracting States shall undertake to adopt the measures necessary to ensure conservation, utilization and development of soil, water, flora and fauna resources in accordance with scientific principles and with due regard to the best interested of the people.

- *Convention Concerning the Protection of the World Cultural and Natural Heritage*

The convention was adopted in Paris, France on October, 17, 1972; the Convention set aside areas of cultural and natural heritage for protection. It places obligations to each State Party to recognize that the duty of ensuring the identification, protection, conservation, presentation and transmission to future generation of the cultural and natural heritage situation on its territory, belongs primarily to the State.

- *Conservation on the Conservation of Migratory Species of Wild Animals*

This convention also known as Bonn Convention was adopted in 1979 and entered into force in 1983. It stipulates actions for the conservation and management of migratory species including habitat conservation.

- *Vienna Convention for the Protection of the Ozone Layer*

The Vienna Convention was adopted in 1985 and entered into force on September 22, 1988. It places general obligation obligations on countries to make appropriate measures to protect the environment against adverse effects resulting from human activities which tend to modify the ozone layer.

- *The Montreal Protocol on Substances that Deplete the Ozone Layer*

The protocol was adopted on September, 16, 1987 as an international treaty to eliminate ozone depleting chemicals production and consumption.

- *Basel Convention on the Control of Trans-bou7ndary Movement of Hazardous Waste and their Disposal*

The Conservation was adopted on March 22, 1989 and entered into force on May, 1989. It forces attention on the hazard of the generation and disposal of hazardous waste. The Convention defines the waste to be regulated and controlled, warned on their trans0boundary movements in other to prevent human and their environmental health against their adverse effects.

- *United Nations Convention on Biological Diversity*

The Convention was adopted in 1994. The objectives of the Convention include the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of benefits arising out of the utilization of genetic resources.

- *United Nations Framework Convention on Climate Change*

The Convention on Climate Change was adopted in 1992 during the Rio Earth Summit in Rio De Janerio, Brasil and entered into 19945; to limit Greenhouse Gas (GHG) emissions which cause global warming.

1.6.3. HUAWEI Technologies Company Limited's Environment, Health and Safety (EHS) Policy

Huawei not only believes in the need to stay at the forefront of technology, but also in the active promotion of environmental awareness and conservation. In order to lead by example, we have implemented the Environment, Health and Safety (EHS) management system based on international standards, which strives to provide a safe and healthy working environment for our employees, and aims to achieve the following objectives:

- Increase awareness of the importance of EHS in our design, production and operation processes.
- Systematically identify potential environmental risks and occupational hazards.
- Lay down specific EHS requirements for our purchasing strategy, and promote EHS throughout the whole supply chain.
- Encourage EHS awareness among our employees and cultivate a corporate culture that emphasizes the individual responsibility that each of us have towards the environment.
- Increase focus on sustainable development through the reduction of energy consumption and efficient usage of resources.
- Perform internal audit and management review of EHS on a regular basis.

HUAWEI Technologies Company Limited has a robust Construction Safety Manual detailing Methods of Work, System of Work Permits to Work etc. This Policy Manual sets out the company's EHS requirements according to national and international standards.
The policy manual places high premium on the protection of its employees, the generation public and the environment at large.
The policy manual also detailed the contingency plans and procedures to be strictly followed in emergency7 situations such as fire explosion, hazardous exposure, radiation incidents, civil unrest, labour unrest and medical emergencies resulting from accidents, illness/electrical shock, slips, trips and fall situation etc.
HUAWEI Technologies Company Limited shall incorporate and integrate safety into her business and will seriously employ programs and procedures to eliminate accidents, protect the environment and secure her facilities. To implement this, well-structured and effective EHS system is developed and implemented. Every activity and operation shall be planned, organized and carried out in a manner that:

- Will avoid injury to any worker, sub-contractor and third party that may be engaged or affected by HUAWEI Technologies Company Limited's activities.
- Will ensure that the health of her workforce is protected and promoted and there is no adverse effect on third party (host communities inclusive).
- Will ensure the personal safety of workers and third party contractors.

- Will ensure that its activities do not have adverse effect on the endorsement in which it operates.

All HUAWEI Technologies Company Limited's activities either by employee or contractors must be performed in compliance with the EHS policy. Work must be suspended when essential systems are not in place.

Project Managers and Supervisors are accountable for the safety of the employees working under their supervision and will ensure that their safety is always in place. Employees have a duty to take substantial care for their own safety and that of other worker who may be affected by their acts or work. They are also bound to comply with the company's health and safety rules and regulations. Supervisors are responsible for implementation of EHS policy under the controls, guidance and co-ordination of the EHS manager.

It is the policy of HUAWEI Technologies Company Limited to ensure the use of relevant and high quality Personal Protective Equipment (PPE) - coverall, safety shoes, Rain coats/boots, hard hats; and hand gloves by persons engaged in her work site operation. Continually, the management shall enforce use and maintenance of available Personal Protective Equipment, which entail regular condition audits and replacement of defective ones.

Thus, in line with the above stated policy, the management of HUAWEI Technologies Company Limited is therefore determined not to spare any means and / or material in the pursuit of the highest standards of health and safety at work in all categories of its responsibilities in the area of influence. This is the only way to achieve the company's fundamental business objective of maintaining adequate protection of life and assets for productive Tool Loss Control (TLC).

Green Products

To ensure that our EHS objectives are met, we started a "Green Products" program that covers R&D, procurement, production and customer support. The program's execution is being overseen by a tri-level organization to guarantee its full support throughout the company. The top management team, which is made up of our Investment Review Board (IRB) members, decides the general direction that the company should take in terms of environment conservation. The middle management team comprises project managers who focus on business processes, R&D, procurement, production, IT and recycling. The third management team is responsible for the program's actual execution.

Huawei has been engaged in the research and development of environmental-friendly products for several years and emphasizes the importance of eco-design throughout the entire IPD process, from concept development to product launch. We aim to achieve three main goals through eco-design: environment conservation, quality enhancement and the rational and efficient usage of resources.

International Standards and Regulations

As a responsible global corporate citizen, Huawei complies with the most important international standards and environmental policies and regulations.

- Huawei complies with ISO 14001:2004 and OHSAS 18001:1999, the most widely-recognized standards on environmental management and occupational health and safety.

- Huawei's products and product components in the European market comply with RoHS (Restriction of the Use of Certain Hazardous Substances) and WEEE (Waste from Electric and Electronic Equipment), directives issued by the European Union aimed at recycling and restricting the use of certain hazardous substances in electrical and electronic equipment.

- Huawei is currently in the process of preparation to comply with the directive on the eco-design of Energy-using Products (EuP) by 2008, a new regulation that sets eco-design requirements for energy-using products. The impact on the environment will be considered at every stage of the product life cycle and assessed in terms of resource and energy consumption, waste, recycling, emission to air, land and water, noise, vibration, radiation, and EMI, thereby ensuring product quality and environmental protection.

- The basic engineering phase commenced with Engineering and design and will incorporate applicable Nigeria standards as well as specifications of the following internationally recognised standards.

- **Power Loss** - FOTP-171 / EIA-455-171 Attenuation by Substitution Measurement for short length Multimode graded index and Single-mode optical fiber cable assemblies

- **Optical Return Loss (ORL)** - FOTP-107 / TIA/EIA-455-107A Return Loss for Fiber optic components

- **OTDR** - FOTP-59 / TIA/EIA-455-8 Measurement of Fiber Point Discontinuities Using an OTDR and FOTP-8 TIA/EIA

- **PMD** - TIA-455-124 – FOTP124 – Polarization-mode Dispersion Measurement for Single- mode Optical Fibers by Interferometry Method

- **Chromatic Dispersion** - FOTP-175 / TIA-455-175-B Measurement Methods and Test Procedures- Chromatic Dispersion.

Energy Conservation

Energy conservation is a major aspect of sustainable development and it is crucial to ensure that future generations get to enjoy the natural resources we often take for granted today.

The ability of telecommunications equipment to improve our means of communication is particularly important because it reduces the need for transportation, and thus resources, especially in less developed countries

Moreover, Huawei Distributed Node B is dust-tight, waterproof, small, and light, allowing it to be installed at minimal cost. It also complies with the IP65 standard and is suitable for use in harsh environmental conditions. Wireless technologies offer convenience and enjoyment in communication for billions of people around the world.

Electromagnetic waves are used in wireless communication equipment to send and receive speech, text messages, pictures, video clips, music tracks, data files, and so on. Research on the effect of electromagnetic waves on the human body dates back to the early twentieth century. With the popularity of wireless communication equipment such as mobile phones and base stations, people are showing growing concerns about electromagnetic exposure. These concerns have been duly addressed by health authorities around the world, including the World Health Organization (WHO), International Commission on Non-Ionizing Radiation Protection (ICNIRP), and Institute of Electrical and Electronics Engineers (IEEE). So far, no sufficient evidence can prove that radio waves have caused any adverse health consequence.

As a leading vendor of wireless communication equipment, Huawei places great importance on the effect of radio waves on environments and health. Huawei is dedicated to providing wireless communication products in compliance with electromagnetic exposure standards and regulations. In addition, Huawei cooperates with telecom operators to construct environmentally-friendly networks in compliance with local and national electromagnetic exposure standards.

1.7 Structure of the EIA Report

The report format and outline of the EIA study is in line with the provocation of the Federal Ministry of Environment’s EIA Guidelines. Accordingly the structure of the report is as follows:

Executive Summary: A non-technical summary of the EIA report

Chapter One: Provides introduction to the project; objectives and scope of work of the EIA; legal and administrative framework as well as information on the project proponent.

Chapter Two: Provides the rationale for the proposed project and analysis of various alternative scenarios.

Chapter Three: Describes the project location, project activities development phases and schedule.

Chapter Four: Describes the current baseline environment (biophysical. chemical, socio-economic and health) characteristics of the project site and its influence.

Chapter Five: Identifies and presents the associated and potential environmental impacts of the proposed project.

Chapter Six: Highlights the recommended mitigation measures for ameliorating any significant adverse environmental impacts and enhancing beneficial impacts.

Chapter Seven: Defines the environmental management plan that will be adopted by the company throughout the project lifecycle.

Chapter Eight: Sets out procedures and remediation plans that will be followed in the event of decommissioning the project.

Chapter Nine: Conclusion and recommendation

References

Appendices

CHAPTER TWO

PROJECT JUSTIFICATION

2.1 Background Information

Currently the ICT infrastructure penetration is low amongst government agencies in Nigeria. Communication between government agencies fully depends on the public communication network and the Internet; this implies that the privacy and information security of government business cannot be guaranteed.

Also, public services such as customs clearance, contract execution and property registration take long processing time and have low efficiency, directly resulting in impeding growth in the economic environment.

It is at this backdrop that the Nigerian Government instituted the National Information Communication Technology Infrastructure Backbone (NICTIB) to raise the level of ICT in government departments, attract the foreign investment, drive social & economic development and fulfil the Vision 2020 long-term development planning objective of Nigeria.

2.2 Value of the project

Galaxy Backbone Ltd signed a commercial contract with Huawei Technologies Co. Ltd in November 2006, on the Nigeria National Information and Communication Technology Infrastructure Backbone (NICTIB) project. The contract sum was valued at **USD 117 million**, requiring down payment of 15% of the commercial contract value. In December 2006, Galaxy Backbone made an advance payment of USD 10 million to Huawei Technologies Co. Ltd.

In May 2011, the China EXIM Bank on the request of the Federal Ministry of Finance of Nigeria provided the project with a buyer's loan of $100 million equivalent to 85% of the total contract sum. The loan was approved in July 2012 and the loan agreement subsequently signed in January 2013. The project is to build a nationwide backbone network with fiber optic technology, comprising a submarine cable landing point, backbone, metro, and subsequent connection to the Federal Secretariat complexes in Abuja, to provide high quality ICT infrastructure network.

The ICT infrastructure network is to eliminate and solve nationwide broadband data challenges whilst helping Government Ministries, Departments and Agencies (MDAs) establish a common information superhighway platform.

In December 2013, the Federal Ministry of Finance of Nigeria on behalf of Galaxy Backbone Ltd, paid out the balance down payment amounting to USD 7.65 million to Huawei Technologies Co., Ltd ("Huawei"), and officially requested Huawei to commence project delivery.

In April 2014, the Nigerian president approved project duty waiver, consequently Huawei commenced site survey and the process for first batch equipment delivery.

2.3 Project Objectives

The project is proposed to construct an Optical Fibre Cable Backbone network to cover the Federal Capital Territory and other parts of the country. This would provide improved Governance Capability by providing a strong and reliable information platform.

This project will be able to deliver connectivity and other Information and Communication Technology infrastructure to Ministries, Departments and Agencies (MDAs) of Government. Nigeria currently has up to 300MDAs connected to its ONEGOV.net network in over 3000 office locations nationwide, making it the largest single network ever developed in the public sector.

On completion, the project will greatly improve the modernization of ICT facilities of the Nigerian government, and strengthen the control capability of the central government of Nigeria over the politics, economy and society of the whole country. It will also create a nice investment environment for foreign investors and create the advantageous macro environment for the political stability and economic growth of the country.

2.4 Need for the project

- ***National Fibre Backbone and Landing Station for Submarine Cable.***

The project is proposed to construct an Optical Fibre Cable Backbone network to cover the Federal Territory, including one Landing Station of for Submarine cables. This would provide government-owned increased capacity and lower cost allowing for faster and more reliable transmission for data and voice.

With this project, Galaxy Backbone Ltd, will be able to deliver connectivity and other Information and Communication Technology infrastructure to Ministries, Departments and Agencies (MDAs) of Government currently has up to 300MDAs connected to its ONEGOV.net network in over 3000 office locations nationwide, making it the largest single network ever developed in the public sector.

On the other hand, the direct-connected Internet gateway to Main One Optic fibre cable system will be capable of transmitting and enabling access to broadband Internet at a speed of almost 5 Terabytes per second – which is much faster than what is currently available in the Europe – and will deliver up to 10 times more capacity than what is currently available here in Nigeria.

- ***Improving Governance Capability of the Government by providing a strong and reliable information platform.***

On completion, the project will greatly improve the modernization of ICT facilities of the Nigerian government, and strengthen the control capability of the central government of Nigeria over the politics, economy and society of the whole country. It will also create a nice investment environment for foreign investment and create the advantageous macro environment for the political stability and economic growth of the country.

- ***Improving Work Efficiency of the Government and Reducing the Administrative Expenditures***

After the completion of the project, about 48 Ministries, Departments and Agencies (MDAs) of the Federal Government, the 36 states capital cities and over 776 local government councils of the whole country will be connected. Government departments will have the capacity to integrate administration and services via network technology.

- ***Bridging the Digital Divide and Extending ICT Facilities to Remote Areas***

Since the project construction will have wide coverage (including the federal government, capital cities of the states and over 776 local government), extending ICT infrastructure and application services to the remote areas and undeveloped areas will help to fulfill the strategic objective of ICT development, bridge the digital divide and realize the sustainable development aspiration of Nigeria.

2.5 Benefits of the Project

This proposed project which is to construct an Optical Fibre Cable Backbone network will positively enhance the performance of the telecommunication industry in satisfying the expectations and demand of both the private and public sectors of the economy. This will undoubtedly increase returns on the investment. The benefits of the project include:

Technical Benefits

1. The Optical Fibre Cable Backbone network will provide reliable infrastructure for telecommunication operation.
2. The project will promote technology upgrade and provide dependable performance and superb reliability under high traffic load.
3. It has the ability to increase the businesses in the telecommunication industry.

Commercial and Economic Benefits

1. The project will improve the quality and efficiency of digital economy, data center enable organizations to conduct business around the clock and round the world.
2. It will ensure continuous business operations in the country.

3. Indirect economic benefits due to increased activities in the Information and Communication Technology (ICT) sector.
4. Provide employment opportunities and encourage foreign investment in the telecommunication industry.

Social Benefits

1. Facilitate crime abatement through improved communication and timely access to emergency response services.
2. Also, from the social perspective, modern and prospering cultures are characterized by well functioning communication network.

2.6 Envisaged sustainability

The proposed project will be undertaken using the Best Availability Technology (BAT) and processes in the industry. To ensure technical, economical and environmental sustainability of the project, the specific measures to be taken shall include but not necessary limited to the following:

2.6.1. Economic Sustainability

This project will be beneficial to the nation in so many ways. The project will provide employment opportunities; support the local community and the nation economy as a whole. For example during the construction phase of the object, indirect and direct job opportunities will be provided for skilled and semi-skilled labour force.

Apart from offering employment to our teaming population, it will improve the efficiency, performance and capacity of business accomplishment. It is the vehicle to realize sustainable development as it would bridge the digital divide between the rural and urban areas. According to a report issued by World Bank, taking Singapore as the example, via the online processing system in e-government, the cost saved during the establishment of one new company taking the mode of attracting foreign investment is between 700 and 20,000 USD, and the time required is shortened from 2 days to 2 hours.

The Nigerian government having fully recognized the importance of e-government, taking cognizance of the fact that e-government infrastructure is the basic drive to realizing long-term planning, has worked out an e-government development strategy. This involves the construction of unified platforms for the national e-government via various modes, plans and projects. This investment no will undoubtedly contribute to increased revenue to our economy.

2.6.2. Technical Sustainability

The development of the National Information Communication Technology Infrastructure Backbone for the country is technically sustainable because of HUAWEI Technologies advance technology deployment and strict adherence to internationally and nationally accepted engineering design and construction standard. In addition, innovative technologies that are economically viable and having minimal environmental, social and health impacts shall be utilized in the execution of the proposed project. The best available technology (BAT) in the telecommunication industry shall be deployed and in strict compliance with national and national and international engineering design codes and construction standards.

The NICTIB network provides abundant and flexible access for citizens to use government service anywhere anytime. NICTIB network is a unified network that features horizontal physical network and vertical virtual network with MPLS VPN technology. Each department can keep its own independence.

A comprehensive Health, Safety and Safety and Environment (HSE) system shall be implemented which will include sustained training and re-training of the project employees and those of contractors.

Strict adherence to procedures in the company's EHS plans shall be encouraged to ensure the facility is operated in a safe and environmentally responsible manner.

2.6.3 Environmental Sustainability

The project construction, installation and commissioning activities techniques vary according to the environment, and we are guided by Regulatory and Engineering Design standards. Working in marshy/swampy areas and water crossing would be approached using appropriate technologies to reduce risk levels. The regulatory requirements involving FMEnv, State and Local Government Councils environmental laws, regulations, standards and edits, and ratified international conventions as well as HUAWEI Technologies Limited's own EHS policy, shall be adopted and implemented to sustain the project environmentally throughout the project's life span. Good housekeeping and waste management practices shall be adopted. There shall be continuous consultations with the host communities. There shall be strict adherence to the implementation of the Environmental Management Plan (EMP) to ensure sustainability of the project.

2.7 Project Alternatives

2.7.1 No Development Option

The no project implies that the proposed development of the National Information Communication Technology Infrastructure Backbone for the country will not be constructed and operated hence there is no need to carry out the EIA study. The option though is environmentally favourable, but economically unviable, as this will hinder the rapid expansion of the telecommunication network and services which will enhance National economic and social development. Such decision will be at cross-purpose with the Federal Government's efforts to boost information and communication in Nigeria, which will in turn satisfy the needs of the populace and serve as a drive towards the Nigeria government goal to become one of the largest twenty economies in the world by the year 2020.

2.7.2 Delayed Project Option

This option implies that the planned project will be delayed until a later date. Such option is usually taken when conditions are unfavourable to project implementation such as in war situation, or where the host community is deeply resentful of the project. Also, if the prevailing economic climate is not quite favourable to the project, then the delayed project option may be feasible. But none of those conditions is applicable. Indeed both the economic and the political environment are most favourably disposed towards the project. Therefore, the implication of delayed project option will mean that all the preliminary work and associated efforts/cost incurred would have come to nothing. Also, the project inflationary trends such a delay may result in unanticipated increase in project cost, which may affect the final profit accruable from the project. These and other related problems make it impracticable to adopt the delay project option.

2.7.3. Alternative Site / Location Option

Other alternatives to the Proposed Action that were considered included a network with a different (i.e. smaller) scale, a network using a different configuration or underground and aerial installation, and a wireless network.

Different Scale Alternative

The proposed network is designed to meet the project purpose and need by optimizing the use of available infrastructure and adding new fiber only where necessary. Although a less extensive network could be implemented, that alternative would fail to address all three critical components of the Proposed Action. Consequently, this alternative was eliminated from further consideration due to its inability to meet the purpose and need.

Different Aerial and Underground Configuration Alternative

Different configurations of aerial and underground installations were also considered. The Proposed Action, as conceived in the Preferred Alternative, is nearly entirely aerial, with only an estimated 5.5 miles of new fiber installation in existing conduit. An alternative network that relies solely on aerial installation is infeasible given the realities of the existing utility infrastructure, land use, and topography and was eliminated from further consideration.

An alternative that utilizes more underground conduit may be able to adequately address the project purpose and need, but would introduce more uncertainty, potential delay, and possible environmental impact into the installation process since the discovery of crushed conduit cannot be reasonably assessed prior to the construction phase. Consequently, an alternative network configuration that uses more underground conduit was eliminated from further consideration due to the increased potential for construction delays and environmental impacts compared to the Preferred Alternative.

Wireless Network Alternative

A wireless network alternative could address some elements of the project purpose and need but would be unable to provide the capacity or speed needed to fully meet the purpose and need. In addition, the installation of wireless infrastructure would require ground disturbance.

Unlike the Preferred Alternative, which uses existing ROWs, development of a wireless network typically requires disturbance of undeveloped areas for necessary site improvements and construction of access roads. Consequently, a wireless network was eliminated from further consideration due to its inability to fully meet the purpose and need, and its greater potential for ground disturbance and associated environmental impacts.

2.7.4. Facility Design Options

It is the goal of National Information Communication Technology Infrastructure Backbone (NICTIB) the owners of the infrastructure that the proposed Data Centre and associated facilities are designed, constructed and operated to be compatible with existing technologies in the telecommunication network, be safe and suitable for the location where they would be installed. The design of the proposed project will comply with national and international standards and good engineering practice for facilities and foundation erection, electrical works, lightening protection and earthing. The infrastructure is designed to promote flexible utilisation of

Information Communication Technology (ICT) resources, reduced capital and operating cost, high energy efficiency, highly-available applicable applications and improved business continuity.

The infrastructure design shall be consistent with the industry recognized design codes and standards including the Telecommunications Industry Association's TIA-92 "Telecommunications Infrastructure Standard for Data Centres". The telecommunication Industry Association (TIA) is the leading trade association representing the global Information and Communication Technology (ICT) industries. Considering the underlying design for the proposed project, an alternative design/ technology option is not considered.

2.7.5. Go ahead Option (Project Option)

The inherent benefits of allowing the project to go ahead as planned are multifarious both to the proponent and to the Nigeria populace. The proposed project will provide a reliable infrastructure for telecommunication operations, allow data/ voice transmission and ensure continuous business operations in the country. Access to data will improve both private and public access to information and facilitates business growth and also provide essential communication for everyday activities and in event of emergencies. Job opportunities for Nigerian professionals, skilled and semi-skilled craftsmen would also be increased and thus yield some income for employed individuals and their dependants.

In addition, this option will go a long way in enhancing the capacity of NICTIB in realising its mandate.

2.7.6. Summary

Given the above mention considerations, the preferred option (Go ahead option) is the optimal one, which combines efficient technology with cost minimization and environmental friendliness. The option to go ahead as planned does outweigh the other options of no project, delay project and alternative site location. The project shall serve to strengthen the economic base of Nigeria, improve ICT sector; and enhance Foreign Investment and everyday communication. The environmental sustainability of the project shall be ensured through the application of Best Available Technology.

Thus, it is envisaged that the proposed project can proceed while ensuring that adequate and appropriate measures are in place to mitigate any identified potential negative impacts of the project on the social, cultural and biophysical environment of the project area.

CHAPTER THREE

PROJECT DESCRIPTION

3.1 Description of Project

The intended NICTB project is to build a ring fiber optic cable round Nigeria, which is covering a distance of 1482km. Fiber optic cable is a high-speed data transmission medium. It contains tiny glass or plastic filaments that carry light beams. Digital data is transmitted through the cable via rapid pulses of light. The receiving end of a fiber optic transmission translates the light pulses into binary values, which can be read by a computer.

Fiber optic cables transmit data via light waves, they can transfer information at the speed of light. Not surprisingly, fiber optic cables provide the fastest data transfer rates of any data transmission medium. They are also less susceptible to noise and interference compared to copper wires or telephone lines. However, fiber optic cables are more fragile than their metallic counterparts and therefore require more protective shielding. While copper wires can be spliced and mended as many times as needed, broken fiber optic cables often need to be replaced.

Since fiber optic cables provide fast transfer speeds and large bandwidth, they are used for a large part of the Internet backbone. For example, most trans-atlantic telecommunications cables between the U.S. and Europe are fiber optic. In recent years, fiber optic technology has become increasingly popular for local Internet connections as well. For example, some ISPs now offer "fiber Internet," which provides Internet access via a fiber optic line. Fiber connections can provide homes and businesses with data transfer speeds of 1 Gbps.

Optical fiber was first commercially deployed in 1977, optical cable is the primary source of long-distance, high-bandwidth communications between telephone companies, multisite organizations and various other long-range communications applications. The composition of optical cable starts with the outer jacket, which is made of a strong and often flexible material. This is followed by plastic cover used to bundle individual optical fiber cables. An optical fiber typically consists of a transparent core surrounded by a transparent cladding material with a lower index of refraction. Light is kept in the core by total internal reflection. Single-wavelength or multiple-wavelength light is passed through the core and keeps traveling inside the core due to the lower refractive index cladding surrounding it, which bounces the light back when it tries to escape.

Two common types of fiber optics are:

- Single-mode fiber (SMF) the Singlemode cables have a core of 8 to 10 microns. In singlemode cables, light travels toward the center of the core in a single wavelength. This focusing of light allows the signal to travel faster and over longer distances without a loss of signal quality than is possible with multimode cabling.
- Multi-mode fiber (MMF) Multimode cables have a core of either 50 or 62.5 microns. In multimode cables, the larger core gathers more light compared to singlemode, and this light reflects off the core and allows more signals to be transmitted. Although more cost-effective than singlemode, multimode cabling does not maintain signal quality over long distances. Thus Single mode fiber cable is used in this project implementation.

The optical cable is going to be installed from Abuja – Akwanga – Lafia – Makurdi – Enugu – Awka – Onitisha – Asaba – Benin – ore – Ijebu Ode – Lagos and also its linking from Onitisha – oweri – PH – Uyo.

For this connectivity there will be a data center in Abuja which will be having a back up data center in Enugu. Others will be having OA sites where the OSN 8800 equipment will be installed, 2.2 OSN equipment The OptiX OSN 8800 T32 and OptiX OSN 8800 T64 are mainly applicable to the backbone core layers. They are also applicable to the core layers and metropolitan convergence layers. The OptiX OSN 8800 T32 and OptiX OSN 8800 T64 can be used with the metropolitan DWDM equipment, SDH equipment, and data communication equipment at the backbone layer to provide a large-capacity transport channel for services and network egresses. The OptiX OSN 8800 T32 and OptiX OSN 8800 T64apply to the long-distance and large-capacity transmission of nation-level trunk and inter-province trunk to maximally meet the requirements of large-capacity and ultra-long haul transmission for carriers. In addition, the OptiX OSN 8800 T32 and OptiX OSN 8800 T64 provide carriers with a stable platform for multi-service operation and future network capacity expansion. The OptiX OSN 8800 T32 and OptiX OSN 8800 T64 use dense wavelength division multiplexing (DWDM) technologies to achieve transparent transmission with multiple services and large capacity. It not only provides service grooming at the optical layer on a wavelength basis by using the ROADM technology, but also provides sub-wavelength grooming based on ODU3/ODU2/ODU1/ODU0.

This improves the flexibility in service grooming and bandwidth utilization to a great extent. The OptiX OSN 8800 can interconnect with the OptiX OSN 6800/OptiX OSN 3800/OptiX OSN 1800 to form an end-to-end OTN network. Also, they can interconnect with the OptiX BWS 1600G to form a WDM network. Typically, the OptiX OSN 8800 is applied to the OTN network. In addition, the OptiX OSN 8800 can interconnect with the NG SDH/PTN or data communication equipment to form a hybrid network, realizing a complete transport solution. See bellow picture of the OSN equipment.

3.2 Project Scope

Table 3.1 List of Coordinates

NO.	Site	latitude	longtitude	remark
1	Abuja	9° 3'52.37"N	7°29'37.53"E	Provide by Galaxy
2	Lafia	8°30'31.71"N	8°32'36.76"E	Provide by Galaxy
3	Makurdi	7°42'38.42"N	8°31'32.32"E	Provide by Galaxy
4	Enugu	6°26'42.36"N	7°29'26.28"E	Provide by Galaxy
5	Enugu Metro	6°25'50.96"N	7°30'55.97"E	Provide by Galaxy
6	Awka	6°14'54.97"N	7° 6'55.17"E	Provide by Galaxy
7	Onitsha	6° 8'5.12"N	6°47'38.93"E	Provide by Galaxy
8	Asaba	6°13'8.21"N	6°41'20.02"E	Provide by Galaxy
9	Owerri	5°28'28.15"N	7° 0'28.77"E	Provide by Galaxy
10	Port Harcourt	4°49'38.78"N	7° 0'20.43"E	Provide by Galaxy
11	Uyo	5° 1'5.04"N	7°53'11.38"E	Provide by Galaxy
12	Eket	4°38'39.06"N	7°55'40.57"E	Provide by Galaxy
13	Benin	6°21'35.74"N	5°40'13.02"E	Provide by Galaxy
14	Ore	6°45'42.03"N	4°52'34.78"E	Provide by Galaxy
15	Ljebu Ode	6°47'28.94"N	3°56'38.72"E	Provide by Galaxy
16	Lagos	6°25'31.66"N	3°36'00.90"E	Provide by Galaxy
17	Akwanga OA	8°54'38.85"N	8°24'22.94"E	Suggest by Huawei

Source: Fieldwork in August 2015

3.3 Project Location

The 1482Km fiber backbone will be constructed from Abuja to Onitsha to Lagos, and Onitsha to Port Harcourt to Uyo. The Data Centers will be setup in Abuja, and some Metro access system located in cities like Abuja, Makurdi, Enugu and Lagos.

1. Metro Access Network

- Build fiber optics metro network in Abuja, the Federal Capital Territory (FCT) of

Nigeria, using SDH and GPON technologies consisting of a 26-node metro core network with related metro access network.

- Deploy 9 eLTE sites and 800-nodes WiFi hotspot network, all within Abuja.

2. Data Center

- Build 2 new Data Centers. One new Data Center located in Abuja FCT and the other new backup Data Center in Enugu.

3. Government Hotlines, Call Center, NOC, and Unified Communication

- Install 25-seater Call Center facility in Abuja FCT.
- Provide 16000 IP phones, 2000 video phones and 5000 capacity PC client telephony in Abuja FCT.
- To build 30 sets Tele Presence and video conference solution.
- Build a Network Operation Center (NOC).

Figure: 3.1: Satellite Image showing the designated states

3.4 Project Design

3.4.1 Galaxy Optical backbone network Design includes three parts:

- Network Design.
- OSP design.
- Site Design.

3.4.2 Backbone Network Design Summary

Galaxy Optical backbone network Design includes three parts:

- DWDM backbone network.
- IP backbone network.
- MSTP backbone network

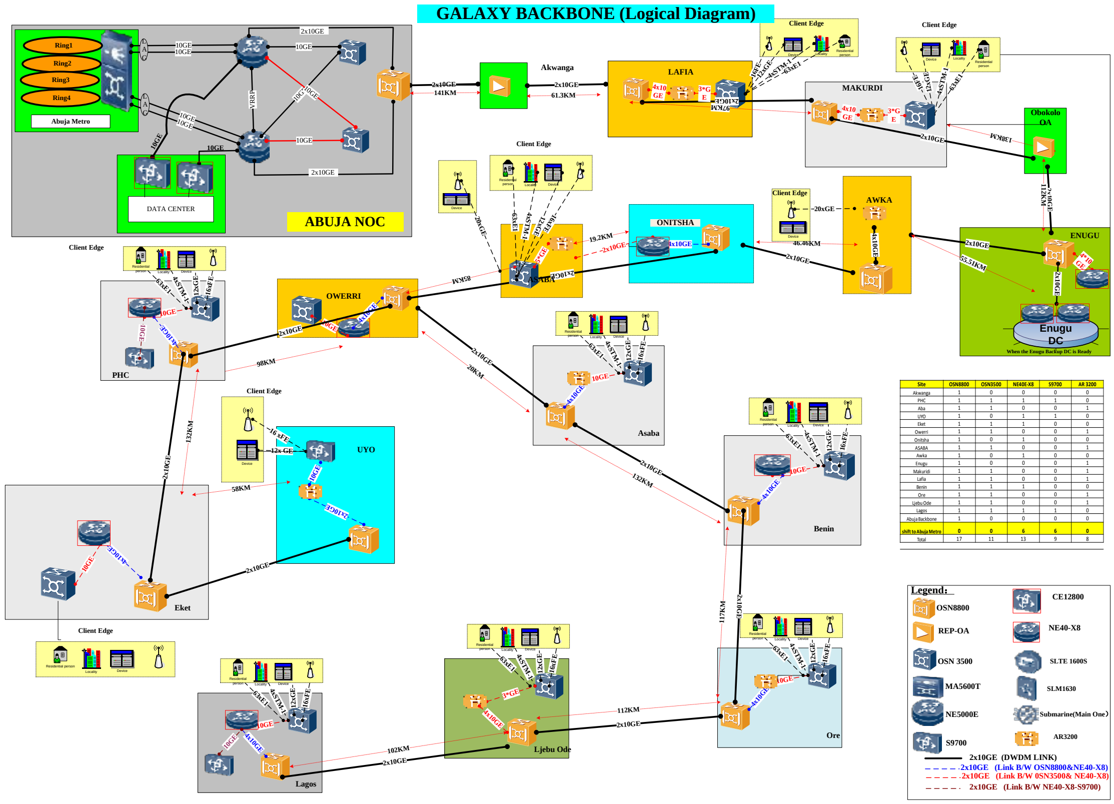


Figure 3.2: Design Backbone Overview

3.4.3 DWDM Network Design

For the NICTIB project, Huawei will implement 1482km as phase1 base on actual survey and design length. And will cover adjoining states including UYO, Eket, PHC, Owerri, Onitsha, Asaba, Awka, Benin, Ore, Ijebu Ode, Lagos, Enugu, Makurdi, Lafia, and Abuja. Huawei will implement and complete the installation of buried Optical Fibre Cable on a turnkey basis.

There are total 17 sites of transmission nodes with DWDM equipment and power material will be setup. Include 2 OLA sites. There are 11 SDH equipments and 13 Core Routers as well. Following is the solution for scope of deployment:

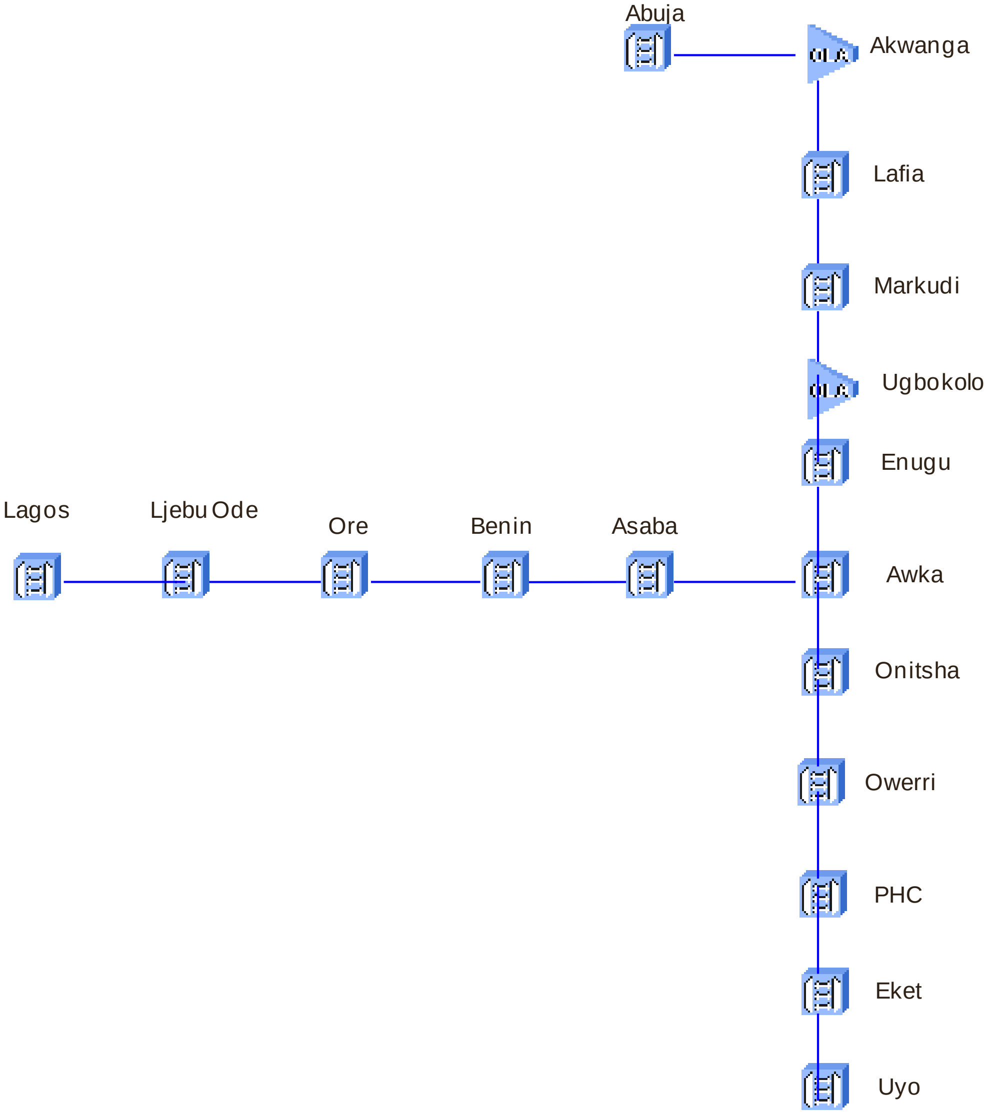


Figure 3.3: Fibre Optic route

Huawei will implement and complete the installation of buried Optical Fibre Cable on a turnkey basis, following the L2 BOQ as below:

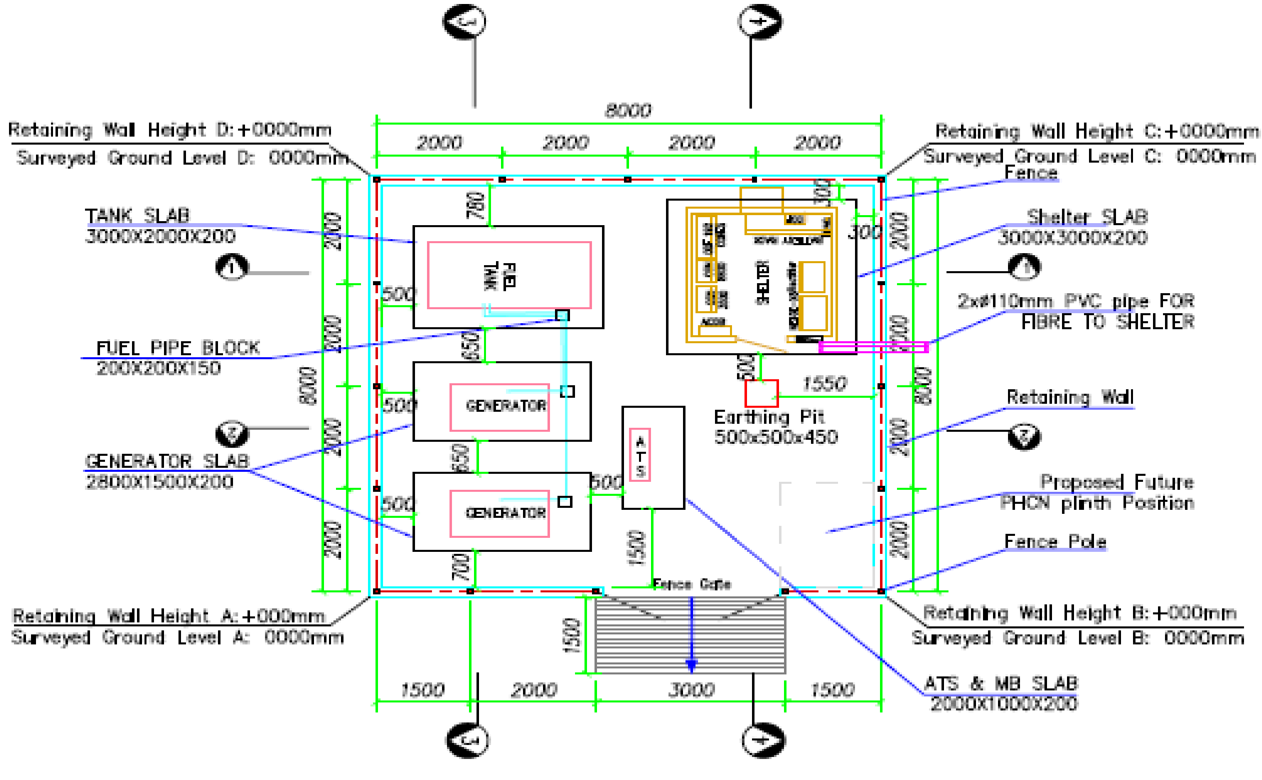


Figure 3.4: Site Specification

The National Information Communication Technology Infrastructure Backbone (NICTIB) network requires a "four-in-one" computer network that integrates data, voice, video and storage systems. Upon completion, the system would guarantee smooth interconnection with other network systems and create the opportunity for future network expansions. The system will therefore employ broadband as the main network with optical fiber as the main transmission medium and IP as the main communication protocol.

This will provide the various ministries with a lowly-priced (1000M Ethernet) fast user access via the optical transmission platform. NICTIB network provides abundant and flexible access for citizens to use government service anywhere anytime. NICTIB network is a unified network that features horizontal physical network and vertical virtual network with MPLS VPN technology. Each department can keep its own independence.

The NICTIB network would be composed of 3 different types of network connection (WAN, MAN and LAN).

The E-Government solution is composed of three layers: ICT infrastructure, Messaging System and Application systems. The Figure 1 below demonstrates the E-Government solution framework.

- *ICT Infrastructure*

The communication infrastructure includes GDC (Government Data Center, a unified data center for E-Government applications), Network Infrastructure (such as LAN, WAN, Wireless, xDSL, FTTx and network devices, such as switch, router, firewall, etc.).

- *Messaging System*

There is a unified messaging platform, a suit of flexible and high effective messaging systems such as video conference, call center, VOIP, above on the communication network to supplies the government communication and cooperation between different departments.

With this messaging platform, the communication and cooperation of the government departments becomes easier, higher efficiency and lower cost.

- *Unified Application Portal*

There are also many applications, such as E-Taxation, E-Education, E-Health, E-Police, E-Finance, E-Finance, E-Energy, etc. Each of the applications faces different department, has different workflow, require different documents. And the Application Portal work out useful information from huge and complex workflow of those applications.

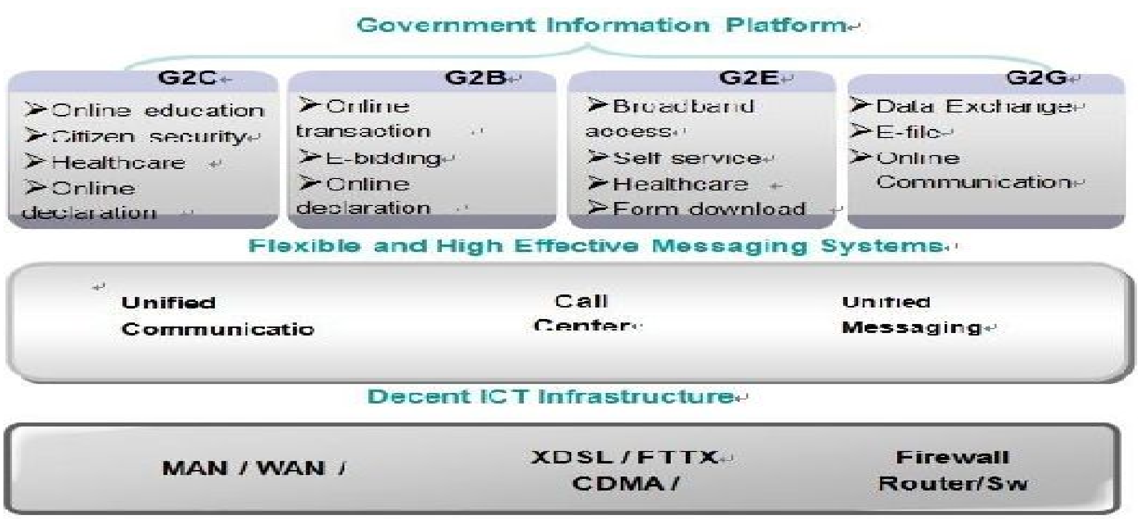


Figure 3.5: The E-government Solution Framework

- *WAN Networking Structure*

The WAN for the Government Network includes the WAN connection from one or more center nodes to the convergence nodes and the WAN connection from the convergence nodes to the edge node network.

The E-government network core will be connected to states by employing the NITEL, MTN or other carriers backbone bandwidth service. NE40E-X8 will be deployed at these nodes of Abuja, Kaduna, Bauchi, Enugu, Port Harcourt and Lagos realize the core ring of NICTIB WAN.

Other state capitals connect to the 2 close core nodes by star topology to realize mutual backup of links so as to ensure the high reliability. NE40E-X3 will be deployed at these nodes.

- *FCTA MAN Infrastructure*

In order to ensure the quality of services within the Federal Government Network, high speed Fiber Optical Cable network will be constructed for the metropolitan area of MDAs in Abuja. F.O.C Duct Network will be deployed underground while Excavation, backfilling and reinstatement of all trench works for ducts fiber installation in accordance with specifications after the field survey, engineering measurements and As-built drawing for implementation.

The 4 core nodes in Abuja employ the 2.5G RPR to build a solid IP/MPLS core; other Federal Ministry nodes using the GE ring. Different ministries can be logically isolated with different MPLS VPN network.

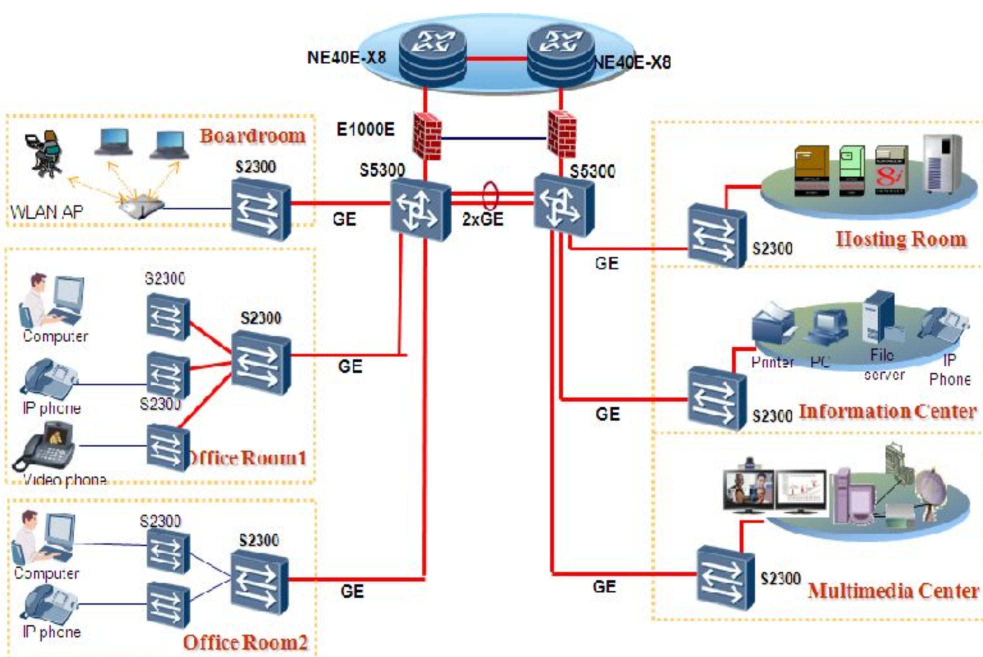


Figure 3.6: Site Specification

- *LAN cabling*

For the LAN of the Government Network, the Fast Ethernet is considered to implement the access service for the user of each unit. Based on the scale of MDAs building, different LAN configuration is designed for federal MDA and capital of states.

Dual network interface cards and disk array are recommended for the key server. For networking, the switch should be in the dual-link backup mode to connect the two core S5300 switches to ensure the network.

Above all, NICTIB will provide a unified network infrastructure for all MDAs, states and local government.

3.4.4 Government Information platform Service

NICTIB will serve as a Government Information platform for all citizens, business, enterprise and MDAs. The services will include:

- Internet Connectivity
- Interconnectivity between Agencies
- Intra-connectivity for MDAs with multiple locations
- Government information platform: Paperless Office automation, Document Security, E-flow, Web-portal, Service Hall, etc.
- Tele-Presence and Multimedia Video and Voice conference
- Toll Free Video and Voice Services over IP infrastructure
- Web and Email Hosting
- Server Co-location and Application Hosting
- Disaster Recovery, Business Continuity and other Datacenter Services
- Network Management

Paperless Office Automation

The system is built in conformity with internationally standards and specifications as well as security system principles, and it is based on the basic architecture supported by customer database and network to realize each OA function. It offers users an office platform with high automation, informatization and security.

Information Service Center

An Information Service center will be proposed in the Capital as a pilot, in which the citizen can obtain information such as: Laws, rules and governance policy from federal government and MDAs. The equipment in this service hall as below:

- Office Equipment. Print / Copy / Scan / Fax One machine, PC, desktop or laptop computer

- Self-service system
- Computer lab and Internet
- TVs for News and image show. etc.

The Self-service terminal is a computer based touch-screen interactive device that provide information access and web application through electronic methods, which is a unattended equipment put at public place such city hall, government building ,airport and library etc. Integration of technologies allows self-service device a wide range of functions, for example, the device enables users to enter public portal to perform online searching, or collect information.

3.4.5 New Generation Green Datacenter

Data Center is the heart of the platform. It will have a network equipment area to provide centralized maintenance for network equipment such as the service access switch, service convergence router, firewall, and egress router. It provides high-speed and convenient service for public.

The **Cloud Computing System** includes following aspects:

1) Automated Operations Portal

- Cloud computing service application can be submitted to the system administrator in a variety of ways.
- The administrator of service application has the permissions to apply and redistribute resources, and other administrative permissions.
- End users can directly access Web-based interface, using the services provided by the cloud computing platform.
- A simple interface of resources application realize the virtualization of IT resources, and rapid deployment.

2) Real-time Monitoring & System Self-healing

- Real-time monitoring: For all hardware devices, virtual resources running in real-time monitoring, while for business load to monitor and manage. When a fault occurs, operation and management platform can detect the fault timely.
- Fault isolation: The system restarts faulty equipment automatically. The faulty equipment will be isolated if it is still unable to recover.
- System self-healing: The system automatically assigns a new, alternative resource and loads the backup image to run.

3) Cloud storage

- Abundant storage business: Net disk, data sharing and synchronization, online storage, online backup, etc.

- High available: File sensitive optimization and multiple RAID technologies will improve performance and reliability.
- Easy management: Full open system, support of union management, and reduced maintenance costs.
- Scalability: Dynamic expansion of the storage server and storage space.
- Energy saving: Idle/standby technology will reduce storage unit power cost.

4) Service operation and manager system of NGDC

Operations Management System consists of:

- Multi-dimensional monitoring system
- Safety management system
- Information security system
- 3 layers maintenance system
- Customer service system
- Failure process
- Configuration change management process
- Grade hardware and service level

5) Unattended network management

- An accurate picture of network topology
- Accurate early warning, targeting network equipment failure
- Real-time control network equipment/server-status
- Network/equipment/server traffic management
- DC hosting server and application management
- Provision of various reports of equipment/server/application

6) Visualization of business management

- To provide integrated management of customer data
- To provide flexible management of the prices of DC products and services
- To provide comprehensive unified resource management of DC
- To provide definable management of DC business process
- To provide standard management and interface support of DC accounting
- To provide DC analysis reports and decision support
- 7-Inch Full Touch screen
- Digital Cordless Phone
- 3-Megapixel HD Camera

- Abundant Interfaces：Dual Network Interfaces, Video Output Interface, Audio Output Interface, USB Ports and so on.

1) EchoLife ET525 Voice IPPhone

EchoLife ET525 is a type of Session Initiation Protocol (SIP) phone. ET525 provides a vivid liquid crystal display (LCD) man-machine interface, two 10/100 Mbit/s network interfaces, multi-party service, and reliable voice quality.

2) eSapce - Personal Communication Assistant

The eSpace multimedia client software is a multimedia soft terminal designed for the enterprise voice solution. It is implemented through the pure software based on the multimedia PC terminal and has no the shape of traditional videoconferencing terminal products. Users need not master the professional knowledge on videoconferencing for using it. The eSpace can provide a multimedia communication platform for family users and business personnel. The eSpace mainly implements the functions such as voice and video communication, call register management, and personal and enterprise address book.

- Audio Call functions
- Multi-party audio conference
- IM and status control
- File transfer
- Offline Messages
- Multimedia Conference

3.4.6 Document Security Exchange

The e-Document Exchange system is set up to replace the traditional manual transfer mode, implementing the digital and network orientation of such main office services as the confidential document, information, meeting and supervision and e-transmission of the document and information. This system is based on the WEB interface and cross platform. The standard confidential document template can be customized to provide the ID recognizing, compressing for transmission, decompressing for reception, management of received and sent documents and the urging for handling and replying functions. Each network access unit can set up an internal document operation and querying system according to its actual conditions.

3.5 Project Construction and Installation Activity

Fiber Backbone Network – Civil Work

Build 1482 KM fiber backbone in Nigeria to cover from Uyo, Lagos to Abuja FCT.
Provide upload and download service points to locations along the cities Uyo, Eket, PHC, Owerri, Onitsha, Asaba, Awka, Benin, Ore, Ijebu Ode, Lagos, Enugu, Makurdi, Lafia, and Abuja.
OFC Implementation
In optical fiber implementation (outside plant known as OSP) there are different stages, first the OSP implementation is divided into two parts.

- The civil
- The telecom.

Procedures for OSP implementation

Survey - first before an OSP project is implemented, a survey is done with the use of GPS to know the geographical position of where the proposed infrastructure will be built, this process helps to build the route design and BOQ for the project.
Because every detail of the route will be known, different activities along the route will be know and also properties that will be replaced as a result to damage during the project will be also noted.
Route cleaning- if it's a back bone the route is firstly cleaned up by cutting the grass along the route where the proposed trenched is to follow.
Handhole Marking – the Handhole numbering is marked along the road so that the propose Handhole location can easily be identified during implementation

Excavation / Trenching – this is the digging of the soil with the conventional trenching method which is used in this part of the world where by digger men are used in digging the soil to a depth of 1.2m depends on the specification. Note in the course of trenching there are some facility or built structures that cannot be dug, so a method called trust boring is used to underpass this an example is a tiled major road that is busy.
See attached diagram bellow for the trust boring method.

OSP Specification

<u>*Duct structure*</u>

- 4 way 26mm/32mm HDPE duct (duct direct buried) will be adopted for suburban area
- 4 way 26mm/32mm HDPE in 1 way 110mm PVC duct will be adopted for urban area.

Manhole size

The Manhole size (L x W x D) is as follows:

- 900 x 900 x 1100 mm (urban)
- 900 × 700 × 820 mm (suburban)

Manhole distance

- MH to MH distance 240m in metro, 1500m in backbone

Duct depth requirement

Commonly according the different soils and areas, the minimum requirements of buried depth of optical cable ducts are as follow: (Unit：m).

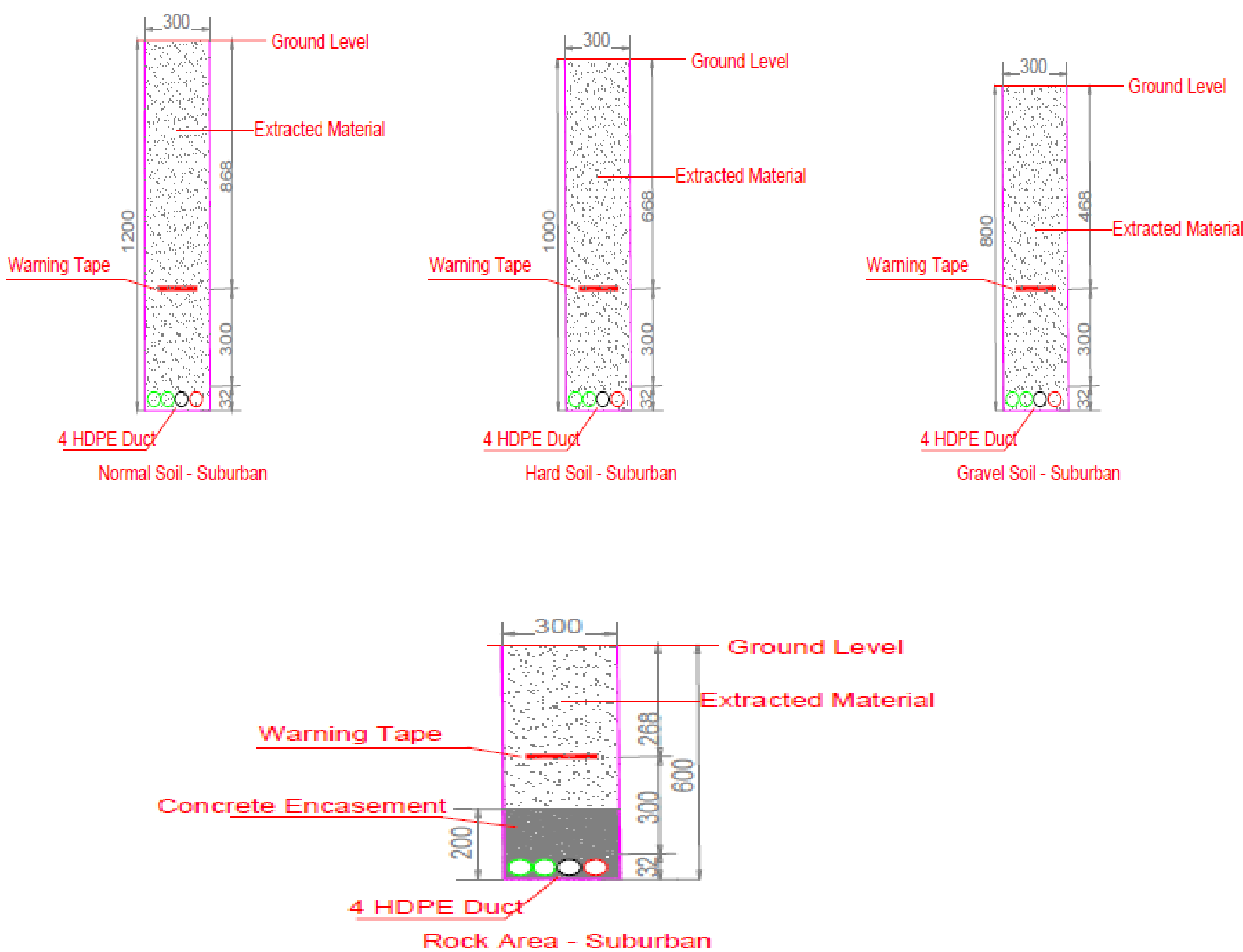


Figure 3.7: Soil Profile Column

HDPE laying – HDPE / Duct is laid after the required depth is reached, the HDPE is the house built for the fiber, it protect the fiber, also note that as the case may be in in Metro (Urban) PVC is used before the HDPE to have a double protection on the fiber. But for the backbone (Suburban) HDPE is laid directly.

Laying of warning Tape – this is the stage of which after the HDPE is buried in the trench, the arranged according to the specification, half backfilling is done on the HDPE and warning (caution) tape is laid on the half backfilled soil ,this warning tape help to indicate to any person digging around the facility line that there is an existing sensitive facility along that route. Its of a very high advantage.

Backfilling – this is the final stage in the civil work aspect where the trench is finally backfilled with the excavated soil and compacted to avoid depression, which can lead to erosion along the trench path if not properly compacted.

HH installation – this is when the cast HH is deployed to site and installed accordingly to the marked location, this serves as a house for the joint closure, which is used to join two fiber together, and also this Hand hole is necessary because in time of maintenance it reduces the Waste of fiber cable as the fiber replacement can be shorten or the excesses stored in the Handhole called slag can cover the damaged section.

Fiber blowing – this is the telecom Aspect, this stage comes in after all the civil work is completed because if civil work is not properly done the telecommunication aspect is always difficult to deliver, thus the telecommunication aspect success depends on the civil work, in the FIBER blowing a blowing machine with compressor is used to blow the fiber cable through the HDPE buried in the trench, which there will be joint in different Handhole depends on the cable length.

Splicing/Termination – this is the method of joining two fiber cable at one end such that there will be continuity in the fiber link from one end to another, termination is the connection of the fiber to the ODF (optical distribution frame) which is connected to the DWDM or OSN as the case may be. After all this is done and OTDR and Light source and power Meter is used to check the link to confirm if the expected loss budget is not exceeded.

For the road sections the infrastructure will consist of a trench with duct (HDPE), or set of ducts (HDPE), that runs parallel to the roadside as shown in the following figure.

The trench is trench to different depth according to soil type

Figure on Infrastructure for the Road Sections-Trenching

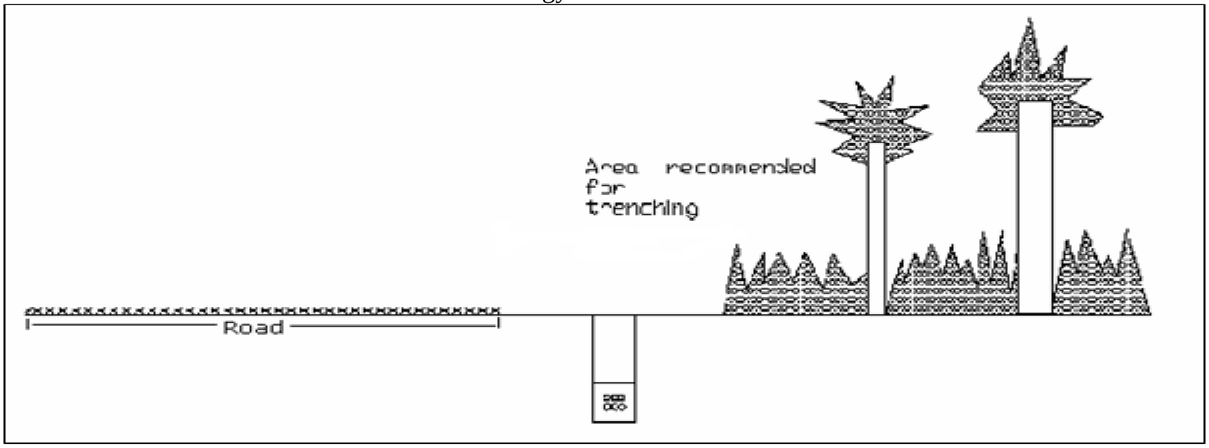


Figure 3.8: Road Corridor showing cable route

- 4 way 26mm/32mm HDPE duct (duct direct buried) will be adopted for suburban area. The color of PVC is grey and the color of HDPE is green, yellow, black and red.
- 4 way 26mm/32mm HDPE in 1 way 110mm PVC duct will be adopted for urban area. The color of PVC is grey and the color of HDPE is green, yellow, black and red.
- 3 way 26mm/32mm HDPE and 4 way 110mm PVC duct will be adopted for urban area in Abuja. The color of PVC is grey and the color of HDPE is green, yellow and red.

Trenching Configuration

Road Configuration-R1

The ducting structure will consist of 4xHDPE 26mm/32mm in suburban, 4xHDPE 26mm/32mm +1 x 110mm PVC in urban. The trench will be backfilled with typically the same material that was extracted from the trench. 110mm steel duct is to be adopted for road crossing/thrust boring/bridge. A warning tape will be laid along the whole length of the trench to prevent accidental damage to the ducts.

Road Configuration-R1 (Special Works)

The ducting structure will consist of 4xHDPE 26mm/32mm in suburban, 4xHDPE 26mm/32mm +1 x 110mm PVC in urban. This is backfilled with typically the same material that was extracted from the trench and an intermediate concrete layer, for trench depth which can't meet requirement in R1 above, A warning tape will be laid along the whole length of the trench to prevent accidental damage to the ducts.

The trench is trench to different depth according to soil type see table below for the different depth according to soil type.

Table 3.2: Soil Type

S/N	Sorts of area for laying cable and soil	Suburban Depth(m)	Urban Depth(m)
1	Normal soil	1.2	1.2
2	Hard soil	1.0	1.1
3	Soil with gravel	0.8	1.0
4	Rock area	0.6	0.6

Note: If trench depth can’t meet requirement in above table, protection measure like galvanized steel pipe protection, concrete protection etc is proposed, review and agreed with customer team.

- The distance from Manhole to Manhole measured by wheel.
- Warning tape depth and presence(0.7m from top surface of trench)
- Manhole installation.
- Concrete or GI Pipe for shallow depths

General Installation Requirements

The subcontractor will use GYFTY-48 core fiber in backbone, GYFTY-96 core fiber in metro, mark on the fiber is "NICTIB", colour of fiber is yellow.

The preferred methods of cable installation inside ducts (or sub-ducts), is "blowing" or "floating" due to them being secure for cable integrity and advantageous for cost efficiency for the long distance sections. However other methods such as pulling can be considered in metro under conditions (costs, schedule, and security).

Throughout the duct network, the sub-ducts will be uniquely identified. Fiber optic cable installation maintains the integrity of the identification system. The Fiber and unit numbering sequences, as described in the cable data sheets, are adhered to.

All splice enclosures should be secured in the splice chamber to the bearers with cable ties, or attached to the chamber wall with the appropriate brackets, to permit straightforward removal of the enclosure for maintenance purposes. At each splice location the cable ends must be sealed until splicing to prevent moisture from entering the cable ends.

requirement, the average length of such coils will be 10 m (no splice) and 2 x 10 m (splice box). Coils will be dimensioned as to respect the manufacturer's cable specification regarding maximum dynamic and static bending radii allowed. Coils are to be tied and placed below the bearers in each chamber against the side wall, or on the floor, as directed. The length of all slack coils and termination loops will be recorded.

Fiber optic cable is installed in accordance with the cable linear schematic documentation. They will provide with special attention to the Fiber optic cable manufacturer's recommendations and standards for cable handling and installation. At no time should any cable drum be left unmanned during cable installation.

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Fiber Optic Cable Installation by Pulling

As the optical Fiber cable provides high capacity transmission channels, The contractor should ensure that the cable's qualities and characteristics are not degraded as a result of the installation process. Excessive pulling tension, torsion or reduced bending radii will not be permitted.

The maximum pulling tension will be as specified on the Cable Data Sheet and the minimum bending radii will be: dynamic (cable in movement) = 20 times outside diameter of the cable and static (cable in place) = 10 times outside diameter of the cable. These limits should be adhered to at all times during installation and especially when placing excess cable in manholes for splicing and slack coils.

Fiber Optic Cable Splicing

Cable route and design will be defined as to minimize the number of splices to be performed on the cable route. The Fiber cables should not be cut and spliced at bridges, roads, pipes, or other crossings without a special approval

.

All Fibers should be joined by means of the fusion splice technique and protected with Fiber optic heat shrink splice protection sleeves, and an approved heat oven should be used to shrink all splice protection sleeves. Care must be exercised to prevent damage to exposed Fibers by overheating.

After the splice is completed, the a test to measure and record the average splice loss at 1550 nm, with an OTDR. A bi-directional, mean splice loss of 0.1 dB or less will be accepted. If after three (3) attempts, the subcontractor is not able to produce a bi-directional [redacted] will be noted as an Out-of-Spec splice.

A result of 0.1 dB is the maximum allowed splice loss for any one splice but it is mandatory that the splice losses average for all sections is 0.07 dB or lower.

Fiber Numbering and Labeling and reservation

Cables should be labeled at each access chamber, splicing position (in and out), building entry (internal and external), ODF, floor of a cable riser and cable termination. The information required on the label should include GALAXY NIGERIA, cable identity and location.

In addition, at every splice position the Fibers should be numbered. The number attached to the splice protection sleeve for bare Fiber and on the protective tubing where the Fiber is sleeved. Each Fiber unit should be numbered at the cable butt and at the midpoint of any stored loop.

Cable reservation standard

	Direct bury	Duct	Aerial
Natural bending	0.7%	1%	0.7%-1%
Reservation at splicing point	20m		
Reservation in manhole	15m		
Reservation in site	30m		

3.6 Production process and/or project operation/maintenance

Production process

Huawei's production process system including the 3D warehouse, the automatic warehouse and the entire production line layout was designed by FhG of Germany. The new system reduced the need for transportation of materials and decreased production time, thereby increasing the all-round efficiency and quality of production.

Huawei has developed a flexible supply chain, which has enhanced our competitiveness in terms of providing fast, cost-effective and quality supply. The suppliers of telecommunications devices have to encounter the power consumption and carbon emission in the process of manufacture and transport. In recent years, Huawei has implemented various energy-saving measures in logistics, reuse of packages, and intensive transport.
For example Huawei:
Enhance the reuse of internal turnover instruments and packages.
Optimize the management of production resources with air conditioning and light system transformation.

- Implement intensive packaging and package reuse of the raw materials or semi-finished products between Juxin (Huawei's subsidiary company) and overseas EMS manufacturers.
- Ensure reasonable utilization of the transport resources through the shipment and container estimation system.
- Implement the green package concept in China and develop a metal container recycle system in cooperation with China Mobile.

Packaging is an indispensable element in the whole manufacturing process of telecommunication devices. In the transport process, packaging consumes a large quantity of natural resources, such as wood. The sustained use of wood poses a long-term threat to global forest resources. In order to reduce the consumption of timber, the industry's leading suppliers are working hard to promote renewable packaging materials and improve the recycling of these resources. At the same time, Huawei has reduced the consumption of packaging materials by utilizing lightweight materials and smaller packaging, continually investigating more appropriate packaging, and extending the life cycle of the packaging products through the establishment and improvement of an effective Recovery System. These can be summarized by using the 6 R concept, that of: rational design, reducing supplies, recycle, reuse, recovery, and renewable.

The "Transportation cabinet" is typically a reusable unit with associated reusable packaging. This solution is based on recycled wood materials, visualized packaging technology, assembly technology, standardization and appropriate design. Together with a universal logistics platform, the "Transportation cabinet" solution reduces the consumption of natural resources such as wood from forests in the packaging and logistics stage, and promotes sustainable development of resource-saving and environmentally friendly packaging and logistics within the industry.

Huawei uses the LCA approach to research the carbon emission of telecommunications devices. LCA is an industry-leading methodology used to measure the carbon emission in the product lifecycle. During recent years, Huawei has used the LCA approach to assess the environmental impacts of the mainstream product family. In 2009, Huawei attained a Resource Reduction of more than 20%.

Project operation/maintenance

Huawei has delivery platforms distributed in Nigeria,with three branch offices (Lagos, Abuja, and Kano), one Managed Service Center in Lagos, one training center in Abuja, 6 TAC and spare parts warehouse distributed in Nigeria, and one local R&D center in Lagos. All these platforms will guarantee this project is delivered smoothly and professionally.

3.7 Project's schedule and technological layout

Project Implementation Schedule

For ease of deployment and project management, the NICTIB project deployment is divided into three levels: Backbone level, Metro access level, and LAN network level. The project will last totally 13 months, from preparation of the project preliminary, site survey and design, manufacturing and logistics, Engineering Implementation & PAC, Implementation in Backbone, Implementation for Metro access network, and Implementation of LAN network and Datacenter, including 1 year and 1 months for the actual project construction. See the table below for details

Technological layout

- 1500Km Optical Fibre Cable Backbone network covering the Federal Territory.
- One Landing point gateway to the International submarine cable of MainOne Cable Company.
- High performance IP Backbone router, switches, and security firewall.
- Metro Access Network Equipment and site construction.
- Secondary Data Centre compliant to Tier4 standard, and Backup Data Centre compliant to Tier3 standard.
- Cloud Computing Platform & Primary Data Centre Expansion.
- Local Area Network infrastructure for the Federal Government.
- Internal Unified Communication platform and Video Telepresence system.
- Application of Office Automation, Document Management System and web-portal platform.
- Government hotline and contact centre.
- Unified Network Management System.
- Training and Capability building.
- Engineering service and Two years warranty service.

Waste Management and Environmental Health and Safety

Huawei not only believes in the need to stay at the forefront of technology, but also in the active promotion of environmental awareness and conservation. In order to lead by example, we have implemented the Environment, Health and Safety (EHS) management system based on international standards, which strives to provide a safe and healthy working environment for our employees, and aims to achieve the following objectives:

- Increase awareness of the importance of EHS in our design, production and operation processes.
- Systematically identify potential environmental risks and occupational hazards.
- Lay down specific EHS requirements for our purchasing strategy, and promote EHS throughout the whole supply chain.
- Encourage EHS awareness among our employees and cultivate a corporate culture that emphasizes the individual responsibility that each of us have towards the environment.
- Increase focus on sustainable development through the reduction of energy consumption and efficient usage of resources.
- Perform internal audit and management review of EHS on a regular basis.

The 3R of (Re-use, Recycle and Reduce) principle of waste management will be adopted in managing the waste that will be generated during the implementation of the project.

Safety Rules for Fiber Optics

- Keep all food and beverages out of the work area. If fiber particles are ingested they can cause internal hemorrhaging.
- Always wear safety glasses with side shields to protect your eyes from fiber shards or splinters. Treat fiber optic splinters the same as you would treat glass splinters.
- Keep track of all fiber and cable scraps and dispose of them properly. If available, work on black work mats and wear disposable lab aprons to minimize fiber particles on your clothing. Fiber particles on your clothing can later get into food, drinks, and/or be ingested by other means.
- Never look directly into the end of fiber cables – especially with a microscope - until you are positive that there is no light source at the other end – having tested it with a power meter. Use a fiber optic power meter to make certain the fiber is dark. When using an optical tracer or continuity checker, look at the fiber from an angle at least 6 inches away from your eye to determine if the visible light is present.
- Contact lens wearers must not handle their lenses until they have thoroughly washed their hands.
- Do not touch your eyes while working with fiber optic systems until your hands have been thoroughly washed.
- Only work in well-ventilated areas.
- Keep all combustible materials safely away from the curing ovens and fusion splicers.
- When finished with the lab, dispose of all scraps properly. Put all fiber scraps in a properly marked container for disposal.
- Thoroughly clean your work area when you are done

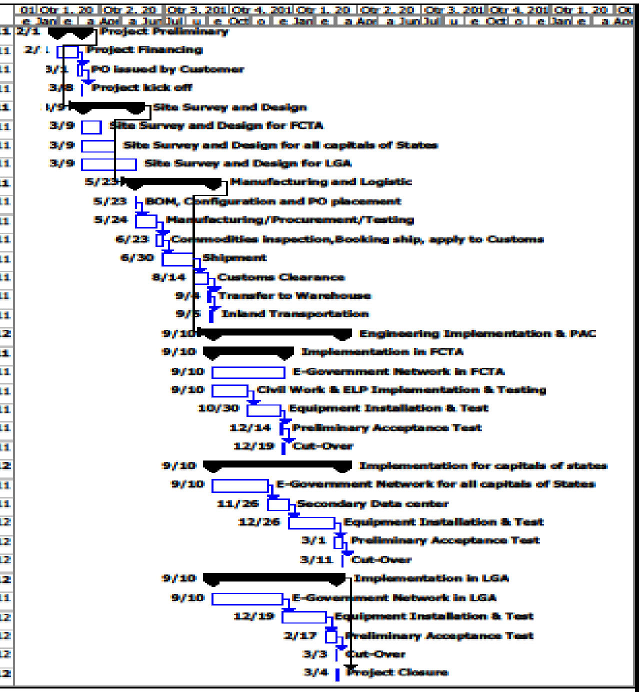
Optical fiber does not have environmental Hazard, but if the implementation is not properly done the follow can occur.

- If the trench Path is not proper backfilled and compacted it can cause erosion path, which can later turn to gully erosion and is some case damage properties around the trench path or even damage roads.

- If the Hand hole is not covered it can cause Accident, as people will be falling inside time to time and some can even break different part of their body.

Table 3.3 Project Schedule

ID	Task Name	Duration	Start	Finish
1	**Project Preliminary**	**36 days**	**February 1, 2011**	**March 8, 2011**
2	Project Financing	28 days	February 1, 2011	February 28, 2011
3	PO issued by Customer	7 days	March 1, 2011	March 7, 2011
4	Project kick off	1 day	March 8, 2011	March 8, 2011
5	**Site Survey and Design**	**75 days**	**March 9, 2011**	**May 22, 2011**
6	Site Survey and Design for FCTA	25 days	March 9, 2011	April 2, 2011
7	Site Survey and Design for all capitals of States	45 days	March 9, 2011	April 22, 2011
8	Site Survey and Design for LGA	75 days	March 9, 2011	May 22, 2011
9	**Manufacturing and Logistic**	**110 days**	**May 23, 2011**	**September 9, 2011**
10	BOM, Configuration and PO placement	1 day	May 23, 2011	May 23, 2011
11	Manufacturing/Procurement/Testing	30 days	May 24, 2011	June 22, 2011
12	Commodities inspection,Booking ship, apply to Customs	7 days	June 23, 2011	June 29, 2011
13	Shipment	45 days	June 30, 2011	August 13, 2011
14	Customs Clearance	21 days	August 14, 2011	September 3, 2011
15	Transfer to Warehouse	1 day	September 4, 2011	September 4, 2011
16	Inland Transportation	5 days	September 5, 2011	September 9, 2011
17	**Engineering Implementation & PAC**	**184 days**	**September 10, 2011**	**March 11, 2012**
18	**Implementation in FCTA**	**101 days**	**September 10, 2011**	**December 19, 2011**
19	E-Government Network in FCTA	101 days	September 10, 2011	December 19, 2011
20	Civil Work & ELP Implementation & Testing	50 days	September 10, 2011	October 29, 2011
21	Equipment Installation & Test	45 days	October 30, 2011	December 13, 2011
22	Preliminary Acceptance Test	5 days	December 14, 2011	December 18, 2011
23	Cut-Over	1 day	December 19, 2011	December 19, 2011
24	**Implementation for capitals of states**	**184 days**	**September 10, 2011**	**March 11, 2012**
25	E-Government Network for all capitals of States	77 days	September 10, 2011	November 25, 2011
26	Secondary Data center	30 days	November 26, 2011	December 25, 2011
27	Equipment Installation & Test	66 days	December 26, 2011	February 29, 2012
28	Preliminary Acceptance Test	10 days	March 1, 2012	March 10, 2012
29	Cut-Over	1 day	March 11, 2012	March 11, 2012
30	**Implementation in LGA**	**176 days**	**September 10, 2011**	**March 3, 2012**
31	E-Government Network in LGA	100 days	September 10, 2011	December 18, 2011
32	Equipment Installation & Test	60 days	December 19, 2011	February 16, 2012
33	Preliminary Acceptance Test	15 days	February 17, 2012	March 2, 2012
34	Cut-Over	1 day	March 3, 2012	March 3, 2012
35	**Project Closure**	**1 day**	**March 4, 2012**	**March 4, 2012**



Project: GALAXY Project Plan
Date: January 12, 2011

Task, Progress, Milestone, Summary, Rolled Up Task, Rolled Up Milestone, Rolled Up Progress, Split, External Tasks, Project Summary, Group By Summary, Deadline

Page 1

CHAPTER FOUR

DESCRIPTION OF THE EXISTING ENVIRONMENT

4.1. INTRODUCTION

This section is the description of the physical, chemical, biological and socio-economic characteristics of Communities in the areas designated for the Fibre Optics in the project area: The optical cable is going to be installed from Abuja – Akwanga – Lafia – Makurdi – Enugu – Awka – Onitisha – Asaba – Benin – ore – Ijebu Ode – Lagos and also its linking from Onitisha – oweri – PH – Uyo.

It provides information on the features, quality and sensitivity of the proposed Fibre Optics. The studies were carried out in order to establish current environmental condition and impacts as a result the proposed project operation.

4.2 . BASELINE DATA ACQUISITION METHOD

The approach adopted in collecting the baseline data incorporates all relevant disciplines. The baseline data of the project area was acquired, using the following methods

- Literature/desktop research
- Field observation
- Sampling and measurements
- Laboratory analysis of samples collected in the field
- Satellite Imagery of the study area

4.2.1 Literature/Desktop Research

This involves the consultation of all relevant textbooks, journals, articles, research publications, previous study reports on similar projects, etc. The data generated from this process include meteorological data, maps, geologic/hydrogeology data and geographic data of the area.

4.2.2 Field Sampling and Observations

Field Sampling and observations was carried out to cover the rainy and dry season. This was aimed at determining the ecological characteristics and variations of the area during the two seasons. The dry season sampling was carried out on the 10th to 14th, August, 2015. This sampling period cover the one seasonal regimes approved for the study. Visual observations were made and documented in the field notebook. Photographs of important features were taken with a digital camera. The environmental components observed include

- Soil characteristics
- Vegetation/forestry
- Land use
- Geology/Hydrogeology
- Hydrobiology
- Fisheries
- Water/Sediment Characteristics
- Socio-economic setting
- Wildlife

The geographical coordinates of the sample locations within and around is given in the table below.

Table 4.1 Geographic coordinates of the sampling points

NO.	Site	latitude	Longtitude	remark
1	Abuja	9° 3'52.37"N	7°29'37.53"E	Provide by Galaxy
2	Lafia	8°30'31.71"N	8°32'36.76"E	Provide by Galaxy
3	Makurdi	7°42'38.42"N	8°31'32.32"E	Provide by Galaxy
4	Enugu	6°26'42.36"N	7°29'26.28"E	Provide by Galaxy
5	Enugu Metro	6°25'50.96"N	7°30'55.97"E	Provide by Galaxy
6	Awka	6°14'54.97"N	7° 6'55.17"E	Provide by Galaxy
7	Onitsha	6° 8'5.12"N	6°47'38.93"E	Provide by Galaxy
8	Asaba	6°13'8.21"N	6°41'20.02"E	Provide by Galaxy
9	Owerri	5°28'28.15"N	7° 0'28.77"E	Provide by Galaxy
10	Port Harcourt	4°49'38.78"N	7° 0'20.43"E	Provide by Galaxy
11	Uyo	5° 1'5.04"N	7°53'11.38"E	Provide by Galaxy
12	Eket	4°38'39.06"N	7°55'40.57"E	Provide by Galaxy
13	Benin	6°21'35.74"N	5°40'13.02"E	Provide by Galaxy
14	Ore	6°45'42.03"N	4°52'34.78"E	Provide by Galaxy
15	Ljebu Ode	6°47'28.94"N	3°56'38.72"E	Provide by Galaxy
16	Lagos	6°25'31.66"N	3°36'00.90"E	Provide by Galaxy
17	Akwanga OA	8°54'38.85"N	8°24'22.94"E	Suggest by Huawei

Control location was selected and taken in secondary ‘vegetation 1.5Km away from the Right- of- Way (RoW) the project site. The geographic coordinates of the control location were as shown on table 4.1 with elevation of 426.9m. Samples of soil, ground water, were collected for analysis. The socio-cultural components were also sampled. The coordinates (spatial location) of each sampling point was determined using a GPS. Samples were collected within 2km radius of the study area. Stratified random sampling pattern was adopted for the study.

Soil Sampling

Surface soil was investigated through visual observation and sampling. Soil samples were obtained from five different designated sampling points in a location to give a composite sample. Hand Auger of uniform cross section was used to ensure that reproducible units of soil samples were collected from depths of 0-15cm and 15-30cm. This ensured high quality representative data collection. Surface litter of un-decomposed plant materials were removed to ensure that uncontaminated soil samples were collected. Soil biological observations were carried out in quadrants of $1m^2$.

Soil samples were collected in appropriately labeled and sealed polythene bags. Samples for physico-chemical analysis were air-dried in a dust free environment while those for microbiological analysis were stored in ice-packed cooler in the field and transferred to the refrigerator at 40^0C.

Groundwater Studies

The water samples were collected into appropriately labeled containers. In-situ measurements of some physico-chemical parameters (pH, conductivity, TDS, and temperature) were carried. Groundwater samples were analyzed for physico-chemical, heavy metals and biological characteristics.

Vegetation Studies

A combination of sampling techniques and study methodology was adopted in the detailed assessment of the vegetation. The major ecosystem types were identified, representative plant specimens’ collected and photographic recordings made.

Sampling Techniques

The quadrant was adopted for the intensive and detailed study of the vegetation while the transect was used for rapid and extensive assessment of the vegetation types. The former consists of six 5m x 5m or 2m x 2m squares demarcated within the study areas while the latter was made up of six lines transects located to cut across the vegetation types in the field. Four quadrants and four lines transects were located within the project area while two quadrants and two lines transects were sited outside the project area and designated as controls. The control areas have similar environmental characteristics as the project location. Within the quadrants and transects the under listed detailed studies were conducted.

Quantitative Assessment of Species Abundance

In each quadrant the abundance, dominance and ecological importance of each plant species were quantified by determining the density, cover, frequency and performance.

Vegetation Characteristics

General and specific characteristics of the vegetation were obtained by determining the floristic composition, life form and biological spectrum.

Floristic Composition

All plant species in each quadrant and transect were identified to family, generic and species levels.

Economic Crops Inventory and Evaluation

All economic crops including plants of medicinal value were identified and documented. Estimates to the economic value of these plants would be derived.

Herbarium Studies

Representative sample of the species in the field were collected and prepared as standard herbarium specimens, using standard techniques. Plant identification was carried out in the field using appropriate floras, manuals and monographs. The preserved specimens would serve as permanent records of the vegetation and floristic composition of the area. Each specimen would always be available for study or quick reference in connection with any future operations in any of the study locations

Noise and air Quality

Ambient air quality parameters (volatile organic carbon, SOx, NOx, COx, etc.) were measured in-situ using Toxirae II gas monitor. Ambient noise levels were measured using ***Testo 815*** noise meter.

4.3 LABORATORY ANALYSIS

The methods of analysis used in this study were those approved by Department of Petroleum Resources (DPR) and Federal Ministry of Environment. Other international analytical procedures were also adopted, for instance, the APHA analytical procedures for water quality. To ensure the reliability and non-degeneration of some unstable physico-chemical parameters, in-situ measurement of pH, turbidity, conductivity, TDS, salinity, dissolved oxygen and temperature were carried out in the field. All field instruments were regularly cleaned and recalibrated after each use.

The Quality Assurance / Control for laboratory analyses is in accordance with DPR/FMEnv recommended method and include blank analyses to establish analyze level, duplicate analyses to establish analytical precision, spiked and blank sample analyses to determine analytical accuracy.

Table 4.2 Summary of Analytical Methods, Techniques and Detection Limits for Various Parameters

Analytical Methods, Techniques and Detection		Equipment Detection Limit	
Parameter	**Analytical Method**	**Equipment Detection Limit Soil (mg/kg)**	**Equipment Detection Limit Water(mg/1)**
Cadmium	ASTM D33557	<0.02	<0.02
Chromium	W1 36 ASTM DI687	<0.10	<0.10
Total Copper	W1 36-APHA 311B	<0.05	<0.05
Lead	W1 36-D2559 ASMD, API-RP 45	<0.20	<0.20
Mercury	APHA 3112B	<0.10	<0.10
Nickel	WI 36 APHA 3111B	<0.05	<0.05
Zinc	W136-D1687 ASTM	<0.010	<0.10
Potassium	W1 34 APHA 311/ASTM D3561	<0.20	<0.20
Vanadium	W1 36-APHA 303C	<1.10	<0.10

Sodium	W1 34-APHA 311B/ASTM D3561	<0.02	<0.05
Fe^{3+}	W1 36D1068 ASTMD 106C	-	-
pH	ASTM D1293 W1-07	-	-
Conductivity	Electrode W1-07	-	-
Turbidity	Turbid metric	<1.00	-
Nitrate	W 128- APHA/ASTM	-	-
Sulphate	HACH DR 2000-Environment Spectrophometric	<1.50	-
Phosphate	APHA 3400P-W1 24 UV/V4	-	<0.002
TDS	Electrometric W1 06	-	-
Dissolved Oxygen	Electrometric W106	-	-
TSS	W 105-APHA-Filtering then weighting	-	-
BOD	5 day incubation method APHA 1989 or Hach- Electrometric	-	<1.0
COD	Oxidation/refluxing with $K_2Cr_2O_7$ in 50% H_2SO_4 or Hach-8000-Colourmetric	-	<4.0
Soil Moisture Content	Air Dry	-	-
SAR	CEAEM/APHA 3111B	-	-
CEC	CAEM	-	-
ESP	CAEM/APHA3111B	-	-
CL^-	ASTM 512A	1.00	1.00
Magnesium	APHA 3111B/ASTM 23591	0.10	0.10
Calcium	APHA3111B	0.10	0.10
Manganese	APHA 3111B	0.10	0.10
PSD	BS 1377/ASTM D422	-	-

Quality Assurance /Control procedure

The Quality Assurance Procedures cover all aspects of the study, and include sample collection, handling laboratory analysis, data coding and manipulation, statistical analyses, presentation and communication of results. Samples chain custody form was used for the registration and tracking of samples from the field to the laboratory.

Sample Collection, Handling and Storage

The sampling and handling of air, soil, and vegetation were carried out in line with the recommended procedures and practices for environmental data collection in Nigeria.

4.4. DESCRIPTION OF THE EXISTING ENVIRONMENT

The details of the environmental data acquired during this study are presented in the following subsections

4.4.1 Climate and Meteorology

The study area is influenced by one seasonal periods i.e., rainy season approved for this study. The raining season is characterized by the Southwest moonson wind which originates from the Atlantic ocean. It brings cold to the area and rain and it usually starts from May and ends around December.

- **Wind**

The mean wind speed in the area is about 3.2ms^{-1} and ranges from 4.0. The prevailing wind in the study area is the South-westerly. Generally the wind in the study area varies between the light breeze, gentle breeze and moderate breeze. The wind speed and direction have effects on human activities and wind could aid the distribution of pollutants in the area. The table 4.4 below shows the wind speed and direction in the study area from year 2008 to 2015.

Table 4.3: Monthly Wind Data (m/s) of the study Area (2008-2015)

YEAR		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2008	Speed	9.1	8.8	9.5	8.5	11	9.5	8.4	6.8	5.4	5.6	5.5	7
	Direction	N	NW	NW	NW	W	NW	W	W	NW	NW	NW	SE
2009	Speed	7	5.6	5.6	6.8	8.5	7.4	5.5	6.3	7.1	6.3	4.7	7
	Direction	SE	NE	N	NW	W	NW	NW	W	NW	NW	NW	NW
2010	Speed	8.1	10	9.3	8.1	10	10.8	9.8	8	8	6	6	7.8
	Direction	NE	N	NE	W	W	W	W	W	NW	NW	SE	SE
20011	Speed	9	9.2	8	11	10.2	7.5	9.7	9.1	6.2	6.7	6.8	8
	Direction	NE	NE	NW	W	W	W	W	W	NW	W	NW	NE
2012	Speed	10.4	8.7	8.3	9.3	8.9	12	10	8	7.6	6.1	5.6	7.7
	Direction	NE	NE	NE	SE	SE	S	S	S	SE	NE	NE	NE

Source: NIMET Oshodi, 2015.

Relative humidity

The study area has a relative humidity, which ranges from 60% to 82% over 24 hours during the dry season. The relative humidity is usually higher in the morning and decreases as the temperature increases towards the day time. The table 4.5 below shows the relative humidity data of the area from year 2008 to 2015.

Table 4.4: Monthly Relative Humidity of the study Area @ 09 & 15 Hrs (%) (2008-2015)

YEAR	TIME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2008	09 Hrs	19	19	38	46	59	73	78	75	55	27	23	22
	15 Hrs	15	13	18	19	41	55	65	58	41	20	16	18
2009	09 Hrs	25	28	17	41	41	70	77	81	77	59	33	23
	15 Hrs	21	12	19	21	51	62	67	57	33	24	24	21
2010	09 Hrs	17	14	38	59	50	63	72	77	72	32	27	29

	15 Hrs	12	10	18	38	40	42	61	60	55	25	20	15
2011	09 Hrs	25	18	18	30	52	67	78	82	72	55	24	23
	15 Hrs	18	12	12	16	27	46	63	66	54	36	17	16
2012	09 Hrs	22	23	15	26	59	64	72	79	59	77	34	53
	15 Hrs	17	14	12	17	36	42	53	62	37	63	27	45

Source: Source: NIMET Oshodi, 2015.

Temperatures

The mean maximum temperature of the area varies between 24.9^{o}C and 33.1^{o}C while the mean minimum temperature varies between 12.2 and 26.1^{o}C. The months of August and September are the coolest with temperature of about 22^{o}C. The table 4.6 below shows the maximum and minimum temperature data of the area from year 2008 to 2015.

Table 4.5: Monthly Maximum and Minimum Temperature of the study area (2008-2015)

YEAR		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2008	MIN	15.3	21.7	25.9	26.1	24.1	22.5	21.5	21.8	21	16.8	13.6	14.2
	MAX	24.9	28	37.3	38.8	37.4	34.3	32.8	31.2	31.6	27.3	33	28.7
2009	MIN	13.1	17.4	19.8	25.3	24.4	22.8	21.8	21.2	21.9	22	17.9	13.6
	MAX	30.7	34.5	33.5	40	39	35.2	32.8	31.2	31	32	32.6	27.8
2010	MIN	16	19.7	24.9	25	24	24.3	22.1	21.6	21.2	22.2	21.1	13.5
	MAX	31.4	35	40.1	37.6	38.9	34.3	32.7	30.9	32.3	34.2	33.3	29.6
2011	MIN	13.3	20.8	22.8	24.8	25.6	24.1	22.1	21.9	22.4	20.6	16.2	15.1
	MAX	28.2	36.5	38.5	39.9	38.2	34.9	31.0	29.9	33.0	33.9	33.6	31
20012	MIN	16.0	19.2	20.5	23.0	25.2	24.4	23.0	22.1	21.9	22.1	16.4	12.2
	MAX	26.0	31.5	37.1	39.0	36.0	35.0	32.9	30.4	34.4	31.6	31.3	28.1

Source: Source: NIMET Oshodi, 2015.

Wind Speed and Directions

The mean annual wind speeds vary between a narrow range of 4.0 and 6.8m/s. The wind is at the peak of the rainy season in May and October, wind speeds are lowest, measuring between 6.5and 6.7m/s. From December, wind speeds begin to rise steadily and peak in March, just before the rains begin. nFigure 1: shows 1996 as recording the highest wind speed of 6.8m/s while 2005 has the lowest with 4.0m/s. Figrue 4.3b shows the

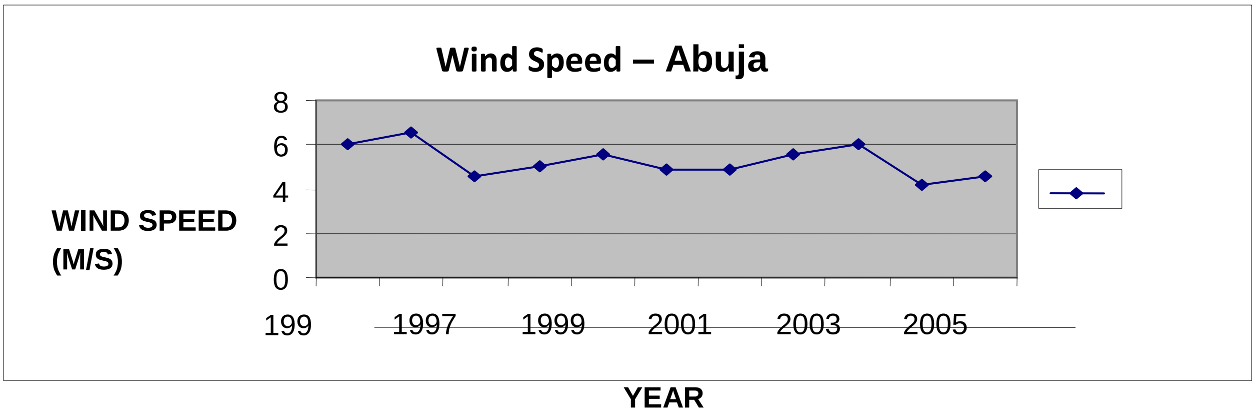
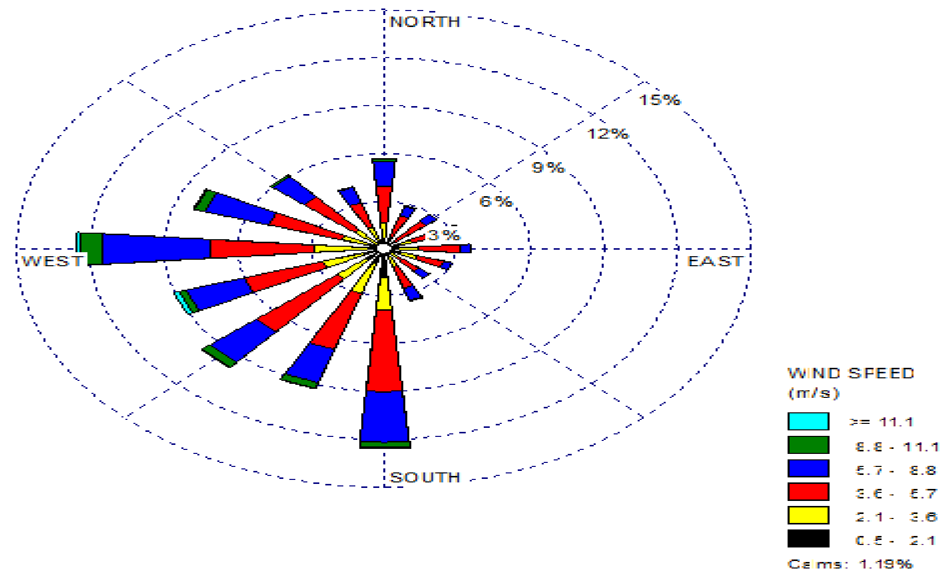


Fig. 4.1: Average Wind Speed in Abuja for the period 1995 - 2015



The wind pattern follows the migratory ITD. According to the statistics available for the last ten years the prevalent wind directions is South-westerly. Often the South-westerlies dominate the wetter period of the year in the area.

Fig. 4.2: Monthly prevailing wind direction in the study area (Abuja, 2015)

4.4.1.1 Sampling Routes

- **Route 1: South-South**
- **Route 2: Southeast**
- **Route 3: Southwest**
- **North Central**

4.4.1.2 Settlements Along Route 1

- **Ambient Air Quality**

The concentration of air pollutants was measured in the project area. The parameters measured include Nitrogen Oxides (NO_X) Sulphur Oxide (SO_X) Carbon II Oxide (CO) Ammonia (NH_3) Volatile Organic Carbon (VOC) Suspended Particulate matter (SPM).

The ambient air quality of the study area for dry season and wet season were shown in table 4.8. The baseline characteristies of the project area were determined as follows: -

- **Climate /Meteorology**

The meteorological data of the project area for wet and dry season was obtained from Nigerian Meteorological Agency. The data obtained covered the following parameters: - Temperature and Evaporation, Relative Humidity, Thunderstorm, Rainfall, Wind Speed and Direction. To complement the data, maximum /minimum thermometer was used to monitor temperature at different locations of the project area.

- **Soil and Topography**

Soil samples were collected from the project area for both seasons. A total of twelve soil samples that includes sub (50cm' or more) and surface soil (0-15cm) were collected from project location and the control. Dutch auger of uniform cross section was used to ensure that uncontaminated and reproducible unit of soil samples were collected. Surface liters of undecomposed plant materials were removed to ensure that contaminated soil samples were collected. Soil samples were collected in appropriately labeled and selected polythene bags in accordance with Standard Procedures of ASTM (Anon, 1994), FMENV (1991) and APRS (1975), and kept away in a large bag in the field vehicle. Samples for physical analysis were dried in a dust free environment. Two core samples were collected for permeability. A topographical survey and landscape of the project area was used to determine drainage patterns and flood control of the area. History of flood and sediment transport of the area and physical observation were used. The soil types in the area were ascertained from maps from the Survey Department, Abuja. Sample equipment used included a 90mm diameter Dutch auger, cutlass (clearing of bush), polythene bags and hand trowel.

- **Geology/Hydrogeology**

The stratigraphy/lithology of the subsurface soil was carried out by systematic geologic mapping of the area. Soil samples were collected and permeability test carried out to determine the soil profile and drainage pattern. The regional and local geology were ascertained from literature review, in particular Alien (1965), Bain (1924), Agboola (1979), Vine (1956) and maps obtained from Federal Surveys Department, on the geology and landforms in Nigeria. Boreholes (located within the project area) were used to determine the underground water quality.

Surface Water

The several rivers were encountered that drains the project area and was studied for the raining season. Two water samples were collected from the upstream and downstream of the river during the season. Also, the flow rates were determined by the use of pinball and stopwatch. Cecchi disc was lowered into the bottom level of the stream to detuning the transparency and depth for the season.

Water samples were collected with 1 liter glass sample bottles to check for physicochemical parameters and 1 liter plastic containers to check for heavy metals. Important use of the river such as domestic, economical, recreational, agricultural and fishes were determined by physical observation. Water samples for microbiology analysis were separated from the pool by transferring 5-l0g or 10mI portion into sterile McCartney bottles.

Water samples were preserved in the ice-packed containers (coolers) in the field and latter transported to the laboratory and refrigerated at 4°C, for trace (heavy) metal analysis. Samples were acidified with 1 liter of concentrated HNO_3 for preservation and to inhibit precipitation of metal ions.

- **Terrestrial Fauna Invertebrate Fauna**

Quadrant sampling was used, at a sampling location and a study area of 5m by 5m ($25m^2$) quadrant was measured out (lvlaxweil, 1971; Slingby and Cook, 1989; Southwood, 1992) and the fauna within the quadrant were identified on sighting, enumerated and recorded directly into a previously prepared table. Insect and spiders were captured with a sweep net or by hand picking. The trails, faeces and burrows of animals and cast of earthworm were also used to indicate the presence and probable numbers of specific animals and species.

• Vegetation

Separate samples quadrants (2m by 2m for herbs and shrubs and lm x lm for grasses) were measured in the sampling locations, which were randomly selected taking into account plant species diversity or rarity, density and dominance. Homogenous habitats were identified and sampled. Belt transects were laid as outlined by Sutherland (1977). In each quadrant, plant species were identified, woody species were enumerated and the vegetation structure observed. Species identification and nomenclature followed the Flora of West Tropical Africa (Hutchinson and Dalziel, 1952- 1974), an outline of Nigerian vegetation (Keay, 1959) established for each vegetation type in the project area using the data from the samples plots.

• Air Quality

The ambient air quality of the project area for wet and dry season was determined by sampling in-situ at nine different locations, the following parameters N02, 502, Ff28, GO, 11CM, and Suspended Particulate Matter (8PM). The 5PM was measured using a digital Dust Indicator Model P-SL2, while 1402, 502, H2S, CO and HCN were measured using N03 meter, 502- meter, CO-meter and NH3 meter respectively. Samplings were done at 2-hour interval at each sample point for eight (8) hours. The equipment used for air sampling is given in table 4.6.

Table 4.6 Air Quality Measurement Equipment

Parameter	Equipment	Model
$N0_2$	$N0_2$-Meter	Toxi RAE Single Gas Monitor ($N0_2$)
$S0_2$	$S0_2$-Meter	Toxi RAE Single Gas Monitor (SO_2)
CO	CO-Meter	Toxi RAE Single Gas Monitor (CO)
NH_3	NH_3-Meter	Toxi RAE Single Gas Monitor (NH_3)
HCN	HCN-Meter	Toxi RAE Single Gas Monitor (HCN)
Noise	Noise-Meter	Rion Sound Level meter NA model
SPM	Dust Monitor	PDR-1000 personal dust meter
H_2S	H_2S-Meter	Toxi RAE Single Gas Monitor (H_2S)

• Sound Level

The baseline sound level of the area was measured using Rion Sound pressure level (decibel) meter, NA model.

The measurement was carried out at nine (9) different locations at Two (2) hours intervals for eight hours for each sample point.

- **Waste Management Data**

The waste inventory data, sources and disposal routes of waste generated from within and around the area were carried out.

Public Health

Interview with health clinic officials and records from (General hospital along the Sampling route were used to determine the health status and disease inventory of the area.

- **Socio-Economics**

Socio-econornic studies were conducted within host communities identified in the project area. The socio-economic studies in the survey area were based largely on extensive literature materials and some field work. Secondary data were collected from available sources while primary information was collected from the community using structured questionnaires and informal interviews.

The socio-economic data gathering for the host community cover the following:

a. Socio-cultural: Cultural and/or religious issues, customs

b. Population: Population distribution

c. Socio-Economic

- **Means of livelihood, economics:** the people are predominantly farmers, Christian and Islam. They have an Emir as their Traditional head with other support traditional rulers in council.

4.5. SOIL QUALITY

Most soils under irrigation in the tropical regions of the world often develop common problems of Salinization and/or alkalization, water logging, soil erosion, nutrient losses and nutrient imbalance if not properly managed. Table 4.14 shows soils related side effects of land in the project area. Most irrigated soils have developed moderate salinity, experience a rise in groundwater level, suffered erosion owing to intensive cultivation and un-lining of the canals, or have experienced a combination of these impacts.

Table 4.7: Salinity (EC) and Alkalinity (Exhangeable Na) Investigations in Soils of Along Sampling Routes (Wet Season).

Soil Location	Depth (cm)	Soil Properties						
		PH		EC	EXCHANGEABLE Cations (Meg/100g			
		1:2 C_aCl_2	Suspensions H_2O	(mmhos/cm)	Na	K	Mg	Ca
Sample 1	0-20	7.0	7.7	170	0.40	2.42	10.5	25.6
Sample 2	0-20	7.1	7.7	190	9.27	9.41	11.2	25.6
Sample 3	0-20	5.5	6.4	90	0.14	0.29	3.5	8.5
Sample 4	0-20	5.4	6.1	40	0.19	0.55	1.2	3.6

Analysis of the data collected shows that in some years to come irrigated soils in the project area may not be subjected to salinity and alkalinity as indicated by the low exchangeable sodium (Na^2). In general, the soil in the project areas can be described as unsaline, based on their content presently.

Table 4.8: Soil Texture along the Transmission Corridor

Sampling Route 1

Appearance	Light Brown	-
Soil Type (USDA)	Sandy	-
pH (15.6^{0}C)	4.2	6-9
Sand	640	-
Silt	200	-
Clay	160	-

Location 2

Appearance	Light Brown	-
Soil Type (USDA)	Sandy	-
pH (15.6^{0}C)	4.2	6-9
Sand	640	-
Silt	200	-

Clay	160	-
Location 3		
Appearance	**Light Brown**	**-**
Soil Type (USDA)	Sandy	-
pH (15.6^{0}C)	4.2	6-9
Sand	640	-
Silt	200	-
Clay	160	-
Location 4		
Appearance	**Light Brown**	**-**
Soil Type (USDA)	Sandy	-
pH (15.6^{0}C)	4.2	6-9
Sand	640	-
Silt	200	-
Clay	160	-

4.5.1. Describing Existing Soil Condition

Physico-chemical characteristics of the soil (pH, moisture content, Total Organic Content (TOC), N_2, NO_3, $P0_4$, $S0_4$) were determined as in table 4.2

Metals: - The samples were first digested in a flame cupboard with conc. HCI and heated before determination of the concentration of exchangeable cations (Na, Fe, Ca, and Mg) and heavy metals in an Atomic Absorption Spectrophotometer (AAS), **Particulate Size:** dry sieving and the percentage of sand, silt and clay determined grain size by sediment using a hydrometer.

Permeability was determined using a felling head permeameter in which water is passed through a soil sample and the hydraulic gradient, and quality of water flowing into /through the sample and measured.

Table 4.9: Summary of analytical methods and equipment used in laboratory analysis of water and soil

S/N	PARAMETERS DETERMINED	EQUIPMENT/TECHNIQUE
1	PH	Jenco UC meter 6100
2	Temperature	Jenco UC meter 6100
3	Conductivity, mS/cm	Hanna HI 8733 meter
4	Salinity % or ppt	Salinometer
5	Dissolved Oxygen, mg/l	DO meter, wrinkler's
6	Transparency (m)	Secchi disc
7	Grain size	Granulometry and sedimentation

8	BOD_S mg/l	Hach BOD track
9	NH_4mg/l	Nessler's reagent
10	NO_3mg/l	Phenoldisulphonic acid
11	$P0_4$mg/l	Colorimetry with molybidnium blue solution
12	SO_4mg/l	Turbiodometry and photometry
13	THC mg/l	Capillary GL
14	Aliphatic and Aromatic mg/l	GC-MS
15	TOC%	Graphic furnace and gravity
16	N%	Graphite furnace and gravity
17	TDS mg/l	Gravimetry after drying to constant weight
18	TSS mg/l	Gravimetry after drying to constant weight
19	Heavy Metal mg/l or ppm	AAS, UNICAM 939, after digestion
20	Soil Moisture Content %	Gravimetry after drying to constant weight
21	Soil permeability	Falling heed permeability test
22	Exchangeable cations mg/l	AAS, after digestion

- **Soil Microbial Status**

The microbial population of the soils of the area showed that the total heterotrophic bacteria count ranged from 2.88 x 10^2 to 1.12 x 10^3 cfu/g, the total fungal count ranged from 1.96 x 10^2 to 3.96 x 10^2 cfu/g as presented in Table 4.3. The predominant bacteria species isolated from the soil were Staphylococcus, Micrococcus, Lactobacilus, Bacillus, Flavobacterium pseudomonas, Arthrobacter, Proteus and Escherichia, while the predominant fungal generally were Aspergillus, Fusarium, Mucor, Cladosporium and Penicillium.

Table 4.10: Microbial Counts of Soil Samples of the Study Area

Soil Sample Points	**Microbial counts**		
	Hydrocarbon utilizing bacteria (cfu/g)	**Heterotrophic bacteria (cfu/g)**	**Total Fungi (cfu/g)**
1	1.00×10^2	1.12×10^3	2.32×10^2
2	1.16×10^2	9.80×10^2	2.92×10^2
4	1.76×10^2	7.84×10^2	1.96×10^2
5	8.80×10^1	8.80×10^2	3.92×10^2
8	1.72×10^2	2.88×10^2	1.96×10^2

(a.) WATER QUALITY

In the course of this study, findings have been considered in relation to the current or proposed water quality objectives for designated areas under the United State Federal Protection Agency (USEPA) and The World Health Organization (WHO) standards. In principle, water quality objectives are quantitative or qualitative standards, required to maintain specified beneficial uses allocated to the designated water control zones, and may be applied either as;

a) Maximum permissible concentration or

b) Limit values which should not be exceeded for more than a specified number of sampling occasions or time periods.

Table 4.11: Sampling 1: Chemical Analysis of Surface Water Along Sampling Route (Wet Season)

PARAMETERS	BLOCK I	BLOCK II	BLOCK III	FME LIMIT
Colour (HU)	32	25	30	Colourless
Temperature ^{c}c	28	28	27.5	7
pH	7.2	7.1	7.1	6-9
Turbidity (NTU)	22	18	20	<40
Suspended solids (mg/1)	18	16	23	15
TDS (mg/l)	550	540	830	-
Total Solids (mg/l)	556	564	842	-
Total Hardness (mg/l)	102	100	110	2000
Carbon dioxide (mg/l)	8.9	8.3	7.6	30
Alkalinity (mg/l)	100	80	95	-
Ammoia (mg/l)	0.9	0.8	0.7	
Chloride (mg/l)	30	33	38	250
Sulphate (mg/l)	249	210	241	10
Phosphate (mg/l)	3.8	2.1	3.2	10
Lead (mg/l)	0.0	0.0	0.0	1.0
Calcium (mg/l)	270	250	280	
Magnesium (mg/l)	60	53	59	-
Iron (mg/l)	1.8	1.6	1.30	-
Manganese (mg/l)	0.5	0.5	0.5	-
BOD_s (mg/l)	5	5	5	5
COD (mg/l)	98	110	105	<1.0
Oil & Grease (mg/l)	0.1	0.1	0.2	<1.0

Source: Field Data 2009

Table 4.12: Sampling 2: Chemical Analysis of Surface Water along Sampling Route (Wet Season)

	Block I		Block II		Block III		
Parameters	**Makurdi**	**Eket**	**Onitsha**	**Ugbokolo**	**Owerri**	**Control**	**FME LIMIT**
Colour (TCU)	15	18	16	18	20	25	Colourless
Temperature (^{0}C)	27.0	26	26	26.5	26	26	7
pH	7.6	7.1	7.3	7.0	7.1	7.2	6-9
Turbidity (N.T.U.)	7	5	8.0	6.0	7	9	<40
Suspended solids (mg/1)	20	14	30	18	15	18	15
Total Dissolves Solids (mg/l)	112	79	130	104	89	97	-
Total Solid (mg/l)	132.0	93.0	160.0	122	104	115	-
Total hardness as CaCoa (mg/l)	106	102	98	126	105	111	2000
Alkalinity as CaCoa (mg/l)	135	140	136	129	132	139	30
Ammoia (NHa) (mg/l)	N.D	N.D	N.D	N.D	N.D	N.D	-
Chloride (CI*) (mg/l)	32	31	28	30	45	38	
Sulphate (SO*^{2}") (mg/l)	105	127	239	210	218	125	250
Phosphate (PO_4^{3}") (mg/l)	N.D	N.D	N.D	N.D	N.D	N.D	10
Lead (Pb) (mg/l)	N.D	N.D	N.D	N.D	N.D	N.D	10
Calcium (Ca) (mg/l)	48.0	67.9	52.1	40.3	55	60	1.0
Magnesium (Mg) (mg/l)	38.0	32.8	45.9	26.1	25	29	-
Iron (Fe) (mg/l)	0.09	0.16	N.D	N.D	N.D	N.D	20
Manganese (Mn) (mg/l)	N.D	N.D	N.D	N.D	N.D	N.D	<1.0

Source: Field Data **N/B:** N.D = Not Detected

Table 4.13: Sample 3: Chemical Analysis of Ground Water Along Sampling Route (Wet Season)

	Block I		Block II		Block III		
Parameters	**Makurdi**	**Eket**	**Onitsha**	**Ugbokolo**	**Owerri**	**Control**	**FME LIMIT**
Colour (TCU)	20	22	16	18	22	21	Colourless
Temperature (^{0}C)	28	28	28	28.5	28	27.5	7
pH	7.1	7.2	7.2	7.0	7.3	7.1	6-9
Turbidity (N.T.U.)	6	7	9	6	5	8	<40
Suspended solids (mg/1)	18	12	25	20	18	20	15
Total Dissolves Solids (mg/l)	120	90	122	94	90	100	-
Total Solid (mg/l)	138	102	145	114	108	120	-
Total hardness as CaCoa (mg/l)	110	90	92	103	109	100	2000
Alkalinity as CaCoa (mg/l)	132	138	132	130	134	140	30
Ammoia (NHa) (mg/l)	N.D	N.D	N.D	N.D	N.D	N.D	-
Chloride (CI*) (mg/l)	30	29	25	32	41	40	
Sulphate (SO*^{2}") (mg/l)	110	114	219	215	231	122	250
Phosphate (PO_4^{3}") (mg/l)	3.2	3.1	2.2	10	3.1	2.2	10
Lead (Pb) (mg/l)	N.D	N.D	N.D	N.D	N.D	N.D	10
Calcium (Ca) (mg/l)	35	69	52	51	45	39	1.0
Magnesium (Mg) (mg/l)	30	28	36	23	18	21	
Iron (Fe) (mg/l)	0.1	0.13	N.D	N.D	N.D	N.D	-
Manganese (Mn) (mg/l)	N.D	N.D	N.D	N.D	N.D	N.D	-

Source: Field Data**N/B:** N.D = Not Detected

4.5.2. Physical Characteristics Ground Water.

In interpreting the results presented, it is emphasized that a spot survey as carried out provides relative values for comparative purposes. The following observations are made on key parameters: -

a) (i) Colour

In the wet season, the river water from all the blocks are essentially cloudy brown in colour due to the presence of large quantity of tine particle in suspension dislodged and washed into the river by sheet erosion as the sampling period coincided with the peak of the wet season. The colour ranges from 25 to 32 TCU for all the blocks, which is above the 15 TCU recommended by WHO and USEPA, above which most people can detect it in a glass of water. The colour ranges from 25 to 32 ECU. The groundwater samples on the other hand are slightly cloudy but clearer than the river water in both the wet season though- the values are still above the WHO and USEPA recommended maximum permissible levels of 15 TCU.

(ii) Temperature

All physical, biological and chemical processes in any aquatic environment are temperature dependent. Increasing water temperature is known to decrease the solubility of oxygen in water and this increases the oxygen demand for aquatic life. Conversely, higher temperature will increase the solubility of many chemical compounds and will especially influence the effect of pollutants on aquatic life. Results from Tables 4.12 and 4.13 show no appreciable variations in the surface water temperatures along the study blocks.

(iii) pH Value

The pH value, or log of the reciprocal of the hydrogen ion, is a measurement of the acidity of water. The pH values of most natural waters are in the range of 4 to 9, with the neutral point being 7.0. At p1-I values less than 7.0, the water has acidic characteristics and values higher than 7.0, the water will have basic characteristics. In the project area, the values for the surface water for both wet The pH values of the waters within the project area lie well within the permissible values by W.H.O., USEPA and UK regulations.

(iv) Solids

Tables 4.9 and 4.10 show the results for Suspended Solids, Total Dissolved Solids (TDS) and Total Solids in the surface water study blocks. The three parameters are measures of turbidity and general polluting potentials in water. They are indices of amount of settle-able and dissolved substances and their presence alters both the physical and chemical properties of water.

The surface water results for wet season presented show moderately high and uniform values of suspended solids, SS and TDS, total solids in the blocks, which can be associated with the terrain of the catchment area. The values are above the WHO and USEPA maximum permissible levels. The values of these parameters are generally within the acceptable limits of WHO and USEPA.

The solid content of ground water within the study area is generally low and uniform during the wet and dry season though the latter shows slightly lower values. Generally, TDS concentrations of 500mg/i or less has been designated as objective level for drinking water provided none of the individual dissolved constituents exceed their particular prescribed values by USEPA. A high concentration of TDS limits the suitability of river as a drinking source as more expensive treatment method would be required. TDS concentrations of not more than 1000mg/I are generally recommended by W.H.O and could also be acceptable for industrial uses.

b) Chemical Properties

i) Organic Pollution

The organic matter found in water can come from a variety of sources such as plant and animal life, partially treated domestic wastes and industrial effluents and the level of organic pollution in the blocks was estimated in terms of Chemical Oxygen Demand (COD). COD test gives an indication of the oxygen required to degrade chemically any organic matter in water as well as the oxygen needed to oxidize inorganic materials, The BOD5 and COD values obtained during the wet season study (Tables 4.9 and 4.10) 'indicates high level of organic pollution of the rivers at 5mg/l for BOD5 while COD values are from 5 mg/l to 5 mg/l in all the study blocks as compared to USEPA's recommended level allowed for' discharge of wastes from various industries into inland water depending on the source of pollution as 40 to 80mg/I for COD with the minimum level expected in fresh water for COD as 10mg/l. Similarly, the BOD5 and COD values obtained during the dry season study (Tables 4.10 and 4.11) indicates high level of organic pollution of the rivers ranging from about 32ing/l to 35 mg/l for BOlD5 while COD values are from 98 mg/l to 110 mg/l in all the study blocks.

The present level of inorganic pollution is attributed to a number of factors along the river course as follows:

a) Pollution essentially due to activities of settlers (like washing) along the river course.
b) Dumping of waste into the river by these settlers and
c) Pollution due to cattle rearing activities along the river course.

ii) Inorganic Pollution

The results of the wet chemistry are presented in Tables 4.9, 4.10, 4.11.

iii) Total Hardness

Water samples from all the study blocks show that values of total hardness during the wet season ranges from 105mg/l to 125mg/I and the water can be classified as slightly hard water, total hardness values ranges from 102mg/l to 110mg/l. The WHO desirable level of 100mg/l is recommended for domestic water use. Total Hardness values in the ground water around the project site for all the seasons range from 90mg/l 126mg/l, being similar to the hardness of the river water.

iv) Nitrogen

Ammonia compounds are found in most natural water originating from various sources with the most important being decomposing plant and animal matter. Results of wet season study in all the blocks show high level of ammonia concentrations ranging -from 1,8mg/l to 2lmg/l. This is as a result of agrochemicals and animal droppings washed into the river during the rainy season. In natural water, it is usually less than 0.1mg/l, levels greater than 0.1 mg/I are indicative of anthropogenic inputs. The WHO set standard for ammonia -nitrogen in drinking water is 1.5mg/I for avoidance of taste and odour while the UK Regulations gives a value of 0.5mg/l. Ammonia compounds were not detected in ground water of the region.

vii) Sulphate

Sulphate in natural waterscome from several sources such as the dissolution of Gypsum and other mineral deposits containing sulphate, from sea water intrusion, from oxidation of sulphate in well aerated water and from industrial effluents where sulphate and sulphuric acids have been used. in the project area, the sulphate concentrations are generally high in the surface waters of all the study blocks in the wet season with values between 31g/l and 46 mg/l .Which is just at the upper permissible limits by WHO, UK Regulations and USEPA with maximum permissible limits of 250mg/l. So also, the sulphate concentrations in the groundwater during wet is 105mg/l is within the permissible maximum limits.

vii) Iron

Iron in water is not harmful but undesirable and occurs mostly in waters through contact with iron minerals and materials containing iron. A large quantity of iron in water impacts taste to water, discolour clothes and plumbing fixtures and causes scaling. Concentration of iron in the surface waters during the wet season are high in all the study blocks with values ranging from 2.lmg/l to 2.2mg/l. Iron concentration in the groundwater of study block I are low with values within the acceptable limits while contamination was not detected in the other study blocks.

ix) Alkalinity

The alkalinity of water principally comprises the sum of the bicarbonates, carbonates and hydroxides of calcium, magnesium, sodium and potassium. If the alkalinity is less than total hardness, the excess hardness is due to permanent hardness. The alkalinity of the surface water in all the study blocks ranges-from 90mg/l to 110mg/l for both the wet season. The alkalinity values are generally lower than the total hardness, with the excess hardness due probably to permanent hardness. There is no maximum value for alkalinity but the UK Regulation has set a minimum alkalinity requirement of 30mg/I as bicarbonate (24.6mg/I $CaCO_3$) when water is softened. Such reduction shall be sought when the water is being treated for drinking. The groundwater value for all the blocks ranges from 129mg/I to 140mg/I, which is slightly higher than the surface water values and the total hardness, with the excess alkalinity being probably due to the presence of sodium bicarbonate, which does not affect hardness.

x) Chloride

Chloride is one of the most stable components in water, being unaffected by most physiochemical or biological processes. Chlorides are derived from natural mineral deposits;

seawater intrusion or airborne sea-spray; agricultural or irrational discharges; urban runoff due to the use of de-icing salts; or from sewage and industrial effluents. Excess chlorides enhance corrosion and taste. The chloride concentrations in the surface waters during the wet season are high, ranging from 31mg/l to 32mg/l, is above the maximum recommended concentration of 250mg/l on taste grounds. In groundwater, the chloride concentrations are lower than those observed in the surface waters, ranging from 25mg/l to 45mg/l, which is still below the maximum permissible levels.

xi) Carbon dioxide

Free carbon dioxide in water (as distinct from that existing as carbonate and bicarbonate) depends on the alkalinity and the pH of a water to determine corrosiveness. Free carbon dioxide in the surface waters in all the blocks ranges from 7.6mg/l to .9 mg/l which is considered high especially for water that is to be used for hydropower.

xii) Lead

Lead is a cumulative poison and the environmental hazard it causes is enormous. Lead was not detected in the surface and groundwater of the project area.

xiii) Grease and Oils

These are derived from hydrocarbons like petroleum products that are spilled and washed into rivers and infiltrate into the ground. Grease and oils were not detected in the surface and groundwater of the project area. The results of physical and chemical analysis are indicative of degrading water quality especially when the period of study falls within the wet season. The constituents of both the surface and ground water are mainly the resultant effect of nature in the ecosystem through weathering, mineralization and erosion with the effect of man compounding the situation. The effects of temperature and pH are within the acceptable levels for natural waters.

It is observed that the concentrations of inorganic constituents of the surface waters which are higher than the maximum permissible levels are derived mainly from mineralization from the rocks and sediments along the river course. Concentration of manganese, sulphate, iron, chloride and magnesium are higher than the tolerable limits. Lead and copper, which in most cases, are as a result of man's activities, were not detected in the waters.

The corrosive quality of water depends on many factors concerning the water itself and the materials it comes in contact with. Nevertheless, three special characteristics that can lead to expectation of corrosiveness are: a low pH value i.e. acidity; high free carbon dioxide content; and an absence or low amount of alkalinity. From the observation of water quality of the study area, which indicates that reservoir, the pH and alkalinity values are high hence the water satisfies only one major characteristic for corrosiveness which can be taken care of by aeration. At present, the general quality of water is poor and does not comply either with WHO or USEPA requirements for portable water supply without adequate treatment but is suitable for' irrigation and hydropower as long as proper coating and protective measures are done.

4.6 HYDROLOGY AND HYDRO GEOLOGY

Geology and Relief: The southern landscape of the state forms part of the low plains of the Benue origin. Other parts of the state are composed of undulating lowlands and a network of hills developed on granites, migmatites, pegmatites and gneisses. Around the salt mining village of Awe are a number of worn volcanic cones.

Most parts of the state that lies within the Benue (valleys are composed of sandstones. However,) around the salt bearing districts of Awe, Keana and Akiri, are detached synclinal areas formed by localized folding. The brine springs of Awa, Azara and Bomanda are associated with anticline axes along which salt bearing beds within the synclines) approach the surface.

The high land areas of the state are found towards the north, notably in Wamba, Nasarawa Eggon and Akwanga Local government Areas. The Eggon rolling hills for example, rise to an average; height of about 1,200m. The Maloney Hill in Keffi is of historical significance.

The state is drained by numerous fast flowing streams/rivers that take their source from the Jos Plateau and flow into the River Benue which also marks the state's southern boundary. Prominent among these are the Mada, Dep, Ayini, and Farin Ruwa rivers.

The Geology of the area is made of the tertiary basalt of the Biu plateau on the north, sedimentary sequence of Bryel and Zange grabens on the northwest and south-east, respectively. The area is underlain by the crystalline basement of north-eastern Nigeria. The relief of the town ranges between 650m in the western part to 370m in the eastern parts.

The study area ranges from south to the north and has flat landscape in the northern and southern parts of the state have isolated hills. While the elevation of the plain is at about 600m above sea level, the hills reach between 700m and 800m. There are many rivers whose drainage system, running approximately north-south towards the Benue River Basin, but with principal tributaries draining from west to east.

4.6.1- Groundwater

Groundwater in the study area occurs in the long and narrow bodies of alluvial aquifer locally forming the banks of the river, cretaceous sediments and weathered basement complex in the project area. The alluvial aquifers and weathered porous zones are recharged by direct percolation of rainfall and wet season river flow, as well as percolation from adjacent hydraulically continuous aquifers and overland surface flows. Yields from groundwater sources vary characteristically from 10 to $14m^3$/hr in the shale and limestone zones to 15 to $40m^3$/hr for alluvial aquifers depending on the formation from the point of view of recharge and on permeability limitation of the aquifer material. The weathered basement sections show low yields ranging from 1.0 m^3/hrto $4m^3$Ihr.

Measurements of water levels in open wells during the wet season show that the water table in settlements close to the reservoir is between 7,8 and 12.8m due to recharge from the reservoir bed while the upland areas in the upstream portion are between 14.5 and 18.7m during this period.

4.7. FISHERIES

The data on the fisheries from the project area obtain from directly from the fishermen catch and interactions with people living along the river bank communities. Most of the fish species were identified at the landing sites using standard guides but the ones that could not be identified immediately were had samples taken for further identification. Secondary information was also obtained from existing literatures.

Fishing activities are pronounced within project area. Fishing is done on a full time basis by small scale and migrant fishermen especially within the project area as well as upstream and downstream of the reservoir. Fishing gears employed by the fisher folks include gillnet different types of traps, hook and lines, long lines, lift net, and cast nets. All the crafts were wooden dugout canoes that are operated by one or two individuals.

A total of 27 species of fish belonging to 16 families were encountered from the project area (Table 4.12). Most of the fishermen operate between 4 to 6 hours per day, either at a stretch or in two phases of early mornings and evenings. All the 27 species encountered are considered to be of commercial importance. A total of 602 species were encountered during the studies and their percentage Composition and abundance of each family and species. These are given in tables 4.13 and 4.12

Though the project area is relatively rich in fish both in biomass and abundance of fish resources, there were however signs of overfishing as most of the fish caught by the fishermen in were mostly under aged Juveniles with only few that have attained maturity. The reason was visibly seen as the small mesh sizes of about 1.25cm to 3cm that are mostly used by the fisher folks. Other implicated causes are high fishing pressure and obnoxious fishing methods.

The fishes observed are highly mobile riverine fishes that move long distances up and down the river respond to seasonal floods by making lateral movements out over the flooded plain and into the pools, running to the main river channels as the flood subsides. The sudden increase in nutrients as a result of both organic and inorganic fertilizers being washed down by rain into ponds, rivers and storage reservoirs generates excessive growth of phytoplancton on which fishes feed. Fishes move up river, disperse on flood plains reproduce rapidly. The offspring feed and grow very fast and tend to move back to the river during the peak of the dry season which results to intensive fishing by fishermen. Large amount of fish as also trapped in marshes as the water recedes. These give the bountiful harvests experienced during the onset of dry season.

Table 4.14 Fishes found along the Route of the project

Family	Species	Common Name	Local Name
Mormyridae	*Marcusenius abadii*	Elephant Fish	Miligi
	Mormyrus haselquisti	Elephant Snout	Miligi
	Mormyrus rume	Bottle Nose	Miligi
	Hyperopisus bebe	Ngai	Kuma
Cichlidae	*Tilapia zilli*	Red Belly Tilapia	Gargaza
	Oreochromis niloticus	Nle Tilapia	Gargaza
	Oreohromis aureus	Blue Tilapia	Gargaza

	Sarotherodon galilaeus	Mango Tilapia	Gargaza
Claroteidae	*Clarotes laticeps*	Wide Head Fish	Maigo
	Auchenoglanis occidentalis	Bubu	Buro
Alestidae	*Brycinus nurse*	Nurse Tetra	Kawara
	Hydrocynus brevis	Tiger Fish	Zawai
	Hydrocynus forskhalii	Elongated Tiger Fish	Zawai
Mochokidae	*Synodontis Nigrita*	Squeaker	Kurungu
	Synodontis schall	Wahrindi	Kurungu
Bagridae	*Bagrus bayad*	Bayad	Dinko
	Bagrus docmak	Semuntundu	Dinko
Latidae	*Lates niloticus*	Nile Perch	Giwan Ruwa
Arapaimide	*Heterotis niloticus*	African Bony Tongue	Bali
Citharinidae	*Citharinus citharius*	Moon Fish	Falia
Cyprinidae	*Labeo coubie*	African Carp	Barkin Dumi
Scilbeidae	*Schilbe myustis*	African Butter Fish	Nalanga
Channidae	*Parachana obscura*	Snake Head Fish	Tufi
Clariidae	*Clarias anguillaris*	Mudfish	Tarwada
Gymnarchidae	*Gymnarchus niloticus*	Aba	Dan Sarki
Hepsetidae	*Hepsetus odoe*	Kafue Pike	Zagundumi
Distichontidae	*Ichthyoborus besse*	Grass Eater	Karen Ruwa

Table 4.15 Percentage Composition by Families of Fish

Family	Percentage(%)
Mormyridae	14.8
Cichlidae	14.8
Claroteidae	7.41
Alestidae	11.11
Mochokidse	7.41
Bagridae	7.41
Latidae	3.7
Arapaimide	3.7
Citharinidae	3.7

Cyprinidae	3.7
Schilbeidae	3.7
Channidae	3.7
Clarrdae	3.7
Gymnarchidae	3.7
Hepsetidae	3.7
Distichontidae	3.7

Abundance And Biomass Data For Fish Species Sampled

Family and Species	Abundance	%	Biomass (G)	%	Length Range(cm)
MORMYRIDAE					
Marcusenius abadii	22	18.2	7000	11.9	15 – 28
M. haselquisti	15	9.9	8000	13.6	18 – 30
Mormyrus rume	32	26.4	3500	59.3	30 – 51
Hyperopisus bebe	22	18.2	1100	18.7	15 – 30
CICHLIDAE					
Tilapia zilli	77	41.8	2310	31.3	7 – 13
O. niloticus	52	28.3	1970	26.7	9 – 15
S. galilaeus	35	19	2100	28.4	9 – 16
Oreochromis aureus	20	10.8	1000	13.6	6 – 12
CLAROTEIDAE					
Clarotes laticeps	40	55.6	35000	59.3	30 – 50
A. occidentalis	32	44.4	24000	40.7	15 – 22
ALESTIDAE					
Brycinus nurse	33	50.0	9000	20	12 – 18
Hydrocynus brevis	14	21.2	19000	42.2	32 – 50
H. forskhalii	19	28.8	17000	37.8	30 – 50
MOCHOKIDAE					
Synodontis nigrita	19	52.8	6000	52.2	8 – 14
S. schall	17	47.2	55000	47.8	9 – 12
BAGRIDAE					
Bagrus bayad	15	41.7	1000	31.2	17 – 30
B. docmak	21	58.3	2200	68.8	22 – 52
LATIDAE					
Latis niloticus	2	100	50000	100	55 and 70
ARAPAIMIDAE					
Heterotis niloticus	1	100	7000	100	42
CITHARINIDAE					
Citharinus citharius	20	100	22500	100	20 – 35
CYPRINIDAE					
Labeo coubie	15	100	14600	100	15 – 33
SCHILBEIDAE					
Schilbe mystus	22	100	3000	100	4 – 8

CHANNIDAE					
Parachanna obscura	15	100	10000	100	25 – 35
CLARIIDAE					
Clarias anguillaris	13	100	10000	100	20 – 52

Table 4.15 cont’d

Family and Species	**Abundance**	**%**	**Biomass (G)**	**%**	**Length Range(cm)**
GYMNARCHIDAE					
G. niloticus	7	100	35000	100	45 – 71
HEPSETIDAE					
Hepsetus Odoe	17	100	9000	100	18 – 32
DISTICHONTIDAE					
Icthyoborus besse	5	100	1000	100	8 - 14

Table 4.16 Ecological indices

Species	No Of Individuals
Marcusenius abadii	22
Mormyrus haselquisti	15
Mormyrus rume	32
Hyperopisus bebe	22
Tilapia zilli	77
Oreochromis niloticus	52
Oreohromis aureus	35
Sarotherodon galilaeus	20
Clarotes laticep	40
Auchenoglanis occidentalis	32
Brycinus nurse	33
Hydrocynus brevis	14
Hydrocynus forskhalii	19
Synodontis nigrita	19
Synodontis schall	17
Bagrus bayad	15
Bagrus docmak	21
Lates niloticus	**2**
Heterotis niloticus	1
Citharinus Citharius	20
Labeo coubie	15
schilbe myustis	22
Parachana obscura	15
Clarias anguillaris	13
Gymnarchus niloticus	7
Hepsetus odoe	17

Ichthyoborus besse	5
Number of species	27
Number of individuals	602
Margalef species richness	4.06
Shannon-Wiener Div. index	9.32
Evenness	2.83

Plate 4.1 : Fishing net (small mesh size)

Plate 4.2: Fingerling of *Ethmalosa fimbriata* (bonga fish) caught in the net

4.8. VEGETATION

The project area falls within the Sudan Vegetation Zone. The Fibre Optic project is forested along the study corridor. The area has a matured forest but not dense. The dense forests are found in the southern states of the south. The corridors in the middle belt state of the country contain short grasses vegetation and scattered trees.

The Rainforest vegetation in the southern states in the south-south, southeast and southwest zones are in the corridor of the study area and the Sudan type, characterized by short grasses and-no tree are found in the middle belt.

Objectives of the Study

This Environmental Impact Assessment was conducted in order to assess and understand the present state of biotic environmental factors (vegetation and wildlife) in relation to other ecosystem characteristics from the view point of the effects of activities to be being undertaken at the site proposed for development of the Fibre Optic project so as to suggest stainable strategies for management of the environment. The study was conducted in consideration of the three key components of the IPAT model – Population, Affluence and Technology (Chertow, 2011).

SAMPLING PROCEDURE

Vegetation

Floristic assessment of the herbaceous and woody flora of the Fibre Optic project and adjoining ecosystems was conducted using Systematic sampling technique. The technique was used to adequately cover sufficient area to adequately represent the entire flora across the landscape. The sample space comprised of a set of four 50 m X 50 m plots carefully laid out at 15 m from the Fibre Optic project upstream, 15 m from the west side of the Fibre Optic project midstream along a tributary, 15 m from the Fibre Optic project downstream, and 15 m from the present town. Herbaceous flora was assessed within each of the plots with 10 quadrats of one square meter dimension laid at 10 m interval along two transects were established at 20 m inter-transect interval from each other. The transects were positioned perpendicular to natural phenomena chosen as baseline, such as the river and the tributary.

Quadrats for each plot were coded Q1-Q10 for the Fibre Optic project site, Q11-Q20 for South of the River, Q21-Q30 for North of the River and Q31-Q40 for the Town plot. Total count of wood flora of each plot was assessed.

A total of forty (40) quadrats comprising 13 for herbaceous and 17 shrubs were used to describe the composition, Relative importance Values (Tables 1 and 2) abundance and diversity of the plant species (Tables 3 and 4), as well as the ecosystem structure of the Fibre Optic project site and environs (Figure 4). One (1) square meter and 10 square meter quadrats were used for the respective categories of plant types. Densities and frequencies of enumerated plants were used to calculate species Relative Importance Values [RIV] and other diversity indices following Kent and Coker, 1992). All species were identified following Akobundu and Agyakwa (1987), and Hutchinson and Dalziel, (1968). Scientific and Family names of plant species were provided. Density values were subjected to diversity analyses using PAST Software (Hammer *et al.*, 2001). Diversity indices determined included Dominance, Shannon-Weiner index, Equitability index, Evenness index and Simpson index. All species density and frequency data were subjected to detrended correspondence (DCA) analyses using DECORANA Software (Hill, 1994).

Table 4.17: Baseline coordinates for plots used for floristic assessment of Fibre Optic project, Nigeria in 2015.

S/N	Plot Description	Quadrat Code	Baseline coordinates (hddd^{0}mm.mmm')	Altitude ASL(m)
1	Upstream	Q1-Q10	9° 3'52.37"N , 7°29'37.53"E	273
2	Midstream	Q11-Q20	6° 8'5.12"N, 6°47'38.93"E	272
3	Downstream	Q21-Q30	4°38'39.06"N, 7°55'40.57"E	237
4	project area	Q31-Q40	6°47'28.94"N, 3°56'38.72"E	244

Species Composition and Flora Diversity of the Fibre Optic project

The study site is composed of thirteen (13) herbaceous plant species which were distributed in nine families (Table 1). These families include Poaceae (4 species), Cyperaceae (2 species), Asteraceae (1 species), Areceae (1 species), Zingiberaceae (1 species), Fabaceae (2 species), Nymphaeaceae (1 species) and Onagraceae (1 species). The woody flora are mainly shrubs and are seventeen (17) species in fourteen (14) families, including Combretaceae (2), Caesalpinaceae (3), Loganiacea (1), Papilonaceae (1), Fabaceae (2), Celastraceae (1), Saponaceae (2), Mimosaceae (1), Solanaceae (1) and Tiliaceae (1). Several individual members of the species occurred, amounting to 205 herbaceous flora and 63 shrubs (Tables 2 and 3).

The most relatively important herbaceous plant species at the site was *Mariscus alternifolius* with a RIV of 17.15. It was followed in order of relative importance by *Mariscus flabelliformis* (RIV = 15.27), *Oryza sativa* (15.23) and *Pennisetum polystachion* (11.43). Millet was intermediately relatively important (6.21). Generally, the site contained a high number of grasses (Poaceae) and sedges (Cyperaceae), especially in grassland and hydromorphic areas respectively. Some ruderals such as *Melanthera scandens and Calopogonum mucunoides* occupied highly disturbed and waste places. Also important was the presence of some plant species of wet importance. These species included the water lily, *Nymphaea lotus* and *Pistia stratiotes* (Table 2).

Woody species of highest relative importance values in the dry upland and wooded savanna area comprised of *Annogeissus leicarpa* (RIV = 25.88) and *Strychnos spinosa* (RIV = 10.63); while *Detarium microcarpum* (RIV = 10.63) occupied both the savanna and riparian systems. Also, *Pterocarpus erinaceus* (RIV = 6.94) and *Acacia Senegal* were most abundant in the savanna. *Combretum collinum* mostly occurred in the riparian vegetation, while *Grewia mollis* (riv = 0.75) was rare at the study site (Table 3).

Table 4.18.: Relative importance values (RIV) of herbaceous flora Along the Study route of the project, Nigeria in 2015.

S/N	Species	Family	RIV	Habitat	Vegetation Type
1	*Mariscus alternifolius*	*Cyperaceae*	17.15	Hydromorphic	Fringe
2	*Mariscus flabelliformis*	*Cyperaceae*	15.27	Hydromorphic	Fringe
3	*Oryza sativa*	*Poaceae*	15.23	Hydromorphic	Emergent
4	*Hyparrhenia rufa*	*Poaceae*	11.43	Upland	Fringe
5	*Pennisetum polystachion*	*Poaceae*	7.70	Upland	Fringe

6	*Panicum glaucum*	*Poaceae*	6.21	Upland	Fringe
7	*Pistia stratiotes*	*Areceae*	5.13	Waterlogged	Floating
8	*Aframomum septrum*	*Zingiberaceae*	5.01	Slightly hydromorphic	Emergent
9	*Ludwigia Abbyssinica*	*Onagraceae*	4.96	Hydromorphic	Emergent
10	*Stylosanthes erecta*	*Fabaceae*	4.69	Hydromorphic	Fringe
11	*Nymphae lotus*	*Nymphaeaceae*	3.09	Waterlogged	Submerged
12	*Melanthera scandens*	*Asteraceae*	2.99	Slightly hydromorphic	Fringe
13	*Calopogonum mucunoides*	*Fabaceae*	1.15	Slightly hydromorphic	Fringe

Table 4.19: Relative importance values (RIV) of woody flora Along the Study route of the project in Nigeria, 2015.

1	*Anogessius leiocarpa*	*Combretaceae*	25.88	Upland
2	*Detarium microcarpum*	*Caesalpinaceae*	14.02	Upland/Riparian
3	*Strychnosspinosa*	*Loganiaceae*	10.63	Upland
4	*Pterocarpus erinaceus*	*Papilionaceae*	6.94	Upland
5	*Acacia Senegal*	*Fabaceae*	6.84	Upland
6	*Acacia nilotica*	*Fabaceae*	4.99	Upland
7	*Daniellia oliveri*	*Caesalpiniaceae*	4.37	Upland
8	*Maytenus senegalensis*	*Celastraceae*	4.24	Upland
9	*Prosopis Africana*	*Mimosaceae*	4.24	Upland/Riparian
10	*Annona senegalensis*	*Sapotaceae*	3.94	Upland
11	*Entada Americana*	*Mimosaceae*	3.19	Upland
12	*Crossopteryx febrifuga*	*Rubiaceae*	2.28	Upland/Riparian
13	*Malacantha alnifolia*	*Sapotaceae*	2.05	Upland
14	*Schiwenkia americana*	*Solanaceae*	2.05	Upland/Riparian
15	*Burkea Africana*	*Caesalpinaceae*	1.99	Upland

16	*Combretum collinum*	*Combretaceae*	1.60	Riparian
17	*Grewia mollis*	*Tiliaceae*	0.75	Upland

The diversity analyses (Table 4) of the herbaceous flora indicated that the variability of the vegetation of the site was high (Simpson index =0.8816) and much of the vegetation was random or natural as opposed to having an order imposed through cultivation for instance(Shannon-Weiner index = 2.316), connoting high diversity. No single or a group of species dominated the landscape at the expense of others since Dominance index (0.1184) was low and evenness index (0.7798) high. Within each of the four plots, occurrence of individual species was more or less equal (Equitability = 0.903).

The diversity indices of woody species followed similar trends (Table 5). None of the 123 species exhibited any particular dominance (Dominance = 0.1105, Evenness = 0.8085), very variable in types (Equitability = 0.917) and randomly occurring (Shannon-Weiner = 2.532)

Table 4.20: Diversity indices of herbaceous flora Along the Study route of the project in Nigeria, 2015

S/N	Diversity Index	Value
1	Taxa_S	13
2	Individuals	205
3	Dominance_D	0.1184
4	Simpson_1-D	0.8816
5	Shannon_H	2.316
6	Evenness_e^H/S	0.7798
7	Equitability_J	0.903

Table 4.21: Diversity indices of woody Along the Study route of the project in Nigeria, 2015

S/N	Diversity Index	Value
1	Taxa_S	13

2	Individuals	123
3	Dominance_D	0.1105
4	Simpson_1-D	0.8895
5	Shannon_H	2.352
6	Evenness_e^H/S	0.8085
7	Equitability_J	0.917

Plate 4.3: Pictorial Evidences Showing the Vegetation and Land Use Patterns Along the Fibre Optic Route in Different States

<table>
<tr><td>
Secondary Forest ('Palm Bush') along East-West Road (PH – Eket axis)</td><td>
Rural Land-Use in Rivers State (Note a strip of Plantain Farm along PH – Owerri Road)</td></tr>
<tr><td>
Black Water System of Isiokpo Rivulet (River State)</td><td>
Awomama Rivulet (Owerri –Onitsha Road, Imo State)</td></tr>
</table>

Obosi Rivulet (Owerri - Onitsha Road, Anambra State), Note the Brown Water; indicative of a water shed characterize by erosion and severe run-off processes

Getting Set to Sample River Niger at Asaba, Delta State. Note the Niger Bridge at the Background

Exposed Alluvial Deposits on the Bank of River Niger, Asaba, Delta state

Onitsha Skyline in Sunset Light (Anambra State). Note the River Port and Niger Bridge (Picture taken from Asaba, Delta State)

Description of herbaceous floristic associations relative to habitat characteristics Along the Study route of the project in Nigeria, 2015

Stand ordination analyses of the herbaceous components of study site revealed six floristic groups of varing sizes, physiognomy and potentials in 2013, and by extension, five main habitat types existed in the wet season of 2015 (Figure 4.20). The physiognomy tends to be determined by moisture content and climate. The DCA ordination used to summarize the ecosystem was based on two flora stands, one of which was the strongest (Axis 1), contributing 98.2% to the variability and the other, the weakest (Axis 2), contributing 25.5% to the variability observed. The resulting biplot indicated a stable communities of submerged wetland flora, riparian fringe flora and grass woodlands; while floating vegetation and emergent floodplains vegetation (including cultivated emergents) are relatively less stable. The last small group consisted of anthropogenically maintained isolated (Figure 4.20).

Wildlife Composition in the study area

Few wildlife was sighted, heard and reported present at the study site and its environs. The faunal species in the area included birds many species of birds. There were sixteen (16) species in 12 families (Table 4.20. They include Helmeted Guinea fowl, Double-spurred Francolin, Common Quail and Common Teal, Lizard Buzzard, Marsh Sandpiper, Cattle Egret, Blue-Breasted Kingfisher, African Grey Hornbill, among others.

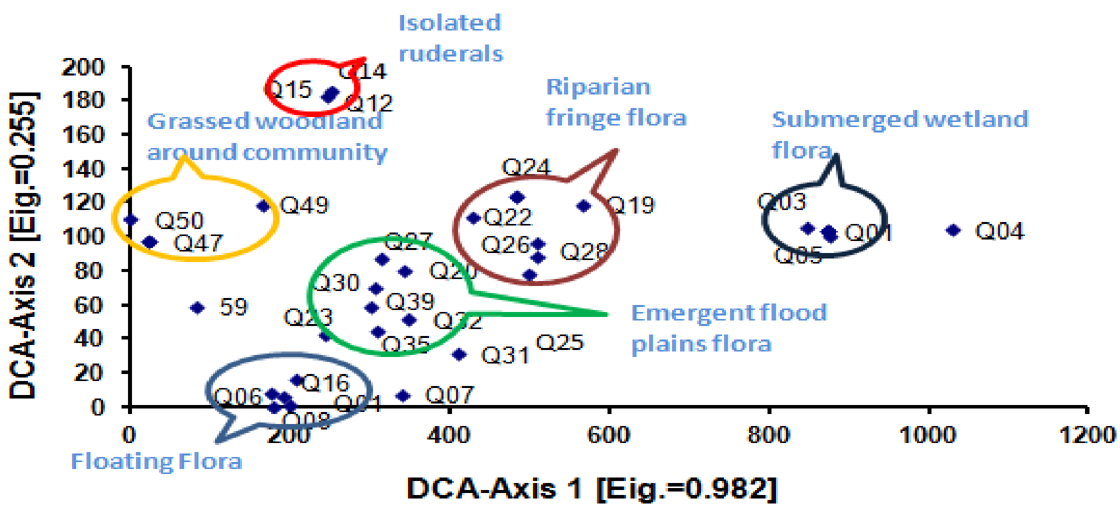


Figure 4.3 Wildlife composition in study area

Table 4.22: Species composition of Along the Study route of the project in Nigeria, 2015

S/N	Wildlife	Scientific name	Family
1	Helmeted Guineafowl	*Numida meleagris*	Numididae
2	Double-spurred Francolin	*Francolinus bicalcaratus*	Phasianidae
3	Common Quail	*Coturnix coturnix*	Phasianidae
4	Common Teal	*Anas crecca*	Anatidae
5	Hottentot Teal	*Anas hottentota*	Anatidae
6	Yellow-billed Stork	*Mycteria ibis*	Ciconiidae
7	Cattle Egret	*Bubulcus ibis*	Ardeidae
8	Great Egret	*Ardea alba*	Ardeidae
9	Darter	*Anhinga melanogaster*	Anhingidae
10	Grey Kestrel	*Falco ardosiaceus*	Falconidae
11	White-headed Vulture	*Trigonoceps occipitalis*	Accipitridae
12	Lizard Buzzard	*Kaupifalco monogrammicus*	Accipitridae
13	Marsh Sandpiper	*Tringa stagnatilis*	Scolopacidae
14	AFibre Optic projectawa Turtle Dove	*Streptopelia hypopyrrha*	Columbidae
15	Blue-breasted Kingfisher	*Halcyon malimbica*	Alcedinidae
16	African Grey Hornbill	*Tockus nasutus*	Bucerotidae

The level, frequency, intensity, nature, duration and dynamics of anthropogenic disturbance on the ecosystem around the study area was such that the the upstream of the route have been impounded in the 29 years of its existence as can be seen in the widening back flow of the Fibre Optic projectmed river, taking farm farmlands and displacing original human settlers in the process. Presently sthe sitaution had some how settled in with appearance of certain species and deposition of alluvium for some productive farming.

Nevertheless, considering the relative youthfulness of the Fibre Optic project and possible adverse impact nit might have on the environment, especially with its proposed development into a hydroelectric power generating Fibre Optic project, the hydrology, pedology and the microclimate of the entire surroundings would be further adeversely affected, unless adequate strategy is put in place and implimented to priotize conservation of vulnerable species of plants and animals, mitigate efects on habitat fragmentation and stream flow.

The Development of fibre optic project and water diversion will impact negatively on the ability of aquatic and associated terrestrial ecosystems to provide goods and services, this is because;

1) There would be flooding as a result of back flow of water in the reservoir especially at the peak of raining season as from around June to September, further displacing humans, animals and eliminating mesophytic and xerophytic plants unaccustomed hydric soil conditions. The effect would be pronounced at both mid-stream and upstream, and can be exacerbated by sustained high water table in the immediate environs.
2) Midstream effect of the Fibre Optic project would cause greater water evaporation and increase in siltation leading to changes in microclimate on one hand and loss of water quality on the other. With increased evaporation, there would be increased salinization and subsequent decline in crop yield in adjoining farms as was the case at the Central Valley of California which was once called the food basket of the world is currently a ghost of its former glory due to increased salt content in the soil which has rendered the soil very unproductive (McNeil, 2000). Increased water evaporation especially mid-stream on the reservoir would lead to hot humid situation, and which some species might not be able to tolerate thereby causing biodiversity instability.
3) As the Fibre Optic project ages, the increased siltation which would cause an increase in salt concentration i.e. Salinization, would cause eutrophication (enrichment of water body) leading toalgal bloom and concurrent reduction of dissolved oxygen in water for use by aquatic life. This would cause biodiversity erosion, might further threaten or eradicate native species in the ecosystem.
4) Spread of water-borne diseases – due to accumulation of water in the ecosystem, water-borne diseases such as schistosomiasis would likely be on the rise. This disease is known to affect the productivity of human population residing around Fibre Optic projects in tropical and sub-tropical environments by causing liver age, urinary tract diseases, nervous and lung.

Large scale loss of vegetation and associated environmental impact: Vegetation serves as platform for production of goods and services for humans other life forms, as well as shelter for many. When it is lost for any reason, especially to Fibre Optic project expansion or development, the source of food and means of survival and shelter for the teeming diversity of life in the ecosystem is negatively affected. These species would either die out from starvation, exposure to predation, epidemics, or poaching or are forced to migrate elsewhere where they usually lack competitive advantage.

Also negatively impacted upon is the ability of the vegetation cover to retrieve CO_2 from the atmosphere, thus leading to the accumulation of CO_2 in the atmosphere in a phenomenon which causes global warming. Currently, the IPCC (inter-governmental Panel on Climate Change) reports that the present atmospheric concentration of CO_2 is 391.76 ppm, and it is significantly and deleteriously higher than the 1990 concentration of 350 ppm (350.org, IPCC, 2007). Associated environmental challenges might be an increase/decrease in length of growing season (depending on location), diseases and pest outbreaks, new pest problems, food insecurity, drought and flooding.

5) Loss of species and ecosystem downstream: Drought and intermittent flooding would occur downstream leading to biodiversity reduction since many native aquatic and plants species unaccustomed to drought and flood will either die or emigrate from the ecosystem.
6) Loss of breeding sites and shelter for birds and other wildlife in the community following flooding midstream and downstream, and drying of stream and drought downstream if water flow via floodgate was inadequate.

4.8.1. LAND USE.

The land resources available to the farmers are sufficient. From the survey, about 9-10 hectares of land are available to a farmer. In the survey, it was observed that out of this, about 90% is under cultivation while 10% is under-fallow.

Protected area management in the project area is largely a human-oriented process that aims to protect areas of high biodiversity value by resolving conflicts between conservation interests and human activities, The overall objective is to improve the protection of nature by reducing and rationalizing extractive use of natural resources. This is done through a process that emphasizes dialogue between protected area staff and local residents rather than a strict reliance on law enforcement, and includes support for local development activities that are in harmony with conservation objectives.

Land Use Pattern

Land use Pattern along Fibre optic Route

The following descriptions apply to land uses indicated on the route map of the proposed fibre optic cable installation. Land use classifications are organized into the following categories: Residential, Mixed use, Commercial, Institutional, Recreational, Agricultural, Forestry, industrial and Public/Open Space.

***Land-Use* Approach & Method**

Land use was examined from both a historical and regional perspective. Site specific analysis of the proposed landing site and for areas within 20-30 metres on both sides of the road within the right of way was seen as an appropriate extent for the area of interest. Relevant land uses immediately adjacent to the outer limits of the selected buffer was also taken into account. The following were also useful in the investigation:

1. Aerial Photographs,

2. Satellite Imagery of the area dating 2015 (Google Earth), and

3. The use of field surveys to incorporate regional observations and documentation of existing land use, while providing verification of land use patterns depicted on the maps.

An accurate and thorough account of past and current land uses in the study area demanded a multi-faceted approach for collating land use information for the area.

Present Land Use

The upload and download stations for the proposed cable lay are mainly situated within the following areas;

1. Federal Secretariats
2. Former Nitel Office, and
3. Federal Organizations e.g. Standard organization of Nigeria in Lagos

The areas identified above are classified as institutional land use. The detail land use within a 100metre buffer around the Upload and download station which is about 64m2 in area coverage in each location is presented in the table below.

Table 4.23: Showing the Sampling locations Across the Selected States

S/NO	Location	Land use Type Within the Premise	Land use Type (100m Buffer)
1	Abuja	Institutional	Institutional
2	Akwanga	Institutional	Residential
3	Lafia	Institutional	Institutional
4	Makurdi	Institutional	Institutional
5	Ugbokolo	Residential	Forestry
6	Enugu	Institutional	Commercial
7	Enugu	Institutional	Institution
8	Awka	Institutional	Institution
9	Onitsha	Institutional	Commercial
10	Asaba	-	
11	Owerri	-	
12	Portharcourt	-	
13	Eket	-	
14	Uyo	-	
15	Benin	Institutional	Institutional
16	Ore		
17	Ijebu	Commercial	
18	Lagos	Institutional	Institutional

Land Use Description along the Cable Route.

The predominant types of land use common along the route are vegetation /Agricultural, Commercial, Institutional, Residential and Mixed use. The fibre optic cable route within the major cities, towns and villages cut across commercial land use and institutional land use except for rural areas and villages where mixed use of commercial land use and residential land use are noticed. It is a common phenomenon to see commercial land use springing up along major road networks or route.

Outside the settlement areas along the cable route is a long stretch of Vegetation and Agricultural land uses noticeable on both sides of the road. Within the North Central Zone from Abuja – Makurdi, agricultural crops like maize, millet, beans and yam are the major agricultural crop along the route. While the south – south and the south west zone present a secondary forest re-growth, with sparse population of various food crops. Major changes, which had occurred during the wet season sampling included denser thicket and taller canopy stature of the predominant vegetation types, greener colouration of the leaves for both planted crops and wild plants and the submergence of some low growing grasses in the lowland areas along the proposed fibre cable route.

The various agricultural land use practice encountered in the study area include, Crop farming to produce cowpea, groundnuts, maize, sorghum, benni seed and leafy vegetables. Shifting cultivation or land rotation practices are however, generally fairly rudimentary, based almost entirely on traditional slash and burn techniques being enhanced by the annual bush fires. This takes place on the up slopes and middle slopes. Under suitable conditions, flood plains are used for intensive cultivation of rice in the wet season, and in the dry season irrigated leafy vegetables are cultivated.

Potential Land Use Conflicts

Potential land use conflicts are few. They can be grouped as follows:

1. Conflicts with transportation corridor (land and Water)

2. Conflicts with existing telecommunications services (land and sea)

3. Conflicts with owners of landing area

Conflicts with transportation corridor (land and Water)

During the process of cable installation, there will be limited potential conflict with road and water going vessels. During the process of physical site surveying as well as the proposed landing of the cable, all relevant parties will be informed of the dates of installation to ensure no incidences of note occurs.

Conflicts with owners of landing area

No conflict is expected with the owners of the landing site. A lease agreement and memorandum of understanding is in place with the property owners. The cable route is also within the right of way of the road network.

4.9. WILDLIFE

A wildlife and habitat survey of the project area was carried out to investigate the effect of the project on forest and wildlife of the area. Questionnaires were administered to individuals and communities in villages visited. Among the individuals interviewed were farmers who frequently set traps for games, and people that rear livestock at home. The professional hunters were difficult to come by in the area since the people in most of the communities visited are predominantly farmers.

In addition to the use of questionnaires, field observations of wildlife species including mammalian fauna, avifauna species in general, granivorous and rodent pests in particular were carried out in selected representative ecological zones in the project area. The stratified sampling technique was adopted for the observations.

The different species of wildlife as indicated by the inhabitants of the project area are shown in Table 4.24.

Table 4.24: List of Common Wildlife Species in the Project Area

S/N	Common Names	Scientific Names	Family	Remarks
1	Bushbuck	*Tragelaphus scriptus*	*Bovidae*	
2	Patas Monkey	*Erythrocebus patas*	*Cercopithecidae*	Savanna-dwelling monkey, has been found around water bodies
3	African Savanna Hares	*Lepus microtis*	*Leporidae*	
4	Striped Ground Squirrel	*Xerus erythropus*	*Sciuridae*	
5	Warthog	*Phacochoerus africanus*	*Suidae*	Found in savannas of Africa
6	Rabbits			It's more of a domesticated species; you may want to leave it out.
7	African Giant Pouched Rat	*Cricetomys gambianus*	*Nesomydae*	
8	Wild Cat			
9	Maxwell's Duiker	*Philantomba maxwellii*	*Bovidae*	
10	Bush Fowl			Already listed among bird

				names given
11	Grass Cutter	*Thryonomys swinderianus*	*Thryonomyidae*	Found in variable habitats, but close to water, and where grain crops and grasses are abundant
12	Waterbuck	***Kobus ellipsiprymnus***	*Bovidae*	

The marked deforestation of the middle belt area and the siltation and consequent reduced base flow/stream flows have been the chief causes of the migration of certain categories of wildlife in the area. On the other hand, the change to a production system in favour of grains crops has increased the population of avifauna and vertebrate pests like quelea birds, rodents, monkeys and baboons. The clearing of the power-line will further increase the migration of some wildlife.

In summary, there is a high percentage reduction of wildlife in the categories of the ungulates, carnivores, antelopes and reptiles; and a low percentage reduction in rodents, and no reduction in the apes and monkeys population. Among the avifauna, there has been a low reduction in the number of partridge and guinea fowl; whereas there has been a phenomenal increase in the population of water-fowls and quelea birds. Continuing hunting and habitat destruction have significantly reduced the populations of most of these species.

Table 4.25: Ambient Air Quality, Dust and Noise Measurements NORTH CENTRAL ZONE

NICTIB PROJECT AT AKWA-IBOM, ENUGU, ANAMBRA, DELTA, EDO, LAGOS, BENUE, NASARAWA AND ABUJA EIA AUGUST 2015:

Sampling Location	GPS/Elevation	SO_2 ppm	NO_2 ppm	CO_2 ppm	CO ppm	H_2S ppm	VOC ppm	Temp. (^0C)	W/S Knots	RH 75.5	LUX	Noise dB(A)	Dust Ug/m^3
KEFFI NASARAWA STATE	N08^{0}51'21.4" E007^{0}52'16.8" Elev-350m	0.3	0.00	0.3	0.2	0.00	0.00	29.4	1.3	56.8	-0.01	68.9	0.26
AKWANGA NITEL	N08^{0}54'28.0" E008^{0}24'32.1" Elev-442m	0.5	-1.00	0.2	0.1	0.00	0.00	33.2	0.1	47.1	-0.01	57.4	0.23
AKWANGA CONTROL	N08^{0}54'27.8" E008^{0}24'34.5" Elev-444m	0.3	-1.00	0.2	0.2	0.00	0.00	37.5	0.1	47.1	-0.02	57.6	0.23
FED. SECT. LAFIYA NASARAWA STATE	N08^{0}32'13.1" E008^{0}31'44.4" Elev-160m	0.3	-1.00	0.1	0.0	0.00	0.00	37.1	0.7	50.1	-0.01	68.1	0.23
FED. SECT. LAFIYA NASARAWA STATE CONTROL	N08^{0}32'10.9" E008^{0}31'44.1" Elev-162m	0.3	-1.00	0.1	0.1	0.00	0.00	36.8	0.6	50.2	-0.01	68.1	0.23
FED. SEC. MAKURDI BENUE STATE	N07^{0}42'38.3" E008^{0}31'30.8" Elev-106m	0.00	-1.1	0.00	0.00	0.00	0.00	33.5	1.00	64.5	-0.02	31.6	0.20
FED. SEC. MAKURDI CONTROL	N07^{0}42'38.3" E008^{0}31'30.8" Elev-106m	0.00	-1.0	0.01	0.01	0.00	0.00	33.3	1.00	64.3	-0.02	39.6	0.20
UGBOKOLO, BENUE STATE	N09^{0}09'41.4" E008^{0}47'44.3" Elev-199m	0.4	-1.0	0.00	0.00	0.00	0.00	34.4	1.6	65.4	-0.01	61.9	0.21
UGBOKOLO, BENUE STATE CONTROL	N09^{0}09'40.1" E008^{0}47'44.2" Elev-199m	0.3	-1.0	0.02	0.01	0.00	0.00	32.8	1.2	62.6	-0.01	67.2	0.21

Table 4.26: Table of Ambient Air Quality, Dust and Noise Measurements SOUTH EAST ZONE

Sampling Location	GPS/Elevation	SO_2 ppm	NO_2 ppm	CO_2 ppm	CO ppm	H_2S ppm	VOC ppm	Temp. (^0C)	W/S Knots	RH 75.5	LUX	Noise dB(A)	Dust Ug/m^3
ENUGU DATA CENTER COAL MINE SECT.	N06^{0}26'39.8" E007^{0}29'24.2" Elev-222m	0.4	-1.0	0.1	0.00	0.00	0.04	33.6	1.6	58.2	-0.01	56.8	0.23
ENUGU DATA CENTER COAL MINE SECT. CONTROL	N06^{0}26'37.5" E007^{0}29'28.0" Elev-224m	0.5	-1.0	0.3	0.02	0.00	0.00	45.8	1.7	54.3	-0.01	56.8	0.22
ENUGU FED. SECRETARIATE	N06^{0}25'52.6" E007^{0}30'59.2" Elev-224m	0.2	-1.0	0.1	0.00	0.00	0.00	40.1	0.3	77.7	-0.01	70.9	0.21
ENUGU FED. SECRETARIATE	N06^{0}25'53.9" E007^{0}30'57.5" Elev-220m	0.2	-0.0	0.01	0.01	0.00	0.00	40.1	0.6	70.2	-0.01	58.7	0.21
ANAMBA NEW FED. SEC. AWKA	N06^{0}14'12.0" E007^{0}04'54.6" Elev-126m	0.4	-1.00	0.1	0.0	0.00	0.00	29.4	1.5	72.7	-0.01	50.5	0.22
ANAMBA NEW FED. SEC. AWKA CONTROL	N06^{0}14'11.9" E007^{0}04'53.2" Elev-121m	0.3	-1.00	0.2	0.1	0.00	0.00	27.2	1.6	68.2	-0.01	60.3	0.21
ONITSHA NITEL, ANAMBA STATE	N06^{0}08'04.8" E006^{0}47'39.3" Elev-65m	0.5	-1.9	0.8	0.6	0.00	0.00	30.3	2.0	71.8	-0.01	66.4	0.26
ONITSHA NITEL, ANAMBA STATE CONTROL	N06^{0}08'04.1" E006^{0}47'38.8" Elev-67m	0.2	-0.2	0.2	0.3	0.00	0.00	27.0	2.1	69.3	-0.01	76.1	0.28
OWERI	N05^{0}28'28.2" E007^{0}00'28.7" Elev-65m	0.4	-1.0	0.3	0.3	0.00	0.00	32.2	1.5	61.0	-0.01	60.3	0.22
OWERI CONTROL	N05^{0}28'23.8" E007^{0}00'25.8" Elev-65m	0.2	-1.0	0.2	0.2	0.00	0.00	30.3	1.2	62.2	-0.01	65.0	0.22
Sampling Location	**GPS/Elevation**	**SO_2**	**NO_2**	**CO_2**	**CO**	**H_2S**	**VOC**	**Temp.**	**W/S**	**RH**	**LUX**	**Noise**	**Dust**

		ppm	ppm	Ppm	ppm	ppm	ppm	(^{0}C)	Knots	75.5		dB(A)	Ug/m^3

Table 4.27: of Ambient Air Quality, Dust and Noise Measurements SOUTH-SOUTH ZONE

Sampling Location	GPS/Elevation	SO_2 ppm	NO_2 Ppm	CO_2 ppm	CO ppm	H_2S ppm	VOC ppm	Temp. (^{0}C)	W/S Knots	RH 75.5	LUX	Noise dB(A)	Dust Ug/m^3
FED. SECT. BENIN	N06^{0}21'33.3" E005^{0}40'14.4" Elev-99m	0.5	-0.2	0.0	0.0	0.00	0.00	41.0	1.3	69.3	-0.01	75.2	0.23
FED. SECT. BENIN CONTROL	N06^{0}21'31.9" E005^{0}40'15.3" Elev-98m	0.4	-1.0	0.2	0.2	0.00	0.00	41.4	1.5	70.4	-0.01	72.0	0.23
FED. SEC. ASABA	N06^{0}13'08.2" E006^{0}41'20.0" Elev-126m	0.2	-1.0	0.2	0.0	0.00	0.00	32.4	1.2	62.5	-0.01	57.5	0.23
ASABA CONTROL	N06^{0}13'11.8" E006^{0}41'21.3" Elev-126m	0.3	-1.0	0.1	0.0	0.00	0.00	33.0	1.4	60.7	-0.01	58.8	0.23
PORTHARCOURT	N04^{0}49'38.7" E007^{0}00'20.4" Elev-47FT	0.4	-1.0	0.5	0.3	0.00	0.00	32.2	1.3	60.0	-0.01	60.0	0.23
PORTHARCOURT CONTROL	N04^{0}49'39.5" E007^{0}00'18.2" Elev-50FT	0.2	-1.0	0.4	0.4	0.00	0.00	33.3	1.4	56.4	-0.01	55.2	0.24
UYO, AKWA IBOM STATE	N05^{0}01'05.0" E007^{0}53'11.4" Elev-231FT	0.2	-1.0	0.5	0.2	0.00	0.00	32.2	1.1	62.8	-0.01	57.3	0.24
UYO, AKWA IBOM STATE CONTROL	N05^{0}01'08.4" E007^{0}53'11.4" Elev-231FT	0.2	-1.0	0.4	0.2	0.00	0.00	34.0	1.1	57.3	-0.01	50.0	0.20
EKET AKWA IBOM STATE	N04^{0}38'39.1" E007^{0}55'40.6" Elev-87FT	0.2	-1.0	0.3	0.1	0.00	0.00	32.0	1.3	59.2	-0.01	58.0	0.20
EKET AKWA IBOM STATE CONTROL	N04^{0}38'38.2" E007^{0}55'40.6" Elev-88FT	0.2	-1.0	0.1	0.1	0.00	0.00	32.0	1.3	59.1	-0.01	63.3	0.20
Sampling Location	**GPS/Elevation**	**SO_2 ppm**	**NO_2 Ppm**	**CO ppm**	**CO ppm**	**H_2S ppm**	**VOC ppm**	**Temp. (^{0}C)**	**W/S Knots**	**RH 75.5**	**LUX**	**Noise dB(A)**	**Dust Ug/m^3**

Table 4.28: Ambient Air Quality, Dust and Noise Measurements SOUTH WEST ZONE

Sampling Location	GPS/Elevation	SO_2 ppm	NO_2 ppm	CO_2 ppm	CO ppm	H_2S ppm	VOC ppm	Temp. (^0C)	W/S Knots	RH 75.5	LUX	Noise dB(A)	Dust Ug/m^3
FED. SECT. BENIN	N06^{0}21'33.3" E005^{0}40'14.4" Elev-99m	0.5	-0.2	0.0	0.0	0.00	0.00	41.0	1.3	69.3	-0.01	75.2	0.23
FED. SECT. BENIN CONTROL	N06^{0}21'31.9" E005^{0}40'15.3" Elev-98m	0.4	-1.0	0.2	0.2	0.00	0.00	41.4	1.5	70.4	-0.01	72.0	0.23
ORE JUNCTION	N06^{0}45'40.1" E004^{0}54'35.1" Elev-88m	0.4	-1.0	0.2	0.2	0.00	0.00	31.2	2.1	62.8	-0.01	67.5	0.24
ORE JUNCTION CONTROL	N06^{0}45'40.1" E004^{0}54'35.1" Elev-88m	0.4	-1.0	0.9	0.8	0.00	0.00	30.2	2.1	62.8	-0.01	78.0	0.24
IJEBU ODE – AJA OKPE JUNCTION	N06^{0}47'27.1" E003^{0}56'38.9" Elev-65m	0.4	-0.9	0.7	0.5	0.00	0.00	28.5	1.2	54.8	-0.01	57.2	0.20
IJEBU ODE – AJA OKPE JUNCTION CONTROL	N06^{0}47'28.5" E003^{0}56'38.6" Elev-64m	0.5	-1.0	2.10	1.7	0.00	0.00	28.4	1.0	54.7	-0.01	74.7	0.20
LAGOS SON OPERATIONAL OFFICE LEKKI	N06^{0}26'46.5" E003^{0}28'19.7" Elev-8m	0.1	-0.9	1.4	1.0	0.00	0.00	31.5	1.5	72.3	-0.01	54.3	0.19
LAGOS SON OPERATIONAL OFFICE LEKKI CONTROL	N06^{0}26'46.5" E003^{0}28'20.5" Elev-8m	0.1	-0.9	1.2	1.0	0.00	0.00	31.5	1.5	72.3	-0.01	54.3	0.19
Sampling Location	**GPS/Elevation**	**SO_2 ppm**	**NO_2 ppm**	**CO Ppm**	**CO ppm**	**H_2S ppm**	**VOC ppm**	**Temp. (^0C)**	**W/S Knots**	**RH 75.5**	**LUX**	**Noise dB(A)**	**Dust Ug/m^3**

Noise Levels

The results of noise level measurement at the locations described in Tables above are shown in column 12.

Noise pollution refers to irritating, distracting, or physically dangerous noise to which people are exposed in their environment and over which they usually have no control. Although loud and frightening sounds are part of nature, urban world and industrial activities has become chronically noisy.

Sound intensity is measured in units called decibels. The decibel scale is logarithmic and climbs steeply: An increase of about three decibels is a doubling of sound volume. In the wilderness, a typical sound level would be 35 decibels. Speech runs 65 to 70 decibels; heavy traffic generates 90 decibels. Rotating equipment such as compressors, process equipment and generators, generates from 100 up to above 120decibels. Even music, when played at very high volume, particularly through personal headphones, is damaging to the ears.

In Nigeria the regulation governing noise pollution requires facility owners to provide protection to workers whenever noise level exceeds 90dBA for a daily 8-hour working period. The equivalent 8-hour exposure calculations are shown in Equation 3.1 noise exposure limits for Nigeria are shown in air measurement table above column 12.

The current practice whereby workers exposed to high noise levels above 90 dBA wear ear protectors should be upheld. The background noise level 31.6-68.9dBA was recorded around the study location. The highest noise was recorded at Ore Junction where traffic was higher with noise level of 78.0Dba.

$$D = \frac{t_1}{T_1} + \frac{t_2}{T_2} + \frac{t_3}{T_3} + \ldots\ldots + \frac{t_n}{T_n} \qquad \textit{Equation 3.1}$$

D = Daily noise dose

t = Actual exposure time at given noise level

T = permissible exposure time at that level, in accordance with Table 3.1

n = Number of discrete periods of exposure above 90dBA

Maximum exposure is attained at D = 1.0, control is required for D > 1.0 and only noise levels above 90 dBA are included in equation 3.1.

Table 4.29 Noise Exposure Limits for Nigeria

PERMISSIBLE EXPOSURE LIMIT dB(A)	Maximum Allowable Daily Exposure Duration (Hour)
90	8
92	6
95	4
97	3
100	2
102	1.5
105	1
110	0.5
115	0.25

Summary of the Results of the Air Quality Survey and Noise Level Measurement

The emission levels of CO_2, NO_X, SO_X, CO, VOCs, H_2S among other gases in the study location were measured. The air quality measurement indicated that all gases analysed were within the Federal Ministry of Environment (FMENV) set limits.

NORTH CENTRAL ZONE

The Noise Level Measured in 'A' scale Decibel (dB) was within the 90dB (A) standard set by both FMEnv. which ranges between 31.6-68.9dBA.

The Total Suspended Particles (TSP) was also within the set limit in all the locations measured and ranges between 0.21-0.26µg/m^3.

The emission levels SO_2 (0.00-0.5), CO_2 (0.00-0.3), CO (0.00-0.2), H_2S (0.00), NO_2 (-01.0 to -0.00), VOCs (0.00), RH (47.1-65.4), Temp. (^{0}C)(29.4-37.5).

Wind speed (W/S) ranges from 0.1 knots to 1.6 knots.

SOUTH EAST ZONE

The Noise Level Measured in 'A' scale Decibel (dB) was within the 90dB (A) standard set by both FMEnv.which ranges between 50.5-76.1dBA.

The Total Suspended Particles (TSP) was also within the set limit in all the locations measured and ranges between 0.21-0.28µg/m^3.

The emission levels SO_2 (0.2-0.5), CO_2 (0.1-1.2), CO (0.00-0.8), H_2S (0.00), NO_2 (-1.9 to -0.00), VOCs (0.00), RH (58.2-77.7), Temp. (^{0}C) (27.0-45.8).

Wind speed (W/S) ranges from 0.3 knots to 2.0 knots.

SOUTH-SOUTH ZONE

The Noise Level Measured in 'A' scale Decibel (dB) was within the 90dB (A) standard set by both FMEnv. which ranges between 50.0-75.2dBA.

The Total Suspended Particles (TSP) was also within the set limit in all the locations measured and ranges between 0.20-0.24µg/m^3.

The emission levels SO_2 (0.2-0.5), CO_2 (0.0-0.5), CO (0.00-0.4), H_2S (0.00), NO_2 (-1.0 to -0.2), VOCs (0.00), RH (56.4-70.4), Temp. (^{0}C) (32.0-41.4).

Wind speed (W/S) ranges from 1.1 knots to 1.5 knots.

SOUTH-WEST ZONE

The Noise Level Measured in 'A' scale Decibel (dB) was within the 90dB (A) standard set by both FMEnv. which ranges between 54.3-78.0dBA.

The Total Suspended Particles (TSP) was also within the set limit in all the locations measured and ranges between 0.19-0.24µg/m^3.

The emission levels SO_2 (0.1-0.5), CO_2 (0.0-2.10), CO (0.00-0.8), H_2S (0.00), NO_2 (-1.0 to -0.2), VOCs (0.00), RH (54.8-72.3), Temp. (^{0}C) (28.4-41.4).

Wind speed (W/S) ranges from 1.0 knots to 2.1 knots.

4.10 PUBLIC HEALTH

4.10.1 General

Over 30 types of diseases are known to be transmitted through water as a medium. Any alteration in the existing pattern of water development and usage may affect the disease pattern. The various diseases transmitted through water and excreta commonly found in Nigeria are shown in Table 4.24, besides these biological agents, a variety of agro-chemicals may also enter water sources and foods and cause disease (Table 4.24).

4.10.1.1 Malaria

In Nigeria, malaria is considered as number one parasitic disease affecting a large number of populations. The causative organisms most widely occurring are: Plasmodium faloiparum (80% of all the infections), malariae (15%) and P. Ovale (5%). Mosquito larvae require water for their development. Major factors that determine habitat preference are shade or sun exposure, quiet or flowing water, temperature, salt content, surface vegetation and floatage, and organic pollution. The common vector species in Nigeria are Anopheles gambiae (Sensu

Stricto), A. arabiensis, A. Funestus and occasionally A. melus. In Nasarawa, a study indicated that A. Gambiae was predominant in wet or transmission season (May'-September).

4.10.1.2 Sehistosomiasis

Schistosomiasis, commonly known as Bilharziasis is endemic in 74 developing countries affecting over 200 million people. Children get heavy infections, which may result in disability or death. It is also a risk for about 600 million people as they. perform daily activities related to swimming, fishing, farming, washing and bathing in water canals or streams. According to an estimate by Food and Agricultural Organization in 1975, about 92 million hectares of irrigated land is available in developing countries, They further feared that water-borne diseases introduced by development projects or spread by them can hinder the completion of such projects by affecting the workers or populations living in the vicinity. In Nigeria, there are two types of Schistosomiasis caused by Shistosorna heamatobium and S. Mansoni, The snail vectors Bulinus and Biomphalaria species, respectively, transmit the infection through slow-flowing streams, ponds or lakes. From 1961 to 1962, Walsh and mellinli (1970) collected 800 snails suspected of transmitting Schistosomiasis in lower Niger and Oh valleys in Nigeria. They were shown to be Bulinus truncatus, B. globosus and Biomphalaria pfefferi.

Teesdale surveyed two lakeside communities (Yelwa and Shagunu) and two communities located at reasonable distances from the lakeshore for human schistosomiasis. He found S. haematobium infection for human schistosomiasis. He found S. haematobiurn infection widespread in all age groups with high intensity in 9- 13 years age group and found that boys' were more affected than the girls. He found less S. mansoni, which occasionally was in association with S. intercalatum.

Table 4.30: Diseases Transmitted through Water and Exereta Commonly Reported in Nigeria

Disease	Pathogen/Ventor	Mode of Transmission
Malaria	Plasmodium sp. (anopheles mosquito)	Mosquito bite
Schistosomiasis	Schitosoma sp. (snail host)	Wading through water infested with snail host
Onchocerciasis	Onchocera volvuvus (Simulium or Black fly)	Simulium bites
Trypanosomiasis	Trypanosome sp. (Tse-tse fly or Glossina sp)	Tse-tse fly bites
Yellow fever	Arbovirous (Aedes mosquito)	Mosquito bite
Filariasis	Wuchereria bancrofti (Culex and Mansonia mosquitoes)	Mosquito bite

Dracunculiasis	Dracunculus medinensis or Guineaworm (Cyclops sp. Or water flea)	Drinking water containing flea
Paragonimiasis	Paragonimus westermani or lung fluke (Fresh water snail, crab or Cray fish)	By eating crab or cary fish
Leptospirosis	Leptospira sp. Or spiro chaete bacterium	Contract with rodent urine
Diarrhea/Dysentry	Amoebic (Entamoeba histo lytica), bacillary (Shigella sp.), other types (Escherichia coli, Campylobacter sp., Rota virus, etc. Giardia sp.)	Drinking plluted water or eating contaminated food; through files and fingers
Cholera	Vibrio cholera	As above
Gastro – enteritis	Miscellaneous bacteria or viruses	As above
Typhoid/Paratyphoid	Salmonella typhi; s paratyphi	As above
Infectious hepatitis	Hepatitis virus A	As above
Ascariasis Ancyclo – stomiasis, trichuriasis, Strongyloidiasis	Helminths	As above

N/B: Vector names are in parenthesis.

4.10.1.3 Onehocerciasis

Onchocerciasis is an infection with a filarial nematode (Onchocerca volvulus) causing a chronic disease which may lead to blindness. It is transmitted by Simulium Fibre Optic projectnsosum which usually lays its eggs in fast flowing and well-aerated streams. African vectors mainly bite on the legs, and microfilariae are most numerous in the. skin of the buttocks and the outer and dorsal surfaces of the calf and ankle. Nodules, severe itching and appearance like lizard skin or depigmentation manifest it. Budden (1956) found that 5.7% of the population in highly endemic areas of northern Nigeria was blind and 70,000 people were seriously at risk. Several reports from Nigeria revealed prevalence rates of '49% (with 26% with nodules, 3.4% with severe ocular symptoms) in one study in 1959, and 40.7% infection in another study in 1963. In Nasarawa, Oil valley, Kontagora/Maingyara and Anna districts an overall prevalence of 54% was recorded during 1967-68 In a study in eastern Nigeria, 887% of the affected people were farmers and 42.9% of them farm with bare top and legs and 99.3% of them claimed to have been bitten by fly. Onchocerciasis is not a serious disease around hydropower Fibre Optic projects. On the other hand, irrigation development may reduce the insect breeding as the flow is regulated.

4.10.1.4 Dracunculiasis

It is popularly known as Guineaworm disease and is caused by Dracunculus medinensis. It is transmitted through a water flea, cyclops that inhabits ponds and stagnant fresh water bodies, It is acquired by drinking such water without any treatment. It is found almost in every State. At present about one million Nigerians are affected every year of which half are farmers and school children. The infected persons are temporarily incapacitated for periods of 1-3 months but an estimated 6,000 suffer irreversible disablement annually. Guineaworm is noted as the leading constraint to rice production in Anambra, Benue, Cross River and I mo States.

4.10.1.5 Trypanosomiasis

It is a vector bone disease transmitted through Tse-tse fly, Glossina palpalis and 0. Techynoicles. These flies breed near water sources under bushes. Bush clearance near watercourses 200m away from settlements is good for effective control. They do not' travel far from their breeding places. The causative agent is Trypanosoma Sp, a parasitic protozoan. The only serious epidemic reported was in 1934 by Duggan in Northern Nigeria. Thompson in 1960 investigated 4 villages in Wawa district and noted that 0.2% to 60% of the populqtion suffered from the disease. Subsequent studies in North West Nigeria revealed that there were no cases of human trypanosomiasis although the vector is prevalent in most areas. Since the completion of the project areaFibre Optic project, there has been no report of this disease. The completion and operation of the Hydropower component is not likely to negatively alter this scenario.

4.10.1.6 Miscellaneous Diseases

Other miscellaneous diseases, which might affect local populations, are helminthiases, yellow fever, viral infections and fish bone infections. In addition, chemicals such as nitrate, nitrites, and pesticides or herbicides continue to pose a serious threat to the, health of the workers where wastewaters from farmlands are washed into the reservoir. They may cause a variety of diseases and show up with a variety of symptoms.

Table 4.31: Commonly used Fertilizers, Herbicides and Pesticides in the project area

Chemical	**Technical Name**	**Effect on Human Health**
Fertilizer		
CAN NPK Urea	Calcium Nitrate	Indirect effect through algal blooms in waters affecting the tastes and odours; nitrates in water cause methaemoglinaemia; certain types of cancers.
Herbicides		
Grammazone	Paraquat (dichloride) Dipyridillium derivative)	Depending on the type: cancer birth defects necrotizing pulmonary fibrosis, neurotoxic, CMS stimulus in fish, mammals, birds, stored in fat tissues.
Pesticides		

Cymbush	Cypomethrine (Synthetic Pyrethroids)	Burning sensation swollen face by evening and disappearing by morning

4.10.2 Existing Health Information

4.10.2.1 Source of Information

Information was obtained from hospitals and clinics in the area and the state ministry of health, the communities, through the use of structured questionnaires and by observation of the surroundings.

4.10.2.2 Collection of Samples of Water and other Materials

Samples of water were collected to find out the nature of contaminants which may have originated from agricultural operation.

4.10.3 Data Analysis

The data was analyzed and presented in table of results. The result of the fieldwork and the prevalence of diseases as obtained from the several relevant bodies are also given,

4.10.3.1 Disease Pattern in the Project Areas

The common diseases in the area are Malaria and Diarrhoea. There are no definite trends over a period. These results also suffer from limitations as there were limited health institutions in the area and they have no records, The State ministry of health also does not have records of disease patterns in this area. The health centres did not' send the results to the Health Ministry and in any case, most villages in the area have no health facility at all. Where they exist, records were scanty, but oral information obtained gave an idea of the level of prevalence of various diseases.

Generally, incidence of water borne diseases is not high despite the presence of the project area reservoir. The completion of the hydropower component is thus not expected to significantly change this, Malaria, Typhoid and Yellow fever have more occurrence than others Malaria is highest, typhoid is at a rate of about two per month and yellow fever is three per year. Vaccination is used to treat typhoid and this has been effective so far.

4.10.3.2 Chemical Use in Study Area

Herbicides are not frequently used in the area as to cause health hazard because of the non-availability, cost and the necessity of guided use. Some of the herbicides wilL destroy all plant and so has to be selectively used. The commonest in use is Graniozone, which requires controlled spraying. Table 4.32 shows the various chemicals used for farming activities in the project area. The use of these chemicals is dependent on farm size, crop and availability. Most of the farmers want fertilizer but get little. The cost of herbicides and pesticides is also a limiting factor. For this reason, the reservoir has not been adversely affected by use of chemicals. Secondly, the terrain and quality of land around the project site is not suitable for extensive farming, thus very little farming practice go on in the immediate surroundings of the site, This situation is expected to remain.

Table 4.32: Agrochemical Use in Project Area

Fertilizer	Urea NPK
Herbicides	Gramozone 9Paraquat) Saro
Pesticides	Basudin Aldrex

4.10.3.3 Data from Communities

The data obtained from various communities though the administration of questionnaire and personal observations are summarized in this section. The data centred on disease pattern, the vector habitat and breeding sites in the areas and behavioural practices of the farmers which may cause or prevent the water related diseases. The results indicate that Malaria, Schistosomiasis, Diarrhoea, and Stomach pain were observed among those interviewed, Mosquito infestation is high and the% snail population is small.

Table: 4.33: Disease Pattern among Communities in the Project Area (n=75)

S/N	Diseases	% Affected (Apr '2005 –Mar-Mar'2006)
1.	Malaria	100.00
	No of attack in 12 months	Once 918.8%) Twice (24.3%) Thrice(14.14%) 4 x (24.3%) Others (18.2%)
2.	Yellow fever etc.	28.4
3.	Schistosomiasis	12.6
4.	Oncho Nodules	33.1
5.	Itching	46.2

6.	Fracunculiasis	1.5
7.	Diarrhoea/Dysentery	51.7
8.	Stomach pain	52.6
9.	Back ache	78.2
10.	Prolonged Hospitalization	3.9

Table: 4.34: Perception of the Presence of Vectors in the Area (n = 75)

S/N	Diseases	% Acknowledged
1.	Mosquitoes (Low Infestation	100.00
2.	Snail Population	42.8
3.	Simulium fly	62.5
4.	Tse-tse fly	82.0
5.	House fly	100.00
6.	Rats/Mice	100.00
7.	Snakes/Scorpions	100.00

Table: 4.35: Behavioral Practices and the Feeling of the People in the Area

S/N	**Diseases**	**%**
1.	Water River Well/borehole Stream Tap	10.6 68.8 18.4 2.2
2.	Use of Pit toilet	70.6
3.	Washing Hand Before Eating	96.8
4.	Contact with water (Bath or Swim)	100.00
5.	Exporsure to Mosquito bites	100.00
6.	Protection Against Mosquiot Bites Bednets Coil Pai-Pia (Local Insecticides) Commercial Insecticides Local herbs	6.6 15.4 5.8 7.2 65.0
7.	Use of: Fertilizers (3 to 30 bags per year Pesticides (2 to 50 litres per year)	50.5
8.	Expected Benefit from Fibre Optic project: Economic gains Source of drinking water	48.3 66.8
9.	Bad effect of Fibre Optic project expected Floods/Farm loops & Fibre Optic project age.	38.4 42.7

4.10.3.4 Comparison of Various Areas

The features of the disease pattern in the studied areas showed the following;

Malaria is everywhere, but the level of Mosquito infestation is not directly related to the occurrence of Malaria. Even during the dry season, malaria is the most prominent disease of all the people.

No disease is at an epidemic level as a result of the existing reservoir.

4.11: SOCIO-ECONOMIC CONDITIONS

The study was to establish baseline social, cultural, level of livelihood, economic conditions and land use pattern of the settlements/areas along the proposed fibre optics cable route. It involved the acquisition and evaluation of both primary and secondary data on population demographics, employment, incomes, education, infrastructure, housing, occupations, among others.

4.11.1 OVERVIEW OF THE FIBER OPTICS ROUTE

The route for the proposed fiber optics cable would traverse thirteen states and Abuja Federal Capital Territory. The states are: Lagos, Ogun, Ondo, Edo, Delta, Anambra, Imo, Rivers, Akwa- Ibom, Enugu, Kogi, Benue, Nasarawa and Abuja Federal Capital Territory. The states and Local Government Areas to be traversed by the proposed fiber optics cable are indicated on table 4.36.

Table 4.36: Communities to be Traversed by the Proposed Fiber Optics Cable

NO	ROUTE	STATE	L.G.A	COMMUNITIES
1	Abuja - Akwanga	F.C.T	Municipal Area Council	Karu
		Nasarawa	Karu	Kuchikau, Goshen, Auta Balaifi, Tudun Wada, Uke,Angwan Tofa, Gora, Angwan Karara, Gidan Zakara, Sabon Gari, NYSC Camp.
			Keffi	Keffi

			Kokona	Ecwa Camp, Angwan Jarmai, Old Army Barracks, Mararraba Maisauri, Bokoko, Marke, Sabon Gida, Angwan Wangibi, Angwan Mayo, Garaku, Agabas Residence, Kampani Mailamba, Ayuka Mayo, Mandara, and Arisu Amba.
			Akwanga	Gudi. Aricha,
2	Akwanga - Lafia		Egon	Nasarawa Eggon, Ewut Sec. School, Mile Uku
			Lafia	Azuba , Azuba Bashayi, Sabon Pegi Shabu, Shabu, Booster station Lafia.
3	Lafia - Makurdi		Obi	Alkaleku, Adevi, Gidan waya, Akanga, Igbacha,
			Keana	Sarkin Noma, Kadarko,
		Benue	Guma	Yelunta, Mbabarough Nongou, Udei Nyieu, Nyieu Ucha, Kwaghshir Agbe, Ukange, Hirnyam, Awuna Not, Ashangu Nbanyieu, Ortaver Ucha, Daudu, Mbawa
			Makurdi	Ancha, Uhembe, Agan, North Bank, Kanshio, Mechanic Village, Apiv, Shom,
4	Makurdi- Ugbokolo		Gwer East	Mbavember, Ikpa Yongo, Northern polytechnic Ikpayongo, Community Secondary School, Ikpayongo, Ayati, Igbor, Mase, Tse-Awar, Jato Daula, Asar, Ahumbe, Cheedu, Mbam, Ahiada, Nyikaa, Gbache, Igbudu Imatse,

				Mbaga, Uturugu, Mbaga, Howe, Tse Udage, Tse Njie, Mbatse, Taraku Mills, Uyaji, Taraku,
			Oturkpo	Ikobi Oturkpo,
			Ohimini	Omoda Dlegwu, Agboke, Atlo,
		Benue	Okpokwu	Apacol of Edu Aigododo Okpoga, Ekenobi Edumoga, Ogbodo Emeje Edumoga, Olanyegba, Ogene Amejo, Okpadu Olanyenu, Ichakwu, Ijege Imejo, Ugbokolo,
		Kogi	Olamaboro	Uyi Ogudu
		Benue	Ogbadigbo	Odoba Otukpo, Obu Otukpa, Otukpa, Alachagaha, Ogene Ago, Effiom Otukpa, Odebe Otukpa, Ugbegbu Akor, Ijadoga, Ade-Igwe Orokam
5	Ugbokolo - Enugu	Enugu	Igbo Eze North	Oma orba inyi
			Udenu	Amalla, Amalla Egazi, Amutenyi Obollo Afor, Obollo Afor, Imileke town, Orba, Owerre okpu orba, Orhum, Amalla, Isienu,
			Nsukka	Eke main market, Eha Alumona, Kpokpo Bus-Stop Opi, Ogbegbor Opi, Opi Nsukka,
			Igbo Eti	Ohodo, Ozalla, Ekwegbe, Umuna, Ohebe Dim, Ogbede Ukehe, Ochima,

			Udi	Amoka Ibite Okpatu, Ogede, Awhum, Ukanu, Ebe, Nineth Mile,Amankwor Uga, Akamu Ngwo,
7	Enugu-Awka		Enugu North	Enugu, Ngwo, Akama Ngwo, Nwankwo Ngwo, Nchanawa, Ogwufia Owa, Omugwa Owa, Ezema Owa, Umuaji, Umumba Ndienu, Chumaba.
			Ezeagu	Ndiagu, Obinofa Ndiagu, Mkpagu
			Orji	Ugwuoba
		Anambra	Awka North	Awka, Amansea Awka Nnamdi Ezikiwe Uni. Awka
			Awka South	Umuokpu
8	Awka-Onitsha		Dunukofia	Ukpo, Abba
			Njikoka	Njikoka
			Oyi	Awkuzu, Umunya, Nteje, Ifite Nteje, Umunya, Isioye Umunya, Tansian Uni. Umunya
			Onitsha North	Onitsha
			Anambra East	Onitsha
	Onitsha -Asaba	Delta	Oshimili south	Elenchere Asaba
			Oshimili north	Asaba
	Asaba-Benin		Aniocha north	Onkpanan, Issele Azagba, Edo-Ogwashi, Onocha Olona, Ogwashi-Uku, Ubulu-Uku, Issele-Uku, Udumuje Ugboko, Igbodo, Ekwuoma, Umunede, Emuhu, Agbor, Ihu-Iyase Agbor,
			Îka north east	
			Ika south	

				Omumu, Alifekede
		Edo	Orhionmo Uhunmwonde Ikpoba okha	Ogan, Abudu, Owa, Uvbe, Okhukhou, Aduhana, Ikweneiro, Ikpoba Itiu, Orio Ozuola, Ugbemudia, Utekon, Benin.
	Benin-Ore		Egor Ovia north east Ovia south west	Ovbiogie, Ekadolor, Obua, Iguawa, Okada Junction, Ugbogui, Ohosu, Evonogbon
		Ondo	Idanre odigbo	Ofosu, Aghejire, Alagbado, Ago-Gboro, Ore
	Ore-Ijebu Ode	Ogun	Ijebu east Ijebu ode	Ore Agro business center Obatedo Agoaye Omotosho power plant Obatedo, Ajibandele
	Ijebu Ode- Lagos		Odogbolu Ikenne Shagamu Ifo	Odogbodu Junction Ikenne-Remo Junction Iperu, Sagamu
	Lagos	Lagos	Ikeja	Lotto
			Kosofe	Asese
			Shomolu	Ibafo
			Lagos mainland	Magboro
			Lagos island	Arepo
			Eti osa	
			Ibeju lekki	
		Onitsha-Owerri		
		Owerri -		

		Port-Harcourt		
		Akwa-Ibom		

Source: Baseline Studies (2015)

4.11.2 METHODOLOGY

The primary data for the study were obtained using a combination of the following:

4.11.2.1 Structured Household Questionnaires.

These were designed to elicit information on: respondents' characteristics, demographic structure and characteristics of the inhabitants, economic structure and patterns, socio-cultural infrastructure and way of life, housing conditions, among others, and community issues and concerns.

4.11.2.2 Community Survey and Inspection

These involved the physical examination and inspection of selected facilities along the Federal Road as well as the route of the proposed fiber optics cable.

4.11.2.3 Group Discussion (GDs)

These were a modification of focus Group Discussion (FGDs) aimed at involving the local people as part of consultation and community engagement. The groups were made up of village head, clerics, representatives of the youth, and some selected elders of the communities. The objective of the group discussions was to identify community's perception of the proposed project, the problems associated with it, and how such problems may be mitigated. Information from such discussions was used to confirm and cross check the veracity of some of the answers provided in the questionnaires.

The above processes were supplemented by secondary data from literature of reliable sources such as census figures (2007) for the Local Government Areas to be traversed by the proposed Fiber Optics cable.

4.11.3 Sampling Procedure

According to the National Population Commission (NPC), the total population of the thirteen states to be traversed by the proposed fiber optics cable is equivalent of the population of the 13 states involved

Details for each state and local government area is indicated on table 4,2.

Given a growth rate of **2.83 per cent**, the current total population is estimated to be about **fifty-three thousand eight hundred and ninety-two** (53,892) .

$Pn = Po\ (1+r)^{n}$

Where:

Pn = projected population

Po = Base year (1991) population

n = Difference in number of years between base and projected year and

r = Population annual growth rate in percentage.

It would however, be observed that in the discussion of results, the number of respondents tended to vary rather remarkably, being either more or less than the copies of questionnaires administered per route. The explanations for this are that: in some cases some respondents did not respond to some of the items in the questionnaire, hence usable to some of the responses were less than the copies administered per route.

4.11.4 Route 1: Abuja – Akwanga

4.11.4.1 Settlements Along Route 1

Settlements along route 1 include: Karu, in Abuka Municipal Council of the Federal Capita Territory; Kuchikau, Goshen, Auta Balaifi, Tudun Wada, Uke,Angwan Tofa, Gora, Angwan Karara, Gidan Zakara, all in Karu Local Government Area of Nasarawa State; Sabon Gari, NYSC Camp, Keffi, Keffi, all in Keffi Local Government Area of Nasarawa State; Hayin Gada, Angwan Maigari, Maisauri, Mararraba Kokona, Sabon Gida, Ajuye, Angwan Mayo, Garaku, Kampani Mailamba and Sabon Kebere all of which are in Kokona Local Government Area of Nasarawa State; Maraban Anguwan Zaria, Alushi, all in Akwanga Local Government Area of Nasarawa State.

4.11.4.2 Occupation

The people engage in various occupations which include trading, civil service, farming, car washing, fuel wood fetching by women, and other artisanal works. There are also trained professionals from all works of life such as engineers, doctors, lawyers, among others. Most people who engage in other occupations also engage in subsistence farming while some people are into full time farming. Major crops farmed along this route are cassava, yam, cocoyam, rice, corn. Major livestock bred in the community are cattle mostly by the Fulani. Others include goat, sheep and poultry.

No shrine or deity was encountered in the course of the EIA baseline study. Similarly, there were no sacred forests and sites of archaeological interest. Religious and social festivals celebrated include Sallah, Christmas and Easter.






Plate 4.4 Fuel Wood and Yam sellers along the Keffi-Akwanga road

4.11.4.3 Educational Institutions

There are several public primary and secondary schools as well as a University in Keffi town. This is in addition to numerous private educational institutions at both primary and secondary levels. The proximity of the route to Abuja, the Federal Capital city significantly influenced dense population with diversity in culture and tradition and equally the growth in the number of privately owned educational institutions.

4.11.4.4 Health and Sanitation

There is Federal Medical Centre at Keffi General Hospital at Akwanga and several government owned primary health centres along this route. There are several privately owned hospitals.

The most common ailment found in settlements along this route include: malaria, typhoid, rheumatism, high blood pressure, diabetes, among others. There have been few cases of HIV and AIDS in Keffi and Akwanga. The types of toilet facilities found in settlements along this route include few water closets while most people still use the pit latrine and bushes. The wastes found in the area are mostly domestic wastes ranging from garbage, papers, nylon, food waste and rags. Waste disposal method is mostly by dumping along the road in open space (see plate). The major source of water supply in the area is by Nasarawa State Water Board.

4.11.4.5 Issues Raised by Residents

The major issue raised by residents along this route is that of payment of compensation to the would-be affected persons who own properties along the route corridor. Residents also advised that once the rmain road is cut, effort should be made to properly re-fill/repair the section.

4.11.5 Route 2: Akwanga - Lafia

4.11.5.1 Settlements Along Route 2

The settlements along route 2 include: Wiko, Gada Biyu, Boson, Gako, Unguwan Ciyawa, and Kuruwan Kabanza, among other several small hamlets. All these settlements are located within Akwanga local government area. Others include Gidan Waya, Nasarawa Eggon, Azuba, Azuban Bashayi. All these settlements are located within Nasarawa Eggon local government area. Sabon-pegi Shabu, Shabu Lafia, Marraraba Akunza, Fassa and Kunza Migili. All these settlements are located within Lafia local government area.

The largest settlement along route 2 is Akwanga and that this town is also a junction town and the headquarters of Nasarawa North senatorial district. It is populated by mainly by the Eggon ethnic group. Others include Mada, Afo, Hausa and the Agbo. About 35% of the population are Muslims, 38% are Christians, and 27% are Traditional worshippers and free thinkers. Two shrines or deity were observed in the course of the baseline study. These shrines were located at Boson settlement and about six hundred metres away from the road. Furthermore, there were no sacred forests and sites of archaeological interest. Religious and social festivals celebrated include Sallah, Christmas and Easter.

Nasarawa Eggon local government area is populated by mainly by the Eggon ethnic group and their traditional headquarters. About 41% of the population are Muslims, 45% are Christians, and 14% are Traditional worshippers and free thinkers. No shrines or deity were observed in the course of the EIA study. Furthermore, there were no sacred forests and sites of archaeological interest. Religious and social festivals celebrated include Sallah, Christmas and Easter.

4.11.5.2 Occupation

Most people here engage in subsistence farming. Major crops farmed in this area are cassava, yam, rice, corn. Major livestock bred in the community are cattle mostly by the Fulani. Others include goat, sheep and poultry. There is also quarrying for different stone aggregates in this area (see plate 4.6). Fuel wood fetching is a major occupation among women within this area. Some residents of Lafia are civil servants and engage in small and medium scale businesses. However, residents of rural areas close to Lafia engage in subsistence farming and small and medium scale businesses.

Plate 4.5: Quarrying Activities along Akwanga-Lafia road

4.11.5.3 Educational Institutions

Akwanga has the Nasarawa State College of Education. There are several secondary schools and primary schools located at Akwanga, Boson, and Gako. Nasarawa Eggon has several public secondary schools and primary schools. In addition, there are few privately owned educational institutions particularly at primary level. The standard of both public and privately owned schools here is mostly below the required standard due to poor facilities including furniture, building and teacher quality and amenities. Lafia has a Federal University, Nassarawa State Polytechnic, College of Agriculture and the school of nursing and midwifery. There are several public primary and secondary schools. Furthermore, Lafia is well provided with privately owned primary and secondary schools.

Plate 4.6 Ewut Sec. School

Plate 4.7 Nasarawa State Polytechnic Lafia

4.11.5.4 Health and Sanitation

Akwanga has a General Hospital and several government owned and privately health centres. Nasarawa Eggon has a General Hospital and several government owned health centres. There are several privately owned hospitals. Lafia being the state capital is provided a General Hospital and several government owned health centres. There are several privately owned hospitals

The most common ailment found in the area include: malaria, typhoid, rheumatism, high blood pressure, diabetes, guinea worm, among others. There have been few cases of HIV and AIDS in this area. The types of toilet facilities found in the area are water closet while some people still use the pit latrine and bushes. The wastes found in the area are mostly domestic wastes ranging from garbage, papers, nylon, food waste and rags. Waste disposal method is mostly by dumping along the road in open space. The major source of water supply in the area is by Nassarawa State Water Board. The wastes found in the area are mostly domestic wastes ranging from garbage, papers, nylon, food waste and rags. Waste management is handled by the Nassarawa State Urban Development Board. The major source of water supply in the area is by Nassarawa State Water Board

4.11.5.5 Infrastructure

Most roads observed in Akwanga, Nasarawa Eggon and Lafia are tarred. Electricity is being supplied by the PHCN and individuals who can afford the use of generators to generate their own power. There is a post office in each of Akwanga, Nasarawa Eggon and Lafia towns and GSM telecommunication facilities of various networks available in these three major towns. The major security outfit in the area is the Nigerian Police. The main source of household fuel used for cooking is kerosene and firewood. Some people in these three major towns use cooking gas.

4.11.5.6 Issues raised by People interviewed at Lafia

The major issue raised by residents along this route is that of payment of compensation to the would-be affected persons who own properties along the route corridor. Residents also advised that once the main road is cut, effort should be made to properly re-fill/repair the section. Others opined that the Abuja – Lafia road should be dualized.

4.11.6 Route 3: Lafia - Makurdi

4.11.6.1 Settlements Along Route 3

The settlements along route 3 include: Bukan Kwato, 58 Squadron Mobole Police Force, Lafia, Akunza Migili, Duguguru, Murya, Agyaragu, Gidanye, Khaswa, Sheigbuwe, all in

Lafia Local Government Area; Alkaleku, Adevi, Gidan waya, Akanga, Igbacha, all in Jenkwe Development Area of Obi Local Government Area; Sarkin Noma, Kadarko, all in Giza Development Area of Obi Local Government Area; Yelunta, Mbabarough Nongou, Udei Nyieu, Nyieu Ucha, Kwaghshir Agbe, Ukange, Hirnyam, Awuna Not, Ashangu Nbanyieu Ortaver Ucha, Daudu, Mbawa community sec. school, Daudu, all in Guma Local Government Area; Ancha, Uhembe, Agan, North Bank, Darver Benue, Fed. Sec. Complex, all in Makurdi Local Government Area of Benue State.

There are myriads of ethnic groups along this route. About 32% of the population are Muslims, 67% are Christians, and 2% are Traditional worshippers and free thinkers. No shrines or deity were observed in the course of this baseline study. Furthermore, there were no sacred forests and sites of archaeological interest. Religious and social festivals celebrated are mainly Sallah, Christmas and Easter.

4.11.6.2 Occupational Activities

Most people here engage in subsistence farming. Major crops farmed in this area are cassava, yam, cocoyam, rice, corn. Major livestock bred in the community are cattle mostly by the Fulani. Others include goat, sheep and poultry. Fuel wood collection and petty trading are major occupations among women within this area.

About 30% of the population are unemployed. There are no known large industrial establishments but small and medium scale businesses particularly within Makurdi town. However, in the rural areas farming is the dominant activity. In addition to farming, rural folks engage in processing wood into various products such as pestles, mortars, and heavy duty vehicle jerk, among others (see the plates below).

Plate 4.8Mortars and pestles for sale along Lafia – Makurdi Highway.

Plate 4.9 Wood Works along Lafia-Makurdi Way

Plate 4.10 Petty Trading at Guma, Benue State

Plate 4.11 Sand Fetching on the North Bank of River Benue

4.11.6.3 Institutional Infrastructure

Lafia has a Federal University, Nassarawa State Polytechnic, College of Agriculture and the school of nursing and midwifery. There are several public primary and secondary schools. Furthermore, Lafia is well provided with privately owned primary and secondary schools.

Plate 4.12 Upload and Download Station at Makurdi

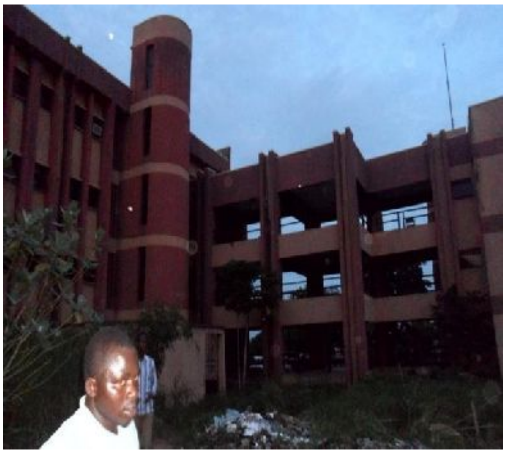


Plate 4.13 Federal Secretariat Makurdi

Educational institutions found Obi and Keana Local Government Areas are mostly rural primary schools, without any basic facility such as furniture and other teaching aids. This is expected as similar communities visited have the same educational institutions status.

Most roads observed in the area are tarred. Electricity is being supplied by the PHCN and individuals who can afford the use of generators to generate their own power. Makurdi is home to Benue State University and the Federal University of Agriculture. In addition, there are several secondary schools and primary schools which are privately and publicly owned.

4.11.6.4 Health and Sanitation

There are health centres in Agyaragu, Jenkwe and Kadarko. The most common ailment found in thees areas include: malaria, typhoid, rheumatism, high blood pressure, diabetes, among others.

Similarly, many health facilities were identified in Makurdi and its environs and these includes private and public clinics and maternities. Generally, it has been revealed that there were cases of HIV and AIDS recorded in the area. This area is an endemic zone for HIV and AIDS.

4.11.7 Route 4: Makurdi - Ugbokolo

4.11.7.1 Settlements Along Route

Settlements along this route include: Kanshio, Mechanic Village, Apiv, Shom, all in Makurdi Local Government Area of Benue State; Mbavember, Ikpa Yongo, Northern polytechnic Ikpayongo, Community Secondary School, Ikpayongo, Ayati, Igbor, Mase, Tse-Awar, Jato Daula, Asar, Ahumbe, Cheedu, Mbam, Ahiada, Nyikaa, Gbache, Igbudu Imatse, Mbaga, Uturugu, Mbaga, Howe, Tse Udage, Tse Njie, Mbatse, Taraku Mills, Uyaji, Taraku, all in Gwer East Local Government Area of Benue State; Ikobi Oturkpo, in Oturkpo Local Government Area of Benue State; Omoda Dlegwu, Agboke, Atlo, all in Ohimini Local Government Area of Benue State; and Apacol of Edu Aigododo Okpoga, Ekenobi Edumoga, Ogbodo Emeje Edumoga, Olanyegba, Ogene Amejo, Okpadu Olanyenu, Ichakwu, Ijege Imejo, Ugbokolo, all in Okpokwu Local Government Area of Benue State.

4.11.7.2 Institutional Infrastructures

Most roads observed in Gwer East section of this route are un-tarred earth roads. Transportation is mostly by road and the people use cars, buses, motorcycles (private and commercial) and bicycles. Electricity is supplied by individuals who can afford the use of generators to generate their own power. The community is connected to the national electricity grid.

Howe is a village and has only two primary schools which are without any tangible infrastructure. That is to say, the schools are without sufficient furniture and teaching aid.

Plate 4.14LEA Primary School at Anja Gwer LGA and UBE Junior Secondary School Igbor, Gwer LGA

Aliade town is the headquarters of Gwer East Local Government Area of Benue State. Due to the relatively large size of this town, a lot of schools are spread in all its nooks and crannies. These include primary and secondary schools with diverse ownership (government, private and religious organizations). There are several hospitals operating in Aliade which include both public and private. St. Vincent Hospital Aliade is one of the few hospitals in the town that stand out. The hospitals here provide mainly primary and secondary health care service. The community is connected to the national electricity grid. Many of the roads are not tarred and intra-town transport is mainly by cars, motor cycles and bicycles.

Plate 4.15 PHC Centre at Igbor and Igbor Child-Youth Ambassador Child Centre

Howe village is close to the Uloho stream in the Gwer Local Government Area of Benue State. The community is relatively small and situated along the highway under consideration. The population is small in terms of number and the people are generally receptive. The community by grading is a village and has only two primary schools which are without any tangible infrastructure. That is to say, the schools are without sufficient furniture and teaching aid.

Health facilities were identified in the area including a private clinic and a maternity centre. Infrastructural facilities such as pipe borne water, electricity and other key amenities are lacking in this community. In summary, it could be said that there is no physical infrastructure provided by Government in the village.

Taraku is the Local Government Headquarter of Taraku Local Government Area of Benue State. The town is relatively big with substantial population. The town boosts of numerous schools both private and public at primary and secondary levels. Many health facilities were identified in the area including private clinics and maternities.

Most roads observed in the area are untarred earth roads. Transportation is mostly by road and the people use cars, buses, motorcycles (private and commercial) and bicycles. Electricity is being supplied by the PHCN and individuals who can afford the use of generators to generate their own power. There is a post office in the community and the GSM telecommunication facilities of various networks are available in the area.

Otukpo is the headquarters of the Otukpo Local Government Area and unofficial headquarters of Benue south senatorial district. It was the headquarters of the former Idoma Province, and remains an important town in Idomaland.

Educational institutions in Otukpo include the following: Benue State Polytechnic, Wesley High School, Dr John Adah College of Health Tech Otukpo, King David Nursery/Primary school, Eziama-Obiato Central School, St. Thomas Anglican Community Secondary School Eziama-Obiato, Community Secondary School, King's Commercial School, Nervic Nursery/Primary School, among others.

4.11.7.3 Occupational Activities

The communities in Howe are predominantly farmers who engage in the cultivation of yam and oranges as their main crops. This explains the large and preponderance of orange orchards in the area.

Aliade community has very high rate of unemployment with percentage as high as about fifty percent. The major crops produced in the community are cassava, yam, cocoyam, palm oil while the livestock bred are poultry, sheep, goat, among others.

Oturkpo has a Capacity Development Centre/Common Facility Centre for Leather products that trains youth on jobs in the leather industry. In addition commercial activities here are at reasonable level with several shops, banks and other commercial concern in operation. Otukpo has several hotels and a host of small and medium scale businesses.

4.11.7.4 Health and Sanitation

There are several hospitals operating in Aliade which include both public and private. St. Vincent Hospital Aliade is one of the few hospitals in the town that stand out. The hospitals here provide mainly primary and secondary health care service.

There are several hospitals operating in Aliade which include both public and private. St. Vincent Hospital Aliade is one of the few hospitals in the town that stand out. The hospitals here provide mainly primary and secondary health care service.

Health facilities identified in Howe community include a private clinic and a maternity centre. Many health facilities were identified in the area including private clinics and maternities. Health care provisions in the community include: Salem Hospital, General Hospital Otukpo, St Theresa Hospital, among several other privately owned health care facilities.

The most common ailment found in the area include, malaria, typhoid, rheumatism, high blood pressure, diabetes, measles etc. there has been few cases of HIV and AIDS in area.

4.11.7.5 Issues raised by People interviewed at Lafia

There were no request for compensation but rather community expressed their happiness over the project.

Plate 4.16 NICTIB Upload and Download Station

Route 5: Ugbokolo – Enugu (Booster Station)

4.11.8.1 Settlements Along Route

Settlements along this route include: Odoba Otukpo, Obu Otukpa, Otukpa, Alachagaha, Ogene Ago, Effiom Otukpa, Odebe Otukpa, Ugbegbu Akor, Nig. Institute of health, Ijadoga, Ade-Igwe Orokam, all in Ogbadibo Local Government Area of Benue State; Uyi Ogudu in Olamaboro Local Government Area of Kogi State; Oma Orba Inyi in Igbo Eze North Local Government Area of Enugu State; Amalla,

Amalla Egazi, Amutenyi Obollo Afor, Obollo Afor, Imileke town, Orba, Owerre okpu orba, Orhum, Amalla, Isienu, all in Udenu Local Government Area of Enugu State; Eke main market, Eha Alumona, Kpokpo Bus-Stop Opi, Ogbegbor Opi, Opi Nsukka, all in Nsukka Local Government Area of Enugu State; Ohodo, Ozalla, Ekwegbe, Umuna, Ohebe Dim, Ogbede Ukehe, Ochima, all in Igbo-Etiti Local Government Area of Enugu State; Amoka Ibite Okpatu, Ogede, Awhum, Ukanu, Ebe, Nineth Mile,Amankwor Uga, Akamu Ngwo, all in Udi Local Government Area of Enugu State.

4.11.8.2 Institutional Infrastructure

Ogeneago is a small village in Ogbadibo Local Government Area of Benue State, Nigeria. The village is blessed with palm trees, crowding most compounds, leaving just enough space for the living quarters. Most roads observed in the area are untarred earth roads. Transportation is mostly by road and the people use cars, buses, motorcycles (private and commercial) and bicycles. Electricity is being supplied by the PHCN and individuals who can afford the use of generators to generate their own power.There is a post office in the community and the GSM telecommunication facilities of various networks are available in the area.

In Otukpa community, primary and secondary schools in the area include: LGEA Adepe Otukpa, LGEA Obu II, Otukpa, LGEA Primary School, Olachagbaha Otukpa,LGEA sp Primary School, court otukpa, Methodist Primary School, Ipole Otukpa, Pilot science primary School ipari, St. Stephen Catholic Primary School, St.Stephen Catholic Primary School, Government College Otukpa, Govt comprehensive secondary school, Komplit comprehensive college, and St Johns' college, Otukpa. There are a number of health facilities identified in the area including private clinics and maternity.

Most roads observed in the area are untarred earth roads. Transportation is mostly by road and the people use cars, buses, motorcycles (private and commercial) and bicycles. Electricity is being supplied by the PHCN and individuals who can afford the use of generators to generate their own power. There is a post office in the community and the GSM telecommunication facilities of various networks are available in the area.

Ublegi is another rural settlement, along Enugu-Makurdi road, in Enugu State.

There are various educational institutions ranging from nursery, primary and secondary. There are about 8 primary schools among which are: community High School, Town School and Unity Primary School; the secondary schools identified include community high school, Popular Vocational Secondary School and Victory Secondary School. The health facilities identified in the area are one Health Centre and Private Clinics and maternity.

Most roads observed in the area are untarred earth roads. Transportation is mostly by road and the people use cars, buses, motorcycles (private and commercial) and bicycles. Electricity is being supplied by the PHCN and individuals who can afford the use of generators to generate their own power. There is a post office in the community and the GSM telecommunication facilities of various networks are available in the area.

Orakam Community is a rural settlement with most of its development activities concentrated along the Enugu 9th Mile-Makurdi road. There is a Council of Chiefs which serves as the cabinet of the traditional ruler. The council is regarded as the Local Supreme court and takes decision on development and welfare issues of the community.

Plate 4.17Some members of the Orakam community

Most roads observed in the area are untarred earth roads. Transportation is mostly by road and the people use cars, buses, motorcycles (private and commercial) and bicycles. Electricity is being supplied by the PHCN and individuals who can afford the use of generators to generate their own power. There is a post office in the community and the GSM telecommunication facilities of various networks are available in the area.

Obollo Afor community is in Udenu Council Area of Enugu state. Situated at the Northern part of Nsukka town, it was formerly the centre of the palm oil trade in the eastern part of the country. Obollor Afor is the Local Government Headquarters of Udenu Local Government Area. Obollo-Afor is the most popular of the Obollo family due to its strategic location along the northern part of the nation.

Plate 4.18 Consultation with the Eze of Obollo and some members of the community

There are various educational institution ranging from nursery, primary, secondary and tertiary institution. Amutenyi Primary School, St. Patrick's School, Obollo-Afor, Central School Ibenda Obollo, Central School, Obollo-Afor, Ogwu primary school, obollo afor boys high school, Girls secondary school, Obollo-Afor, Enugu, Obollo-Afor Secondary School.

There are several health facilities identified in the area. The most prominent among them is Our Lady of Lourdes (Mission Hospital). There are four (4nos) Health Centers and one under construction. Private Hospital and Clinics are also available.

Most roads observed in the area are untarred earth roads. Transportation is mostly by road and the people use cars, buses, motorcycles (private and commercial) and

bicycles. Electricity is being supplied by the PHCN and individuals who can afford the use of generators to generate their own power. There is a post office in the community and the GSM telecommunication facilities of various networks are available in the area.

Orba community is one of the numerous communities located along the Makurdi – 9th Mile axis of the road planned for rehabilitation and is located in Udenu L.G.A. of Enugu State. Most roads observed in the area are untarred earth roads. Transportation is mostly by road and the people use cars, buses, motorcycles (private and commercial) and bicycles. Electricity is being supplied by the PHCN and individuals who can afford the use of generators to generate their own power. There is a post office in the community and the GSM telecommunication facilities of various networks are available in the area.

Nsukka is a town and the name of a Local Government Area in Enugu State. Nsukka Town is known as the site of the University of Nigeri, the first indigenous Nigerian University. Currently the town has a number of Federal Parastatals in the University such as NABDA, CBSS, and the Energy Research Centre. There are a good number of tarred roads in Nsukka town. Transportation is mostly by road and the people use cars, buses, motorcycles (private and commercial) and bicycles. Electricity is being supplied by the PHCN and individuals who can afford the use of generators to generate their own power. There is a post office in the community and the GSM telecommunication facilities of various networks are available in the area. Nsukka has some of the most recognized educational institutions in south-eastern Nigeria including: St. Theresa's College Nsukka (all boys) right at the heart of Nsukka and run by the Catholic Church is one of the oldest in Nsukka township, Nsukka High School with Anglican Church heritage, Queen of the Holy Rosary Secondary School-Catholic Church perspective, St Cyprian's Special Science School Nsukka, which is an all science boarding school for girls, and Urban Girls Secondary School, among many others.

In addition, there are many other educational institutions ranging from nursery, primary, secondary and tertiary institution. Some of these schools include; OBFO

International Academy Boy's Secondary School Nru, Nsukka Federal Government Girls College,Nsukka,Enugu Government Technical College, Nsukka Government Technical College, Nsukka, model secondary school nsukka, Nsukka High School, Opi Boys Sec. school, Opi, Nsukka, Enugu, Urban Girls' Secondary School, among others.

Ozalla Uwelu is an autonomous community in Igbo-Etiti local government area of Enugu State. There are various educational institution ranging from nursery, primary, secondary and tertiary institution. There are about 15 primary schools, most of which are private schools. There are also a number of public primary schools in the area. There are about 4 secondary schools in the community. There are several health facilities identified in the area. Private hospitals and clinics are also available.

Most roads observed in the area are untarred earth roads. Electricity is being supplied by the PHCN and individuals who can afford the use of generators to generate their own power. There is a post office in the community and the GSM telecommunication facilities of various networks available in the area.

Ogbede community is in Igbo Etiti Local Government Area of Enugu State. Although the community is relatively small, there are about three public primary schools and two community secondary schools in operation. Rate of enrolment as well as attendance is high amongst the pupils which could be attributable to high level of educational benefits.

Health facilities/Institutions operating in the community include the Community Health Centre Igbo Etiti (Federal Government owned), Federal Health ports 1 – 6 attached to churches and Private hospitals operate side by side.

4.11.8.3 Occupational Activities

The people of Ogeneago and Otukpa communities are predominantly rural and farmers whose major crops are yam, cassava, cocoyam, plantain, palm oil, palm wine. Major livestock bred are poultry, goat and sheep. The only industry in the community is Durugo and Company Ltd. There are no estates, hotels and guest houses or banks in this community.

Ublegi is another rural settlement and that no industrial activity was identified in the community except small scale welding industries, Slaughter houses and small scale palm processing industries. No Hotels or guest houses were identified in the town and also no bank is located in the area.

Orakam community people are very hard working and engage in various forms of occupational activities for their sustenance. A side of trading, various Hotels and guest houses were identified in the town as sources of income and revenue to the inhabitants. To boost these activities, there is Microfinance bank in operation within the town which serve both as deposit and credit services organization.

The Obollo people are agriculturalists and grow such crops as cassava, yams, cocoyam, cashew and palm kernels which they carry to the market places to be sold. The dry season affords the people the opportunity to engage in bush burning. After the burning of bushes, breaking of the ground follows immediately to give way for planting. Planting is therefore ready to be embarked on. Pottery and basket making is also common among the people. They also reared animals like goats which were in high demand. There is also a microfinance bank in Obollo and a big market called Afor market. Various Hotels and guest houses were identified in the town.

Orba community is virtually a semi-urban setting although it has well enlightened population; modern industry which involves manufacturing does not exist. However, service activities such as commerce inform of trading, Hotels and guest houses were identified in the town.

Commercial activity in Nsukka is moderate and dominated by trading in goods and provision of services in areas of hotels and guest houses. Other areas include civil services operation of restaurants, pharmercies , among others.

Ozalla Uwelu and Ogbede people engage in various occupations which include trading, civil service, farming and other artisanal works. There are also trained professionals from all works of life such as engineers, doctors, lawyers, etc. Most people who engage in other occupations also engage in subsistence farming while some people are into full time farming. The crops that are commonly cultivated in the area include yam, maize cassava, cocoa yam and vegetables. Some people also engage in live stock farming such as poultry and piggery, fishery, etc. Most households engage in rearing of some domestic animals, such as goats, fowl, dogs.

Plate 4.19 Basket Weaving along Ugbokolo-Enugu Road and Petty Trading at 9th Mile near Enugu

4.11.8.4 Health and Sanitation

The health facilities identified in Ogeneago, Ublegi, Orakam, Obollo Afor, Ozalla Uwelu, Ogbede and Orba Communities include one Health Center and Private Clinics and maternity. There are a number of health facilities identified in Otukpa Community include private clinics and maternity. The most prominent among them is Our Lady of Lourdes (Mission Hospital) Obollo Afor. There are several health facilities identified in Nsukka. Bishop Shanahan Hospital and Mount Arafat Hospital are among the private facilities.

4.11.8.5 Issues raised by People interviewed at Ugbokolo

The communities were very excited about the plan to boost communication was long over-due. For this reason, they raised neither objection nor complaint but wished that the project will be executed as proposed. They also expressed its hope that the contractor would employ their youths for the road rehabilitation project.

Plate 4.20 Interview Session at Ugbokolo, Benue State

Route 6: Enugu (Booster Station) – Enugu (Metro)

4.11.9.1 Settlements Along Route

This route is entirely within Enugu metropolis. This route covers the booster station (upload and download) located along Okpara road to the Federal Secretariat in Enugu Metropolis.

4.11.9.2 Institutional Infrastructure

There are numerous educational institutions ranging from nursery, primary, secondary and tertiary institutions prominent among them include: Institute of Technology Enugu. Similarly, there are several health care facilities in Enugu. Enugu is home to a number of Federal Parastatals.

Plate 4.21 Federal Secretariat Enugu

4.11.9.3 Occupational Activities

As the headquarters of the Former Eastern Region, capital of former Anambra State and now capital of Enugu State, Enugu is one of the commercial hubs of Nigeria. Enugu is home to modern industry which involves manufacturing and service industy activities such as commerce inform of trading, Hotels and guest houses were identified in the town. Most residents are civil servants.

Plate 4.22 Economic Activities in Enugu

4.11.9.4 Health and Sanitation

Enugu is well provided with primary, secondary and tertiary health care facilities which are both privately and public owned. Prominent among which is the University of Nigeria Teaching Hospital Enugu,

4.11.9.5 Issues raised by People interviewed at Enugu

Residents were very excited about the plan to boost internet services and communication and that it was long over-due. For this reason, they raised neither objection nor complaint but wished that the project will be executed as proposed. They also expressed the hope that the contractor would employ their youths for the road rehabilitation project and that any property that would be affected should be dully and fully compensated.

Plate 4.23 Interview Session at Enugu Upload and Download Station

Route 7: Enugu to Awka

4.11.10.1 Settlements Along Route

The communities laying along this route include: Enugu, Ngwo, Akama Ngwo, Nwankwo Ngwo, Nchanawa, Ogwufia Owa, Omugwa Owa, Ezema Owa, Umuaji, Umumba Ndienu, Chumaba, all in Enugu North Local Government Area; Ndiagu, Obinofa Ndiagu, Mkpagu, all in Ezeagu Local Government Area; and Ugwuoba in Orji Local Government Area of Enugu State; Awka, Amansea Awka, Nnamdi Ezikiwe Uni. Awka, all in Awka North Local Government Area; Umuokpu and Awka Town in Awka South Local Government Area of Anambra State.

4.11.10.2 Institutional Infrastructure

There are numerous educational institutions ranging from nursery, primary, secondary and tertiary institutions prominent among them include: Nnamdi Azikiwe University Awka Similarly, there are several health care facilities in Awka. Awka is home to a number of Federal Government Parastatals one of which is the Federal Government Secretariat the host of the upload and download station at Awka. The Enugu-Awka road is really in a terrible shape. Awka, the Anambra State capital is well provided with good networks of roads and there so many undergoing construction and repairs.
Awka is well provided with primary, secondary and tertiary health care facilities

Plate 4.24 Federal Secretariat at Awka and Anambra State Secretariat at Awka

4.11.10.3 Occupational Activities

Most residents of Awka are civil servants and with some engaged in small and medium scale business. Most residents of Ezeagu and Orji Local Government Areas along the Enugu-Awka route are farmers with women engaged in petty trading and operating hospitality services.

4.11.10.4 Health and Sanitation

Awka is well provided with primary, secondary and tertiary health care facilities which are both privately and public owned. Prominent among which is the Nnamdi Azikiwe University Teaching Hospital Awka.

4.11.10.5 Issues raised by People interviewed at Awka

Residents along this route were very excited about the plan to boost internet services and communication and that it was long over-due. For this reason, they raised neither objection nor complaint but wished that the project will be executed as proposed. They also expressed the hope that the contractor would employ their youths for the road rehabilitation project and that any property that would be affected should be dully and fully compensated.

Route 8: Awka to Onitsha

4.11.11.1 Settlements Along Route

Settlement along this route include: Ukpo, Abba in Dunukofia Local Government Area; Njikoka in Njikoka Local Government Area; Awkuzu, Umunya, Nteje, Ifite Nteje, Umunya, Isioye Umunya, Tansian Uni. Umunya, all in Oyi Local Government Area of Aambra State.

4.11.11.2 Institutional Infrastructure

Onitsha is a foremost city in eastern Nigeria. There are numerous educational institutions ranging from nursery, primary, secondary and tertiary institutions in Onitsha. Similarly, there are several health care facilities in Onitsha. Onitsha is well provided with primary, secondary and tertiary health care facilities

4.11.11.3 Occupational Activities

Most residents of Onitsha are businessmen and women and with many engaged in small and medium scale business. There are few civil servants in Onitsha mostly local government workers. Most women in Onitsha engaged in petty trading and operating hospitality services. Onitsha is the commercial nerve of eastern Nigeria.

Plate 4.25 A Bussy Street in Onitsha and A Bussy Street in Onitsha

4.11.11.4 Health and Sanitation

Onitsha is well provided with primary, secondary and tertiary health care facilities which are both privately and public owned. Waste management is a major environmental problem in Onitsha.

4.11.11.5 Issues raised by People interviewed at Onitsha

Residents along this route were very excited about the plan to boost internet services and communication and that it was long over-due. For this reason, they raised neither objection nor complaint but wished that the project will be executed as proposed. They also expressed the hope that the contractor would employ their youths for the road rehabilitation project and that any property that would be affected should be dully and fully compensated.

Plate 4.26 Niger Bridge at Onitsha

Route 9: Onitsha- Asaba

4.11.12.1 Settlements Along Route

Settlements along this route include the following communities: Elenchere Asaba in Oshimili South Local Government Area; Asaba in Oshimili North Local Government Area of Delta State.

4.11.12.2 Institutional Infrastructure

Asaba is the capital of Delta State. There are numerous educational institutions ranging from nursery, primary, secondary and tertiary institutions in Asaba. Similarly, there are several health care facilities in Asaba. Asaba is well provided with primary, secondary and tertiary health care facilities.

4.11.12.3 Occupational Activities

Most residents of Asaba are civil servants and businessmen and women and with many engaged in small and medium scale business. Most women in Asaba engaged in petty trading and operating hospitality services. Asaba is a civil servant town.

4.11.12.4 Health and Sanitation

Asaba is well provided with primary, secondary and tertiary health care facilities which are both privately and public owned. Waste management is a major environmental problem in Asaba.

4.11.12.5 Issues raised by People interviewed at Asaba

Residents along this route were very excited about the plan to boost internet services and communication and that it was long over-due. For this reason, they raised neither objection nor complaint but wished that the project will be executed as proposed. They also expressed the hope that the contractor would employ their youths for the road rehabilitation project and that any property that would be affected should be dully and fully compensated.

Route 10: Asaba-Benin

4.11.13.1 Settlements Along Route

Settlements along this route include the following communities: Onkpanan, Issele Azagba, Edo-Ogwashi, Onocha Olona, Ogwashi-Uku, Ubulu-Uku, Issele-Uku, Udumuje Ugboko, Igbodo, Ekwuoma, Umunede, Emuhu, Agbor, Ihu-Iyase Agbor, Omumu, Alifekede, all in Aniocha North, Îka north East and Ika South Local Government Areas of Delta State; Ogan, Abudu, Owa, Uvbe, Okhukhou, Aduhana, Ikweneiro, Ikpoba Itiu, Orio Ozuola, Ugbemudia, Utekon, Benin, all in Orhionmo, Uhunmwonde, Ikpoba Okha Local Government Areas of Edo State.

4.11.13.2 Institutional Infrastructure

Benin is the capital of Edo State. There are numerous educational institutions ranging from nursery, primary, secondary and tertiary institutions in Benin one of which is the University of Benin. Similarly, there are several health care facilities in Benin. Benin is well provided with primary, secondary and tertiary health care facilities such as the University of Benin Teaching Hospital. Most of the road networks are undergoing renovation and dualization.

Plate 4.27 Federal Secretariat Benin City and Benin – Auchi road undergoing dualization

4.11.13.3 Occupational Activities

Most residents of Benin are civil servants and businessmen and women and with many engaged in small and medium scale business. Most women in Benin engaged in petty trading and operating hospitality services. Benin is famous for its arts which is universally renowned.

4.11.13.4 Health and Sanitation

Benin is well provided with primary, secondary and tertiary health care facilities which are both privately and public owned. Waste management is a major environmental problem in Benin.

4.11.13.5 Issues raised by People interviewed at Benin

Residents along this route were very excited about the plan to boost internet services and communication and that it was long over-due. For this reason, they raised neither objection nor complaint but wished that the project will be executed as proposed. They also expressed the hope that the contractor would employ their youths for the road rehabilitation project and that any property that would be affected should be dully and fully compensated.

Route 11: Benin- Ore

4.11.14.1 Settlements Along Route

Settlements along this route include the following communities: Ovbiogie, Ekadolor, Obua, Iguawa, Okada Junction, Ugbogui, Ohosu, Evonogbon, all in Egor, Ovia north east, Ovia south west Local Government Areas of Edo State; Ofosu, Aghejire, Alagbado, Ago-Gboro, Ore, all in Idanre and Odigbo Local Government Areas of Ondo State.

4.11.14.2 Institutional Infrastructure

There are numerous educational institutions ranging from nursery, primary, secondary and tertiary institutions along this route particularly at Ore. Ore is well provided with primary, secondary and tertiary health care facilities.

4.11.14.3 Occupational Activities

Most residents of this route are subsistence farmers and women engage in petty trading. There are artisans of different trades.

4.11.14.4 Health and Sanitation

Ore is well provided with primary, secondary and tertiary health care facilities which are both privately and public owned. Waste management is not a major environmental problem in Ore.

4.11.14.5 Issues raised by People interviewed at Benin

Residents along this route were very excited about the plan to boost internet services and communication and that it was long over-due. For this reason, they raised neither objection nor complaint but wished that the project will be executed as proposed. They also expressed the hope that the contractor would employ their youths for the road rehabilitation project and that any property that would be affected should be dully and fully compensated.

Route 12: Ore-Ijebu Ode

4.11.15.1 Settlements Along Route

Settlements along this route include the following communities: Ore Agro business center, Obatedo Agoaye, Omotosho power plant, Obatedo, Ajibandele, all in Ijebu East and Ijebu Ode Local Government Areas of Ogun State.

4.11.15.2 Institutional Infrastructure

There are numerous educational institutions ranging from nursery, primary, secondary and tertiary institutions along this route particularly Ogun State University at Agoaye, Omotosho power plant, among others.

4.11.15.3 Occupational Activities

Most residents of this route are subsistence farmers and women engage in petty trading. There are artisans of different trades.

4.11.15.4 Health and Sanitation

Ijebu-Ode is well provided with primary, secondary and tertiary health care facilities which are both privately and public owned. Waste management is not a major environmental problem in Ore.

4.11.15.5 Issues raised by People interviewed at Benin

Residents along this route were very excited about the plan to boost internet services and communication and that it was long over-due. For this reason, they raised neither objection nor complaint but wished that the project will be executed as proposed. They also expressed the hope that the contractor would employ their youths for the road rehabilitation project and that any property that would be affected should be dully and fully compensated.

4.11.16.1 Settlements Along Route

Settlements along this route include the following communities: Odogbodu Junction, Ikenne-Remo Junction, Iperu, Sagamu, all in Odogbolu, Ikenne and Shagamu Local Government Areas of Ogun State; ad Ikeja, Kosofe, Shomolu, Lagos mainland, Lagos island, Eti Osa, Ibeju lekki Local Government Areas of Lagos State.

CHAPTER FIVE
ASSOCIATED AND POTENTIAL IMPACTS

5.1 INTRODUCTION

This chapter discusses the associated and potential impacts of the Optic Fibre project as instituted by the National Information Communication Technology Infrastructure Backbone (NICTIB is described in Chapter 3 of this Report.

The impacts are discussed in relation to project interactions with the biophysical, social and health characteristics of the project environment. The chapter presents an overview of the impact assessment methodology as well as results of impact screening followed by detailed qualitative and quantitative impact assessments.
Both associated impacts (i.e., those that will occur) and potential impacts (i.e., those that could occur) are assessed.

The impact assessment approach utilizes elements of various impact identification and prediction methods that have been developed and tested over time such as checklists, matrices, flowcharts, networks, mathematical and statistical models, as well as overlays using maps and Geographical Information Systems (GIS).

The approach is a mix of elements drawn from these techniques, and it meets the following criteria for EIA methodology as identified by SCOPE (1979). The approach:

- Is comprehensive
- Is selective
- Is exclusive
- Gives confidence limits to the predictions
- Is objective; and
- Predicts interactions

The impact assessment methodology is discussed further in Section 5.2. The results of the impact assessment are discussed in subsequent sections.

5.2 METHODOLOGY

This section discusses the overall methodology used to identify, qualify and quantify the impacts of the proposed Optic Fibre project on the host environment. The overall methodology comprises five stages (Figure 5-1).

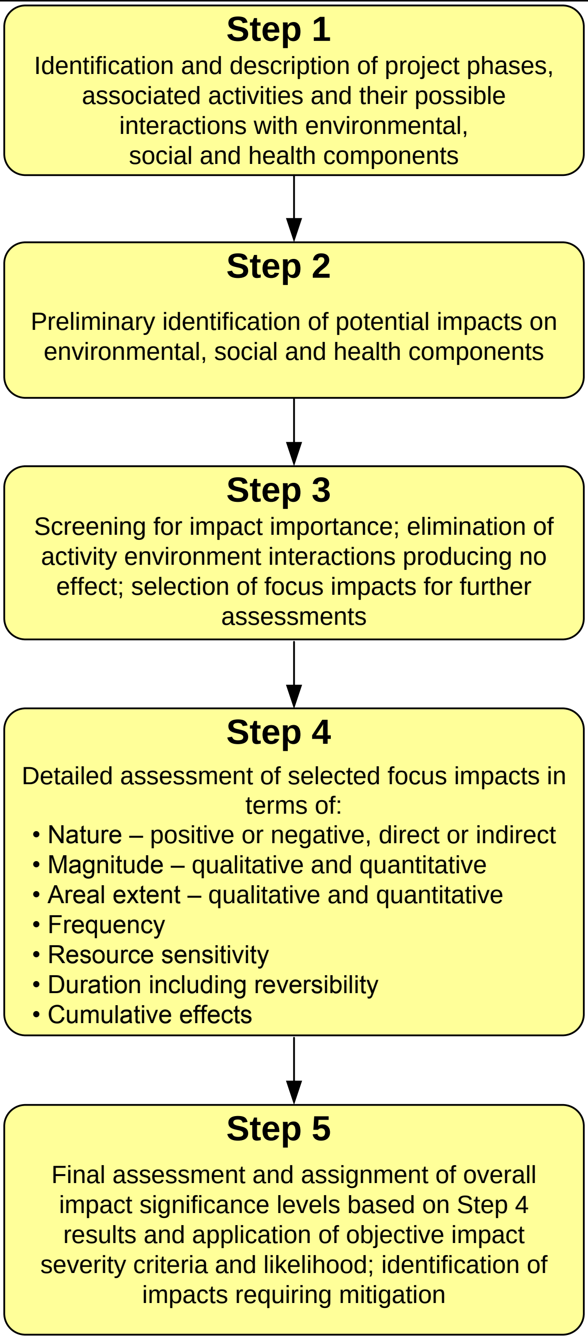


Figure 5 1: Impact Assessment Process

5.2.1 Activities and Affected Media

The analysis of impacts covers the following project phases and associated activities of the project:

- Clearing and Excavation Activities
- Shore-based Construction Works
- Fibre route Construction
- Installation and Commissioning

- Operations
- Decommissioning

For each project phase, potentially affected environmental media are identified and the nature of the effects are qualified and quantified. Chapter 3 provides a summary of the schedule of the proposed activities as well as estimated labour levels.

To aid the impact analyses, individual activities have been identified for each project phase and discussed in relation to their interactions with various environmental components. Two areas are however discussed in the context of all project phases:

- Wastes and emissions handling; and
- Health effects.

5.2.2 Preliminary Identification and Screening

In line with recommended impact assessment approaches (FMEnv, 1995; UNEP, 1996; Canter, 1996; DPR 2002, Lohani*et al*., 1997) the first level of impact assessment involves the preliminary identification and screening of potential environmental impacts by anticipating activity-environment interactions. This requires a thorough understanding of the project activities (project description), the project setting (the environmental and social characteristics), and the interaction with environmental components. A modified Leopold matrix (Leopold, 1971) was used for the identification and screening. The matrix arrays project activities against environmental (biophysical, social and health) components, and supports a methodical, comprehensive, and objective identification of the impacts that each distinct project activity may have on the biophysical, social, and health components.
Impact identification is based on Wathern (1988), who defines an impact as “having both spatial and temporal components and can be described as the change in an environmental parameter over a specified period within a defined area, resulting from a particular activity compared with the situation which would have occurred had the activity not been initiated”.

To further guide the identification and screening of impacts using the matrix, established environmental impact indicators or indices are developed for each of the environmental interaction categories. Impact indicators are the observable or measurable parameters of each environmental component that can be directly or indirectly linked to changes in environmental conditions. Table 5.1 gives the specific environmental components and sub-elements used and a description of the indicators.
The integrated impact assessment is conducted with consideration of environmental, social and health elements and has therefore utilized procedures specific to each element where applicable. For example, the health aspects considered procedures of Samuel *et al*. (1998) and Commonwealth of Australia (2001) in the approach. In general though, the impact identification and assessment methodology has integrated the procedures into a single approach.

Table 5.1: Environmental, Social and Health Components and Impact Indicators

Components	Impact Indicators
Biophysical	
Geology	Changes to geology, geomorphology, topography
Soil	Changes to physical and chemical properties and soil ecology
Surface Water	Changes to water quality indices, (physicochemical properties, hydrocarbons, metals and hydrobiology); Introduction of exotic species, changes in habitat quality, abundance, diversity; Effluent discharge
Hydrobiology and Fisheries	Changes in water quality, changes in fisheries productivity
Vegetation	Changes to vegetation population, health, species abundance and diversity and impact on endangered and economic species, food chain effects
Wildlife	Changes to wildlife assemblages, impact on endangered and economic species, food chain effects
Air	Emissions of NO_x, SO_x, PM, CO, VOC, greenhouse gases (CO_2, CH_4, and N_2O), ozone and changes to ground level concentrations of pollutants
Vibration and Noise	Change in noise or vibration levels at sensitive receptors
Aesthetics	Physical presence of facilities, increased night time light
Groundwater	Contamination of shallow or deep groundwater resources, change in ground water resources
Social	
Population	Changes in population indices, total population, gender ratio, age distribution
Infrastructure	Improvement or pressure on existing urban/rural infrastructure including waste handling facilities
Macro and Micro economy	Change in macro and micro economy, employment, standard of living, occupation
Social and Cultural Structure	Disruption in local authority and governance structure; change in social behaviours; intra and inter ethnic clashes;
Physical and Economic Displacement	Permanent physical displacement from residence as a result of project land take, or activities; permanent or temporary displacement from land or water based livelihood activities; partial or whole severance from social and cultural networks
Cultural and Archaeological resources	Physical disturbance of shrines, burial grounds, archaeological resources or other desecration

Table 5.1: Environmental, Social and Health Components and Impact Indicators

Components	Impact Indicators
Transportation	Alteration in means of transportation or ability to move efficiently
Education	Change in primary, secondary and tertiary education school enrolment and attendance
Health Determinants	
Pollution Related Health Effects	Increase in concentration of, and exposure to non ionizing radiation, air pollutants of concern (NOx, SOx, VOC, CO, PM), contamination of surface waters and potable ground water, increased vibration and noise beyond regulatory limits, increased night time light beyond acceptable limits.
Communicable and Non Communicable Diseases	Change in incidence of communicable and non-communicable diseases or disease causing factors
Morbidity and Mortality	Change in health of workers and of general public, change in security of the area
Nutritional status	Changes to nutritional status
Health Care/Recreational Facilities	Changes in availability of and access to health care and recreational facilities
Psychosocial factors	Drug use/abuse, communal violence, crime, suicide, depression and prostitution; changing expectations of quality of life
Fertility	Changes to fertility levels, changes in birth rates
Accidents/Fires/Explosions	Changes to rate of occurrence and severity of accidents/fires/explosions

Modified Leopold Matrix Screening

The modified Leopold impact matrix (Table 5.2) consists of a horizontal list of biophysical and social environment components that could be affected by the proposed project activities versus a vertical list of project activities, which represent environmental aspects, or "sources of impact," associated with each sub project phase. Environmental aspects are elements of an activity that can or will interact with the biophysical, social and health conditions within the area of influence.

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

- Major: 2
- Minor:1
- Negligible or no effect: - (*a dash*)
- Positive: +

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

- A **Major impact** is one that would affect a large (higher than 40%) amount of a resource and or have a relatively large footprint and persist for a long time or is irreversible.
- A **Minor impact** is one that could either affect a large (as defined above) or moderate (less than 40%) amount of an affected resource, has a mid to long term effect (1 to 10 years) but is most likely reversible.
- A **Negligible impact** is one that may occur but based on experience, available scientific information and expert knowledge will have no measurable effect on the environmental component.
- A **Positive** impact is one that adds a measurable benefit to the immediate and larger project environment including its social, cultural and health dimensions.

All number entries denote negative impacts. Cells with both positive sign (+) and numbers indicate that the specific activity and environment interaction will potentially result in both a positive and negative impact.

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

- Available knowledge of the project activities;
- Documented impacts of similar projects in similar environments;
- Consultation with experts;
- Discussions with Optic Fibre project personnel; and
- Professional judgment.

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

5.2.3 Detailed Assessment of Impacts

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

- Federal Ministry of Environment (FMEnv) EIA Guidelines;

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

The impact assessment approach applied to the Optic Fibre Project also incorporates additional impact quantification steps.

Table 5.2: Screening Matrix for Potential Impacts (Biophysical and Social Impacts)

PROJECT PHASES AND ACTIVITIES	Biophysical Impact Indicators											Social Impact Indicators							
	Geology / Topography	Soil	Surface Water	Hydrobiology and	Vegetation	Wildlife	Air /Radiation	Vibration and Noise	Aesthetics	Groundwater	Sediments	Population	Infrastructure	Macro and micro	Social and Cultural	Physical and Economic Displacement	Cultural and	Transportation	Education
Clearing and Site Excavation Activities																			
Physical Presence of Workers, Equipment and Materials on Site	-	1	1	-	-	-	-	1	-	1	-	1	1	1	1	2	1	1	1
Transportation of Workers and Materials	-	-	1	1	-	-	1	-	-	-	-	-	-	+, 1	-	+, 1	-	1	-
Site Clearing	-	1	1	1	2	2	1	1	-	-	-	-	-	+	1	1	1	1	-
Excavation	2	-	2	2	-	-	1	1	-	-	2	-	-	2	-	2	-	1	-
Wastes and Emissions Handling and Disposal	2	1	2	2	2	1	1	1	-	-	2	-	1	2	-	2	-	-	-
Onsite Construction Works																			
Physical Presence of Workers, Equipment and Materials on site	-	-	1	1	-	-	1	1	-	1	1	1	1	+, 1	1	1	1	-	1

Table 5.2: Screening Matrix for Potential Impacts (Biophysical and Social Impacts)

PROJECT PHASES AND ACTIVITIES	Biophysical Impact Indicators											Social Impact Indicators							
	Geology / Topography	Soil	Surface Water	Hydrobiology and	Vegetation	Wildlife	Air /Radiation	Vibration and Noise	Aesthetics	Groundwater	Sediments	Population	Infrastructure	Macro and micro	Social and Cultural	Physical and Economic Displacement	Cultural and	Transportation	Education
Transportation of Workers and Materials	-	-	1	1	-	-	1	1	-	-	-	-	-	+, 1	-	1	-	1	-
Wastes and Emissions Handling and Disposal	-	1	1	1	-	-	1	-	-	1	1	-	-	+, -	-	-	-	-	-
Construction Activities																			
Optic Fibre Line Construction	1	1	-	-	2	-	1	1	-	-	-	-	-	+, 1	-	1	1	1	1
Transmission Line Construction	-	1	-	-	2	-	1	1	-	-	-	-	-	+, 1	-	1	1	1	1
Civil Works	-	-	1	1	-	-	1	1	-	1	-	-	-	+, 1	-	-	-	-	1
Installation, Hook Up and Commissioning																			
Operations																			

Table 5.2: Screening Matrix for Potential Impacts (Biophysical and Social Impacts)																			
PROJECT PHASES AND ACTIVITIES	Biophysical Impact Indicators											Social Impact Indicators							
	Geology / Topography	Soil	Surface Water	Hydrobiology and	Vegetation	Wildlife	Air /Radiation	Vibration and Noise	Aesthetics	Groundwater	Sediments	Population	Infrastructure	Macro and micro	Social and Cultural	Physical and Economic Displacement	Cultural and	Transportation	Education
Equipment Operations	-	-	-	-	-	-	2	2	2	1	1	-	+	+	-	+	-	-	+
Optic Fibre Transmission Line	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wastes and Emissions Handling and Disposal	-	-	1	1	-	-	2	2	-	-	-	-	1	+	-	-	-	-	-
Decommissioning																			
Removal of Installed Facilities	1	1	1	1	1	-	1	1	-	1	1	-	-	+, 1	-	+,1	-	+, 1	-
Wastes and Emissions Handling and Disposal	-	1	1	1	-	-	1	1	-	1	1	-	-	+, 1	-	+,1	-	-	-

5.2.3.1 Impact Severity Evaluation

During detailed assessment, five criteria were used to assess the severity of the environmental (biophysical, social, and health) impacts that were not screened out in the earlier steps.

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

- Biological and physical environment
- Social environment
- Health and Safety of the public or workers

The detailed assessment of impacts involved evaluating the potential effects of project activities on the impact indicators but in greater detail. Impacts were assessed as to whether they are positive (beneficial) or negative (detrimental). Only negative impacts were given detailed assessment.

5.2.3.2 Evaluation Criteria

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

Note that characterization of an impact includes the criteria for negligible. This would be applied when an impact characteristic either does not apply or when it is so low so as not to be noticed. In general, impact effects need to be observed to pass the initial screening but negligible is used in some instances and a negligible rating would be considered in deriving the overall impact severity. The term is omitted from the impact assessment matrix table that follow this section, but the criteria are described in the preceding text.

The following describes the severity rating criteria.

Magnitude

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

- High - large amount of the resource or population is affected; easily observable and measurable effect

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

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

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

Duration

Duration is defined as the time that is estimated for a population or resource to return to baseline conditions (i.e., before the impact). The duration is calculated from the time the impact begins, which may coincide with the start of the activity that causes the impact. The duration of an impact is characterized as follows:

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

Characterization of the duration of an impact as low, medium, or high includes consideration of the degree of reversibility of the impact. Impacts for which the duration is classified as high, as defined above, are considered irreversible impacts.

Frequency

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

- High – impact will occur continuously throughout the life of the project (e.g., continuous process wastewater discharge)
- Medium – impact will occur intermittently over the life of the project (e.g., blow down, flaring and venting)
- Low - impact will occur rarely or a very limited number of times (e.g., construction impacts)

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

Extent

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

- High – impact has influence well beyond the project environment to the regional or even global environment
- Medium – impact limited to the general vicinity of the project site or study area
- Low – impact limited to the immediate area of the activity or occurrence
- Negligible – impact limited to a very small part of the activity area

Sensitivity

Sensitivity refers to economic, social, and/or environmental/ecological relevance of the receptor, including the intrinsic sensitivity of the resource, reliance on the receptor by people for sustenance, livelihood, cultural significance or economic activity, and to the importance of direct impacts to persons associated with the resource.

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

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

5.2.3.3 Impact Significance

The following section describes the method by which the overall impact severity rating and associated impact significance is derived.

Impact Severity Rating

To reach an overall impact severity rating for each impact assessed, the five impact severity criteria above are aggregated using impact severity matrices. Aggregation is at three levels.

First, magnitude and areal extent are combined to arrive at a rating for the Impact Quantum while duration and frequency are aggregated to give the overall Temporal Effects. Impact Quantum and Temporal Effects are then combined and their resulting aggregate assessed in terms of sensitivity to arrive at the overall impact severity. Table 5.3, Table 5.4, and Table 5.5 show the aggregation process.

Impact Likelihood

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

It should be noted that the likelihood criteria are applied to the likelihood of the impact occurring and not of the activity occurring. Thus the overall severity rating (significance) of a negative environmental impact is a function of its severity as earlier defined and the likelihood of occurrence as defined in the table. For example, a moderate impact that has a high likelihood of occurrence would be more severe than a major impact with a very low likelihood of occurrence. Assigning a significance ranking and a likelihood ranking to each impact allows for semi-quantitative evaluation of the severity of the impact. The colour coded impact severity matrix presented in (Table 5.6) illustrates the application of the impact severity and likelihood. The likelihood ranking is placed in the y-axis and the impact significance ranking in the x-axis. The colour codes are also used in the text discussing each impact assessed using this method.

Overall Impact Significance

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

The criteria are summarized in Table 5.3.

Table 5.3: Impact Assessment of Spatial Effects

SPATIAL EFFECTS			
Magnitude	**Areal Extent**		
	Low	**Medium**	**High**
Low	Low	Medium	Medium
Medium	Low	Medium	High
High	Medium	High	High

Table 5.4: Impact Assessment of Temporal Effects

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

Table 5.5: Impact Assessment of Combined Spatial and Temporal Effects

COMBINED SPATIAL AND TEMPORAL EFFECTS			
TEMPORAL EFFECTS	**SPATIAL EFFECTS**		
	Low	**Medium**	**High**
Low	Low	Low	Medium
Medium	Low	Medium	High
High	Medium	High	High

Table 5.6: Overall Impact Assessment Severity (Combined Spatial and Temporal Effects and Sensitivity)

IMPACT ASSESSMENT AND SENSITIVITY			
SENSITIVITY	**COMBINED SPATIAL AND TEMPORAL EFFECTS**		
	Low	**Medium**	**High**
Low	Minor	Minor	Moderate
Medium	Minor	Moderate	Major
High	Moderate	Major	Major

Table 5.7: Overall Impact Significance

OVERALL SIGNIFICANCE				
LIKELIHOOD	**SEVERITY**			
	Positive	**Minor**	**Moderate**	**Major**
Low	BENEFICIAL	LOW	LOW	MODERATE
Medium	BENEFICIAL	LOW	MODERATE	HIGH
High	BENEFICIAL	MODERATE	HIGH	HIGH

Table 5.8: Summary of Impact Severity						
	SPATIAL EFFECTS		**TEMPORAL EFFECTS**		**SENSITIVITY**	**LIKELIHOOD**
	Magnitude	**Areal Extent**	**Frequency**	**Duration**	**Receptor**	**Likelihood**
High	Large amount of resource or population affected; easily measurable; or greater than the quantitative or semi-quantitative criteria	Impact to the national, regional, or global environment	Impact will occur continuously throughout the life of the project	Impact is long-term; recovery would not occur within ten years	Receptor is of high economic, social, and/or environmental relevance; has very high intrinsic sensitivity	Impact is likely to occur during normal operations (i.e., greater than 70% likelihood of occurring or has been known to result routinely, though not necessarily in all similar circumstances)
Medium	Moderate amount of resource or population affected; generally measurable or observable; or at the quantitative or semi-quantitative criteria	Impact to the general vicinity of the project site or study area	Impact will occur intermittently over the life of the project	Impact is moderate-term and recovery will occur between one year and ten years	Receptor is of moderate economic, social, and/or environmental relevance; has moderate intrinsic sensitivity	Impact could occur infrequently during construction or normal operations, but could occur more readily if safeguards and controls breakdown (i.e., between approximately 20% to 70% likelihood of occurring or impact has been known to result in similar circumstances)
Low	Small amount of resource or population affected; or less than the	Impact limited to the immediate vicinity of the activity or occurrence	Impact will rarely occur or will occur on a limited number or occasions	Impact is short-term and recovery will occur in less than one year	Receptor is of low economic, social, and/or environmental relevance; has low intrinsic sensitivity.	Impact highly unlikely, given the controls in place (i.e., between approximately 2% to 20% likelihood of

	quantitative or semi-quantitative criteria; may be in the range of normal					occurring or impact has been known to result, but only very rarely, in similar circumstances
Negligible	Amount of resource or population affected is unnoticeable or immeasurably small; or impact not detected or at background conditions	Impact limited to a very small part of the activity area	Impact never occurs or impact is not possible	Impact is very short term and recovery is nearly immediate	Receptor is not of economic, social, and/or environmental relevance; has no sensitivity to impact	Impact has approximately less than 2% likelihood of occurring; impact unknown to have previously occurred in similar circumstances

5.2.4 Project Associated and Potential Impacts

The associated (i.e., known) and potential impacts discussed in the following sections are those activity-environment interactions in the impact matrix, which have entries as either “1”, “2” or “+” and therefore were not screened out.

For easier reading and to avoid repetition, the discussion of the detailed impact analyses is presented under project phases and key project activities. Impact identification prefixes have also been assigned to each impact discussion for ease of reference. Impacts are discussed under two main phases:

- **Pre-Operations Impacts** – these are those impacts that are applicable to all project activities, which take place prior to the commissioning and operations of the power plant. Project Activities under Pre-operations are:
  - PP = Physical Presence of Workers and Equipment
  - TR = Transportation of Workers and Materials to Site
  - SC = Site Clearing and Preparation
  - CR = Onsite Construction Works;
  - EX = Excavation
  - HC = Hook Up and Commissioning;
  - WE = Wastes and Emissions Handling and Disposal

- **Operations Impacts**– these are impacts applicable only to the operations phase. Project activity impacts discussed under this phase are:
  - OM = Operations and Maintenance
  - OP = Optic Fibre Line
  - WE = Wastes and Emissions Handling and Disposal

Beneficial (Positive) and Health impacts are further discussed in the context of the entire project and cover both pre-operations and operations activities. Their applicable impact identification prefixes are:

  - B = Beneficial Impact (+ve)
  - H = Health Impacts

Other project-environment interactions and associated or potential negative impacts that are peculiar to individual activities are discussed under the applicable project activity.

The following sections and tables describe positive and negative impacts of the Optic Fibre Project activities as discussed in Chapter 3. The positive impacts relate mostly to increased employment, improved income and associated gains.

5.3 PROJECT BENEFICIAL (POSITIVE) IMPACTS

The Optic Fibre Project will result in a number of beneficial impacts to the host environment. Most positive impacts will affect the social, economic, or health characteristics of the area.

5.3.1 Increase in Income from Transportation (B1)

During the Optic Fibre project implementation, there will be transportation of workers, equipment, and supplies to and from the project area by road and boat. Nigerian companies involved in road and water borne transportation will benefit directly from the increase in demand for transportation services related to the project. Although specific estimates of income generation associated with this business opportunity are presently hard to determine, it is anticipated that 98% or more of the transport business will be handled by Nigerian Companies drawing workers from both within and outside the project areas.

5.3.2 Increase in Income from Employment (B2)

A number of Nigerians (local area indigenes and others) will be employed during the implementation of the Optic Fibre project activities. Up to 300 people will be employed over the approximately 13 month implementation period. The project labour requirements includes a mix of local, national, and expatriate workers, based on need and skills, and prioritised for the recruitment of nationals. The Optic Fibre Project will be executed by local contractors, so a number of jobs will be filled by local and national workers with additional support from expatriates and other developing country Nationals.

5.3.3 Project Supporting Income Generating Service Activities (B3)

There will be opportunities for income-generating activities associated with the Optic Fibre Project. Small enterprises will be able to provide professional and supporting services to the project and workers. For example, local firms would be contracted to handle solid wastes. Transportation support for workers, materials, and equipment will also generate local income.

5.3.4 Increased Trading of Local and National Materials (B4)

The Optic Fibre Project activities will require raw materials, services and supplies. Raw materials and supplies will be sourced locally and from other locations within Nigeria. These could include food items, office stationary, accommodation, cleaning, vehicles, and other items. Trading opportunities within and around the immediate project area and the nearest urban centers (e.g., urban area) will also increase as a result of an influx of people during the project implementation.

5.3.5 Skills Acquisition and Training for Workers from Local Communities (B5)

Unskilled workers employed during the project implementation will acquire skills and training while employed. Skills acquisition and vocational training will include equipment operators, cable pulling, fitting and electrical work. The acquired skills will be valuable for obtaining work on other projects.

5.3.6 Improved Quality of Life (B6)

The communities of the project area will experience a generally better quality of life through improved electricity availability, increased commerce and other social interventions. These facilities will also help reduce the disease burden and general morbidity and contribute to meeting the Millennium Development Goals (MDG) in the project area.

5.3.7 Better Social Inclusion (B7)

Social exclusion is often caused by spatial inequalities due to disparities between rural and urban areas, and also between geographically advantaged and disadvantaged areas. The Optic Fibre project will provide additional electricity that can be used in the local area and for the country. Improved electricity supply will lead will help reduce the spatial disadvantages experienced by the communities of the project area. Activities of economic and political importance that are often concentrated in urban centres will be more accessible to the communities in the project area as the area develops further.

Table 5.9: Summary of Positive and Negative Impacts of the OPTIC FIBRE Project

Impact ID	Project Phase and Activity	Impact Category	Environmental Impact	Impact Significance
B1	All Project Phases	Positive Impact	Transportation of workers, equipment, and supplies to and from the project area by road and boat.	Beneficial
B2	All Project Phases	Positive Impact	Employed generation during the implementation of the Optic Fibre project activities.	Beneficial
B3	All Project Phases	Positive Impact	Opportunities for income-generating activities associated with the Optic Fibre project.	Beneficial
B4	All Project Phases	Positive Impact	Trading opportunities within and around the immediate project area and the nearest urban centres	Beneficial
B5	All Project Phases	Positive Impact	Unskilled workers employed during the project implementation will acquire skills and training while employed.	Beneficial
B6	All Project Phases	Positive Impact	Better quality of life.	Beneficial
B7	All Project Phases	Positive Impact	Better Social Inclusion	Beneficial
PP1	Pre Operation Phases	Physical Presence of Workers and Equipment	Impacts on existing infrastructure	Moderate
PP2	Pre Operation Phases	Physical Presence of Workers and Equipment	Impacts on Micro and Macro Economy	Moderate
PP3	Pre Operation Phases	Physical Presence of Workers and Equipment	Impacts Social and Cultural Structure	Moderate
PP4	Pre Operation Phases	Physical Presence of Workers and Equipment	Impacts Cultural and Archaeological Resources	Low
PP5	Pre Operation Phases	Physical Presence of Workers and Equipment	Impacts on Education	Low
PP6	Pre Operation Phases	Physical Presence of Workers and	Impact on Groundwater Quality	Moderate

		Equipment		
TR1	Pre Operation Phases	Transportation of Workers and Materials	Impacts on Transportation	Low
TR2	Pre Operation Phases	Transportation of Workers and Materials	Impacts on Surface Water, Hydrobiology and Fisheries	Low
SC1	Pre Operation Phases	Site Clearing and Excavation	Impacts on Soil and Ecology	Moderate
SC2	Pre Operation Phases	Site Clearing and Excavation	Surface Water Quality, Sediment and Hydrobiology	Low
SC3	Pre Operation Phases	Site Clearing and Excavation	Impacts on Vegetation and Wildlife	Moderate
SC4	Pre Operation Phases	Site Clearing and Excavation	Cultural and Archaeological Resources	Moderate
SC5	Pre Operation Phases	Site Clearing and Excavation	Physical and Economic Displacement	Moderate
SC6	Pre Operation Phases	Site Clearing and Excavation	Impacts on Human Movement	Low
SC7	Pre Operation Phases	Site Clearing and Excavation	Vibration and Noise	Low
CR1	Pre Operation Phases	Construction Activities	Vibration and Noise Impacts	Low
CR2	Pre Operation Phases	Construction Activities	Impacts on Human Traffic	Low
DR1.1	Pre Operation Phases	Physical Excavation Activity	Surface Water Quality and Hydrobiology	Low
DR1.2	Pre Operation Phases	Physical Excavation Activity	Physical and Economic Displacement	Low
DR1.3	Pre Operation Phases	Physical Excavation Activity	Change in Topography	Low
WE1.1	Pre Operation Phases	Waste and Emissions Generation and Disposal	Air Emissions	Moderate
WE1.2	Pre Operation Phases	Waste and Emissions Generation and Disposal	Solid Waste	Moderate
WE1.3	Pre Operation Phases	Waste and Emissions Generation and Disposal	Liquid Wastes and Discharge	Moderate
WE1.5	Pre-Operations (Excavation)	Waste and Emissions Generation and Disposal	Excavation Spoil Disposal	Moderate

OM1.1	Operations	Physical Presence of Equipment	Visual Impacts	Moderate
OM1.2	Operations	Energised Optic Fibre	Impacts of Magnetic Fields	Low
OM1.3	Operations	Physical Presence of Transmission Lines	Impacts on Wildlife	Low
OM1.4	Operations	Waste and Emissions	Operations Solid Waste	Moderate
OM1.5	Operations	Waste and Emissions	Air Emissions	Low
OM1.6	Operations	Waste and Emissions	Waste Disposal	Low
H1.1	All Projects	Pollution Related Health Effects	Sanitary and Solid Waste Health Effects	Moderate
H1.2	Operations	Pollution Related Health Effects	Noise and Vibration Impacts	Moderate
H1.3a	Pre-Operations	Pollution Related Health Effects	Air Emission Impacts	Low
H1.3b	Operations	Pollution Related Health Effects	Air Emission Impacts	Low
H2.1	Pre-Operations and Operations	Influx Related Health Effects	Communicable and Non-Communicable Diseases	Moderate
H2.3	Pre-Operations and Operations	Influx Related Health Effects	Fertility	Low
H2.4	Pre-Operations and Operations	Influx Related Health Effects	Quality of Health Care	Low
H2.5	Pre-Operations and Operations	Influx Related Health Effects	Psychosocial Factors	Low
H2.6	Pre-Operations and Operations	Influx Related Health Effects	Occupational and Road Traffic Accidents, and Fires	High
H3.1	Operations	Special Health Effects	Lightning Strike	Low
H3.2	Operations	Special Health Effects	Forest Fires	Moderate
H4	General Infrastructure Developments	Occupational Health Hazards	Over-exertion	Moderate
		Occupational Health Hazards	Slips and Falls	Moderate
		Occupational Health Hazards	Slips and Falls	Moderate
		Occupational Health Hazards	Work in Heights	Moderate
		Occupational Health Hazards	Struck by Objects	Moderate
		Occupational Health Hazards	Moving Machinery	Moderate

		Occupational Health Hazards	Confined Spaces and Excavations	Moderate
		Occupational Health Hazards	Working at height	Moderate
		Occupational Health Hazards	magnetic field	Moderate
		Occupational Health Hazards	Exposure to chemicals	Moderate
CM	All Project Phases	Cumulative Impacts	Land take	Low
CM			Influx	Moderate
CM			Transportation Effect	Moderate
D1	Decommissioning	All Categories	Transportation of Workers and Materials	Moderate
D2			Wind Down Operations	Moderate
D3			Physical Removal of Installed Facilities	Moderate
D4			Remediation and Restoration Activities	Moderate
D5			Wastes and Emissions, Generation and Handling	Moderate

5.4 PROJECT NEGATIVE IMPACTS

5.4.1 Impacts Associated with Physical Presence of Workers and Equipment (PP)

To support the construction activities, a temporary base camp consisting of pre-fabricated temporary buildings shall be established around the project area. The camp shall act as the management base for the site preparation, Optic Fibre laying, transmission line, and civil construction works. The camp may accommodate some of the employed workers while other workers will live in the nearby communities and towns. It is also anticipated that in addition to workers engaged for the project, there will be an influx of job seekers into the general project area

5.4.1.1 Impact on Infrastructure (PP1)
Project Activity: Physical Presence of Workers and Equipment
Project Phase: Pre Operation Phases

The influx of engaged workers and job seekers will lead to increased demand for goods and services and will cause some pressure on existing infrastructure such as housing, educational facilities, roads, hospitals and others in the area. As has been observed on other similar projects in Nigeria, local residents may lease their houses to migrants and there will be an increase in road and water traffic, which will further put some pressure on the existing roads and may also affect users of the water ways.
The pre-operation activities will not require more than 300 workers over the entire period from Excavation through site clearing and to completion of all construction and hook up activities. Moreover, not all workers will be on the site at the same time. For every worker engaged, at least one job seeker is expected to migrate into the area. Thus, as many as 600 migrants (workers and job seekers) are expected in the project area over the pre-operations phase of the Optic Fibre project. Some of these workers will be existing local area residents.

Assuming 80% of the workforce required will be migrants into the area, the magnitude of this impact is medium since the current projected population of the communities in the area ranges from 987 to about 11,100. Population increase could reach up to 5% in the communities of the project area.

The areal extent of the impact is low since it will be limited to the communities in the general project area. Impact frequency is medium (will occur on and off during the pre-operations phase), while the impact duration is potentially long-term because of the additive effects on the already poor infrastructure. Moreover, some of the migrants may settle in the area. Given the inadequate state of infrastructure in some of the communities, the sensitivity of infrastructure to the population increase is considered medium.

Overall impact severity is moderate while the impact likelihood is medium given the anticipated increase. Overall impact significance is therefore moderate.

Impact Severity	Impact Likelihood	Overall Impact Significance
Moderate	**Medium**	**Moderate**

5.4.1.2 Impact on Micro and Macro Economy (PP2)
Project Activity: Physical Presence of Workers and Equipment
Project Phase: Pre-Operations

The physical presence of workers in the project area during the site preparation of the shore base, Excavation and construction phases together with employment-seeking migrants will result in increased commercial activities around the temporary base camp and nearby communities and those near active work areas. Some labour will be hired locally. There is a high likelihood of an increase in the price of food, medicine, transportation and general goods and services in the project area as a result of the influx. While increased commerce is a positive impact, inflation is negative particularly if some sectors of the population do not benefit from the increased commerce within the area.

The use of local labour following the end of the site clearing/preparation and construction activities will be drastically reduced. Workers laid off after the pre-operations phase could potentially feel the effects of the unemployment and the rapid decrease in personal income ("boom-bust effect"). Over 60% of the local area residents currently earn less than ₦10,000.00 (Ten thousand Naira only) per month (approximately US$63). Locals engaged on the project would likely earn significantly more than their present income and, than others not employed by the project. Increased earnings will lead to life-style changes including more expensive habits and in some cases, additional dependants, including wives, children, and other family members. Experience from similar developments elsewhere in Nigeria indicate that loss of this income can result in tension and conflicts between the people and the project.

Although the potential increase in prices cannot be readily quantified, the impact magnitude is considered medium given the potential population increase. Assuming that workers are not re-employed, the magnitude of the effects of the loss of employment could also medium. The areal extent of the impact would be low as it will be largely limited to the immediate project area. The impact frequency is medium since the construction will go on for about 13 months. The impact duration is potentially medium because the demand will reduce after pre-operations activities are completed but based on experience gained from other projects in Nigeria, prices may not completely return to pre-activity levels. The sensitivity of the resource (local economy) to the impact is high given the general poor income in the area.

Overall impact severity is therefore moderate and impact likelihood is medium. Overall impact significance is moderate.

Impact Severity	Impact Likelihood	Overall Impact Significance
Moderate	Medium	Moderate

5.4.1.3 Social and Cultural Structure (PP3)
Project Activity: Physical Presence of Workers and Equipment
Project Phase: Pre-Operations

A temporary base camp will be installed to house workers and provide support facilities during the pre-operations period of the Optic Fibre project. The temporary base camp activities could lead to a slight increase (about 5%) in the population of communities of the project area. Since most of the workers and the majority of economic migrants are likely to be male, this influx will lead to a significant change in the ratio of males to females.

The population increase directly or indirectly related to the project, combined with increased income could trigger a rise in negative social behaviours such as prostitution and crime. Prostitution is not new in the study area and surrounding urban centres. Increased prostitution activities often results in increased incidences of sexually transmitted diseases, and could also exacerbate social problems through a negative change in value systems. Additionally, increased commerce and the creation of new wealth mostly among the youth could threaten the area’s existing authority structure. The overall changes could potentially threaten the security of people in the communities.

Further, some of the housing (about 10%) in communities of the general project area is basic and consist of mud intermingled with block houses (i.e., constructed of cement blocks). The labour camp will be supplied with potable water, electricity and will provide significantly better living conditions compared to the project area’s existing housing. Conflicts may arise over the difference in living conditions for local people when compared to the labour camp construction workers.

The magnitude of this impact is low given the anticipated increase in population during the activity. The geographical extent of the impact is low as it will be restricted to the key population centres and a few others in the area. The frequency of the impact is medium as it will be intermittent during the pre-operations phase. Impact duration is potentially long-term and therefore high, since some migrants may remain in the area and once exposure to improved living standards has occurred, expectations are unlikely to return to previous levels. The sensitivity of the social and cultural structure in the area is considered medium.

Overall impact severity is moderate while impact likelihood is medium. Overall impact significance is therefore high.

Impact Severity	Impact Likelihood	Overall Impact Significance
Moderate	Medium	Moderate

5.4.1.4 Cultural and Archaeological Resources (PP4)
Project Activity: Physical Presence of Workers and Equipment
Project Phase: Pre-Operations

Over 80% of residents in the communities of the project area are Christians. However a handful of residents are traditionalists and some maintain traditional African religious shrines. Additionally, burial grounds are held sacred by the natives. Non-natives living or working in the area may not be conversant with traditional religious practices and rules on shrines and so may inadvertently break traditional religious rules by engaging in culturally unacceptable behaviour.

The potential magnitude of this impact is low since the population increase is only about 5%. The areal extent of the impact is low since as mentioned earlier, traditional worship requiring shrines is not widespread and burial grounds are usually well identified in the area. The frequency of the impact would be intermittent during the pre-operations phase of the project while the impact duration could be long term and thus high, since shrines could be destroyed. The sensitivity of these cultural aspects is high.

Impact severity is moderate while impact likelihood is low since locals typically protect their cultural resources and shrines are not widespread in the area. Moreover most Nigerians are aware of African religions and respect and abide by local customs. The overall impact is therefore of low significance.

Impact Severity	Impact Likelihood	Overall Impact Significance
Moderate	Low	Low

5.4.1.5 Impact on Education (PP5)
Project Activity: Physical Presence of Workers and Equipment
Project Phase: Pre-Operations

During site clearing, preparation and onsite construction activities, direct and indirect work for semi-skilled and unskilled workers age 15 and older could become available. Young indigenes in the project area and its environs will be attracted to this opportunity especially because it will typically pay higher wages than other income generating activities available in the area. In addition, some of the young people may be attracted to illegal activities such as prostitution, fraud and stealing. The attraction to earn income could potentially, either directly for the project (for young adults), or through some other indirect income generating enterprises, cause young people to abandon or suspend their education. Of particular concern are children in primary and secondary education. Baseline information indicates that the educational facilities and systems in the area are not adequate and this, together with a disruption in education, has the potential to seriously reduce the future potential for the area's young people.

The magnitude of this impact is low given the relatively low number of workers required for the project. The areal extent of the impact will be low since most of those affected will come from around the project area. Impact frequency is low as the impact will fall off once the pre-operations activities are completed while impact duration is potentially long-term and thus high. The sensitivity of people's education to the impact is considered low due to strong social and cultural support for education by the people in the area and the recent free primary and secondary education policy.

Overall impact severity is moderate while impact likelihood is low since the social survey indicates that people value education and would continue to support their children's schooling and additional income for local workers would improve affordability of better education. Moreover, education is a focal area for project-related community development. Overall impact significance is therefore low.

Impact Severity	Impact Likelihood	Overall Impact Significance
Moderate	Low	Low

5.4.1.6 Impact on Groundwater Quality (PP6)
Project Activity: Physical Presence of Workers and Equipment
Project Phase: Pre-Operations

The presence of heavy machinery and workers within and around work areas during the project site clearing, preparation and construction phase could potentially result in impacts to groundwater. The soil study indicates high permeability and a relatively shallow groundwater table in some areas (less than 2m). Uncontrolled wash down of oil and grease from equipment or accidental release of any other chemicals stored or used on site could directly impact shallow drinking water wells.

The potential magnitude of this impact is considered low because all wash down water will be contained. In the unlikely event of a release of hazardous materials, only small quantities would be involved. The areal extent of the impact is low given that the anticipated quantities of any spilled materials will be small and therefore not spread over a wide area. The frequency of this impact could be medium, i.e., intermittent during the project pre-operations phase. If contaminated by persistent materials such as petroleum or other chemicals, the impact duration in affected areas could be long term (high). The sensitivity of the resource is considered high given the importance of the groundwater resources to the people of the area.

Overall impact severity is moderate while impact likelihood is medium. The overall impact significance is therefore moderate.

Impact Severity	Impact Likelihood	Overall Impact Significance
Moderate	**Medium**	**Moderate**

5.4.2 Impacts Associated with Transportation of Workers and Materials (TR)

During the project implementation, there will be transportation of workers and materials to and from the active work areas. Traffic in and out of project area will increase. Currently there is an improved road into the area, which helps the make travel in and out of the areas fairly smooth. The project could result in additional pressure on the traffic situation in the area during the pre-operations phase of the project. Increased water traffic is also anticipated.

5.4.2.1 Impact on Transportation (TR1)

Project Activity: Transportation of Workers and Materials

Project Phase: Pre-Operations

Transportation of workers and materials during the site clearing, preparation and onsite construction activities of the project will lead to increased traffic activity along the main road into project area and the nearby waterways leading to the area. Increased vehicular and boat traffic in the area could lead to longer commuting time for existing road users. The increased traffic could also lead to additional road and waterway accidents (discussed later in the chapter).

The magnitude of the impact will be medium since it is anticipated that vehicular and boat traffic in and out of the project area will not increase beyond 40% of the existing traffic. The areal extent of the impact is considered low since project-related traffic impacts will be largely restricted to the immediate work areas. The frequency of this impact will be intermittent during the pre-operations construction period and is thus medium, while impact duration will be low as the effects of the disruption will be short-lived. The sensitivity of the resource is considered medium given the anticipated traffic increase and the recently improved road.
Impact severity is minor while impact likelihood medium since the anticipated traffic increase will occur. The overall impact significance is therefore low.

Impact Severity	Impact Likelihood	Overall Impact Significance
Minor	Medium	Low

5.4.2.2 Impact on Surface Water, Hydrobiology and Fisheries (TR2)
Project Activity: Transportation of Workers and Materials
Project Phase: Pre-Operations

Vessels transporting workers, supplies and machinery to and from the project site will navigate the open seas, the Imo River and other rivers from major ports in the Niger Delta to the area. The increased vessel traffic will result in additional perturbation to the surface water and the seabed and perhaps minimally impact water quality from small releases of hydrocarbons. Physical disturbance will cause some perturbations to the seabed in shallower waters, which could impact habitats/communities of some aquatic organisms. The physical perturbation will result in increased turbidity while minor hydrocarbon releases from vessels will cause some pollution and increased COD levels.

The magnitude of this impact is considered low since the increase in vessel traffic will be minimal during the pre-operations activities and most of the vessels will arrive are likely to come in through the Atlantic Ocean. The areal extent of the impact is considered small (low) compared to the vast size of the ocean resources. The frequency of the impact is medium as it will occur intermittently over the 13 month period. Impact duration is considered to be short (low) as the environment will be expected to return to background levels within a few hours after each impact occasion. Although the waters of the Niger Delta are economically and ecologically important, the sensitivity of the resource to the impact is considered low and the impact is reversible.

The likelihood of this impact occurring is medium since the vessel movement is certain to occur. The overall severity rating of the impact is minor. The impact significance is therefore low.

Impact Severity	Impact Likelihood	Overall Impact Significance
Minor	Medium	Low

5.4.3 Impacts of Site Clearing/Preparation Activities (SC)

The proposed power plant will be sited over an area of about 4hectares. Some of this land will be used for the shore based facilities will the rest will be excavated to accommodate the basin for barges. The Optic Fibre and transmission line routes will also be cleared prior to trenching. Clearing activities will entail the removal of vegetation, tree roots and top soil. Excavators, bulldozers, graders and dumper trucks will be used for clearing. Cleared top soil will be stockpiled and reused for landscaping. Excess topsoil, if any, will be moved to a stockpile to be used at other locations or used to reclaim existing swamps in the area. Useful materials cleared from the sites will first be offered to local inhabitants. Vegetation and other material which have no re-use value will be burnt on site. The total area to be cleared for the project will be about 28.5ha assuming a 50m corridor for Optic Fibre.

Associated and potential impacts related to site clearing activities are related to the physical clearing process, the alteration of the landscape and conversion of lands (land take).

5.4.3.1 Impact on Soil and Ecology (SC1)

Project Activity: Site Clearing and Preparation

Project Phase: Pre-Operations

Site clearing activities will involve the removal of vegetation and top soil as well as the clearing of flora across various habitat types in the project area. The areas to be cleared will be mostly dry lowland rainforest, which currently covers most of the project area. The other habitats that will be affected are freshwater swamp and mangrove swamp forests. Some flora and fauna within these habitats are economically, medicinally and ecologically important. Clearing will result in a loss of habitat for the fauna including wildlife. The clearing activity will also result in further degradation of soil fertility.

The magnitude of this impact is low since only a small proportion of the remaining lowland and swamp forests in the general area will be affected. The areal extent is low since it will be limited to the sites that are cleared. The frequency of the impact is low being a one-time activity while the duration is high since the land will be occupied for many years. Moreover, reversibility to pre clearing status will be difficult to achieve given the degraded state of the soil. The sensitivity of the affected ecological resources is considered medium partly because the percentage of land to be taken is not significant compared to what will be left for the locals and also because a good portion of the lowland rain forest is already degraded from farming. However, although the entire project facilities (plant, Optic Fibre and transmission line) will be located within the project area, it is noted that the local people have lost a significant portion of their lands to industrial activity.

Impact severity is minor. Likelihood is high since the sites will definitely be cleared. Overall impact significance is therefore moderate.

Impact Severity	Impact Likelihood	Overall Impact Significance
Minor	High	Moderate

5.4.3.2 Surface Water Quality, Sediment and Hydrobiology (SC2)

Project Activity: Site Clearing and Preparation

Project Phase: Pre-Operations

Storm water runoff from the cleared sites into surface water bodies (e.g., around River), particularly during the rainy season would cause an increase in turbidity and suspended solids in the receiving waters. Runoff could contain some contaminants such as oil and grease, heavy metals and other chemicals that may have been released during site clearing activities. The increase in turbidity may affect plankton communities, benthic organisms and fisheries in rivers and streams.

The magnitude of the impact is medium since the quantity of run-off could be significant relative to the size of the River but will be contained or treated. Areal extent of the impact is low as the effects will not extend beyond the immediate project area. The impact frequency is intermittent and thus medium during the project pre-operations phase. Impact duration is short lived for the tidally influenced creeks. Moreover, many of the local swampy areas already receive some amount of turbid water during the rainy season naturally, and thus sensitivity to the impact is low. Impact severity is minor. Impact likelihood is medium since Optic Fibre will implement safe guards to prevent runoff and erosion from the cleared sites. Overall impact significance is therefore low.

Impact Severity	Impact Likelihood	Overall Impact Significance
Minor	Medium	Low

5.4.3.3 Impacts on Vegetation and Wildlife (SC3)
Project Activity: Site Clearing and Preparation
Project Phase: Pre-Operations

Trees, shrubs, and climbers as well as associated fauna, will be lost when the project site, Optic Fibre route transmission line corridor are cleared. Land use and land cover data from the environmental baseline study indicates that over 90% of the area to be cleared is lowland forest, some portions of which are fallow and farmlands. There are also freshwater swamp forest areas that are quite rich in biodiversity. Significant poaching and logging have reduced wildlife in the area however local people make use of the vegetation for timber, edible fruit, mat making, furniture, medicine, and spices.

Wildlife assemblage in the project area is not very rich. However, some species identified in the area are either on Schedule 1 (Endangered) or Schedule 2 (Vulnerable) of the Nigerian Endangered Species Act (1985).

While all the vegetation in the cleared areas will be lost, most mobile fauna will move out of the affected areas. Other fauna, particularly organisms with narrow ecological tolerance and limited range (e.g., snakes and other reptiles, rodents, and shrews) will potentially be killed or may attempt to move to less affected places and may end up in settlements. Due to relatively low animal density the adjoining area should be an adequate habitat buffer for fauna.

Given the area of land to be taken up by the project, the magnitude of this impact is low. The areal extent of the impact is also low since the impact will be restricted to the project area. The impact frequency is also low since site clearing is a one-time activity. The impact duration is long-term and thus high. Resource sensitivity is low since land conversion will not affect the environmental functionality of the remaining land. Impact severity is minor. Impact likelihood is high as it is certain to occur. Overall impact significance is therefore moderate.

Impact Severity	Impact Likelihood	Overall Impact Significance
Minor	High	Moderate

5.4.3.4 *Cultural and Archaeological Resources (SC4)*
Project Activity: Site Clearing and Preparation
Project Phase: Pre-Operations

About 28 ha of land will be cleared for the Optic Fibre project. Available data suggests that there are no shrines and burial grounds within the areas to be cleared. Moreover, shrines are usually situated around communities/settlements. There could however be unauthorized clearing by the people near project facilities for construction of housing by job seekers and migrants. Although non-project migrants are expected to be Nigerian, and thus sensitive to cultural resources and traditional African religious practices, such unplanned clearing could inadvertently impact existing cultural and archaeological resources.

The magnitude of this impact is low since baseline data suggests that there are few shrines in the area and the labour camp will likely be carefully situated to avoid such cultural sites. The areal extent of the impact is low given the location of the land area to be cleared in relation to the settlements of the project area. The frequency of the impact would be low although the impact duration would be long-term if any shrines are destroyed and is thus high. Because this represents an important cultural aspect, the sensitivity of the resource is high.

Impact severity is moderate while impact likelihood is medium since Optic Fibre plans to identify the location of all shrines and none are known to occur in the sites to be cleared. If any are encountered, a “chance finds” procedures would be followed and Optic Fibre would address relocation of any shrines. The overall, impact is therefore of moderate significance.

Impact Severity	Impact Likelihood	Overall Impact Significance
Moderate	Medium	Moderate

5.4.3.5 *Physical and Economic Displacement (SC5)*
Project Activity: Site Clearing and Preparation
Project Type: All Sub Projects

The area of land to be acquired and cleared for the Optic Fibre project is about 28ha as earlier discussed. This area will be converted for various uses including a temporary camp, shore based facilities and right of way. Land-take and site clearing will not lead to physical displacement of communities that live within and in close proximity to the sites. Although all of the project facilities will be situated within the State delineated Export Processing Zone (EPZ), some land users will be economically displaced because farming and foraging are key sources of livelihood in the area and some farmers will no longer have access to sections of this zone which they currently rely on. In addition to compensation paid by EPZ for lands taken, Optic Fibre will pursue a compensation programme for genuine land users prior to the commencement of project activities and this will ensure adequate compensation paid to landowners and land users.

The magnitude of the land take is considered medium because although important, farming is not the most common profession in the project area. The areal extent of the land take is considered low given the available land in the general area. The impact frequency of the land take is low as it is a one-time event. The duration of the economic displacement is considered medium because affected persons will likely be able to find alternative locations for farming and foraging. It is noted however that the available land in the general area is already constrained by industrial activities in the area. The sensitivity of the resource is high because of the past land take activities.

Impact severity is moderate while the impact likelihood is low since Optic Fibre will pursue a compensation strategy for all affected persons. The overall impact significance is moderate.

Impact Severity	Impact Likelihood	Overall Impact Significance
Moderate	Medium	Moderate

5.4.3.6 Impact on Human Movement (SC6)
Project Activity: Site Clearing Activities
Project Phase: Pre-Operations

During the pre-operations activities, portions of the sites will be fenced to restrict public access for safety and security purposes. Although most of the project sites will be acquired by the Optic Fibre , any regular transport and traffic routes (foot paths and road tracks) that cross the sites could be cut off, requiring diversions or the use of alternative routes.

These disruptions will negatively impact human movement and could affect social, economic and livelihood networks in the area. The effects would especially be felt on market days when movement is the highest. It will also have a greater effect on people who travel mostly by foot since diversions could increase the distance between points.

The magnitude of this impact is low since proposed activities will (if at all) affect only one or two road tracks. The areal extent of the impact is also low since such effects will be limited. The impact frequency is low for the site clearing activities and duration is also low since it is limited to the period of the pre-operations activities only. The sensitivity of the resource to the impact is medium as it could partly affect the local people's productivity.

Impact severity is minor while the impact likelihood is low given that procedures will also be in place to try and minimize road and foot traffic disruption. Overall impact significance is low.

Impact Severity	Impact Likelihood	Overall Impact Significance
Minor	**Low**	**Low**

5.4.3.7 Vibration and Noise (SC7)
Project Activity: Site Clearing
Project Phase: Pre-Operations

Site clearing activities will involve the use of chain saws, bull dozers, and other motorized equipment. Noise and vibration levels around work areas during site clearing will therefore increase, but only during the day as no work will be performed at night. Noise and vibrations would also cause birds, and other mobile fauna to move away from the source, while nearby communities could experience unusual noise and vibration impacts; noise effects on humans are covered under health impacts.

The magnitude of this impact is low since people and animals affected by noise and vibration are restricted to those in the immediate vicinity of the sites being cleared. The areal extent is also low as the impacts will be generally restricted to the immediate area. Impact frequency is low since site clearing is a one-time event while the duration of the impact is also low. Noise will only be generated for a short period. The sensitivity of the affected resource to noise is considered low given the mobility of potentially affected resources, the relatively sparse population density in some of the project area and project measures to reduce noise. For fauna, there is an adequate buffer to handle migration.

Impact severity is minor. Impact likelihood is moderate given the understanding of the ecological resources in the area. Overall impact significance is therefore low.

Impact Severity	Impact Likelihood	Overall Impact Significance
Minor	Moderate	Low

5.4.4 Onsite Construction Activities (CR)

The physical onsite construction associated with the OPTIC FIBRE project will involve numerous civil works activities including vehicle movement, carpentry/joinery, block work, concrete mixing, welding, trenching, electrical works, pipe-laying and others. Transportation related impacts and those associated with the physical presence of workers and materials on site have been discussed earlier. Other construction and installation impacts, that are similar for all the key project activities are discussed below.

5.4.4.1 Vibration and Noise Impacts (CR1)
Project Activity: Construction Activities
Project Phase: Pre-Operations

Physical construction activities will involve the use of much equipment, machines and work activities on site. While construction is ongoing, noise and vibration will be generated at each work site, although at various times. Noise and vibration generating activities include carpentry/joinery, block work, cement batching plant operations, lifting machinery operations and general vehicular movement.

Noise and vibration levels around work areas during construction will therefore increase, but mostly during the day as night time work will be avoided as much as possible. Noise and vibrations would also cause birds, and other mobile fauna to move away from the source, while nearby communities could experience unusual noise and vibration impacts; noise effects on humans are covered under health impacts.

The magnitude of this impact is low since the anticipated noise increase will not be so significant, and people and animals affected by noise and vibration are restricted to those in the immediate vicinity of the work areas. The areal extent is also low as the impacts will be generally restricted to the immediate work area. Impact frequency is intermittent over the construction phase (i.e., medium) while the duration of the impact will be short-lived also (low). The sensitivity of the affected resource to noise is considered low given the mobility of potentially affected resources, the relatively sparse population density in some parts of the project area and project measures to reduce noise. As indicated earlier, fauna have an adequate buffer to handle migration.

Impact severity is minor while likelihood is moderate given the understanding of the ecological resources in the area. Overall impact significance is therefore low.

Impact Severity	Impact Likelihood	Overall Impact Significance
Minor	Moderate	Low

5.4.4.2 Impact on Human Traffic (CR2)
Project Activity: Construction Activities
Project Phase: Pre-Operations

Construction sites and routes for project facilities will be partially or wholly fenced to restrict access for safety and security purposes. Access restriction could affect regular human tracks that cross the sites as those that typically trek across the area may need to find alternative routes. Disruptions to trekking paths will negatively impact people's movement and could affect social, economic and livelihood networks in the area. The effects would especially be felt on market days when movement is the highest. Diversions could increase walking distance between regular points of commute.

The magnitude of this impact is low since construction activities will (if at all) impact only a few trekking routes in the area. The areal extent of the impact is low as it will be restricted to a small area. The impact frequency is intermittent (medium) and duration is also short term because it will last only for the period of construction. The sensitivity of the resource to the impact is medium as it could also affect the local people's productivity.

Impact severity is minor. Impact likelihood is medium given that procedures will be in place to try and minimize disruption road, and foot traffic. Overall impact significance is low.

Impact Severity	Impact Likelihood	Overall Impact Significance
Minor	Medium	Low

5.4.5 Excavation Impacts

The Optic Fibre project will require Excavation of sections of the River to create adequate navigation depth to transport the power barges to site and at the end of the creek to create the basin where the barges will sit. These details have been discussed in Chapter 3. The associated and potential negative impacts that are peculiar to the proposed Excavation are discussed below. Other impacts, which are similar to those of other activities, were covered in earlier sections.

5.4.5.1 Surface Water Quality, and Hydrobiology (DR1.1)
Project Activity: Physical Excavation Activity
Project Phase: Pre-Operations

The proposed Excavation activities will cause suspension of excavated materials in the water column within River and the Imo River. This will increase turbidity which will affect water quality. Fish and other aquatic organisms that do not migrate away from the area could be directly affected by the activity. Organisms living in the sediments at the bottom of the creek and river (benthos) which cannot readily move from the area of disturbance will be affected through habitat disturbance and physical smothering from settling sediments.

Excavation will also create areas in River substantially deeper than they were originally. This will have an effect on the natural flow of the creek along those stretches tending to slow the waters. Deepening of the channels could also lead to slope instability and creek bank erosion.

The magnitude of the impact will be high since the water will be affected by turbidity from sediments and there will be a temporary loss of benthic habitat by the Excavation. The areal extent of the impact on water quality will be low since only River and some sections of the Imo River (estimated to be less than 1km north and south of the creek-river confluence) will be affected. Impact frequency will be continuous but only for the limited Excavation period and is therefore low. Even though Excavation activities will last for less than 4 months, the duration of the impact could be low to medium. Localized water quality conditions are expected to return to pre-Excavation conditions within weeks after the completion and overall, turbidity will return to baseline conditions in within days. Impacts on benthic organisms will however be medium as the benthic environment will take significantly longer to recover. Past Excavation activities have not hindered fishing activities and fish spawning for long periods. This indicates that the continued ability of this surface water to recover is good, and that the sensitivity of the resource is therefore medium.
Impact severity is moderate while impact likelihood is high. The overall impact significance is therefore high.

Impact Severity	Impact Likelihood	Overall Impact Significance
Moderate	**High**	**Moderate**

5.4.5.2 Physical and Economic Displacement (DR1.2)
Project Activity: Physical Excavation Activity
Project Phase: Pre-Operations

Excavation effects could have an effect on fishing activities, especially in areas close to the active Excavation sites. Areas most affected by turbidity will not be viable fishing grounds while impacts last. Additional, the dredger will constitute a temporary physical obstacle to fishing boats while an exclusion zone will be maintained around it. Fish traps set in River will need to be relocated. Moreover, some of the locations within the creek would not be available for the some types of fisheries due to significant deepening of sections of the creek. However, other fishing methods could potentially be employed. The creek bottom would be permanently altered and could potentially decrease in terms of fisheries productivity.

The magnitude of the impact is tied to the areal extent and is considered medium since impacts will be restricted to the River and a few kilometres from its North and South of the confluence with the Imo River. The frequency of this impact will be intermittent for the short period of Excavation and thus low. Impact duration will be low since most of the fisheries impacts will be short lived. The sensitivity of the resource is high given the importance of fishing to the local economy.

Impact severity is moderate while the likelihood of the impact is high. Overall impact significance is high.

Impact Severity	Impact Likelihood	Overall Impact Significance
Moderate	**High**	**Moderate**

5.4.5.3 Change in Topography (DR1.3)
Project Activity: Physical Excavation Activity
Project Phase: Pre-Operations

Excavation will be carried out to deepen sections of River and to create a basin where the power plant will be situated. Some excavated material generated during this process may be dumped on the banks of the River. This is indeed common practice in the Niger Delta. Dumping of spoils on the creek banks will lead to slight topography elevations along the banks and this will in turn affect the natural local drainage patterns. Altered drainage patterns could cause areas to change from water pooling to water shedding areas, while others may retain more water and for longer periods. If the natural surface water drainage pattern were not restored or properly mitigated, some vegetation could be cut off from its regular water and nutrient supply while others may experience increased flooding and water pooling. These alterations could affect nearby vegetation and result in habitat fragmentation and thus die back.

The magnitude of this impact is low since some of the drainage has already been altered by earlier activities in the area and additional changes in topography will be limited for a few areas only. The areal extent is low for the same reason. Impact frequency is low as this is a one-time event. The impact duration is potentially long term (high) if vegetation dieback were to occur. The sensitivity of the resource is low medium since the potentially affected areas are few and not critical habitats or of major economic importance.

Impact severity is minor while the likelihood is medium. Moreover, Optic Fibre will seek to ensure that Excavation activities do not alter the natural topography in the area and where necessary, maintain or restore water and nutrient flow. Overall impact significance is therefore low.

Impact Severity	Impact Likelihood	Overall Impact Significance
Minor	Medium	Low

5.4.6 Optic Fibre Construction Impacts (PPL)

The Optic Fibre project activities will include the installation and operation of a 3.2km Optic Fibre in the project area as earlier discussed. The Optic Fibre will be layed in a trench to be dug across habitats of the area and then buried. Impacts of the associated site clearing have been discussed earlier. The discussion below is therefore restricted to trenching.

5.4.6.1 Salt Water Intrusion (PPL1.1)
Project Activity: Optic Fibre Installation
Project Phase: Pre-Operations

Trenching will typically involve the removal of soil along the entire Optic Fibre route. The route extends from the plant site at the end of the River to upland areas slightly North East of the site. During trenching, water from the surrounding swamps will fill the trench as soil is excavated. The salinity of the River and swamps around it is sometimes higher than 8ppt, which is beyond the tolerable salinity level for fresh water plant species in the upland habitats. Thus, freshwater vegetation along the corridor of the trench could experience die back as a result of salt water intrusion. The die back could also continue after the burial of the Optic Fibre if the trench is not covered to pre-excavation levels.

The magnitude of this impact is high given the higher than tolerable salinity in the brackish water. The areal extent will salt water affected vegetation will be medium as it could extend beyond the immediate corridor of the trench at high tides but not over a very large area. Impact frequency will be intermittent (medium) while impact duration could be potentially longterm (high). The sensitivity of the resource to the impact is considered medium because it is not particularly vulnerable to the impact.

The impact severity is major while the likelihood is medium. The overall impact significance is therefore high.

Impact Severity	Impact Likelihood	Overall Impact Significance
Moderate	Medium	Moderate

5.4.7 Hook Up and Commissioning Impacts

From the foregoing, it can be argued that the key potential environmental impacts of commissioning and hook up activities are related to the emission and effluent streams that will be generated and how they will be handled. These are discussed subsequently under wastes and emissions handling.

5.4.8 Wastes and Emissions Handling (Pre-Operations)

Different wastes and emissions will be generated during the project pre-operations activities. Combustion engines and clearing activities produce air pollutants. Other wastes will comprise felled trees and cleared vegetation, top soil, spent oils and domestic waste from the worker's camps. Some wastes generated from site clearing that are not taken away for use by the local people will be burned on site. There will also be an increase in domestic wastes generated in the nearby settlements as a result of the increase in population directly due to the project and from non-project related migrants including employment-seekers. While all Optic Fibre contractors will be required to maintain and implement waste management plans in line with regulatory requirements, the waste situation in the communities and other non-project areas could be significantly worsened due to influx.

Optic Fibre camp areas will be equipped with sanitary waste systems and garbage collection systems. Optic Fibre will also implement a waste management plan for all activities leading up to the commencement of plant operations.
Associated and potential impacts are described for each of the expected types of waste associated with the project pre-operations activities.

5.4.8.1 Air Emissions (WE1.1)
Impact Category: Waste and Emissions Generation and Disposal
Project Phase: Pre-Operations

Ambient air quality monitoring indicates that only low levels of pollutants of concern currently exist in the project area. The pre-operations activities associated with the project will result in emissions of air pollutants during the operation of combustion engines, burning of organic material from site clearing, and dust during site clearing and grading.

The emissions could cause an increase in concentrations of sulphur oxides, nitrogen oxides, carbon monoxide, Volatile Organic Compounds (VOC) and particulates within the immediate vicinity of emission sources. Dust created from general construction activities would also lead to an increase in air pollutants around the project area.

Burning of organic waste will also create emissions of particulates, sulphur oxides, nitrogen oxides, carbon monoxide, Volatile Organic Compounds (VOC). Depending on the size of the pile of material being burned and the nature of the material, levels of particulates could still be high one km from the source.

The magnitude of this impact is potentially high since operation of fuel-powered equipment and generators will significantly increase air pollutants albeit, close to the point of release. The areal extent of the impact could extend beyond a few kilometres from the source although the highest levels of contaminants will be concentrated to the immediate vicinity of the source where the public will not be allowed. In addition, prevailing wind direction in the area is from the southwest which would direct any emissions generally away from the creek communities which are the closest to the project sites; areal extent is therefore low. The frequency of the impact is intermittent (although it will be constant in the locations while pre-operations activities are occurring) and is thus low. Impact duration is low since the air quality would be expected to return to baseline conditions after burning is completed. The sensitivity of the resource to the impact is considered moderate since air quality in the project area is currently good and any deterioration would be noticeable.

The impact severity is minor while the impact likelihood is high. Overall impact significance is therefore moderate.

Impact Severity	Impact Likelihood	Overall Impact Significance
Minor	**High**	**Moderate**

5.4.8.2 Solid Waste (WE1.2)
Project Activity: Waste and Emissions Generation and Disposal
Project Phase: Pre-Operations

The Optic Fibre project will implement a program to manage project-related solid waste in compliance with Nigerian regulations and in line with international best practices. This will include the proper treatment and disposal of solid wastes and a “cradle to grave” approach to management of the waste. Regardless, solid waste removed for offsite disposal could strain the available waste handling facilities outside the area. In addition wastes could be disposed of illegally in open dump areas and waterways.

In addition to solid waste generated and managed by the project, there will be an increase in solid waste in the communities and surrounding areas due to influx of project workers and non-project related migrants. Excess waste may accumulate in the communities or the surrounding areas.

For non-project generated wastes (given existing waste management situation and anticipated waste quantities during the pre-operations phase) the magnitude would be medium especially since the anticipated number of migrants at this stage will be low. Areal extent would be low as the exacerbation of the waste management problem will be experienced only around a few sites and the increase will be minimal compared to the already existing lack of waste management. Some communities may experience minimal solid waste problems while others may be more severely affected. The frequency of the impact will be medium. Wastes will be generated continuously, but only for short periods and only for the period of pre-operations activities. If the waste handling situation in the local area persists and waste accumulates, the duration of the impact could be long-term, and is therefore of high severity. The impact is however reversible. The sensitivity of the receiving environment is high.

Impact severity is moderate. Impact likelihood is medium because of the anticipated population influx, the current lack of a public waste disposal system and lack of waste management facilities in the area. Overall impact significance is moderate.

Impact Severity	Impact Likelihood	Overall Impact Significance
Moderate	**Medium**	**Moderate**

5.4.8.3 Liquid Wastes and Discharge (WE1.3)
Project Activity: Waste and Emissions Generation and Disposal
Project Phase: Pre-Operations

The Optic Fibre project will provide for proper handling of aqueous wastes and control of discharge in compliance with Nigerian regulations and in line with international best practices. Water from sinks, showers, and laundries; sewage; and other organically-loaded effluents from the worker's camp will be generated during the site preparation and construction activities. The sewage and sanitary wastes generated from temporary camps will be handled by a system which prevents contamination of the groundwater. Sewage generated at the temporary construction camps, will be collected in a closed system comprising a septic tank to separate solid materials from liquid wastes. The liquids would then be piped to a holding tank. A certified third-party waste disposal contractor will be engaged to collect waste from the tanks on a regular basis and treat the sanitary waste offsite.

Treated water would be discharged to nearby water body after treatment to Nigerian and international standards. Bio solids will be removed and disposed of in line with regulatory requirements.
Some Optic Fibre contractors for the early access infrastructure works may provide accommodation on barges, supply vessels or temporary cabins, while some workers will reside in settlements in the project area. Optic Fibre will require that project vessels, barges and temporary accommodation have proper sanitary treatment systems and that sanitary

wastes be treated by the vessel operator. Discharge of sewage in waterways, as well as to the ground, will be prohibited.

While Optic Fibre will manage liquid waste generated at its facilities, project workers and others who move into the area and will increase the volume of sanitary wastes. Given the already poor sanitary facilities in the project area, the migration will aggravate the effects of already inadequate waste handling and could result in increased quantities of untreated sanitary waste being discharged directly into the environment. Discharge of untreated aqueous wastes would lead to an increase in the levels of pathogens, BOD, COD and turbidity in the receiving waters and would negatively affect the water quality.

The potential magnitude of the impact is medium as the volume of non-treated wastes will not be significant. The areal extent of the impact is low since the affected area will be limited to a few locations in the project area. Impact frequency is intermittent over the period of the pre-operations activities and is therefore medium. The duration of impacts from sanitary and other wastewater discharges would be short to medium term as the water quality would recover within a short time once the pollutant source is removed. The sensitivity of the resource to untreated sanitary waste water discharge is considered medium given the importance of the waters (surface water and groundwater) of the area for fishing and other domestic uses.

Impact severity is moderate. Impact likelihood is medium, given the existing poor pubic liquid waste handling facilities. Overall impact significance is therefore moderate.

Impact Severity	Impact Likelihood	Overall Impact Significance
Moderate	**Medium**	**Moderate**

5.4.8.4 Dredge Spoil Disposal (WE1.5)
Project Activity: Waste and Emissions Generation and Disposal
Project Phase: Pre-Operations (Excavation)

An estimated 900,000m^3 of material will be excavated from the River channel and the area at its end, from which a basin will be created to accommodate the power plant. The material to be removed must be disposed in an environmentally acceptable manner. Field sampling data indicates that the sediments from the creek are not contaminated. To minimize environmental impact, Optic Fibre plans to store excavated material on barges and then ship the spoils to marine waters beyond 50m depths for disposal and away from artisanal fishing grounds.

The disposal of dredge spoils in the marine environment will lead to the generation of sediment plumes over a relatively wide area during the period of disposal until the sediments are fully settled. This will impact marine waters in the area through increased turbidity and total suspended solids, which will temporarily degrade the quality of the water thereby affecting marine ecology (plankton and fish). The area will not be attractive feeding grounds for fish during the disposal period. In addition, physical smothering and burial of benthic organism within in the area will occur. Smothered and buried benthic organisms may be temporarily lost, but are likely to be re-colonised later.

The magnitude of the impact will be high because turbidity impacts in the affected area will be less than severe and some benthic species will be lost. The areal extent of the impact is best assessed based on sediment plume modelling analysis, which is not readily available. Areal extent is however estimated to be about $4.5km^2$ assuming the settling spoil volume of $900,000m^3$ forms a 2cm high deposit on the seabed. Impact frequency will be intermittent during the Excavation period and is therefore medium. Impact duration will be relatively short for water column impacts but will be high for benthic organisms. The affected water should return to background levels less than a month after the disposal is completed but benthic communities will be temporarily lost for some months to a year. The sensitivity of the resource is considered low since the proposed disposal is not an active fishing ground and not a spawning area for juvenile or young fish.

The overall impact severity is minor while the likelihood of occurrence is high. The impact significance is therefore moderate.

Impact Severity	Impact Likelihood	Overall Impact Significance
Minor	High	Moderate

5.4.9 Operations and Maintenance Impacts (OM)

The operational phase of OPTIC FIBRE Power Project entails the generation and transmission of electricity from the barge plant using gas supplied to the plant via the installed Optic Fibre. The operations phase will require significantly lower numbers of workers compared to the earlier project activities. Operations impacts are discussed below.

5.4.9.1 Visual Impacts (OM 1.1)
Project Activity: Physical Presence of Plant
Project Phase: Operations

The potential impacts of the project on the scenery and views of the project environment were analysed to determine the visual impacts of the project. Visual impacts are described as the “change in the appearance of the landscape as a result of development which can be positive (improvement) or negative (detraction)”. Details of the visual impact analyses are given in Appendix I. The visual impact analyses considered six viewpoints of which, all but one a considered but one will be substantially visually impacted as summarized in below.

The substantially impacted location is a private jetty operated by the owner of a residential property located about 0.4km from the plant site. The area is open water with the project site located on the opposite side of the river. The owner of the residential property also owns a bar. The jetty has capacity for up to three vessels at a time. The location of these features is specifically linked to the value of the existing landscape character at the water's edge. The extent to which the bar is used by the public is not known and this location does not represent a regional 'hot spot' for recreation and nightlife entertainment. There is no national or international tourism to this location. The receptor is not considered sensitive.

The extent of change at this location is considered high. The presence of the Optic Fibre site will result in a fundamental change of character from the existing view (dominated by open water and mangroves in the background) to an industrial setting which features an exhaust stack, power generation infrastructure and artificial lighting. The use of artificial lighting has the potential to result in highly visible light glare which is reflected by the water.

Overall, the visual impact at the location is considered substantial due to a fundamental change in the existing view. However, few people will be affected by this impact as the residential property and bar does not attract significant numbers of people, and the location is not used for national/international tourism

The magnitude of the visual impact is considered low since only one location will be substantially impacted from the various viewpoints. The areal extent is considered low for the same reason. Impact frequency will be continuous and so is the duration (high). The sensitivity of the resource is considered low to the impact. Overall impact severity is moderate while the likelihood is medium. Impact significance is therefore moderate.

Impact Severity	Impact Likelihood	Overall Impact Significance
Moderate	**Medium**	**Moderate**

5.4.9.2 Impact of Electric and Magnetic Fields (OM1.2)
Impact Category: Generation and Transmission
Project Phase: Operations

Once installed and operational, the power facilities (generator, transmission lines, and other associated facilities) will become active and charged (i.e., carry electric voltage). The voltage in each device will produce electric and magnetic fields (EMF), which are emitted invisible lines of force. Electric field strengths increase with increasing voltage. Magnetic fields also result from the flow of electric current and increase in strength as the current increases. While electric fields are shielded by various materials (conductors and non-conductors), such as trees and building materials, magnetic fields pass through most materials and are difficult to shield. Both fields however decrease rapidly with distance from source. Further, mmagnetic fields can induce currents in conducting objects. Electric fields can create static charges in ungrounded, conducting materials.

There are concerns over health impacts of long term exposure to EMF strengths from power facilities. Additionally, the operation of high voltage substations and overhead lines can generate electromagnetic fields over a wide range of frequencies, from power (50 Hz) to radio frequencies and could affect other electrical or electronic equipment in the vicinity. Studies (e.g., NRC 1997, WHO 2007a, WHO, 2007b) on the effects of long term exposure to EMF suggest minimal (if at all) adverse effects on plant, animal species, and on human health. Some animals (e.g., migratory birds, bats, and certain fish and insects) are however strongly dependent on magnetic fields for their orientation or migration. Thus, for safety, non-interference and preventive health purposes, safe EMF levels and exposure limits are typically prescribed for power facilities.

The magnitude of EMF on plants and animals is considered low given the available data on EMF effects and the anticipated EMF levels from the various facilities. The expected EMF levels will be based on National Guidelines for power facilities. The areal extent of the impact is considered low also because EMF strength decreases vary rapidly with distance from the source. Impact frequency is continuous and thus high, while the duration of impacts on animals or radio frequency (if it does occur) will be intermittent (medium). The sensitivity of the potentially affected resources to the impact is low since EMF has not been a major cause of adverse environmental hazards in Nigeria or other parts of the world.

The impact severity is minor while the likelihood is low. Overall impact significance is therefore low.

Impact Severity	Impact Likelihood	Overall Impact Significance
Minor	**Low**	**Low**

5.4.9.3 *Impacts on Wildlife (OM1.3)*
Impact Category: Physical Presence of Transmission Lines
Project Phase: Operations

Transmission towers and lines are typically high enough to reach the flight path of birds and bats. They could be obstructions to birds or fatally affect bats through electrocution. Bird collisions with power lines can occur in large numbers if located within their daily flight paths or migration route, or if groups are traveling at night or during low light conditions (e.g. dense fog). Bird and bat collisions with power lines can also damage electric installations leading to power outages and fires.

The magnitude of this impact is tied to its areal extent and is considered low since the area to be taken up by the transmission line is considered small compared to the available flight area for birds and bats. The impact frequency could be intermittent (medium) once the power lines are operational while impact duration could be long term if particular species are intermittently affected, albeit on a continuous basis. Although the migration paths of the avian species in the area have not been well studied, the sensitivity of the avian and bat population to the impact is considered low as power lines already exist in many parts of Nigeria and are not known to have impacted bird and bat populations over time. The severity of the impact is minor while the likelihood is medium. Overall impact significance is therefore low.

Impact Severity	Impact Likelihood	Overall Impact Significance
Minor	**Medium**	**Low**

5.4.9.4 Operations Solid Waste (OMI.4)

Impact Category: Waste and Emissions

Project Phase: Operations

Various solid wastes streams including domestic, medical and hazardous wastes such as chemicals will be generated during the operations phase of the Optic Fibre project. If poorly managed, some wastes may end up in dump sites within the general project area and other dumpsites offsite. The primary impact of concern for solid wastes shipped offsite (i.e., from the plant site) will be the strain on the inadequate existing waste handling facilities in the area and in Nigeria in general.

Given the expected quantities of waste, the magnitude of this impact is considered medium and only if wastes are allowed to end up in the dump sites in the general project area, otherwise it is low. Areal extent of the impact is medium as the exacerbation (if at all) of the waste management problem will be experienced around a few sites but may go beyond the immediate area. It will, however, be minimal compared to the existing scale of the problem. The frequency of the impact will be medium since wastes will be taken offsite intermittently for the twenty year period of the plant operation. If the waste handling situation in the country persists the duration of the impact could be long term, and is therefore of high severity. Moreover, environmental impacts of wastes could be long term. The impact is, however, reversible. The sensitivity of the waste situation in the area is considered medium.

The overall impact severity rating is major and the likelihood is low since Optic Fibre will develop and implement a cradle to grave waste management plan for the plant operations. The overall impact significance is therefore moderate.

Impact Severity	Impact Likelihood	Overall Impact Significance
Major	**Low**	**Moderate**

5.4.9.5 Air Emissions (OM1.5)

Impact Category: Waste and Emissions

Project Phase: Operations

Air emissions during operations will include nitrogen oxides, sulphur oxides, carbon monoxide, volatile organic carbons (VOC) and some particulates. Operation phase estimates of some these air pollutants have been given in Chapter 3. Their concentrations in the atmosphere will increase in the area during operations and are estimated to contribute about 1,066,473 tonnes per year in greenhouse gas equivalents.

Air quality models have been run to assess the impacts and distance effects of the pollutants. The modelling considered stack emissions from the power plant which are identified as the main sources of criteria air pollutants in the proposed project. The emissions are as a result of combustion activities in the power plants. Criteria pollutants modelled for the ground level concentrations include: carbon monoxide (CO), nitrogen oxides (NO_X), hydrocarbons (HC) and total suspended particulate (PM) due to the characteristics of the fuel to be used during operation. Emission rates and exhaust vent stack parameters (height, diameter, exhaust temperature, and exit velocity) used as model input parameters were obtained from the proposed project details.

Worst case scenario results show that the change in ambient air concentration of key pollutants at selected receptors will result in concentrations between 1.64% and 99.9% of the regulatory limits for various pollutants. Anticipated impacts will be: 1.64 – 7.21% of PM limit, 0.01 – 0.14 of CO limit, 0.01 – 0.10% of HC limit, 1.31 – 27.58% of SO_2 limit and 7.81 – 91.99% of NO_X limit. The set limits for all the air quality parameters considered will not be exceeded at any of the receptors.

Table 5.10: Predicted Worst Case Impacts on Ambient Air Quality of Selected Receptors

Receptor	SO_2^*		CO*		NO_X^*		PM*		HC*	
	Conc. (μg/m^3)	% of Limit	Conc. (μg/m^3)	% of Limit	Conc. (μg/m^3)	% of Limit	Conc. (μg/m^3)	% of Limit	Conc. (μg/m^3)	% of Limit
Project Site	0.34	1.31	1.35	0.01	5.86	7.81	6.61	2.64	0.46	0.01
Ikot Obong	3.05	11.73	16.51	0.14	68.99	91.99	5	2.00	5.59	0.09
Wyda Fishing Settlement	5.48	21.08	7.12	0.06	20.2	26.93	15.2	6.08	6.21	0.10
UAC Jetty	3.44	13.23	1.97	0.02	51.19	68.25	16.42	6.57	3.97	0.07
Ikot Abasi	1.32	5.08	4.68	0.04	34.66	46.21	18.02	7.21	2.73	0.05
Ikpetim	6.19	23.81	14.14	0.12	10.34	13.79	7.21	2.88	4.99	0.08
Aibiama	3.67	14.12	13.6	0.12	58.61	78.15	4.1	1.64	4.56	0.08
Okoro Inyong	7.17	27.58	7.66	0.07	35.92	47.89	8.13	3.25	5.03	0.08

Although the concentrations of all the pollutant gases exceed background levels at the project site, the magnitude of air quality impacts is low since ground concentration levels will be nowhere near regulatory limits at the closest population centres. Moreover, the project will result in the utilization of gas that may otherwise have been flared. When compared to the gas flaring scenario, a lower GHG emission (about 107,000 tonnes per annum) is estimated for the project, indicating a positive environmental impact. The areal extent of the impact is low since increased concentrations will be felt only within 2km of the plant site. Impact frequency is however high as emissions will be continuous during plant operations (25 years). The duration of air quality impacts is potentially high since many of these gases can lead to respiratory ailments and mortality if beyond certain concentrations. The sensitivity of the resource to the impact is considered medium. Health Impacts are discussed separately.

The overall impact severity is moderate while the likelihood of a palpable impact is low given the low concentrations that are expected at the population centres. The overall impact significance is therefore low.

Impact Severity	Impact Likelihood	Overall Impact Significance
Moderate	**Low**	**Low**

5.4.9.6 Effluent Handling and Disposal (OM1.6)
Impact Category: Waste and Emissions
Project Phase: Operations

Sewage (black water); “grey” water from sinks, showers, and laundries; and other organic laden effluents from personnel accommodations will be generated during the plant operation. In addition, storm waters will be collected, treated and discharged into the River. Most of the sewage and sanitary wastes will be treated in a sanitary wastewater treatment plant to be provided on the plant site. Domestic and process/storm water wastewater will be treated to regulatory limits before being discharged overboard. Receiving waters will be impacted only if process upsets occur. Discharge of untreated aqueous wastes will lead to increase in pathogens, BOD, COD and turbidity impacts in receiving waters.

The potential magnitude of the impact is low as the bulk of sanitary wastes to be generated during operations will be properly treated prior to disposal. The areal extent of the impact is low since the area to be affected will be localized around the discharge point. Impact frequency is high since the discharge will be continuous during the life time of the project. The duration of impacts from sanitary and other wastewater discharges could be short to medium term. The sensitivity of the resource to waste water impacts is considered medium given the importance of the waters of the area for fishing.

The overall impact severity is moderate while there is a low likelihood of its occurrence given plans for waste water. The overall impact significance is therefore Low.

Impact Severity	Impact Likelihood	Overall Impact Significance
Moderate	**Low**	**Low**

5.4.10 Health Impacts (H)

Associated and potential health impacts of the Optic Fibre project activities are covered in the following sections. The discussion addresses mostly public health issues, although project workers' health (and safety) i.e., occupational health issues are also highlighted. Impacts are discussed under the following headings: pollution related health effects, communicable and non-communicable diseases, fertility, health care and recreational infrastructure, psychosocial factors, accidents, spills, and fires.

Pollution related health impacts are those that arise from direct or indirect exposure to sources of pollution. Sources may include sanitary waste discharges, solid waste handling and disposal, air emissions, and noise pollution. Sanitary wastes, effluents and solid wastes if discharged or disposed around settlements can lead to improved breeding conditions for pathogens and disease vectors while also polluting the environment. This impact is of particular concern since some parts of the area prone to flooding and water-pooling. Moreover, ingestion of contaminated drinking water could lead to health problems in the community. Likewise, bioaccumulation of pollutants poses a threat to human health as pollutants build up in the food chain.

Associated and potential health impacts associated with the project are categorized as related either to pollution effects (H1) or influx related effects (H2).Health impacts associated with particular project activities and which need to be addressed individually because they require particular attention to eliminate or reduce their occurrence and or effects are discussed as special health impacts (H3).

5.4.10.1 Sanitary and Solid Waste Health Effects (H1.1)
Impact Category: Pollution Related Health Effects
Project Phase: All Projects

While the project will implement a program to manage solid and liquid wastes, increased population in some settlements as a result of in-migration will cause an increase in sanitary waste discharges and effluents. Untreated sanitary waste and other effluents as well as solid waste can increase the existing prevalence of water and vector borne diseases (e.g., typhoid and diarrhoea) and other disease vectors in the project area. Baseline conditions indicate already poor domestic waste disposal practices and sanitary facilities in some parts of the project area. Disease vectors such as rats and mosquitoes are common around households, while the baseline study found *E. coli* in a number of drinking water sources. These disease vectors and agents will readily increase if population influx in affected communities is not managed.

The magnitude of the potential impact is low the since anticipated population increase in affected communities during the site clearing and construction phases of the project would be generally low for most communities. The areal extent of the impact would be low since health impacts would be restricted to affected communities. The frequency of the impact is high as it could be continuous throughout the site preparation, construction and post-construction. Impact duration would be typically short term if detected early, although some pollution related diseases can be chronic. Given the anticipated population increase and current poor hygiene conditions in the area, sensitivity of the area to the health impacts from pollution is considered medium.

Impact severity is moderate while impact likelihood is medium given the anticipated population influx in some communities. Overall impact significance is therefore moderate.

Impact Severity	Impact Likelihood	Overall Impact Significance
Moderate	**Medium**	**Moderate**

5.4.10.2 Noise and Vibration Impacts (H1.2)
Impact Category: Pollution Related Health Effects
Project Phase: Operations

There will be an increase in noise and vibration during the implementation of various activities associated with the Optic Fibre project. Increased noise and vibration will be associated with site clearing/preparation and construction activities due to the movement of vehicles, machinery, joinery and others as well as general increased human activity. The plant operations will also result in continuous noise while the plant is in operation. For pre-operations impacts, people inhabiting dwellings close to active construction sites are mostly at risk. The project will however require that contractors comply with noise emissions limits and compliance with this requirement will insure that noise levels at the nearby population centres will not impact human health. Moreover, night time work will be avoided as much as possible.

Noise impacts during the operations are of particular concern because the plant will cause increased noise in the area during the day and at night. Vibration and noise from the operations of the power plant will emanate from the turbines, coolers, transformers, workshops, water treatment plant, diesel generator, switch yards and other installed components. To better understand the spatial extent of noise impacts particularly noise effects at the nearby receptors, noise models were run using Noise Map 2000 software. Details of the modelling method and results are given in Appendix H, while the worst case scenario is illustrated in Figure 5-2.

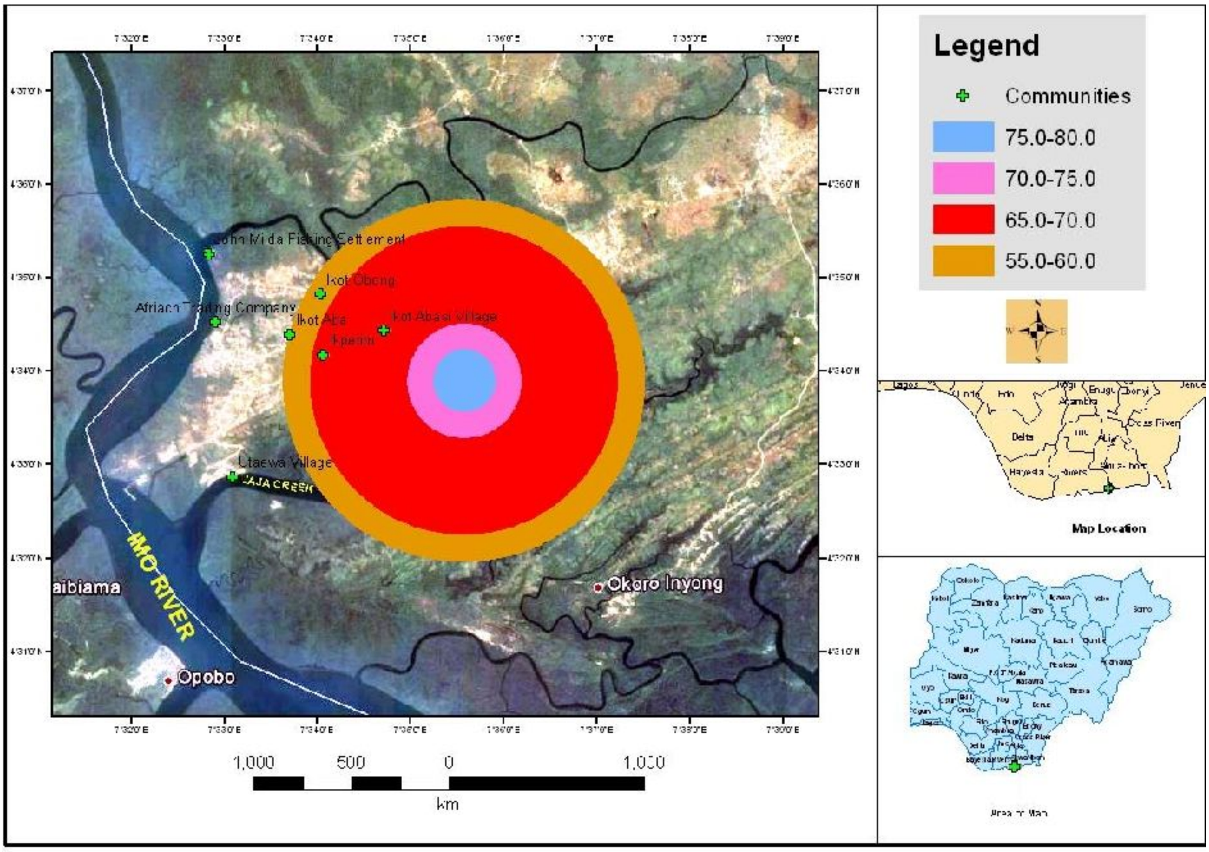


Figure 5-2: Modelled Worst Case Project Related Noise Levels in the OPTIC FIBRE Project Area

The highest noise from the power plant is generated when the two turbines are in operation. The anticipated maximum noise at the point of generation will be 138 dB(A) (i.e. 135 dB(A) + 135 dB(A)). The anticipated maximum ambient noise to be received by receptors within the proposed project site will be about 80 dB(A). At the 330 kv substation, receptors will receive about 70 – 75 dB(A) while in Ikot Abasi, receptors will receive about 65 – 70 dB(A) which is the World Bank recommended ambient noise level for industrial and commercial area. Other receptors are situated farther out and will be exposed to lower noise levels.

In terms of human health effects, noise pollution can be a general nuisance and cause sleep disturbance. Noise impacts were further studied using modelling tools as discussed in earlier sections.

The magnitude of this impact is medium as noise levels beyond work areas will be generally within limits at most locations. Night time noise will generally be palpable at the nearest locations but not beyond regulatory limits. The areal extent of the impact is low since increased noise levels will be generally localised to work areas. Impact frequency is continuous during operations. The duration of noise-related health impacts could be potentially long term if there are any cases of hearing impairment. Although a large part of the project area can be described as generally quiet and rural, the sensitivity of the receptors to noise impacts is considered medium because they are not particularly vulnerable to the anticipated noise given the existing industrial activity in the area.

Impact severity is moderate while the likelihood of occurrence is medium. Overall impact significance is therefore moderate.

Impact Severity	Impact Likelihood	Overall Impact Significance
Moderate	**Medium**	**Moderate**

5.4.10.3 Air Emission Impacts (H1.3a)
Impact Category: Pollution Related Health Effects
Project Phase: Pre-Operations

Burning of cleared vegetation and other organic wastes on site together with emissions from other sources such as combustion engines will lead to an increase in air pollutants around the project area. These activities will result in an increase in concentrations of sulphur oxides, nitrogen oxides, carbon monoxide, Volatile Organic Compounds (VOC) and particulates (such as dust). In addition to air pollution, these pollutants can accumulate in the soil and in surface water bodies.

Baseline studies have shown that existing levels of air pollutants in the area are low.
Burning of organic waste will create emissions of particulates, sulphur oxides, nitrogen oxides, carbon monoxide, Volatile Organic Compounds (VOC). Depending upon the size of the pile of material being burned and the nature of the material, levels of particulates could still be high 1 km from the source.

In terms of human health, short term exposure to high levels of particulates and other pollutants could give rise to respiratory difficulty. Prolonged exposure could result in lung and heart diseases.

The magnitude of this impact is considered medium since air emission could be significant during the site clearing/preparation and construction phases of the project, although emission dispersion is expected to take place fairly rapidly. The areal extent of the impact is low since pollutant levels will decrease rapidly away from the source of emission and only areas close to the points of release will likely experience levels beyond regulatory limits. Impact frequency would also be intermittent (i.e., medium). While exposures could result in short term respiratory problems, the duration of health related effects of air pollution could be potentially long term if a serious health effect were to develop. The sensitivity of the resource to air emissions effects is medium since this air quality is currently relatively free of air pollutants.

Impact severity is moderate while impact likelihood is low since people can avoid impacted areas while worst emissions occur. Overall impact significance is low.

Impact Severity	Impact Likelihood	Overall Impact Significance
Moderate	Low	Low

5.4.10.4 Air Emission Impacts (H1.3b)
Impact Category: Pollution Related Health Effects
Project Phase: Operations

During commissioning, there will be several equipment and facility testing activities, which will lead to the release of air pollutants from various sources including vents and joints among others. Plant operations will also result in similar releases. Expected pollutant air gas emissions include nitrogen oxides, sulphur oxides, carbon monoxide, Volatile Organic Compounds (VOC) and particulates.

Air emission modelling was carried out to further assess the spatial and temporal nature of potential air impacts from the project operations as mentioned in earlier sections.

Based on the modelling results, the overall magnitude of the air quality impact on health will be low. This is also expected given the open air location of the releases. Air emissions are not expected to exceed regulatory standards beyond the immediate vicinity of the release locations. The areal extent of the impacts will also be low. Impact frequency is medium as it will be intermittent but for 25 years. The impact duration is potentially high as air emissions will continue during the lifetime of the project. Workers on the facility are perhaps more exposed to air quality impacts. Heath impacts are discussed later. The air quality in the area is considered to be of medium sensitivity to the impact. The impact severity is moderate while the likelihood of an impact of concern occurring is low given the modelling results. The overall impact significance is low.

Impact Severity	Impact Likelihood	Overall Impact Significance
Moderate	Low	Low

5.4.10.5 Communicable and Non-Communicable Diseases (H2.1)
Impact Category: Influx Related Health Effects
Project Phase: Pre-Operations and Operations

Diseases of concern in the area include malaria, respiratory tract infections, typhoid fever, diarrhoea, hypertension, diabetes mellitus, osteo arthritis and eye conditions. Exposures to road and river accidents are also common though fatalities have been minimal.

The anticipated in-migration and associated increase in close human interaction mostly during the pre-operations phase of the project have the potential to significantly add to the incidence of both communicable and non-communicable diseases in the communities of the project area. The present household size in the area is already large and increase in incomes could lead to larger house-holds during this phase. Job seekers could also include extended family members. The existing lack of potable water, poor domestic waste disposal and poor sanitary facilities in some parts of the project area are likely to deteriorate, further worsening health conditions.

The potential magnitude of this impact would be medium for settlements where migrants settle but in general low if the entire project area is considered. The areal extent of the impact is potentially high given the potential of some communicable diseases to spread through the population and potentially over a large geographic area. The frequency of the impact would be low. The impact duration could potentially be long term for diseases such as HIV/AIDS. The resource sensitivity is high given the anticipated population increase and considering the already high incidence of a number of diseases in the area. Additionally, the existing health system in the project area is inadequate and will be further stretched during the project implementation.

The impact severity is major while impact likelihood is medium. Overall impact significance is therefore high.

Impact Severity	Impact Likelihood	Overall Impact Significance
Maderate	**Medium**	**Moderate**

5.4.10.6 Fertility (H2.2)
Impact Category: Influx Related Health Effects
Project Phase: Pre-Operations and Operations

Known causes of infertility in both men and women are STDs, stress, lifestyle and in some cases pollution. While the Optic Fibre project activities should not lead to the types of pollution known to affect fertility, activities that could increase STDs, stress and fertility-threatening lifestyles are possible.

The potential magnitude of this impact is low since fertility-threatening STDs, stress and lifestyles are not expected to affect a large number of people in the area. The areal extent of the impact is also low because the main causes of infertility would be restricted to the project area if fertility impacts are recorded. Impact frequency is intermittent during the site clearing/preparation and construction phases of the project and thus medium. Impact duration could be potentially long-term. The sensitivity of the populations to the impact is considered low given the relatively high fertility rate for the area and since the project activities are not expected to have negative impacts on fertility.

Impact severity is minor and impact likelihood is low. Overall impact significance is therefore low.

Impact Severity	Impact Likelihood	Overall Impact Significance
Minor	Low	Low

5.4.10.7 Quality of Health Care (H2.3)
Impact Category: Influx Related Health Effects
Project Phase: Pre-Operations and Operations

There is relatively high morbidity in the project area from common endemic diseases characteristic of semi urban and rural Nigerian populations. Morbidity rates could increase as a result of increased population and household sizes (and the resultant increase in communicable and non-communicable diseases), a decrease in physical activity due to lifestyle changes, as well as a potential increase in risky health practices such as smoking, prostitution and marijuana use. Mortality rates in the area are also similar to national averages.

The existing health care system and available medical facilities in the area are inadequate for the current population. Most residents in the project area patronize patent medicine dealers while some people patronize traditional health homes; both are typically ill-equipped to cater to most severe illnesses.

While persons working directly on the project are likely to include many healthy young men, the project-induced indirect population influx may result in a significant rise in mortality rates due to the additional health risks that could occur (e.g., increase in disease burden, prostitution, conflict, crime and accidents.

The magnitude of this impact would be medium as morbidity rates would generally increase without the availability of quality health care system or facilities in the area. Although the health risks would be restricted to the project area, the areal extent of the impact is potentially high due to the potential of the spread of communicable diseases through the population and potentially over a large geographical area.

Impact frequency is intermittent during the various project phases and thus medium but duration is potentially long term considering diseases such HIV/AIDS. The sensitivity of the resources to the activity is considered high since the anticipated influx will only cause a more than moderate population increase.

Impact severity is major and the likelihood is medium. Overall impact significance is therefore high.

Impact Severity	Impact Likelihood	Overall Impact Significance
Moderate	**Medium**	**Moderate**

5.4.10.8 Psychosocial Factors (H2.4)
Impact Category: Influx Related Health Effects
Project Phase: Pre-Operations and Operations

The Optic Fibre project activities will likely result in an increase in income for both project workers and for persons indirectly earning income from the projects' activities. Potential rise in some personal incomes; strain on the social, religious and cultural structure from influx of people to the area; and employment related stresses, including disengagement from work at the completion of pre-operations activities could all have an effect on people's psychosocial health. These psychosocial factors could manifest themselves in various ways including risky behaviour.

For example, greater available income would allow people the ability to purchase alcohol and marijuana, both of which are commonly used in the project area. While alcohol use is not necessarily a health problem, increased affordability on one hand and stress or depression on the other, could cause people to abuse alcohol and drugs, thus creating an increase in health problems.

Health problems could also result from other psychosocial factors such as anger (e.g., physical violence or abuse) as a result of dissatisfaction with work related remuneration.

The potential magnitude of this impact is low given the anticipated population increase. Areal extent of the impact is low since such effects will not go beyond the immediate area. The frequency of the impact will be low given experience from similar projects elsewhere. Impact duration will be medium as most affected persons should recover after a short time and chronic effects would not be expected. The sensitivity of the resource to the psychosocial health issues is low since the local cultural structure has some good ability to deal with such issues.

Impact severity is minor while the likelihood of occurrence is considered low since the social structure is capable of dealing with drug and alcohol related issues. This is supported by similar developments in other parts of Nigeria where psychosocial factors have not contributed significantly to ill health. Overall impact significance is therefore low.

Impact Severity	Impact Likelihood	Overall Impact Significance
Minor	Low	Low

5.4.10.9 Accidents, Spills, and Fires (H2.5)
Impact Category: Influx Related Health Effects
Project Phase: Pre-Operations and Operations

Accidents including spills (fuel and other hazardous chemicals), fires, vehicle, navigation accidents, and work area mishaps affecting the general public are possible hazards during the pre-operations and operational phases of the Optic Fibre project. Population influx during pre-operations will increase the risk of such accidents, including domestic fires.

Assuming the case of a major accident such as a major fire incident or road accident, the magnitude of the impact would be high depending on the number of persons that will be affected and if there are fatalities. The areal extent of the impact will be low since it will be limited to the project area although the extended effect on dependants makes the impact potentially medium. Impact frequency of such worst case scenarios will be in its worst form, intermittent, and thus medium while the duration of any such impact could be long term. The sensitivity of the resources to the impact is considered high.

Impact severity is therefore major while impact likelihood is medium given the less than satisfactory history and record of construction and general development-related hazards in Nigeria. While project related accidents can be readily reduced through project HSE plans and safe guards, domestic accidents and fires may be more common during project implementation. Overall impact significance is therefore high.

Impact Severity	Impact Likelihood	Overall Impact Significance
Moderate	Medium	Moderate

5.4.10.10. Lightning Strike (H3.1)
Impact Category: Special Health Effects

Project Phase: Operations

Lightning is a random and unpredictable event. Its' physical characteristics include current levels sometimes in excess of 400 kA, temperatures to 50,000 degrees F., and speeds approaching one third the speed of light. Lightning will usually strike the highest nearby object, which might be a power line tower or wire. Power facilities are designed to withstand lightning strikes by channeling them to ground at the tower. Lightning interference occurs mainly on overhead lines and has been a problem since the earliest days of the electricity supply industry. Damage from lightning strikes can result from the energy of the initial strike or from secondary effects, such as fires, electrical ground faults, or power loss. Over voltages which occur on the lines, travel toward the terminal or substation, and can cause damage, particularly to expensive equipment such as transformers.

People working or moving around areas affected by lightning are at risk of electric shocks induced by lightning. Short-term health problems can include mild daze to paralysis, and long-term issues can cause recurring problems. Some shocks can lead to death.

The transmission lines in the project area will be built with overhead ground wires that lead a lightning strike into the ground for dissipation. Thus, a safety zone will be created under the ground wires at the top of structures and along the line for the width of the right-of-way. Applicable national safe guidelines will be followed when installing, repairing, or upgrading the lines or equipment. Transmission line structures will be well grounded, and the conductors insulated from the structure.

The magnitude of the lightening impact is tied to its areal extent and is typically low as wide spread damage is not common. The frequency of lightening impacts is intermittent, while the duration of associated health impacts could be long term. The sensitivity of populations to lightning is considered low given the project plans to address possible lightning effects in accordance with national safety guidelines. The impact severity is minor while the likelihood is low. The overall impact significance is therefore low.

Impact Severity	Impact Likelihood	Overall Impact Significance
Minor	**Low**	**Low**

5.4.10.11 Forest Fires (H3.2)

Impact Category: Special Health Effects

Project Phase: Operations

The right of way along power transmission lines is often maintained by the owners of the line. The route is cleared regularly of vegetation to prevent public interference with the lines and fires. Conditions that are conducive to fires could develop if underlying growth is left uncleared for some time or if cleared materials are left under the lines. A major fire situation could affect lives and property.

A worst case scenario will be a fire incident that engulfs one or more households. The magnitude of the impact is considered high even if only one household is affected. The areal extent of the impact is however potentially medium because of the effect of the death of family members with dependants. The occurrence of such an impact cannot be frequent and is therefore low while the duration of associated impacts are potentially long term. The sensitivity of the resource (human health) to the impact is considered high. Impact severity is major while likelihood is low. Overall impact significance is therefore moderate.

Impact Severity	Impact Likelihood	Overall Impact Significance
Major	Low	Moderate

5.4.10.12 Occupational Health Hazards (H4)

All occupations and day to day livelihood activities are fraught with potential hazards, which vary depending on the nature of the work, methods used, trade tools and environmental factors. For Optic Fibre project, a host of occupational health hazards are readily identified. These include physical, chemical, biological and special hazards. These hazards are highlighted below.

a. General Infrastructure Developments

Over-exertion
The most common causes of injuries in construction sites are over-exertion, and ergonomic injuries and illnesses, such as repetitive motion, over-exertion, and manual handling.

Slips and Falls
Poor housekeeping, such as excessive waste debris, loose construction materials, liquid spills, and uncontrolled use of electrical cords and ropes on the ground, are associated with slips and falls on the same elevation. They are also among the most frequent cause of lost time accidents at construction sites.

Work in Heights
Falls from elevation associated with working with ladders, scaffolding, and partially built or demolished structures are among the most common cause of fatal or permanent disabling injury at construction sites.

Struck by Objects

Construction and demolition activities may pose significant hazards related to the potential fall of materials or tools, as well as ejection of solid particles from abrasive or other types of power tools which can result in injury to the head, eyes, and extremities.

Moving Machinery

Vehicle traffic and use of lifting equipment in the movement of machinery and materials on a construction site may pose temporary hazards, such as physical contact, spills, dust, emissions, and noise. Heavy equipment operators have limited
fields of view close to their equipment and may not see pedestrians close to the vehicle. Center-articulated vehicles create a significant impact or crush hazard zone on the outboard side of a turn while moving.

Confined Spaces and Excavations

Examples of confined spaces that may be present in construction or demolition sites include: silos, vats, hoppers, utility vaults, tanks, sewers, pipes, and access shafts. Ditches and trenches may also be considered a confined space when access or egress
is limited. Construction activities may as well pose a risk of exposure to

- Dust
- Chemicals
- Hazardous or flammable materials
- Wastes in a combination of liquid, solid, or gaseous forms,

b. **Power Generation Transmission and Distribution**

Live power lines

Exposure of workers to occupational hazards may result from contact with live power lines during construction, maintenance, and operation activities.

Working at height

Exposure of worker to occupational hazards may happen when working at elevation during construction, maintenance, and operation activities.

Electric and magnetic field

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 chemicals

Exposure of workers to chemicals in this sector primarily include handling of pesticides (herbicides) used for right–of-way maintenance, and exposure to PCB in transformers and other electrical components. Potential exposures to chemicals include dermal contact and inhalation during their storage, preparation and application.

The magnitude of occupational health impacts is generally low because the numbers of workers that are potentially affected are few compared to the overall worker's population. The areal extent is medium because occupational health effects typically affect dependants, some of who may be outside the immediate project area. The impact frequency during the various implementation is intermittent (medium) and mostly during construction while impact durations are potentially high if a worker dies or is maimed. The sensitivity of workers occupational health is high. The impact severity is major while the likelihood is low given the planned project operational controls. The overall impact significance is moderate.

Impact Severity	Impact Likelihood	Overall Impact Significance
Major	**Low**	**Moderate**

5.4.11 Indirect and Cumulative Impacts

5.4.11.1 Indirect Impacts

Indirect impacts are those effects caused by the action and occurring later in time or farther removed in distance, but still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.

Indirect impacts are triggered by direct impacts to the biophysical, social (and economic), and health environment that cause an effect to a larger system. Since the effect of the indirect impact may be removed in both distance and time from the immediate project site, it may be invisible to the immediate area of influence. Major indirect impacts have been evaluated when the related activity is central to the project development and are discussed with the direct impacts earlier in this chapter. Indirect effects identified for the Optic Fibre project relate mostly to population influx, and physical and economic displacement.

5.4.11.2 Cumulative Impacts (CM)

According to the US Council on Environmental Quality (CEQ, 1987) cumulative impacts are those impacts on the environment, which result from incremental effects of a specific action when added to past, present and reasonably foreseeable future actions regardless of who undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time.

In this report, direct impacts that affect an already impacted or impaired resource (e.g., poor health infrastructure in the area) are discussed as part of direct impacts.
Notable cumulative effects of the Optic Fibre project are those that add on to the existing stress in the area. These are:

- Land take
- Influx
- Transportation Effects

Land take and Development in the project Area

The Optic Fibre project will lead to acquisition and clearing of up to 28hectares of land including wetlands and lowland rainforest vegetationwithin and around the general project area. This land take and clearing is in addition to the land use changes that have occurred in the area over time. Studies (e.g., Pauleit*et al*, 2005) have shown that environmental impacts associated with land take include:

- Loss of biodiversity
- Increased ambient temperature
- Increased run off.

The proposed Optic Fibre project and subsequent projects that may be sited in the Project area will no doubt add-on to these effects in the project area. While the impacts are not readily quantifiable due to inadequate data, their overall significance is considered medium to high.

5.5 NEGATIVE IMPACTS OF DECOMMISSIONING

Detailed plans for facility decommissioning, applicable environmental restoration and remediation will be developed towards the end of the lifetime of the project. If the Facility is not taken over at the end of the project lifetime, it will be dismantled and removed for appropriate disposal according to a management plan to be developed and approved nearer the time. If required by the regulations in force at the end of the project lifetime the concrete foundations will also be removed. The major activities to be carried out during this phase have been identified and potential impacts screened.

D1 Transportation of Workers and Materials

During decommissioning, workers and materials will be transported to and from the plant site. As with other aspects of the project transportation will be by road and water. There will be palpable increase in road and vessel traffic at this time.

The impact screening exercise carried out earlier identified the following key potential and associated impacts of the transportation during decommissioning.

- Impacts on surface water quality and sediment
- Impacts on hydrobiology and fisheries

These impacts will be assessed in further detail during the development of the decommissioning plan.

D2 Wind Down Operations

Plans for decommissioning will be put in place as early as five years ahead of the final shut down of the project. There will be gradual wind down of operations which will include a gradual shut down of facilities and reduction in the number of operating personnel. Ultimately, all Optic Fibre project workers (employees and contract personnel) will be disengaged. It is not clear at this time if any workers will be re deployed to other duties within across the shareholder firms. Disengaged workers will experience a loss in income. The impact screening identified the impact on macro and micro economy as the main negative impact that may arise from wind down operations.

D3 Physical Removal of Installed Facilities

Installed and decommissioned facilities will be left in place, converted to other uses, or removed to other locations for re-use, recycling or disposal. All facilities and materials to be removed from the project site are potentially waste material unless they can be recycled or utilised. During facility removal also, there is the possibility of air emissions, minor spills of fuel, chemicals and other materials. Additionally, ambient noise and vibration will increase during the physical removal of the facilities. Potential impacts identified from impact screening, which will be later assessed in further detail are as follows:

- Impacts on surface water quality and sediments
- Impacts on hydrobiology and fisheries
- Noise and vibration impacts
- Impacts on ground water resources
- Impacts on macro and micro economy

D4 Remediation and Restoration Activities

Remediation and restoration activities generally impact the environment positively. However depending on the remediation/restoration requirements and management approach, these activities could potentially impact the environment negatively. For instance, the use of fertilizers to facilitate plant growth can lead to surface and ground water quality impairment while planting non-native species could cause an imbalance in the ecosystem. Potential impacts to be assessed at a later date are:

- Impacts on water quality
- Impacts on ground water quality.

D5 Wastes and Emissions: Generation and Handling

Wastes and emissions generation and handling are arguably the most important potential impacts of the Optic Fibre plant decommissioning. Types and quantities of air emissions, effluents and solid wastes that will be generated from decommissioning activities are not ready at this time. Potential impacts will however include the following:

- Impacts on air quality
- Impacts on water quality
- Impacts on solid waste infrastructure

All potential and associated impacts of the decommissioning phase are assigned moderate impact significance at this stage and will be assessed in further detail during the development of the decommissioning plan.

CHAPTER SIX
MITIGATION MEASURES

6.1 INTRODUCTION

Mitigation measures are actions taken to enhance positive impacts and to minimize negative ones. They aim to improve the environmental sustainability of a project. Depending on the nature of the impact they seek to ameliorate, they can already be applied during the design or implementation stage of the project. Mitigation measures are implemented on a continuous basis through the project's life-cycle.

This chapter summarizes mitigation measures that will be taken by Optic Fibre Project to assure environmental sustainability of the proposed power project and its related activities.

6.1.1 Specific and General Mitigations

Specific mitigation measures have been identified during the course of the environmental impact assessment to reduce the negative effects of those impacts identified through detailed analysis. Specification of mitigations focussed on impacts identified as high or medium overall impact significance ("HIGH" and "MODERATE" in Chapter 5). Mitigations are however also identified for "LOW" impacts in order to keep them at acceptable levels.

Mitigation measures developed as part of the EIA or related processes during the design phase are discussed as **Specific Mitigation Measures**. Specific mitigation measures are aimed at reducing negative impacts to acceptable levels and where possible, enhancing positive ones. The impacts are therefore re-assessed to determine the effect of each of these specific mitigation measures and the residual impacts are presented.

In order to meet the HSE performance objectives of the project, a number of mitigation measures are built into the project design and operating philosophy as specifications for environmental, social and health performance. **General Mitigation Measures** are those that Optic Fibre Project have already adopted and built into their standards, designs, and plans. In addition, operational best practices will be followed for the implementation phase (post-construction). Since Optic Fibre Project has committed itself and its contractors to these mitigation measures, they are expected to significantly improve the environmental sustainability of the project. When it was known that the general mitigations were part of the project plan, they were accounted for when assessing the potential impacts presented in Chapter 5.

6.1.2 Implementation of Mitigations

Mitigations are presented in this chapter in relation to specific project activities. In practice however, they are implemented as part of overall operational plans and procedures used by Optic Fibre Project and its contractors to control their work and ensure compliance with protective measures. Throughout this chapter, reference is made to a particular plan or set of plans that will address the specific impact and mitigation. The organization of the plans and procedures is the subject of the Environmental Management Plan (EMP) that is described in Chapter 7.

As part of its Sustainability Commitment, Optic Fibre Project has committed to requiring that its contractors and sub-contractors comply with their obligations in a manner consistent with their Environmental, Social and Health Management Plans and/or the sustainability commitment. Mitigation measures will be required of all contractors through contractual obligation. Each contractor will be required to develop a specific Environmental Management Plan (EMP) to support this EIA, particularly the overall EMP. They will also be required to provide formal plans, procedures, and other submissions to ensure proper implementation of protective measures and of the specific mitigation requirements identified by the EIA.

Each Contractor is required to submit the following plans for review by Optic Fibre Project to determine adherence to requirements of the project's overall HSE management plans. These plans must be approved by the Optic Fibre Project before work can commence:

- Environmental Management Plan;
- Waste Management Plan;
- Emergency Response Plan; and
- Security Plan.

Optic Fibre Project will also develop the following plans:

- Influx Management Plan;
- Labour Plan (including Job Rules);
- Compensation Plan;
- Community Development Plan; and
- Transportation and Journey Management Plan.

The EMP presented in Chapter 7 provides specific requirements to monitor the effectiveness of mitigation measures. Optic Fibre Project will revisit and, to the extent possible, develop alternatives for any mitigation measures that are not resulting in the intended outcome.

6.2 SPECIFIC MITIGATION MEASURES

Mitigations specific to activities and the activity's impacts were identified during the EIA to address impacts not minimized by the General Mitigation Measures. These specific mitigation measures are presented for each impact category in Table 6-1 following the format used in Chapter 5.

Optic Fibre Project has developed mitigations working within the framework of Best Available Technology Not Entailing Excessive Cost (BATNEEC) with the goal of reducing impacts or the risk of impacts to "As Low As Reasonably Practicable" (ALARP). In determining whether to implement mitigation measure, especially for those recommended by the EIA, the following factors have been taken into consideration:

- Feasibility;
- Ease of implementation;
- Local suitability;
- Institutional requirements;
- Training requirements;
- Monitoring requirements;
- Cost (capital and operating); and
- Cost-effectiveness.

The residual impact ratings presented were reached by re-assessing the impacts and the effect of the mitigation on the impact severity criteria and likelihood. For instance, implementing an influx plan will address most impacts associated with population increase in the communities. Similarly project support to self-help initiatives and awareness campaigns on solid waste management practices, such as waste collection and proper storage, will reduce, but not eliminate, the magnitude of influx-related increase in solid wastes.

It is noted however that some impacts by their very nature may not be readily mitigated to low significance levels. For some of these, in-kind or compensatory measures will be taken as mitigation. One example is land take and economic displacement which will be addressed through the compensation procedures developed for the project. Some social impacts may require wider-reaching government action for effective mitigation (e.g., provision of basic infrastructure). In this regard, Optic Fibre Project will through advocacy and continuous engagement, work with communities and the Government of Project Area to bring about the desired outcomes.

Table 6.1:Summary of Impacts, Mitigations and Residual Impacts of the Proposed Optic Fibre project

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impact Significance	Mitigation Measures	Residual Impact
PP	**Impacts Associated With Physical Presence of Workers and Equipment**					
PP1	Pre-Operation Phase	Physical Presence of Workers and Equipment	**Impacts on Infrastructure** In-migration of workers and job seekers putting pressure on existing infrastructure.	**Moderate**	OPTIC FIBRE PROJECT shall ✓ Develop and implement an influx management plan to look into specific options to address anticipated pressure on existing infrastructure such as housing, roads, hospitals, educational facilities in the communities ✓ Employ casual/unskilled labour primarily from local communities. ✓ Give priority consideration to qualified local community for hiring of workers. ✓ Shall handle the hiring of and payment to immigrant workers off location to discourage migrating job seekers. ✓ Shall provide closed camp with adequate facilities for construction workers, so that they do not interfere with local facilities	Low
PP2			**Impacts on Macro and Micro Economy** Increase in the prices of food, goods and services as result of population increase coupled with increased in demand for food, goods and services. Un-employment boom-bust resulting in tension and conflicts	**Moderate**	OPTIC FIBRE PROJECT shall: ✓ Develop and implement an influx management plan, which will look into specific options to address anticipated increase in prices of food, medicine, transportation, recruitment of workers, community expansion, housing plan, inflation reduction, security and other general goods and services ✓ Maintain an up- to-date food basket survey. ✓ Adopt workers disengagement plans to address boom-bust effects ✓ Strengthen existing cooperatives societies together with the establishment of new ones to engage in various commercial activities that will reduce inflation. ✓ Employ casual/unskilled labour primarily from local communities. ✓ Give priority consideration to qualified local community for hiring workers.	Low
PP3			**Impacts on Social and Cultural Structure**	**Moderate**	OPTIC FIBRE PROJECT shall ✓ Conduct periodic STD and HIV/AIDs and general	Low

Table 6.1:Summary of Impacts, Mitigations and Residual Impacts of the Proposed Optic Fibre project

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impact Significance	Mitigation Measures	Residual Impact
			Marginal increase in population within the project area will lead to an increase in negative vices such as prostitution (commercial sex work) and crime thereby affecting social and cultural systems through a negative change in value systems.		safe sex awareness campaigns in the project area ✓ Consider keeping a percentage and certain category of jobs for females ✓ Support initiatives including educational programmes aimed at preserving the local language, cultural structures and traditions	
PP4			**Impacts on Cultural and Archaeological Resources** Non-natives living or working in the area may not be conversant with traditional religious practices and rules on shrines and so may inadvertently break traditional religious rules by living in sacred areas or engaging in culturally unacceptable behaviour.	**Low**	OPTIC FIBRE PROJECT shall: ✓ Require that Contractors conduct induction programs to educate staff and contractors with the aid of the community elders on traditional religious practices, rules on shrines, culturally acceptable behaviour, and acquaint them with the sacred areas in the communities of the project area. ✓ Ensure work ceases if remains or artifacts are discovered on site during earthworks, and the contractor shall immediately inform the company's representatives and contact the relevant authority.	Low
PP5			**Impacts on Education** The attraction to earn income could potentially, either directly from the project, or through some other indirect income generating enterprises, cause young people to abandon or suspend their education.	**Low**	OPTIC FIBRE PROJECT shall: ✓ Make sure no underage/school age children is or are involved in any paying job or non paying job on the project, hence shifting their attention from the opportunities in the project.	Low
PP6			**Impacts on Ground Water** Wash down of oil and grease and any chemicals/soluble hazardous materials stored or used.	**Moderate**	OPTIC FIBRE PROJECT shall: ✓ Implement non-permeable lay-down areas for project machinery equipment ✓ Make sure that chemicals and all hazardous substances shall be kept within contained areas ✓ Ensure that all spent oil and hazardous chemicals are properly containerised for proper disposal.	Low

Table 6.1:Summary of Impacts, Mitigations and Residual Impacts of the Proposed Optic Fibre project

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impact Significance	Mitigation Measures	Residual Impact
Impacts Associated With Transportation of Workers and Material						
TR1	Pre-Operation Phase	Transportation of Workers and Material	**Impacts on Transportation** Increased vehicular and boat traffic in the area could lead to longer commuting time for existing road users.	Low	OPTIC FIBRE PROJECT shall: ✓ Ensure that as much as possible, all heavy duty trucks working on the project move at off peak hours.	Low
TR2			**Impacts on Surface Water, Hydrobiology and Fisheries** The increased vessel traffic will result in additional perturbation to the surface water and the seabed and perhaps minimally impact water quality from small releases of hydrocarbons which could impact habitats/communities of some aquatic organisms.	Low	✓ OPTIC FIBRE PROJECT shall ensure that all project vessels adopt journey Hazard Management plans, which shall include maximum allowable speed when travelling in shallow water. ✓ OPTIC FIBRE PROJECT shall use front runner and other means to forewarn potentially affected fishing communities to be used prior to the use of large vessels ✓ OPTIC FIBRE PROJECT shall ensure that all vessel movement adopt normal transportation routes following NIWA regulated corridors to minimise the interface with other waterways users ✓ OPTIC FIBRE PROJECT shall conduct prior consultation and notification of communities to be affected for the development of a procedure to address any income or net losses ✓ OPTIC FIBRE PROJECT shall control the frequency of movement of vessel along the sensitive areas.	Low
Impacts Associated With Site Clearing And Preparation Activities						
SC1	Pre-Operation Phase	Site Clearing and Preparation	**Impacts on Soil Ecology** Removal of dry lowland rainforest vegetation, freshwater swamp forest and some of the top soil from the project site will result in loss of soil fertility, and near annihilation of soil ecology	Moderate	OPTIC FIBRE PROJECT shall: ✓ Limit site clearing to the needed portions only and leave as much green area as possible. ✓ Ensure excavated soils are backfilled and properly levelled out to prevent the creation of ruts and the associated pond ✓ Ensure that the topography excavated and non-build	Low

Table 6.1:Summary of Impacts, Mitigations and Residual Impacts of the Proposed Optic Fibre project

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impact Significance	Mitigation Measures	Residual Impact
			in the affected areas		areas are restored to pre-site clearing status.	
SC2			**Impacts on Surface Water Quality, Hydrobiology and Sediment** Run off from the site into nearby rivers and streams resulting in increased turbidity and total suspended which may affect plankton communities, benthic organisms and fisheries in rivers and streams.	**Low**	OPTIC FIBRE PROJECT shall: ✓ Construct drainage lines where necessary on the site ✓ Ensure runoff from the site shall be channelled through sediment/silt traps before discharge into nearby water bodies ✓ Backfill and properly compact trenches to minimize impact on surface waters as a result of highly turbid runoff inputs	Low
SC3			**Impacts on Vegetation and Wildlife** Loss of wildlife, trees, shrubs, and climbers as well as associated fauna within the area of the forest to be taken up for the project	**Moderate**	OPTIC FIBRE PROJECT shall: ✓ Keep site clearing to a minimum and leave as much vegetation as possible within project areas. ✓ Encourage the use of existing cleared or disturbed areas for the Contractor's Camp, stockpiling of materials etc. ✓ Ensure that the indigenous/primary forests are not to be removed unless required for construction purposes, nor shall new access routes be cut through indigenous vegetation. ✓ Trim rather than remove vegetation wherever possible. ✓ Strictly control clearing and preparation activities where it occurs in close proximity to indigenous/primary forest. ✓ Ensure that the limits of clearing and preparation activities must be clearly demarcated as per the Environmental Specifications to reduce unnecessary site clearing ✓ Prohibit contractor's and staff from removal or harvesting of trees or medicinal plants, and from poaching (through trapping, poisoning or shooting) or otherwise harm wild animals in the area. ✓ Prohibit harvesting/ use of indigenous/primary plants as	Low

Table 6.1:Summary of Impacts, Mitigations and Residual Impacts of the Proposed Optic Fibre project

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impact Significance	Mitigation Measures	Residual Impact
					firewood and other uses unless they are obtained from approved cleared areas. ✓ Ensure a slow and "systematic clearing method" to give room for the escape of the wildlife ✓ Prohibit the killing of wildlife for food by the contractor/project personnel.	
SC4			**Impacts on Culture and Archaeological Resources** Unauthorized clearing by the people near project facilities for construction of housing by people not associated with the project, hence leading toloss of shrines, burial grounds and other archaeological resources.	**Moderate**	OPTIC FIBRE PROJECT shall: ✓ Implement an influx management plan to address the preservation of cultural and archaeological structures and resources. ✓ Create a buffer zone between the OPTIC FIBRE PROJECT project area and the communities where there shall be neither clearing nor structures.	Low
SC5			**Physical and Economic Displacement Impacts** Loss of farm land and forage to site clearing and construction activities	**Moderate**	OPTIC FIBRE PROJECT shall: ✓ Provide livelihood enhancement support for affected persons ✓ Implement a grievance procedure to ensure all livelihood complaints about enhancement benefits are handled in a structured and timely manner and to resolve conflicts ✓ Monitor, document and evaluate livelihood enhancement process	Low
SC6			**Impacts on transportation** Increased traffic activities along the project area leading to longer commuting time for existing road users	**Low**	OPTIC FIBRE PROJECT shall: ✓ Implement a method statement for site clearing to reduce impacts on transportation ✓ Avoid as many roads and tracks currently used by pedestrians and road users in the project area ✓ Provide alternative routes to pedestrians if existing roads and tracks are blocked off ✓ Notify communities of plans to block roads or tracks ✓ As much as possible, avoid peak periods to transport supplies and equipment during project implementation.	Low

Table 6.1:Summary of Impacts, Mitigations and Residual Impacts of the Proposed Optic Fibre project

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impact Significance	Mitigation Measures	Residual Impact
SC7			**Vibration and Noise Impacts** Increased noise and vibration generated by heavy equipment use for land clearing	Low	OPTIC FIBRE PROJECT shall: ✓ Ensure all contractors avoid night time work as much as possible ✓ Pre-notify affected parties of their activities and shall provide ear muffs for people working with or near noise generating equipment ✓ Ensure that project staff are not exposed to more than nine hours at a go on any equipment generating noise level of more than 90 dBA .	Low
Impacts Associated With Construction Activities						
CR1	Pre-Operation Phase	Construction Activities	**Vibration and Noise Impacts** Increased noise and vibration generating activities like carpentry/joinery, block work, cement batching plant, lifting machinery operations and general vehicular movement.	Low	OPTIC FIBRE PROJECT shall: ✓ Ensure that project staff are not exposed to more than nine hours at a go on any equipment generating noise level of more than 90 dBA	Low
CR2			**Impacts on Human Movement** Disruptions to trekking paths will negatively impact people's movement and could affect social, economic and livelihood networks in the area.	Low	OPTIC FIBRE PROJECT shall: ✓ Avoid as many existing roads and tracks currently used by pedestrians and road users in the project area ✓ As much as possible, avoid peak periods to transport supplies and equipment during project implementation. ✓ Provide alternative routes to pedestrians if existing roads and tracks are blocked off ✓ Notify communities of plans to block roads or tracks ✓ As much as possible, avoid peak periods to transport supplies and equipment during project implementation	Low
Impacts Associated With Excavation						
DR1.1	Pre-Operation Phase	Physical Excavation Activity	**Impacts on Surface Water Quality, Sediments and Hydrology** Increased turbidity which will affect water quality. Fish and	High	OPTIC FIBRE PROJECT shall: ✓ Use silt curtains while Excavation to ensure that suspended solids in discharge water is minimized ✓ Prior to initiation of Excavation, complete a modelling	Low

Table 6.1:Summary of Impacts, Mitigations and Residual Impacts of the Proposed Optic Fibre project

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impact Significance	Mitigation Measures	Residual Impact
			other aquatic organisms that do not migrate away from the area could be directly affected by the activity.		study simulation to guide Excavation and mitigation of its effects	
DR1.2			**Impacts on Physical and Economic Displacement** Areas mostly affected by turbidity will not be viable fishing grounds while impacts last. Fish traps set in affected part of the Creek will need to be relocated	High	✓ Where loss of fishing grounds or rights is envisaged or established, OPTIC FIBRE PROJECT shall implementa livelihood compensation and enhancement programme for project affected persons (PAP). The program shall also include a grievance mechanism	Low
DR1.3			**Change in Topography** Dumping of spoils on the creek banks will lead to slight topography elevations.	Low	✓ OPTIC FIBRE PROJECT shall ensure that Excavation activities do not alter the natural topography in the area and where necessary, maintain or restore water and nutrient flow. ✓ OPTIC FIBRE PROJECT shall require that contractors working on Excavation maintain a Excavation plan that maintains natural topography in the area	Low
Impacts Associated With Pipeline Construction						
PPL1.1	Pre-Operations	Pipeline Installation	**Salt Water Intrusion Impacts** Trenching activities along the pipeline route will open up the area for salt water encroachment/intrusion. This could lead to the death of fresh water plants and animals.	High	OPTIC FIBRE PROJECT shall ensure that: OPTIC FIBRE PROJECT shall: ✓ Ensure that trenchingis carried out in a sequence to limit the risk of saltwater intrusion to the freshwater areas ✓ Sheet piles shall be used during construction to block off the salt water influx ✓ Pipeline trenches shall be covered to pre-excavation levels ✓ The effectiveness of the saltwater barriers shall be monitored	Low
Impacts Associated with Wastes and Emissions Handling						
WE1.1	**Pre-Operations**	**Waste and Emissions Generation**	**Air Emissions Impacts** Emissions of air pollutants	Moderate	OPTIC FIBRE PROJECT shall: ✓ Service all equipment regularly, and shall use low emission equipment	Low

Table 6.1:Summary of Impacts, Mitigations and Residual Impacts of the Proposed Optic Fibre project

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impact Significance	Mitigation Measures	Residual Impact
		and Disposal	during the operation of combustion engines, burning of organic material from site clearing, and dust during site clearing and grading.		✓ Require that all contractors maintain their equipment in good condition ✓ Require that engines are turned off when not required ✓ Reduce burning of organic material to the barest minimum	
WE1.2	**Pre-Operations**	**Waste and Emissions Generation and Disposal**	**Solid Waste Impacts** Illegal disposal of waste in open dump areas and waterways.	Moderate	✓OPTIC FIBRE PROJECT shall implement a waste minimization and utilization strategy as much as possible to reduce the amount of wastes to be generated ✓OPTIC FIBRE PROJECT shall develop and implement an approved waste management plan for all project phases in line with regulatory requirements ✓OPTIC FIBRE PROJECT shall ensure proper waste manifesting for all non incinerated wastes and all other construction wastes taking off the plant site for disposal ✓OPTIC FIBRE PROJECT shall contract only with approved and permitted waste handling firms and technologies ✓OPTIC FIBRE PROJECT shall monitor its waste contractors	Low
WE1.3	Pre-Operations	Waste and Emissions Generation and Disposal	**Liquid Wastes and Discharge Impacts** Generation of organically-loaded effluents from sinks, showers, laundries activities and sewage during the site preparation and construction in the worker's camp.	Moderate	OPTIC FIBRE PROJECT shall: ✓ Ensure sewage generated at the temporary construction camps, will be collected in a closed system comprising a conservancy tank,which is then piped to a holding tank. ✓ OPTIC FIBRE PROJECT shall engage the services of a certified third-party waste disposal contractor to collect waste from the tanks on a regular basis and treat the sanitary waste offsite. ✓ Implement a public training program to increase awareness of basic sanitation ✓ Extend project sanitary waste handling to potentially affected communities during construction	Low

Table 6.1:Summary of Impacts, Mitigations and Residual Impacts of the Proposed Optic Fibre project

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impact Significance	Mitigation Measures	Residual Impact
WE1.4	Pre-Operations	Waste and Emissions Generation and Disposal		Moderate	✓ OPTIC FIBRE PROJECT will pump all hydrotest discharge water into barge tanks, where the effluent will be neutralized with hydrogen peroxide. ✓ OPTIC FIBRE PROJECT shall carry out Eco-toxicity tests on hydrotest water before and after neutralization to ensure it meets applicable best practice standards before discharge. ✓ OPTIC FIBRE PROJECT shall ensure discharge is done at a location beyond artisanal fishing grounds.	Low
WE1.5	Pre Operation (Excavation)	Waste and Emissions Generation and Disposal	**Excavation Spoil Disposal Impacts** The disposal of dredge spoils in the marine environment will lead to the generation of sediment plumes, increase turbidity and total suspended solids.	Moderate	✓ Test dredge spoils prior to disposal to ensure they are not contaminated ✓ OPTIC FIBRE PROJECT store dredged material on barges and then ship the spoils to marine waters beyond 50m depths for disposal and away from artisanal fishing grounds. ✓ OPTIC FIBRE PROJECT shall require that contractors handling spoils disposal implement a disposal method that does not allow the creation of piles of spoils	Low
Impacts Associated With Physical Presence of Plant						
OM1.1	Operations	Physical Presence of Plant	**Visual Impacts** Fundamental change in the appearance of the landscape as a result of the project	Moderate	OPTIC FIBRE PROJECT Shall: ✓ Use natural screening to minimise the extent of change of view to the water's edge, using natural vegetation (such as tall trees) where possible; and ✓ Implement a "down" lighting strategy to minimise the potential for light emissions to pass beyond the project boundary and be reflected by open water	Low
OM1.2	Operations	Generation and Transmission	**Impacts of Electric and Magnetic Fields** Adverse effects of electric and magnetic field on plant, animal species, and on human health.	Low	OPTIC FIBRE PROJECT shall; ✓ Set personal exposure monitoring equipment to warn of exposure levels that are below occupational exposure reference levels (e.g. 50 percent). ✓ Limit exposure time through work rotation	Low

Table 6.1:Summary of Impacts, Mitigations and Residual Impacts of the Proposed Optic Fibre project

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impact Significance	Mitigation Measures	Residual Impact
					✓ Increase the distance between the EMF source and the worker, when feasible, or the use of shielding materials ✓ Prepare and implement an EMF safety program including the following components: o Identification of potential exposure levels in the workplace o Surveys of exposure levels in new projects and the use of personal monitors during working activities o Training of workers in the identification of occupational EMF levels and hazards o Establishment and identification of safety zones to differentiate between work areas with expected elevated EMF levels compared to those acceptable for public exposure, limiting access to properly trained workers o Implementation of action plans to address potential or confirmed exposure levels that exceed reference occupational exposure levels developed by international organizations such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP),	
OM1.3	Operations	Physical Presence of Transmission Lines	**Impacts on Wildlife** Collision of birds with transmission lines and electrocution of bats as well as the danger of coating chemicals and pesticides.	Low	✓ Avoid the use of pesticides that fall under the World Health Organization Recommended Classification of Pesticides by Hazard Classes 1a and 1b ✓ Apply pesticides based on criteria (e.g. field observations, weather data, time of treatment, and dosage) and maintain a pesticide logbook to record such information ✓ Avoid flight paths of birds when finalizing high tension cable route.	Low
OM1.4	Operations	Waste and Emissions	**Operations Solid Waste Impacts** In addition to solid waste	Moderate	OPTIC FIBRE PROJECT shall: ✓ Pursue a waste minimization and utilization strategy ✓ Develop and implement an approved waste management	Low

Table 6.1:Summary of Impacts, Mitigations and Residual Impacts of the Proposed Optic Fibre project

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impact Significance	Mitigation Measures	Residual Impact
			generated and managed by the project, there will be an increase in solid waste in the communities and surrounding areas due to influx of project workers and non-project related migrants. Excess waste may accumulate in the communities or the surrounding areas.		plan for operations also ✓ Ensure proper waste manifesting for all project related wastes ✓ Engage government approved and reputable waste management firms in waste handling and disposal Implement waste management auditing ✓ Work with communities to develop and implement basic waste handling procedures among residents ✓ Implement a public training program to increase awareness of basic sanitation	
OM1.5	Operations	Waste and Emissions	**Air Emissions Impacts** The increment of the green house gases in the atmosphere resulting from the operations in the facility.	Low	OPTIC FIBRE PROJECT shall: ✓ As much as possible ensure the use of modern equipment that minimize emissions of pollutant gases during operation ✓ Ensure proper maintenance of combustion equipment to ensure efficient combustion ✓ Monitor the air-quality continuously as a mitigative step to ensure that the overall significance does not increase	Low
OM1.6	Operations	Waste and Emissions	**Effluent Handling and Disposal Impacts** Generation of sewage (black water); "grey" water from sinks, showers, and laundries; and other organic laden effluents from personnel accommodations during plant operation.	Low	OPTIC FIBRE PROJECT shall: ✓ Ensure sewage generated at the living area of staff, will be collected in a closed system comprising a conservancy tank to separate solid materials from liquid wastes. The liquids would then be piped to a holding tank. ✓ OPTIC FIBRE PROJECT shall engage the service of a certified third-party waste disposal contractor to collect waste from the tanks on a regular basis and treat the sanitary waste offsite.	Low
Health Impacts						
H1.1	All Projects	Pollution Related Health	**Sanitary and Solid Waste Health Effects** Untreated sanitary waste and	**Moderate**	OPTIC FIBRE PROJECT shall; ✓ Implement a Contractors Sanitation Plan for the	Low

Table 6.1:Summary of Impacts, Mitigations and Residual Impacts of the Proposed Optic Fibre project

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impact Significance	Mitigation Measures	Residual Impact
		Effects	other effluents as well as solid waste can increase the existing prevalence of water and vector borne diseases and other disease vectors in the project area.		project ✓ Support health enlightenment campaigns, which provide guidelines and tips for improved sanitary conditions in the communities ✓ Support indigenes to establish commercial sanitary services that will serve the project area ✓ Require its contractors to provide HSE induction training to all workers engaged on the project	
H1.2	Operations	Pollution Related Health Effects	**Noise and Vibration Impacts** Increase in noise and vibration during the implementation of various activities associated with the OPTIC FIBRE PROJECT project.	**Moderate**	OPTIC FIBRE PROJECT shall: ✓ Implement a noise abatement plan ✓ Adopt noise attenuation measures such as installation of acoustic mufflers on large engines and equipment; ✓ Provide hearing protection to all workers on site ✓ Avoid night time work as much as possible	Low
H1.3a	Pre-Operations	Pollution Related Health Effects	**Air Emission Impacts** Burning of cleared vegetation and other organic wastes on site together with emissions from combustion engines will lead to an increase in air pollutants.	**Low**	OPTIC FIBRE PROJECT shall: ✓ Service all equipment regularly, and shall use low emission equipment ✓ Require that all contractors maintain their equipment in good condition ✓ Require that engines are turned off when not required ✓ Reduce burning of organic material to the barest minimum	Low
H1.3b	Operations	Pollution Related Health Effects	**Air Emission Impacts** Plant operations will result in releases of pollutant gases like nitrogen oxides, sulphur oxides, carbon monoxide, Volatile Organic Compounds (VOC) and particulates.	**Low**	OPTIC FIBRE PROJECT shall ✓ Service all equipment regularly, and shall use low emission equipment ✓ Monitor operations emissions to ensure pollutants are kept within regulatory limits	Low
H2.1	Pre-Operations and	Influx Related Health	**Communicable and Non-Communicable Diseases** Influx of people into the area as	**High**	OPTIC FIBRE PROJECT shall: ✓ Conduct periodic health awareness campaigns for STDs especially AIDS, and support safe sex initiatives	Moderate

Table 6.1:Summary of Impacts, Mitigations and Residual Impacts of the Proposed Optic Fibre project

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impact Significance	Mitigation Measures	Residual Impact
	Operations	Effects	a result of the project could lead to outbreak ofCommunicable and Non-Communicable Diseases among the populace.		✓ Support indigenes to establish commercial sanitary services that will serve the area ✓ Through advocacy, encourage State and Local Governments to improve housing and other facilities in the area ✓ Provide adequate medical facilities for all construction workers.	
H2.2	Pre-Operations and Operations	Influx Related Health Effects	**Impacts on Fertility** The possibility of activities that could increase STD, stress and fertility-threatening lifestyles.	**Low**	OPTIC FIBRE PROJECT shall: ✓ Monitor this health determinant as a mitigative step to ensure that the overall significance does not increase	Low
H2.3	Pre-Operations and Operations	Influx Related Health Effects	**Impacts on Quality of Health Care** Inadequate health care system and medical facilities in the area for the populace.	**High**	✓ As part of its social development plan, OPTIC FIBRE PROJECT will embark on health care interventions to improve general health awareness and the availability of health care facilities in the area ✓ OPTIC FIBRE PROJECT shall periodically sponsor cultural and recreational activities such as festivals and sports competitions. ✓ OPTIC FIBRE PROJECT workers from the community shall have access to the medical facilities that will be provided in the construction camp and power plant premises. Adequate medical facilities shall be provided for all construction workers and those employed to operate the plant. ✓ OPTIC FIBRE PROJECT shall conduct periodic health awareness campaigns for STDs especially AIDS and also support safe sex initiatives ✓ The mitigation measures shall be implemented in phases from pre operations to operations	Moderate

Table 6.1:Summary of Impacts, Mitigations and Residual Impacts of the Proposed Optic Fibre project

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impact Significance	Mitigation Measures	Residual Impact
H2.4	Pre-Operations and Operations	Influx Related Health Effects	**Psychosocial Factors** Strain on the social, religious and cultural structure from influx of people to the area could lead to psychosocial factors.	Low	OPTIC FIBRE PROJECT shall; ✓ Inculcate induction training into its employment program to intimate new intake with the culture and religious belief of the people. ✓ Maintain and implement a Drug and Alcohol Policy for all aspects of the project ✓ Support anti-drug crusades and campaigns in the area ✓ Ensure that its contractors develop and implement a workers disengagement plan to address the potential boom-bust impacts	Low
H2.5	Pre-Operations and Operations	Influx Related Health Effects	**Accidents, Spills, and Fires Impacts** Accidents including spills (fuel and hazardous chemicals), fires, vehicle navigation accidents are hazards that may be linked to the project activities in the environments	High	OPTIC FIBRE PROJECT shall: ✓ Require that all its Contractors develop and implement HSE Plans for their activities ✓ Review all contractor HSE plans prior to contract award. ✓ Ensure that all contractors and workers comply with OPTIC FIBRE PROJECT occupational health and safety guidelines and standards for general work practices, hours of work, air emissions, noise and light. ✓ Carry out routine safety checks on the working equipment in line with standard safety procedures and OPTIC FIBRE PROJECT Operating Controls. ✓ Ensure all contractors staff are trained on basic safety procedures and emergency response procedures and environmental issues. ✓ Require that contractors maintain emergency and first aid facilities at strategic locations throughout the project area ✓ Develop and maintain an emergency, oil and chemical spill prevention and response/counter measures plans for all phases of the project ✓ Require that all contractors maintain a journey hazard management plan	Moderate
H3.1	Operations	Special	**Lightning Strike Impacts** Lightning strike on power line,	Low	OPTIC FIBRE PROJECT shall: ✓ Design transmission facilities to withstand lightning	Low

Table 6.1:Summary of Impacts, Mitigations and Residual Impacts of the Proposed Optic Fibre project

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impact Significance	Mitigation Measures	Residual Impact
		Health Effect	tower or wire.		strikes by channeling them to ground at the tower	
H3.2	Operations	Special Health Effects	**Forest Fires Impacts** The possibility of bush fire if the right of way (RoW) is not well cleared. It could also occur as a result of electric faults.	**Moderate**	OPTIC FIBRE PROJECT shall; ✓ Routinely monitor right-of-way vegetation for fire risk ✓ Remove blow down and other high-hazard fuel accumulations along right –of- way ✓ Use time thinning, slashing, and other maintenance activities to avoid forest fire seasons ✓ Dispose of maintenance slash by truck or controlled burning. Controlled burning shall adhere to applicable burning regulations, fire suppression equipment requirements, and will be typically monitored by a fire watcher ✓ Plant and manage fire resistant species (e.g. hardwoods) within, and adjacent to, rights-of-way ✓ Establish a network of fuel breaks of less flammable materials or cleared land to slow progress of fires and allow fire fighting access.	Low
Occupational Health Impacts						
H4	General Infrastructure Developments	Health Hazards	Over exertion	**Moderate**	OPTIC FIBRE PROJECT shall: ✓ Ensure the use of mechanical assists to eliminate or reduce exertions required to lift materials, hold tools and work objects, and requiring multi-person lifts if weights exceed thresholds ✓ Select and design of tools that reduce force requirements and holding times, and improve postures ✓ Provide user adjustable work stations ✓ Incorporate rest and stretch breaks into work processes, and conducting job rotation ✓ Implement quality control and maintenance programs that reduce unnecessary forces and exertions ✓ Consider additional special conditions where required such as for left handed persons	Low
			Slips and falls	**Moderate**	OPTIC FIBRE PROJECT shall and require that contractors	Low

Table 6.1:Summary of Impacts, Mitigations and Residual Impacts of the Proposed Optic Fibre project

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impact Significance	Mitigation Measures	Residual Impact
					implement the following slip and fall prevention and protection measure for all workers exposed to the hazard: ✓ Training and use of temporary fall prevention devices, such as rails or other barriers able to support a weight of 200 pounds, when working at heights equal or greater than two meters or at any height if the risk includes falling into operating machinery, into water or other liquid, into hazardous substances, or through an opening in a work surface ✓ Training and use of personal fall arrest systems, such as full body harnesses and energy absorbing lanyards able to support 5000 pounds (also described in this section in Working at Heights above), as well as fall rescue procedures to deal with workers whose fall has been successfully arrested. The tie in point of the fall arresting system should also be able to support 5000 pounds ✓ Use of control zones and safety monitoring systems to warn workers of their proximity to fall hazard zones, as well as securing, marking, and labeling covers for openings in floors, roofs, or walking surfaces ✓ Delineate work zones so as to separate workers from traffic and from equipment as much as possible ✓ Reduce allowable vehicle speeds in work zones ✓ Use of high-visibility safety apparel for workers in the vicinity of traffic	
			Work in Heights	**Moderate**	OPTIC FIBRE PROJECT shall and require that contractors implement the following fall prevention and protection measure for all workers exposed to the hazard of falling more than two meters: ✓ Installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area ✓ Proper use of ladders and scaffolds by trained employees ✓ Use of fall prevention devices, including safety belt and	Low

Table 6.1:Summary of Impacts, Mitigations and Residual Impacts of the Proposed Optic Fibre project

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impact Significance	Mitigation Measures	Residual Impact
					lanyard travel limiting devices to prevent access to fall hazard area, or fall protection devices such as full body harnesses used in conjunction with shock absorbing lanyards or self-retracting inertial fall arrest devices attached to fixed anchor point or horizontal life-lines ✓ Appropriate training in use, serviceability, and integrity of the necessary PPE ✓ Inclusion of rescue and/or recovery plans, and equipment to respond to workers after an arrested fall	
			Confined Spaces and Excavations	**Moderate**	OPTIC FIBRE PROJECT shall and require that contractors implement the following prevention and protection measures for all work areas with this hazard exposure: ✓ Control site-specific factors which may contribute to excavation slope instability including, for example, the use of excavation dewatering, side-walls support, and slope gradient adjustments that eliminate or minimize the risk of collapse, entrapment, or drowning ✓ Provide safe means of access and egress from excavations, such as graded slopes, graded access route, or stairs and ladders ✓ Avoid the operation of combustion equipment for prolonged periods inside excavations areas where other workers are required to enter unless the area is actively ventilated ✓ Implement a permit to work procedure for all work in confined spaces	Low
			Struck by Objects	**Moderate**	OPTIC FIBRE PROJECT shall and require that contractors implement the following prevention and protection measure for all workers exposed to the hazard: ✓ Using a designated and restricted waste drop or discharge zones, and/or a chute for safe movement of wastes from upper to lower levels ✓ Conducting sawing, cutting, grinding, sanding, chipping or chiseling with proper guards and anchoring as	Low

Table 6.1:Summary of Impacts, Mitigations and Residual Impacts of the Proposed Optic Fibre project

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impact Significance	Mitigation Measures	Residual Impact
					applicable ✓ Maintain clear traffic ways to avoid driving of heavy equipment over loose scrap ✓ Use temporary fall protection measures in scaffolds and out edges of elevated work surfaces, such as hand rails and toe boards to prevent materials from being dislodged ✓ Evacuate work areas during blasting operations, and use blast mats or other means of deflection to minimize fly rock or ejection of demolition debris if work is conducted in proximity to people or structures ✓ Ensure use of appropriate PPE, such as safety glasses with side shields, face shields, hard hats, and safety shoes ✓ Delineate work zones so as to separate workers from traffic and from equipment as much as possible ✓ Reduce allowable vehicle speeds in work zones ✓ Use of high-visibility safety apparel for workers in the vicinity of traffic	
			Moving Machinery	**Moderate**	OPTIC FIBRE PROJECT shall and require that contractors implement the following prevention and protection measures for all work areas with this hazard exposure: ✓ Plan and segregate the location of vehicle traffic, machine operation, and walking areas, and controlling vehicle traffic through the use of one-way traffic routes ✓ Establish and enforce speed limits, and on-site trained flag-people wearing high-visibility vests or outer clothing covering to direct traffic ✓ Ensure the visibility of personnel through their use of high visibility vests when working in or walking through heavy equipment operating areas, and training of workers to verify eye contact with equipment operators before approaching the operating vehicle ✓ Ensure moving equipment is outfitted with audible back-	Low

Table 6.1:Summary of Impacts, Mitigations and Residual Impacts of the Proposed Optic Fibre project

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impact Significance	Mitigation Measures	Residual Impact
					up alarms ✓ Use inspected and well-maintained lifting devices that are appropriate for the load, such as cranes, and securing loads when lifting them to higher job-site elevations.	
	Power Generation Transmission and Distribution	Live Power lines	Working at height	**Moderate**	OPTIC FIBRE PROJECT shall, and require that contractors implement the following fall prevention and protection measure for all workers exposed to the hazard of falling while working on power projects: ✓ Test structures for integrity prior to undertaking work ✓ Implement a fall protection program that includes training in climbing techniques and use of fall protection measures; inspection, maintenance, and replacement of fall protection equipment; and rescue of fall-arrested workers, among others ✓ Establish criteria for use of 100 percent fall protection (typically when working over 2 meters above the working surface. The fall protection system shall be appropriate for the tower structure and necessary movements, including ascent, descent, and moving from point to point; ✓ Install fixtures on tower components to facilitate the useof fall protection systems ✓ Provide adequate work-positioning device system for workers. ✓ Ensure proper rating for hoisting equipment ✓ Ensure proper maintenance of hoisting equipment and properly train hoist operators ✓ Use Safety belts that are not less than 16 millimeters (mm) (5/8 inch) two-in-one nylon or material of equivalent strength. ✓ Replace rope safety belts before signs of aging or fraying of fibers become evident ✓ When operating power tools at height, require that workers use a second (backup) safety strap;	Low

Table 6.1:Summary of Impacts, Mitigations and Residual Impacts of the Proposed Optic Fibre project

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impact Significance	Mitigation Measures	Residual Impact
					Remove signs and other obstructions from poles or structures prior to undertaking work.	
			Electric and magnetic field	**Moderate**	OPTIC FIBRE PROJECT shall, and require that contractors implement the following measures to address occupational EMF exposure: ✓ Prepare and implement an EMF safety program including the following components: ○ Identification of potential exposure levels in the workplace ○ Surveys of exposure levels in new projects and the use of personal monitors during working activities ○ Training of workers in the identification of occupational EMF levels and hazards ○ Establishment and identification of safety zones to differentiate between work areas with expected elevated EMF levels compared to those acceptable for public exposure, limiting access to properly trained workers ○ Implementation of action plans to address potential or confirmed exposure levels that exceed reference occupational exposure levels developed by international organizations such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP), ✓ Set personal exposure monitoring equipment to warn of exposure levels that are below occupational exposure reference levels (e.g. 50 percent). ✓ Limit exposure time through work rotation Increase the distance between the EMF source and the worker, when feasible, or the use of shielding materials.	Low
			Exposure to chemicals	**Moderate**	OPTIC FIBRE PROJECT shall and require contractors to implement the following mitigating measures for occupational chemical exposure health hazards associated	Low

Table 6.1:Summary of Impacts, Mitigations and Residual Impacts of the Proposed Optic Fibre project

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impact Significance	Mitigation Measures	Residual Impact
					with solid waste handling facilities: ✓ Provide adequate personnel facilities, including washing areas and areas to change clothes before and after work ✓ Ventilate enclosed processing areas (e.g., dust in waste size reduction areas), ✓ Monitor breathing zone air quality in work areas at processing and transfer facility using direct-reading instruments that measure methane and oxygen deficiency Prohibit eating, smoking, and drinking except in designated areas	
Cumulative Impact						
CU	All Project	Cumulative Impact	Land Take: Loss of Biodiversity and Increase in Ambient Temperature Increased Run Off	Moderate - High	✓ OPTIC FIBRE PROJECT shall advocate working with the State Government to develop green belts and conservation areas within the area.	Moderate
			Influx	**Moderate**	✓ OPTIC FIBRE PROJECT shall work with the State Government to develop and implement a Master Plan that addresses the negative impacts of population growth in the entire area.	Low
Impacts Associated With Decommissioning						
D1	Decommissioning	All Categories	Transportation of Workers and Materials	**Moderate**	Impacts will be further assessed during development of substantive decommissioning and abandonment plan	
D2			Wind Down Operations	**Moderate**		
D3			Physical Removal of Installed Facilities	**Moderate**		
D4			Remediation and Restoration Activities	**Moderate**		
D5			Wastes and Emissions, Generation and Handling	**Moderate**		

6.3 GENERAL MITIGATION MEASURES

General mitigation measures encompass those measures built into the engineering design or operational design of the project. These measures are environmental, social, and health best practices, most already in use by the project sponsors in their operations or proposed as operational controls during the project execution. Some mitigations are however specific to impacts associated with particular activities of the various project activities.

Many general mitigation measures have been developed and adopted by the project before the EIA process commenced; therefore, the impact assessment has already applied them in assessing the project impacts. Furthermore these measures were incorporated into the Optic Fibre Project Project-design considerations and project implementation planning as part of the overall operational controls and EMP for the project.

These mitigations will be incorporated into plans and procedures that contractors will follow to ensure the protection of the environment. The measures will be implemented by Optic Fibre Project directly, and passed on through contractual commitments to its contractors, subcontractors, and suppliers. Further details about the content of each plan and operational control are provided in Chapter 7.

6.3.1 Livelihood Enhancement Plan

The Optic Fibre Project will implement a livelihood enhancement plan for land users affected by the foot print taken up for project facilities. It is noted that land users and owners had been previously compensated by the State Government and so no compensation is due to them. The enhancement plan is to ensure affected persons are positively impacted by the project and will be pursued under Optic Fibre Project's overarching Community Relations and Development Plan.

6.3.2 OPTIC FIBRE PROJECT Community Development Plan

Optic Fibre Project has developed the framework for a Community Development Plan that will be used as a vehicle for social intervention in some of the communities within the project area. The plan will seek to address the effects of the project on the local area, while also addressing other development needs of the local communities. In this regard, some areas of social intervention have been identified. These include but are not limited to improvements in the area of income generation, health; education (primary, secondary, tertiary and vocational) and infrastructure.
Additionally, the plan seeks to give priority to indigenes of the local area on employment by the project. Optic Fibre Project will implement a short-term development activities focussed on mitigating local impacts associated with project activities. The plan will incorporate the specific mitigations identified to reduce specific impacts (Table 6-1). This plan will be further developed in consultation with the local communities.

Longer-term plans will be developed in partnership with the Project Area Government and will focus on broader economic and social interventions.

CHAPTER SEVEN
ENVIRONMENTAL MANAGEMENT PLAN (EMP)

7.1 INTRODUCTION

An Environmental Management Plan (EMP) is a company's organizational plan or programme used in the management of operations to ensure environmental sustainability. The EMP is the component of an EIA that provides the procedures and processes that can be incorporated into the organization's activities to measure and check, in a continuous mode, the compliance with, and effectiveness of the mitigation measures recommended for minimizing or eliminating the identified negative impacts of the planned project throughout its life cycle. In addition to this, the EMP is also often used to ensure compliance with statutory requirements and corporate safety and environmental policies attached to the organization's operations.

The application of the EMP resulting from an EIA usually starts from the project planning phase, when all the mechanisms required for effective implementation of recommended mitigation measures are put in place. Other components of the EMP usually find application during the project operational phase, as monitoring tools for the compliance of specific environmental attributes with required operational regulatory standards.

The EMP developed in this section of the EIA report has taken into consideration, all known project activities and plans including those relating to Excavation, site clearing, construction and plant operations; predicted impacts of the proposed project as contained in Chapter 5; and the prescribed mitigation measures to control or completely eliminate the negative impacts of the proposed HUAWEI Technologies project as contained in Chapter 6.

HUAWEI TECHNOLOGIES shall incorporate this EMP into all the stages of its proposed project activities to manage, monitor and control all the potential and associated impacts of the project on the bio-physical and socio-economic characteristics, as well as, the health and safety of the workers and the public in the project area. The implementation of the EMP by HUAWEI TECHNOLOGIES as the project progresses shall also be in accordance with the Nigerian and other applicable international HSE standards and regulations.

HUAWEI TECHNOLOGIES has established and shall maintain a comprehensive EMP to achieve its health, safety, and environmental (HSE) regulatory compliance objectives, institutional responsibilities (e.g., World Bank and IFC Performance Standards), and other related commitments. An EMP is a component of the project's overall Environment Management System (EMS) which is the programme used to ensure environmental, social, and health performance.

With respect to the significant impacts identified by the EIA, the EMP identifies the linkage between each significant impact (high or moderate significance); the relevant mitigation measures; and the monitoring approach. Further, through this EMP, significant impacts are referenced to:

- Applicable regulatory requirements, institutional responsibilities and other commitments;
- Relevant HUAWEI TECHNOLOGIES operational controls (e.g., management best practices, construction and operation specifications, procedures, and work instructions); and
- Mitigation and regulatory monitoring of institutional roles.

This EMP applies to all the HUAWEI TECHNOLOGIES activities covered by this EIA.

7.2 POLICIES

HUAWEI TECHNOLOGIES has developed an HSE Policy and a Sustainability Commitment which together state the company's commitment to conducting business in a socially responsible and ethical manner, and to protecting health, safety and the environment.

In its HSE Policy, HUAWEI TECHNOLOGIES has committed to:

- Integrate health, safety and environmental matters into every aspect of its activities and set objectives to drive continual improvement;
- Comply with all relevant health, safety and environmental laws and regulations;
- Initiate and maintain effective arrangements for communication within the organisation, with contractors, the public or its agents and other stakeholders regarding health, safety and environmental matters;
- Apply relevant standards, good engineering practices and principles of risk management to protect health, safety and the environment and to ensure the integrity, reliability and efficiency of HUAWEI TECHNOLOGIES facilities;
- Exhibit socially responsible leadership, demonstrate exemplary health, safety and environmental performance and publicly report performance;
- Conserve HUAWEI TECHNOLOGIES assets and natural resources, and minimise the impact of OPTIC FIBRE's activities on the environment, by conducting impact assessments, and ensuring responsible management of emissions, discharges and waste streams. This includes efficient use of energy in its operations;
- Identify present or future potential health, safety and environmental hazards resulting from HUAWEI TECHNOLOGIES operations, conduct risk assessments and select and implement appropriate measures to manage the risks;
- Develop and implement a health, safety and environment plan which includes implementation of prioritised procedures to form a complete management system;
- Maintain adequate emergency preparedness and response capabilities;
- Effectively communicate HUAWEI TECHNOLOGIES health, safety and environmental requirements to all contractors and subcontractors and require them to manage HSE in accordance with the HUAWEI TECHNOLOGIES Policy;
- Ensure conformity with this policy by a comprehensive compliance program including audits; and
- Adequately resource health, safety and environment functions throughout the business.

The primary vehicles through which HUAWEI TECHNOLOGIES shall meet the commitments in the HSE Policy are its comprehensive HSE Management System and the associated planning documents. The planning documents include this EMP, and others associated with it.

7.3 PLANNING

7.3.1 Management Programme

This EMP is intended to meet the management programme requirements of World Bank OP 4.01 and IFC Performance Standard 1 Social and Environmental Assessment and Management Systems to establish and manage a programme of mitigation and performance-improvement measures and actions that address the identified social and environmental risks and impacts.

7.3.2 Environmental Management Plan

The goal of this EMP is to ensure full compliance with HUAWEI TECHNOLOGIES's HSE Policy and with mitigation and other commitments made in the EIA. It outlines the actions necessary to attain this goal, and describes the means, time frames, and designation of responsibility required for compliance and conformance.

HUAWEI TECHNOLOGIES has taken a systematic approach to the EMP and its content and organization is designed to meet the requirements of *International Organization for Standardization 14001: 2003 Technical Specification and Guidance for Use*.

This EMP organises HSE philosophies, policies, plans and procedures, and attributes roles and responsibilities for each systematically. This EMP has priority over and states the guidelines and instructions for the preparation of the EPC Contractors' EMPs that will provide the detail of exactly what, where, and when they apply mitigation and monitor for effectiveness. HUAWEI TECHNOLOGIES will maintain a "road map" of HSE documentation.

The HUAWEI TECHNOLOGIESEMP incorporates a number of associated plans that provide additional detail on the processes and procedures that HUAWEI TECHNOLOGIES will use to comply with specific HSE requirements. Some of these plans are already in place while others are being developed and will be in place prior to commencement of works that require their use. Plans specifically related to this EMP are:

- HSE Management Plan (Safety Plan)
- Waste Management Plan;
- Emergency Response Plan;
- Influx Management Plan;
- Labour Plan (including Job Rules);
- Community Relations and Development Plan; and
- Journey Management Plan.

Other plans that will support HUAWEI TECHNOLOGIES's activities but are not specific to this EMP include:

- Health Management Plan; and
- Compliance and Permitting Plan.

7.3.2.1 EPC Contractor Management Plan(s)

HUAWEI TECHNOLOGIES will engage EPC contractors to implement the project works. The EPC contractors are responsible for performing all work:

- In compliance with relevant national and international HSE legislation and regulations, and with other requirements to which HUAWEI TECHNOLOGIES subscribes;
- In conformance with HUAWEI TECHNOLOGIES's Health, Safety and Environmental Management System; and
- In accordance with HUAWEI TECHNOLOGIES's technical and quality specifications.

HUAWEI TECHNOLOGIES will provide specifications for environmental compliance and performance (through this EIA and EMP and the associated plans) and, as a contractual requirement, the EPC Contractor must develop and provide to HUAWEI TECHNOLOGIES its own specific management plans, incorporating:

- Health, Safety and Environment Policy Statements, Programs, and Management Systems;
- Health, Safety, and Environment Organization;
- Health, Safety, and Environment Responsibilities;
- HSE Procedures;
- Employee HSE Training Programs;
- Waste Management Plans;
- Emergency Response/Evacuation Plans;
- Land Transportation Safety Management System;
- Hazardous Materials Management Program;
- Industrial Hygiene and Medical Protection Plans.

The EPC Contractors must also provide documentation detailing their plans for:

- Implementing the measures required in the EIA and this EMP;
- Local Content;
- Logistics;
- Security; and
- Community Relations.

The EPC Contractor's management plans must conform to the requirements HUAWEI TECHNOLOGIES's overarching plans. EPC Contractor's plans will be reviewed and approved by HUAWEI TECHNOLOGIES and incorporated into, and form part of, HUAWEI TECHNOLOGIES's overall EMP.

Contractors will be required to self-monitor against their plan and the contractor's compliance with the plan will be routinely monitored by HUAWEI TECHNOLOGIES directly or by third-parties and in conjunction with environmental regulators. Contractors will be required to submit regular reports of monitoring activities and HUAWEI TECHNOLOGIES will review these on a regular basis.

The EPC Contractor will be contractually required to provide sufficient resources to manage HSE aspects of the work to be performed. This includes providing resources to ensure sub-contractor compliance and a process for emergency stop-work orders in response to monitoring triggers.

7.4 IMPLEMENTATION

7.4.1 Management Organization

In accordance with regulatory requirements, HUAWEI TECHNOLOGIES has established an HSE organization structure that defines roles, responsibilities and authority to put into practice an effective HSE Management System, including undertaking any training necessary to do so. The specific roles of the key positions in the structure are described in Table 7.1.

During pre-operations activities, all instructions and official communications regarding environmental matters shall follow the generic organogram shown in Figure 7-1. The organisational structure identifies and defines the authority structure, and the communication structure for the various parties involved in the construction of the proposed development. The structure may require revision as the project unfolds.

The roles and responsibilities of each category of persons or group of persons involved in the implementation of this EMP are further described below.

7.4.1.1 HUAWEI TECHNOLOGIESHSE Manager

The HUAWEI TECHNOLOGIESHSE Manager shall:

- Be responsible for the implementation, administration and enforcement of the EMP within the HUAWEI TECHNOLOGIES project area and other areas where work is carried out under the authority of HUAWEI TECHNOLOGIES.
- Be bound by the conditions, responsibilities and provisions contained therein;
- Ensure that the EMP is regularly updated in light of experience, monitoring findings and best practice; and in light of the findings of the EIA.
- Ensure that the EMP specifications are included in all tender documents issued for building works and activities, and shall ensure that the prospective tenders/ contractors abide by the provisions thereof;
- Appoint an HSE Supervisor to monitor implementation of and compliance with the EMP for the duration of construction activities;

- Notify the HUAWEI TECHNOLOGIES Management and Board of Directors of the commencement of any construction operations as well as compliance with provisions of the EMP as set out in this document; and
- Be liable/ accountable, to the relevant authority, for any contravention of the Environmental Impact Statement Authorization or non-compliance by any Contractor under their supervision.

The HSE Manager shall work closely with a Constructions Manager to be appointed for the project.

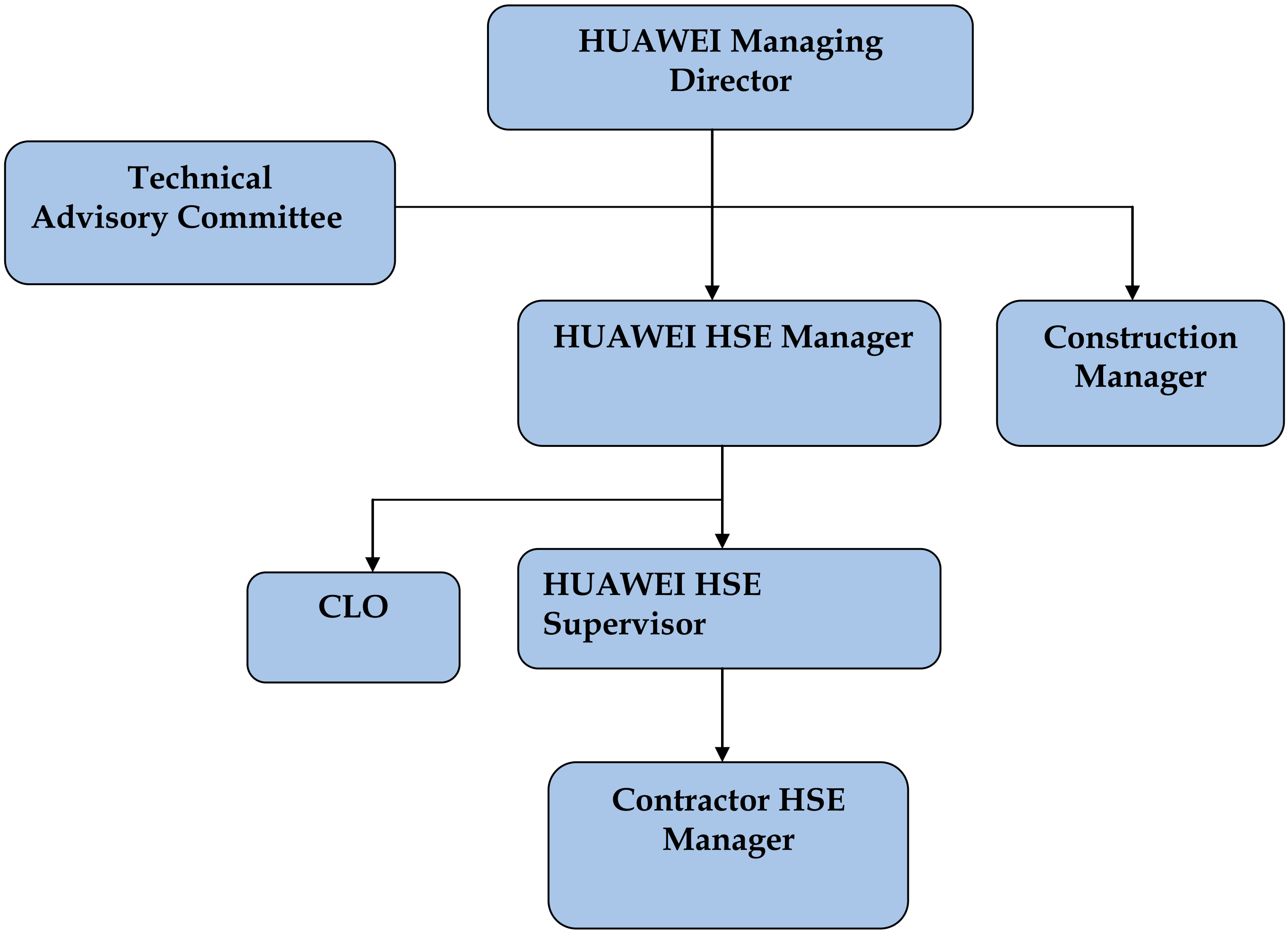


Figure 7-1: HSE Responsibility and Communication Organogram (Pre-Operations Phase)

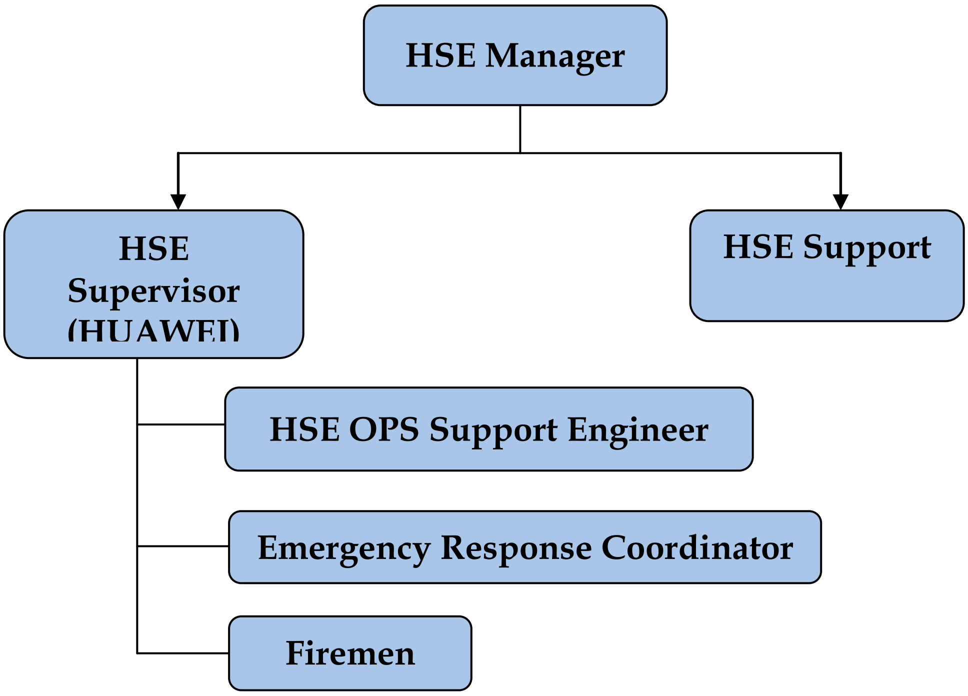


Figure 7-2: HSE Responsibility and Communication Organogram (Operations Phase)

7.4.1.2 Technical Advisory Committee

The role of the Technical Advisory Committee will be to provide the HUAWEI TECHNOLOGIES comments and input on the following:

- The contents of the EMP and the need for its updating;
- The design and construction of facilities;
- Compliance with EMP and other regulatory permit conditions; and · Documentation produced as part of the EMP.

It should be noted that the Committee shall not interfere with the administrative functions of the HUAWEI TECHNOLOGIES or with the professional duties of staff; nor shall they impair the ability of staff to implement HUAWEI TECHNOLOGIES policy decisions. The Committee is merely an advisory forum. The Committee has no legal standing other than matters related to comment on the EMP. The Technical Advisory Committee may be part of the audit committee on invitation by the HUAWEI TECHNOLOGIES.

7.4.1.3 The HSE Supervisor

The HSE Supervisor will be appointed for the duration of all on site pre-operations activities. He will be responsible for monitoring, reviewing and verifying compliance with the EMP by Contractors appointed to undertake any of the pre-operations works.

The HSE Supervisor shall:

- Be appointed by the HUAWEI TECHNOLOGIES Management to monitor compliance with and assist in implementing the EMP on site;
- Visit the work sites regularly, to ascertain the level of compliance of works, as well as attend regular contractor meetings and monthly site meetings with the project management team. It is recommended that the supervisor be resident on site or close by during implementation of the pre-operations activities.
- Assist the Contractor in ensuring that the necessary environmental authorizations and permits have been obtained;
- Monitor and verify that the EMP is adhered to at all times and take action if the specifications are not followed;
- Monitor and verify that environmental impacts are kept to a minimum;
- Review and approve construction method statements together with the Consultants/Engineers Representative and Advisory Committee;
- Assist the Contractor in finding environmentally responsible solutions to problems;
- Report back on the environmental issues at the monthly site meetings and other meetings that may be called regarding environmental matters;
- Keep records of all activities/incidents concerning the environment on Site in the Site Diary;
- Keep a register of complaints in the Site Office and recording and dealing with any community comments or issues;
- Monitor the undertaking by the Contractor of environmental awareness training for all new personnel coming to site; or undertake environmental awareness courses themselves;
- Advise on the removal of person(s) and/or equipment not complying with the specifications (done via the Consultant/Engineers Representative/ HUAWEI TECHNOLOGIES);
- Ensure that activities on site comply with legislation of relevance to the environment;
- Compile and complete HSE performance checklists as necessary;
- Keep a photographic record of progress on Site from an environmental perspective;
- Continually, internally review the EMP and submit a report to HUAWEI TECHNOLOGIES Management and Technical Advisory Committee at various stages of the project and upon completion of pre-operations activities; and
- Assist in creating environmental awareness and training of Contractor personnel.

7.4.1.4 The Community Liaison Officer (CLO)

The Community Liaison Officer (CLO) shall:

- Be the main contact between community representatives and the HUAWEI TECHNOLOGIES (through the HSE Supervisor, Construction Manager and External Relations Director).
- Assist in resolving all disputes between HUAWEI TECHNOLOGIES and/ or Contractors and the communities

7.4.1.5 The Contractor

HUAWEI TECHNOLOGIES shall ensure that all Contractors engaged shall:

- Appoint a person responsible for HSE matters on site;
- Ensure that all employees, co-contractors and sub-contractors employed comply with the requirements and provisions of the EMP;
- Notify the HSE Supervisor of the anticipated programme of works and fully disclose all details of activities involved;
- Complete and submit all requisite information, in terms of the EMP, for approval prior to the onset of activities;
- Notify the HSE Supervisor of all incidents, accidents and transgressions on site with respect to HSE management as well as requirements of the EMP and corrective actions/remedial action taken;
- Inform the HSE Supervisor of any complaints received; and
- Be responsible for HSE awareness and training of all staff on site.

7.4.1.6 Consultants/Construction Manager

The Consultant/ Construction Manager shall:

- Ensure the pre-operations activities are all carried out in accordance with the Contract specifications; and
- Assist the HSE Supervisor as necessary in ensuring that Contractors comply with the provisions of theEMP.

7.4.1.7 Stakeholders

Stakeholders shall assist in the general environmental management and monitoring of the area by providing comments/ reports to the HUAWEI TECHNOLOGIES and/ or the environmental authorities, the Contractor etc., as necessary.

Table 7.1: EMP Roles and Responsibilities

Position	Responsibility
OPTIC FIBRE	
HUAWEI TECHNOLOGIES Managing Director	Oversee and coordinate all activities pertaining to the activities; ultimately responsible for HSE during the construction phase.
HUAWEI TECHNOLOGIESHSE Manager	Ensure that HUAWEI TECHNOLOGIES and all its contractors operate in accordance with applicable regulatory environmental requirements and its HSE plans, while also assisting line management in performing their line duties.
HSE Supervisor	Ownership of HSE issues. Ensure that environmental regulatory requirements are met and that recommendations in the EIA to mitigate against project impacts are properly implemented. Visits work sites regularly to monitor HSE compliance issues and supervise 3rd party HSE performance audits.
Community Liaison Officer	Responsible for liaising with the host communities and regulators on OPTIC FIBRE's behalf; ensure contractor's compliance with HUAWEI TECHNOLOGIES labour protocols. Management of Community Liaison among contractors. Supervise compensation and land acquisition issues. Monitor, report and ensure the efficient working conditions of all HUAWEI TECHNOLOGIES facilities on site
Contractor	
HSE Manager/Supervisor	Ensure that environmental regulatory requirements are met and that recommendations in the EIA to mitigate against project impacts are properly implemented
Community Relations Manager/Community Liaison Officer	Oversee interaction with communities and other stakeholders in line with HUAWEI TECHNOLOGIES Community Relations Plan and EMP
Human Resources Manager	Oversee contractor's worker employment procedures in line with HUAWEI TECHNOLOGIE S labour protocols. Monitor performance against contractor local content targets.

7.4.2 Training

HUAWEI TECHNOLOGIES shall identify, plan, monitor, and record HSE training needs for personnel whose work may have a significant adverse impact upon the environment or social conditions. HUAWEI TECHNOLOGIES recognizes that it is important that employees and Contractors at each relevant function and level are aware of HUAWEI TECHNOLOGIES environmental, social, and health policy; potential impacts of their activities; roles and responsibilities in achieving conformance with the policy and procedures.

This will be achieved through a formal HSE training process. It is expected that employee training will include awareness of and competency with respect to:

- Environmental and social impacts that could potentially arise from their activities;

- Necessity of conforming to the requirements of the EIA and EMP, in order to avoid or reduce those impacts; and
- Roles and responsibilities to achieve that conformity, including with regard to change management and emergency response.

The HSE Manager is responsible for coordinating the training, maintaining employee-training records, and ensuring that these are monitored and reviewed on a regular basis. The HSE Manager will also periodically verify that staffs are performing competently through discussion and observation.

Employees responsible for performing site inspections shall receive training drawing on external resources as necessary. Training will be coordinated by the HSE Manager and/or Community Relations Officer prior to the beginning of field activities. Upon completion of training and once deemed competent in the requirements, staff will be allowed to train other people.

Similarly the HUAWEI TECHNOLOGIES shall require that each of the Contractors institute training for its personnel. Each Contractor is responsible for site HSE awareness training for personnel working on the job sites. The Contractor is also responsible for identification of any additional training requirements to maintain required competency levels.

The Contractor training program will be subject to approval by HUAWEI TECHNOLOGIES and it will be audited to ensure that:

- Training programs are adequate;
- All contractor personnel requiring training have been trained; and
- Contractor has periodically verified that its personnel perform competently after training.

7.4.3 Communication

The HUAWEI TECHNOLOGIES's HSE Manager is responsible for communications with the public and with public stakeholder organizations. The Community Relations Officer is also responsible for interactions with communities and the general public. The HUAWEI TECHNOLOGIES Community Relations Plan will follow formal written procedures to document these communications.

With regard to HSE issues, the company's Managing Director will facilitate dissemination of information necessary to mitigate impacts through coordinating public notifications (e.g., meetings, media announcements, written postings) and through stakeholder interaction.

The HSE Manager is responsible for communication of HSE issues to and from regulatory authorities. The Managing Director is kept informed of such communications. Pertinent information arising from such interactions shall be communicated to the Contractors.

Communications also occur between various levels of the project and federal and state regulatory authorities during the activities. These meetings may occur as needed to accommodate field visits and discuss scheduling and planning issues. These discussions would likely address areas of concern, emerging HSE issues, and environmental and social performance based on the analysis of internal audits and field reports. Meetings can also be expected to include discussion of upcoming work plans and coordination issues. Whereas it is anticipated that the Contractor HSE staff may interact with representatives from regulatory authorities on an informal, day-to-day basis regarding routine matters, the HUAWEI TECHNOLOGIESHSE Manager shall be the point of contact for formal communications. The HUAWEI TECHNOLOGIES HSE Manager shall be responsible for communicating any pertinent information arising from such discussions to appropriate Contractors.

The HUAWEI TECHNOLOGIES will maintain a written register of stakeholder interactions to effectively track communications and so that commitments made to follow up actions can be tracked and implemented. This includes grievances that are also tracked through the formal grievance procedure and communications that come through the Community Liaison activities.

7.4.4 Documentation

HUAWEI TECHNOLOGIES will control HSE documentation, including plans (e.g., the EMP); associated procedures; and checklists, forms, and reports, through a formal company procedure. The document control procedure also describes the processes that HUAWEI TECHNOLOGIES and the Contractor will employ for official communication of both hardcopy and electronic (through the internet) document deliverables. In addition, it describes the requirement for electronic filing and posting and for assignment of a document tracking and control number (including revision codes).

HUAWEI TECHNOLOGIES will appoint a senior member of its staff as Document Control Manager. HE or SHE shall be responsible for maintaining a master listing of applicable documents, including HSE documents, and making sure that this list is communicated to the appropriate parties. The HUAWEI TECHNOLOGIES HSE Manager is responsible for providing notice to the affected parties of changes or revisions to documents, for issuing revised copies and for checking that the information is communicated within that party's organization appropriately.
The Contractor shall be required to develop a system for maintaining and controlling its own HSE documentation and describe these systems in their respective HSE Plans and Site-Specific HSE Plans.

7.5 HUAWEI TECHNOLOGIES ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

According to the ISO 14001, an Environmental Management System (EMS) is that part of the overall management system which includes organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the Environmental Policy. What this definition connotes is that, for an EMS to be put in place in an organization, the organization must already have an Environmental Policy[1]. In the case of HUAWEI TECHNOLOGIES, a combined health, safety and environmental policy already exists (refer to Section 1.3.5 of Chapter 1). The importance of an EMS is that it assists an organization in achieving excellence in sustainable environmental development.

HUAWEI TECHNOLOGIES HSEMS provides a number of key policies and documentation to assure HSE Performance of the company. The HSE Document Plan is as follows:

A. Primary Documents

- Health & Safety Policy
- Environmental Policy
- Driving Policy
- Harassment, Violence & Abuse Policy
- Alcohol, Drug & Substance Abuse Policy
- Contractor's HSE Policy
- Management of Change Policy

B. Primary Supporting Documents

- HSE-MS Manual
- Contractor's HSE Manual
- Employees HSE Handbook
- Office HSE Manual

C. Programs & Plans

- Short Service Employees Program
- Hazard Communication Program
- Lock Out Tag Out Program
- Waste Management Plan
- Commitment, Training, Targets & Recognition Program
- Incident & Investigation Program
- Emergency Response Plan
- Behaviour Based Safety Program
- Inspection, Audit & Compliance Program
- Journey Management Program
- Alcohol, Drug and Smoking Program
- Risk Assessment & Management Program

[1] According to ISO 14001,an Environmental Policy is a statement by the organization of its intentions and principles in relations to its overall environmental performance, which provides a framework for action and for setting up its environmental objectives and targets. The environmental policy is the driving force for the development of an effective environmental management system that helps in setting up an environmental target for achieving the organization's environmental and safety objectives. It also ensures the establishment and maintenance of compliance with Environmental Management System standards

- Ergonomics

7.6 ENVIRONMENTAL MONITORING PLAN

An Environmental Monitoring Plan is the systematic schedule for collection of environmental data through a series of repetitive measurements. UNEP (1996) describes three known types of environmental monitoring within the conceptual EIA framework as follows:

- *Baseline monitoring:* This refers to the measurements of environmental parameters during the pre-project period;
- *Effects monitoring:* This involves the measurements of environmental parameters during project construction and implementation so as to detect changes in these parameters which can be attributed to the project; and
- *Compliance monitoring:* It is the periodic or continuous measurement of environmental parameters or discharges to ensure that regulatory requirements and standards are met. Compliance monitoring can further be broken down into:
  - Mitigative measures monitoring, which relates to the prescribed mitigation measures put in place by the pre-project EIA to the existing operational structure of the project, and
  - Regulatory compliance monitoring, which compares the regulatory monitoring requirements to the existing operational, occupational and environmental parameters.

HUAWEI TECHNOLOGIES shall adopt a systematic monitoring schedule that will comprise both effects and compliance monitoring plans for the implementation of the proposed power project. Baseline requirements are already embodied in Chapter 4 of this report and are, therefore, not considered in this chapter. The monitoring schedule prescribed by this EIA shall be implemented as the Post-EIA Monitoring Programme by HUAWEI TECHNOLOGIES.

7.6.1 Objectives of Post-EIA Environmental Monitoring

The Post-EIA Environmental Monitoring Plan described in this report has the broad goals of demonstrating whether an environmental change will occur that is adducible to the Excavation, site preparation, construction and operations activities of the HUAWEI TECHNOLOGIES Project so as to forewarn the project the company’s management and staff of unanticipated adverse impacts or changes in impact trends. Other specific objectives of the Post-EIA environmental monitoring plan are to:

- Check the effectiveness of suggested mitigative measures
- Ensure that the project activities (pre-construction, construction and operation) are carried out in accordance with the prescribed mitigation measures and existing compliance regulatory procedures, and
- Provide an early warning system such that prompt action can be taken whenever an impact indicator signifies a potentially critical influence on the receiving environmental parameters.

Impact indicators are defined in terms of carrying capacity, threshold levels, and regulation/enforcement standards. The implementation of the suggested EMP will allow HUAWEI TECHNOLOGIES to potentially control and manage the timing, location and level of impacts as well as potentially provide the cause and effect data for the empirical verification or validation of various predictive models of action/impact relationships.

7.6.2 Scope of the Environmental Monitoring Plan

The Environmental Monitoring Plan shall cover two types of monitoring activities as follows,

a. Monitoring of compliance with
   i. mitigation measures during site preparation and construction activities,
   ii. mitigation measures during operations plus equipment performance standards,
b. Effects-environmental monitoring, which includes sampling and analyses of discharges and the recipient environmental components during site preparation, construction and operational activities.

The monitoring programme under the plan shall establish the specifics of the environmental and socioeconomic monitoring parameters for each component of the environment that will be affected by the proposed project. The components shall include:

- Air quality
- Noise
- Water quality (surface and sub-surface water qualities)
- Hydrology
- Hydrobiology and fisheries
- Vegetation and wildlife
- Sediment quality
- Waste management
- Traffic and transport
- Personnel health and safety
- Public health and safety
- Socioeconomic impact

Based on the project activities, predicted impacts and recommended mitigation measures, the monitoring programme described below is considered adequate for the project.

7.6.2.1 Proposed Environmental Monitoring Programme

For all project phases and activities, regular data collection, audits, inspections, and related monitoring activities will be required for each impact category at a pre-determined frequency, either based on the schedule established in the regulations for Regulatory Monitoring or based on the Post-EIA monitoring schedule established in this Chapter for specific project activities.

Reports will be submitted to the FMEnv, and to other regulatory agencies as may be required. All monitoring components will be subject to internal audits by HUAWEI TECHNOLOGIES and externally by the Nigerian regulatory authorities. Each monitoring programme will follow the established schedule; monitoring may be performed daily, weekly, quarterly, semi-annually, annually, biennially, or continuously, depending upon the resource, regulatory specifications for monitoring, and the project-specific requirements for other Post-EIA Monitoring programmes.

The detailed monitoring plan will follow the Nigerian regulatory requirements as well as the World Bank's *Environmental Performance Monitoring and Supervision Guidelines* (World Bank *Update to the Environmental Assessment Sourcebook* No. 14, June 1996 and updates). For each affected resource area, the following items identified in the World Bank guidelines will be described:

- Monitoring objectives
- Parameters to be measured, methods employed, sampling locations and frequency as well as definition of thresholds that will indicate the need for remedial actions
- Institutional responsibilities and timescales for monitoring
- Reporting requirements
- Costs and financing provisions

7.6.2.2 Monitoring Schedule and Parameters to be monitored

HUAWEI TECHNOLOGIES has developed a schedule for Post-EIA Monitoring that includes both compliance and effects monitoring. The monitoring program provides details of various parameters to be monitored periodically.

After the first six months of project operation, the Post-EIA Monitoring program will be reviewed, and monitoring frequencies, other than those explicitly identified in the regulations, may be adjusted based on prior measurements. If sampled levels have been consistently low for some parameters, monitoring of those parameters may become infrequent or be eliminated from the Post-EIA Monitoring Programme. Table 7.2 summarises the recommended mitigation, monitoring, and training for each category of environmental resources and impacts.

Although the "action party" for all compliance and other Post-EIA Monitoring schedules described in Table 7.1 will be HUAWEI TECHNOLOGIES, the company may employ qualified and certified contractors to conduct certain monitoring activities described in the table on its behalf.

However, HUAWEI TECHNOLOGIES will retain the responsibility for all Regulatory Compliance Monitoring and other Post-EIA Monitoring Activities and for oversight of contractors.

HUAWEI TECHNOLOGIES will submit reports of the Post-EIA Monitoring Programme to the FMEnv periodically as may be prescribed in EIA approval permits and documentation.

7.6.2.3 Regulatory Approval Process

HUAWEI TECHNOLOGIES shall incorporate a number of measures in its project implementation procedure to ensure that all necessary regulatory approvals are received for all aspects of the project as required by the national and local regulations. The regulatory approval process shall require FMEnv EIA approval prior to commencement of onsite project activities.

Table 7.2: Summary of Impacts, Mitigations, Effects Monitoring Requirements and Residual Impacts

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
PP	**Impacts Associated With Physical Presence of Workers and Equipment**							
PP1	Pre-Operation Phase	Physical Presence of Workers and Equipment	**Impacts on Infrastructure** In-migration of workers and job seekers putting pressure on existing infrastructure.	Moderate	HUAWEI TECHNOLOGIES shall ✓ Develop and implement an influx management plan to look into specific options to address anticipated pressure on existing infrastructure such as housing, roads, hospitals, educational facilities in the communities ✓ Employ casual/unskilled labour primarily from local communities. ✓ Give priority consideration to qualified local community for hiring of workers. ✓ Shall handle the hiring of and payment to immigrant workers off location to discourage migrating job seekers. ✓ Shall provide closed camp with adequate facilities for construction workers, so that they do not interfere with local facilities	Low	Collect demographic information for the communities in the area and analyze for the following parameters: Community infrastructure, health records, waste inventory, e.t.c. Monitor Compliance with mitigation measures	Effects Monitoring Twice a year during site preparation and construction; Mitigation Compliance Monitoring Once every month
PP2			**Impacts on Macro and Micro Economy** Increase in the prices of food, goods and services as result of population increase coupled with increased in demand for food, goods and services. Un-employment boom-bust resulting in tension and conflicts	Moderate	HUAWEI TECHNOLOGIES shall: ✓ Develop and implement an influx management plan, which will look into specific options to address anticipated increase in prices of food, medicine, transportation, recruitment of workers, community expansion, housing plan, inflation reduction, security and other general goods and services ✓ Maintain an up- to-date food basket survey. ✓ Adopt workers disengagement plans to address boom-bust effects ✓ Strengthen existing cooperatives societies together with the	Low	Monitor prices of food, transport and other services. Monitor Compliance with mitigation measures Monitor employment related grievances and incidents	Effects Monitoring Twice a year during site preparation and construction; Mitigation Compliance Monitoring Once every month Effects Monitoring Twice a year during site preparation and

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
					establishment of new ones to engage in various commercial activities that will reduce inflation. ✓ Employ casual/unskilled labour primarily from local communities. ✓ Give priority consideration to qualified local community for hiring workers.		Monitor compliance with mitigation measures	construction; Mitigation Compliance Monitoring Once every month
PP3			**Impacts Social and Cultural Structure** Marginal increase in population within the project area will lead to an increase in negative vices such as prostitution (commercial sex work) and crime thereby affecting social and cultural systems through a negative change in value systems.	Moderate	HUAWEI TECHNOLOGIES shall ✓ Conduct periodic STD and HIV/AIDs and general safe sex awareness campaigns in the project area ✓ Consider keeping a percentage and certain category of jobs for females ✓ Support initiatives including educational programmes aimed at preserving the local language, cultural structures and traditions	Low	Collect demographic information and analyze for the following parameters: Prostitution, crime, and conflicts. Monitor Compliance with Mitigation Measures	Effects Monitoring Once before construction, every 6 months thereafter and once, 6 months after construction ends. Mitigation Compliance Monitoring Once every month
PP4			**Impacts on Cultural and Archaeological Resources** Non-natives living or working in the area may not be conversant with traditional religious practices and rules on shrines and so	Low	HUAWEI TECHNOLOGIES shall: ✓ Require that Contractors conduct induction programs to educate staff and contractors with the aid of the community elders on traditional religious practices, rules on shrines, culturally acceptable behaviour, and acquaint them with the sacred areas in the communities of the project area. ✓ Ensure work ceases if remains or	Low	Monitor cultural violations and archaeological finds in the project area. Monitor Compliance with mitigation	Effects Monitoring Once every 6 months during site clearing and construction and once, 6 months after construction ends.

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
			may inadvertently break traditional religious rules by living in sacred areas or engaging in culturally unacceptable behaviour.		artifacts are discovered on site during earthworks, and the contractor shall immediately inform the company's representatives and contact the relevant authority.		measures	Mitigation Compliance Monitoring Once 3 months
PP5			**Impacts on Education** The attraction to earn income could potentially, either directly from the project, or through some other indirect income generating enterprises, cause young people to abandon or suspend their education.	Low	HUAWEI TECHNOLOGIES shall: ✓ Make sure no underage/school age children is or are involved in any paying job or non paying job on the project, hence shifting their attention from the opportunities in the project.	Low	Monitor school attendance in primary and secondary schools of the project area. Monitor compliance with mitigation measures.	Effects Monitoring Once every 6 months during construction and once 6 months after construction ends. Mitigation Compliance Monitoring Once every month
PP6			**Impacts on Ground Water** Wash down of oil and grease and any chemicals/soluble hazardous materials stored or used.	Moderate	HUAWEI TECHNOLOGIES shall: ✓ Implement non-permeable lay-down areas for project machinery equipment ✓ Make sure that chemicals and all hazardous substances shall be kept within contained areas ✓ Ensure that all spent oil and hazardous chemicals are properly containerised for proper disposal.	Low	Sample ground water resources in the project area from community wells and monitoring boreholes Monitor compliance with mitigation measures	Effects Monitoring Once every 3 months during construction and once 6 months after construction ends. Mitigation Compliance Monitoring Once every month
Impact Associated With Transportation of Workers and Material								
TR1	Pre-Operation	Transportation	**Impacts on**	Low	HUAWEI TECHNOLOGIES shall:	Low	Conduct traffic	Effects

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
	Phase	of Workers and Material	**Transportation** Increased vehicular and traffic in the area could lead to longer commuting time for existing road users.		✓ Ensure that as much as possible, all heavy duty trucks working on the project move at off peak hours.		survey along major and minor roads used by the project particularly those around communities Monitor compliance with mitigation measures.	Monitoring Once every 3 months during construction and once 6 months after construction ends. Mitigation Compliance Monitoring Once every month
TR2			**Impacts on Surface Water, Hydrobiology and Fisheries** The increased vessel traffic will result in additional perturbation to the surface water and the seabed and perhaps minimally impact water quality from small releases of hydrocarbons which could impact habitats/communities of some aquatic organisms.	Low	✓ HUAWEI TECHNOLOGIES shall ensure that all project vessels adopt journey Hazard Management plans, which shall include maximum allowable speed when travelling in shallow water. ✓ HUAWEI TECHNOLOGIES shall use front runner and other means to forewarn potentially affected fishing communities to be used prior to the use of large vessels ✓ HUAWEI TECHNOLOGIES shall ensure that all vessel movement adopt normal transportation routes following NIWA regulated corridors to minimise the interface with other waterways users ✓ HUAWEI TECHNOLOGIES shall conduct prior consultation and notification of communities to be affected for the development of a	Low	Monitor water quality in Imo River,. Parameters: Turbidity, TSS, oil & grease, heavy metals, microbiology, plankton, and water physico chemical properties	Effects Monitoring Once a month completion

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					procedure to address any income or net losses ✓ HUAWEI TECHNOLOGIES shall control the frequency of movement of vessel along the sensitive areas.			
Impacts Associated With Site Clearing And Preparation Activities								
SC1	Pre-Operation Phase	Site Clearing and Preparation	**Impacts on Soil Ecology** Removal of dry lowland rainforest vegetation, freshwater swamp forest and some of the top soil from the project site will result in loss of soil fertility, and near annihilation of soil ecology in the affected areas	Moderate	HUAWEI TECHNOLOGIES shall: ✓ Limit site clearing to the needed portions only and leave as much green area as possible. ✓ Ensure excavated soils are backfilled and properly levelled out to prevent the creation of ruts and the associated pond ✓ Ensure that the topography excavated and non-build areas are restored to pre-site clearing status.	Low	Monitor compliance with mitigation measures	Mitigation Compliance Monitoring Once every 3 months
SC2			**Impacts on Surface Water Quality, Hydrobiology and Sediment** Run off from the site into nearby rivers and streams resulting in increased turbidity and total suspended which may affect plankton communities, benthic organisms and fisheries in rivers and streams.	Low	HUAWEI TECHNOLOGIES shall: ✓ Construct drainage lines where necessary on the site ✓ Ensure runoff from the site shall be channelled through sediment/silt traps before discharge into nearby water bodies ✓ Backfill and properly compact trenches to minimize impact on surface waters as a result of highly turbid runoff inputs	Low	Monitor water quality in receiving waters of the project area. Parameters: Turbidity, TSS, oil & grease, heavy metals, microbiology, plankton, and water physico chemical properties.	Effects monitoring will be once every 3 months during site clearing and construction once 3-6 months thereafter. Mitigation Compliance Monitoring Once every month during activity

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							Monitor compliance with mitigation measures	
SC3			**Impacts on Vegetation and Wildlife** Loss of wildlife, trees, shrubs, and climbers as well as associated fauna within the area of the forest to be taken up for the project	Moderate	HUAWEI TECHNOLOGIES shall: ✓ Keep site clearing to a minimum and leave as much vegetation as possible within project areas. ✓ Encourage the use of existing cleared or disturbed areas for the Contractor's Camp, stockpiling of materials etc. ✓ Ensure that the indigenous/primary forests are not to be removed unless required for construction purposes, nor shall new access routes be cut through indigenous vegetation. ✓ Trim rather than remove vegetation wherever possible. ✓ Strictly control clearing and preparation activities where it occurs in close proximity to indigenous/primary forest. ✓ Ensure that the limits of clearing and preparation activities must be clearly demarcated as per the Environmental Specifications to reduce unnecessary site clearing ✓ Prohibit contractor's and staff from removal or harvesting of trees or medicinal plants, and from poaching (through trapping, poisoning or shooting) or otherwise harm wild animals in the area. ✓ Prohibit harvesting/ use of indigenous/primary plants as firewood	Low	Monitor compliance with mitigation measures	Mitigation Compliance Monitoring Once every 3 months during activity

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					and other uses unless they are obtained from approved cleared areas. ✓ Ensure a slow and "systematic clearing method" to give room for the escape of the wildlife ✓ Prohibit the killing of wildlife for food by the contractor/project personnel.			
SC4			**Impacts on Culture and Archaeological Resources** Unauthorized clearing by the people near project facilities for construction of housing by people not associated with the project, hence leading to loss of shrines, burial grounds and other archaeological resources.	Moderate	HUAWEI TECHNOLOGIES shall: ✓ Implement an influx management plan to address the preservation of cultural and archaeological structures and resources. ✓ Create a buffer zone between the HUAWEI TECHNOLOGIES project area and the communities where there shall be neither clearing nor structures.	Low	Monitor cultural violations and archaeological finds in the project area. Monitor Compliance with mitigation measures	Effects Monitoring Once every 6 months during site clearing and construction and once, 6 months after construction ends. Mitigation Compliance Monitoring Once every 3 months
SC5			**Physical and Economic Displacement Impacts** Loss of farm land and forage to site clearing and construction activities	Moderate	HUAWEI TECHNOLOGIES shall: ✓ Provide livelihood enhancement support for affected persons ✓ Implement a grievance procedure to ensure all livelihood complaints about enhancement benefits are handled in a structured and timely manner and to resolve conflicts ✓ Monitor, document and evaluate livelihood enhancement process	Low	Review grievance records and compensation implementation. Conduct grievance survey Monitor compliance with mitigation	Effects Monitoring Once every 6 months during site clearing and construction and once in 6 months after construction ends. Mitigation Compliance Monitoring

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
							measures	Once every 3 months
SC6			**<u>Impacts on transportation</u>** Increased traffic activities along the project area leading to longer commuting time for existing road users	Low	HUAWEI TECHNOLOGIES shall: ✓ Implement a method statement for site clearing to reduce impacts on transportation ✓ Avoid as many roads and tracks currently used by pedestrians and road users in the project area ✓ Provide alternative routes to pedestrians if existing roads and tracks are blocked off ✓ Notify communities of plans to block roads or tracks ✓ As much as possible, avoid peak periods to transport supplies and equipment during project implementation.	Low	Conduct traffic survey along major and minor roads used by the project particularly those around communities Monitor compliance with mitigation measures.	<u>Effects Monitoring</u> Once every 3 months during site clearing and once 6 months after it ends <u>Mitigation Compliance Monitoring</u> Once every month
SC7			**<u>Vibration and Noise Impacts</u>** Increased noise and vibration generated by heavy equipment use for land clearing	Low	HUAWEI TECHNOLOGIES shall: ✓ Ensure all contractors avoid night time work as much as possible ✓ Pre-notify affected parties of their activities and shall provide ear muffs for people working with or near noise generating equipment ✓ Ensure that project staff are not exposed to more than nine hours at a go on any equipment generating noise level of more than 90 dBA .	Low	Conduct noise sampling (daytime and night time noise) in the project area Monitor Compliance with mitigation measures	<u>Effects Monitoring</u> Once every 3 months during site clearing and once 6 months after it ends. <u>Mitigation Compliance Monitoring</u> Once every 3 months during activity
Impacts Associated With Construction Activities								

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CR1	Pre-Operation Phase	Construction Activities	**Vibration and Noise Impacts** Increased noise and vibration generating activities like carpentry/joinery, block work, cement batching plant, lifting machinery operations and general vehicular movement.	Low	HUAWEI TECHNOLOGIES shall: ✓ Ensure that project staff are not exposed to more than nine hours at a go on any equipment generating noise level of more than 90 dBA	Low	Conduct noise sampling (daytime and night time noise) in the project area Monitor Compliance with mitigation measures	Effects Monitoring Once every 3 months during construction and once in 6 months after construction ends. Mitigation Compliance Monitoring Once every 3 months during activity
CR2			**Impacts on Human Movement** Disruptions to trekking paths will negatively impact people's movement and could affect social, economic and livelihood networks in the area.	Low	HUAWEI TECHNOLOGIES shall: ✓ Avoid as many existing roads and tracks currently used by pedestrians and road users in the project area ✓ As much as possible, avoid peak periods to transport supplies and equipment during project implementation. ✓ Provide alternative routes to pedestrians if existing roads and tracks are blocked off ✓ Notify communities of plans to block roads or tracks ✓ As much as possible, avoid peak periods to transport supplies and equipment during project implementation	Low	Conduct traffic survey along major and minor roads used by the project particularly those around communities Monitor compliance with mitigation measures.	Effects Monitoring Once every 3 months during construction and once in 6 months after construction ends. Mitigation Compliance Monitoring Once every month
Impacts Associated With Excavation								
DR1.1	Pre-Operation Phase	Physical Excavation Activity	**Impacts on Surface Water Quality, Sediments and**	High	HUAWEI TECHNOLOGIES shall: ✓ Use silt curtains while Excavation to ensure that suspended solids in	Low	Monitor water quality in Imo River,	Effects Monitoring Once a month completion

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
			Hydrology Increased turbidity which will affect water quality. Fish and other aquatic organisms that do not migrate away from the area could be directly affected by the activity.		discharge water is minimized ✓ Prior to initiation of Excavation, complete a modelling study simulation to guide Excavation and mitigation of its effects		Parameters: Turbidity, TSS, oil & grease, heavy metals, microbiology, plankton, and water physico chemical properties	
DR1.2			**Physical and Economic Displacement Impacts** Areas mostly affected by turbidity will not be viable fishing grounds while impacts last. Fish traps set in affected part of the Creek will need to be relocated	High	✓ Where loss of fishing grounds or rights is envisaged or established, HUAWEI TECHNOLOGIES shall implement a livelihood compensation and enhancement programme for project affected persons (PAP). The program shall also include a grievance mechanism	Low	Review grievance records and compensation implementation. Conduct grievance survey Monitor compliance with mitigation measures	Effects Monitoring Once every 6 months during site clearing and construction and once in 6 months after construction ends. Mitigation Compliance Monitoring Once every 3 months
DR1.3			**Change in Topography** Dumping of spoils on the creek banks will lead to slight topography elevations.	Low	✓ HUAWEI TECHNOLOGIES shall ensure that Excavation activities do not alter the natural topography in the area and where necessary, maintain or restore water and nutrient flow. ✓ HUAWEI TECHNOLOGIES shall require that contractors working on Excavation maintain a Excavation plan that maintains natural topography in the area	Low	Monitoring of shoreline changes along the Imo River	Monthly during the Excavation activities till two months after the Excavation is completed.

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Impacts Associated With Optic Fibre Construction								
PPL1.1	Pre-Operations	Pipeline Installation	**Salt Water Intrusion Impacts** Trenching activities along the pipeline route will open up the area for salt water encroachment/intrusion. This could lead to the death of fresh water plants and animals.	High	HUAWEI TECHNOLOGIES shall ensure that: HUAWEI TECHNOLOGIES shall: ✓ Ensure that trenching is carried out in a sequence to limit the risk of saltwater intrusion to the freshwater areas ✓ Sheet piles shall be used during construction to block off the salt water influx ✓ Pipeline trenches shall be covered to pre-excavation levels ✓ The effectiveness of the saltwater barriers shall be monitored	Low	Sample River and creek water in project area. Monitor effects with compliance with mitigation measures.	Effects Monitoring Twice a year during site preparation and construction; Once every year for the next five years. Mitigation Measures Compliance Monitoring Once every month during construction
Impacts Associated with Wastes and Emissions Handling								
WE1.1	Pre-Operations	Waste and Emissions Generation and Disposal	**Air Emissions Impacts** Emissions of air pollutants during the operation of combustion engines, burning of organic material from site clearing, and dust during site clearing and grading.	Moderate	HUAWEI TECHNOLOGIES shall: ✓ Service all equipment regularly, and shall use low emission equipment ✓ Require that all contractors maintain their equipment in good condition ✓ Require that engines are turned off when not required ✓ Reduce burning of organic material to the barest minimum	Low	Conduct ambient air monitoring for pollutant gases (NOx, SOx, VOCs, CO) and particulates Monitor Compliance with Mitigation Measures	Effects Monitoring Once every 3 months during site clearing and construction and once 3 months after construction ends. Mitigation Compliance Monitoring Every 3 months from site clearing through construction

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
WE1.2	Pre-Operations	Waste and Emissions Generation and Disposal	**Solid Waste Impacts** Illegal disposal of waste in open dump areas and waterways.	Moderate	✓ HUAWEI TECHNOLOGIES shall implement a waste minimization and utilization strategy as much as possible to reduce the amount of wastes to be generated ✓ HUAWEI TECHNOLOGIES shall develop and implement an approved waste management plan for all project phases in line with regulatory requirements ✓ HUAWEI TECHNOLOGIES shall ensure proper waste manifesting for all non incinerated wastes and all other construction wastes taking off the plant site for disposal ✓ HUAWEI TECHNOLOGIES shall contract only with approved and permitted waste handling firms and technologies ✓ HUAWEI TECHNOLOGIES shall monitor its waste contractors	Low	Monitor Compliance With Mitigation Measures	Mitigation Compliance Monitoring Every 3 months from site clearing through construction
WE1.3	Pre-Operations	Waste and Emissions Generation and Disposal	**Liquid Wastes and Discharge Impacts** Generation of organically-loaded effluents from sinks, showers, laundries activities and sewage during the site preparation and construction in the worker's camp.	Moderate	HUAWEI TECHNOLOGIES shall: ✓ Ensure sewage generated at the temporary construction camps, will be collected in a closed system comprising a conservancy tank, which is then piped to a holding tank. ✓ HUAWEI TECHNOLOGIES shall engage the services of a certified third-party waste disposal contractor to collect waste from the tanks on a regular basis and treat the sanitary	Low	Monitor Compliance With Mitigation Measures	Mitigation Compliance Monitoring Every 3 months from site clearing through construction

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
					waste offsite. ✓ Implement a public training program to increase awareness of basic sanitation ✓ Extend project sanitary waste handling to potentially affected communities during construction			
WE1.4	Pre-Operations	Waste and Emissions Generation and Disposal	**Water Disposal Impacts** Disposal of about 1500m^3 of water..	Moderate	✓ HUAWEI TECHNOLOGIES will pump all discharge water into barge tanks, where the effluent will be neutralized with hydrogen peroxide. ✓ HUAWEI TECHNOLOGIES shall carry out Eco-toxicity tests on water before and after neutralization to ensure it meets applicable best practice standards before discharge. ✓ HUAWEI TECHNOLOGIESs hall ensure discharge is done at a location beyond artisanal fishing grounds.	Low	Monitor Compliance With Mitigation Measures	Not applicable
WE1.5	Pre Operation (Excavation)	Waste and Emissions Generation and Disposal	**Excavation Spoil Disposal Impacts** The disposal of dredge spoils in the marine environment will lead to the generation of sediment plumes, increase turbidity and total suspended solids.	Moderate	✓ Test dredge spoils prior to disposal to ensure they are not contaminated ✓ HUAWEI TECHNOLOGIES store dredged material on barges and then ship the spoils to marine waters beyond 50m depths for disposal and away from artisanal fishing grounds. ✓ HUAWEI TECHNOLOGIES shall require that contractors handling spoils disposal implement a disposal method that does not allow the creation of piles of spoils.	Low	Monitor Compliance With Mitigation Measures.	Mitigation Compliance Monitoring Monitor monthly during the Excavation and disposal period until 3 months after completion.
Impacts Associated With Physical Presence of Equipment								
OM1.1	Operations	Physical Presence of	**Visual Impacts** Fundamental change in	Moderate	HUAWEI TECHNOLOGIES Shall: ✓ Use natural screening to minimise the	Low	Monitor Compliance	Mitigation Compliance

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		Plant	the appearance of the landscape as a result of the project		extent of change of view to the water's edge, using natural vegetation (such as tall trees) where possible; and ✓ Implement a "down" lighting strategy to minimise the potential for light emissions to pass beyond the project boundary and be reflected by open water		With Mitigation Measures.	<u>Monitoring</u> Once in 6 months for the space of 3 years
OM1.2	Operations	Generation and Transmission	**<u>Impacts of Electric and Magnetic Fields</u>** Adverse effects of electric and magnetic field on plant, animal species, and on human health.	Low	HUAWEI TECHNOLOGIES shall; ✓ Set personal exposure monitoring equipment to warn of exposure levels that are below occupational exposure reference levels (e.g. 50 percent). ✓ Limit exposure time through work rotation ✓ Increase the distance between the EMF source and the worker, when feasible, or the use of shielding materials ✓ Prepare and implement an EMF safety program including the following components: ○ Identification of potential exposure levels in the workplace ○ Surveys of exposure levels in new projects and the use of personal monitors during working activities ○ Training of workers in the identification of occupational EMF levels and hazards ○ Establishment and identification of safety zones to differentiate between work areas with expected elevated	Low	Monitor Compliance with Mitigation Measures	At the design stage, and prior to commissioning of facility and every 2 years during Audit

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					EMF levels compared to those acceptable for public exposure, limiting access to properly trained workers ○ Implementation of action plans to address potential or confirmed exposure levels that exceed reference occupational exposure levels developed by international organizations such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP),			
OM1.3	Operations	Physical Presence of Transmission Lines	**Impacts on Wildlife** Collision of birds with transmission lines and electrocution of bats as well as the danger of coating chemicals and pesticides.	Low	✓ Avoid the use of pesticides that fall under the World Health Organization Recommended Classification of Pesticides by Hazard Classes 1a and 1b ✓ Apply pesticides based on criteria (e.g. field observations, weather data, time of treatment, and dosage) and maintain a pesticide logbook to record such information ✓ Avoid flight paths of birds when finalizing high tension cable route.	Low	Monitor Compliance with Mitigation Measures	Effects Monitoring Every 6 months from construction through operations. Mitigation Measures Compliance Monitoring Once every 6 months during construction and once annually during operations
OM1.4	Operations	Waste and Emissions	**Operations Solid Waste Impacts** In addition to solid waste generated and managed by the project,	Moderate	HUAWEI TECHNOLOGIES shall: ✓ Pursue a waste minimization and utilization strategy ✓ Develop and implement an approved waste management plan for operations	Low	Monitor Compliance With Mitigation Measures	Mitigation Compliance Monitoring Every 3 months from site clearing

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			there will be an increase in solid waste in the communities and surrounding areas due to influx of project workers and non-project related migrants. Excess waste may accumulate in the communities or the surrounding areas.		also ✓ Ensure proper waste manifesting for all project related wastes ✓ Engage government approved and reputable waste management firms in waste handling and disposal Implement waste management auditing ✓ Work with communities to develop and implement basic waste handling procedures among residents ✓ Implement a public training program to increase awareness of basic sanitation			through construction
OM1.5	Operations	Waste and Emissions	**Air Emissions Impacts** The increment of the green house gases in the atmosphere resulting from the operations in the facility.	Low	HUAWEI TECHNOLOGIES shall: ✓ As much as possible ensure the use of modern equipment that minimize emissions of pollutant gases during operation ✓ Ensure proper maintenance of combustion equipment to ensure efficient combustion ✓ Monitor the air-quality continuously as a mitigation step to ensure that the overall significance does not increase	Low	Conduct ambient air monitoring for pollutant gases (NOx, SOx, VOCs, CO) and particulates Monitor Compliance with Mitigation Measures	Effects Monitoring Once every 3 months during site clearing and construction and once 3 months after construction ends. Mitigation Compliance Monitoring Every 3 months from site clearing through construction
OM1.6	Operations	Waste and Emissions	**Effluent Handling and Disposal Impacts** Generation of sewage (black water); "grey" water from sinks, showers, and laundries;	Low	HUAWEI TECHNOLOGIES shall: ✓ Ensure sewage generated at the living area of staff, will be collected in a closed system comprising a conservancy tank to separate solid materials from liquid wastes. The	Low	Monitor Compliance With Mitigation Measures	Mitigation Compliance Monitoring Every 3 months from site clearing through

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
			and other organic laden effluents from personnel accommodations during plant operation.		liquids would then be piped to a holding tank. ✓ HUAWEI TECHNOLOGIES shall engage the service of a certified third-party waste disposal contractor to collect waste from the tanks on a regular basis and treat the sanitary waste offsite.			construction.
Health Impacts								
H1.1	All Projects	Pollution Related Health Effects	**<u>Sanitary and Solid Waste Health Effects</u>** Untreated sanitary waste and other effluents as well as solid waste can increase the existing prevalence of water and vector borne diseases and other disease vectors in the project area.	Moderate	HUAWEI TECHNOLOGIES shall; ✓ Implement a Contractors Sanitation Plan for the project ✓ Support health enlightenment campaigns, which provide guidelines and tips for improved sanitary conditions in the communities ✓ Support indigenes to establish commercial sanitary services that will serve the project area ✓ Require its contractors to provide HSE induction training to all workers engaged on the project	Low	Conduct community health survey in the project area including improvements in sanitary conditions Monitor Compliance with Mitigation Measures	<u>Effects monitoring</u> Every 6 months from site clearing through construction. <u>Mitigation Measures Compliance Monitoring</u> Once every 6 months during site clearing and construction
H1.2	Operations	Pollution Related Health Effects	**<u>Noise and Vibration Impacts</u>** Increase in noise and vibration during the implementation of various activities associated with the HUAWEI TECHNOLOGIES project.	Moderate	HUAWEI TECHNOLOGIES shall: ✓ Implement a noise abatement plan ✓ Adopt noise attenuation measures such as installation of acoustic mufflers on large engines and equipment; ✓ Provide hearing protection to all workers on site ✓ Avoid night time work as much as possible	Low	Conduct community health survey in the project area including improvements in sanitary conditions Monitor Compliance	<u>Effects monitoring</u> Every 6 months from site clearing through construction. <u>Mitigation Measures Compliance Monitoring</u> Once every 6 months during site

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
							with Mitigation Measures	clearing and construction.
H1.3a	Pre-Operations	Pollution Related Health Effects	**Air Emission Impacts** Burning of cleared vegetation and other organic wastes on site together with emissions from combustion engines will lead to an increase in air pollutants.	Low	HUAWEI TECHNOLOGIES shall: ✓ Service all equipment regularly, and shall use low emission equipment ✓ Require that all contractors maintain their equipment in good condition ✓ Require that engines are turned off when not required ✓ Reduce burning of organic material to the barest minimum	Low	Conduct ambient air monitoring for pollutant gases (NO_x, SO_x, VOCs, CO) and particulates Monitor Compliance with Mitigation Measures	Effects Monitoring Once every 3 months during site clearing and construction and once 3 months after construction ends. Mitigation Compliance Monitoring Every 3 months from site clearing through construction.
H1.3b	Operations	Pollution Related Health Effects	**Air Emission Impacts** Plant operations will result in releases of pollutant gases like nitrogen oxides, sulphur oxides, carbon monoxide, Volatile Organic Compounds (VOC) and particulates.	Low	HUAWEI TECHNOLOGIES shall ✓ Service all equipment regularly, and shall use low emission equipment ✓ Monitor operations emissions to ensure pollutants are kept within regulatory limits	Low	Conduct ambient air monitoring for pollutant gases (NO_x, SO_x, VOCs, CO) and particulates Monitor Compliance with Mitigation Measures	Effects Monitoring Once every 3 months. Mitigation Compliance Monitoring Every 3 months
H2.1	Pre-Operations and Operations	Influx Related Health Effects	**Communicable and Non-Communicable Diseases** Influx of people into the area as a result of	High	HUAWEI TECHNOLOGIES shall: ✓ Conduct periodic health awareness campaigns for STDs especially AIDS, and support safe sex initiatives ✓ Support indigenes to establish	Moderate	Conduct community health survey in the project area including	Effects monitoring Every 6 months from site clearing through construction and

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
			the project could lead to outbreak of Communicable and Non-Communicable Diseases among the populace.		commercial sanitary services that will serve the area ✓ Through advocacy, encourage State and Local Governments to improve housing and other facilities in the area ✓ Provide adequate medical facilities for all construction workers.		improvements in sanitary conditions, HIV incidences etc. Monitor Compliance with Mitigation Measures	operations. Mitigation Measures Compliance Monitoring Once every 6 months during site clearing, construction and operations.
H2.2	Pre- Operations and Operations	Influx Related Health Effects	**Impacts on Fertility** The possibility of activities that could increase STD, stress and fertility-threatening lifestyles.	Low	HUAWEI TECHNOLOGIES shall: ✓ Monitor this health determinant as a mitigative step to ensure that the overall significance does not increase	Low	Conduct community health survey in the project area including improvements in sanitary conditions	Effects monitoring Every 6 months from site clearing through construction and operations.
H2.3	Pre-Operations and Operations	Influx Related Health Effects	**Impacts on Quality of Health Care** Inadequate health care system and medical facilities in the area for the populace.	High	✓ As part of its social development plan, HUAWEI TECHNOLOGIES will embark on health care interventions to improve general health awareness and the availability of health care facilities in the area ✓ HUAWEI TECHNOLOGIES shall periodically sponsor cultural and recreational activities such as festivals and sports competitions. ✓ HUAWEI TECHNOLOGIES workers from the community shall have access to the medical facilities that will be provided in the construction camp and	Moderate	Conduct community health survey in the project area including improvements in sanitary conditions, health care adequacy etc. Monitor Compliance	Effects monitoring Every 6 months from site clearing through construction and operations Mitigation Measures Compliance Monitoring Once every 6 months during site clearing, construction and

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
					power plant premises. Adequate medical facilities shall be provided for all construction workers and those employed to operate the plant. ✓ HUAWEI TECHNOLOGIES shall conduct periodic health awareness campaigns for STDs especially AIDS and also support safe sex initiatives ✓ The mitigation measures shall be implemented in phases from pre operations to operations			operations.
H2.4	Pre-Operations and Operations	Influx Related Health Effects	**Psychosocial Factors** Strain on the social, religious and cultural structure from influx of people to the area could lead to psychosocial factors.	Low	HUAWEI TECHNOLOGIES shall; ✓ Inculcate induction training into its employment program to intimate new intake with the culture and religious belief of the people. ✓ Maintain and implement a Drug and Alcohol Policy for all aspects of the project ✓ Support anti-drug crusades and campaigns in the area ✓ Ensure that its contractors develop and implement a workers disengagement plan to address the potential boom-bust impacts	Low	Conduct community health survey in the project area including substance use. Monitor Compliance with Mitigation Measures	monitoring Every 6 months from site clearing through construction and operations. Mitigation Measures Compliance Monitoring Once every 6 months during site clearing, construction and operations.
H2.5	Pre-Operations and Operations	Influx Related Health Effects	**Accidents, Spills, and Fires Impacts** Accidents including spills (fuel and hazardous chemicals), fires, vehicle navigation	High	HUAWEI TECHNOLOGIES shall: ✓ Require that all its Contractors develop and implement HSE Plans for their activities ✓ Review all contractor HSE plans prior to contract award.	Moderate	Monitor Compliance with Mitigation Measures	Mitigation Measures Compliance Monitoring Once every 6 months during site

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
			accidents are hazards that may be linked to the project activities in the environments		✓ Ensure that all contractors and workers comply with HUAWEI TECHNOLOGIESOccupational health and safety guidelines and standards for general work practices, hours of work, air emissions, noise and light. ✓ Carry out routine safety checks on the working equipment in line with standard safety procedures and HUAWEI TECHNOLOGIES Operating Controls. ✓ Ensure all contractors staff are trained on basic safety procedures and emergency response procedures and environmental issues. ✓ Require that contractors maintain emergency and first aid facilities at strategic locations throughout the project area ✓ Develop and maintain an emergency, oil and chemical spill prevention and response/counter measures plans for all phases of the project ✓ Require that all contractors maintain a journey hazard management plan			clearing, construction and operations
H3.1	Operations	Special Health Effect	**Lightning Strike Impacts** Lightning strike on power line, tower or wire.	Low	HUAWEI TECHNOLOGIES shall: ✓ Design transmission facilities to withstand lightning strikes by channeling them to ground at the tower	Low	Monitor Compliance with Mitigation Measures	At the design stage, and prior to commissioning of facility and thereafter.
H3.2	Operations	Special Health Effects	**Forest Fires Impacts** The possibility of bush fire if the right of way (RoW) is not well cleared. It could also	Moderate	HUAWEI TECHNOLOGIES shall; ✓ Routinely monitor right-of-way vegetation for fire risk ✓ Remove blow down and other high-hazard fuel accumulations along right	Low	Monitor Compliance with Mitigation Measures	Mitigation Measures Compliance Monitoring Once upon

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
			occur as a result of electric faults.		–of- way ✓ Use time thinning, slashing, and other maintenance activities to avoid forest fire seasons ✓ Dispose of maintenance slash by truck or controlled burning. Controlled burning shall adhere to applicable burning regulations, fire suppression equipment requirements, and will be typically monitored by a fire watcher ✓ Plant and manage fire resistant species (e.g. hardwoods) within, and adjacent to, rights-of-way ✓ Establish a network of fuel breaks of less flammable materials or cleared land to slow progress of fires and allow fire fighting access.			completion of construction and every 2 years as part of Audit.
Occupational Health Impacts								
H4	General Infrastructure Developments	Health Hazards	Over exertion	Moderate	HUAWEI TECHNOLOGIES shall: ✓ Ensure the use of mechanical assists to eliminate or reduce exertions required to lift materials, hold tools and work objects, and requiring multi-person lifts if weights exceed thresholds ✓ Select and design of tools that reduce force requirements and holding times, and improve postures ✓ Provide user adjustable work stations ✓ Incorporate rest and stretch breaks into work processes, and conducting job rotation ✓ Implement quality control and maintenance programs that reduce unnecessary forces and exertions ✓ Consider additional special conditions	Low	Monitor Compliance with Mitigation Measures	Once every 6 months during site clearing and construction and once annually during operations.

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
					where required such as for left handed persons			
			Slips and falls	Moderate	HUAWEI TECHNOLOGIES shall and require that contractors implement the following slip and fall prevention and protection measure for all workers exposed to the hazard: ✓ Training and use of temporary fall prevention devices, such as rails or other barriers able to support a weight of 200 pounds, when working at heights equal or greater than two meters or at any height if the risk includes falling into operating machinery, into water or other liquid, into hazardous substances, or through an opening in a work surface ✓ Training and use of personal fall arrest systems, such as full body harnesses and energy absorbing lanyards able to support 5000 pounds (also described in this section in Working at Heights above), as well as fall rescue procedures to deal with workers whose fall has been successfully arrested. The tie in point of the fall arresting system should also be able to support 5000 pounds ✓ Use of control zones and safety monitoring systems to warn workers of their proximity to fall hazard zones, as well as securing, marking, and labeling covers for openings in floors, roofs, or walking surfaces ✓ Delineate work zones so as to separate	Low	Monitor Compliance with Mitigation Measures	Once every 6 months during site clearing and construction and once annually during operations

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
					workers from traffic and from equipment as much as possible ✓ Reduce allowable vehicle speeds in work zones ✓ Use of high-visibility safety apparel for workers in the vicinity of traffic			
			Work in Heights	Moderate	HUAWEI TECHNOLOGIES shall and require that contractors implement the following fall prevention and protection measure for all workers exposed to the hazard of falling more than two meters: ✓ Installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area ✓ Proper use of ladders and scaffolds by trained employees ✓ Use of fall prevention devices, including safety belt and lanyard travel limiting devices to prevent access to fall hazard area, or fall protection devices such as full body harnesses used in conjunction with shock absorbing lanyards or self-retracting inertial fall arrest devices attached to fixed anchor point or horizontal life-lines ✓ Appropriate training in use, serviceability, and integrity of the necessary PPE ✓ Inclusion of rescue and/or recovery plans, and equipment to respond to workers after an arrested fall	Low	Monitor Compliance with Mitigation Measures	Once every 6 months during site clearing and construction and once annually during operations.
			Confined Spaces and Excavations	Moderate	HUAWEI TECHNOLOGIES shall and require that contractors implement the following prevention and protection	Low	Monitor Compliance with Mitigation	Once every 6 months during site clearing and

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
					measures for all work areas with this hazard exposure: ✓ Control site-specific factors which may contribute to excavation slope instability including, for example, the use of excavation dewatering, side-walls support, and slope gradient adjustments that eliminate or minimize the risk of collapse, entrapment, or drowning ✓ Provide safe means of access and egress from excavations, such as graded slopes, graded access route, or stairs and ladders ✓ Avoid the operation of combustion equipment for prolonged periods inside excavations areas where other workers are required to enter unless the area is actively ventilated ✓ Implement a permit to work procedure for all work in confined spaces		Measures	construction and once annually during operations
			Struck by Objects	Moderate	HUAWEI TECHNOLOGIES shall and require that contractors implement the following prevention and protection measure for all workers exposed to the hazard: ✓ Using a designated and restricted waste drop or discharge zones, and/or a chute for safe movement of wastes from upper to lower levels ✓ Conducting sawing, cutting, grinding, sanding, chipping or chiseling with proper guards and anchoring as applicable ✓ Maintain clear traffic ways to avoid	Low	Monitor Compliance with Mitigation Measures	Once every 6 months during site clearing and construction and once annually during operations.

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
					driving of heavy equipment over loose scrap ✓ Use temporary fall protection measures in scaffolds and out edges of elevated work surfaces, such as hand rails and toe boards to prevent materials from being dislodged ✓ Evacuate work areas during blasting operations, and use blast mats or other means of deflection to minimize fly rock or ejection of demolition debris if work is conducted in proximity to people or structures ✓ Ensure use of appropriate PPE, such as safety glasses with side shields, face shields, hard hats, and safety shoes ✓ Delineate work zones so as to separate workers from traffic and from equipment as much as possible ✓ Reduce allowable vehicle speeds in work zones ✓ Use of high-visibility safety apparel for workers in the vicinity of traffic			
			Moving Machinery	Moderate	HUAWEI TECHNOLOGIES shall and require that contractors implement the following prevention and protection measures for all work areas with this hazard exposure: ✓ Plan and segregate the location of vehicle traffic, machine operation, and walking areas, and controlling vehicle traffic through the use of one-way traffic routes ✓ Establish and enforce speed limits, and on-site trained flag-people wearing	Low	Monitor Compliance with Mitigation Measures	Once every 6 months during construction and once annually during operations

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
					high-visibility vests or outer clothing covering to direct traffic ✓ Ensure the visibility of personnel through their use of high visibility vests when working in or walking through heavy equipment operating areas, and training of workers to verify eye contact with equipment operators before approaching the operating vehicle ✓ Ensure moving equipment is outfitted with audible back-up alarms ✓ Use inspected and well-maintained lifting devices that are appropriate for the load, such as cranes, and securing loads when lifting them to higher job-site elevations.			
	Power Generation Transmission and Distribution	Live Power lines	Working at height	Moderate	HUAWEI TECHNOLOGIES shall, and require that contractors implement the following fall prevention and protection measure for all workers exposed to the hazard of falling while working on power projects: ✓ Test structures for integrity prior to undertaking work ✓ Implement a fall protection program that includes training in climbing techniques and use of fall protection measures; inspection, maintenance, and replacement of fall protection equipment; and rescue of fall-arrested workers, among others ✓ Establish criteria for use of 100 percent fall protection (typically when working over 2 meters above the	Low	Monitor Compliance with Mitigation Measures	Once every 6 months during construction and once annually during operations.

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
					working surface. The fall protection system shall be appropriate for the tower structure and necessary movements, including ascent, descent, and moving from point to point; ✓ Install fixtures on tower components to facilitate the use of fall protection systems ✓ Provide adequate work-positioning device system for workers. ✓ Ensure proper rating for hoisting equipment ✓ Ensure proper maintenance of hoisting equipment and properly train hoist operators ✓ Use Safety belts that are not less than 16 millimeters (mm) (5/8 inch) two-in-one nylon or material of equivalent strength. ✓ Replace rope safety belts before signs of aging or fraying of fibers become evident ✓ When operating power tools at height, require that workers use a second (backup) safety strap; Remove signs and other obstructions from poles or structures prior to undertaking work.			
			Electric and magnetic field	Moderate	HUAWEI TECHNOLOGIES shall, and require that contractors implement the following measures to address occupational EMF exposure: ✓ Prepare and implement an EMF safety program including the following components:	Low	Monitor compliance with mitigation measures	Mitigation Compliance Monitoring At the commencement of operations of power lines and 1-

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
					○ Identification of potential exposure levels in the workplace ○ Surveys of exposure levels in new projects and the use of personal monitors during working activities ○ Training of workers in the identification of occupational EMF levels and hazards ○ Establishment and identification of safety zones to differentiate between work areas with expected elevated EMF levels compared to those acceptable for public exposure, limiting access to properly trained workers ○ Implementation of action plans to address potential or confirmed exposure levels that exceed reference occupational exposure levels developed by international organizations such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP), ✓ Set personal exposure monitoring equipment to warn of exposure levels that are below occupational exposure reference levels (e.g. 50 percent). ✓ Limit exposure time through work rotation Increase the distance between the EMF			year into operation. Audit facility every 2 years

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
					source and the worker, when feasible, or the use of shielding materials.			
			Exposure to chemicals	Moderate	HUAWEI TECHNOLOGIES shall and require contractors to implement the following mitigating measures for occupational chemical exposure health hazards associated with solid waste handling facilities: ✓ Provide adequate personnel facilities, including washing areas and areas to change clothes before and after work ✓ Ventilate enclosed processing areas (e.g., dust in waste size reduction areas), ✓ Monitor breathing zone air quality in work areas at processing and transfer facility using direct-reading instruments that measure methane and oxygen deficiency Prohibit eating, smoking, and drinking except in designated areas	Low	Conduct periodic medical examination on staff exposed to chemicals Monitor Compliance with Mitigation Measures	Effects Monitoring Every 6 months from construction through operations. Mitigation Measures Compliance Monitoring Once every 6 months during construction and once annually during operations
Cumulative Impacts								
CU	All Project	Cumulative Impact	Land Take: Loss of Biodiversity and Increase in Ambient Temperature Increased Run Off	Moderate - High	✓ HUAWEI TECHNOLOGIES shall advocate working with the State Government to develop green belts and conservation areas within the area.	Moderate	Monitoring to be handled as part of larger regional plans with State Government	HUAWEI TECHNOLOGIES and the State Government shall fix the frequency as deemed fit
			Influx	Moderate	✓ HUAWEI TECHNOLOGIES shall work with the State Government to develop and implement a Master Plan that addresses the negative impacts of population growth in the entire area.	Low		

Impact ID	Project Activity & Phase	Impact Category	Environmental Impacts	Impacts Significance	Mitigation Measures	Residual Impact	Effects and Mitigation Compliance Monitoring	Monitoring Frequency
Impacts Associated With Decommissioning								
D1	Decommissioning	All Categories	Transportation of Workers and Materials	Moderate	Impacts will be further assessed during development of substantive decommissioning and abandonment plan			
D2			Wind Down Operations	Moderate				
D3			Physical Removal of Installed Facilities	Moderate				
D4			Remediation and Restoration Activities	Moderate				
D5			Wastes and Emissions, Generation and Handling	Moderate				

7.7 EMERGENCY RESPONSE PLANNING REQUIREMENTS

HUAWEI TECHNOLOGIES has incorporated necessary safety measures into the engineering design of the proposed power plant to ensure that the release of products, hazards, incidents, near misses and accidents are minimized, if not completely eliminated. Given the fact that accidents do occur due to human error, equipment failure or sabotage, there is a need to put in place sound and cost effective emergency response and contingency plans that can be promptly activated to minimize losses due to such accidents. Such contingency plans shall cover all project facilities and ancillary services.

HUAWEI TECHNOLOGIES shall implement best in class procedures to curtail leaks and emergency situations. These procedures shall promote the confidence of asset owners, operators and the general public and also greatly minimizes the potential risk of any spills, leakages or accidents.

7.8 CHECKING AND CORRECTIVE ACTION

The objective of the inspection and monitoring activities described in this section is to verify compliance with the EMP. The inspection and monitoring approach will also be reflected in Contractor's HSE procedures. EPC Contractors will be responsible for implementing HUAWEI TECHNOLOGIES's environmental and social commitments in the field on a daily basis. Auditing of the monitoring and inspection activities by the Contractor and by HUAWEI TECHNOLOGIES provide the mechanism by which HUAWEI TECHNOLOGIES insures that it remains compliant with regulatory commitments as well as its own HSE standards and policies.

The *inspection* activities described in this EMP refer to qualitative monitoring, e.g., visual inspections. The *monitoring* activities described in this EMP refer to effects and regulatory monitoring, some of which are empirical.

7.8.1 Inspection

Inspections shall be conducted by the Contractor's HSE department on a daily basis. The results of the inspection and monitoring activities shall be made available to the HUAWEI TECHNOLOGIESHSE Supervisor on a weekly basis or more frequently if requested by the, HSE Manager.

7.8.2 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.

With respect to the significant impacts identified in the EIA, HUAWEI TECHNOLOGIES has developed a program to monitor the effectiveness of the mitigation measures and also comply with regulatory monitoring requirements (Table 7-2). The program has been discussed in earlier sections.

7.8.3 Remediation Plans after Decommissioning

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. Therefore, investors make appropriate plans for either temporarily or permanent closures of facilities after the expiration of the project useful life. The useful life of any project is determined by a number of factors, among which are:

- Specifications of materials,
- Durability of equipment and machinery,
- Profitability of the proposed project and
- Importance of the end product.

HUAWEI TECHNOLOGIES has estimated that the proposed project will last for 20 years. The activities to be carried out during the decommissioning phase shall include the following:

- Dismantling of the facility and other ancillary equipment and
- Removal of all structures.

The potential impacts that might result from the decommissioning phase of the proposed project have been earlier identified and discussed in Chapter 5.

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.

7.9 MITIGATION MEASURES AND MONITORING IMPLEMENTATION BUDGET

The costs associated with each of the mitigation measures and associated training and monitoring activities identified in Table 7.2 have been included in the HUAWEI TECHNOLOGIES project budget considerations by the company. These costs will be refined throughout project implementation phases to reflect reality at time of implementation.

CHAPTER EIGHT
DECOMISSIONING

8.1 INTRODUCTION

The Optic Fibre is expected to serve for about Fifty years after which it will be decommissioned. This period often marks the end of their useful lifetime and heralds the requirement to abandon and decommission the projects.

Decommissioning may also be required if the Optic fibre has failures in its integrity and other facilities are no longer useful and the proponents decide that they no longer want to continue with the venture. Since the HUAWEI TECHNOLOGIES will depend on the functioning of this facility, it will eventually be decommissioned.

The HUAWEI TECHNOLOGIES would be designed, built and maintained to operate efficiently for about 50 years after which, it will be decommissioned in conformance with a plan that meets local regulatory requirements and international standards.

A general approach will be to commence detailed planning of decommissioning and abandonment activities about five years in advance. This should ensure a safe, environmentally friendly, and efficient decommissioning/abandonment programme.

Discussed below are the end processes of the offshore decommissioning flow chart (Figure 8.1)

8.1.1 Refurbishment and re-use

As much as practicable, building and equipments will be refurbished and re-used. This method is generally better than demolition because the environmental costs of energy, water and materials are less.

8.1.2 Scrapping

During demolition, equipments made out of steel e.g., cables and onshore equipments shall be treated and scrapped in order to enable specified contractors recycle and re-use such materials.

8.1.3 Offsite Waste disposal

Industrial waste which cannot be recycled or re-used will be sent to approve treatment and disposal sites for proper disposal. Only certified waste contractors and approved technologies shall be engaged and monitored to ensure that all regulations concerning waste disposal at registered sites are followed.

8.1.4 Remediation and re-vegetation

Vegetation in the plant areas will be restored based on the results of assessments and studies conducted prior to a final restoration plan. This plan will be based on restoring structure and functionality to the baseline environment which will take into account risk, value and socio-economic and community concerns. Groundwater monitoring will be carried out to detect any contamination. In the case of contaminated groundwater, on-site treatment or extraction will be done. Also, surface waters and offshore locations will be treated using organic and inorganic remediation strategies in order to reduce impacts on nearby waters.

Before decommissioning, HUAWEI TECHNOLOGIES will develop a plan that will establish:

- Facilities to be decommissioned and removed
- Environmental aspects of the decommissioning activity
- Methods for facility re-use, recycling, disposal, or removal
- Proper consultation with all stakeholders (communities, other land users and regulators)
- Efforts to mitigate negative environmental, socioeconomic and health impacts
- Appropriate site rehabilitation strategies
- Programmes for restoring the environment in accordance with national and international best-practices and regulatory requirements
- Scope of work to assess possible residual impacts of the plant on the environment; specifically any future restrictions on other activities

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

At the present time, only preliminary plans exist for decommissioning and abandonment. Additional details will be developed as the project progresses. The regulatory agencies like the FMEnv must be carried along during this process of decommissioning. The decommissioning plan will consider all facilities associated with the HUAWEI TECHNOLOGIES Project.

8.2 STAKEHOLDERS CONSULTATION FOR DECOMMISSIONING

The project decommissioning plan will include consultation with various stakeholders including employees from various departments within HUAWEI TECHNOLOGIES, communities, nearby facility regulators and experts. The decommissioning team will include competent personnel from various departments within HUAWEI TECHNOLOGIES as well as the regulatory authorities and personnel from nearby facilities.

8.3 WIND-DOWN OPERATIONS

As the HUAWEI TECHNOLOGIES project approaches the end of its economic viability, plans will be put in place to wind down operations. These will include a review and rationalisation of operations and personnel with a possible gradual shut down of some facilities. The decommissioning of the plan will be planned for a significant period before the cessation of activity. This will allow for a carefully planned redeployment and, where necessary, disengagement of personnel as appropriate.

8.4 DECOMMISSIONING OF FACILITIES

At the end of the facilities' utility, all equipment will be decommissioned. The Optic fibre will be removed from the ground. HUAWEI TECHNOLOGIES Health Safety and Environmental Management Systems will be implemented to assure safety of personnel and the public during decommissioning as well as minimise negative environmental impacts. Particular attention will be paid to the following:

8.4.1 Protection from Air Pollutant Emissions

As part of the decommissioning procedure for the HUAWEI TECHNOLOGIES project attention will be paid to the air quality of the immediate environment.

8.4.2 Protection from Noise

Decommissioning contractors will be required to comply with noise impact abatement measures and acoustic mufflers shall be installed on large equipment to reduce noise levels as much as practicable. Workers will also be provided with ear protective devices for protection against exposure to noise.

8.4.3 Waste Handling

Waste will be segregated according to the risks they pose and the treatment and handling required. This segregation also improves the chances of recycling. Contractors and trained workers will handle and dispose of waste in a responsible manner.

8.4.4 Salt Water Management

Decommissioning activities may require trenching to dislodge the optic fibre cables. Plans will therefore include measures to prevent negative impacts.

RE-USE/RECYCLING OF EQUIPMENT

All facility components that can be used or recycled will be identified and quantified. Office buildings will either be sold or converted to other uses. Alternatively, the buildings may be donated to host communities. Vehicles and other facilities will be scrapped and/or moved to other locations. Cleared locations will be re-vegetated using fast growing native species. Contaminated soils attributable to project activities will be remediated and restored.

8.5 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 decommissioned facilities
- Details of methods used for decommissioning
- Nature of decommissioning (partial or whole)
- Record of consultation meetings
- Details of recyclable/reusable materials/facility components
- Decontaminated facilities
- Decommissioning Schedule
- State of the surrounding environment
- Waste Management Plan
- Plans for restoration/remediation where necessary

CHAPTER NINE
CONCLUSION

The consideration of health, safety and environmental (HSE) issues potentially arising from the proposed Optic Fibre project commenced as early as the project conceptualization stage, and will progress through project construction and operations.

A comprehensive EIA study of the project components and activities has been prepared in accordance with Nigerian regulations and contemporary international best practices in EIA studies.

This EIA Report has presented project plans and activities. The associated positive and potential negative effects of the project changes on the environmental (biophysical), socio-economic, and health characteristics of the project have been documented and as appropriate, evaluated in detail. Mitigation measures have also been prescribed for significant negative impacts.

In line with applicable Nigerian and international best practices, the EIA process incorporated extensive stakeholder consultation.

As currently planned, the Optic fibre project has the potential to positively impact the Nigerian economy at both the macro and micro scale.

All project-related potential negative impacts were mitigated through the design and process development stages by specific activities, commitments and action plans. Adherence to these measures and regulatory compliance requirements shall ensure that impacts assessed as having low significance subsequently remain at tolerable levels.

The effects of those impacts identified as having potentially moderate and high significance consequences will also be either eliminated or minimized through the implementation of appropriate mitigation measures as recommended in this report.

Suitable mitigation measures have been designed for each of the potential negative impacts. Similarly, a detailed waste management plan that assures responsible and environmentally acceptable handling of all wastes generated by Optic fibre project will also be implemented. Hazardous material spill contingency plans have been developed as indicated in the report.

This EIA Report also provides an Environmental Management Plan (EMP), which will be implemented with a number of action plans including:

- Waste Management Plan
- Journey Management Plan
- Influx Management Plan
- Emergency Response Plan
- Community Relations and Development Plan

HUAWEI TECHNOLOGIES is committed to executing the EMP and the entire project in a safe and environmentally responsible manner. The company also embraces the concept of Corporate Social Responsibility and will continue working with Government and other stakeholders towards the implementation of a participatory Community Relations and Development Plan as a process to ensure continuous stakeholder involvement and benefit from the project.

If implemented in adherence to applicable environmental and safety requirements, built-in design/process mitigation measures, and the additional mitigation measures as recommended in this EIA Report, the environmental sustainability of the Optic fibre project is indeed assured.

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