DRAFT ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

FOR THE

PROPOSED EBONYI STATE INTERNATIONAL OLYMPIC STADIUM, ABAKALIKI LOCAL GOVERNMENT AREAS, EBONYI STATE

BY

EBONYI STATE GOVERNMENT

SUBMITTED TO

FEDERAL MINISTRY OF ENVIRONMENT

Environment House, Mabushi, FCT, Abuja

OCTOBER, 2020

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Prepared by	**Signature**
Capital Natural Eco	
Approved By	
Ebonyi State Government	
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LIST OF ABBREVIATIONS AND ACRONYMS

%	-	Percentage
^{O}C	-	Degree Celsius
AfDB	-	African Development Bank
ALARP	-	As Low as Reasonably Practicable
AQ	-	Air Quality
As	-	Arsenic
AS	-	Approach Surface
ASTM	-	American Society for Testing and Materials
Ba	-	Barium
BAT	-	Best Available Technique
BATNEEC	-	Best Available Technology Not Entailing Excessive Cost
BOD	-	Biochemical Oxygen Demand
BTEX	-	Benzene, Toluene, Ethylbenzene, and Xylene
C	-	Simpson's Dominance Index
Ca	-	Calcium
Cd	-	Cadmium
CDC	-	Community Development Committee
CEC	-	Cation Exchange Capacity
CH_4	-	Methane
Cl^-	-	Chloride Ion
CLO	-	Community Liaison Officer
CO	-	Carbon Monoxide
CO_2	-	Carbon Dioxide
COD	-	Chemical Oxygen Demand
Cr	-	Chromium
CSR	-	Corporate Social Responsibility

Cu	-	Copper
dBA	-	Decibels
Deg	-	Degree
DO	-	Dissolved Oxygen
EA	-	Environmental Assessment
EAG	-	Environmental Assessment Guidelines
EIA	-	Environmental Impact Assessment
EIS	-	Environmental Impact Statement
ESMP	-	Environmental and Social Management Plan
EMS	-	Environment Management System
EPA	-	Environmental Protection Agency
ESA	-	Environmentally Sensitive Areas
ESMS	-	Environmental and Social Management System
EPA	-	Environmental Protection Agency
Fe	-	Iron
FEPA	-	Federal Environmental Protection Agency
FGD	-	Focus Group Discussion
FIFA	-	Internationale de Football Association
FMEnv	-	Federal Ministry of Environment
FRSC	-	Federal Road Safety Commission
Ft	-	Feet
GHGs	-	Greenhouse Gases
GIS	-	Geographical Information Systems
GPS	-	Global Positioning System
GW	-	Groundwater
H_2S	-	Hydrogen Sulphide
HCO_3^-	-	Bicarbonate Ion
Hg	-	Mercury

HSE	-	Health Safety and Environment
HSE-MS	-	Health Safety and Environment Management System
HSSE	-	Health, Safety, Security, and Environment
HUB	-	Hydrocarbon Utilizing Bacteria
HUF	-	Hydrocarbon Utilizing Fungi
IAAF	-	International Amateur Athletic Federation
IFC	-	International Finance Corporation
ITCZ	-	Inter-Tropical Convergence Zone
j	-	Equitability Index
K	-	Potassium
KII	-	Key Informant Interview
Km	-	Kilometre
Km/h	-	Kilometre per hour
KVA	-	Kilo Volt-Amps
LAU	-	Land Use Act
Lat	-	Latitude
LGA	-	Local Government Area
Long	-	Longitude
Mg	-	Magnesium
Mo-Gas	-	Motor Gasoline
N	-	Nermetea
N	-	North
NESREA	-	National Environmental Standards and Regulations Enforcement Agency
NGOs	-	Non-Governmental Organisations
NH_4^+	-	Ammonium
NGN	-	Nigerian Naira
Ni	-	Nickel

NiMet	-	Nigerian Meteorological Agency
NO_2	-	Nitrogen Dioxide
NO_3	-	Nitrate
NO_3^-	-	Nitrate Ion
NO_x	-	Mono-Nitrogen Oxides
NNE	-	North North East
NPC	-	National Population Commission of Nigeria
NPE	-	National Policy on the Environment
NW	-	North West
OSH	-	Occupational Safety and Health
PAH	-	Polynuclear Aromatic Hydrocarbons
PAST	-	Paleontological Statistics
Pb	-	Lead
pH	-	Hydrogen ion concentration
Plc	-	Public Limited Company
PM	-	Particulate Matter
PPE	-	Personal Protective Equipment
QA/QC	-	Quality Assurance/ Quality Control
QHSE	-	Quality, Health, Safety, and Environment
RH	-	Relative Humidity
SEPA	-	State Environmental Protection Agency
SHOC	-	Safe Handling of Chemical
SIA	-	Social Impact Assessment
SO_4	-	Sulphate
SO_x	-	Sulphur Oxides
SOW	-	Scope of Work
Sp	-	Species
SPM	-	Suspended Particulate Matter

SMS	-	Safety Management System
SSW	-	South South West
STI	-	Sexually Transmitted Infection
TAH	-	Total Aliphatic Hydrocarbon
TDS	-	Total Dissolved Solids
THB	-	Total Heterotrophic Bacteria
THC	-	Total Hydrocarbon Content
THF	-	Total Heterotrophic Fungi
TMAX	-	Temperature maximum
TMIN	-	Temperature minimum
TOC	-	Total Organic Content
TOCS	-	Take Off Climb Surface
ToR	-	Terms of Reference
TPH	-	Total Petroleum Hydrocarbon
TS	-	Transitional Surface
TSS	-	Total Suspended Solids
UNEP	-	United Nations Environment Programme
UNFCCC	-	United Nations Framework Convention on Climate Change
UNICEF	-	United Nations International Children Emergency Fund
US AID	-	United States Agency for International Developments
USD	-	United States Dollars
USEPA	-	United States Environmental Protection Agency
V	-	Vanadium
V	-	Volts
VDU	-	Vacuum Distillation Unit

VOC	-	Volatile Organic Carbon
W	-	West
WHO	-	World Health Organization
WMO	-	World Meteorological Organization
WMP	-	Waste Management Plan
WWTU	-	Waste-Water Treatment Unit
Zn	-	Zinc

LIST OF ESIA PREPARERS/CONTRIBUTORS		
Natural Capital Eco Team		
Name	**Qualification**	**Responsibility**
Dr.Ituah Eugene	*Ph.D. Environmental Management*	Project Director
Ndubuisi Ikegwu	*M.Sc. Environmental Management*	Project Manager
Emmanuel George	*M.Sc. Geology*	Project Coordinator
Dr. Tunde Emmanuel	*Ph.D. Fisheries*	ESIA Peer Review
Uzor Cletus	*M.Sc. Biology*	Plankton & Benthos Study
Isusu. A	*M.Sc. Sociology*	Socioeconomics and Health Survey
Okoro Ndidi	*M.Sc. Marine Science*	Surface Water/Groundwater
Dr. Tunde Amusan	*Ph.D. Geology*	Soil/Geology
Isaac Eniayewuni	*B.Sc. Env, Science, and Tech*	ESMP
Charles Omoyeni, *NEBOSH Dip*	*M.Sc. Geochemist*	Impact Evaluation
Dr. Oludara Agboola	*Ph.D. Zoology*	Wildlife Studies
Ebenezer Olubode	*B.Sc. Microbiology*	Microbiology
Akpodono Ovie	*M.Sc. Botany*	Vegetation Studies
Onohwosafe Stanley	*M.Sc. Chemistry*	Air Quality and Noise
Adeola Agoi	*HND Business Admin*	Admin/Report Production

Declaration

Ebonyi State Government, the proponent of Ebonyi State International Olympic Stadium, identifies and accepts responsibility for all statements and judgments made in this report entitled '*ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT FOR EBONYI STATE INTERNATIONAL OLYMPIC STADIUM ABAKALIKI LGA, EBONYI STATE*'.

Executive Summary

1.1 Background Information

Major sports events comprise one of the fastest-growing segments of the world tourism market, making this sector one of the most important economic activities in the world. The associated infrastructure of major sports events is usually connected with the construction of venues and sports facilities such as the proposed Ebonyi state international Olympic stadium.

In this regard, Ebonyi State Government intends to construct and develop a Fédération Internationale de Football Association (FIFA) and International Amateur Athletic Federation (IAAF) compliant 30,000 (Thirty thousand) seating capacity International Olympic Stadium and other sporting facilities of international standard to be sited at Abakaliki Local Government Area which is the state capital. The goal is to boost the development of sports at the state level with excellent sporting facilities with the highest standard in football, athletics, and other sports. The excellent facilities shall also be used for hosting local, national, and international sporting activities. They shall be used for participation training of athletes, coaches, and sporting officials. They can also be used for sporting talent hunting and nurturing. They are designed as multifunctional facilities for sporting and non-sporting activities such as social, political, and religious gatherings. With the development of these modern and standard facilities and infrastructure, sports can be used to attract the attention of the world to Ebonyi State

In compliance with the requirements of the *Environmental Impact Assessment (EIA) Act Cap E12, LFN 2004* of Federal Ministry of Environment (FMEnv) as well as complying with the state's Environment, Health, safety and security policies, Ebonyi State Government through her consultant, Natural Capital Eco, accredited by Federal Ministry of Environment (FMEnv), Department of Petroleum Resources (DPR), and National Environmental Standards and Regulations Enforcement Agency (NESREA) wishes to carry out an Environmental and Social Impact Assessment (ESIA) of the proposed International Olympic Stadium. The ESIA presents the baseline environmental condition of the receiving environment, identified associated and potential impacts of the proposed development, and recommended control techniques/mitigation measures to manage the impacts.

1.2 ESIA Objective

The assessment was carried out to amongst other things:

- determine the baseline (biophysical, social, and health) conditions of the proposed project environment;
- determine and document the sources of impact from the proposed development/project activities and identify the environmental, social, and health components of the environment that can be potentially impacted;
- proffer appropriate mitigation measures for negative impacts and make recommendations aimed at sustaining the beneficial impacts of the projects on the environment;
- aid early selection of best available techniques (including technology and method of operation) that can help in realizing the project environmental objectives; and
- develop cost-effective Environmental Management Plan (EMP) as well as provide recommendations for monitoring and management activities

1.3 ESIA Work Scope

The ESIA scope of work includes:

- Impact identification, prediction, interpretation, and evaluation;
- Development of cost-effective mitigation measures, monitoring programmes, and Environmental and Social Management Plan (ESMP) covering the project life span; and
- Preparation of a detailed draft report to meet FMEnv permitting requirements.

1.4 ESIA Methodology

1) Project scoping exercise
2) Site verification
3) Desktop literature survey
4) Stakeholder consultation
5) Baseline field data gathering
6) Project impact assessment and development of mitigation measures
7) Development of Environmental Management Plan
8) ESIA submission and
9) Post ESIA impact mitigation monitoring

1.5 Legal and administrative framework

The proposed project is affected by several national, state, and international legislation that has been considered by the ESIA. A review of relevant legislation was done and briefed.

- National Policy on Environment (1989, Revised 1999, 2016)
- Environmental Impact Assessment (EIA) Act CAP E12, LFN 2004
- Land Use Act L5 LFN 2004
- Forestry Law CAP 55, 1994
- Endangered Species Act (Cap 108), 1990
- Labour Act, 1999
- Harmful Wastes CAP HI LFN 2004
- Water Resources Act CAP W2 LFN 2004
- Embedded Generation Regulation, NERC, 2012
- Workmen Compensation Act, 1987
- Abandonment Guidelines 1995
- National Environmental Standards and Regulations Enforcement Agency (NESREA) Act 92, 2007
- The Federal Ministry of Sport
- National Sports Policy of Nigeria (2009)
- Ebonyi State Ministry of Environment
- Ebonyi State Environmental Protection Agency (EBSEPA)
- Ebonyi State Ministry of Lands, Survey, and Housing
- Fédération Internationale de Football Association (FIFA)
- FIFA Stadium Safety and Security Regulations
- International Association of Athletics Federations (IAAF)
- Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal, 1989 (Nigeria signed the Basel Convention document on 15th March 1990 and ratified it on 13th March 1991. Nigeria also ratified the amendment to the Basel Convention on 24th May 2004)
- UNFCCC, Paris agreement of 2016 [The agreement was signed on 22 September 2016 and ratified by Nigeria on 16th May 2017]
- United Nations Guiding Principles on the Human Environment [Nigeria signed the Basel Convention document in 1992 and ratified in 1994]
- Polluters Pays Principle (Adopted by Nigeria in 1999)
- United Nations Framework Convention on Climate Change (1992)
- Nagoya Protocol of 2010

- Kyoto Protocol of 2004
- Cartagena Protocol on Bio-safety of 2003
- Montreal Protocol on Substances that Deplete the Ozone Layer, 1988

2.1 Justification of Project

Over the years, sports have transformed into a tool for social integration, international diplomacy, economic prosperity, wealth creation, employment generation, and avenue to fame and world recognition. Across Ebonyi state, open fields are used as sporting arenas that do not conform to any standard or specification. However, to produce world-class sportsmen and women, there must be world-class sporting facilities that must meet the minimum standard set by National and International sporting Federations.

Ebonyi state like most other states of the country harbours a very high concentration of young people between the ages of 14 to 30 an age bracket in which most people feel they have come of age, have the most energy, and the world in their pocket. It is an age range in which people want to experiment with things and explore the vast horizon of life before them.

The value of the proposed International Olympic Stadium Project is estimated at USD 9, 700,000 or NGN 3, 500, 000,000 (Three Billion Five Hundred Million Naira). In keeping with the project's quality standards, the project's useful life is estimated at 50 years.

2.2 Envisage Sustainability

The project's sustainability is addressed under the following:

Economic Sustainability: Ebonyi State Government in collaboration Ministry of Sport will ensure standard business ethics and transparency; preventing corruption, encourage public advocacy and lobbying, transparency in payment of taxes, encouraging human rights and security. Money accruing from the cargo handling activities will continually contribute additional revenue to Ebonyi State and the Federal Government of Nigeria. More jobs will be created and this in turn shall meet Ebonyi State government financial, socioeconomic, and material obligations to the host communities. The favourable enabling environment ensures that the Stadium shall continue to exist for decades as a business venture and as an industry. This project will be partly funded by the Ebonyi State Government.

Technical Sustainability: The proposed International Stadium Project shall adopt the principle of Best Available Techniques (BAT) for design, construction, and operation. To ensure technical sustainability, the following principles shall be enshrined in the project:

- Local content will be generously utilised in the design, construction, and operation
- Skills transfer will be encouraged between expatriates' engineers and local engineers to close the gap in knowledge throughout the project life.
- Ebonyi State Government shall ensure the training and retraining of its local Engineers.

Social Sustainability: There will be a Robust stakeholder engagement and also establishment of a grievance mechanism that will be designed to receive and facilitate the resolution of concerns and grievances about the Project's environmental and social performance as part of its Environmental and Social Management System (ESMS).

Environmental Sustainability: The environmental sustainability of the project is premised on the following:

- ***Design*:** Ebonyi State Government shall ensure that the Stadium is designed, constructed, and operated in a manner that will keep all the potential adverse environmental effects to the minimum and within the acceptable regulatory levels.
- ***Compliance:*** compliance with applicable national and international environmental regulations and best practices.
- ***Monitoring***: ISO 20906:2009 Acoustics – Unattended monitoring of sound in the vicinity of the stadium shall be designed and implemented. Other environmental parameters such as emissions as stipulated in ***FIFA Stadium Safety and Security Regulations*** shall be carried out.

2.3 Project Options and Alternatives

2.3.1 Option Three: Go-Ahead Option

The Project option admits and emphasizes the vital need for the planned development. Considering its many benefits, this option was significantly weighed positive. This option will contribute to improved and increased production which will enhance the revenue base of Nigeria. It will also enhance job creation and many more direct and indirect socio-economic benefits. This Go-Ahead option was

deemed viable and therefore considered. The proposed project should therefore be executed as planned.

2.3.2 Project Alternatives

The identification and investigation of alternatives is a key aspect of the ESIA process. Therefore, all reasonable and feasible alternatives were identified and assessed during the scoping phase to determine the most suitable alternatives to consider and assess during the ESIA phase. The preferred project alternatives are highlighted and presented here.

Alternatives can typically be identified according to:

a) Technology alternatives;
b) Site/Location alternatives

3.1 Project and Process Description

3.1.1 Project Location

The proposed project area falls on longitude 8.01671, latitude 6.29332 for point A, longitude 8.10666, latitude 6.28987 for point B, longitude 8.10661, latitude 6.28661 for point C, and longitude 8.11158, latitude 6.28388 for point D. This location cuts across 2 communities namely: Agbaja-Unuhu and Enyima-agu communities in Abakaliki Local Government Area of Ebonyi State.

3.1.2 Project Description

The Stadium master plan includes but not limited to the following facilities:

1. 30,000 seating capacity main Bowl (Track and field events)
2. Olympic size swimming pool
3. Indoor Sports hall
4. Volleyball courts
5. Basketball courts
6. Handball courts
7. Tennis courts
8. Squash courts
9. Hockey court
10. Technical building
11. Main Bowl training pitches

3.2 Project Activities

The project activities will broadly cover the following areas:

- **Pre-construction activities include**
  - site preparation,
  - engineering design,
  - materials delivery etc.
- **Construction activities include**
  - construction of 30,000 seating capacity main Bowl (Track and field events)
  - construction of office complex, courts e.t.c
  - installation of various equipment, power generation equipment, etc.)
  - civil works.
- **Operational activities include**
  - operation of the Stadium,
  - Maintenance of the Stadium and
  - Movement of spectators/teams in and out of the Stadium etc.
- **The decommissioning activities include**
  - Removal of Stadium components for relocation or sale

3.3 Waste Management Plan

Ebonyi State Waste Management Plan (WMP) for this Project will focus on the handling, storage, and disposal of waste / hazardous materials. As the first step of the management plan, types of waste and its possible sources would be identified. For each identified waste component and its source, a possible control method and disposal plan would be worked out.

S/No	Particular	Type/Quantity	Control/Disposal Plan
During Construction			
1	**1) all kind of soil/ construction or demolition wastes**	-	• Construction wastes such as soil, brick, block e.tc will be used for levelling at the site, stockpile in the open area proposed to be developed as part of the landscaping area
	Municipal Waste (domestic and commercial)	• Kitchen wastes • Metal scrap and empty metal drum of non-hazardous material • Paper and wood scrap	• The waste shall be collected in designated wastes bins, segregated at source, and disposed of in line with FMEnv guideline through FMEnv accredited waste manager
	Hazardous waste	• Containers containing paint residue during the construction phase	• Collected in a specially designated waste bin and disposed of in line with FMEnv guideline through FMEnv accredited waste manager
		• Waste oil to be generated from DG	• Waste oil shall be sold to a third party for reuse or recycling
		Service & Maintenance yard	• Segregate into usable & non-usable, release non-usable scrap to scrap buyer.
2	Machinery cleaning wastewater	Oily cleaning water from service and maintenance yard	• Oil skimmed off in a saver pit, stored in a waste oil drum, and sold to discerning vendors for reuse or recycling.
3	Air pollution	1) Loading & haulage of materials	• Only sharp teeth shall be installed on the buckets of loading machines.

			• Operators & their helpers shall be provided dust masks • Water spraying shall be adopted at loading points and all long-haul roads to avoid /reduce dust being airborne. • Dense green belts would be planted around dust generation points and on both sides of haul roads, along slopes, etc., • All the construction machinery will be new and meet international standards and hence, the noise level will be well within the prescribed limit of 85 dB(A). • Noise level may fluctuate periodically and this impact remains localized. • Noise control measures include: • Provision of silencers, PPEs to all HEMM. • The machine shall remain off when not in use • Provision of earplugs/muffs to workmen. • Preventive maintenance of Construction equipment. • Reducing exposure time to high noise levels.
4	Noise pollution	Heavy earthmoving machinery (HEMM)	
During Operation			
1	Domestic waste	Organic in nature	Will be handed to the local authority for disposal through

		FMEnv accredited Waste Manager
2	Waste from sport activities	Will be segregated as biodegradable and non-biodegradable and disposed of through FMEnv accredited Waste Manager
	Domestic Waste Water	Will be treated in Water Treatment Plant and the treated water will be used in flushing of toilets and irrigation purposes within the project premise
	Used oil from the DG sets	Used/Waste oil shall be sold to a third party for reuse or recycling

3.4 Project Schedule

The project is scheduled to reach completion in 3 years. On approval of the project ESIA by FMEnv, hopefully in the third quarter of 2020, site preparation will commence immediately. This will run concurrently with preparation for procurements. This will follow by excavation and foundation work for the module. Installation of pipes and the modules will follow. The commission is envisaged in the fourth quarter of 2021.

S/N	Activity	2019	2020				2021			
		Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	Appointment of Consultants to prepare ESIA									
2.	ESIA Preparation & Certification Process									
2	Pre-Construction: Design & Manufacture									

3	Construction Phase: construction of 30,000 seating capacity, office complex, courts e.t.c, installation of various equipment, power generation equipment, etc.) civil works.	
5	Commissioning	

4.1 Baseline Social and Environmental Characteristics of the Project Area

The baseline environmental and social characteristics of the proposed project area were established based on two (2) climatic season on-site field sampling carried out in the study area. The dry season field sampling exercise was conducted on Thursday 12th through Saturday 15th March 2020 while the wet season field sampling was carried out from …. to… 2020.

The baseline condition was stabled for the following components of the environment

1) Weather and climate
2) Air quality and Noise
3) Surface water
4) Groundwater
5) Soil
6) Plankton and benthos
7) Sediment
8) Vegetation and wildlife

The sampling was carried out following the requirements of *EIA Act CAP E12, LFN 2004***.** Grid and transect sampling approaches were adopted concerning environmental components intended for sampling. A total of seventeen (17) geo-referenced sampling stations and an additional three (3) control points were established for soil and vegetation while twenty-two (22) geo-referenced sampling stations and an additional 3 controls points were established for air quality, noise and 2 sampling stations and 1 control for groundwater within 5km spatial radius in line with the FMEnv ESIA Terms of Reference (ToR). All the samples collected on the field which were witnessed by FMEnv representative were preserved with ice chests and immediately taken to Anila Resources Limited, Lagos for analysis

4.2 Description of the Baseline Environment

The study area which is located in Ebonyi State is one of the States in South-eastern Nigeria. Ebonyi State lies approximately within latitudes 5° 40' and 6° 45' North of the Equator and longitudes 7°30' and 8°30'East of the Greenwich meridian. The prevailing climatic condition in the area is characterized primarily by two regimes which are the rainy and the dry seasons. The rainy season is usually from April to October; while the dry season starts from October through to February. The area can be described as having a bimodal rainfall pattern.

Atmospheric temperature is a measure of the temperature of the atmosphere of the earth atmospheric which varies slowly with day and night season. In the study area temperature values are high throughout the year over the project environment. Mean maximum ambient temperature values range between 32°C in February and 28°C in July and September, while minimum temperatures range between 29°C in March and 27°C in August. A quick overview of the data indicates that higher temperatures were recorded at the peak of the dry season, between November and May, while lower temperatures were recorded in the rainy season, between June and October. The rains appear to have a moderating influence on temperatures. The average minimum and average maximum recorded during the field data gathering showed a stable temperature condition within the period under review.

Rainfall: (amount and distribution) is the single most important element for defining the climatic seasons in the tropics where the project corridor is located characterized by two dominant seasons; *the wet and the dry seasons*. The rainy season is usually from April to October; while the dry season starts from October through to February. The area can be described as having a bimodal rainfall pattern. The wet season has its first peak in July and the second occurs in September, the area records annual rainfall of between 1613.8mm to 2136.27mm, the dry season starts in November, when the dry continental North-eastern wind blows from the Mediterranean Sea across the Sahara desert and Samarian desert and down to the southern part of Nigeria. About 60-70% of the dwellers of the southeast zone are found to engage in agriculture mainly crop farming. Agriculture is a very significant sector of the economy for the zone and the sources of raw materials used in the processing industries which serve as another area of employment and income generation for the people.

Relative humidity (RH) is the amount of water in the air compared with the amount of water required to saturate the same volume of water at the same temperature. Similar to atmospheric temperature trends, based on NiMet weather data (2017), the Relative Humidity of the study area from was observed to be in stable condition from 1997 – 2017. The relative humidity is high, usually over 80% in the early morning but falls to between 45% and 70% in the afternoon. It is the highest between May and October. The average RH recorded for the study area within the period under review was 52.7% in the wet season and 73% in the dry season.

Wind Speed and Directions

The project area is dominated by two seasonal reverse winds, the dry tropical wind or the north-easterly winds from January to March, and the tropical maritime wind or the south-westerly winds From April to December. The prevailing wind direction in the area is southwest at an average speed of 1.4 m/s. There are slightly lower speeds in October/February while high wind speeds are obtained from March to September. The wind pattern follows the migratory ITD. According to the statistics available for the last ten years, the prevalent wind directions are South-westerly. Often, the South-westerly dominates the wetter period of the year in the area while North-easterly dominates the drier season. Depending on the shifts in the pressure belts in the neighbouring Gulf of Guinea, they are interspersed respectively by South-easterly and North-westerly.

Air pollutant gases and greenhouses gases are important air quality indicators. Given the nature of the project with the potential for emissions, these gases were determined in situ. The study showed that most of the pollutant gases such as hydrogen sulphide (H_2S), Oxides of sulfur (SOx), Nitrogen oxides (NOx) and greenhouse gases such as Carbon monoxide (CO) and NOx were mostly <0.001 at all the sampling stations.

However, the concentrations of volatile organic compounds during the dry season sampling period showed that the VOC concentration ranged from 0.5 to 2.8ppm with a mean value of 1.65ppm. Yet, all the values obtained during the two seasons are lower than the stipulated limit of 160ppm by FMENv.

Also, the concentration of particulates in the ambient air during the dry season ranged from 23.6 µg/m^3 to 63.8 µg/m^3 (mean value of 45.3 µg/m^3) for the particle size of 2.5 microns. In the same vein, the concentration of particulates in the ambient air during the dry season ranged from 36.7µg/m^3 to 216 µg/m^3 (mean value of 126.35µg/m^3) for the particle size of 10 microns. All the values recorded for particle size were below the FMEnv limit of 250µg/m^3.

The average minimum and maximum noise levels recorded at the project area during the dry season were 41.05 dB and 68.7dB respectively. A large proportion of background noise in the area is due to human activities around the project area. Despite this, the mean values recorded are below the FMEnv limit of 90dB (A) for 8 hours exposure respectively.

During the dry season, the values of pH ranged from 8.02 to 8.43. The water temperature for the dry season ranged from 27.93 to 28.97 ^{O}C. The water Turbidity ranged from 2.8 to 23.8 NTU during the dry season. Total Suspended Solids ranged from 1.06 to 7.25 mg/l while Electrical conductivity varied between 365 and 1075 µS/cm in the dry season. Total Alkalinity ranged from 162.5 to 187.5 mg/L in all sampling locations during the 2020 dry season.

The groundwater Dissolved Oxygen (DO) recorded for the dry season was between 3.4 and 3.7 mg/L while the groundwater Chemical Oxygen Demand (COD) values were generally low with values ranging from 15.09 to 16.0mg/L. The groundwater Biological Oxygen Demand (BOD^5) had a mean value of 2.495 mg/L in the dry season.

The groundwater cations were dominated by Sodium (Na), Calcium (Ca), and Potassium (K). Sodium has values ranging from 33.20 to 41.69mg/L. Also, Potassium has values ranging from 2.11 to 2.55mg/L while Calcium ranged from 7.13 to 9.68mg/L. During the dry season study, the heavy metal concentration values were low in all the sampling locations and do not pose any pollution threat related to hydrocarbon contamination. The highest value recorded for heavy metals was for Iron, followed by zinc.

The pH of the topsoil in the dry season ranged between 6.2 (moderately acidic) to 7.03 (moderately basic) while the subsoil ranged from 6.07 to 6.9 which indicates that

the subsoils are acidic. Within the topsoil, the average total organic carbon was 1.98% while the subsoil was 2.68 % during fieldwork.

The average CEC in the topsoil of the dry season was 125.62mg/kg while the average value of subsoil was 86.32 mg/kg. Generally, the CEC of the soils is low. Two factors are mainly responsible for CEC in soils.

The exchangeable cations (K^+, Na^+, and Ca^{2+}) varied across the sampling locations and with depth in both seasons. In the topsoil samples collected in the dry season, sodium ranged from 128.75mg/kg to 285.84mg/kg, with a mean of 207.295 mg/kg; potassium ranged from 19.15mg/kg to 61.54mg/kg, with a mean of 40.345mg/kg; while calcium ranged from 129.87mg/kg to 241.61mg/kg, with a mean value of 185.74 mg/kg.

In the bottom soil samples collected in the dry season, sodium ranged from 128.75mg/kg to 157.5 mg/kg, with a mean of 143.125mg/kg; potassium ranged from 19.15mg/kg to 62.54mg/kg, with a mean of 40.845mg/kg; while calcium ranged from 129.88mg/kg to 241.5 mg/kg, with a mean of 185.69mg/kg. These exchangeable cations are essential to plant macro nutrients present in the soil and are vital for plant growth and survival.

For Anions**, t**he mean concentrations in the top soil for the dry season were as follows; NH_4-N(7.62mg/kg), NO_3^-(23.195mg/kg), PO_4^-(3.62mg/kg) SO_4^{2-}(76.99mg/kg). Similarly, in the sub soil, mean concentration were NH_4-N(6.55 mg/kg), NO_3^- (21.59mg/kg), PO_4^-(3.83mg/kg) SO_4^{2-}(52.87mg/kg).

4.3 Flora and Fauna

The vegetation of the project area is rich in species diversity and the floristic composition is characterized by the following: *Raphia hookerii, Uapaca hendolotic, Elaeis guineensis, Pterocarpus santalinoides, Cleiostopholis patens, Anthocteista vogelii, Symphonia globulifera Mitragyna Ciliata, Dalbergia ecastaphythm, Alchornea cordifolia, Ficus spp., Treculia Africana. Rauwolfia macrophylla, Funtumia Africana, Alstonia cinerria, Musanga necropolises, Albania spp., Klainedoxa gabonensis, and Irvingia gabonensis Necropolises, Albania spp., Klainedoxa gabonensis, and Irvingia gabonensis* occur in this ecotype mostly.

Fauna involved a survey/census of mammals, birds' reptiles, and amphibians around the study area Grey Dove, Kite, Hawk, Eagle, Gorilla, Pigeon, Crocodile, Owl, Deer, Cane Mouse, Squirrel, Shrew, Grasscutter, Yellow Antelope, Monkey, Pigmy Hippopotamus, Bush Pigs, Porcupine, Civet cat, Tortoise, Monitor Lizard, Agama Lizard, Snake Lizard, Alligator, Cobra.

4.4 Geology of Ebonyi State

Ebonyi State falls within the *Asu-River Geologic Group (Lower Cretaceous), Eze-Aku shale formation, and Nkporo Formations*. The State is made up mainly of *hydromorphic soils* which consist of reddish-brown gravely and pale coloured clayey soil, shallow in-depth, and of the shale parent material. The topography is largely a tableland; the highest point 162m and the lowest 15m above sea level.

4.5 Baseline Social and Economic Condition

The proposed project is located in Abakaliki Local Government Areas of Ebonyi State and the identified host communities are Agbaja-Unuhu and Enyima-Agu. The Stadium project is aimed at improving the economic and social well-being of not only immediate communities and Local Governments and the State but also the South East region and the country at large. The communities directly affected by the project have an estimate of 370,200 populations, making up of 12.44% of the total population of the affected LGA

4.5.1 Stakeholder Consultation

The assessment ensured a robust consultation with the stakeholder community. The stakeholder communities are receptive to the proposed project. They gave assurance of their support. The project shall also ensure continual consultation covering the project life to ensure its sustainability.

Meanwhile, a random sampling technique was used in selecting respondents from the surveyed communities during the community gathering (focus group discussion) as well as during the cross-section of the respondent within each community with the adult population as the target. At the end of the focus group discussion (FGD) sessions/community-wide interaction meetings, structured questionnaires were administered to a cross-section of each of the community with the aid of the community's leadership and facilitator. As a survey instrument and primary data collection method, the questionnaire was structured such that binary, optional and

open-ended questions were asked to solicit the necessary answers to questions from the householder. Out of 100 questionnaires administered, 88 were retrieved representing 88%.

The questionnaires revealed the age distribution of respondents, household size, marital status of the sampled population, household size, household and population structure, educational status and characteristics, occupation, employment, and income-generating activities, income levels and distribution, religion, customs and belief system

5.1 Associated and Potential Impacts of the Project

The proposed projects will interact with the environment in various ways known as the "*development's aspects*" which could cause change or alteration in the baseline environmental condition, this change is known as ''*impact*''. The identified environmental aspects of the proposed development that can cause impacts on the environment include:

Pre-Construction phase activities

- Land take for the stadium
- Mobilisation (transport) to the site (equipment, personnel and construction modules)
- Energy requirements (provision of energy for construction)
- Labour requirements
- Site Preparation (vegetation and land clearing)
- Excavation of the land area

Construction phase activities

- Piling
- Site fabrication (welding) and coating
- Construction of Main Bowl of the stadium
- Construction of Car park
- Installation of electric poles and transformers
- Backfilling
- Commissioning stadium
- Demobilization

The operational phase activities are

- Operations/ maintenance (normal)
- Operations/maintenance (abnormal)

D. The decommissioning activities include

- Demolition and Evacuation

The overall intent of the ESIA study is to identify and characterise all the associated and environmental impacts or effects that will be caused by International Olympic Stadium. Though there are several approaches for the prediction and evaluation of project environmental impacts, the ISO 14001 method was selected for this study. The ISO 14001 method is simple to apply, provides a high level of detail, and relies on limited data.

Based on the method adopted, impacts ranging from low to severe significance were identified, qualified, and quantified. Among the impacts that have high significance ranking include:

a) Injury and trapped impact to personnel from heavy lifting during construction
b) air pollution and climate change potential arising from fugitive emissions
c) surface water contamination from wastewater and effluent discharges
d) explosion and fire from routine activities and accidental occurrences
e) noise pollution from process equipment
f) land and water pollution from potential oil spill incidents
g) Traffic and transport impact from the loading of finished products

6.1 Mitigation Measures

The actions and measures that Ebonyi State Government intends to take to reduce (or eliminate) negative impacts and promote positive environmental, social, and health impacts of the proposed project are therefore presented in this chapter. In these mitigation measures, the emphasis is placed on those negative impacts rated as significantly medium and high. These measures are aimed at reducing the impacts to As Low As Reasonably Possible (ALARP). The residual impacts that could arise despite these mitigation measures were also noted. Significant negative impacts are expected to be mitigated through effective implementation of the Health, Safety, and Environment (HSE) policies put in place during the different phases of the project

Residual Effects can be considered as those that remain significant following the application of mitigation measures, although they are likely to have been reduced in magnitude as a result of the mitigation measure implemented.

Overall, on balance, with the provision of the proposed mitigation measures outlined, the positive impacts of the scheme will considerably outweigh the negative impacts. The public as a whole will benefit from the completion of the project.

Once the mitigation measures outlined are implemented, the residual impact of construction and operation on the different elements identified will not be significant.

An overall mitigation measure is to undertake a Job Hazard Analysis, to enable each worker to assess the risks associated with the job and work safely using procedural guidelines in handling equipment and the facilities.

Effective and responsible handling and disposal of wastes are key elements in the environmental management system. Wastes refer to any material (solid, liquid, gaseous, or mixture) that is surplus to requirements. Waste management for the project shall be carried out in line with the Ebonyi State Government waste management policy and guidelines, as well as international best practices.

Ebonyi State Government shall take all practical and cost-effective measures to minimise the generation of wastes, by employing the four Rs (Reduce, Reuse, Recycle, and Recovery) through the process of optimization or redesign, efficient procedures, and good housekeeping.

Waste shall be managed in the following ways:

- Inventorisation
- Classification
- Segregation
- Wastes quantification
- Wastes tracking; and
- Wastes disposal

7.1 Environmental and Social Management Plan (ESMP)

Ebonyi State Government has established a comprehensive Environmental and Social Management Plan (ESMP) to achieve its corporate health, safety, and environment (HSE) policy objectives and to fulfill its regulatory compliance requirements to FMEnv and NCAA. This ESMP is developed to help fulfill the requirements for environmental protection as stipulated in *Part 16 of Nigerian Civil Aviation Authority Regulations (2006)*. The ESMP provides the procedures and processes that will be used to check, monitor, and continually improve the effectiveness of the recommended mitigation and enhancement measures.

Risk Assessment and Management Plan

Risk assessment and management shall be an integral part of the proposed project's execution. Risks related to project execution and operations shall be identified by a structured approach. Risk assessments shall be planned and conducted in advance of appropriate activities to allow resolution of risk without schedule interruption. Personnel shall be included in risk assessments to ensure that risks are correctly identified and assessed.

Emergency Response Plan (ERP)

Ebonyi State Government has developed plans and procedures to identify the potential for and response to environmental accidents and health and safety emergencies and for preventing and mitigating potentially adverse environmental and social impacts that may be associated with them.

The objective of the ERP is to ensure that any emergency affecting the place of operational activities is dealt with efficiently and professionally so that the safety of personnel is not compromised in any way, the environmental pollution risks are prevented or minimized, and that all other losses which may arise from emergencies are prevented or minimized. The ERP addresses emergency response procedures for the Contractor, Subcontractors, and all personnel working for the Project.

Emergency Incident Reporting

In a situation of a fire outbreak or other emergency that poses an immediate danger to people or property, an employee should sound the fire alarm if they can do so safely before evacuating. Follow emergency evacuation procedures. An employee should calmly notify others, and respond to the emergency as appropriate. Procedures for responding to specific types of emergencies are

described below. Do not attempt to handle emergency duties – e.g., firefighting – for which you do not have training.

Community Engagement Policy

Community is made up of the people who live, work, visit, or invest in the Agbaja-Unuhu and Enyima-Agu communities where the proposed project will be situated. Community Engagement is the process through which the community is informed about and/or invited to contribute, through consultation or involvement, to proposals or policy changes relating to Agbaja-Unuhu and Enyima-Agu communities, events, strategic plans, issues, and projects.

7.2 Performance Indicators Monitoring

The ESMP also incorporated the Performance Indicators Monitoring Programme which 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. The Monitoring Program recommends construction phase surveillance and operation phase monitoring to be jointly carried out by a third party consultant and HSE department.

A weekly monitoring programme was recommended for emissions, noise, and wastewater quality monitoring. Other parameters such as surface water, groundwater, and soil qualities could be monitored every quarter. A three year (3) environmental audit was also recommended for the facility in line with FMEnv requirement.

8.0 Decommissioning and Restoration Plan

The life span of any proposed project is hinged on some considerations. It is important to put in place plans to recover and/or restore the project site to its original state after the project is closed or decommissioned. This requires a good understanding of all the environmental components of the project on the ecosystem during its lifespan (50 years). At the decommissioning stage, the facility is taken out of its current operational use with the isolation of its units. When a project has undergone this process, it is then abandoned or modified for reuse. This Chapter presents the Ebonyi State International Olympic Stadium decommissioning and abandonment plan.

Outline of Planning and Implementation Programme are as follow:

1) Ebonyi State Government shall commence activities related to decommissioning, at least, one (1) year before abandonment,
2) Determine the scope of decommissioning. Currently, the plan is to convert the runway to a farm road at the end of the project's life, instead of removal. However, this is subject to review following consultations,
3) Engagement and due consultation of stakeholders (including FMEnv, FIFA, IAAF, communities, Ebonyi State Government, etc.) shall be instituted,
4) Put in place a Decommissioning Plan Report for review and approval by FMEnv/ FIFA/IAAF. The plan shall include:
   - identification of all components of the project that will be disengaged, removed, or exhumed;
   - method(s) for removal or re-use of any project unit/ material if applicable;
   - effort being put in place to mitigate any environmental impacts associated with the decommissioning process; and
   - appropriate site remediation/rehabilitation programme
5) Ensure the safety of operation, taking into consideration all appropriate international conventions, regulatory requirements, and corporate policies.
6) Remove all structures (surface and sub-surface structures) with due regard for the protection of the environment.

Following decommissioning and abandonment, Ebonyi State Government will carry out site remediation and restoration work as part of the project's environmental management programmes. This will entail:

1) A survey of the decommissioned site for contamination as part of a conceptual site model and a strategy plan;
2) Evaluation of the site hydrology and geology;
3) Preparation of a site assessment report to be approved by FMEnv and NCAA
4) Interim action or remediation is designed to confirm the applicability and feasibility of one or more potential remedial options.

9.1 Conclusion

The Ebonyi State International Olympic Stadium Environmental and Social Impact Assessment (ESIA) draft report was prepared *following the Environmental Impact Assessment (EIA) Act CAP E12, LFN 2004*. The study area baseline environmental description was based on two seasons of field sampling consolidated by a review of previous studies on the same environment.

The goal of the ESIA process was to get to a position where the Project does not have any major residual impacts on the environment, certainly not ones that would endure into the long term or extend over a large area. Therefore, following the application of mitigation measures, the residual impacts became short-term, mostly localized, and reversible. Similarly, recommendations were also proffered for the beneficial impacts of the projects to enhance/sustain them.

To establish the project's operational requirements aimed at ensuring it delivers its stated business objective in an environmentally responsible manner, an Environmental and Social Management Plan (ESMP) was developed. The ESMP translated the mitigation/enhancement measures to action points. Similarly, performance indicators monitoring and audit programmes were recommended. This is to ensure that all impact indicators for the various environmental components are within statutory limits throughout the project life.

To this end, Ebonyi State Government hereby solicits approval of the project by the Federal Ministry of Environment (FMEnv).

Acknowledgment

Ebonyi State Government sincerely appreciates the representatives of the Federal Ministry of Environment, Federal Ministry of Sport, and National Sports Commission for the unflinching supports they gave throughout the assessment study. The contributions of the Ebonyi State Government and Natural Capital Eco study team (the ESIA Consultant) are also generously recognised and appreciated.

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Major sports events comprise one of the fastest-growing segments of the world tourism market, making this sector one of the most important economic activities in the world. The associated infrastructure of major sports events is usually connected with the construction of venues and sports facilities such as the proposed Ebonyi state international Olympic stadium.

In this regard, Ebonyi State Government intends to construct and develop a Fédération Internationale de Football Association (FIFA) and International Amateur Athletic Federation (IAAF) compliant 30,000 (Thirty thousand) seating capacity International Olympic Stadium and other sporting facilities of international standard to be sited at Abakaliki Local Government Area which is the state capital. The goal is to boost the development of sports at the state level with excellent sporting facilities with the highest standard in football, athletics, and other sports. The excellent facilities shall also be used for hosting local, national, and international sporting activities. They shall be used for participation training of athletes, coaches, and sporting officials. They can also be used for sporting talent hunting and nurturing. They are designed as multifunctional facilities for sporting and non-sporting activities such as social, political, and religious gatherings. With the development of these modern and standard facilities and infrastructure, sports can be used to attract the attention of the world to Ebonyi State

In compliance with the requirements of the *Environmental Impact Assessment (EIA) Act Cap E12, LFN 2004* of Federal Ministry of Environment (FMEnv) as well as complying with the state's Environment, Health, safety and security policies, Ebonyi State Government through her consultant, Natural Capital Eco, accredited by Federal Ministry of Environment (FMEnv), Department of Petroleum Resources (DPR), and National Environmental Standards and Regulations Enforcement Agency (NESREA) wishes to carry out an Environmental and Social Impact Assessment (ESIA) of the proposed International Olympic

Stadium. The ESIA presents the baseline environmental condition of the receiving environment, identified associated and potential impacts of the proposed development, and recommended control techniques/mitigation measures to manage the impacts.

1.2 Objectives of the ESIA

The purpose of the ESIA is to evaluate the environmental and related social /health implications (negative and positive) that may arise from the proposed international Olympic stadium project/activities. The study therefore will:

- Determine the baseline (biophysical, social, and health) conditions of the proposed project environment;
- Assess the potential impacts of the planned development on biophysical, social, and health components of the environment;
- Determine and document the sources of impact from the proposed development/project activities and identify the environmental, social, and health components of the environment that can be potentially impacted;
- Identify and evaluate the potential socio-economic effects of the project on the communities including impacts on cultural heritages, properties, social infrastructures, and natural resources;
- Proffer appropriate mitigation measures for negative impacts and make recommendations aimed at sustaining the beneficial impacts of the projects on the environment;
- Aid early selection of best available techniques (including technology and method of operation) that can help in realizing the project environmental objectives;
- Develop and establish an appropriate Environmental and Social Management Plan (ESMP) as well as provide recommendations for monitoring and mitigation activities.

1.3 ESIA Scope

The ESIA scope of work includes:

- Review of national and international environmental regulations, standards, codes,

and conventions relevant to the proposed project activities;

- Establish the baseline environmental condition of the project area through literature research;
- ESIA Field Sampling/Survey (Two seasons as recommended by FMEnv);
- Laboratory analysis of samples collected during the field sampling/survey;
- Impact identification, prediction, interpretation, and evaluation;
- Development of cost-effective mitigation measures, monitoring programmes, and Environmental and Social Management Plan (ESMP) covering the project life span; and
- Preparation of a detailed report to meet FMEnv permitting requirements.

1.4 ESIA Methodology

The ESIA was carried out in line with procedures provided in the *EIA Sectoral and Procedural Guidelines (1995)* as summarized below:

i. Preliminary Activities

The ESIA preliminary activities carried out include:

- Project scoping;

  The ESIA Scoping Workshop was organized on Wednesday 29th January 2020 to allow an early, open and interactive process of determining the major issues and impacts that would be important in decision-making on the proposal. The comprehensive report of scoping is attached in *Appendix I*. Interested and Affected Parties (I&Aps) database include amongst others: landowners, communities, regulatory authorities, Local Government Authority, and other special interest groups namely:

  - ⊙ Host community (Agbaja-Unuhu and Enyima-Agu Communities in Abakaliki Local Government Area of Ebonyi State)
  - ⊙ Federal Ministry of Environment
  - ⊙ Nigeria Police Force;
  - ⊙ Nigeria Civil Defense Corps;
  - ⊙ Ministry of Environment;
  - ⊙ Ebonyi State Ministry of Special Projects

- ⊙ Ebonyi State Ministry of Environment
- ⊙ Ebonyi State Ministry of Sport
- ⊙ Abakaliki Local Government Representatives
- ⊙ Federal Ministry of Sports
- ⊙ National Sport Commission

- Preparation of an environmental screening report for Ebonyi State Government project conceptual alternatives; and
- Site verification by officials of FMEnv.

ii. Desktop/Literature Survey

A literature survey, which involves consultation/desktop review of previous studies in the project area, was carried out for the initial unravelling of local and regional environmental baseline conditions of the project area. Some of the information gathered from the literature review was used to complement the results of actual field samplings. Such secondary studies include (Nimet Data) and others as stated in the references.

iii. Stakeholders' Consultation

A consultation was instituted throughout the entire ESIA process. This involved information dissemination to and interaction/dialogues with stakeholders in the project to intimate them with the project and associated impacts, address their concerns, solicit their support, and document their expectations on relevant environmental, social, and health issues. The stakeholders consulted include:

- Federal Ministry of Environment (FMEnv);
- Ebonyi State Ministry of Special Project;
- Ebonyi State Ministry of Environment; and
- Stakeholder communities (Agbaja-Unuhu and Enyima-Agu Communities in Abakaliki Local Government Area of Ebonyi State).

iv. Field Sampling and Laboratory Analysis

Field sampling was carried out to gather primary environmental and socio-economic data. The data collected were used to characterize the environment and establish the baseline

condition of the proposed project area. Samples were subsequently analyzed at Anilla Resource Limited. Anilla Resources Limited is accredited by DPR and FMEnv. The following components of the environment were studied:

- ***Climate and Meteorology***

Description of regional climatic conditions including thirty-year meteorological records on ambient temperature, rainfall, sunshine, wind speed, wind direction, seasonal variations, and extremes was carried out and presented in the ESIA.

- ***Air Quality and Noise***

The up and down-wind in and around the study area was analysed for air quality. Parameters analysed include Volatile Organic Compounds (VOCs), Nitrogen II Oxide (NO_2), Nitrogen (I) Oxide (NO), Sulphur IV Oxide (SO_2), Ammonia (NH_3), Carbon Monoxide (CO), Hydrogen Sulphide (H_2S), Suspended Particulate Matters (SPM), and ambient Noise level. The values obtained in the study area were compared with statutory limits provided by FMEnv.

- ***Sediment and Benthic Investigation***

The samples of sediment collected from the surface water bodies were analysed for physicochemical composition, heavy metals, hydrocarbons, and microbial compositions. The benthic macro-organisms were also studied.

- ***Surface Water Samples***

The surface water samples were collected, preserved, and analysed for physicochemical composition, heavy metals, hydrocarbons, and microbial compositions.

- ***Hydrobiology***

The surface water plankton study was carried out to determine the abundance of organisms and their species composition.

- ***Ecological Studies***

The review of micro and macro benthic organism's species, diversity, abundance, occurrence frequency was carried out. A study of vegetation and wildlife composition of the study area was carried out via sampling, in situ observation, and tissue analysis.

- ***Social/Health Impact Studies***

The socioeconomic and health status of the area was reviewed against the following:

- Description of settlements and man-made features
- Description of economic and historical sites
- Description of population distribution
- Description of the income distribution
- Description of recreational facilities
- Description of social organizations and institutions
- Description of occupation and employment structure
- Description of cultural and religious practices
- Description of stakeholder community health status and facilities
- Description of community health needs and concerns of stakeholder communities
- Description of community structure, employment markets, and labour supply, income distribution, and consumption.
- Determination of the views of the affected populations through discussion with local communities.
- Determine the effects of Stadium activities on cultural heritage/artifacts, and other historical/cultural patrimony of the affected communities.

v. Impact Identification

The potential and cumulative adverse and beneficial impacts of the project activities on the environment were identified by considering the interactions of the environmental aspects at the different phases of the project. The *EIA Sectoral and Procedural Guidelines (1995)* and the conceptual engineering project description among other source references, were used in the process. Evaluation of the identified impacts was carried out using such criteria as

legal/regulatory requirements in respect of the current activities, magnitude of impacts, risk posed by impacts, public perception, and importance of affected environmental component. The results are documented in chapter five of this report.

vi. Impact Mitigation and Environmental Management Plan

Mitigation measures were proffered for identified associated and potential impacts. In proffering mitigation measures designed to prevent, reduce or control the adverse impacts of the environmental aspects of the project, professional judgment (based on scientific deductions) project experience, knowledge of the ecosystem in which the project is located and consensus of opinions among experts were used as tools. Other resource materials consulted include the Federal Ministry of Environment (FMEnv) ESIA Guidelines and the World Bank Environmental Source Book, etc.

Also, measures were proffered to enhance/optimize the beneficial impacts of the project. Chapter six of this report documents the mitigation measures prescribed for identified significant impacts of the project (both adverse and beneficial). To ensure sustainable implementation of the mitigation measure recommended, an Environmental and Social Management Plan (ESMP) was also developed for the project, applicable for the project life span.

vii. Reporting and Review

The findings of the study are documented in this Report. The final version of the report shall be issued following the regulators/stakeholders' review meeting. The review shall address the stakeholders' concerns and incorporate any comments arising from the review meeting as shall be directed by FMEnv. Also, to allow for on-going improvement of operational practices if those initially established prove inadequate, post auditing or monitoring has been designed into the Environmental and Social Management Plan (ESMP) developed for the project. The ESMP shall also enable a rapid rescue/response if an unforeseen social or environmental impact occurs from the proposed project.

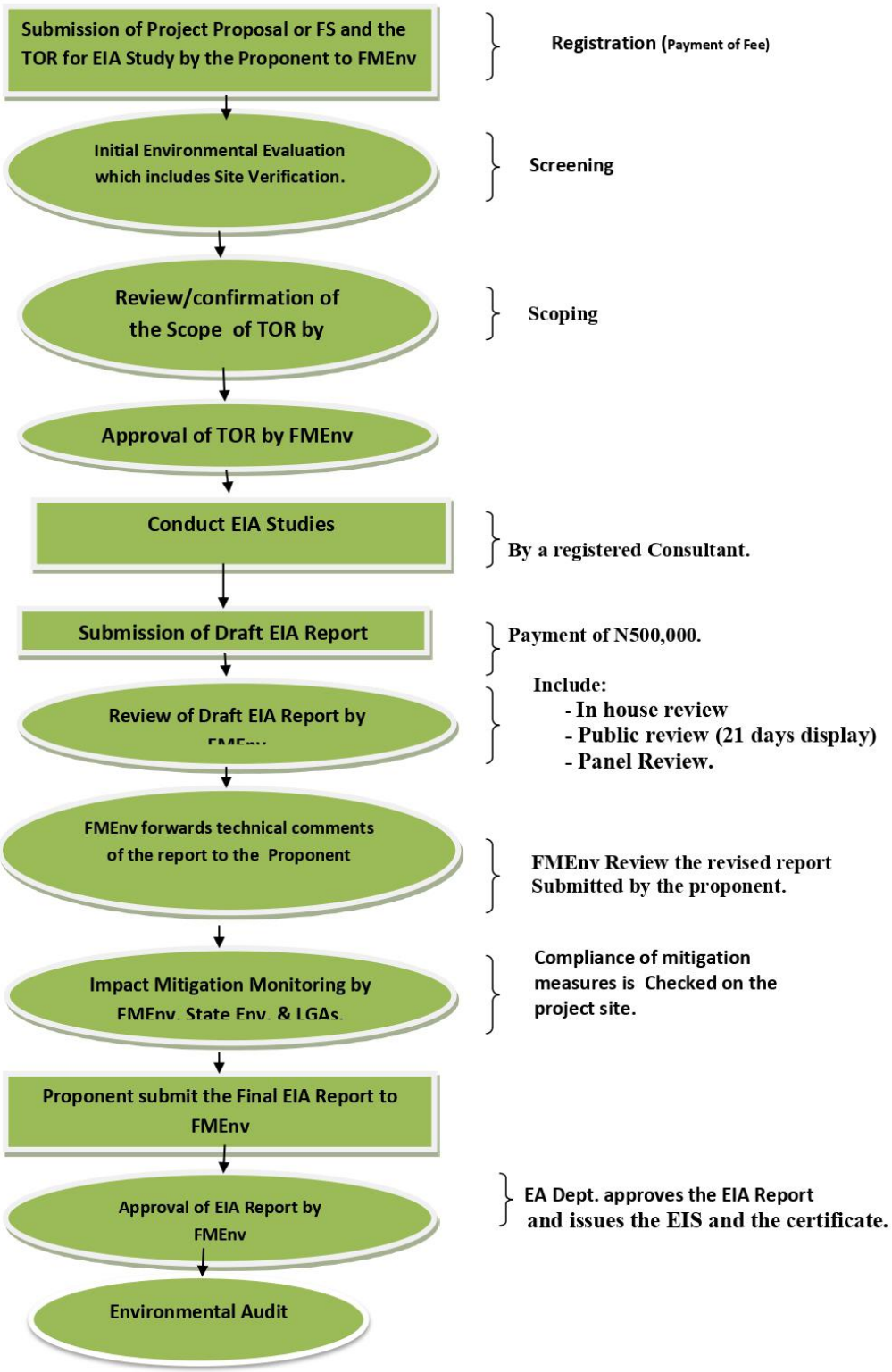

Figure 1.1: ESIA process flowchart (source: https://ead.gov.ng/)

1.5 Legal and Regulatory Framework

The project is affected by several federal, state, and international legislation which have been considered by the ESIA. A review of the relevant legislation was done and presented in this section.

1.5.1 National Legislations

- **National Policy on Environment (1989, Revised 2016). Issued by Federal Environmental Protection Agency (FEPA)**

Nigeria enunciated a National Policy on the Environment to achieve sustainable development in Nigeria, and in particular to:

- Secure quality of environment adequate for good health and well-being;
- Conserve and use the environment and natural resources for the benefit of present and future generations;
- Restore, maintain, and enhance the ecosystem and ecological processes essential for the functioning of the biosphere to preserve biological diversity and the principle of optimum sustainable yield in the use of living natural resources and ecosystems;
- Raise public awareness and promote understanding of the essential linkages between the environment, resources, and development, and encourage individual and community participation in environmental improvement efforts; and
- Co-operate in good faith with other countries' international organizations and agencies to achieve optimal use of Trans-boundary natural resources and effective prevention or abatement of Trans-boundary environmental degradation (Article 2.0).

- ***Environmental Impact Assessment (EIA) Act CAP E12, LFN 2004***

The EIA institutional framework is provided by *the Environmental Impact Assessment (EIA) Act. CAP E12, LFN 2004*. Environmental Impact Assessment (EIA) is an assessment of the potential impacts whether positive or negative, of a proposed project on the natural environment. The E.I.A Act, as it is informally called, deals with the considerations of

environmental impact in respect of public and private projects. Sections relevant to environmental emergency prevention under the EIA include: -

- Section 2 (1) requires an assessment of public or private projects likely to have a significant (negative) impact on the environment.
- Section 2 (4) requires an application in writing to the Agency before embarking on projects for their environmental assessment to determine approval.
- Section 13 establishes cases where an EIA is required and
- Section 60 creates a legal liability for contravention of any provision.

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- ***National Environmental Protection (Effluent Limitation) Regulation 1991, S. 1.8 Regulation 1991:*** Official Gazette, Federal Republic of Nigeria No. 42, Vol.78, August 1991, which requires the installation of anti-pollution equipment for detoxification of effluents and chemical discharges from the company's existing facilities.

- ***National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Waste) Regulation 1991, S. 1.9 Regulation 1991:*** Official Gazette, Federal Republic of Nigeria No. 42, Vol. 78, August 1991, which imposes restrictions on the release of hazardous or toxic substances into the air, water and land into Nigeria's ecosystems beyond the limits approved by FEPA.

- ***National Environmental Protection (Management of Solid and Hazardous Waste) Regulation 1991, S. 1.15 Regulation 1991:*** Official Gazette, Federal Republic of Nigeria, No. 102, Vol. 78, 31st December 1991; describes the requirements for Groundwater protection, surface impoundment, land treatment, waste piles, landfill, incinerators, etc.

- **Land Use Act L5 LFN 2004**

The Land Use Act L5 LFN of 2004 protects the rights of all Nigerians to use and enjoy the land in Nigeria which must be protected and preserved. The land acquisition must follow all the due process of law.

- **Forestry Law CAP 55, 1994**

This Act provides for the preservation of forests and the setting up of forest reserves.

- Prohibits any act that may lead to the destruction of or cause injury to any forest produce, forest growth, or forestry property in Nigeria.
- Prescribes the administrative framework for the management, utilization, and protection of forestry resources in Nigeria.

- **Endangered Species Act (Cap 108), 1990**

The Endangered Species Act (Control of International Trade and Traffic) Cap.108 Law of Nigeria, 1990 prohibits the hunting, capture, and trade of endangered species.

- **Labour Act, 1999**

Nigeria has ratified all eight core International Labour Organization Conventions. The Labour Act (1999) is the primary law protecting the employment rights of individual workers. The Act covers protection of wages; contracts; employment terms and conditions; recruitment; and classifies workers and special worker types.

- **Harmful Wastes CAP HI LFN 2004**

Harmful Waste (Special Criminal Provisions etc) Act (Cap H1 LFN 2004). This law prohibits the carrying, depositing, and dumping of harmful waste on land and in territorial waters.

- **Water Resources Act CAP W2 LFN 2004**

Water Resources Act (Cap W2 LFN 2004). This aims at promoting the optimum development, use, and protection of water resources.

- **Embedded Generation Regulation, NERC, 2012**

NERC (Embedded Generation) Regulation 2012 and NERC (Independent Electricity Distribution Network) Regulation 2012. Embedded Power is a form of distributed generation. Regulation 35 of the NERC (Embedded Generation) Regulation 2012, otherwise the EG regulation provides that: “Embedded Generation or 'EG' means the generation of electricity that is directly connected to and evacuated through a distribution system.” The EG

regulation was also enacted along with the NERC (Independent Electricity Distribution Network) Regulation 2012, otherwise known as the IEDN regulation. Both regulations are to be read together to understand the regulatory context of embedded generation and distribution of embedded power as it relates to off-grid solutions on the basis that an embedded generator may generate electricity to connect and evacuate same via an independent electricity distribution system not operated by a Distribution Company of Nigeria which is regarded as an isolated off-grid IEDN not connected to an existing distribution network. The IEDN regulation governs isolated independent electricity distribution networks (IEDN) within urban and rural areas and in particular empowers NERC to license off-grid IEDN. Where the generation capacity is 6MW and above, under the EG regulation, such must comply with the applicable provisions of the grid code. Generation capacity of 20MW and above must be centrally dispatched by the system operator following the provisions of the National Electric Power Policy (NEPP).

- **Workmen Compensation Act, 1987**

An Act to provide for compensation for injuries and death suffered by workmen in the course of their employment. This legislation, which was the first of its kind in Nigeria, sought to incorporate international standards relating to workmen's compensation and cater to the welfare of injured workmen.

(1) An employer shall pay compensation to any of his employees who suffers injury from any accident arising out of and in the course of his employment. (2) An employer shall pay compensation to the person or persons entitled to the estate of any of his employees who dies as a result of an accident arising out of and in the course of his employment.

- **Abandonment Guidelines 1995**

The guidelines help to ensure the environment is returned to, as much as reasonably practicable, its original/baseline conditions.

- **National Environmental Standards and Regulations Enforcement Agency (NESREA) Act 92, 2007**

NESREA Act, Official Gazette No. 92. Vol. 94 of 31st July 2007 of the Federal Government in line with section 20 of the 1999 Constitution of the Federal Republic of Nigeria, established the National Environmental Standards and Regulations Enforcement Agency (NESREA), a parastatal of the Federal Ministry of Environment. The Federal Government through NESREA has developed twenty-four (24) Environmental Regulations which have been published in the Federal Republic of Nigeria Official Gazette and are now in force.

The NESREA Regulations relevant to the proposed development include the following:

1) **National Environmental (Mining and Processing of Coal, Ores and Industrial Minerals) Regulations, 2009. S. I. No. 31**: This Regulation seeks to minimize pollution from mining and processing of coal, ores, and industrial minerals.
2) **National Environmental (Ozone Layer Protection) Regulations, 2009. S. I. No. 32.** These provisions seek to prohibit the import, manufacture, sale, and the use of ozone-depleting substances.
3) **National Environmental (Noise Standards and Control) Regulations, 2009. S. I. No. 35.** The main objective of the provisions of this Regulation is to ensure the tranquility of the human environment or surroundings and their psychological well-being by regulating noise levels.
4) **National Environmental (Soil Erosion and Flood Control) Regulations, 2010. S. I. No. 12.** The overall objective of these Regulations is to check all earth-disturbing activities, practices, or developments for non-agricultural, commercial, industrial, and residential purposes.
5) **National Environmental (Control of Vehicular Emissions from Petrol and Diesel Engines) Regulations, 2010. S. I. No. 20.** The purpose of these regulations is to restore, preserve, and improve the quality of air. The standards contained herein provide for the protection of the air from pollutants from vehicular emission.
6) **National Environmental (Watershed, Mountainous, Hilly, and Catchments Areas) Regulations, 2009. S. I. No. 27**: This makes provisions for the protection of water catchment areas

7) **National Environmental (Desertification Control and Drought Mitigation) Regulations, 2010. S. I. No. 13**: This Regulation seeks to provide an effective and pragmatic regulatory framework for the sustainable use of all areas already affected by desertification and the protection of vulnerable lands
8) **National Environmental (Protection of Endangered Species in International Trade) Regulations, 2010. S. I. No. 16**: The major objective of this Regulation is to protect species of endangered wildlife from extinction through the prohibition of trade, importation, etc.
9) **National Environmental (Surface and Groundwater Quality Control) Regulations, 2010. S. I. No. 22**: The purpose of this Regulation is to restore, enhance, and preserve the physical, chemical, and biological integrity of the nation's surface waters, and to maintain existing water uses.

- **The Federal Ministry of Sport**

The Ministry is the outcome of the merger of the defunct Federal Ministry of Youth Development (FMYD) and the National Sports Commission (NSC) by the proclamation of His Excellency, Mr. President on the restructuring of Ministries, Departments, and Agencies (MDAs) of Government on 11th November 2016.

The functions of the Ministry include the following:

- Designing guidelines for youth and sports development activities in the country;
- formulating monitoring and reviewing the National Youth and Sports Policies;
- articulating relevant programmes of action for youth and sports development;
- coordinating and monitoring youth and sports development activities at the three levels of Government and the collaborating partners;
- collaborating with all stakeholders for the funding of the youth and sports sectors;
- creating opportunities for youth to be involved in decision-making processes in matters that affect them, the environment, and society;
- inculcating in the youth, the values of human rights, social justice, equity, fairness, and gender equality;

- promoting a conducive atmosphere for the social, mental, emotional, and physical development of the youth;
- promoting formal and informal training of youth and athletes in life and livelihood skill;
- establishing sustainable developmental projects in the Youth and Sports sectors;
- promoting, in collaboration with other youth and sports bodies, the physical fitness and general wellbeing of all persons in Nigeria;
- organizing, or assisting financially or otherwise, the participation in sports at inter-state, national and international levels;
- providing enabling environment for the development of coaches, technical and support staff for effective training of athletes;
- conducting and encouraging research into all matters relating to Youth and Sports;
- providing, maintaining, and upgrading Youth and Sports Centres and facilities for training Nigerians in youth and sports development activities;
- ensuring the participation of all sportsmen/women were required in inter-state, national, or international competitions;
- coordinating and integrating efforts to raise the standard of performance in Sports in Nigeria;
- promoting international cooperation to facilitate youth and sports development;
- collaborate with relevant stakeholders to promote the holistic development of physically challenged persons in all field of endeavors including sports; and
- to liaise with MDAs and development partners engaged in the provision of youth and sports development services in the country for coordination and harmonization of all youth and sports development initiatives across the country.

Mandate

- Formulation, Implementation, Monitoring and Evaluation of Policies and Programmes on Youths and Sports Development towards Wealth Creation, Youth Empowerment, Physical Fitness, and Well-being, Achieving Excellence in Sports, National Unity, and Sustainable Development.

Mission

- To Provide Sustainable Framework for the Formulation and Implementation of Policies, Programmes, and other Initiatives which Promote and Enhance Youth and Sports Development in collaboration with Stakeholders.

Vision

- A Nigerian with Empowered and Successful Youth in all fields of life and Nigerians that are adequately supported to excel in sports at all levels.

- **National Sports Policy of Nigeria (2009)**

This policy seeks to clearly outline the obligations of the stakeholders in sports such that all parties will be educated to achieve the desired result in sports development.

PHILOSOPHY

To encourage participation in sport as an avenue for enhancement of health, the exhibition of an innate physical attribute, expression of talents, skills, and alleviation of poverty.

VISION

To establish a technically efficient institution equipped with the desired professional manpower, resources, right equipment, and well-maintained facilities for sports development and participation.

MISSION

To develop the sports sector to a world-class level where it would provide continuous improvement of quality of life for the entire citizenry to the extent that Nigeria would be recognised as one of the leading sporting countries in the world.

OBJECTIVES

The National Sports Policy shall seek to fulfill the following objectives:

a) To develop sports to become an instrument of national unity.

b) Utilise achievements in sports to boost the country's image in the comity of nations.

c) Develop Athletes, Coaches, Technical Officials, Sports Scientists, Sports Medicine Practitioners, and Administrators to be among the best in the world.
d) Attract major international sporting events to Nigeria and exploit their benefits for tourism and the economy.
e) Create an enabling environment for sports goods manufacturing industries.
f) Use sports as an avenue to minimize anti-social behaviour.
g) Promote sport as a means to generate employment and create wealth.
h) To allow the physically challenged person to participate in sports of their choice.
i) Encourage private sector investment in all sectors of sports.
j) Ensure utilisation of Information Technology to collate sports data for effective planning and dissemination of information.
k) Encourage the provision of recreational and sporting facilities by the three tiers of government.
l) Ensure adequate and proper funding of sports at all levels.
m) Promote School and Institutional Sports Development and Competitions at all three tiers of Government.
n) Ensure that Sports are an integral part of the curriculum of Educational Institutions at all levers (Nursery, Primary, Secondary, and Tertiary).
o) Encourage mass participation in sports and recreation to use exercise for the improvement of the general health and fitness of citizens.

1.5.2 Ebonyi State Legislation

Ebonyi State Ministry of Environment

Ebonyi state ministry of environment was created on 27th August 2011, to tackle most of the environmental challenges in the state. This ministry, in line with the elements of SEED/NEEDS/MDG on environmentally sustainable development, has set out numerous targets to be achieved to reduce the unprecedented scale and speed of environmental pollutions, degradation, and the depletion of natural resources.

The vision of the Ministry is the to find solutions to local, regional and global air pollution, accumulation and distribution of toxic waste, destruction, and depletion of forests, soil, and water, depletion of the ozone layer, and emission of "green-house" grasses threatening the

survival of humans and thousands of other living spaces, the integrity of the earth and its bio-diversity, the security of the nation, and the heritage of future generations.

Ministry of Environment believes that "cleanliness is next to godliness and a healthy nation is a wealthy nation". Given this, the Ministry has ensured the proper waste and environmental management by providing sanitation disposal of all types of waste for the preservation of our environment. This has an impact on the lives of the citizenry in diverse ways.

Ebonyi State Environmental Protection Agency (EBSEPA)

The mandate for the establishment of Ebonyi State Environmental protection Agency was on 6th December 1996 by His Excellency, the first military administrator of Ebonyi State Commander Walter Feghabor (FSS, PSCT). The edict establishing the Agency was however signed into law in February 1998. This Edict was repealed and replaced with a more comprehensive one signed on 28th May 1999.

The agency is made up of six departments which include

- Engineering, Ecology and natural resources conservation (EWRC)
- Pollution control and waste management (PWM)
- Research and development (RD)
- Personnel Management/Administration (PM/A).
- Finance and supply (FS)
- Planning, research, and statistics (PRS)

The agency also performs the following functions:

- Flood and soil erosion control in all parts of the state. Its activities here include identification, planning, design, and implementation of mitigation measures
- Restoration of degraded lands due to mining, quarrying, or other industrial operations.
- Solid waste management in all parts of the state.
- Policy formulation, monitoring, and enforcement of environmental standards and guidelines for pollution control in industries, homes, water bodies air, and solid.
- Maintenance of waterways and a network of the drainage system in the state.
- Environmental beautification through landscaping, planting of flowers, and trees.

- Biodiversity conservation including the development of recreation parks.
- Ensuring the general well-being of the Ebonyi Environment.

Ebonyi State Ministry of Lands, Survey, and Housing

The present Ministry of Lands, Survey, and Housing was merged with the Housing Department of the former Ministry of Housing and Environment which gave it the present nomenclature as the Ministry of Lands, Survey, and Housing.

The functions of the ministry include the following:

- General land administration and management which include formulation, interpretation, documentation, etc.
- Valuation of rights, crops enumeration, assessment of compensation, analysis of formulation and undertaking of market surveys and research on land values;
- Building and Engineering services which include preparation of valuation certificates, supervision and overseeing construction of all public building preparation of structural engineering design of steel
- Architectural service which includes preparing working and detailed drawing and As-built drawing preparation of contract document and establishing conceptual design as well as broad specification.
- Preparation of Bill of Quantity of Government Projects, preparation of estimates, measuring sites and locations preparation of valuation for an interim payment, cost panning and analyzing building cost, etc.
- Preparation of regional plans, sub-regional plans, and planning within the framework of national policies.
- Provision of survey framework to facilitate the registration of the certificate of occupancy under the law Land Use Act, carrying out all survey and mapping matter of the state, handling of matters relating to both intrastate and interstate boundary matters in liaison with appropriate authorities.
- Planning designing construction, supervision, development, and management of private, commercial, public, and residential houses for acquisition, sale or rentals by members of the public etc.
- Precession of other specialized administration and financial services via the officer of

Planning Research and Statistics, Public Relations, Finance, and General administration.

Ebonyi State Ministry of Infrastructural Development for Concession

Ministry of Infrastructural Development for Concession was created to bring to bear his quest for an all-round and total transformation of Ebonyi State with Infrastructure that will stand the test of time.

1.5.3 International Conventions Ratified by Nigeria

The proposed development will have impacts on local as wells as the regional environment. The regional impact could result from the emission of greenhouse gases (GHGs) via maintenance of aircraft and the Stadium which could affect global climate change. Therefore, the EIA considered relevant international Conventions, Agreements, and Protocols on climate change and other pertinent environmental issues relevant to Nigeria.

Ebonyi State Government is committed to its environmental management by complying with relevant international legislation covering various environmental effects arising from the operation of the International Olympic Stadium, including noise, gaseous emission, particulate, liquid effluent, and solid waste.

- **Fédération Internationale de Football Association (FIFA)**

The need for a single body to oversee association football became apparent at the beginning of the 20th century with the increasing popularity of international fixtures. The Fédération Internationale de Football Association (FIFA) was founded in the rear of the headquarters of the Union des Sociétés Françaises de Sports Athlétiques (USFSA) at the Rue Saint Honoré 229 in Paris on 21 May 1904.

FIFA's supreme body is the FIFA Congress, an assembly made up of representatives from each affiliated member association. Each national football association has one vote, regardless of its size or footballing strength. The Congress assembles in ordinary session once every year, and extraordinary sessions have been held once a year since 1998.

Congress makes decisions relating to FIFA's governing statutes and their method of implementation and application. Only Congress can pass changes to FIFA's statutes. The congress approves the annual report, and decides on the acceptance of new national associations, and holds elections. Congress elects the President of FIFA, its general secretary, and the other members of the FIFA Council in the year following the FIFA World Cup.

FIFA Council – formerly called the FIFA Executive Committee and chaired by the president – is the main decision-making body of the organization in the intervals of congress. The council is composed of 37 people: the president; 8 vice presidents; and 28 members from the confederations, with at least one of them being a woman. The Executive Committee is the body that decides which country will host the World Cup.

FIFA's worldwide organizational structure also consists of several other bodies, under the authority of the FIFA Council or created by Congress as standing committees. Among those bodies are the FIFA Emergency Committee, the FIFA Ethics Committee, the Finance Committee, the Disciplinary Committee, and the Referees Committee.

The FIFA Emergency Committee deals with all matters requiring immediate settlement in the time frame between the regular meetings of the FIFA Council. The Emergency Committee consists of the FIFA president as well as one member from each confederation. Emergency Committee decisions made are immediately put into legal effect, although they need to be ratified at the next Executive Committee meeting.

The laws that govern football, known officially as the Laws of the Game, are not solely the responsibility of FIFA; they are maintained by a body called the International Football Association Board (IFAB). FIFA has members on its board (four representatives); the other four are provided by the football associations of the United Kingdom: England, Scotland, Wales, and Northern Ireland, who jointly established IFAB in 1882 and are recognized for the creation and history of the game. Changes to the Laws of the Game must be agreed upon by at least six of the eight delegates.

The FIFA Statutes form the overarching document guiding FIFA's governing system. The governing system is divided into separate bodies that have the appropriate powers to create a system of checks and balances. It consists of four general bodies: the congress, the executive committee, the general secretariat, and standing and ad-hoc committees.

FIFA Stadium Safety and Security Regulations

Scope of application

1. The host associations of FIFA events shall apply these regulations (including qualifying and final competition matches) when these events are under the direct administration of FIFA.

2. Furthermore, FIFA recommends that these regulations be used as guidelines for all international matches following the FIFA Regulations Governing International Matches.

3. If an association or confederation arranges an event that will be administrated and governed by its competition regulations, the respective association's or confederation's safety and security regulations shall apply and these regulations may only serve as guidelines.

4. These regulations constitute the minimum requirements; however, when the respective association's or confederation's safety and security provisions are stricter or more exhaustive than some or all of the principles established hereinafter, those safety and security provisions shall prevail.

Basic principles

- Successful stadium safety and security strike the right balance between stadium design and stadium management. Guidance on new builds and stadium refurbishments can be found in the FIFA publication *Football Stadiums – Technical Recommendations and Requirements*, which should be used as a reference for all FIFA events together with the latest version of this document.

- A stadium may only be used to host a FIFA event if the structural and technical condition of the stadium complies with the host nation's safety requirements and a safety certificate has been issued by the relevant authority.

- The laws, regulations, ordinances, and administrative directives in place for the construction and technical facilities of stadiums shall be respected.

- The maximum number of spectators admitted into the stadium shall not exceed the stadium's agreed maximum safe capacity.

Responsibility

- Associations are responsible for appointing an occupationally competent national security officer, as defined hereinafter.

- The associations, through the national security officer and the stadium safety and security management team as defined hereinafter, are responsible for ensuring the safety and security of all spectators, players, officials, VIPs/VVIPs, and any person present at a stadium hosting a FIFA event.

- If the association, event organiser, or stadium authority has no legal authority to arrange the necessary safety and security measures, it must cooperate with the relevant host nation authorities to ensure that they are in place. If any of the FIFA Stadium Safety and Security Regulations are not in place, the association must be informed immediately, who in turn must inform FIFA.

- The association must ensure that the stadium safety and security management team is aware of and fully understands the obligations placed upon them, including:

    - The requirements of the stadium safety certificate to be issued by the

relevant authority.

- The requirements for a safety certificate for any temporary demountable structures.
- The host nation's/confederation's/association's stadium safety and security regulations.
- The FIFA Stadium Safety and Security Regulations.
- The FIFA publication *Football Stadiums – Technical Recommendations and Requirements*.
- FIFA Medical Assessment and Research Centre (F-MARC) – *Football Emergency Medicine Manual*.
- The host nation's fire safety legislation.
- The host nation's health and safety at work legislation.
- The host nation's legislation relating to people with disabilities.
- The host nation's civil contingencies legislation and/or guidelines.
- Insurance requirements, where applicable.
- Any other specific laws of the host nation that may have relevant safety or security implications.

➢ **International Association of Athletics Federations (IAAF)**

The International Association of Athletics Federations (IAAF) is the worldwide governing body for professional-level athletics and track and field. Its purpose is to create and regulate professional level meets and to set the standards for administering competitions, using equipment, and documenting world records. Its role as a world leader in athletics, transforming an amateur fad into a professional industry, has made a huge impact on professional sports.

➢ **Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal, 1989 (Nigeria signed the Basel Convention document on 15th March 1990 and ratified it on 13th March 1991. Nigeria also ratified the amendment to the Basel Convention on 24th May 2004)**

The convention focuses attention on the hazards of the generation and disposal of hazardous wastes. The convention defines the wastes to regulate and control their trans-boundary movement to protect human and environmental health against their adverse effects. Some highlights of the convention include:

- The generator of hazardous waste should carry out duties about the transport and disposal of such generated waste in a manner that is consistent with the protection of the environment, whatever the place of disposal,
- All should recognize that any State has the sovereign right to ban the entry or disposal of foreign hazardous wastes and other wastes in its territory,
- It should be recognized also that there is an increasing desire for the prohibition of trans boundary movements of hazardous wastes and their disposal in other States, especially developing countries,
- Hazardous wastes and other wastes should, as far as is compatible with environmentally sound and efficient management, be disposed of in the State where they were generated,
- Transboundary movements of such wastes from the State of their generation to any other State should be permitted only when conducted under conditions which do not endanger human health and the environment, and under conditions in conformity with the provisions of this Convention,
- Control of transboundary movement of hazardous wastes and other wastes will act as an incentive for their environmentally sound management and the reduction of the volume of such transboundary movement,
- States should take measures for the proper exchange of information on and control of the transboundary movement of hazardous wastes and other wastes from and to those States,

- **UNFCCC, Paris agreement of 2016 [The agreement was signed on 22 September 2016 and ratified by Nigeria on 16th May 2017]**

  The world is in a race to limit climate change and find workable, practical, and cost-efficient solutions (Renewable Energy, Circular Economy, and Natural Capital) to this

emergency that is redefining global partnerships in a way not seen before. This is a race we, as humanity, can win. But for this to happen, unprecedented leadership, sacrifices, concessions from all nations big and small are needed. Nigeria has ratified the 2915 Paris Agreement. This is commendable considering it is one of the top six greenhouse gas emitters in Africa.

The Paris Agreement builds upon the Convention and for the first time brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so. As such, it charts a new course in the global climate effort.

The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.

Additionally, the agreement aims to strengthen the ability of countries to deal with the impacts of climate change. To reach these ambitious goals, appropriate financial flows, a new technology framework, and an enhanced capacity-building framework will be put in place, thus supporting action by developing countries and the most vulnerable countries, in line with their national objectives. The Agreement also provides for enhanced transparency of action and support through a more robust transparency framework.

The country’s Nationally Determined Contributions (NDCs) made under the Paris Agreement embodies the country’s efforts to reduce national emissions and to adapt to the effects of climate change. If fully implemented, these efforts will pave way for a low carbon economy and result in about a 50 percent reduction in emissions. At the same time, the economy will grow at an average annual rate of five percent by 2030. This represents an important milestone in tackling the challenges of climate change.

- **United Nations Guiding Principles on the Human Environment [Nigeria signed the Basel Convention document in 1992 and ratified in 1994]**

The United Nations (UN) published the concept of Guiding Principles on the Human Environment in 1972. Ten of these Guiding Principles were defined as formal declarations that express the basis on which an environmental policy can be built and which provide a foundation for action.

- **The Rio Declaration on Environment and Development [Nigeria signed the Basel Convention document in 1992 and ratified in 1994]**

The UN Conference on Environment and Development met at Rio de Janeiro in June 1992, at which time it reaffirmed the 1972 declaration on the Human Environment, and sought to build upon it. This was done to establish a new and equitable global partnership through the creation of new levels of cooperation among states, key sectors of societies, and people. It was also to aid work towards international agreements, which respect the interests of all, protect the integrity of the global environmental development system, and recognize the integral and interdependent nature of the earth.

- **Polluters Pays Principle (Adopted by Nigeria in 1999)**

In environmental law, the polluter pays principle is enacted to make the party responsible for producing pollution responsible for paying for the damage done to the natural environment. It is regarded as a regional custom because of the strong support it has received in most Organisation for Economic Co-operation and Development (OECD) and European Community (EC) countries.

The polluter pays principle underpins environmental policy such as an ecotax, which, if enacted by the government, deters and essentially reduces greenhouse gas emissions. Some eco-taxes underpinned by the polluter pays principle include: the Gas Guzzler Tax, in the US, Corporate Average Fuel Economy (CAFE) - a "polluter pays" fine. The U.S. Superfund law requires polluters to pay for clean-up of hazardous waste sites when the polluters can be identified.

Polluter pays is also known as extended producer responsibility (EPR). This is a concept that was probably first described by Thomas Lindhqvist for the Swedish government in 1990. EPR seeks to shift the responsibility for dealing with waste from governments (and thus, taxpayers and society at large) to the entities producing it. In effect, it internalised the cost of waste disposal into the cost of the product, theoretically meaning that the producers will improve the waste profile of their products, thus decreasing waste and increasing possibilities for reuse and recycling.

- **United Nations Framework Convention on Climate Change (1992)**

The convention on climate change was signed in 1992 during the Earth Summit in Rio de Janeiro. Its implementation did not come into force till 1994. In this declaration, developed countries and economies in transition were mandated to limit their emissions of greenhouse gases which cause global warming. However, no mandatory emission/restrictions were placed on developing countries. This is now being reviewed including binding higher emission reduction by developed countries.

- **Nagoya Protocol of 2010**

The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity, also known as the Nagoya Protocol on Access and Benefit Sharing (ABS) is a 2010 supplementary agreement to the 1992 Convention on Biological Diversity (CBD). Its aim is the implementation of one of the three objectives of the CBD: the fair and equitable sharing of benefits arising out of the utilization of genetic resources, thereby contributing to the conservation and sustainable use of biodiversity. However, there are concerns that the added bureaucracy and legislation will, overall, be damaging to the monitoring and collection of biodiversity, to conservation, to the international response to infectious diseases, and research.

- **Kyoto Protocol of 2004**

The Kyoto Protocol is an international treaty which extends the 1992 United Nations Framework Convention on Climate Change (UNFCCC) that commits state parties to

reduce greenhouse gas emissions, based on the scientific consensus that (part one) global warming is occurring and (part two) it is extremely likely that human-made CO_2 emissions have predominantly caused it. The Kyoto Protocol was adopted in Kyoto, Japan on 11 December 1997 and entered into force on 16 February 2005. There are currently 192 parties (Canada withdrew from the protocol, effective December 2012) to the Protocol.

The Kyoto Protocol implemented the objective of the UNFCCC to reduce the onset of global warming by reducing greenhouse gas concentrations in the atmosphere to "a level that would prevent dangerous anthropogenic interference with the climate system" (Article 2). The Kyoto Protocol applies to the six greenhouse gases listed in Annex A: Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), and Sulphur hexafluoride (SF_6).

The Protocol is based on the principle of common but differentiated responsibilities: it acknowledges that individual countries have different capabilities in combating climate change, owing to economic development, and therefore puts the obligation to reduce current emissions on developed countries on the basis that they are historically responsible for the current levels of greenhouse gases in the atmosphere.

- **Stockholm Convention Against Persistent Organic Pollutants of 2004**

Stockholm Convention on Persistent Organic Pollutants is an international environmental treaty, signed in 2001 and effective from May 2004, that aims to eliminate or restrict the production and use of persistent organic pollutants (POPs). In 1995, the Governing Council of the United Nations Environment Programme (UNEP) called for global action to be taken on POPs, which is defined as "chemical substances that persist in the environment, bio-accumulate through the food web, and pose a risk of causing adverse effects to human health and the environment".

Following this, the Intergovernmental Forum on Chemical Safety (IFCS) and the International Programme on Chemical Safety (IPCS) prepared an assessment of the 12

worst offenders, known as the *dirty dozen*. The INC met five times between June 1998 and December 2000 to elaborate the convention, and delegates adopted the Stockholm Convention on POPs at the Conference of the Plenipotentiaries convened from 22–23 May 2001 in Stockholm, Sweden.

The negotiations for the Convention were completed on 23 May 2001 in Stockholm. The convention entered into force on 17 May 2004 with ratification by an initial 128 parties and 151 signatories. Co-signatories agree to outlaw nine of the dirty dozen chemicals, limit the use of DDT to malaria control, and curtail inadvertent production of dioxins and furans.

Parties to the convention have agreed to a process by which persistent toxic compounds can be reviewed and added to the convention if they meet certain criteria for persistence and transboundary threat. The first set of new chemicals to be added to the Convention was agreed upon at a conference in Geneva on 8 May 2009.
As of June 2018, there are 182 parties to the Convention, (181 states and the European Union). Notable non-ratifying states include the United States, Israel, Malaysia, and Italy.
The Stockholm Convention was adopted to EU legislation in REGULATION (EC) No 850/2004.

- **Cartagena Protocol on Bio-safety of 2003**

The Cartagena Protocol on Biosafety to the Convention on Biological Diversity is an international agreement on biosafety as a supplement to the Convention on Biological Diversity effective since 2003. The Biosafety Protocol seeks to protect biological diversity from the potential risks posed by genetically modified organisms resulting from modern biotechnology.

The Biosafety Protocol makes clear that products from new technologies must be based on the precautionary principle and allow developing nations to balance public health against economic benefits. It will for example let countries ban imports of genetically modified organisms if they feel there is not enough scientific evidence that the product is safe and

requires exporters to label shipments containing genetically altered commodities such as corn or cotton.

- **Montreal Protocol on Substances that Deplete the Ozone Layer, 1988**

The Montreal Protocol on Substances that Deplete the Ozone Layer (a protocol to the Vienna Convention for the Protection of the Ozone Layer) is an international treaty designed to protect the ozone layer by phasing out the production of numerous substances that are responsible for ozone depletion. It was agreed on 26 August 1987, and entered into force on 26 August 1989, followed by the first meeting in Helsinki, May 1989. Since then, it has undergone eight revisions, in 1990 (London), 1991 (Nairobi), 1992 (Copenhagen), 1993 (Bangkok), 1995 (Vienna), 1997 (Montreal), 1998 (Australia), 1999 (Beijing), and 2016 (Kigali, adopted, but not in force). As a result of the international agreement, the ozone hole in Antarctica is slowly recovering. Climate projections indicate that the ozone layer will return to 1980 levels between 2050 and 2070.

The treaty is structured around several groups of halogenated hydrocarbons that deplete stratospheric ozone. All of the ozone-depleting substances controlled by the Montreal Protocol contain either chlorine or bromine (substances containing only fluorine do not harm the ozone layer). Some ozone-depleting substances (ODSs) are not yet controlled by the Montreal Protocol, including nitrous oxide (N_2O). For a table of ozone-depleting substances controlled by the Montreal Protocol see. For each group of ODSs, the treaty provides a timetable on which the production of those substances must be shot out and eventually eliminated. This included a 10-year phase-in for developing countries identified in Article 5 of the treaty.

The stated purpose of the treaty is that the signatory states: "Recognizing that worldwide emissions of certain substances can significantly deplete and otherwise modify the ozone layer in a manner that is likely to result in adverse effects on human health and the environment. Determined to protect the ozone layer by taking precautionary measures to

control equitably total global emissions of substances that deplete it with the ultimate objective of their elimination based on developments in scientific knowledge".

- **The 13th UN Biodiversity Conference – COP 13 of Cancun-Mexico, December 2016**

The UN Biodiversity Conference was held from 2-17 December 2016, in Cancun, Mexico. The Conference opened with a High-Level Segment on 2-3 December under the theme "Mainstreaming Biodiversity for Well-being." The main part of the UN Biodiversity Conference started Sunday afternoon, 4 December, and included the thirteenth meeting of the Conference of the Parties (COP 13) to the Convention on Biological Diversity (CBD), the eighth meeting of the Conference of the Parties serving as the Meeting of the Parties to the Cartagena Protocol on Biosafety (CP COP-MOP 8) and the second meeting of the Conference of the Parties serving as the Meeting of the Parties to the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (NP COP-MOP 2). More than 8,000 delegates participated in the Conference, representing parties and other governments, UN agencies, intergovernmental, non-governmental, indigenous and local community organizations, academia, and the private sector.

The Conference addressed jointly: issues related to operations of the Convention, including integration among the Convention and its Protocols, and reporting; capacity building and technical and scientific cooperation; cooperation with other conventions and international organizations; and resource mobilization, the financial mechanism and the budget for the next biennium.

CBD COP 13 further considered a series of substantive, organizational, and financial issues, and adopted 37 decisions. Among other items, it reviewed progress towards implementation of the Strategic Plan for Biodiversity 2011-2020 and the achievement of the Aichi Biodiversity Targets, and related means of implementation; and considered strategic actions to enhance implementation of the Strategic Plan and achievement of the Aichi

Targets, including mainstreaming and the integration of biodiversity within and across sectors.

CP COP-MOP 8 adopted 19 decisions. It considered the report of the Compliance Committee; reviewed the Framework and Action Plan for Capacity Building; provided guidance on the operation and activities of the Biosafety Clearing-House; and addressed issues on risk assessment and risk management, including a coordinated approach on the issue of synthetic biology, and socio-economic considerations, among other items.
NP COP-MOP 2 reviewed progress towards Aichi Target 16 on the Nagoya Protocol and adopted 14 decisions on, among other issues, on the need for and modalities of a global multilateral benefit-sharing mechanism, and the Access and Benefit-sharing (ABS) Clearing-House.

1.5.4 International Best Practices

Other considerations of the ESIA include other international best practices. International institutions provide guidance on best practices for the ESIA process and place emphasis on achieving sustainable environmental, social, and health outcomes. They also provide environmental standards and limits for emissions and discharges. Some key project impact mitigation measures such as resettlement are also specified.

The overall project design and this ESIA will align with international best practices such as guidelines published by the International Finance Corporation (IFC) and the World Bank. The following is a summary of the specific international requirements and standards that will be applied to this ESIA. It should be noted that, given the private-sector nature of the development, the IFC Performance Standards described below will be most directly applicable to the project in this case.

- **ISO 20906:2009 Acoustics – Unattended monitoring of aircraft sound in the vicinity of Stadiums**

This International Organisation for Standardisation (ISO) gives requirements for reliable measurement of aircraft sound. It describes a threshold system of sound event recognition

in a complex sound environment with multiple aircraft and other sound sources. ISO 20906:2009 specifies:

- The typical application for a permanently installed sound-monitoring system around a Stadium.
- Performance specifications for instruments and requirements for their unattended installation and operation, to determine continuously monitored sound pressure levels of aircraft sound at selected locations
- Requirements for monitoring the sound of aircraft operations at a Stadium.
- Requirements for the quantities to be determined to describe the sound of aircraft operations.
- Requirements for data to be reported and frequency of publication of reports.
- A procedure for determining the expanded uncertainty of the reported data in accordance with ISO/IEC Guide 98-3, Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM: 1995).

➢ **World Bank Guidelines on Environmental Assessment**

The World Bank requires an Environmental Impact Assessment (EIA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable to improve decision making. Additionally, the policy specifies that the Bank undertakes environmental screening of each proposed project to determine the appropriate extent and type of EIA. The Bank classifies projects into one of four categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts. Details of World Bank EIA procedures and guidelines are published in the bank's EA Source Books Vols. i – iii of 1991.

World Bank Operational and Safeguard Policies

The World Bank is committed to several operational and safeguards policies that aim to prevent and mitigate undue harm to people and their environment in any development initiative involving the bank. These policies provide guidelines for bank and borrower staff in the identification, preparation, and implementation of programs and projects. There are ten

World Bank Environmental/Safeguard Policies. As discussed below not all these policies are triggered by the Ebonyi State International Olympic Stadium development.

The World Bank policies that have been triggered by the proposed International Olympic Stadium are:

- **Operational Policy (OP)/Bank Procedure (BP) 4.01: Environmental Assessment (last updated February 2011)**.
  This is the umbrella policy for the Bank's environmental 'safeguard policies' which among others include: Natural Habitats (OP 4.04), Forests (OP 4.36), and Physical Cultural Resources (OP 4.11).
- **Operational Policy/Bank Procedure 4.04** - ***Natural Habitat*** - seeks to ensure that World Bank-supported infrastructure and other development projects take into account the conservation of biodiversity, as well as the numerous environmental services and products which natural habitats provide to human society.
- **Operational Policy/Bank Procedure 4.36** - ***Forests.*** This policy aims to reduce deforestation, enhance the environmental contribution of forested areas, promote afforestation, reduce poverty, and encourage economic development.
- **Operational Policy 4.09 - *Pest Management* -** policy recognizes that pesticides can be persistent and harmful to the environment for a long time. If pesticides must be used, the policy requires that Pest Management Plan (PMP) be prepared by the borrower, either as a stand-alone document or as part of an Environmental Assessment.
- **Operational Policy /Bank Procedure 4.11 - *Physical Cultural Resources*** seeks to avoid, or mitigate, adverse impacts on cultural resources from development projects that the World Bank finances.

The Bank requires environmental assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus improve decision making.

Such EA is carried out by the borrower to evaluate a project's potential environmental risks and impacts in its area of influence. The EA process analyzes project alternatives; identifies

ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation. The Bank favours preventive measures over mitigatory or compensatory measures, whenever feasible.

EA looks at the interaction of the project with the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples, and physical cultural resources); and where applicable, transboundary and global environmental aspects.

- **The IFC Performance Standards**

The IFC applies Performance Standards to manage social and environmental risks and impacts and to enhance development opportunities in the private sector. The IFC Performance Standards encompass eight topics:

- ✓ **Environmental and Social Assessment and Management System:** Commercial clients/investees are required to manage the environmental and social performance of their business activity, which should also involve communication between the client/investee, its workers, and the local communities directly affected by the business activity. This requires the development of a good management system, appropriate to the size and nature of the business activity, to promote sound and sustainable environmental and social performance as well as lead to improved financial outcomes.

- ✓ **Labour and Working Conditions:** For any business, its workforce is a valuable asset and a sound worker-management relationship is a key component of the overall success of the enterprise. By protecting the basic rights of workers, treating workers fairly, and providing them with safe and healthy working conditions, commercial clients/investees can enhance the efficiency and productivity of their operations and strengthen worker commitment and retention.

- ✓ **Pollution Prevention and Abatement:** Increased industrial activity and urbanization often generate increased levels of pollution to air, water, and land that may threaten people and the environment at the local, regional, and global level. Commercial clients/investees are required to integrate pollution prevention and control technologies and practices (as technically and financially feasible as well as cost-effective) into their business activities.

- ✓ **Community Health, Safety, and Security:** Business activities can increase the potential for community exposure to risks and impacts arising from equipment accidents, structural failures, and releases of hazardous materials as well as impacts on a community's natural resources, exposure to diseases, and the use of security personnel. Commercial clients/investees are responsible for avoiding or minimizing the risks and impacts on community health, safety, and security that may arise from their business activities.

- ✓ **Land Acquisition and Involuntary Resettlement:** Land acquisition due to the business activities of a commercial client/investees may result in the physical displacement (relocation or loss of shelter) and economic displacement (loss of access to resources necessary for income generation or as means of livelihood) of individuals or communities. Involuntary resettlement occurs when affected individuals or communities do not have the right to refuse land acquisition and are displaced, which may result in long-term hardship and impoverishment as well as environmental damage and social stress. Commercial clients/investees are required to avoid physical or economic displacement or minimize impacts on displaced individuals or communities through appropriate measures such as fair compensation and improving livelihoods and living conditions.
- ✓ **Biodiversity Conservation and Sustainable Natural Resource Management:** Protecting and conserving biodiversity (including genetic, species, and ecosystem diversity) and its ability to change and evolve, is fundamental to sustainable development. Commercial clients/investees are required to avoid or mitigate threats to

biodiversity arising from their business activities and to promote the use of renewable natural resources in their operations.

- ✓ **Indigenous Peoples:** Indigenous Peoples are recognized as social groups with identities that are distinct from other groups in national societies and are often among the marginalized and vulnerable. Their economic, social, and legal status may limit their capacity to defend their interests and rights to lands and natural and cultural resources. Commercial clients/investees are required to ensure that their business activities respect the identity, culture, and natural resource-based livelihoods of Indigenous Peoples and reduce exposure to impoverishment and disease.

- ✓ **Cultural Heritage:** Cultural heritage encompasses properties and sites of archaeological, historical, cultural, artistic, and religious significance as well as unique environmental features and cultural knowledge, innovations, and practices of communities embodying traditional lifestyles, which are protected for current and future generations. Commercial clients/investees are required to avoid significant damage to cultural heritage due to their business activities.

- ➢ **Environmental and Social Safeguards Policies (African Development Bank)**

The African Development Bank issued its Environmental Assessment Guidelines (EAG) in 1992, but since then, many changes have occurred in the Bank's structure and operations. The revised Environmental and Social Assessment Procedures (ESAP 2015) have therefore been updated to reflect the more integrated approach addressing all cross-cutting themes as well as the new organizational structure. The main purpose of the Environmental and Social Assessment Procedures (ESAP) is to improve decision-making and project results in order to ensure that Bank-financed projects, plans, and programs are environmentally and socially sustainable as well as in line with Bank's policies and guidelines. The ESAP applies to the Bank's public sector operations. Similar procedures were developed and approved for the Bank's private sector operations: AfDB Environmental Review Procedures for Private Sector Operations (2000). Other relevant AfDB policies are AfDB Policy on the Environment (2004), AfDB Environmental Review Procedures for Private Sector Operations (2000), AfDB

Gender Policy (2001), AfDB Policy on Poverty Reduction (2004), and AfDB Policy on Involuntary Resettlement (2003).

- **The "Equator Principles"**

The Equator Principles (EPs) are a voluntary set of guidelines that provide credit risk management framework for determining, assessing, and managing environmental and social risk in project finance transactions. They apply globally to development projects with a capital cost of $50 million or more in all industry sectors. Equator Principle Financial Institutions (EPFIs) commit to implementing the EP in their internal environmental policies, social policies, procedures, and standards for financing projects, and they will not provide Project Finance or Project-Related Corporate loans to projects where the client will not, or is unable to comply with the EP. The latest revision to the EPs (referred to as The Equator Principles III – 2013) is effective from 4th June 2013.

The EPs, which are broadly aligned with the IFC Sustainability Framework (2012), cover the areas Seen in Table ***1.1*** below:

Table 1.1: IFC Equator Principles

Code	Principle	Description
1	Review and categorization	Screening to determine the magnitude of the proposed project's potential environmental and social risks and impacts
2	Environmental and social assessment	Aimed at addressing the relevant environmental and social risks and impacts of the proposed Project, as well as, propose measures to minimise, mitigate, and offset adverse impacts in a manner relevant and appropriate to the nature and scale of the proposed Project
3	Applicable environmental and social	Ensure compliance with relevant host country laws, regulations, and permits that pertain to environmental and social issues

Code	Principle	Description
	standards	
4	Environmental and Social Management System and Equator Principle Action Plan	Develop or maintain an Environmental and Social Management System (ESMS) to address issues raised in the assessment process
5	Stakeholder engagement	Ensure effective Stakeholder Engagement in a structured and culturally appropriate manner with likely to be affected Communities and other Stakeholders. The consultation process should be tailored to the risks and impacts of the Project; the Project's phase of development; the language preferences of the Affected Communities; their decision-making processes; and the needs of disadvantaged and vulnerable groups.
6	Grievance mechanism	Establish a grievance mechanism designed to receive and facilitate the resolution of concerns and grievances about the Project's environmental and social performance as part of the ESMS
7	Independent review	An Independent Environmental and Social Consultant, not directly associated with the client, will carry out an Independent Review of the Assessment Documentation
8	Covenants	Ensure compliance with all relevant host country environmental and social laws, regulations, and permits in all material respects and during construction and operation
9	Independent monitoring and	Ensure the appointment of an Independent Environmental and Social Consultant, or /qualified and

Code	Principle	Description
	monitoring	experienced external experts to verify monitoring information
10	Reporting and transparency	Ensure that, at a minimum, a summary of the ESIA is accessible and available online

- **Concept of Circular Economy**

The world can maximise chances of avoiding dangerous climate change by moving to a circular economy, thereby allowing societies to meet the goals of the Paris Agreement on Climate Action. A circular economy is a regenerative system in which resource input and waste, emission, and energy leakage are minimized by slowing, closing, and narrowing energy and material loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling.

Our current economic model relies on the traditional linear economy, which follows the pattern of creation, consumption, and disposal of products. However, this linear economy is not sustainable. It leads to increasing pressure on finite resources and generates significant waste and emissions. Instead, the concept of a “circular economy” was devised to minimize waste and pollution and make the most of resources by keeping products and materials in use as much as possible, and by recovering and regenerating products and materials at the end of each service life.

The transition from a linear economy to a circular economy can put economic growth on a sustainable pathway, by reducing finite resources consumption and minimizing waste and environmental impacts. According to Ellen MacArthur Foundation1, the implementation of the circular economy is guided by three principles:

- Waste equals Food – Redefining the purpose of end-of-life products can extend their durability and reduce the environmental impacts of manufacturing new products. Within a closed-loop, appropriate maintenance, reuse, refurbishment, and recycling

can extend the life cycle of products. These products are no longer to be considered as waste, but as essential inputs to manufacturers and service providers;

- Use renewable resources – By increasing the utilization of renewable or waste-derived resource and energy, the circular economy model could create new types of jobs and reduce environmental impacts, including carbon emissions.
- Build resilience through diversity – To achieve the reduction of virgin material consumption and waste generation, supply chains need to be developed to reorient products from one manufacturing process into another. Therefore, designing a circular economy model requires bringing together various companies and stakeholders, which serve different functions within a circular economy system.

Currently, the concept of the circular economy has been integrated through many national and organizational policies. For example, it was acknowledged as one of China's national development strategies throughout the country's 12th Five-Year Plan (2011-2015) and its Circular Economy Promotion Law of 2009. In 2015, the European Commission launched its Action Plan for the Circular Economy programme, which sets out a policy framework with measures and targets on waste management. The concept of the circular economy is also an integral part of the following United Nations' Sustainable Development Goals: Clean Water and Sanitation, Affordable and Clean Energy, Decent Work and Economic Growth, Industry, Innovation and Infrastructure, Sustainable Cities and Communities, Responsible Consumption and Production, Climate Action, Life Below Water, Life on Land and Partnerships for the Goals.

- **Concept of Renewable Energy**

Renewable energy is one of the most effective tools we have in the fight against climate change, and there is every reason to believe it will succeed. A recent New York Times column seems to imply that renewable energy investments set back efforts to address climate change—nothing could be further from the truth. What's more, renewable technologies can increasingly save customers money as they displace emissions from fossil fuels.

Wind and solar energy have experienced remarkable growth and huge cost improvements over the past decade with no signs of slowing down. Prices are declining rapidly, and renewable energy is becoming increasingly competitive with fossil fuels all around the country. In some places, new renewable energy is already cheaper than continuing to operate old, inefficient, and dirty fossil fuel-fired or nuclear power plants.

The investment firm Lazard estimates that the cost of generating electricity from wind and solar has declined by 58 percent and 78 percent, respectively, since 2009. Those cost trends are expected to continue and coupled with the recent extension of federal tax credits for renewable energy, wind, and solar growth is widely expected to accelerate over the next several years, with capacity projected to double from 2015 levels by 2021. With careful planning, renewable energy and clean energy options like increased energy efficiency and storing energy for use later will help pave the way.

In the longer term, the U.S. Environmental Protection Agency's Clean Power Plan to establish the first national limits on carbon pollution from power plants will continue to drive renewable energy growth. Wind and solar energy will play a central role in achieving the emissions cuts required, and carbon policies like the Clean Power Plan will be critical to ensuring that low-carbon resources are prioritized over higher-emitting power plants.

In addition to the climate benefits that they will help deliver, renewables already provide a wide range of market and public health benefits that far outweigh their costs. A recent report from the Department of Energy and Lawrence Berkeley National (LBNL) Laboratory found that renewable portfolio standards—state policies that mandate that a specific amount of the state's electricity comes from renewables—provide a wide range of economic, health, and climate benefits. The report concluded that in 2013 alone, renewable standards across the country saved customers up to $1.2 billion from reduced wholesale electric prices and $1.3 billion to $3.7 billion from lower natural gas prices (as a result of lower demand for natural gas across the power sector).

The non-market benefits of renewable energy also are considerable. The LBNL researchers estimated that renewables supported nearly 200,000 jobs, provided $5.2 billion worth of health benefits through improved air quality, and resulted in global climate benefits of $2.2 billion. At the same time, according to a separate report by DBL Investors, the top 10 leading renewable states experienced *lower* electricity price increases than the bottom 10 states between 2002 and 2013.

In a sign of the declining status of large, inflexible baseload resources, PG&E recently announced it will close the Diablo Canyon nuclear plant in California and replace it with 100 percent clean energy (NRDC is a signatory), PG&E explains: “California’s electric grid is in the midst of a significant shift that creates challenges for the facility in the coming decades. Changes in state policies, the electric generation fleet, and market conditions combine to reduce the need for large, inflexible baseload power plants.”

As we move forward, there are several grid planning practices and technologies that will help facilitate America's transition to higher and higher amounts of renewable energy. For example, as more and more cars on the road become electric, those vehicles can help store electricity and manage peak demand so that supply and demand can be better aligned. Demand response (compensating customers for altering their electricity use at specific periods) and time of use electricity pricing can provide similar support. Leading states are currently contemplating how to design policies and market structures that support a modernized, low-carbon grid. Planning for the future can and must be done in parallel with promoting strong renewables growth in the present. Renewable energy is already helping address climate change. It’s time to put our feet on the accelerator.

- **Concept of Natural Capital**

Ecosystems are deteriorating worldwide, and with them, the capacity to support human wellbeing and sustainable economic growth. The degradation of the natural environment has many causes, but a major contributing factor, as identified in the Millennium Ecosystem Assessment (MA), is the failure to value the numerous services provided by ecosystems.

Therefore, part of the solution to this problem must focus on ensuring that policymaking takes into account the full value of ecosystem services.

'Natural capital' is a useful concept to help achieve this goal. Natural capital refers to those aspects of the natural environment that deliver socio-economic value through ecosystem services. For example, wetlands provide water treatment and purification services; prevent floods by retaining surface runoff, and provide wildlife habitat. Natural capital exists alongside and often underpins, man-made capital.

Natural capital is another term for the stock of renewable and non-renewable resources (e.g. plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits to people. All this means is that any part of the natural world that benefits people or that underpins the provision of benefits to people, is a form of natural capital.

Natural capital is a stock, and from it flows ecosystem services or benefits. These services (where service is defined as 'a system supplying a public need') can provide economic, social, environmental, cultural, spiritual, or eudemonic benefits, and the value of these benefits be understood in qualitative or quantitative (including economic) terms, depending on the context. Biodiversity is an essential component of natural capital stocks and an indicator of their condition and resilience. Biodiversity itself provides benefits directly to people.

At the heart of the natural capital, the approach is the understanding that nature underpins human health, wealth, culture, identity, and happiness, and that how it does so can be complex and little understood. A natural capital approach works to illuminate this value and helps decision-makers to understand the complex ways in which natural, social and economic systems interact, impact, and depend upon one another.

Without an understanding of their relationships to natural capital, many decision-makers will be at least partly 'flying blind', and can consequently make decisions that are ineffective, inefficient, or counterproductive.

The integration of ecosystem valuation into policymaking and economic statistics has increasingly focused on 'greening' the national income accounts. Currently, natural capital is not comprehensively recorded and therefore not fully recognised in policymaking processes. By not including the value of ecosystem services in the cost-benefit analysis of policy options, decision-makers are often choosing solutions that are detrimental to a country's stock of natural capital. The forestry sector demonstrates this very clearly; the income from harvesting timber is measured and recorded, whereas the simultaneous depletion of important ecosystem services, including climate regulation, carbon sequestration, and erosion control, are not. To reconcile economic and environmental interests, the value of natural capital should be integrated into government decision-making. For this to happen three things are required:

- Scientific information regarding the status and trends of natural capital;
- Economic valuation methodologies that assign an accurate value to natural capital;
- Political leadership to ensure the integration of this value into policy-making processes.

The fundamental question for organizations to ask themselves is; how dependent is my business model on the health of the natural world, and how are my actions impacting nature's ability to provide what I am dependent on?

This simple exercise can be a watershed moment for management teams, who often realize that their success, and ultimately their profitability, is dependent on the health of several natural organisms, ecosystems, and phenomena that had never been considered before.

1.6 Ebonyi State Government Health, Safety, Security, Environment (HSSE) and Community Relations (CR) Policy

Ebonyi State Government is committed to conducting its operations with utmost health, safety, security, and environment (HSSE) and corporate social responsibility (CSR) standards internationally obtainable in the Aviation industry. Ebonyi State Government HSSE and CSR policy which is a driver to environmental protection is stated thus, we will give utmost regards to safety, the security of persons, preservation of the operating

environment, and peaceful coexistence with host communities and the public. We believe that the achievement of this commitment is an integral part of efficient and profitable business management. To achieve this, we will be guided by the following:

- ***Health and Safety Policy***

We shall establish a safe work-permit system and conduct our operations in accordance with applicable statutory regulations and aviation best practices. We will encourage Company and Contractor's employees to maintain a healthy work/life balance.

We shall provide appropriate Personnel Protective Equipment (PPE) for employees and enforce their use following the Policy. Contractors are similarly required to provide appropriate equipment and ensure use in compliance with the Ebonyi State Government PPE Policy. Compliance with Ebonyi State Government Health and Safety rules and regulations will be a condition of employment for both Company and Contractors employees.

We shall promptly report and investigate all incidents, including Near Misses to determine the cause(s), and share lessons learned, across the organization and contractors. We will establish contingency plans for foreseeable emergencies and regularly conduct exercises to train all on emergency response procedures.

- ***Environment***

We shall conduct all Company operations with due regard to the preservation of the environment and in compliance with applicable Local Regulations and Guidelines, and International codes of practice. We will develop Environmental Management Plans and monitor the effectiveness of mitigating measures and review as necessary.

- ***Security***

We will partner with host Communities to secure lives and assets. We will apply non-confrontational security strategies in compliance with National and International Laws concerning Human Rights.

- ***Community***

We regard our host communities as stakeholders and our primary objective in the partnership is to promote capacity building. We will pursue proactive engagements with communities and utilize the atmosphere of peaceful coexistence achieved to implement sustainable development programs for communities.

1.7 Sources of Data

Some of the data and information presented in this report were obtained from existing literature, past studies carried out in the study area, and nearby locations such as NiMet data of 1997-2017, National Population Census data e.t.c. However, the majority of the information put together in this report was based on two seasons of field activities, sampling/measurements, and laboratory analysis of sampled environmental components between February and July 2020.

1.8 Structure of the Report

The ESIA is structured following *the EIA Sectoral and Procedural Guidelines, 2016- 2018* as presented below:

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CHAPTER TWO
PROJECT JUSTIFICATION

2.1 Background Information

The problems found in our societies generally confront our young adults who are more vulnerable to violence, crime, alcohol, drug, and sexual abuse. In the years before and immediately after independence, policies in our schools tried to govern these problems and reduce their effect by emphasizing sports as a major component in the range of recommended extracurricular activities.

Between 1960- and 1980 the first-generation universities encourage intercollegiate athletic programmes in various sports for both male and female students. Those first-generation universities had developed standard sports arenas and programmes for football, basketball, volleyball, tennis, swimming, field and track events, and other sports within the first of their establishment. This initiative came as a result of the huge success achieved by football and athletic competitions organized around the country at the secondary school level. The fallout of this policy trust was the mass participation in intercollegiate sports competitions that culminated in the establishment of the Nigerian University Games (NUGA). This made way for the campus models that represented Nigeria in International competitions. Outside the University system, young people chose to join up with Rangers International (Enugu Rangers), Vasco Dagama, ICC (Shooting Stars of Ibadan), the Red Devils, etc. where they could make a career, represent the country, and live a fulfilled life. This gave models like Christian Chukwu, Segun Odegbami, Peter Rufai, and others whom young people look up to.

However, over the years sports have been relegated to the background due to neglect, lack of consistent government policies, and funding. The construction of these modern and standard sporting facilities in Abakaliki is geared toward addressing this neglect with the prospect of diverting the excess energy of the youth into useful and productive ventures.

2.2 Project Need

Over the years, sports have transformed into a tool for social integration, international diplomacy, economic prosperity, wealth creation, employment generation, and avenue

to fame and world recognition. Across Ebonyi state, open fields are used as sporting arenas that do not conform to any standard or specification. However, to produce world-class sportsmen and women, there must be world-class sporting facilities that must meet the minimum standard set by National and International sporting Federations.

Ebonyi state like most other states of the country harbours a very high concentration of young people between the ages of 14 to 30 an age bracket in which most people feel they have come of age, have the most energy, and the world in their pocket. It is an age range in which people want to experiment with things and explore the vast horizon of life before them.

These youths can be galvanized into a potent force that will not only overcome the peculiar of the time but will overflow into pushing the frontier of human development. However, if not properly harnessed these same virtues becomes a destructive force as they create their excitement and fun to ventilate themselves even when that means engaging in battles such as banditry, kidnappings, cultism, and armed robbery. Within our villages, towns, schools, and campus, the growth of cultism and extreme anti-social behaviours for instance coincides with the systematic degradation of sporting facilities in our schools and the failure to build standard sporting facilities due to unfavourable government, especially during the military era. However, things can change for the better.

To change for the better, only the best will suffice. With the world as a global village young people think of global standards. They want to be able to compete with their peers out there and so make-shift pitches and other sloppy arrangements will no longer move them to participate. Ebonyi State needs the facilities and a good sports programme at the grass-root level to bolster its curriculum and drive home her posturing as a catalyst for excellence in youth development in the state. The development of these facilities is expected to enhance the process of engaging the youths in positive and productive ventures.

2.3 Benefit of the Project

Investment in the construction of modern and standard sporting facilities in the state is an investment in the youths of the state and an outstanding and enduring legacy for the

present administration. In specific terms, the construction of the facilities will generate employment within the state and Nigeria as a whole. Access to modern and standard sports facilities will help the youth of the state to channel their energy into positive and productive uses with the prospect of projecting the state into national and International limelight through hosting and participation in sports competitions.

- ***Provision of Employment:***

The project is in line with one of the Millennium Development Goals (MDGs) to eradicate poverty, through the creation of employment opportunities. The project is poised to improve overall economic activity for the Agbaja-Unuhu and Enyima-Agu communities in the Abakaliki Local Government Area community. It is estimated that over 250 skilled and unskilled workers will directly or indirectly be engaged throughout the project lifecycle – pre-construction, construction, operations & maintenance, and decommissioning phase.

2.4 Value of the project

The value of the proposed International Stadium Project is estimated at USD 970,000 or NGN 350, 000,000 (Three Hundred and Fifty Million Naira). In keeping with the project's quality standards, the project's useful life is estimated at 40 years.

2.5 Project's Sustainability

The proposed project's sustainability is viewed as ensuring that the benefits realized are maintained and continue to influence positively into the foreseeable future. The project's sustainability is addressed under four key areas: it's economic, technical, social, and environmental sustainability potentials

2.5.1 Environmental Sustainability of the Project

The proposed International Stadium Project shall be environmentally sustainable because Ebonyi State Government including the Ministry of Sports activities will continually be guided by applicable environmental regulations such as ***FIFA Stadium Safety and Security Regulations*** Also, incorporating the findings and recommendations of this ESIA and subsequent implementation of the Environmental & Social Management Plan (ESMP) for the project's activities will ensure the desired

environmental sustainability.

The Ebonyi State Government's Safety, Health, and Environment (HSE) policies and programs will also be brought to bear on the project throughout the project life. A standard Environmental Management System (EMS) which conforms to ISO 14001:2015 shall be developed for the management of the project's aspects and anticipated impacts. The environmental sustainability of the project is premised on the following:

- ***Design*:** Ebonyi State Government shall ensure that the Stadium is designed, constructed, and operated in a manner that will keep all the potential adverse environmental effects to the minimum and within the acceptable regulatory levels.
- ***Compliance:*** compliance with applicable national and international environmental regulations and best practices.

Monitoring*:* ISO 20906:2009 Acoustics – Unattended monitoring of sound in the vicinity of the stadium shall be designed and implemented. Other environmental parameters such as emissions as stipulated in ***FIFA Stadium Safety and Security Regulations*** shall be carried out.

The General environmental, health and safety (EHS) guidelines to be adopted by Ebonyi State Government addresses "Good International Industry Practices" in three focus areas in line with *World Bank Group Environmental, Health, and Safety Guidelines for General Industry (2016)* which are*:*

- Environment,
- Occupational Health and Safety,
- Community Health and Safety

Also, the following guidelines shall be adopted to make the proposed project environmentally sustainable.

- ISO 14064-1:2006 *Greenhouse gases - Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals*: it specifies principles and requirements for the design, development, management, reporting, and verification of an organization's GHG inventory.
- ISO 14064-2:2006 *Greenhouse gases - Part 2: Specification with guidance at the project level for quantification, monitoring, and reporting of greenhouse gas emission*

reductions or removal enhancements: it specifies principles and requirements and provides guidance at the project level for quantification, monitoring, and reporting of activities intended to cause GHG emission reductions. It includes requirements for planning a GHG project, for identifying and selecting GHG sources, for monitoring, quantifying, documenting, and reporting GHG project performances, and for managing data quality.

- ISO 14064-3:2006 *Greenhouse gases - Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions* specifies requirements for selecting GHG validators/verifiers, establishing the level of assurance, objectives, criteria, and scope, determining the validation approach, assessing GHG data, information, information systems and controls, and preparing validation statements. It can be applied to organizational or GHG project quantification, including GHG quantification, monitoring and reporting carried out following ISO 14064-1 or ISO 14064-2.
- ISO 14040:2006 *Environmental management - Life cycle assessment -- Principles and framework* describes criteria and framework for life cycle assessment (LCA) and includes the definition of the goal and scope of each LCA phase, as well as the relationship between the LCA phases, reporting, critical review and limitations of the LCA, and conditions for use of value choices. ISO 14040:2006 covers life cycle assessment and life cycle inventory studies, but it does not describe the technique, nor specify methods for each phase. The application of LCA results is considered during the definition of the goal (and the scope), but the application itself is beyond the scope of this International Standard.
- ISO 14044:2006 *Environmental management - Life cycle assessment - Requirements and guidelines* specify requirements and provide guidelines for life cycle assessment following principles and framework of ISO 14040:2006. It covers life cycle assessment and life cycle inventory studies

2.5.2 Technical Sustainability of the Project

The proposed International Stadium Project shall adopt the principle of Best Available Techniques (BAT) for design, construction, and operation. To ensure technical sustainability, the following principles shall be enshrined in the project:

- Local content will be generously utilised in the design, construction, and operation
- Skills transfer will be encouraged between expatriates engineers and local engineers to close the gap in knowledge throughout the project life.
- Ebonyi State Government shall ensure the training and retraining of its local Engineers.

2.5.3 Economic Sustainability of the Project

Ebonyi State Government in collaboration Ministry of Sport will ensure standard business ethics and transparency; preventing corruption, encourage public advocacy and lobbying, transparency in payment of taxes, encouraging human rights and security. Proceeds accruing from the sporting activities will continually contribute additional revenue to Ebonyi State and the Federal Government of Nigeria. More jobs will be created and this in turn shall meet Ebonyi State government financial, socioeconomic, and material obligations to the host communities. The favourable enabling environment ensures that the Stadium shall continue to exist for decades as a business venture and as an industry. This project will be partly funded by the Ebonyi State Government.

2.5.4 Social Sustainability of the Project

To ensure the social sustainability of the project, the Ebonyi State Government will ensure:

a) ***Robust and sustained stakeholder engagement****:* Ebonyi State Government will ensure sustained and effective Stakeholder Engagement in a structured and culturally appropriate manner with affected communities principally, Agbaja-Unuhu and Enyima-Agu Communities The consultation process will be tailored to the risks and impacts of the Project; the Project's phase of development; the language preferences of the affected communities; their decision-making processes; and the needs of disadvantaged and vulnerable groups. In the demonstration of Ebonyi State Government's social policies, robust community engagement was instituted as part of the ESIA work (details are presented in Chapter Four).

b) ***Establish a grievance mechanism:*** This shall be designed to receive and facilitate the resolution of concerns and grievances about the project's environmental and social performance as part of its Environmental and Social Management System (ESMS). Potential sources of grievances and acts of sabotage could include community youth groups, tribal conflicts, etc.

c) ***Security Surveillance of the Stadium:*** Encroachment and breach of Stadium security by a third party that can typically cause safety and environment incidents shall be monitored. Monitoring will include

i. Human tampering;

ii. Acts of terrorism.

2.6 Project Options and Alternatives

Established ESIA processes including the requirements of Nigerian regulations call for an analysis of reasonable alternatives to various elements of the proposed project. To align with the Federal Ministry of Environment's (FMEnv) *National Environmental Protection (Effluent Limitations) Regulation of 1991* which mandates early selection of best engineering and operational options for new point sources, a range of alternatives and options were evaluated to facilitate identification of the most appropriate means of meeting the project's environmental objective.

Project alternatives analysis in environmental assessment is designed to bring environmental and social considerations into project selection as well as the early stages of project planning, and the later stages of site selection, design, and implementation. The benefits of evaluating alternatives are for the selection of the best project design, selection of the best project location, and most efficient use of resources which will aid avoidance of adverse impacts and achievement of sustainable development goals. Therefore, the following options and alternatives were appraised:

- Project options: No project options; Delayed project options; and Go-ahead option
- Project alternatives: Alternative location/site, alternative design/technology.

2.6.1 Project Options

- ***Option One: No Project Option***

This option assumes that the project will not take place which means that no further development will take place in Abakaliki LGA because of the non-viability of the feasibility studies. The No Project option will harm the local and national economies. The significant socio-economic and industrial development benefits associated with the proposed development such as increased business opportunities, increased revenue to the government, increased foreign exchange earnings, employment opportunities, etc.

will be forfeited. As a result, the 'No Project option' was not considered to be a viable or acceptable option for the proposed project.

- ***Option Two: Delayed Project Option***

Due to some unfavorable conditions such as civil unrest or hostilities within the stakeholder communities, malicious public opinion, unfavorable government policies, prevailing bad economic conditions, or any force majeure, implementation of a proposed project may be delayed. Considering this option implies that the development's activities would be stalled until conditions become conducive. Interestingly, none of the above mentioned or any related delaying factors currently exist against the proposed development, therefore the delayed project option was not considered a preferred option and thus was not selected.

- ***Option Three: Go-Ahead Option***

The Project option admits and emphasizes the vital need for the planned development. Considering its many benefits, this option was significantly weighed positive. This option will contribute to improved and increased production which will enhance the revenue base of Nigeria. It will also enhance job creation and many more direct and indirect socio-economic benefits. This Go-Ahead option was deemed viable and therefore considered. The proposed project should therefore be executed as planned.

2.6.2 Project Alternatives

The identification and investigation of alternatives is a key aspect of the ESIA process. Therefore, all reasonable and feasible alternatives were identified and assessed during the scoping phase to determine the most suitable alternatives to consider and assess during the ESIA phase. The preferred project alternatives are highlighted and presented here.

Alternatives can typically be identified according to:

a) Technology alternatives;
b) Site/Location alternatives
c) Stadium type and Structural Alternatives

For any alternative to be considered feasible such an alternative must meet the need and purpose of the development proposal without presenting significantly high

associated impacts. The alternatives are described and the advantages and disadvantages are presented. It is further indicated which alternatives are considered feasible from a technical as well as environmental perspective.

Incremental alternatives typically arise during the ESIA process and are usually suggested as a means of addressing identified impacts. These alternatives are closely linked to the identification of mitigation measures and are not specifically identified as distinct alternatives. This section provides information on the development of footprint alternatives, as well as the type of activity, activity layout, technological and operational aspects of the activity.

Alternative 1: Site/ Location Alternatives

Several alternative sites for the Stadium location were evaluated such as Abakaliki, Afikpo, and Onueke. Selection of the preferred location (Abakaliki) for the Stadium was based on the following criteria (amongst others);

a) It falls within the state capital which has experienced a major transformation
b) Three to five stars hotels to accommodate people during major sporting activities are many in Abakaliki
c) Transport: Proximity to the major road;
d) Sensitive area (Many of the existing environmental resources/values are not of prime importance) The project site: (1) does not contain any valuable ecological resources (either terrestrial or aquatic), (2) does not contain any items of archaeological significance or historical importance, (3) is not subject to floods or seismic disturbances, (4) is not heavily populated; The unit shall be located at least a radial distance of 3km away from any human habitation and (5) is not the location of significant mineral resources or mining activities.
e) Availability of already acquired land*:* Taking the proposed development to another location will mean that a new land will have to be acquired. Shifting the project to another location will incur additional cost on investment because new land has to be purchased, a new business strategy needs to be adopted, etc. This action plan will also result in a loss of time. The necessary approval for the current site has been obtained and all required fees have been paid by the Ebonyi State Government.

Alternative 2: Stadium type and Structural Alternatives

Mini Stadium is a stadium that hosts only football activities and training. It is just a park with a seating capacity between 5,000 to 10,000. It cannot host other sporting activities because of its size. Since it is a mini stadium and most times local, the structural designs are not always made based on the local standards. As such, it cannot host international sporting competitions.

Olympic Stadium is also known as a multi-purpose stadium which means that it can be used for many sporting activities both national and international. It increases valuable tourism, which can boost local economies. The Olympics increase a host country's global trade, stature, and create a sense of national pride. This is the preferred alternative.

Having chosen the Olympic Stadium over the mini-stadium, the proposed International Olympic Stadium shall strictly adhere to international and national engineering design, construction standards, and codes of practices which shall be adopted at all stages of the proposed project development to ensure the technical viability of the project. During the operational stage, the proposed Stadium shall enable access to modern and standard sports facilities which will help the youth of the state to channel their energy into positive and productive uses with the prospect of projecting the state into national and International limelight through hosting and participation in sports competitions.

Alternative 1: Technology Alternatives

Conventional technology.

This technology is not environmentally friendly and has led to an increase in Greenhouse Gases (GHGs) in the atmosphere causing climate change.

Green Stadium Technology

The proposed International Olympic Stadium shall strictly adhere to international and national terminal engineering design, construction standards, and codes of practices of the green stadium which shall include rainwater harvesting, recycling wastewater, using wind turbines for energy, installing solar panels, planting rooftop gardens and green fleet vehicles which will help to leave tremendous carbon footprints. Going with Green stadium technology shall help mitigate climate change and bring substantial benefits

which shall include reduced operational costs, reduced capital asset life cycle costs, greater utilization of assets, improved benefits to the community, optimization of new and better technologies, as well as reduced environmental, health and safety risks.

2.7 Summary

Having considered several of the project's options in terms of their social, economic, technical, and environmental implications/benefits both in the short and run, the project option which gives credence to the execution of the proposed project was selected. In an attempt to select the Best Available Technique (BAT) in line with the National Environmental Protection (Effluents Limitation) Regulations 1991, many alternatives were also considered which favours the selection of execution of the proposed project on the selected site based on its viability. Therefore, the proposed project should be executed as planned.

CHAPTER THREE
PROJECT DESCRIPTION

3.1 Background Information

This chapter provides details on the proposed International Olympic Stadium construction, installation, and operational processes. The details cover the nature of the key project activities, facilities, equipment, operations, personnel, and the implementation schedule. The aim is to enable the scope and extent of the project to be understood, and for all potential sources of impacts to be identified. It is also to facilitate the selection of best available techniques (BAT) as required by the National Environmental Protection (Effluent Limitations Regulations) of 1991. Ebonyi State Government intends to design, install, and operate the plant in line with the best international standards.

3.2 About the Proponent and Project

Ebonyi State Government intends to construct and develop a FIFA and IAAF compliant 30,000 (Thirty thousand) seating capacity international stadium and other sporting facilities of international standard to be sited at Abakaliki Local Government Area which is the state capital. The goal is to boost the development of sports at the state level with excellent sporting facilities with the highest standard in football, Athletics, and other sports. The excellent facilities shall also be used for hosting local, national, and international sporting activities. They shall be used for participation training of athletes, coaches, and sporting officials. They can also be used for sporting talent hunting and nurturing. They are designed as multifunctional facilities for sporting and non-sporting activities such as social, political, and religious gatherings. With the development of these modern and standard facilities and infrastructure, sports can be used to attract the attention of the world to Ebonyi State

Ebonyi State is in south-eastern Nigeria. It is inhabited and populated primarily by the Igbo with the city of Abakaliki as its capital and largest city. Other major townships include Afikpo, Onueke, Effium, Aba Omege, Ezzamgbo, Edda, Amasiri, Unwana, Echara Ikwo, Egu-Ubia, Ụbụrụ, Onicha, etc. It was one of the six states created in 1996 by the then federal military government of General Sani Abacha. The State of Ebonyi was created from parts of both Enugu State and Abia State, which were the Abakaliki division from Enugu State and the Afikpo division from Abia State respectively. It has three senatorial zones, the Abakaliki division makes up Ebonyi North and Ebonyi Central senatorial zones, while the Afikpo division

makes up the Ebonyi South senatorial zone. Ebonyi has thirteen local government areas as well as local development centres created by the state government. It is home to six prominent higher institutions of learning: Ebonyi State University, Abakaliki (EBSU); Alex Ekwueme Federal University Ndufu Alike Ikwo; Akanu Ibiam Federal Polytechnic, Unwana; Federal College of Agriculture, Ishiagu; Ebonyi State College of Education Ikwo (EBSCOEI) and College of Health Sciences, Ezzamgbo.

3.3 Project Location

The proposed project area covering an extent of 40 hectares falls on longitude 8.01671, latitude 6.29332 for point A, longitude 8.10666, latitude 6.28987 for point B, longitude 8.10661, latitude 6.28661 for point C, and longitude 8.11158, latitude 6.28388 for point D. This location cuts across 2 communities namely: Agbaja-Unuhu and Enyima-agu communities in Abakaliki Local Government Area of Ebonyi State. The location has good proximity to a major Afikpo Road with no cultural heritage.

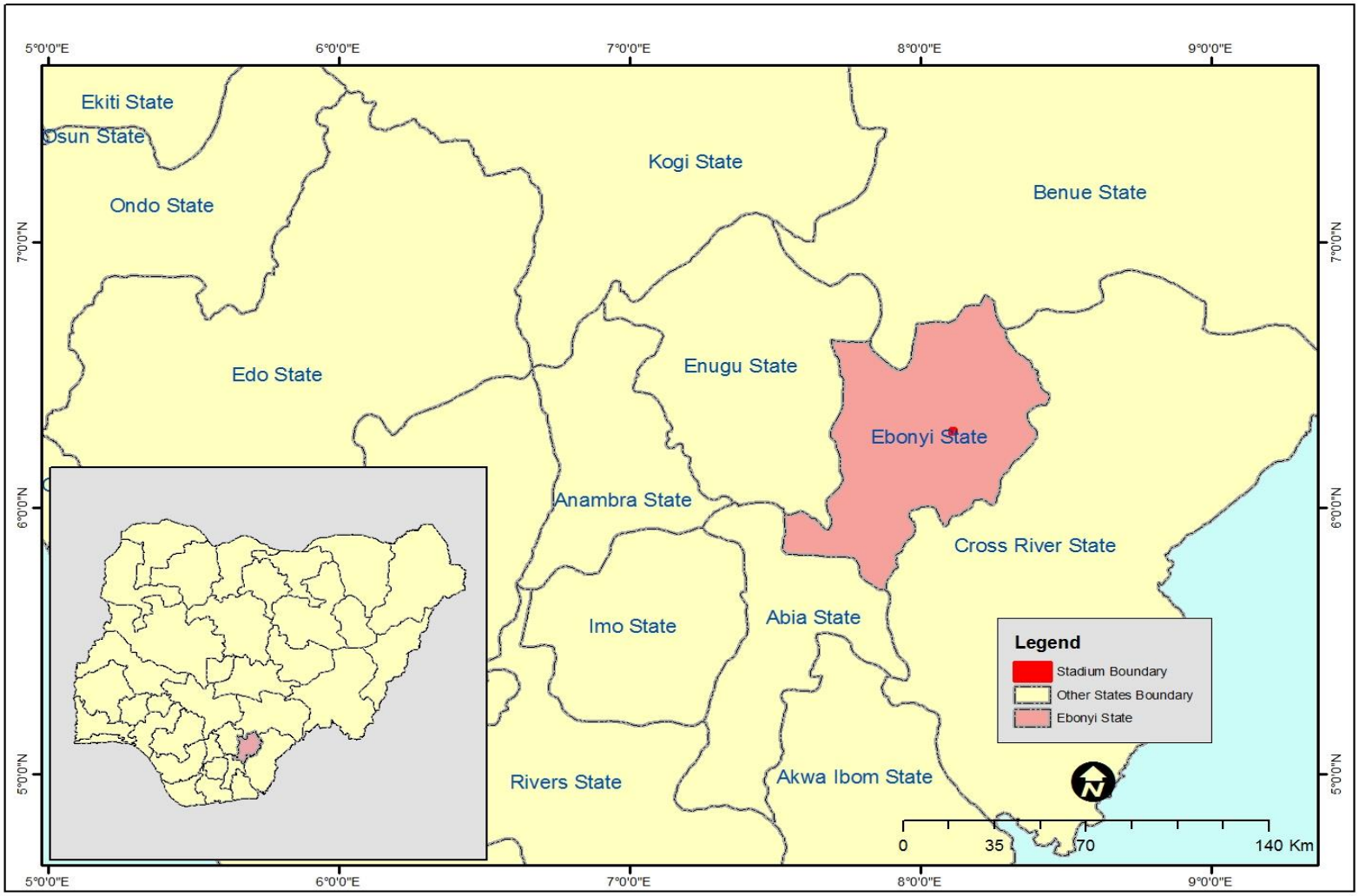


Figure 3.1: Map of Nigeria showing Ebonyi State with the project location

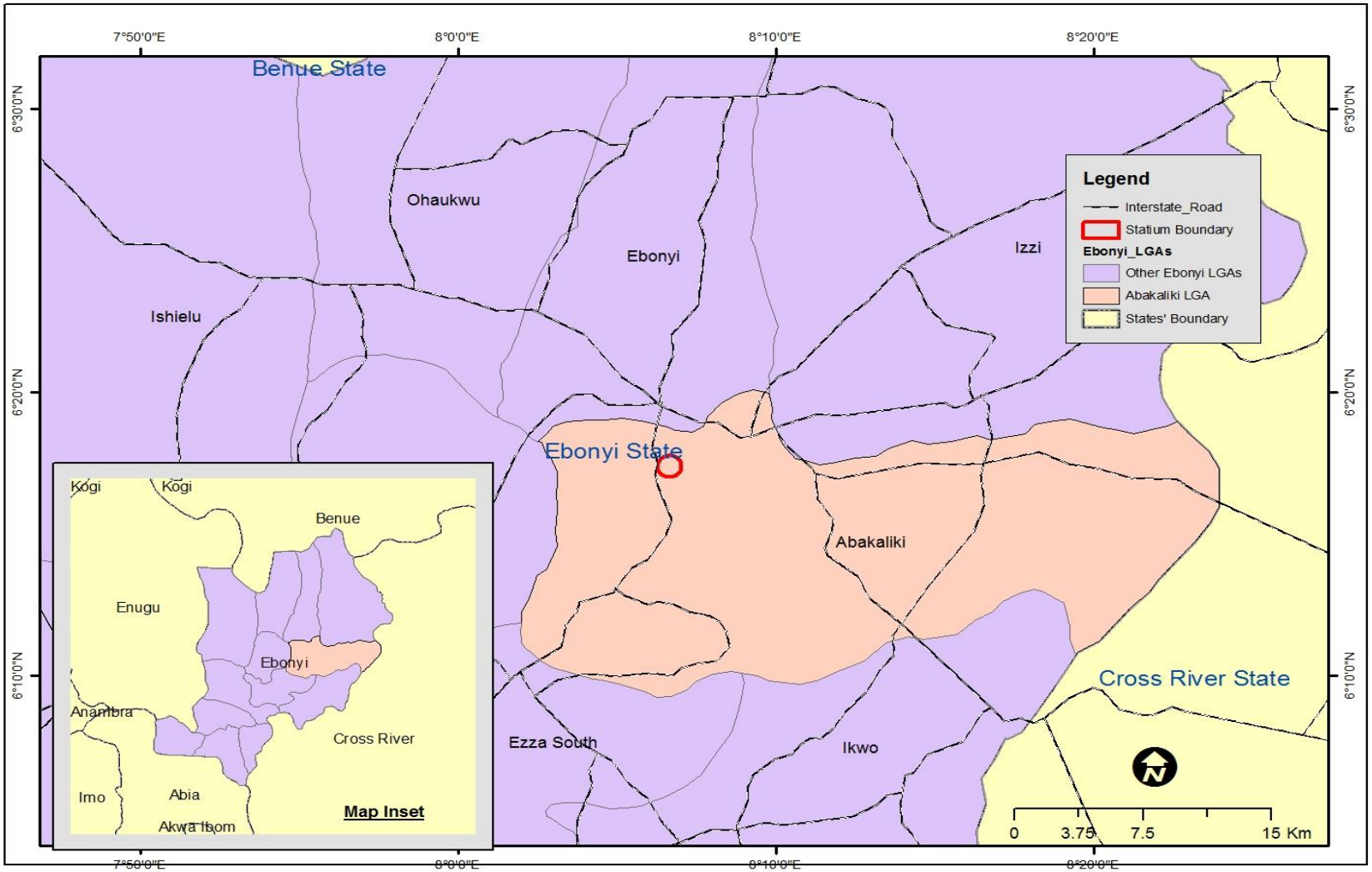


Figure 3.2: Map of Ebonyi showing the project Location (Abakaliki LGA)

Plate 3.1: The Proposed Project location

3.4 Description of the Proposed Project Overall Activity

3.4.1 Description of the Proposed International Olympic Stadium

The Stadium master plan includes but not limited to the following facilities:

1. 30,000 seating capacity main Bowl (Track and field events)
2. Olympic size swimming pool
3. Indoor Sports hall
4. Volleyball courts
5. Basketball courts
6. Handball courts
7. Tennis courts
8. Squash courts
9. Hockey court
10. Technical building
11. Main Bowl training pitches

Main bowl features

1. Reception halls
2. Accreditation room
3. Two Seminar rooms
4. Stadium manager's office
5. Ten Administrative offices
6. Security room
7. Protocol rooms
8. Worship area
9. Four players' changing rooms
    i. Lockers rooms
    ii. Physiotherapy rooms
    iii. Jacuzzi baths
    iv. Sauna baths
    v. 14 showers each (x4)

vi. Foot basins

vii. Cold Store

viii. Dry stores

ix. Equipment stores

10. Match officials changing rooms
11. Four match review rooms
12. Two mixed zones
13. Doping room/Laboratory
14. Referees changing rooms
15. Clinic

a. Two private wards

b. Consultant's/Doctors' room

c. Clinic reception

d. Two toilets

e. Ambulance bay

16. VIP lounges
17. Restaurants
18. Offices
19. Lounge
20. Secretary
21. Dining room
22. Podium
23. State box
24. Restaurants
25. VIP lounges
26. Two conference rooms
27. Two meeting rooms
28. Post-match interview room
29. Lettable spaces
30. Police station with holding cells
31. Event management office

32. Dressing room for ball boys (kids)
33. Media centre (media working area)
34. Media tribune
35. Flash interview positions
36. Accreditation office for media
37. General Spectators' area (Able and Disable)
38. Ticketing
39. Shops
40. Shops (Kiosks)
41. Twenty-two lettable shops
42. Public toilets (Males and Females)
43. Twenty-two corporate and hospitality suites
44. Control rooms
45. Technical room
46. Camera platform
47. Standard FIFA pitch
48. 8-lane IAAF standard tracks

3.4.2 The Project Activities

The project activities will broadly cover the following areas:

- **Pre-construction activities include**
  - site preparation,
  - engineering design,
  - materials delivery, etc.
- **Construction activities include**
  - construction of 30,000 seating capacity main Bowl (Track and field events)
  - construction of office complex, courts e.t.c
  - installation of various equipment, power generation equipment, etc.)
  - civil works.

- **Operational activities include**
  - operation of the Stadium,
  - Maintenance of the Stadium and
  - Movement of spectators/teams in and out of the Stadium etc.
- **The decommissioning activities include**
  - Removal of Stadium components for relocation or sale

Description of the Project's Construction Activities

Pre-construction Investigations

The implementation of the project‟s design and construction phase will start with a thorough investigation of the site‟s biological and physical resources to minimize any unforeseen adverse impacts during the project cycle.

Sourcing and Transportation of Building Materials

Building materials will be transported to the project site from their extraction, manufacture, or storage sites using transport trucks. The building materials to be used in the construction of the project will be sourced from neighbouring areas. Greater emphasis will be laid on the procurement of building materials from within the local area, which will make both economic and environmental sense as it will reduce the negative impacts of transportation of the materials to the project site through the reduced distance of travel by the materials transport vehicles.

Clearance of Vegetation.

The site has some vegetation cover including grass growing in it. All cleared vegetation will be replaced through landscaping.

Storage of Materials

Building materials will be stored on site. Bulky materials such as rough stones, ballast, sand, and steel will be carefully piled on site. To avoid piling large quantities of materials on-site, Ebonyi State Government shall order bulky materials such as sand, gravel, and

stones in bits. Materials such as cement, paints, and glasses among others shall be stored in temporary storage structures, which will be constructed within the project site for this purpose.

Excavation and Foundation Works

The soil cover in the proposed area is thin and the subsoils are exposed to the surface in some areas, with a thin layer of black cotton soil about 4 inches deep. However, this shall be excavated and disposed of in approved sites (preferably exhausted quarries).

Masonry, Concrete Work, and Related Activities

The construction of the stadium walls, foundations, floors, pavements, drainage systems, perimeter fence, and parking area among other components of the project shall involve a lot of masonry work and related activities. General masonry and related activities will include stone shaping, concrete mixing, plastering, slab construction, construction of foundations, and erection of building walls and curing of fresh concrete surfaces. These activities are known to be labour intensive and will be supplemented by machinery.

Structural Steel Works

The stadium and associated facilities will be reinforced with structural steel for stability. Structural steelworks will involve steel cutting, welding, and erection.

Roofing and Sheet Metal Works

Roofing activities will include sheet metal cutting, raising the roofing materials such as iron sheets and structural steel to the roof, and fastening the roofing materials to the roof.

Electrical Work

Electrical work during construction of the premises shall include installation of electrical gadgets and appliances including electrical cables, lighting apparatus, sockets, etc. Besides, there shall be other activities involving the use of electricity such as welding and metal cutting.

Plumbing

Installation of pipe-work for water supply and distribution shall be carried out within the entire stadium.

Landscaping

To improve the aesthetic value or visual quality of the site once construction ceases, the proponent shall carry out landscaping. This shall include the establishment of a theme garden and lush grass lawns where applicable and shall involve replenishment of the topsoil. It is noteworthy that Ebonyi State Government shall use plant species that are available locally preferably indigenous ones for landscaping.

Buildings Construction

The proposed International Olympic Stadium would cover an area of approximately 40 hectares with an approximate floor area of 1,750,000 square feet. It is anticipated to be a steel-structured stadium that would meet all state and local seismic standards. For design flexibility, the new stadium would have a maximum height of 250 feet above the ground surface including any lighting and architectural features on top of the structure. The stadium shall be four levels and include a fixed partial roof covering a portion of the seating area. The proposed fixed partial roof stadium would have a capacity for 30,000 spectators.

The overall design would meet FIFA and IAAF Standards and also meet current state and local seismic standards. Additionally, the design would consider building user safety, security, and functionality.

The technology used in the design and construction of the stadium will be based on international standards, which have been customized by various stadia in Nigeria. The project will consist of a stadium with associated facilities, parking lots, and infrastructure as presented in the architectural drawings in this project description.

The stadium will be constructed as per the respective structural engineer's detail as provided for in the drawings presented in this chapter. The stadium structures will consist

of concrete appropriately reinforced with metal (steel and iron). The roof will consist of structural steel and roofing sheets. The stadium will be provided with a well-designed concrete staircase for ease of access.

The stadium will be provided with facilities for drainage of stormwater from the roof through peripheral drainage systems into the drainage channels provided and out into the natural drainage channel/system. Drainage pipes will be of the PVC type and will be laid under the stadium and the driveway encased in concrete. This is a densely built area and such need for public drainage channel suffices. The stadium will have adequate natural ventilation through the provision of permanent vents in all habitable rooms, adequate natural and artificial light, piped water stored in above-ground water tanks, and firefighting facilities.

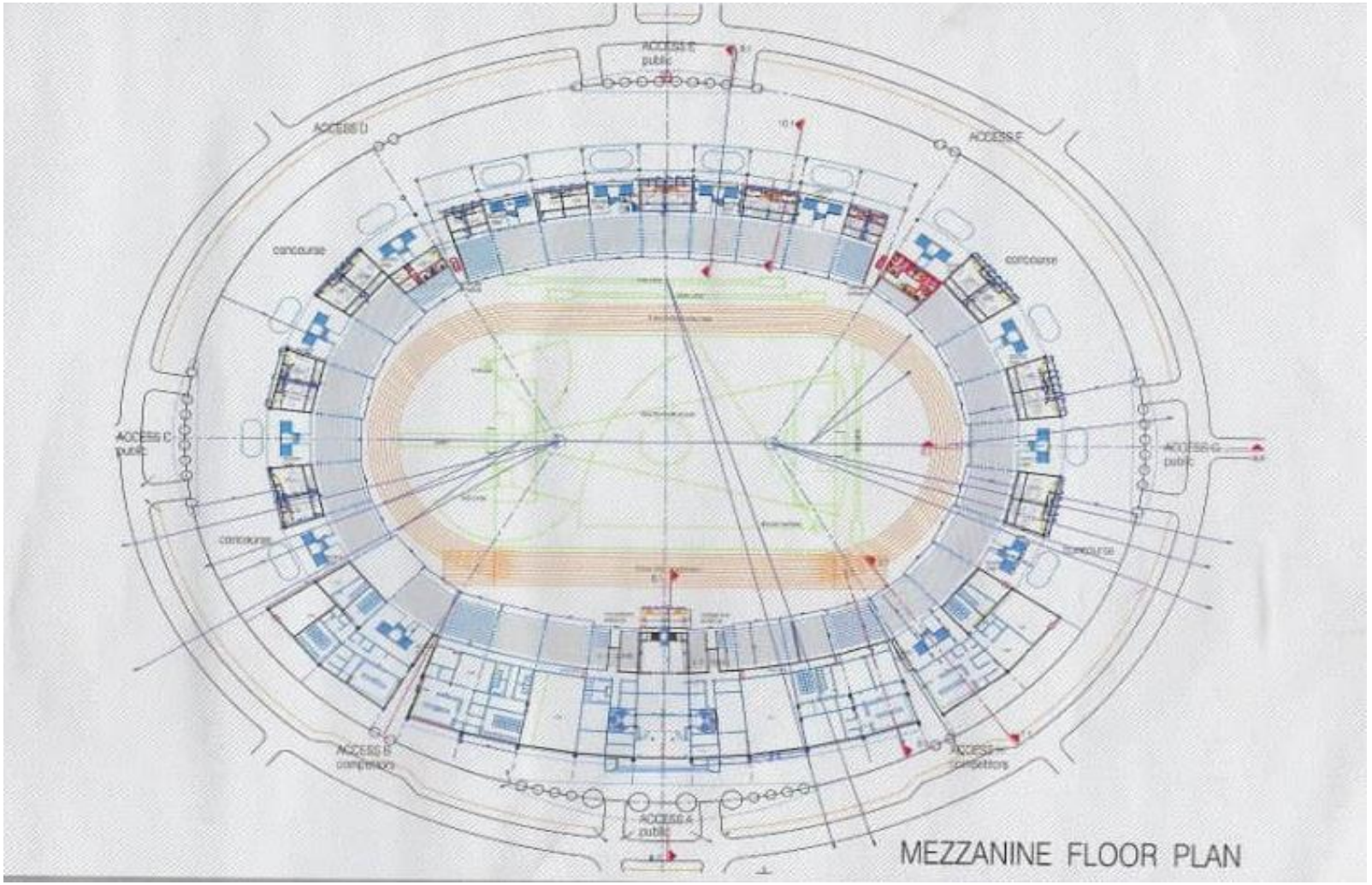


Figure 3.3: Mezzanine Floor Plan

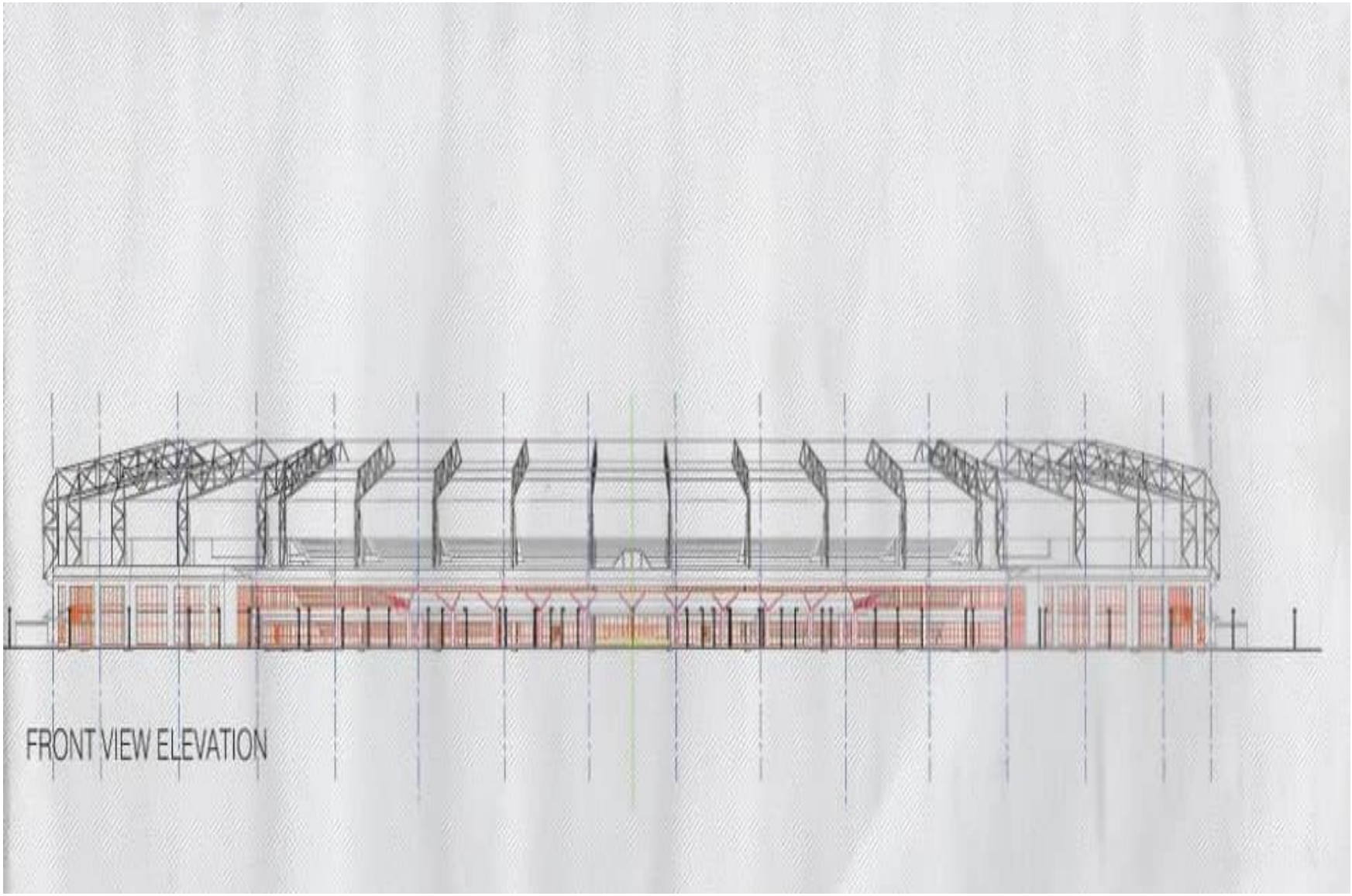


Figure 3.4: Front Elevation

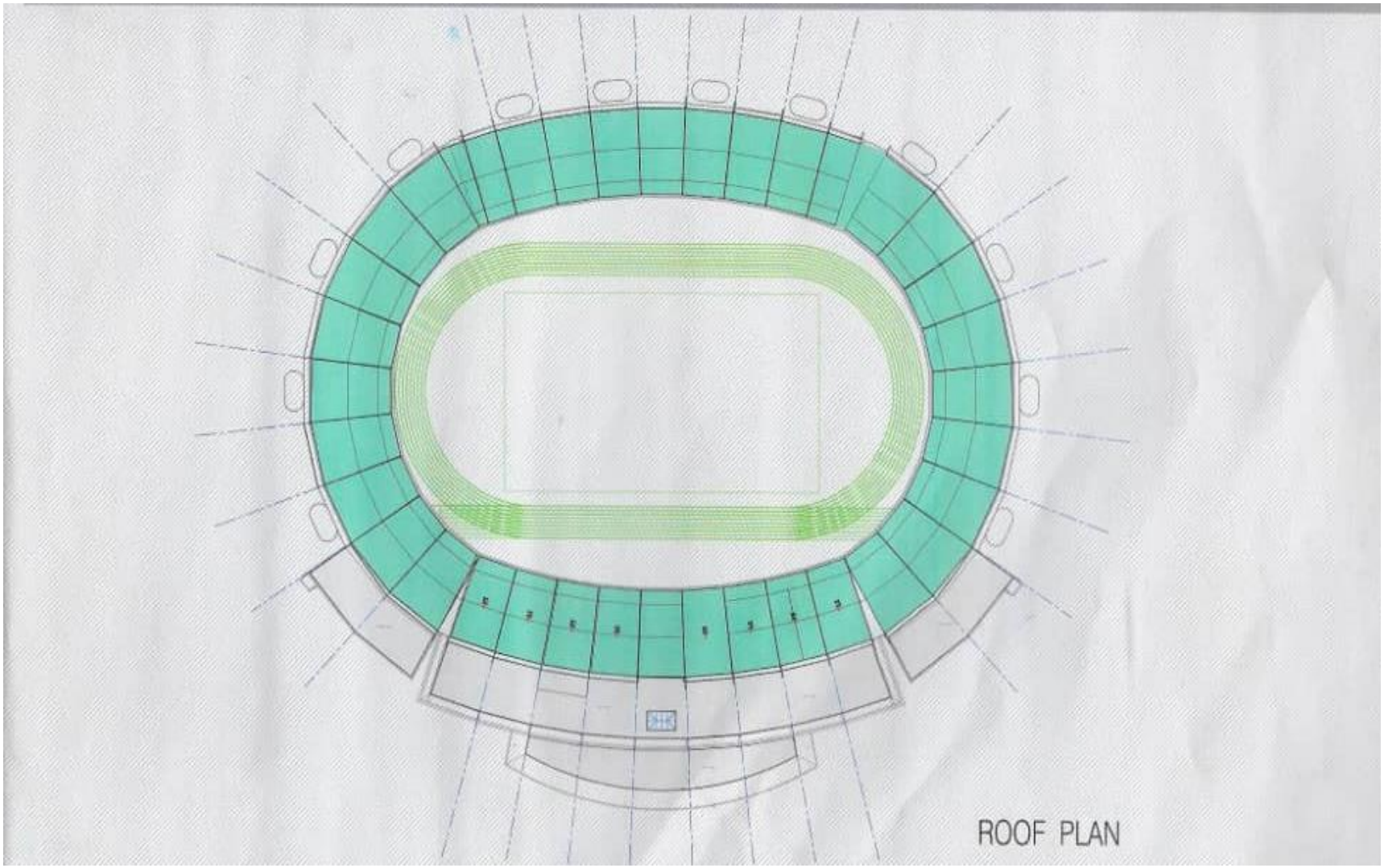


Figure 3.5: Roof Plan

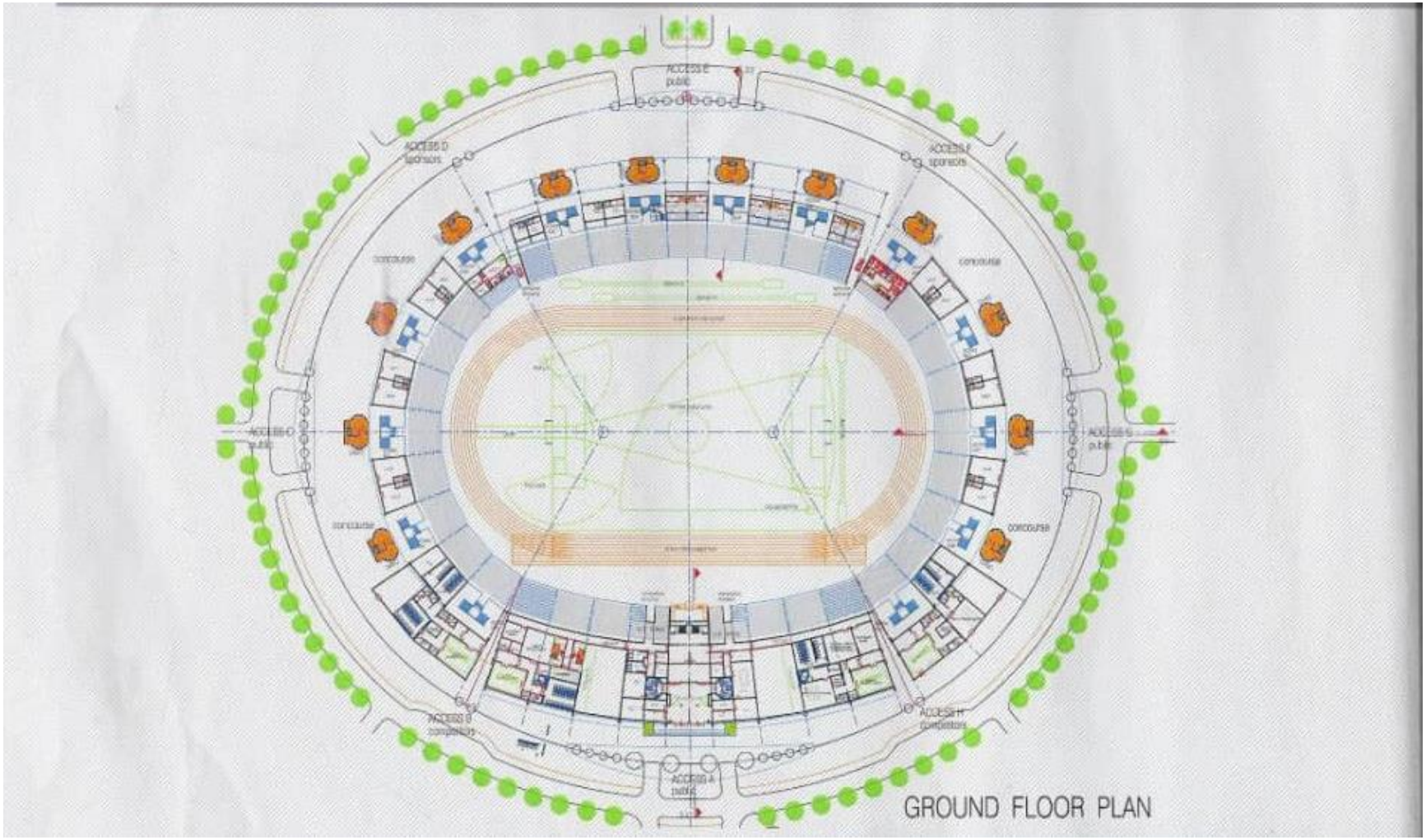


Figure 3.6: Ground Floor Plan

Parking Lot

The parking lot shall be designed to improve access in and out of the proposed stadium. The on-site collector roads shall be connected to preferred and general parking zones and to create safe passageways to the stadium for the users to avoid interacting with inbound or outbound traffic flow.

Several reserved parking stalls shall be provided for cars and buses. Service and security vehicles and TV broadcasting/satellite trucks would have dedicated spaces located as not to interfere with the normal game day in and out of traffic flow. Larger individual stalls shall be provided to avoid visual interference with the natural flow of inbound and outbound traffic patterns.

The stadium would incorporate design features to enhance and improve attendees' approach with pedestrian linkages integrated with a layered security strategy. Nearest to the building shall be the ticket gates and entries, with the most secured layer being not less than 100 feet from any stadium structure. Farther out from this point at 200 to 300 feet shall be the security screening point with the user queuing area beyond that. This layered perimeter approach to the stadium entrances shall be in a plaza setting with landscaping accents.

Seating

The proposed stadium would have a seating capacity of 30,000 seats in four tiers of seating. The permanent regular seating configuration would include general seating for 20,000, and premium seating for 5,000 composed of 3,800 boxes, club, and very important person (VIP) seats, as well as 1,000 suite seats. There shall be 200 of the seats designated for disabled and companion seating. On the other hand, the temporary seating configuration would include general seating for 5,000 spectators.

Stadium Lighting

The new stadium would include lighting consisting of stadium event lighting and exterior stadium lighting (i.e., building perimeter lighting and parking lot lighting), as well as interior

emergency lighting. The event lighting would include an outdoor metal light-emitting diode (LED) or similar energy-efficient luminaire floodlights with internal reflector systems to control spill light and glare.

The lighting shall be a minimum of 1,500 watts per fixture and the fixtures shall be mounted within the partial roof of the proposed stadium; mainly along and on both sidelines of the playing field and would not extend above the stadium structure. The foot-candle level provided shall be consistent with high definition (HD) broadcast levels. Lighting levels in the stands would gradually taper off from the maximum light intensity levels on the playing field. Emergency lighting would provide approximately 2 foot-candles average illumination for an emergency exit from the seating area and the playing field.

The exterior lighting at the proposed stadium shall be designed to illuminate pedestrian paths and parking areas around the stadium. Existing parking lot lighting shall be more energy-efficient light standards.

Sustainable Design

The proposed stadium would include energy efficiency, water conservation, low-impact development, and other green building practices, which shall be incorporated into the final design to meet FIFA and IAAF standards. Energy conservation measures would also include the use of solar photovoltaic energy. When coupled with a parking shade canopy, the photovoltaic system provides shade while generating electricity.

Other energy-saving measures include the use of LED lighting inside and outside the stadium and for the scoreboard and field signs. A comprehensive energy control system shall be included utilizing motion sensors and photocells to avoid over lighting. Other anticipated energy-saving features would likely include the building orientation, use of low-flow plumbing fixtures, use of high-efficiency electrical fixtures, an integrated recycling program.

Fire Safety

Fire and Gas System

The F&G Detection System is designed and installed to provide detection of fire or leak of flammable gas, rapidly and reliably. It continuously monitors all areas where a fire or accumulation of a flammable/explosive gas mixture may occur. The Fire and Gas system is not generally related to any particular process but instead is divided into fire areas by location. Each fire area is designed to be self-contained, in that it should detect fire and gas by several types of sensors, and control fire protection and firefighting devices to contain and fight the fire within the fire area. A fire area protection datasheet shows what detection exists for each fire area, and which fire protection action should be taken in case of an incident. The type and number of the detection, protection, and fighting devices depends on the type of equipment and size of the fire area and they vary for different process areas. The key features of the F&G detection system are highlighted below.

Fire detection:

- Gas detection: Combustible and toxic gas, electro-catalytic or optical (IR) detector
- Flame detection: Ultraviolet (UV) or infra-red (IR) optical detectors
- Fire detection: Heat and ionic smoke detectors
- Manual pushbuttons

Firefighting, protection:

- Gas-based firefighting, such as CO_2
- Foam-based firefighting
- Water-based firefighting: sprinklers, mist (water spray), and deluge
- Protection: Interface to emergency shutdown and HVAC fire dampers.
- Warning and escape: PA systems, beacons/lights, fire door, and damper release

For fire detection, coincidence and logic are often used to identify false alarms. In such schemes, several detectors in the same area are required to detect a fire condition or gas

leakage for an automatic reaction. This will include different detection principles, e.g., a fire, but not welding or lightning strike. Action is controlled by a Fire and Gas system (F&G). Like the ESD system, F&G action is specified in a cause and effect chart called the Fire Area Protection Datasheet. This chart shows all detectors and fire protection systems in a fire area and how the system will operate. The F&G system provides supervisory functions, either in the F&G or the Information Management System (IMS) to handle such tasks as maintenance, calibration or replacement, and hot work permits, e.g., welding.

- Firewater trucks shall also be included in the Stadium.

3.4.3 Muster Points

Muster points have been designated to allow personnel to:

- Assemble/muster in relative safety;
- Monitor and have certain control functions to mitigate the effects of the incident;
- Evaluate the incident as it develops;
- Make effective command decisions regarding control of the incident, deployment of emergency response teams and should it be necessary, the ultimate evacuation and abandonment of the installation; and
- Carry out essential communications, to alert emergency groups, to communicate with personnel, and to assist with the coordination of rescue.

3.4.3.1 Water Supply and Consumption

Stadium water supply to the site shall be from borehole water piped to the site and stored in the raw water storage tank. The raw water storage tank will have a capacity of 1,200 m^3 which will be sufficient for water storage for a few days in case of disturbance to the raw water supply. A mini water treatment plant of 39.65m^3 (6.1m x 2.5m x 2.6m) shall be made for the Project to supply processed water for the closed-circuit cooling system and general service water to the Stadium and potable water to the office buildings. Also, two fire/service water storage tanks with a capacity of 700m^3 each will be installed with a 300m^3 fire water reserve. The Stadium shall require approximately 1000 m^3 of water from the boreholes per day.

3.4.3.2 Drainage System

Well-constructed and well-maintained drainage channels shall be installed to accommodate events of flood. The drainage channels shall run the entire perimeter of the Stadium.

Figure 3.7: 3D Site Layout of the Stadium

Figure 3.8: 3D Site Layout of the Stadium

Description of the Project's Operational Activities

Solid Waste

The proponent will provide facilities for handling solid waste generated within the facility. These will include dust bins/skips for temporarily holding waste within the premises before final disposal at the designated dumping site. The solid wastes from each block will be assembled in the garbage collection point ready for disposal by a Ministry of Environment licensed waste disposal company. Private waste disposal companies that are approved by the Ministry of Environment will be responsible for solid waste disposal.

Waste Water and Stormwater Management

Sewage generated from the stadium will be discharged through Ebonyi State Environmental Protection Agency (EBSEPA) with cradle to grave management of these wastes.

Cleaning

The Ebonyi State Government shall be responsible for regular washing and cleaning of the entire stadium. Cleaning operations shall involve the use of substantial amounts of water, disinfectants, and detergents.

General Repairs and Maintenance

The stadium and associated facilities shall be repaired and maintained regularly during the operational phase of the project. Such activities shall include repair of stadium walls and floors, repairs and maintenance of electrical gadgets and equipment, repairs of leaking water pipes, painting, maintenance of flower gardens and grass lawns, and replacement of worn-out materials among others.

Stadium Operations and Use

The proposed stadium box office would be located on the ground level of the stadium. The box office is expected to be open year-round from 9:00 a.m. to 5:00 p.m. Monday through

Saturday and for 3 hours before kick-off on Saturday and Sunday home game days during football season.

The proposed stadium would be designed specifically for use for international sports activities and by an NPFL team. The proposed stadium, however, is expected to be used for other non-NFF events that are similar to the type of events that have occurred at other Stadia across Nigeria. Table 3.1 includes a list of event types that could occur at the proposed International Olympic Stadium.

Table 3.1: Summary of Anticipated Events at the Proposed Stadium

Event	Projected Proposed Stadium Event Days	Projected Proposed Stadium Attendance	Projected Proposed Stadium On-site Parking Usage
STADIUM EVENTS			
NFF Football			
Qualifier (Men)	6games	30,000	1000
Qualifier (Women)	6games	10,000	500
All African Games	10Games	30,000	1000
Other Sporting activities		30,000	1000
NPF Football			
NPFL Pre- & Regular Season	10 home games	5,000	14,000
NPFL Post-Season	2 games	5,000	12,000

Other Events			
High School Football	3 games	2,000	200
Soccer Games	5	30,000	1,000
Concerts	2	30,000	1,500
MISCELLANEOUS EVENTS			
Large Events	10	15,001-20,000	
Medium Events	52	5,001-15,000	
Small Events	55	501–5,000	
Minor Events	195	Less than 500	

NPFL Football Games

The NFF season generally occurs between August and January and consists of 20 total game days, with each team participating in a minimum of 18 games (with 9 of those games played on the team's home field). Training camp typically opens off-site in late July.

NPFL football events would occur on weekends with occasional Monday and/or Thursday evening games. Weekend games would occur on either Saturday (typically only during preseason and post-season) or Sunday (all season) with start times of around 1:00 p.m. or 5:30 p.m. Weekday games typically have a start time of 5:30 p.m.

In addition to the pre-season and regular season NPFL games, there is also the possibility that up to two post-season playoff games could occur in the proposed stadium. The proposed stadium would also have the potential to host a Super Bowl game. The Super Bowl would likely only occur approximately once every 5 years.

Many attendees participate in tailgating activities before the start of each game. Many ticket holders arrive more than 2 hours before the start of each game. Tailgating activities would be restricted to attendees parking in designated areas of the parking lots.

Other Events

The remaining events are characterized as smaller stadium-type events and non-stadium events. Smaller stadium events include the championship high school football games, Polytechnic, and Universities games. Other stadium uses include soccer games, concerts, etc.

Non-stadium events would include functions within the on-site conference facilities and parking lot events such as car sales, recreational vehicle sales, law enforcement training, legal racing, fun runs, and cultural festivals.

Description of the Project's Decommissioning Activities

Decommissioning is an important phase in the project cycle and comes last to wind up the operational activities of a particular project. It refers to the final disposal of the project and associated materials at the expiry of the project lifespan (50 years). If such a stage is reached, the proponent needs to remove all materials resulting from the demolition/ decommissioning of the site. The following should be undertaken to restore the environment.

- Remove all underground facilities from the site
- The site should be well landscaped by flattening the mounds of soil and
- Planting indigenous trees and flowers
- All the equipment should be removed from the site
- Fence and signpost unsafe areas until natural stabilization occur
- Backfill surface openings if practical

Dismantling of Equipment and Fixtures

All equipment including electrical installations, furniture partitions, pipe-work, and sinks among others will be dismantled and removed from the site on decommissioning of the project. Priority will be given to the reuse of this equipment in other projects. This will be achieved through the resale of the equipment to other stadia owners or contractors or donations of this equipment to schools, churches, and charitable institutions.

Site Restoration

Once all the waste resulting from demolition and dismantling works is removed from the site, the site will be restored through the replenishment of the topsoil and re-vegetation using indigenous plant species.

3.5 WASTE MANAGEMENT

3.5.1 WASTE MANAGEMENT PLAN

Ebonyi State Waste Management Plan (WMP) for this Project will focus on the handling, storage, and disposal of waste / hazardous materials. As the first step of the management plan, types of waste and its possible sources shall be identified. For each identified waste component and its source, a possible control method and disposal plan shall be worked out. Table 3.2 below presents a synopsis of the WMP.

Table 3.2: WMP for Stadium Construction and Operational Activities			
S/No	**Particular**	**Type/Quantity**	**Control/Disposal Plan**
During Construction			
1	1) all kind of soil/ construction or demolition wastes	-	• Construction wastes such as soil, brick, block e.tc will be used for levelling at the site, stockpile in the open area proposed to be developed as part of the landscaping area
	Municipal Waste (domestic and commercial)	• Kitchen wastes • Metal scrap and empty metal drum of non-hazardous material • Paper and wood scrap	• The waste shall be collected in designated wastes bins, segregated at source, and disposed of in line with FMEnv guideline through FMEnv accredited waste manager
	Hazardous waste	• Containers containing paint residue during the construction phase • Waste oil to be generated from DG	• Collected in a specially designated waste bin and disposed of in line with FMEnv guideline through FMEnv accredited waste manager • Waste oil shall be sold to a third party for reuse or recycling
		Service & Maintenance yard	• Segregate into usable & nonusable, and release non-usable scrap to scrap buyer.

2	Machinery cleaning wastewater	Oily cleaning water from service and maintenance yard	• Oil skimmed off in a saver pit, stored in a waste oil drum, and sold to discerning vendors for reuse or recycling.
3	Air pollution	1) Loading & haulage of materials	• Only sharp teeth shall be installed on the buckets of loading machines. • Operators & their helpers shall be provided dust masks
			• Water spraying shall be adopted at loading points and all long-haul roads to avoid /reduce dust being airborne. • Dense green belts would be planted around dust generation points and on both sides of haul roads, along slopes, etc.,
4	Noise pollution	Heavy earthmoving machinery (HEMM)	• All the construction machinery will be new and meet international standards and hence, the noise level will be well within the prescribed limit of 85 dB(A). • Noise level may fluctuate periodically and this impact remains localized.
			• Noise control measures include: • Provision of silencers, PPEs to all HEMM.

			• The machine shall remain off when not in use • Provision of earplugs/muffs to workmen. • Preventive maintenance of Construction equipment. • Reducing exposure time to high noise levels.
During Operation			
1	Domestic waste	Organic in nature	Will be handed to the local authority for disposal through FMEnv accredited Waste Manager
2	Waste from sport activities		Will be segregated as biodegradable and non-biodegradable and disposed of through FMEnv accredited Waste Manager
	Domestic Waste Water		Will be treated in Water Treatment Plant and the treated water will be used in flushing of toilets and irrigation purposes within the project premise
	Used oil from the DG sets		Used/Waste oil shall be sold to a third party for reuse or recycling

3.6 Independent Verification and Certification

Ebonyi State Government shall engage independent third-party experts to witness, audit, and participate in all aspects of the project design and implementation i.e., to verify the quality of engineering work which establishes that the project has been designed, fabricated, installed, pre-commissioned, and handed over following the relevant international and national codes and standards. Surveillance and verification activities associated with manufacture, fabrication, installation, and pre-commissioning will also be assigned to a third party in conjunction with Ebonyi State Government representation.

3.7 Project Health, Safety, Security and Environment (HSSE) Activities

The Company will appoint a dedicated HSSE Team for the Project which will be capable of meeting the Project Health, Safety, Security, and Environmental objectives through the implementation of procedures and technical activities. This Team will interface with all relevant departments to guarantee that all documents produced and activities performed during the designing and execution of the Project complies with the HSSE Plan, HSE Requirements, and objectives.

3.7.1 Traffic Plan

An appropriate plan shall be made for traffic to be created by the vehicular movement of goods, products, equipment, and personnel in and out of site to mitigate any anticipated traffic impact on existing traffic conditions of the area. A designated parking lot shall be designated for trucks and heavy-duty lorries. Movement of trucks, lorries shall be planned to avoid impact on the existing roads.

3.7.2 Site Security

The site shall be protected with a dual perimeter fence and gated. The security shall be on 24 hours' basis against. Access control mechanism and 24 hours CCTV cameral shall be installed to prevent unauthorized entry and any act of terrorism and sabotage. A team of civil and military personnel will constitute the security team.

3.8 Nigerian Content

3.8.1 Selection of contractors and vendors

Ebonyi State shall make concerted efforts to empower more Nigerians and Nigerian companies to render key services. Such service will cover every aspect of the project that can be effectively carried out by Nigerian vendors, either alone or in conjunction with other companies, with the sole aim of ensuring competencies in the job contracted. As required by law, bids that seek to maximize local content without jeopardizing the quality of the job and within 1% in financial magnitude to best commercial qualifying bid will be uppermost during consideration.

3.8.2 Fabrication Structural fittings

With the prevalence of local service companies and mills, 45% of pipe spools shall be sourced from within Nigeria. Preparation of Fabrication Drawings / Isometric drawings, Procurement of Materials, welding as per ASME using qualified welders, Complete Fabrication including marking, cutting, rolling, and welding as per the required codes/standards, Complete QA/QC documentation and as-built drawings, shall be domiciled within the country.

3.8.3 Employment

i. Project Execution and Delivery

Employing competent and qualified local contractors to provide technical and non-technical services and support is key to this project. Nigerian engineers and technicians shall make up the bulk of the workforce during the execution of the International Olympic Stadium proposed. Welders, pipe-fitters, scaffolders, and other artisans shall be Nigerians, except wherever such competencies are lacking; and locals shall be given requisite training in such fields to enable them to carry out the tasks required of them. The project team constituted shall be 60% Nigeria nationals.

ii. Operation of Stadium during its life-time

Without mincing words, the Ebonyi State Government is committed to employing 90% of its operators, engineers, and technicians to be Nigerians with 50% of the workforce coming from the host and impacted communities. The phase-out plan and the consequent training program will be based on the specific training needs and professional requirements of the target positions. Upon qualifying for the relevant position by Nigerian personnel, the position held until that time by the expatriate shall be filled by the Nigerian, thus increasing the Nigerian content of the company concerned as required.

3.8.4 Training

Training and capacity development of manpower for Ebonyi State Government International Olympic Stadium shall be outsourced mostly to wholly indigenous Nigerian companies. For specialized training not available in Nigeria, foreign counterparts with the requisite capability shall be mandated to carry out the training in Nigeria with the aim of maximizing utilization of Nigerian training venues, hotels, and a host of associated services. Training will only be done outside the Nigerian shore if the gadgets, equipment, and specialized infrastructure are unavailable in Nigeria or unfeasible to domicile in Nigeria. Barring all these, 95% of the training will be done in Nigeria.

3.8.5 Materials sourcing

Crushed rock, gravel, sand, and clay are ubiquitous building materials that will be used for the construction of the dwellings, and in the construction industry for civil engineering works such as roads, buildings, bridges, and sumps. The acquisition, sourcing, and utilization of these raw materials and other building materials such as cement, structural rods, and associated fittings will be done in Nigeria in its entirety.

3.8.6 Engineering design

i. Options selection and project definition studies shall be done 100% in Nigeria. Feasibility studies, site selection, soil tests needed for foundation design, and other such preliminary data gathering and computation will be done 100% in Nigeria.

Process study reporting, risk analysis, and preliminary engineering studies will be carried out by Nigerian companies.

i. Detailed Engineering design for general facilities shall be domiciled in Nigeria.

3.8.7 Fabrication

Fabrication of all piles, pipe racks, bridges including all galvanizing works for the plant is to be done in Nigeria. Third-party services relating to fabrication and construction including but not limited to mechanical tests as well as certification of welding procedures and welders will be carried out in Nigeria. Nigerian Institute of Welding will certify all such tests in collaboration with international accreditation bodies. The following will be specifically executed in Nigeria.

3.8.8 Construction

The site preparation and infrastructural development will be totally executed by Nigerian companies. All civil/structural, piping, mechanical construction, construction and erection of underground storage tanks, erection of steel structure pipe bridges, processing bridges, processing and interconnecting piping, chemical water treatment, and processing plant will be contracted to competent Nigerian companies or their foreign affiliates.

3.9 Manpower Requirement

The total estimated manpower requirement for the construction and operation phases of the International Olympic Stadium is given in **Table 3.3.**

Table 3.3: Estimated Manpower Requirement for New Integrated Terminal Building

Sn.	Phase	Regular	Contract
A.	**Direct Employment**		
1.	Construction Phase	50	300 to 400

2.	Operation Phase	60	700
B.	**Indirect Employment**	More than 2000	

3.10 Project Schedule

The project is scheduled to reach completion in 3 years. The tentative execution plan following approval of the project ESIA is presented in **Table 3.4** below.

Table 3.4: Tentative project schedule

S/N	Activity	2019	2020				2021			
		Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	Appointment of Consultants to prepare ESIA									
2.	ESIA Preparation & Certification Process									
2	Pre-Construction: Design & Manufacture									
3	Construction Phase: construction of 30,000 seating capacity, office complex, courts e.t.c, installation of various equipment, power generation equipment, etc.) civil works.									
5	Commissioning									

CHAPTER FOUR
DESCRIPTION OF THE ENVIRONMENT

4.1 Background Information

The detail baseline environmental and social description of proposed International Stadium is presented in this chapter.

The baseline environmental and social characteristics of the proposed project area were established based on two (2) climatic season on-site field sampling carried out in the study area. The dry season field sampling exercise was conducted on Thursday 12th through Saturday 15th March, 2020 while the wet season field sampling was carried out from Thursday 23rd to Friday 24th July, 2020.

Plate 4.1: Field Sampling Team, FMEnv Rep and Ebonyi State Government Representative

4.1.1 Study Approach

A review of the relevant literature enabled the background information on the environmental characterization of the proposed project location (study area) to be obtained. The commencement of field work was preceded by a reconnaissance visit to the site. The proposed Stadium location is a green field that cuts across two communities namely Agbaja-Unuhu and Enyima-agu communities in Abakaliki Local Government Area of Ebonyi State. There are seasonal streams and pond within the Area of Potential Project Influence (APPI).

A multidisciplinary team of experts in various areas was employed to undertake this study. The area of expertise includes; Ecology (Wildlife/Vegetation), Climatology, Air Quality, soil, Socio Economic etc. These experts were engaged with a view to developing the baseline conditions of the study area.

4.1.2 Field Data Acquisition Method

Preliminary investigations were made through field sampling surveys, questionnaires, interviews and review of existing reports, maps and literature. Information on the climate conditions of the project was collected from the Nigerian Meteorological Institute (NIMET) 1997-2017. For this purpose, information for a period of at least 20 years 1997-2017 was obtained. Specifics of data collection methods are presented in the following subsections.

4.2 Study Methodology

4.2.1 Sampling Design

The sampling was carried out in accordance with the requirements of *EIA Act CAP E12, LFN 2004.* Grid and transect sampling approaches were adopted with respect to environmental components intended for sampling. A total of seventeen (17) geo-referenced sampling stations and additional three (3) control points were established for soil and vegetation while twenty-two (22) geo-referenced sampling stations and additional 3 controls points were established for air quality, noise and 2 sampling stations and 1 control for groundwater within 5km spatial radius in line with the FMEnv ESIA Terms of Reference (ToR). The sampling coordinate is attached in ***Appendices 4.1a-b. 'Figures 4.1a-1b*** show the sampling maps.

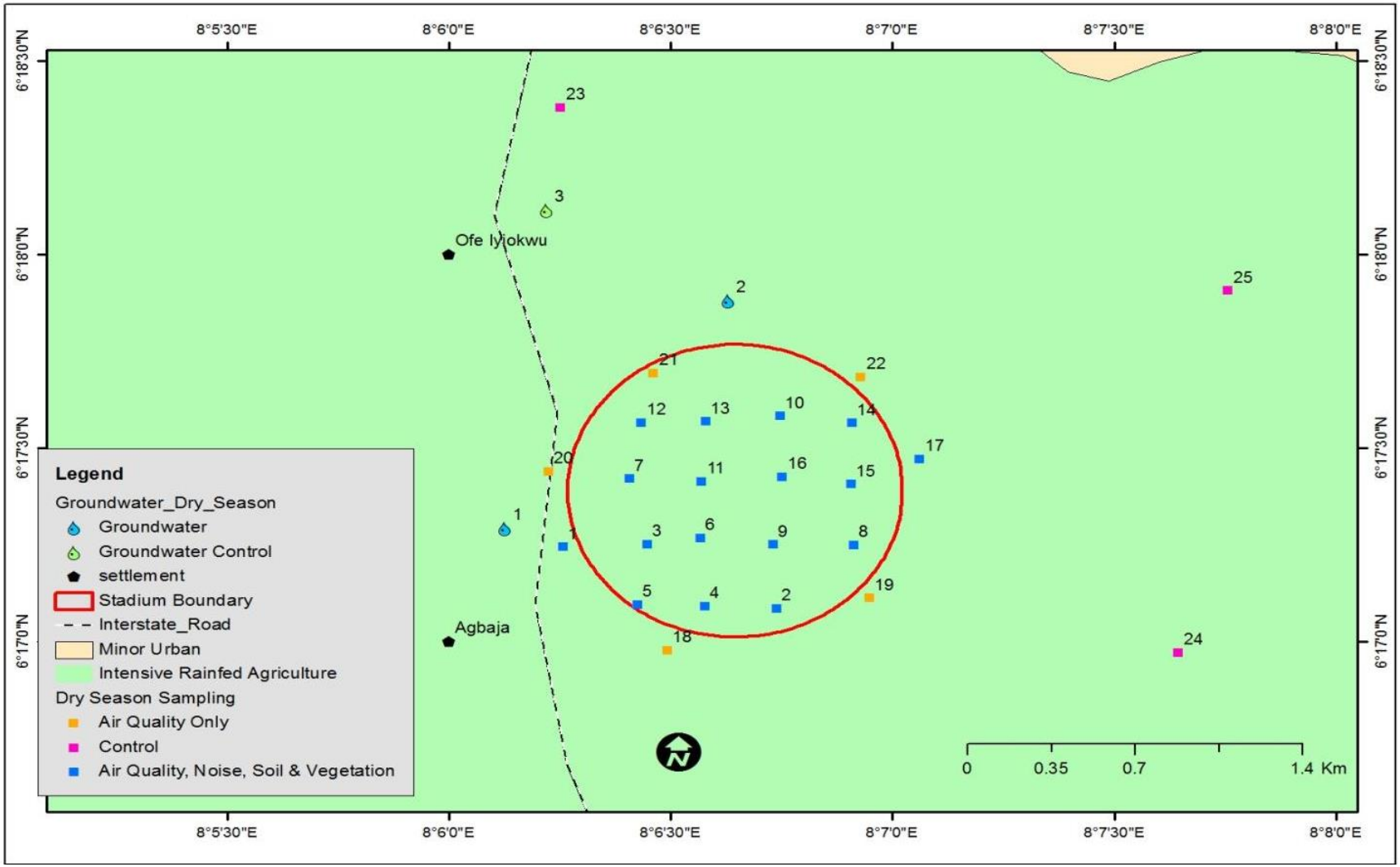


Figure 4.1a: Map showing sampling stations for air quality, Noise Groundwater, Soil and Vegetation (Dry seasons)

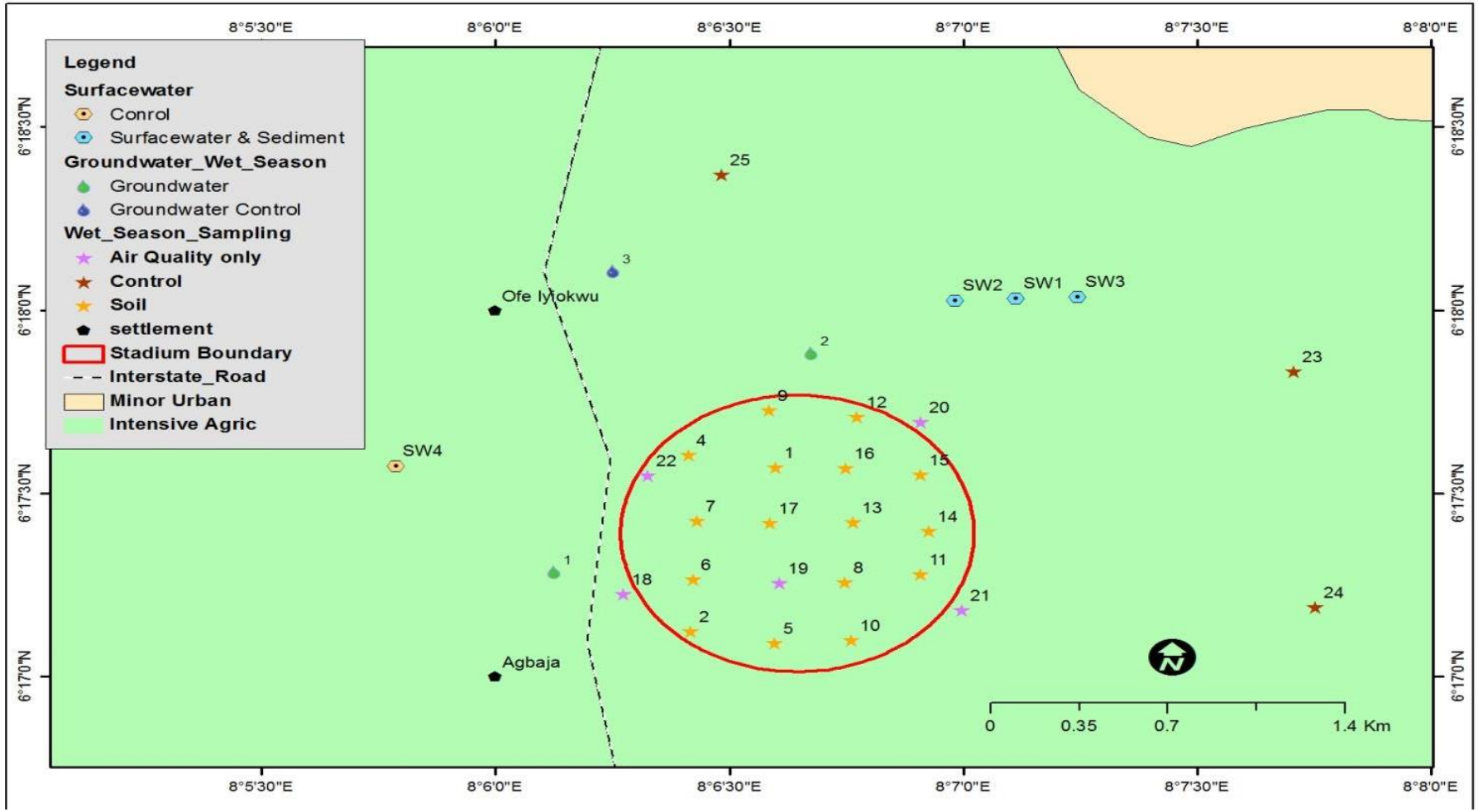


Figure 4.1b: Map showing sampling stations for air quality, Noise Groundwater, Soil, Vegetation, Surface water and Sediment (Wet seasons)

4.2.2 Sampling Equipment and Laboratory Technique

Sample collection, handling, storage, transfer, data coding and documentation followed the *EIA Act CAP E12, LFN 2004.* All the samples collected on the field which were witnessed by FMEnv representative were preserved with ice chests and immediately taken to Anila Resources Limited, Lagos for analysis. The samples were then stored adequately in designated freezers at <4^{o}C prior to analysis. Laboratory analysis which was also witnessed by FMEnv staff was timely carried out in line with the samples' respective analytical times as recommended in FEPA (1991) ***(Table 4.1)***

Table 4.1: Sampling and Laboratory Technique

Parameter	Symbol	Unit	Test method
Physico-chemistry			
Ph	pH		in situ
Temperature	T	^{o}C	in situ
Conductivity	EC	S/cm	in situ
Dissolved oxygen	DO	mg/L	in situ
Salinity	S	‰	in situ
Turbidity	Turb	NTU	in situ
Total suspended solids	TSS	mg/L	APHA 2540D
Total dissolved solids	TDS	mg/L	APHA 2540C
Heavy metals			
Arsenic	As	mg/L	AAS
Cadmium	Cd	mg/L	AAS
Arsenic	As	mg/L	AAS
Chromium	Cr	mg/L	AAS
Copper	Cu	mg/L	AAS
Mercury	Hg	Mg/l	AAS
Ferric iron	Fe3+	mg/L	AAS
Ferro iron	Fe2+	mg/L	AAS
Lead	Pb	mg/L	AAS
Nickel	Ni	Mg/l	AAS
Manganese	Mn	Mg/l	AAS
Cations			

Parameter	Symbol	Unit	Test method
Magnesium	Mg	mg/L	AAS
Potassium	K	mg/L	AAS
Sodium	Na	mg/L	AAS
Zinc	Zn	mg/L	AAS
Aluminium	Al	mg/L	AAS
Anions			
Carbon dioxide	CO_2	mg/L	APHA 4500-CO2
Carbonate and bicarbonate	HCO_3	mg/L	APHA 2320B
Fluoride	F	mg/L	APHA 4500
Nitrate	NO_3	mg/L	APHA 4500
Nitrite	NO_2	mg/L	APHA 4500
Phosphorus total	P	mg/L	APHA 4500
Sulphate	SO_4	mg/L	APHA 4500
Sulphide	S^{2-}	mg/L	APHA 4500
Organics			
Total Organic Carbon (TOC)	TOC	mg/L	APHA 5310
Dissolved organic carbon	DOC	mg/L	APHA 5310
Total mineral oil		mg/L	EPA 8015
BTEX	BTEX	mg/L	EPA 8260
Phenol		mg/L	APHA 5330C
Chemical oxygen demand	COD	mg O_2/l	APHA 5220B
Biological oxygen demand	BOD	mg O_2/l	APHA 5210B
Polycyclic aromatic hydrocarbons	PAH	mg/L	EPA8260
Macro and Micro-biology			
Chlorophyll		mg/L	UV
Phytoplankton population density		number of cells / l	Coulter Counter
Bacteria count		(cfu/100ml x 103)	APHA 9215C

FEPA, 1991

4.2.3 Sampled Parameters

Abiotic and biotic components were studied; they include climate/meteorology, air quality and noise, soil, vegetation, wildlife, socio-economics and health status. During the field

sampling, in situ measurement was done for parameters with short holding analytical time while other samples were collected for laboratory analysis.

4.2.3.1 Abiotic Component

a) Climate and meteorological studies

The purpose of the climatic and meteorological study is to establish meteorological conditions in-and-around the study area. The climatic characteristics of the study area relating to the following were extracted from historical and field sampling data. The following data were collected:

a) Temperature
b) Rainfall
c) Relative humidity
d) Wind patterns (speed and direction)
e) Sunshine (hours and intensity)

A hand-held battery powered high precision Spymaster (SM 28) pocket Weather Tracker, made in the USA was used for data collection for wind speed, humidity, temperature and wind direction (i.e. microclimatic data). Although the microclimatic data was acquired via field measurement, macroclimatic data (long term data) was acquired from the database of the Nigerian Meteorological Agency (NiMet).

A weather station was set up at the same sampling stations for soil sampling during the field survey. Sampling was allowed to run for a minimum of 30 minutes in order to establish a microclimatic data of that particular station. All precautions taken when setting up a weather station and during measurements were observed for the onsite measurements according to the World Meteorological Organization (WMO) standard. These include setting up the weather station away from obstacles like buildings and tall vegetation, using an instrument shelter to display all temperature sensitive instruments, orienting the instrument shelter so that the sun's radiation does not fall directly on the

instrument during reading and setting up the weather station in an area representative of the study area's totality. ***Table 4.2*** below presents weather data acquisition techniques.

Table 4.2: Weather Study Equipment

Climatic Variable	**Instrumentation/Method**
Air temperature	Dry bulb thermometer
Relative humidity	Psychrometer/hygrometer
Wind speed	Anemometer
Wind direction	Wind vane
Cloud cover	Direct observation

b) Ambient air quality and air borne noise level investigations

Gases that are of environmental importance such as toxic gases, greenhouses gases and ozone depleting gases were examined. Portable AEROQUAL Air Quality Monitor (Series 300 Model) was used for air quality determination. Pollutant gases such as NOx, SOx, NH_3, H_2S, CO and VOC were determined. The analyser contains sensor for each gas and each sensor analyse the quality of the respective gases in the ambient air. It is a digital meter, which reads parameters at a time weighted average. An EXTECH instrument (USA), model 407730 Sound level meter with high sensitivity was used, the instrument can measure as low as 30 dB (A) and as high as 150 dB (A). The accuracy is ±1.5 dB (A).

The AeroQual multi-gas detector, Extech noise level meter, SKYMASTER Weather Tracker, and Met One Aero Track Handheld Airborne Particle Counter (manufactured in USA, Model 9303) used for the study are shown in **Plate 4.2a**. Air quality, Noise and Weather condition were determined in situ and recorded. Data collection was done from the hours of 10:00AM – 5:00PM. **Plate 4.2b** shows the data collection process.

Plate 4.2a: In Situ Meters - 1: Aeroqual multi gas meter, 2: GPS, Aero Track Handheld Airborne Particle Counter (SPM), 3: Noise Meter and Weather tracker and 4: SO_2 meter, NO_2 meter, H_2S meter etc.

Plate 4.2b: Air quality sampling activity

c)* Water Quality Sampling Methodology *(Groundwater and Surface water)

Groundwater samples were collected from 4 existing boreholes (3 samples and 1 control) while surface water samples were collected from 3 sampling stations (downstream, mid-stream and upstream) and 1 control for surface water inside seasonal pond/streams only during wet season as there was no water in these pond/streams during dry season. These samples were immediately analysed for parameters with short holding analytical time such as pH, dissolved oxygen (DO), electrical conductivity, salinity, temperature, and turbidity. Samples were collected into sterilized and appropriate sampling containers. Samples for physico-chemical and heavy metals analyses were collected in plastic containers while those for hydrocarbons and were collected in glass bottles. Samples for microbiological analyses were collected in 15ml McCartney sample containers. Collected samples were properly labeled, preserved, stored in an ice chest thermos cooler and transported to the laboratory for analyses. Parameters with short holding analytical time

were analyzed in situ, while others were analyzed at the lab. A summary of the laboratory methods used for the various water quality analyses is presented in **Table 4.3**.

Table 4.3: Summary of Laboratory Methods for Water Analysis

Water Parameter	**Analytical Method**
Organics:	
Total Hydrocarbons (THC)	N-Hexane Extract using GC
Total Organic Carbon (TOC)	Dichromate Wet Oxidation (Walkley and Black, 1934)
Metals:	
Alkali Metals (Ca, Mg, Na and K)	Flame Photometry (Jone, 1988
Other Metals: (Cr, Cu, Fe, Ni, V, Pb, Zn, Cd, Hg, and Mn)	Atomic Absorption Spectrophotometry (AAS)
Physico-chemistry:	
TDS/TSS	TDS/TSS meter (APHA 209C)
BOD_5	Titrimetric (Winklers APHA 422)
TOC	Titrimetric, wet digestion (APHA 422)
Anions (SO42-, NO3-, PO43-, Cl-)	Colorimetric, autoanalyzer (ASTM 3867, APHA 427C)
Alkalinity	Titrimetric (APHA 427C)
Microbiology:	
Heterotrophic Bacteria	Plate count
Culturable Fungi	Plate count
Coliform Bacteria	Plate count, MPN (Crickshank, 1975)

Plate 4.3: Sampling of Groundwater and surface water quality

d) Hydrobiology studies and Fisheries

- ***Planktons and Benthos***

Qualitative plankton samples were collected by towing a 55 µm mesh plankton net at a very slow speed just below the water surface for 5 min at each sampling station. The net was hauled in and the sample transferred into a 250 mL well labeled plastic container with screw cap. Each sample was preserved with 4% buffered formalin solution to prevent decay of the samples (Nwankwo, 2004) and transferred to the laboratory for microscopic analyses.

Sediment samples were collected with an Ekman-Birge Grab from the same location where surface water samples were collected. The sediment samples were placed in sampling bags after sieving to remove dirt and debris, labelled and stored in a coolant to prevent microbial degradation of the hydrocarbon ***Plate 4.4*** shows sediment sieving procedure.

Plate 4.4: Sampling of Sediment Plankton, Zooplankton and Benthic Macroinvertebrates

Plankton Analysis: The plankton samples were concentrated by allowing cells to settle for at 48 hours and thereafter decanted. The micro transects drop count method as described by Lackey (1938) was employed to investigate the plankton samples. One drop of each concentrated sample was thoroughly investigated five times by observing all fields within the cover slip border using a Wild II binocular microscope with calibrated eye piece at different magnifications (10× and 40×). The total number of plankton identified was recorded as number of cells per ml. Relevant texts were used to aid identifications

(Patrick and Reimer, 1975; Wimpenny, 1966; Waife and Frid, 2001; Rosowski, 2003; Siver, 2003) in the Ecotoxicology Lab of Zoology Department University of Lagos.

Benthic Macroinvertebrates Analysis: Benthic macroinvertebrates were sorted in the laboratory using a hand lens of 500x magnification and an American optical dissecting microscope and stored in labelled specimen bottles containing 4% formalin for later examination. Benthic invertebrates were subsequently identified to their lowest generic level, using appropriate identification keys at the Zoology Department Laboratory, University of Lagos.

The community structure of the planktons and benthos was done using the measures of biological diversity such as species richness index, Menhinick's Index, Shannon and Weiner diversity index, Species Equitability or Evenness index and Simpson's dominance index.

e) Soil quality investigation

To ensure a representative sampling, soil samples were collected from 3 cores from each sampling point at depths of 0-15cm and 15-30cm for top soil and sub soil respectively ***(Plate 4.4).*** Samples were collected with stainless screw type soil auger into plastic bags for physicochemical and microorganism analysis. Separate samples were also collected into aluminium foil hydrocarbon content determination.

Plate 4.5: Soil sampling activity at the proposed project site

4.2.3.2 Biotic Components

f) Vegetation and Wildlife Studies

⊙ Sampling Technique for Floristic and Faunal Data Collection

Floristic data were collected using systematic sampling technique with 6 quadrats of one square meter each at each sampling location for assessment of herbaceous flora. Sampling for faunal species followed point sampling design, and walking along foot paths was used (Walsh and White, 1999). Data collected on faunal species included species composition of each sampling location.

⊙ Species Identification

Identification of species was done using methodology provided by Akobundu and Agyakwa (1998); Johnson (1997) for herbaceous flora; and Dalziel and Hutchinson (1979) and Keay *et al.* (1967) for woody flora. Identification of faunal species was done using the methodology provided by Adeyanju *et al.* (2012)

⊙ *Data Analyses*

All quantitative data were subjected to Relative Importance Values analysis following Kent and Coker (1992) and Olubode *et al* (2009). Multivariate analyses for ordination and phytosociology of species and stands describing the ecology of the sampling stations followed Hammer *et al.* (2001) using Paleontological Statistics (PAST) 2.14 version software for detrended correspondence and cluster analyses. Two-Way Indicator Species Analyses (TWINSPAN), 2012 version software was used for determination of phytosociology of the flora (Hill, 1994, 2012).

⊙ *Statistical analyses*

Indices of species diversity and evenness were used to characterize the faunal community structure. The Margalef's index (d) of taxa richness, Shannon-Wienner index of general diversity (H) and Evenness (E) were used to express the descriptive properties.

Margalef's Index (d): d= $\frac{S-1}{3.322 \log N}$

Where,

S = number of taxa

N = total number of individuals

Shannon-Wienner Diversity Index (H): H = $3.322(\log N - \frac{\sum Ni \log Ni}{N})$

Where,

N = Total number individuals in all species

Ni = Number of individuals in each species

3.322= Conversion factor from base 10 to base 2

H' = Diversity (0-4)

The Evenness component of diversity expresses the degree of uniformity in the distribution of individuals of each taxon in the collections.

Species evenness (j): $j = \frac{H}{Hmax}$

where,

H= Shannon-Wienner Diversity Index

Hmax. = logarithm of the number of species in the population (Zar, 1983).

The Slack system was used in the determination of dominant, sub-dominant, common and rare groups of genera. Taxonomic groups or genera comprising:

15% or more of the total number of individuals collected = Dominant

5 - 14% = Sub-dominant

1 - 4% = common

<1% = Rare.

g) Microbiology

Surface and ground water, bottom sediments and soil samples were collected into sterile plastic bottles and polythene bags, kept at 2-6^{o}C and analysed for microbial contents.

⊙ ***Heterotrophic Bacterial Counts***

The total heterotrophic bacteria in both water and sediment were enumerated using modified yeast extract agar (Cruickshank *et al*, 1975). Bacteria isolates were identified according to the scheme for Buchanan and Gibbons (1974).

⊙ ***Determination of Fungal Content***

The total fungal counts in the water and sediment samples were determined using Emmons, Binford and Utz's modified Sabouraud Dextrose Agar (Cruickshank, *et al*, 1975). Isolated fungi were identified based on the associated spores and mycelia and their growth characteristic on the isolation medium.

⊙ ***Determination of Percentage Petroleum Degrading Bacteria and Fungi***

The petroleum degrading bacteria were enumerated on petroleum agar medium, while chloramphenicol was added to this medium for the selective isolation and enumeration of petroleum degrading fungi. Any bacteria or fungi growing on these media were regarded as petroleum utilizers or degraders. The percentage of these counts on the total heterotrophic bacteria or fungal counts were then calculated to obtain the percentage petroleum degrading bacteria and fungi respectively in each sample.

4.2.3.3 Laboratory Analysis Procedures

Sample collection, handling, storage, transfer to the laboratory, data coding and documentation followed the FMEnv's EIA procedural guidelines. All the samples collected on the field were preserved in ice chests and immediately taken to the laboratory. The samples were then stored adequately with the sediment samples stored in designated freezers at - 4^{o}C and water samples stored in well cooled refrigerators prior to analysis. ***Table 4.4*** shows analysis procedures employed.

Table 4.4: Analytical procedure

Parameter	***Method/Instrument***
Temperature (^{o}C)	Hanna portable digital meter
pH	Hanna portable digital meter
Conductivity (µS/cm)	Hanna portable digital meter
TDS (mg/L)	Hanna portable digital meter
TSS (mg/L)	Gravimetry
Turbidity (NTU)	Turbidity meter
DO (mg/L)	Hanna DO Meter and Test Kit
BOD_5 (mg/L)	DO measurement after 5 days
COD (mg/L)	Dichromate/titrimetry
Alkalinity (mg$CaCO_3$/l)	Titrimetry
Salinity as chloride (mg/L)	Titrimetry
Total hardness (mg$CaCO_3$/l)	Titrimetry using EDTA

Parameter	***Method/Instrument***
Sulphate (mg/L)	Turbidimetry
Phosphate (mg/L)	Spectrophotometry
Nitrate (mg/L)	Spectrophotometry
Ammonia (mg/L)	Nesslerisation
Hydrogen sulphide (mg/L)	Titrimetry
Oil and grease (mg/L)	Extraction / Spectrophotometry
Total hydrocarbon (mg/L)	Extraction / Gas chromatography
Calcium (mg/L)	Titrimetry using EDTA
Magnesium (mg/L)	Titrimetry using EDTA
Cadmium (mg/L)	Atomic Absorption Spectrophotometer (AAS)
Chromium (mg/L)	AAS
Copper (mg/L)	AAS
iron (mg/L)	AAS
Lead (mg/L)	AAS
Manganese (mg/L)	AAS
Nickel (mg/L)	AAS
Vanadium (mg/L)	AAS
Zinc (mg/L)	AAS

AAA: Atomic absorption spectrometry, GC, Gas chromatography

Source: FEPA, 1991

The samples were analysed at Anila Resources Nigeria Limited, located at #5, Afisman Drive, off Awolowo Way, Ikeja Lagos, Nigeria. Laboratory analysis was timely carried out in line within the respective samples analytical time as recommended in FEPA (1991) and APHA *et al*, 1980; Golterman *et al*., 1978; and US EPA (1979). ***Plates 4.5a & b*** below show lab analysis procedure being witnessed by officials of FMEnv and data running being carried out by the lab scientist respectively. See ***Appendix 4.1*** for the lab witness attendance, analysis witness form and samples chain of custody form (signed section).

Plate 4.6a: Lab analysis procedure being witnessed by officials of FMEnv at Anila Resources

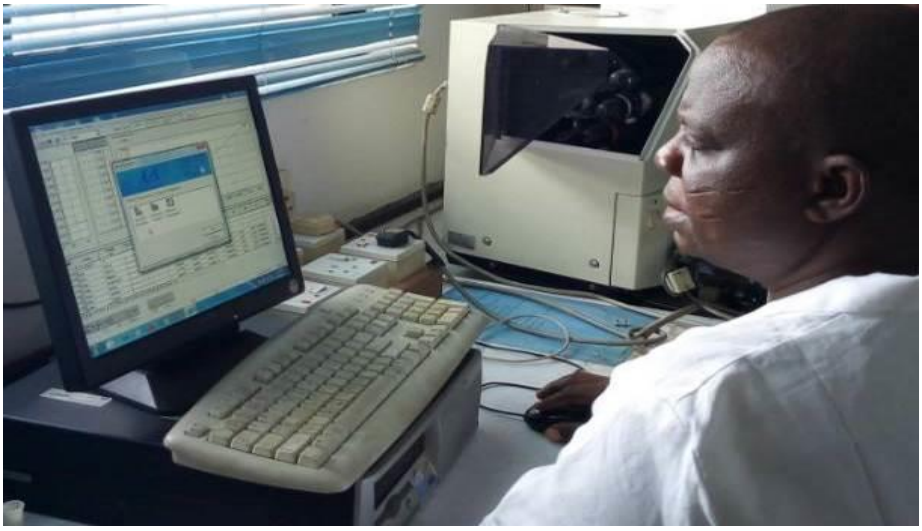


Plate 4.6b: Data running being carried out by Anila Resources' lead scientist

4.2.3.4 Quality Control/Quality Assurance (QA/QC) Procedures

QA/QC procedures cover all aspects of the study, including sample collection and handling, laboratory analyses, generation of data and coding, data storage and treatment

and report preparation. The quality assurance programme employed in the fieldwork and laboratory analyses were in accordance with *FEPA (1991)*.

- ***Sample Collection and Handling***

In preparation for fieldwork, glassware to be used were washed with detergent solutions, rinsed with tap water, then soaked in 1:3 nitric acid solutions for 24 hours to remove organic materials, washed again with tap water and rinsed with distilled water. Plastic containers were washed with detergents, rinsed with tap water, followed by distilled water. After drying, all the containers were rinsed with acetone to remove organic materials, and rinsed with distilled water. Aluminium foils were obtained for soil and sediment samples. Sampling equipment was rinsed with portions of the water to be sampled. Samples per sampling point were taken with thoroughly cleansed containers. Sterile wide-mouth polypropylene and Pyrex glass sample bottles were used. Samples for oil and grease were collected in clean and dry glass-stoppered bottles and were usually not completely filled to avoid losing oil when the stopper was inserted.

- ***Sample Identification***

Specific details on sample identification were entered on a permanent label to reflect node, date, sample matrix, sampling point, sample number, depth etc.

- ***Laboratory Analysis and Generation of Data***

Possible sources of error in laboratory analysis include contamination of reagents and materials, lack of sensitivity of equipment, lack of calibrations, poor data entry and interpretation. Glassware and other containers used for each analysis were thoroughly cleansed as appropriate for each parameter. All glassware used for oil and grease determination was pre-rinsed with Analar grade xylene. Glassware for determination of metals were pre-soaked in dilute nitric acid and then rinsed well with distilled water. All reagents and chemicals of high purity (mostly Analar grade) were used. Freshly distilled water prepared in our laboratory was used for all dilutions.

The various instruments and equipment for measuring physico-chemical parameters used were in good working condition. Periodic control checks were usually carried out on such instruments/equipment and the performance record maintained. The pH meters

were calibrated using HACH commercial buffer standards. Appropriate colour standards of diluted potassium dichromate or potassium permanganate solutions are frequently used to check the wavelength settings and sensitivities of the absorption spectrophotometer. For analytical determination requiring the use of calibration curves, such curves were plotted using standard solutions prepared from analytical grade reagents. Records of such calibration curves were maintained and frequent re-calibration checks were carried out. Analytical blanks were incorporated per specific batches of samples to compensate for the sample preparation and determination steps. All the analyses were replicated and the means reported.

⊙ ***Storage/Preservation***

Samples were analysed at minimum time after collection they could be subject to microbial degradation and transformation. Samples were stored in ice-chest as a cooling device and transported to the laboratory where they were refrigerated at 4°C or kept in a freezer as appropriate. Samples for heavy metal analyses were preserved with 1:1 nitric acid and oil and grease with 1 ml of 1:1 H_2SO_4 as soon as they were collected. Adherence to good preservation procedures ensured that errors were not introduced into the analytical process.

Plate 4.7: Sample preservation procedure being witnessed by FMEnv officials

⊙ ***Chain of Samples Custody Procedure***

There is a Master Register for all samples brought into the laboratory. Following registration of the sample, a Sample Data Sheet containing pertinent information on the sample was opened for each sample. The information includes:

a) sample reference number;
b) nature or type of sample;
c) site of collection;
d) date and time of collection; and
e) Mode of preservation (depends on nature of material) and analytical data from the field

And results of laboratory analyses of representative samples.

Appropriate methods were used in storing the remaining stock materials and sub samples. Samples for storage were kept in labelled compartments on shelves in a storage room. Samples sent to co-operating laboratories were recorded in the Master Register and accompanied by essential data pertaining to the sample material.

⊙ ***Evaluation of Results***

Raw data obtained from the instrumental measurements were used in calculating the concentrations of the various parameters, using standardized formulae. All such calculations were crosschecked. Outlying values were deleted from the replicate data before calculation of mean concentrations. A quick identification of results, which deviate from the normal trend, was usually done. The sum of the anion concentration in meq/l should be equal to the sum of the cation's concentration also in meq/l. Differences within 5% are acceptable.

$$\% \text{ Difference} = \frac{(\text{Cations}) \text{ minus } (\text{anions})}{(\text{Cations}) \text{ plus } (\text{anions})}$$

Also, calculated and observed conductivity measurements and IDS data were compared, to check reliability and accuracy of data. The laboratory analytical methods used were those recommended by FEPA, 1991.

⊙ ***Occupational Safety and Health (OSH) Program***

Safety measures were adopted for field samples and lab analysis in line with Ebonyi State Government and Natural Capital Eco HSE policies. On arrival the entire team comprising of FMEnv, representative of Ebonyi State Government and Natural Capital Eco were briefed on safety on site to familiarize them with essential safety precautionary measures, emergency response procedures and hazards associated with each plant/facility. The safety briefing was corroborated with Safety pep-talk on each sampling day. Personal Protective Equipment (PPE) were worn in all situations involving handling of toxic/dangerous materials in line with the procedures provided in the Natural Capital Eco safe handling of chemical card (SHOC). A total of 150 man-hours was used for the sampling without Lost Time Injury (LTI).

4.2.4 Geology of Ebonyi State

Ebonyi State falls within the ***Asu-River Geologic Group (Lower Cretaceous), Eze-Aku shale formation and Nkporo Formations***. The State is made up mainly of ***hydromorphic soils*** which consist of reddish brown gravely and pale coloured clayey soil, shallow in depth, and of shale parent material. The topography is largely a table land; highest point 162m and lowest 15m above sea level.

The state lies within the Cross-River Drainage Basin. Major rivers in the state are the Eastern and Western Ebonyi Rivers which are tributaries of Cross River. All other rivers and streams are tributaries of these two Ebonyi Rivers. Existence of groundwater in parts of the state varies and is seriously influenced by the local geology. While the greater part, which includes the Abakaliki Metropolis, Onueke, some parts of Afikpo north and their environs record reduced groundwater yield to hand dug well and boreholes due to the

underlying aquiclude. Other locations have good to fair groundwater yield to hand dug well and boreholes (some parts of Afikpo,

Ebonyi State lies mostly in the Ebonyi (Aboine) River Basin and the Cross-River Plains. The area contains, two main geological formations. From the east to the west and in terms of age and sequence of exposure, the formations are, The Asu River Group of the Albian Age (Lower Cretaceous) made up of shales, sandstones and siltstones. The study area; Abakaliki and its environs is of great geological importance due to its position in the Benue trough and the tectonic activities witnessed in the area. It is underlain by shales of the Abakaliki formation of the Albian Asu River Group. This study area is part of the Southern Benue Trough in the South eastern part of Nigeria. The Southern Benue Trough is part of the Benue depression which comprises mainly the Abakaliki Anticlinorium and Afikpo syncline to the east and the Anambra basin to the west.

The Asu River Group was first described by Bain (1924) as lower Shales. Reyment (1965) also described the litho and biostratigraphy of the Asu River Group with its type locality along Asu River. A middle Albian age was assigned to the group by Reyment (1957) on the basis of ammonites such as *Oxytropidoceras hausa* and *Oxytropidoceras manuaniceras sp*. Deposition was under marine conditions giving rise to deposits of alternating shales and siltstones with occurrence of sandstones.

A sequence of mafic lavas, pyroclastic flows, tuffs and agglomerates forms part of the Cretaceous succession within the Benue Trough of Nigeria. These volcanic rocks are best exposed in the area round the interpretation of the different rock types encountered, to reconstruct and interpret their depositional environments and paleogrography by using the various lithofacies, their stratigraphic relationship, structures and sedimentological character and paleontology. Also, to know the mineral potentials, hydrogeology, engineering geology and land use significance of the different rock types, minerals and geological features.

4.3 Socioeconomics and Stakeholder Consultation

4.3.1 Socioeconomics and Health Study Approach

The socio-economic data gathering involved the use of some techniques like interview schedule, survey question administration, key informant interview and focus group discussion (FGD). These techniques are found to be useful in participatory rural and learning appraisal techniques. The field survey study was carried out across the identified project affected communities and also facilitated by the various communities' representative who attended the pre-field mobilization meeting/scoping workshop as well as members of the communities who are familiar with data gathering exercise.

In the study both qualitative and quantitative techniques were used for data collection and as a primary technique of data gathering, community consultation and focus group discussions were used as well as community leaders and other participants. In the process, probing questions on crucial socio-economic issues were raised and answers ask for from the participants in relation to their positions in community and level of knowledge (See ***Plate 4.5***). Visitations were also carried out on the existing social infrastructural facilities and services, e.g., education and health care for necessary information on education and health. As a survey instrument and primary data gathering method, the questionnaire was structured such that binary, optional and open-ended questions were raised to solicit the necessary answers to questions from the community members.

Meanwhile, random sampling technique was used in selecting respondents from the surveyed communities during the community gathering (focus group discussion) as well as during the cross session of respondent within each community with the adult population as the target. At the end of the focus group discussion (FGD) sessions/community-wide interaction meetings, structured questionnaires were administered to a cross section of each of the community with the aid of the community's leadership and facilitator. As a survey instrument and primary data collection method, the questionnaire was structured such that binary, optional and open-ended questions were asked to solicit the necessary answers to questions from the householder. Out of 100

questionnaires administered, 88 were retrieved representing 88% (***Table 4.5***). Below are some sampled pictures during focus group discussion (FGD) with the communities.

***Table 4.5*: Focus Group Discussion (FGD) Venue**

S/no	Community	Questionnaire administered	Questionnaire retrieved
1	Agbaja-Unuhu	50	43
2	Enyima-Agu	50	45
	Total	100	88 (88%)

4.3.2 Socio-economic Data Analysis and Presentation

In analyzing the primary and secondary data, simple descriptive methods and summary statistics like mean, range, mode and percentage were used. Also, some of the data were presented in tables and graphs. These are national, regional, state, local government area, community, household and individual respondent. Meanwhile, the population of the host communities was projected using result of the 2006 national census released by the National Population Census (NPC).

The linear extrapolation and exponential growth model of population projection method are often used in estimating population. While the linear extrapolation model assumes population growth to occur in constant increment over time, the exponential model assumes rate of population growth as not constant but rather changes with time, growing faster as the population size increases. Put differently, population more often than not grows exponentially rather than linearly. However, the exponential growth model was used in estimating the population of the communities. Thus

Exponential Growth Model: $Pn = Po\ (1+r)^n$

Where:

Po = population in the base year

R = annual growth rate of the population

N = time lapse in years

[a][b]

Plate 4.8 a&b; Stakeholder's scoping workshop at Abakaliki LGA Secretariat, prior to the field data gathering exercise.

Plate 4.8c: Snapshot by Stakeholders after scoping workshop at Abakaliki LGA Secretariat

[d]

[e]

Plate 4.8[d and e]: ESIA team in an interactive session with the representative of the 2 communities

4.4 Baseline Environmental Condition

4.4.1 Climate/Meteorology, Ambient Air Quality and Noise of the Study Area

4.4.1.1 Climate/Meteorology

Nigeria is located between latitudes 4 and 11 degrees north. The term "tropical" generally refers to any region falling between the Tropic of Cancer and the Tropic of Capricorn. Therefore, Nigeria's climate is basically tropical. The country enjoys a climate characterised by the hot and wet conditions associated with the movement of the Inter-Tropical Convergence Zone (ITCZ) north and south of the equator. ITCZ is the convergence of two air masses which are the Tropical maritime (Tm) and the Tropical continental (Tc). The former is associated with the moisture-laden south-west winds (south westerlies) which blow from the Atlantic Ocean, while the latter is the dry and dusty north-east winds (easterlies) which blow from the Sahara Desert. When the zone of convergence of the two air masses, is to the south of the equator, the north-east winds prevail over Nigeria, thus producing the dry-season conditions (November – March).

Conversely, when the ITCZ moves into the Northern Hemisphere, the rain-bearing south westerlies prevail as far inland as possible, bringing rain fall during the wet season (April – October). This low-pressure belt begins its northward shift in January and returns to southern Nigeria in July. The 2017 Climate Review of Nigerian Metrological Agency (NiMet) noted that the ITCZ moved northwards from latitude 7.9ºN in January to reach latitude 20.9ºN in August. Its positions from June through October were 1-2 degrees of latitude higher than normal positions but its positions were below normal in April, November and December. Thus, the seasonal northward and southward oscillatory movement of the ITCZ largely dictates the weather pattern of Nigeria.

The weather elements that make up climate include rainfall, temperature, humidity, wind, cloud, solar radiation, dust and aerosol. Climate is not static and is often defined as “average weather” together with its variability from the average. Climate fluctuation or variability refers to variations in the mean state and other statistics (such as standard

deviations, the occurrence of extremes, etc.) of the climate on all spatial and temporal scales beyond that of individual weather events. The overall changes in temperature, rainfall and other meteorological parameters determine the annual changes in climate over a given region.

The study area which is located in Ebonyi State is one of the States in South-eastern Nigeria. Ebonyi State lies approximately within latitudes 5° 40’ and 6° 45’ North of the Equator and longitudes 7°30' and 8°30'East of the Greenwich meridian. The prevailing climatic condition in the area is characterized primarily by two regimes which are the rainy and the dry seasons. The rainy season is usually from April to October; while the dry season starts from October through to February. The area can be described as having a bimodal rainfall pattern.

- ***Baseline macroclimatic description of the study are***

Atmospheric temperature is a measure of the temperature of the atmosphere of the earth atmospheric which varies slowly with day and night season. In the study area temperature values are high throughout the year over the project environment. Mean maximum ambient temperature values range between 32^{o}C in February and 28^{o}C in July and September, while minimum temperatures range between 29^{o}C in March and 27^{o}C in August. A quick overview of the data indicates that higher temperatures were recorded at the peak of the dry season, between November and May, while lower temperatures were recorded in the rainy season, between June and October. It is obvious that the rains appear to have a moderating influence on temperatures. The average minimum and average maximum recorded during the field data gathering showed a stable temperature condition within the period under review. See **Figure 4.2** below.

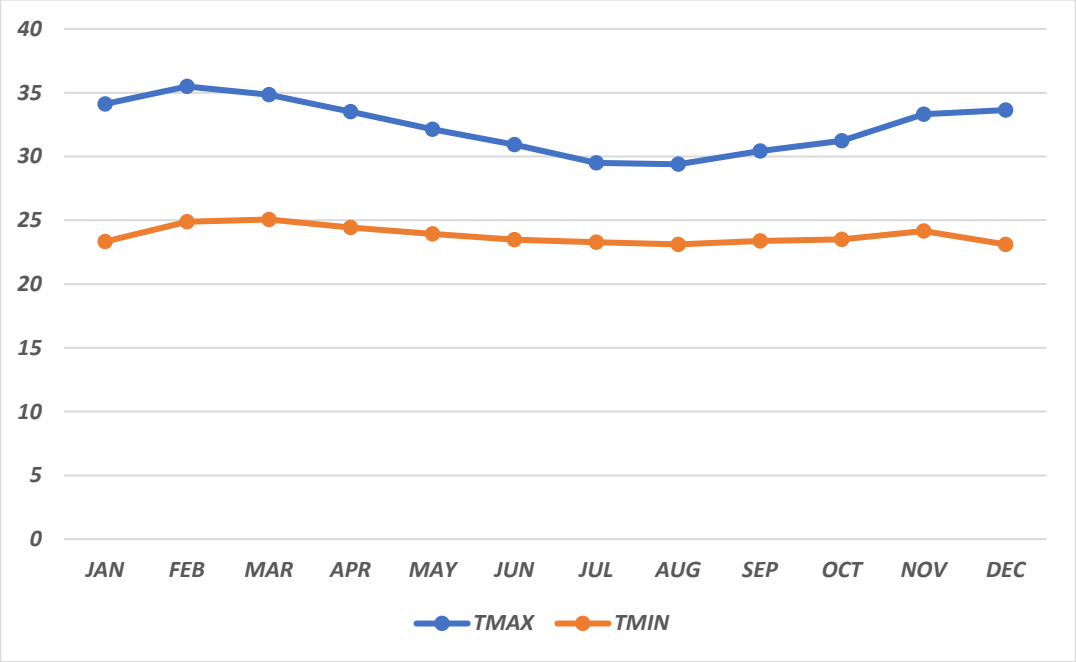


Figure 4.2: Average Temperature in Ebonyi State (1997-2017) *Source: NIMET*

Rainfall: (amount and distribution) is the single most important element for defining the climatic seasons in the tropics where the project corridor is located characterized by two dominant seasons; *the wet and the dry seasons*. The rainy season is usually from April to October; while the dry season starts from October through to February. The area can be described as having a bimodal rainfall pattern. The wet season has its first peak in July and the second occurs in September, the area records annual rainfall of between 1613.8mm to 2136.27mm, the dry season starts in November, when the dry continental North-eastern wind blows from the Mediterranean Sea across the Sahara desert and Samarian desert and down to the southern part of Nigeria. About 60-70% of the dwellers of southeast zone are found to engage in agriculture mainly crop farming. Agriculture is a very significant sector of the economy for the zone and the sources of raw materials used in the processing industries which serve as another area of employment and income generation for the people.

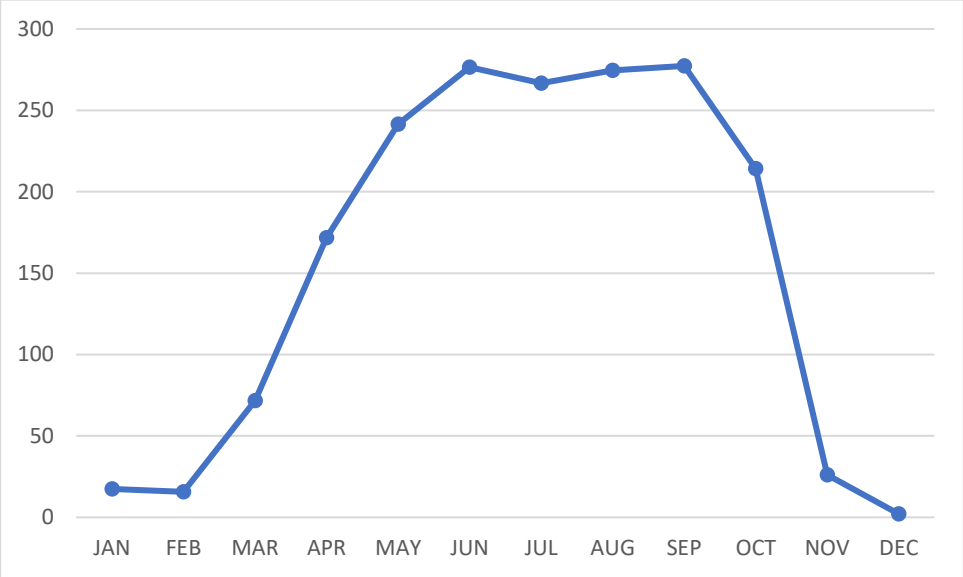


Figure 4.3: Average Rainfall Pattern in Ebonyi State (1997-2017) *Source: NiMet*

Relative humidity (RH) is the amount of water in the air compared with the amount of water required to saturate the same volume of water at the same temperature. Similar to atmospheric temperature trend, based on NiMet weather data (2017), the Relative Humidity of the study area from was observed to be in stable condition from 1997 – 2017. Relative humidity is high, usually over 80% in the early morning but falls to between 45% and 70% in the afternoon. It is highest between May and October. The average RH recorded for the study area within the period under review was 52.7% in wet season and 73% in dry season (***Figure 4.4***).

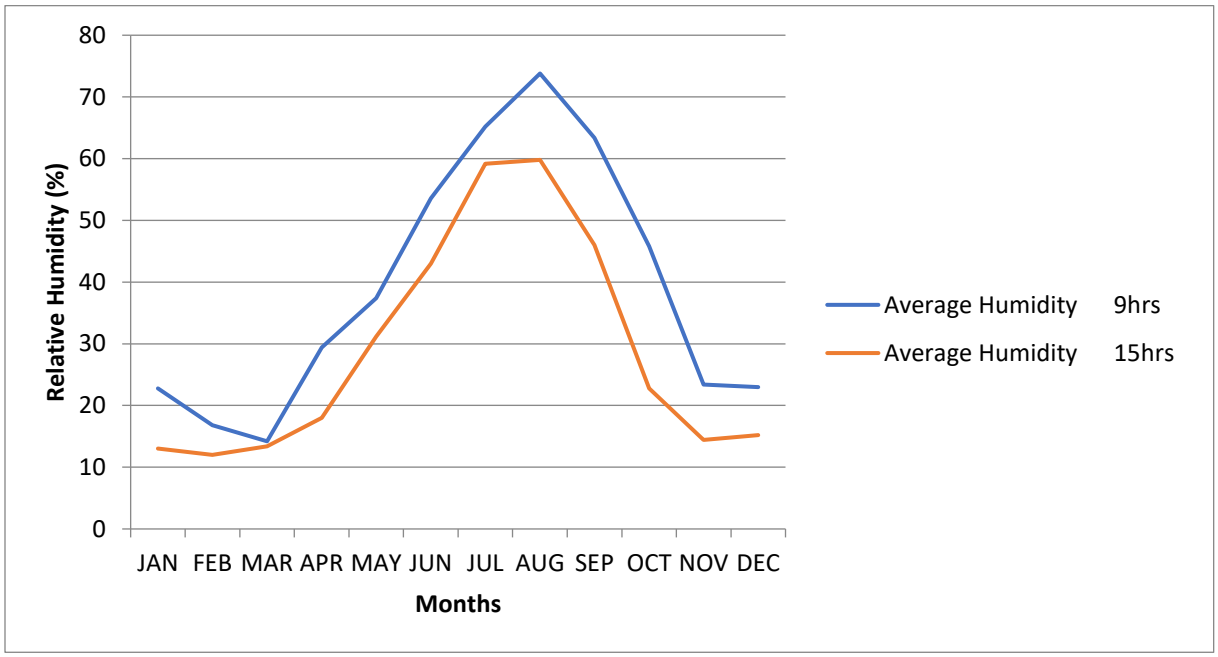


Figure 4.4: Average Relative Humidity in Ebonyi State (1997-2017) *Source: NiMet*

Wind Speed and Directions

The project area is dominated by two seasonal reverse winds, the dry tropical wind or the north-easterly winds from January to March and the tropical maritime wind or the south-westerly winds From April to December. The prevailing wind direction in the area is southwest at an average speed of 1.4 m/s. There are slightly lower speeds in October/February while high wind speeds are obtained from March to September. 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-westerly dominate the wetter period of the year in the area while North-easterly dominates the drier season. Depending on the shifts in the pressure belts in the neighbouring Gulf of Guinea, they are interspersed respectively by South-easterly and North-westerly.

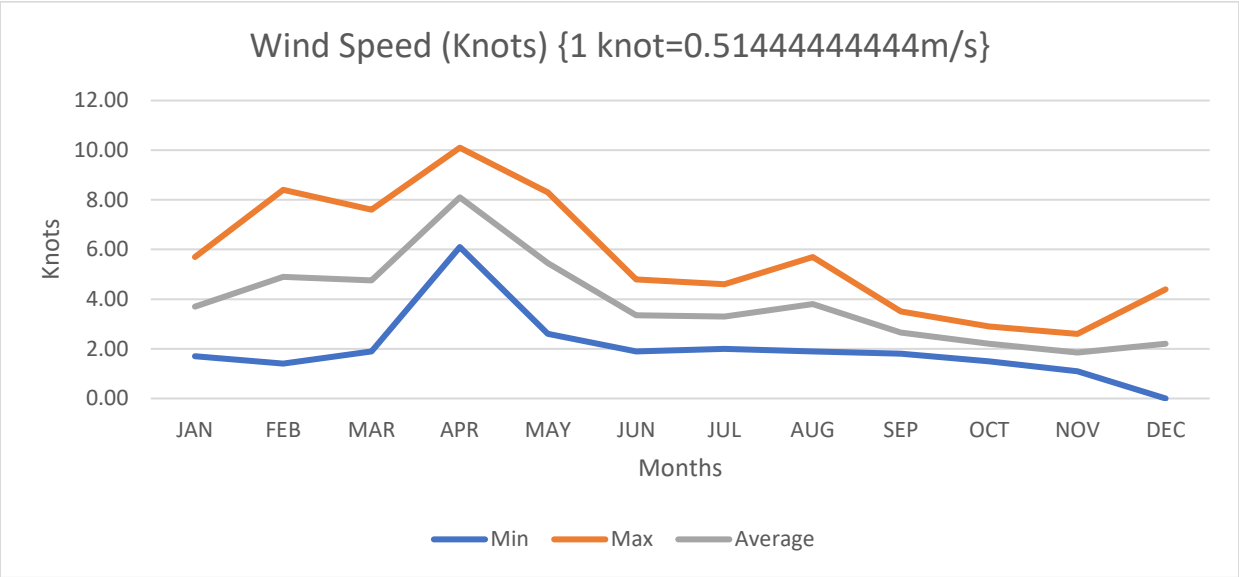


Figure 4.5: Average Wind Speed in Ebonyi State (1997-2017) *Source: NiMet* {1 knot=0.51444444444m/s}

- ***Baseline microclimatic data of the study area***

Microclimatic data can be described as the weather data for a short period of time typically daily, unlike macroclimatic data which covers a longer period typically in years, as discussed above. The baseline microclimatic description of the study area was based on in situ data collection (fieldwork 2020) ***(Appendices 4.2a to 4.2b).*** The microclimatic condition of the area shows similar condition with the data derived from NiMet, between 1997 and 2017.

Ambient temperature is a weather variable that could be directly but temporarily affected by the proposed refinery project. Sources of heat causing ambient temperature rise include flaring, vapour emission and thermal emission from process equipment. Therefore, the ESIA established the ambient temperature for the project area. The study was carried out within the hours of 8:00 AM to 6:00 PM, to present a representative temperature value for day and night.

The study recorded 30^{O}C as the mean temperature of the project area with the maximum being 31.4^{O}C and the minimum 30.80^{O}C for dry season and mean value of 30.40 ^{O}C ranging from 30.40 ^{O}C to 30.43 ^{O}C during wet season ***(Appendices 4.2a to 4.2b).*** The

temperature variation was observed to be influenced by daily time variation. It was low in the morning and gradually increases towards afternoon. Maximum temperature was recorded just after noon. Also, towards the evening, temperature also declines.

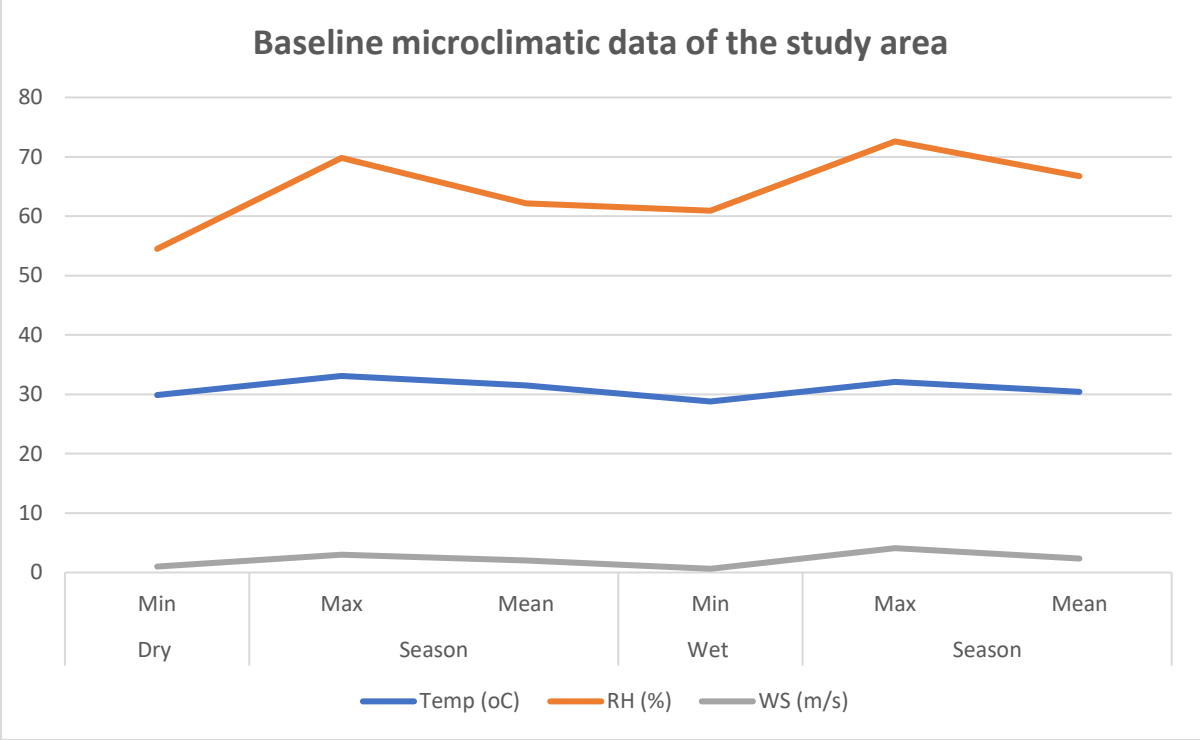


Figure 4.6: Baseline microclimatic data of the study area

The Wind speed value ranged from 1.0ms^{-1} to 3.0ms^{-1} for dry season and 0.624ms^{-1} to 4.1 ms^{-1} during wet season. The dominant wind direction was observed to be South West directions.

4.4.1.2 Air Quality Study

- ***Oxides of Nitrogen (NOx)***

NOx is the group formula for nitric oxide (NO) and nitrogen dioxide (NO_2). Nitrogen dioxide is a toxic component in the air; it could be released directly from combustion points or arises as the oxidation product of nitric oxide which is a less harmful species. NO_2

forms quickly from emissions from cars, trucks and buses, power plants, and off-road equipment. The NO_X concentrations during the dry and wet seasons sampling period in all sampling locations were below detection limit of 0.10ppm which also below the stipulated limit of 0.04 – 0.06ppm by FMEnv.

- ***Oxides of Sulphur (SO_X)***

SOx is the group formula for SO_2, SO_3 and SO_4^{2-} which usually occur as both primary and secondary air pollutants. Power plants, industry, and the oceans emit these gases as primary pollutants. In addition, biological decay processes and some industrial sources emit H_2S which is oxidized to form the secondary pollutant, SO_2. The combustion of fossil fuels containing Sulphur yields SO_2 in direct proportion to the Sulphur content of the fuel.

The primary threat of SO_2 to urban atmosphere may arise not from SO_2 itself but from the changes it undergoes in the atmosphere such as the formation of sulphuric acid (H_2SO_4), a reaction which is catalysed by particulate matter; and the formation of sulphate aerosols. SO_2 can also be absorbed on small particles such as the salts of iron, manganese and vanadium present in the atmosphere and thus enter the alveoli of the lungs. The SO_X concentrations during the dry and wet seasons sampling period in all sampling locations were below detection limit of 0.10ppm which also below the stipulated limit of 0.01ppm by FMEnv. ***(Appendices 4.2a to 4.2b).***

- ***Carbon monoxide (CO)***

CO is a colorless, odorless gas emitted from combustion processes. In urban areas, the majority of CO emissions to ambient air come from mobile sources. At extremely high levels, CO can cause death (Kao, 1994). In the study area, CO concentrations during dry sampling period ranged from 0.0 to 0.2ppm with a mean value of 0.1ppm while it ranged from 0 to 0.1ppm with a mean value of 0.005ppm during wet season. ***(Appendices 4.2a to 4.2b).*** Thus, the values obtained were below the stipulated limit of 10ppm by the FMEnv.

- ***Hydrogen sulphide (H_2S)***

Concentration of hydrogen sulphide for dry season ranged from 0.2 to 0.5ppm with a mean value of 0.35ppm while it ranged from 0 to 0.1ppm with a mean value of 0.05ppm during wet season. The concentration during this season were found below the limit of FMEnv. The observed concentration of hydrogen sulphide in the dry season might be due to the microbial breakdown/decomposition of waste material around the vicinity of the project area.

- ***Volatile Organic Compounds (VOCs)***

VOC is an aggregate parameter defining volatile hydrocarbon compounds. These are airborne and are usually composed of low and intermediate molecular weight hydrocarbons. The concentrations of volatile organic compounds during dry season sampling period showed that the VOC concentration ranged from 0.5 to 2.8ppm with a mean value of 1.65ppm while the mean value during wet season was 0.5ppm ranging from 0 to 1.0ppm ***(Appendices 4.2a to 4.2b).*** However, all the values obtained during the season under consideration are lower than the stipulated limit of 160ppm by FMEnv.

- ***Suspended Particulate Matters (SPM)***

The concentration of particulates in the ambient air during dry season ranged from 23.6 µg/m^3 to 55.3 µg/m^3 (mean value of 39.45µg/m^3) for particle size of 2.5 micron. In the same vein, the concentration of particulates in the ambient air during dry season ranged from 41.3µg/m^3 to 195 µg/m^3 (mean value of 118.15µg/m^3) for particle size of 10 micron. During wet season, SPM ranged from 3.6µg/m^3 to 12.6 µg/m^3 (mean value of 8.1µg/m^3) for particle size of 2.5 micron. In the same vein, the concentration of particulates in the ambient air during dry season ranged from 9.01µg/m^3 to 22.25µg/m^3 (mean value of 15.63µg/m^3) for particle size of 10 micron. All the values recorded for particle size were below the FMEnv limit of 250µg/m^3.

- ***Carbon Dioxide***

Carbon dioxide levels in the ambient air typically occur at concentrations between 300 and 400ppm. CO_2 is one of the essential ingredients for photosynthesis which promotes plant productivity through improved plant growth and vigour. Carbon dioxide plays a role in

ensuring earlier flowering, higher fruit yields, improved stem strength and flower size. CO_2 levels recorded in the dry season study ranged from 200 - 368 ppm with a mean value of 284 ppm. These levels were lower than those recorded in the wet season that had concentrations ranging from 278ppm to 375ppm, with a mean of 326.5ppm (**Table 4.6**). The CO_2 concentrations recorded in the study were within the FMEnv limit of 400 ppm – 500ppm.

The concentrations in the wet season were higher than the concentration recorded in the dry season, which can be linked with the plant growth cycle where photosynthesis outweighs respiration during plant growth. As a result, plants take more CO_2 out of the atmosphere during the dry season when they are growing the most and this can result in lower CO_2 concentrations in the atmosphere. Despite the fact that respiration occurs all the time, it is more frequent in the wet season months of the year, resulting in higher CO_2 levels in the ambient air.

4.4.1.3 Noise Level

The average minimum and maximum noise levels recorded at the project area during dry season was 41.05 dB and 63.850dB respectively while it was 58.95dB and 69.9 dB respectively during wet season. A large proportion of background noise in the area is due to human activities around the project area. In spite of this, the mean values recorded are below the FMEnv limit of 90dB (A) for 8 hours exposure respectively.

Table 4.6: Summary of Air Quality, Noise and Microclimate Data for The Study Area

		SOx (ppm)	VOC (ppm)	NOx (ppm	NH_3 (ppm)	H_2S (ppm)	CO (ppm)	CO_2 (ppm)	SPM (2.5) (µg/m³)	SPM (10) (µg/m³)	Noise (dB (A) Min	Noise (dB (A) Max	Temp (ºC)	RH (%)	WS (m/s)
Dry Season	Min	0	0.5	0	0	0.2	0	200	23.6	41.3	32.7	59	29.9	54.5	1
	Max	0	2.8	0	0	0.5	0.2	368	55.3	195	49.4	68.7	33.1	69.8	3
	Mean	0	1.65	0	0	0.35	0.1	284	39.45	118.15	41.05	63.85	31.5	62.15	2
	Cntrl 1	0	2.88	0	0	0.4	0.1	200	29.1	73.3	38.7	64.4	31.4	61.1	2.2
	Cntrl 2	0	0.74	0	0	0.4	0.1	230	33.6	90.6	47.5	60.9	30.8	59.8	0.6
	Cntrl 3	0	0.69	0	0	0	0.5	222	36.2	69.7	39.3	64.5	30	17.2	1.1
Wet Season	Min	0	0	0	0.001	0	0	278	3.6	9.01	49.3	60	28.8	60.9	0.624
	Max	0.001	1	0.001	1.421	0.1	0.01	375	12.6	22.25	68.6	79.8	32.1	72.6	4.1
	Mean	0.0005	0.5	0.0005	0.711	0.05	0.005	326.5	8.1	15.63	58.95	69.9	30.45	66.75	2.362
	Cntrl 1	0	0	0	0.54	0	0	366.33	11.14	13.37	50.8	63.9	30.43	61.1	2.68
	Cntrl 2	0.00	0.00	0.00	0.26	0.00	0.00	310.00	10.61	12.84	51.80	65.70	30.40	61.70	2.15
	Cntrl 3	0.00	0.00	0.00	0.16	0.00	0.00	398.00	10.46	12.50	49.80	60.10	30.40	60.90	2.75
FMEnv Limits		**0.01**	**160**	**0.04 -0.06**	**0.29**	**0.006**	**10**	**400-500**	**150**	**250**	**90**	**90**			

Source: Natural Eco Capital Fieldwork, 2020 ***BDL: Below Detection Limit,*** Detection limit for NO_2 = 0.10ppm; Detection limit for SO_2 = 0.10ppm; Detection limit for CO = 1ppm

4.4.2 Groundwater Baseline Description

The Physico-chemical analysis results of groundwater collected from existing borehole in the project area during wet and dry seasons are presented in ***Appendices 4.3a and 4.3b .*** The quality of the groundwater samples were compared with World Health Organisation (WHO) drinking water quality index, with most of the parameters recorded to be within WHO drinking water quality index, except for low pH value recorded at some stations. The water is generally clear and unobjectionable in terms of odour and other physical appearances.

- ***Physico-chemical Description of groundwater***

During the wet season of 2020 the values of pH ranged from 6.5 to 6.9 which are slightly acidic while the values ranged from 6.76 to 6.94 which are slightly acidic during the dry season of 2020. (***Appendices 4.3a and 4.3b***). These values show that groundwater around the project area were all acidic and are below the FMEnv and WHO limit of 6.5 – 8.5 for drinkable water except a location during the dry season sampling

The water temperature for the wet season ranged from 30.8 to 31.2^{O}C while it had constant value of 24.50 ^{O}C during the dry season of 2020. The water Turbidity has a constant value of <0.01 (NTU) during the dry season of 2020 while the values ranged from 0.92 to 1.15 NTU during the wet season. Total Suspended Solids in 2020 dry season were not detected, meanwhile the values ranged from 0.32 to 0.37mg/L during the wet season. Electrical conductivity varied between 51.2 and 76.60 µS/cm in 2020 dry season while the values ranged from 47.9 and 54.5µS/cm during wet season. Total Alkalinity values were nil in 2020 dry season while the parameter ranged from 4.0 to 10mg/L during wet season 2020 study.

The groundwater Dissolved Oxygen (DO) recorded for dry season was between 3.87 and 3.94mg/L while the values ranged from 6.6 to 7.1 mg/L during the wet season. The groundwater Chemical Oxygen Demand (COD) values is an indicative measure of the amount of oxygen that can be consumed by reactions in a measured solution were sampled and the values ranged from 8.0 to 16.0mg/L in 2020 dry season while the values ranged from 7.73 to 8.87mg/L during the wet season. The groundwater Biological Oxygen Demand (BOD_5) is the amount of dissolved oxygen needed (i.e.

demanded) by aerobic biological organisms to break down organic material present in a given water sample at certain temperature over a specific time period has a mean value of 1.86mg/L during dry season and 3.85mg/L in wet season.

The groundwater cations were dominated by Sodium (Na), Calcium (Ca) and Potassium (K) as presented in Table 4.6***.*** Sodium has values ranging from 2.83 to 6.713mg/L in dry season while the values ranged from 2.75 to 4.54 mg/L during wet season. Also, Potassium has values ranging from 0.621 to 0.814mg/L in dry season while the values ranged from 0.36 to 0.41 mg/L during wet season. Calcium (Ca) and Magnesium (Mg) were also measured during the two seasons with Magnesium ranging from 0.163 to 0.1721mg/L during dry season and 0.84 to 0.98mg/L during wet season. Also, Calcium ranged from 5.43 to 8.14mg/L during dry season while 2.34 to 2.71mg/L in wet season. During the wet and dry seasons studies, the heavy metal concentration values were low in all the stations and do not pose any pollution threat related to hydrocarbon contamination.

Groundwater hydrocarbon concentration is a very important quality monitoring parameter for oil and gas activities, as it can be used to detect any oil related groundwater pollution. Hydrocarbon concentration of the groundwater was generally low during dry season (***Table 4.6***). Similarly, during wet season study, the ground water hydrocarbon concentration also recorded low concentration below detection limit. This is an indication of no oil pollution in the project area. Both seasons groundwater hydrocarbon concentration are within FMEnv limits.

- ***Groundwater microbial analysis***

From the Microbiology results recorded, THB count which varied from 2.1 x 10^4 cfu/ml to 2.30 x 10^4cfu/ml for wet season while the values ranged from 2.11 x 10^4 cfu/ml to 2.5 x 10^4cfu/ml during dry season. THF count of 1.0 x 10^3cfu/ml to 1.20 x 10^3cfu/ml was recorded for wet season while THF count of 1.0 x 10^3cfu/ml to 2.0 x 10^3cfu/ml was recorded for dry season. HUB was not detected during dry season and wet season activities. HUF count also could not be detected during the field sampling for the two seasons under consideration. Bacteria Identified in Groundwater were *Streptococcusspp, Enterobacter spp., Enterococcus spp*while the Fungi identified in Groundwater are *Penicillium spp., Aspergillus spp*

Table 4.7: Summary of Physical, Chemical and Microbiological Properties of the Groundwater Sampled During Wet and Dry Seasons of 2020

	2020 (Dry Season)					2020 (Wet Season)					FMEnv Limits	WHO Limits
Parameters	**Min**	**Max**	**Mean**	**Stdev**	**Control**	**Min**	**Max**	**Mean**	**Stdev**	**Control**		
pH	6.76	6.94	6.85	0.09	7.38	6.5	6.9	6.7	0.2	7.2	6 – 8.5	6 - 9
Electrical Conductivity (µS/cm)	51.2	76.6	63.9	12.7	65.6	47.9	54.5	51.2	3.3	50.2	NS	900
TDS (mg/L)	25.6	38.3	31.95	6.35	32.8	9	19	14	5	25.1	1500	-
Temperature (ºC)	24.5	24.5	24.5	0	24.6	30.8	31.2	31	0.2	29.9	30	<40
TSS (mg/L)	ND	ND	ND	ND	ND	0.32	0.37	0.345	0.025	0.25	-	-
Turbidity(NTU)	<0.01	<0.01	<0.01	<0.01	<0.01	0.92	1.15	1.035	0.115	1.8	-	5
Total Hardness(mg/L)	16	20	18	2	16	9	11	10	1	7		
Cl^-(mg/L)	8.37	12.55	10.46	2.09	10.46	6.49	8.55	7.52	1.03	5	-	250
SO_4^{2-} (mg/L)	2.823	6.713	4.768	1.945	5.143	1.16	1.84	1.5	0.34	0.86	-	100
NO_3 - N (mg/L)	1.339	1.384	1.3615	0.0225	1.304	0.34	0.41	0.375	0.035	0.31	-	-
Phosphate (mg/L)	0.163	0.172	0.1675	0.0045	0.156	<0.01	<0.01	<0.01	0	<0.01	-	-
Alkalinity (mg/L)	Nil	Nil	Nil	0	Nil	4	10	7	3	6	-	100.00
Salinity(mg/L)	0.03	0.05	0.04	0.01	0.04	0.01	0.01	0.01	0	0.02		

COD (mg/L)	8	16	12	4	8	7.73	8.87	8.3	0.57	9.93	-	-
O & G (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	10	-
DO (mg/L)	3.87	3.94	3.905	0.035	3.9	6.6	7.1	6.85	0.25	6.9	6	-
BOD_5 (mg/L)	1.8	1.91	1.855	0.055	1.85	3.7	4	3.85	0.15	3.3	-	-
Cr^{+6} (mg/L)	0.014	0.025	0.0195	0.0055	0.016	<0.001	<0.001	<0.001	0	<0.001	0.05	0.005
Cd(mg/L)	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.001	0	<0.001	0.01	0.005
Cu(mg/L)	<0.001	<0.001	<0.001	0	<0.001	0.005	0.014	0.0095	0.0045	0.005	-	1.00
Pb(mg/L)	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.001	0	<0.001	0.05	0.01
Ba(mg/L)	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.001	0.00	<0.001		
Fe(mg/L)	0.3	0.321	0.3105	0.0105	0.292	0.635	1.029	0.832	0.197	0.956	1	0.3
Ni(mg/L)	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.001	0.00	<0.001	-	
V(mg/)	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.001	0	<0.001	-	-
Zn(mg/L)	0.127	0.144	0.1355	0.0085	0.122	<0.001	0.14	0.14	0	<0.001	1.5	5.00
Hg(mg/L)	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.001	0	<0.001	-	-
Mn(mg/L)	0.195	0.211	0.203	0.008	0.207	<0.001	<0.001	<0.001	0	<0.001	0.01	0.10
Ca(mg/L)	5.43	8.14	6.785	1.355	6.79	2.34	2.71	2.525	0.185	1.26	-	-
Mg(mg/L)	0.163	0.172	0.1675	0.0045	0.156	0.84	0.98	0.91	0.07	0.65	-	-
Na(mg/L)	2.823	6.713	4.768	1.945	5.143	2.75	4.54	3.645	0.895	1.97	-	--
K(mg/L)	0.621	0.814	0.7175	0.0965	0.714	0.36	0.41	0.385	0.025	0.16	-	-

PAH(mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<5.0	-
Total TPH (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<5.0	-
THC(mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Total Coliform MPN/ 100ml	<1.8	1.8	1.8	0	<1.8	Nil	Nil	Nil	0	Nil	-	-
THB cfu/ml X 10^4	2.11	2.5	2.305	0.195	2	2.1	2.3 x	22	0	2.2 x 10^3	-	100
THF cfu/ml X 10^3	1	2	1.5	0.5	1	1.0	1.2	11	0	1.4 x 10^2	-	-
HUB cfu/ml X 10^3	ND	ND	ND	0	ND	Nil	Nil	Nil	0.00	Nil	-	-
HUF cfu/ml X 10^2	ND	ND	ND	0	ND	Nil	Nil	Nil	0.00	Nil	-	-

Source: Natural Eco Capital Fieldwork, 2020

4.4.3 Soil Physicochemical Properties

4.4.3.1 Soil Description

The summaries (descriptive statistics) of the Physico-chemical, Heavy metals and Microbial properties of the soils are as shown in ***Appendices 4.3a and 4.3b*.**

- ***Soil textural description***

The entire soil texture fraction was dominated by sandy loamy soil in most of the sampling locations.

- ***Physico-chemical Description***

pH: The soils had a mean pH of 5.8 with a range of 5.3 to 6.3for the top soil and 5.1 to 6.2 with a mean value of 5.81 for the sub soil in dry season while it range ranged from 4.12 to 5.16 for the top soil and 4.08 to 5.34 with a mean value of 4.86 for the sub soil in the wet season, indicating acidic conditions of the area activities. (Tables 4.8a and b).

Cation Exchange Capacity (CEC) of the soils: The cation exchange capacity of the soils ranged from 36.59 to 87.451.11cmol/kg with a mean value of 62.02cmol/kg for top soil and 37.15 to 97.97 cmol/kg with a mean value of 77.95 cmol/kg for sub soil during dry season while it ranged from 9.2 to 10.24cmol/kg with a mean value of 1.2.06cmol/kg for top soil and 6.98 to 16.5 for subsoil in wet season. The C.E.C. is the sum of the exchangeable bases, namely, calcium, magnesium, potassium and sodium ***(Tables 4.7a and b).***

Total Organic Carbon (T.O.C): The Total Organic Carbon value were between 1.29% and 1.84%, with a mean value of 1.565% for top soil and 1.04 to 13.1% in dry season while it ranged from 0.27% to 1.21% for top soil and 0.16 to 0.98% in wet season***(Tables 4.7a and b).***The production, accumulation and degradation of organic matter are greatly dependent on climate. Temperature, soil moisture and topography are the major factors affecting the accumulation of organic matter in soils.

Organic matter tends to accumulate under wet or cold conditions where decomposer activity is impeded by low temperature (Buol, 1990) or excess moisture which results

in anaerobic conditions (Trofimov et al 2008). Conversely, high temperatures of tropical climates as in the present assessment enables rapid decomposition of organic matter and leaching of plant nutrients. Excessive slope may encourage the erosion of the top layer of soil which holds most of the raw organic material that would otherwise eventually become humus.

In view of the observations during the field studies, the present variability in total organic carbon content of the soils could be attributed to its high accumulation around the densely vegetated and unhampered secondary forest portion of the area. The other areas possess less dense vegetation cover leading to reduced rate of plant residue returns and accumulation with inherent high decomposition rate on the texture of the soil.

Total Nitrogen: Total Nitrogen content of the soil was between 20.09 and 29.9% with a mean concentration of 24.99% for top soil while it ranges from 21.73 to 28.23% with a mean value of 22.76% for sub soil during dry season while it ranged 0.11 to 0.25% for top soil and 0.09 to 0.28% in wet season***(Tables 4.7a and b).***The total nitrogen content of soil depends on the climate, vegetation, topography, age and soil management. Usually more nitrogen is under grassland than under forest. Humans formation promotes nitrogen immobilization. Cultivation decreases soil nitrogen by exposing soil to more air which bacteria can use and no-tillage maintains more nitrogen than tillage. The relative high values of total nitrogen indicate fertility level of the soils.

Electrical Conductivity: The electrical conductivity values were between 50.1 and 90.05 µS/cm for both top and sub soil during dry season. This also ranged from 27 to 421µS/cm during wet season. The electrical conductivity values were all generally low. This is an indication of low levels of electrolytes in the soil, and where they are abundant, the sandy texture of the soils facilitates leaching.

Anions: The mean concentrations of the anions were as follows: Sulphate SO_4^{2-} (78.74 mg/kg for top soil and76.44 mg/kg for sub soil) during dry season and (11.4 mg/kg for

top soil and 3.96mg/kg for sub soil) during wet season, and nitrate, NO_3^- (11.97mg/kg for top soil and 11.52 mg/kg for sub soil) during dry season and (0.7 mg/kg for top soil and 0.79mg/kg for sub soil) during wet season, nitrite, NO_2 (0.085mg/kg for top soil and 0.082 mg/kg for sub soil) during dry season and (0.052mg/kg for top soil and 0.059mg/kg for sub soil) during wet season.

- ***Heavy Metals Soil Composition***

Heavy Metals: The mean concentration of the heavy metals were as follows; Iron, Fe (2.066 mg/kg for top soil and 2.294mk/kg for sub soil)during dry season and (7866 mg/kg for top soil and 8088mk/kg for sub soil) during wet season; Nickel, Ni (<0.001mg/kg for top soil and <0.001mk/kg for sub soil) during dry season and (1.44mg/kg for top soil and 3.525mk/kg for sub soil) during wet season; Chromium, Cr (0.057mg/kg for top soil and 0.0485mk/kg for sub soil) during dry season and (1.73 mg/kg for top soil and 1.83mk/kg for sub soil) during wet season; Cadmium, Cd (<0.001mg/kg for top soil and <0.001mk/kg for sub soil) during dry season and (0.56 mg/kg for top soil and 0.58mk/kg for sub soil) during wet season; Zinc, Zn (0.154mg/kg for top soil and 0.176mk/kg for sub soil) during dry season and (20.66 mg/kg for top soil and 35.83mk/kg for sub soil) during wet season; Mercury, Hg (<0.001mg/kg for top soil and <0.001mk/kg for sub soil) during dry season and (<0.001mg/kg for top soil and <0.001mk/kg for sub soil) during wet season; Lead, Pb (<0.001mg/kg for top soil and <0.001mk/kg for sub soil) during dry season and (1.98 mg/kg for top soil and 2.04mk/kg for sub soil) during wet season.

- ***Soil Oil and Grease (O & G) and Organic Composition***

Total Hydrocarbon (THC) has a mean value of 0.312mg/kg and 0.917mg/kg for both top and sub soils respectively in the dry season while it has a mean value of 0.32mg/kg and 0.43mg/kg for both top and sub soils respectively during the wet season. Total Petroleum Hydrocarbon (TPH): The total petroleum hydrocarbon content of the soil was ranged from 0.738 to 0.895mg/kg for both the wet and the dry season while it has a mean value of 0.246mg/kg and 0.358mg/kg for both top and sub soils respectively during the wet season.

- ***Microbial Composition***

Hydrocarbon utilizing bacteria (HUB) and Hydrocarbon utilizing fungi were not detected during dry season while they had a mean 1.1 x 10^2cfu/g and 0.9 x 10^2cfu/g and 0.55 x 10^2cfu/g and 0.6 x 10^2cfu/g respectively during wet season. Total Heterotrophic Bacteria (THB) had a mean amount of 5.575 and 5.275 x 10^4cfu/g for both top and sub soils respectively during dry season and 9.4 and 4.85 x 10^4cfu/g during wet season for both top and sub soils respectively, while Total Heterotrophic Fungi (THF) had a mean amount of 3.2 and 3.0 x 10^4cfu/g during dry season for both top and sub soils respectively and 5.4 and 3.9x 10^4cfu/g during wet season for both top and sub soils respectively.

Predominant bacteria isolates identified in the soil were *Streptococcus spp., Bacillus spp, Pseudomonas spp. Lactobacillus spp, Mycobacterium spp, Arthrobacter spp,* while Predominant fungi isolates identified in pillars soil were *Aspergillus spp., Mucor spp, Fusarium spp, Candida spp, Cladosporium spp, Rhodotorulaspp, Penicillium spp*

Table 4.7a: Summary of Physical, Chemical and Microbiological Properties of the Soil sampled during Dry season 2020

	Top Soil					Sub Soil				
	Min	**Max**	**Average**	**Control**	**StDev**	**Min**	**Max**	**Average**	**Control**	**StDev**
pH	5.3	6.3	5.8	5.79	0.5	5.1	6.2	5.65	5.81	0.55
Temp. (^{0}C)	25.6	26.4	26	25.96	0.4	25.5	26.1	25.8	25.91	0.3
Cond. (µS/cm)	50.1	83.5	66.8	66.38	16.7	52.1	90.05	71.075	67.16	18.975
Redox Pot. (mV)	100.2	151.5	125.85	130.9	25.65	105.5	140.5	123	132.48	17.5
TOC(%)	1.29	1.84	1.565	1.54	0.275	1.04	13.1	7.07	1.45	6.03
Porosity(%)	63	68	65.5	66.2	2.5	63	69	66	66.87	3
Sulphate(mg/kg)	52.37	105.1	78.735	88.11	26.365	55.86	96.94	76.4	81.48	20.54
Phosphate(mg/kg)	0.869	1.401	1.135	0.96	0.266	0.853	1.343	1.098	0.94	0.245
Total-Nitrogen(%)	20.09	29.9	24.995	23.56	4.905	21.73	28.23	24.98	22.76	3.25
Nitrate(mg/kg)	9.52	14.41	11.965	11.15	2.445	9.125	13.92	11.5225	10.67	2.3975
Nitrite(mg/kg)	0.05	0.119	0.0845	0.12	0.0345	0.035	0.129	0.082	0.12	0.047
Carbonate(mg/kg)	58.01	89.5	73.755	89.45	15.745	58.02	89.72	73.87	89.37	15.85
Ammonium(mg/kg)	10.52	15.49	13.005	12.29	2.485	11.42	14.41	12.915	11.98	1.495
Sodium(mg/kg)	21.71	43.42	32.565	34.72	10.855	21.71	54.28	37.995	34.71	16.285
Potassium(mg/kg)	2.022	4.658	3.34	2.1	1.318	2.045	3.545	2.795	2.1	0.75
Calcium(mg/kg)	8.02	32.06	20.04	25.65	12.02	8.02	32.06	20.04	25.65	12.02
Magnesium(mg/kg)	4.84	19.36	12.1	15.49	7.26	4.84	19.36	12.1	15.49	7.26
CEC(cmol/kg)	36.59	87.45	62.02	77.96	25.43	37.15	97.97	67.56	77.95	30.41
Iron(mg/kg)	1.51	2.621	2.0655	1.98	0.5555	1.716	2.871	2.2935	1.97	0.5775
Zinc(mg/kg)	0.128	0.18	0.154	0.16	0.026	0.161	0.19	0.1755	0.16	0.0145
Chromium(mg/kg)	0.037	0.076	0.0565	0.06	0.0195	0.013	0.084	0.0485	0.06	0.0355
Lead(mg/kg)	<0.001	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.001	0
Cadmium(mg/kg)	<0.001	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.001	0

Mercury(mg/kg)	<0.001	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.001	0
Vanadium (mg/kg)	<0.001	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.001	0
Nickel(mg/kg)	<0.001	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.001	0
Barium(mg/kg)	<0.001	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.001	0
TPH(total) (mg/kg)	<0.001	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.001	0
BTEX(mg/kg)	<0.001	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.001	0
THC(mg/kg)	<0.001	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.001	0
Oil and Grease (mg/kg)	<0.001	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.001	0
THB(cfu/g) x10^4)	3.05	8.1	5.575	3.56	2.525	2.05	8.5	5.275	3.89	3.225
THF(cfu/g) x10^3)	1	5.4	3.2	3.09	2.2	1	5	3	2.62	2
HUB(cfu/g) x10^1)	ND	ND	ND	ND	0	ND	ND	ND	ND	0
HUF(cfu/g) x10^1)	ND	ND	ND	ND	0	ND	ND	ND	ND	0
Feacal coliform	11	21	16	15.8	5	11	26	18.5	17.13	7.5
SRB	ND	ND	ND	ND	0	ND	ND	ND	ND	0

Source: Natural Eco Capital Fieldwork, 2020

CEC: Cation Exchangeable Capacity, THB: Total Heterotrophic Bacteria,

THF: Total Heterotrophic Fungi, HUB: Hydrocarbon Utilizing Bacteria,

HUF: Hydrocarbon Utilizing Fungi, SRB: Sulphur Reducing Bacteria

Table 4.7b: Summary of Physical, Chemical and Microbiological Properties of the Soil sampled during wet season 2020

Parameters	**Top Soil**							**Sub Soil**						
Physiochemical:	**Min**	**Max**	**Mean**	**StDev**	**TS C1**	**TS C2**	**TS C3**	**Min**	**Max**	**Mean**	**StDev**	**TS C1**	**TS C2**	**TS C3**
pH (1:1, soil to water)	4.12	5.16	4.84	0.459852	5.20	5.57	4.12	4.08	5.34	4.86	0.63592	5.34	5.46	4.19
Electrical Conductivity	27	109	73	75.73379	76	41	100	27	421	113	207.162	90	32	72
Temperature	26.8	27.1	26.98	0.129615	27.1	26.9	26.9	26.7	27.2	27.00833	0.25226	27.1	27.1	27
Nitrite	0.036	0.082	0.052	0.016439	0.046	0.049	0.039	0.03	0.092	0.059	0.03102	0.039	0.043	0.033
Chloride	1.77	10.64	9.57	20.12239	7.09	3.55	10.64	1.77	106.35	17.21	56.4525	10.64	1.77	7.09
Sulphate	2.64	18.41	11.4	21.11173	7.89	5.27	13.15	2.64	5.27	3.96	1.315	10.52	2.64	7.89
TOC	0.27	1.21	0.58	0.377	1.05	0.20	1.05	0.16	0.98	0.79	0.42922	0.31	0.08	0.47
Total Phosphorous	0.013	0.028	0.018	0.005409	0.016	0.017	0.014	0.011	0.031	0.021	0.01	0.014	0.015	0.012
Ammonium	0.14	0.32	0.2	0.064499	0.18	0.19	0.16	0.12	0.36	0.23	0.12014	0.16	0.17	0.13
Nitrate	0.49	1.11	0.7	0.221317	0.62	0.66	0.53	0.4	1.24	0.79	0.42036	0.53	0.58	0.44
Total Nitrogen	0.11	0.25	0.16	0.050066	0.14	0.15	0.12	0.09	0.28	0.18	0.09504	0.12	0.13	0.10
Oil & Grease	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bulk density	1.42	2.29	2.05	0.22526	1.92	2.13	1.88	1.54	2.15	2.02	0.3213	1.99	2.12	1.96
Porosity	12.5	30.6	21.9	7.12131	27.5	19.6	29.1	9.1	41.9	23.3	16.4491	24.9	20.0	26.0
Percent Carbon	0.21	0.93	0.43	0.291527	0.81	0.15	0.81	0.12	0.9	0.57	0.39154	0.24	0.06	0.36
CEC	9.20	10.24	12.06	2.968301	13.04	13.31	17.21	6.98	16.5	12.11	4.76479	10.54	15.89	16.20
Particle Size Distribution:														
Sand	2	84	72.12	25.15762	81	86	78	3	87	75.21	45.4776	78	83	84
Silt	4	85	17.56	23.13626	8	6	11	2	76	14.13	39.6884	11	7	4
Clay	7	18	10.32	4.115532	11	8	11	3	21	10.33	9.0515	11	10	12
Heavy Metals:														
Cu	0.46	10.53	3.39	3.044775	1.90	0.75	1.03	0.56	8.83	3.36	4.20622	0.86	0.27	0.54
Fe	3658	33615	7866	5972.799	3149	4999	5563	2759	13303	8088	5272.1	3064	3988	4991
Ni	1.56	7.32	1.44	1.669898	1.26	0.55	0.63	0.18	5.48	3.525	2.74804	1.84	0.40	0.20
Zn	13.20	34.25	20.66	7.054775	18.88	17.80	15.35	10.84	35.83	20.82	12.5791	16.35	18.62	16.49
Pb	0.75	4.57	1.98	1.185974	3.25	0.89	0.73	0.8	4	2.04	1.61344	3.17	1.09	0.40
Mn	6.60	59.75	14.93	11.82064	14.28	10.10	7.11	5.3	33.65	15.24	14.3843	12.38	9.46	8.56
Cd	0.12	1.32	0.56	0.392458	0.32	0.25	0.26	0.18	1.33	0.58	0.58381	0.47	0.31	0.19
Cr	0.54	3.39	1.73	0.971006	1.00	1.97	0.99	0.78	4.2	1.83	1.75194	1.45	0.54	0.68
Ba	0.34	2.65	1.28	0.690994	1.00	0.78	0.86	1.25	2.5	1.3	0.7077	1.20	0.63	0.92

V	<0.001	0.20	0.11	0.031241	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001
Hg	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001
Cations:														
Na	0.53	2.98	1.26	0.690754	0.54	1.21	1.89	0.58	2.74	1.36	1.0938	0.68	1.13	0.79
K	0.10	1.20	0.62	0.481811	0.18	0.46	0.34	0.11	1.31	0.6	0.60335	1.13	1.57	1.28
Ca	1.22	5.86	3.48	1.236175	4.24	3.44	5.77	1.68	4.98	3.33	1.65	2.54	4.87	3.86
Mg	1.38	3.21	1.63	0.742356	1.08	1.20	2.21	0.19	3.25	1.58	1.53213	1.19	1.32	2.27
Organics:														
TPH(total) (mg/kg)	<0.001	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
BTEX(mg/kg)	<0.001	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
THC(mg/kg)	<0.001	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
Microbiological Test:														
THB x 10^4	10.1	9.7	9.4	0.351188	4.8	4.9	7.6	2.4	7.3	4.85	2.45	2.6	2.8	4.7
THF x 10^3	3.2	7.6	5.4	2.2	4.0	4.0	4.0	2.2	5.6	3.9	1.7	6.8	5.6	2.2
HUB x 10^2	0.2	2	1.1	0.9	2.2	0.2	1.7	0	1.8	0.9	0.9	0.5	1.3	0.7
HUF x 10^2	0	1.1	0.55	0.55	1.4	Nil	0.9	0	1.2	0.6	0.6	0.2	0.4	0.3

Source: Natural Eco Capital Fieldwork, 2020

CEC: Cation Exchangeable Capacity, THB: Total Heterotrophic Bacteria,

THF: Total Heterotrophic Fungi, HUB: Hydrocarbon Utilizing Bacteria,

HUF: Hydrocarbon Utilizing Fungi, SRB: Sulphur Reducing Bacteria

4.4.4 Surface Water Quality

Surface water within the project area (seasonal pond/streams) was sampled and analysed for both conservative and non-conservative determinants only on wet season. Surface water was sampled at four (4) sampling stations (up mid and & downstream). The samples were analyzed using standard recommended methods of water analysis for physico-chemical and microbiological parameters. The obtained characteristics are as summarized in Table 4.8.

4.4.4.1 Surface Water Physico-Chemical Properties

The physico-chemical properties of the water investigated in the study area are presented in this section.

Temperature

Water bodies undergo temperature variations along with normal climatic fluctuations. These variations occur seasonally and in some water bodies over a period of 24 hours. Temperature affects physical, chemical, and biological processes in water bodies, and therefore the concentration of many variables. Increased temperature also decreases the solubility of gases. The metabolic rate of aquatic organisms is also related to temperature and in warm waters respiration rate increases leading to increased oxygen consumption and increased decomposition of organic matter. Growth rates also increase (this is most noticeable in bacteria and phytoplankton. The water temperatures fluctuated seasonally with lowest values occurring in the dry season and as depicted in the adopted wet season data, the highest values were recorded in the dry season. The mean wet season 2020 surface water temperature 24.6°C.

pH

The pH is an important variable in water quality assessment as it influences many biological and chemical processes within the rivers. The pH is the measure of acid balance of a solution and is defined as the negative of the logarithm to the base 10 of hydrogen ion concentration. The pH scale runs from 0 to 14 (i.e very acidic to very

alkaline) with a pH of 7 representing a neutral condition. It is controlled by the dissolved chemical compounds and biochemical processes in the rivers. Daily variation in pH can be caused by photosynthesis and respiratory cycles of algae in eutrophic waters. High values can be obtained in eutrophic waters. The pH values determined across the study area during the wet season study ranged from 6.26 to 6.38 with a mean value of 6.32 during 2020 wet season.

Electrical Conductivity

This is the ability of an aqueous solution to carry an electric current. The conductivity of a medium depends on the presence of ions, their total concentration, mobility, valence, relative concentration and the temperature of the system. The conductivity of an aqueous solution is also roughly proportional to the concentration of dissolved solids it contains. Thus, conductivity is useful as an index of total dissolved solids in water. Specific conductivity values ranged from 72.6 to 91.1micro Siemens per centimetre (µs/cm) (mean = 81.85) during wet season. The conductivity values were lower than the WHO limit of 900 µs/cm, this reveals that the water body is low in ions.

Dissolved Oxygen (Mg/L)

The oxygen content of a water body is a fundamental measurement in water quality, providing information which can elucidate water mass movements, net primary productivity, atmosphere-water interactions and carbon remineralization process. The oxygen content of a water sample is largely determined by a balance between: (a) the exchange of atmospheric oxygen with the upper layer, (b) net increase due to photosynthetic processes and (c) net decrease due to respiratory demands and heterotrophic processes. Concentrations of oxygen below 5 mg/L may adversely affect the functioning and survival of biological communities and below 2 mg/L may lead to the death of most fish. Oxygen requirements for fish vary with species and age of the fish. The ranges between 3.0 mg/L and 6.0 mg/L is the critical range level for nearly all fishes. The value for dissolved oxygen ranged from 4.22 to 4.63mg/L with a mean value of 4.43mg/L in the wet season of 2020. These values reveal that the oxygen requirement of

the water body is within the favorable limit for fishes but could adversely affect the survival of other biological communities.

Total Dissolved Solids (Mg/L)

TDS values obtained for the wet season samples analyses showed a range of 36.3 to 45.5 mg/L with a mean value of 40.9 mg/L.

Turbidity (NTU)

Surface water turbidity values for the wet season ranged from 0.1 to 2.1NTU with a mean of 1.1NTU.

Salinity (%)

Salinity is a measure of the total amount of dissolved salts in a water body. The anions and cations that make up the salinity include chloride, sodium, sulfate, magnesium, calcium and potassium. Since these constituent ions are low in fresh water, the salinity of most fresh waters is 0. The salinity was zero in all the locations. The wet season 2017 samples results obtained for salinity from the fresh water system ranged from 0.04 to 0.06% during wet season of 2020.

***Organics* (mg/L)**

The wet season samples showed results indicating that Total Petroleum Hydrocarbon Content (Total Aliphatic Hydrocarbon Content and Polynuclear Aromatic Hydrocarbon Content), BTEX, Total Hydrocarbon (THC) and Oil and Grease were below the equipment detection limit (<0.001 mg/L).

***Heavy Metals*(mg/L).**

The concentration of heavy metals analysed are relatively very low in both seasons' samples. They were all below detection limit and no appreciable difference was observed except for iron (fe) ranged from 0.419 to 0.621mg/L, zinc (zn) ranged from 0.410 to 0.444mg/L, copper (cu) ranged from 0.132 to 0.147 mg/L.

***Exchangeable Cations*(mg/L).**

The exchangeable bases (Ca2+, K+, Na+and Mg2+) are present at varying levels during the wet season (2020) samples. Calcium ranged from 3.21 to 4.81mg/L, Magnesium ranged from 1.94 tom2.9mg/L, Potassium ranged from 1.148 to 1.358mg/L and Sodium ranged from 5.43 to10.86mg/L

Surface water Microbiology

The microbial properties of surface water samples obtained from the study area are presented in Table 3.8 for the wet season 2020.

The result shows that the statistical variation in the microbial population densities of Total Heterotrophic Bacteria (THB) in the samples count, varied from 3.18 x 10^3 cfu/ml to 4.11 x 10^3 cfu/ml, and Total Heterotrophic Fungi (THF) count of 1.87 x 10^2 cfu/ml to 2.15 x 10^2 cfu/ml. While those of Hydrocarbon Utilizing Bacteria species (HUB) count and Hydrocarbon Utilizing Fungi (HUF) were not detected. Coliform bacteria were also present in the surface water, with a variation of 2 to 3.6 MPN/100ml.

Table 4.8: Physico-Chemical and Microbiological Analysis Results of Surface Water Samples Collected at the study area (Wet Season 2020)

Sample		SW 1	SW 2	SW 3	SW C	Min	Max	Average	Stdev
Colour	Pt/Co	1	1	1	1	**1**	**1**	**1**	**0**
Alkalinity	mg/L	Nil	Nil	Nil	Nil	**Nil**	**Nil**	**Nil**	**0**
Conductivity	µs/cm	91.1	72.9	72.6	69.8	**72.6**	**91.1**	**81.85**	**9.25**
pH		6.33	6.38	6.26	6.07	**6.26**	**6.38**	**6.32**	**0.06**
Temp.	^{0}C	24.6	24.6	24.6	24.6	**24.6**	**24.6**	**24.6**	**4.35E-15**
Total Hardness	mg/L	25	20	20	16	**20**	**25**	**22.5**	**2.5**
COD	mg/L	8	8	8	8	**8**	**8**	**8**	**0**
BOD	mg/L	1.83	1.95	2.21	2.1	**1.83**	**2.21**	**2.02**	**0.19**
DO	mg/L	4.22	4.4	4.63	4.56	**4.22**	**4.63**	**4.425**	**0.205**
Salinity	psu	0.06	0.05	0.04	0.04	**0.04**	**0.06**	**0.05**	**0**
TSS	mg/L	0.06	0.95	1.1	1.24	**0.06**	**1.1**	**0.58**	**0.52**
TDS	mg/L	45.5	36.5	36.3	34.9	**36.3**	**45.5**	**40.9**	**0**
Turbidity	NTU	0.1	1.8	2.1	2.4	**0.1**	**2.1**	**1.1**	**1**
Redox Potential	mV	45.5	36.5	36.3	34.9	**36.3**	**45.5**	**40.9**	**4.6**
Phosphate	mg/L	0.168	0.164	0.175	0.176	**0.164**	**0.175**	**0.1695**	**0.0055**
Sulphate	mg/L	6.452	6.974	6.432	4.718	**6.432**	**6.974**	**6.703**	**0.271**
Nitrate	mg/L	1.832	1.364	1.37	1.869	**1.364**	**1.832**	**1.598**	**0.234**
Chloride	mg/L	16.73	12.55	8.37	6.27	**8.37**	**16.73**	**12.55**	**4.18**
Calcium	mg/L	4.81	4.81	3.21	3.21	**3.21**	**4.81**	**4.01**	**0.8**
Ammonium	mg/L	0.509	0.341	0.346	0.564	**0.341**	**0.509**	**0.425**	**0.084**
Potassium	mg/L	1.358	1.202	1.148	1.031	**1.148**	**1.358**	**1.253**	**0.105**
Sodium	mg/L	10.86	8.14	5.43	4.07	**5.43**	**10.86**	**8.145**	**0**
Carbonate	mg/L	Nil	Nil	Nil	Nil	**Nil**	**Nil**	**Nil**	**0**
Magnesium	mg/L	2.9	2.9	1.94	1.94	**1.94**	**2.9**	**2.42**	**0.48**
Iron	mg/L	0.621	0.578	0.419	0.522	**0.419**	**0.621**	**0.52**	**0.101**
Zinc	mg/L	0.41	0.431	0.478	0.422	**0.41**	**0.478**	**0.444**	**0.034**
Manganese	mg/L	0.214	0.233	0.219	0.217	**0.214**	**0.233**	**0.2235**	**0.0095**
Copper	mg/L	0.147	0.135	0.132	0.133	**0.132**	**0.147**	**0.1395**	**0**
Chromium	mg/L	<0.001	<0.001	<0.001	<0.001	**<0.001**	**<0.001**	**<0.001**	**0**
Lead	mg/L	<0.001	<0.001	<0.001	<0.001	**<0.001**	**<0.001**	**<0.001**	**0**

Cadmium	mg/L	<0.001	<0.001	<0.001	<0.001	**<0.001**	**<0.001**	**<0.001**	**0**
Mercury	mg/L	<0.001	<0.001	<0.001	<0.001	**<0.001**	**<0.001**	**<0.001**	**0**
Vanadium	mg/L	<0.001	<0.001	<0.001	<0.001	**<0.001**	**<0.001**	**<0.001**	**0**
Nickel	mg/L	<0.001	<0.001	<0.001	<0.001	**<0.001**	**<0.001**	**<0.001**	**0**
Barium	mg/L	<0.001	<0.001	<0.001	<0.001	**<0.001**	**<0.001**	**<0.001**	**0**
PAHs	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0**
TPH	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0**
Oil & Grease	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0**
THC	mg/L	0.095	0.058	0.053	0.044	**0.053**	**0.095**	**0.074**	**0.021**
THB	cfu/ml ($x10^3$)	4.11	3.24	3.18	3.11	**3.18**	**4.11**	**3.645**	**0.465**
THF	sfu/ml ($x10^2$)	2.15	2	1.87	134	**1.87**	**2.15**	**2.01**	**0.14**
HUB	cfu/ml ($x10^1$)	ND	ND	ND	ND	**ND**	**ND**	**ND**	**0**
HUF	sfu/ml ($x10^1$)	ND	ND	ND	ND	**ND**	**ND**	**ND**	**0**
Feacal coliform	MPN/100ML	3.6	3.6	2	2	**2**	**3.6**	**2.8**	**0.8**

Source: Natural Eco Capital Fieldwork, 2020

4.4.5 Sediment Studies

The summary (in mean and range) of the physiochemical characteristics of the sediments in the study area is presented in table 4.9. The sediments are slightly acidic to almost neutral and the Total Hydrocarbon level of the sediments was low. The heavy metals have a relatively high and wide range of concentrations. The summary (in mean and range) of the physiochemical characteristics of the sediments in the study area is presented in table below.

pH: The sediments in the entire area were mainly acidic with pH ranging from 5.7 slightly acidic to 6.19 also slightly acidic in the wet season

Total Organic Carbon (TOC %): The sediments exhibited wide variability in terms of total organic carbon content. TOC ranged from 1.06% to 1.23%, with a mean value of 1.145% in the wet season. The production, accumulation and degradation of organic matter are greatly dependent on climate. Temperature, sediment moisture and topography are the major factors affecting the accumulation of organic matter in sediments.

Organic matter tends to accumulate under wet or cold conditions where decomposer activity is impeded by low temperature (Buol, 1990) or excess moisture which results in anaerobic conditions (Trofimov et al 2008). Conversely, excessive rain and high temperatures of tropical climates as in the present assessment enables rapid decomposition of organic matter and leaching of plant nutrients. Excessive slope may encourage the erosion of the top layer of sediment which holds most of the raw organic material that would otherwise eventually become humus.

Nitrate: The trend exhibited by the total organic carbon content was also manifested by the total organic matter content. Nitrate content varied between 14.01 to 14.85% with a mean value of 14.43% in the wet season.

Anions: Sulphate, Chloride: The mean levels of these anions (wet season) were as follows; Sulphate (129.8 mg/kg) and Chloride (33.47 mg/kg) respectively.

Electrical Conductivity (E.C): The E.C. of the sediments varied between 87.6 to 139 µS/cm with a mean value of 113.3 µS/cm (wet season).

Organics (mg/kg)

The wet season samples showed results indicating that Total Petroleum Hydrocarbon Content, Polynuclear Aromatic Hydrocarbon, Total Hydrocarbon Content (THC) and Oil and Grease were below the equipment detection limit (<0.001 mg/kg),

Heavy metals: The mean concentration of the heavy metals in the wet season and related sediment micronutrient elements were as follows; Iron (2.136 mg/kg), Zinc (0.4775mg/kg), Chromium (<0.001 mg/kg), Lead (<0.001 mg/kg), Copper (0.124mg/kg), Cadmium(<0.001 mg/kg), Nickel(<0.001 mg/kg), Barium (<0.001 mg/kg). These values are consistent with levels of these metals as found in non-contaminated or none anthropogenically impacted sediments, except for lead in the wet season. The concentration of heavy metals analysed were relatively very low in both seasons' samples.

The result shows during wet season that the statistical variation in the microbial population densities of Total Heterotrophic Bacteria (THB) in the samples count, varied from 4.3 x 10^3 cfu/g to 5 x 10^3 cfu/g, and Total Heterotrophic Fungi (THF) count ranged from 2 to 4.3 x 10^2 cfu/g. While those of Hydrocarbon Utilising Bacteria species (HUB) count and Hydrocarbon Utilising Fungi (HUF) were not detected. Coliform bacteria were also present in the sediment, with a variation of 8 to 12 MPN/100g.

Bacteria identified in surface water are *Staphylococcus spp., Bacillus spp, Pseudomonas spp.* while Fungi identified in surface water are *Penicillium spp., Aspergillus spp. Mucor spp and Fusarium spp.*

Table 4.9: Characteristics of Sediments (Wet season 2020)

Parameter	Unit	Min	Max	Average	Stdev	Control

Conductivity	**µs/cm**		87.6	139	113.3	25.7	131
pH			5.7	6.19	5.945	0.245	5.52
Redox Potential	**mV**		113.5	125	119.25	5.75	151.5
TOC	**%**		1.06	1.23	1.145	0.085	1.76
Salinity	**psu**		0.06	0.09	0.075	0.015	0.09
Particle Size	**Soil**	**%**	87	90	88.5	90	1.5
	Clay	**%**	7	8	7.5	7	0.5
	Silt	**%**	3	5	4	3	1
Phosphate	**mg/Kg**		1.042	1.209	1.1255	0.0835	1.078
Sulphate	**mg/Kg**		120	139.6	129.8	9.8	97.22
Nitrate	**mg/Kg**		14.01	14.85	14.43	0.42	14.2
Chloride	**mg/Kg**		33.47	50.2	41.835	8.365	50.2
Ammonium	**mg/Kg**		14.64	15.49	15.065	0.425	15.85
Calcium	**mg/Kg**		16.03	40.08	28.055	12.025	32.06
Potassium	**mg/Kg**		3.777	5.451	4.614	0.837	5.147
Sodium	**mg/Kg**		32.57	43.42	37.995	5.425	32.57
Carbonate	**mg/Kg**		89.47	90	89.735	0.265	88.74
Magnesium	**mg/Kg**		9.68	24.2	16.94	7.26	19.36
Iron	**mg/Kg**		2.125	2.147	2.136	0.011	2.201
Zinc	**mg/Kg**		0.413	0.542	0.4775	0.0645	0.461
Copper	**mg/Kg**		0.107	0.141	0.124	0.017	0.112
Chromium	**mg/Kg**		<0.001	<0.001	<0.001	0	<0.001
Lead	**mg/Kg**		<0.001	<0.001	<0.001	0	<0.001
Cadmium	**mg/Kg**		<0.001	<0.001	<0.001	0	<0.001

Mercury	**mg/Kg**	<0.001	<0.001	<0.001	0	<0.001
Vanadium	**mg/Kg**	<0.001	<0.001	<0.001	0	<0.001
Nickel	**mg/Kg**	<0.001	<0.001	<0.001	0	<0.001
Barium	**mg/Kg**	<0.001	<0.001	<0.001	0	<0.001
PAHs	**mg/Kg**	<0.001	<0.001	<0.001	<0.001	0
BTEX	**mg/Kg**	<0.001	<0.001	<0.001	<0.001	0
Oil & Grease	**mg/Kg**	<0.001	<0.001	<0.001	<0.001	0
THC	**mg/Kg**	<0.001	<0.001	<0.001	<0.001	0
THB	**cfu/g ($x10^3$)**	4.3	5	4.65	0.35	8.05
THF	**sfu/g($x10^2$)**	2	4.3	3.15	1.15	1.05
HUB	**cfu/g ($x10^1$)**	ND	ND	ND	0	ND
HUF	**sfu/g($x10^1$)**	ND	ND	ND	0	ND
Feacal coliform	**MPN/100ML**	8.2	12	10.1	1.9	9.1
SRB	**cfu/g ($x10^1$)**	ND	ND	ND	0	ND

Source: Natural Eco Capital Fieldwork, 2020

4.4.5.1 Plankton and Zooplankton Analysis

The waterbody was wade able, hence quantitative technique was deployed in sampling plankton. Quantitative plankton samples were collected by sieving 100 litres of water with a 55 µm mesh plankton. The water was collected with a plastic bucket from the water body and poured into the plankton net. The sample retained in the collector of the net was transferred into a 250 mL well labeled plastic container with screw cap. Each sample was preserved with 4% buffered formalin solution and stored in the laboratory. After 48 hours and prior to microscope analysis, samples were concentrated to 10 ml.

An Ekman-Birge grab was used to collect bottom sediment at each station. The sediment samples were sieved with a 0.5mm mesh sieve to remove fine sediments

and any other extraneous material. The organisms retained in the sieve as well as other materials like shell fragments, coarse sediment grains and debris were transferred to appropriate containers. The sample was then fixed with 10% formalin solution and stored in the laboratory.

Laboratory Analysis

Plankton Analysis: The Laboratory analysis of the plankton and benthos samples was done in the Environmental Laboratory of the National Centre for Energy and Environment. In the laboratory, plankton samples were sorted using Olympus Universal Vanox Research Microscope Model 230485 using X40-100 magnification. Identification was done using standard taxonomic keys and literatures (Imoobe and Egborge, 1997; Korinek, 1999; Siver, 2003; Verlecar and Desai, 2004; Suthers and Rissik, 2009;). Each quantitative sample was concentrated to 10 ml and from this, 1 ml of sample was taken and all individual taxa present were counted. Relative abundance was calculated as the number of individuals per litre of water filtered through the net.

Benthic Macroinvertebrates Analysis: Benthic macroinvertebrates were sorted in the laboratory using a hand lens of 500x magnification and an American optical dissecting microscope and stored in labelled specimen bottles containing 4% formalin for later examination. Benthic invertebrates were subsequently identified to their lowest generic level, using appropriate identification keys (Mackie, 1998; Fernando, 2002; Olomukoro and Egborge, 2003; Bouchard, 2004).

Statistical Analysis

The relative abundance of each group of organisms were computed using the data from their counts. Diversity indices such as taxa richness, number of individuals, Shannon-Weiner (H), Dominance Index (D), Simpson (1-D), Evenness (E) and Margalef Index (M) each representing different aspects of the faunal diversity were computed using paleontological statistics software tool pack (PAST).

RESULTS AND DISCUSSION

Plankton

The word 'plankton' is of Greek origin, meaning to wander. It is used to refer to pelagic organisms which do not have any ability to swim, rather they are carried by water current, floating passively in the water column. However, a few have the ability to swim, but they are so small that swimming does not move them far compared to the distance they are carried by the water. Plankton is broadly subdivided into two categories based primarily on their mode of nutrition. This include the phytoplankton which are the planktonic plants and zooplankton, which are the planktonic animals.

Phytoplankton: The phytoplankton is responsible for most of the primary production in aquatic ecosystems. They represent an important link in the food chain in all freshwater ecosystems, estuaries, coastal waters and oceans. All other living forms of higher trophic levels are directly or indirectly dependant on phytoplankton for their energy. Phytoplankton survey thus indicates the trophic status of the ecosystem. The phytoplankton is composed of single-celled algae. Cells of the plankton algae are largely microscopic in size ranging from a few microns to a few hundred microns in the longest dimension. Species may also occur as colonies or filaments composed of many cells.

The phytoplankton species composition, distribution and abundance in the study area is provided in table 4.10.

Table 4.10: Phytoplankton composition, abundance and distribution

Phytoplankton Species	Station 1	Station 2	Station 3	Control
Division Cyanophyta				
Microcystis aeruginosa		3	1	3
Oscillatoria tenuis	1	1		
Anabaena sp		4		2
Division Bacillariophyta				
Cymbella puscilla		1		2
Nitzchia filiformis	1	2	1	
Division Chlorophyta				
Pediastrum sp	2		2	3

Scenedesmus sp		1	2	3
Division Euglenophyta				
Trachelomonas armata	1		1	3
Total	**5**	**12**	**7**	**16**

The community composition of phytoplankton species recorded in this study reflected a dominantly freshwater population. The phytoplankton community in this study was dominated by Division Cyanophyta in terms of species number and total number of individuals (abundance). The percentage composition of phytoplankton divisions recorded in this study is provided in figure 4.7. The distribution of phytoplankton species varied considerably between the study stations, with the highest number recorded in the control stations. This could be attributed to the undisturbed nature of the control station, with minimal anthropogenic activities. According to Bellinger and Sigee, (2010), higher magnitude of human interference significantly impairs water quality and the community structure of freshwater biota.

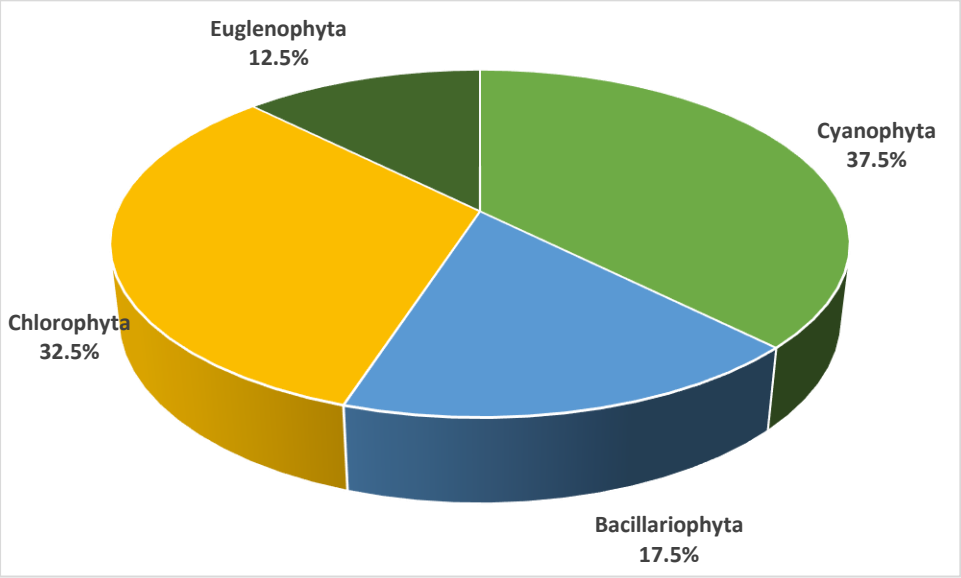


Figure 4.7: Percentage composition of phytoplankton divisions

Figure 4.8 shows the spatial variation in phytoplankton abundance. The abundance of phytoplankton was significantly different in the study area ($p<0.05$), as a result of the very low abundance recorded in stations 1 and 3.

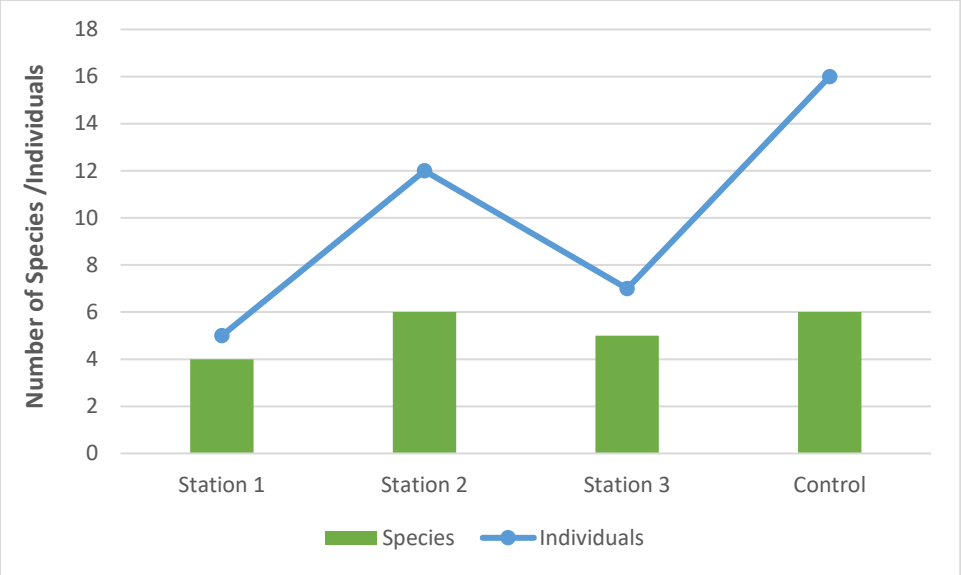


Figure 4.8: Spatial variation in the number of phytoplankton species and their abundance

The analysis of diversity indices of phytoplankton revealed that the Margalef (Species Richness) index, Simpson's Index and Shanon _H which measures diversity were generally low, however, species diversity was highest in the control stations. The diversity indices of phytoplankton community are presented in table 4.11.

Table 4.11: Phytoplankton diversity indices

Diversity Indices	Station 1	Station 2	Station 3	Control
Species	4	6	5	6
Individuals	5	12	7	16
Simpson_1-D	0.720	0.778	0.776	0.828
Shannon_H	1.332	1.633	1.550	1.775
Evenness_e^H/S	0.947	0.853	0.942	0.984
Margalef	1.864	2.012	2.056	1.803

Zooplankton: In this study, 7 zooplankton species were encountered. The zooplankton community comprised of species from Order Cladocera, Order Cyclopoida and Phylum Rotifera. The cyclops crustaceans and rotifers were each represented by 2 species, while 3 cladoceran species were encountered with 14

individuals. The checklist of zooplankton species in this study, their abundance and distribution across the study stations is presented in table 4.12.

Table 4.12: Zooplankton species checklist, distribution and abundance

Zooplankton Species	Station 1	Station 2	Station 3	Control
Cladocera				
Bosmina longirostris			1	2
Bosminopsis dietersi	2	1		1
Moina micrura	1	3	2	1
Copepoda				
Crytocyclops bicolor	2	1	2	
Mesocyclops bodanicola		1		4
Rotifera				
Lecance sp		2	2	
Keratella tropica				2
Total	**5**	**8**	**7**	**10**

The dominant zooplankton taxa encountered in this study was Order Cladocera with 47% of the entire zooplankton population. The most abundant Cladoceran in terms of abundance and distribution was *Moina micrura*, they were recorded in all the study stations. Figure 4.9 shows the percentage composition of the various taxonomic groups that made up the zooplankton population recorded in this study.

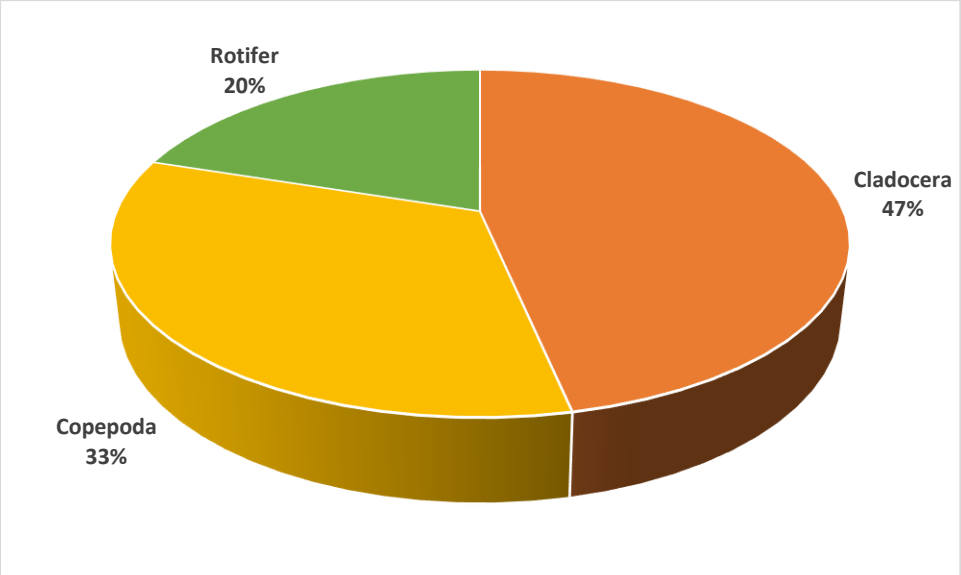


Figure 4.9: Percentage composition of zooplankton taxonomic groups

Zooplankton abundance within the study area did not vary significantly (P>0.05). The spatial variation of zooplankton species and abundance across the study stations is provided in figure 4.10

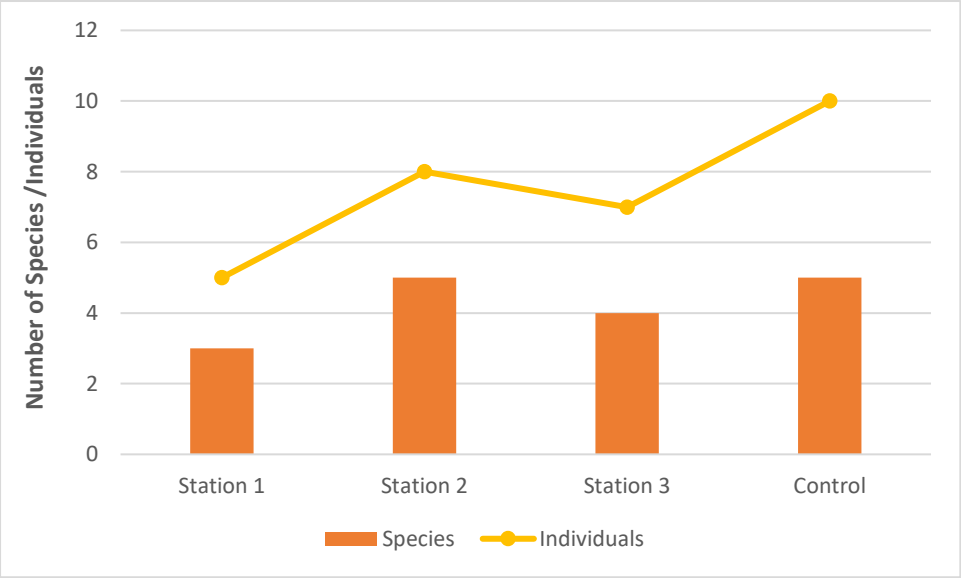


Figure 4.10: Spatial variation in the number of phytoplankton species and their abundance

The diversity indices of zooplankton fauna are presented in table 4. Simpson Index (1 – D) varied from 0.640 in Station 1 to 0.750 in Station 2. These values indicate that the zooplankton community is not very stable. This index is always higher where the community is dominated by less number of species and when the dominance is shared

by large number of species (Whittaker, 1965). Shannon Weiner Index ranged from 1.055 (Station 1) to 1.494 (Station 2). According to the report of Fernando (1998), that classified Shannon Wiener Index into a scale with relative values, the zooplankton community showed very low diversity in the study area. Similarly, species richness as indicated by Margalef Index was highest in Station 2 (1.924) and lowest in Station 1 (1.243). The species richness in the area was very low.as well as other diversity indices were very low in the study area. The low diversity indices in this survey may be attributed to environmental degradation due to anthropogenic pressures as well as other biotic factors (Ravera, 2001).

Table 4.13: Diversity analysis for zooplankton

Diversity Indices	Station 1	Station 2	Station 3	Control
Species	3	5	4	5
Individuals	5	8	7	10
Simpson_1-D	0.640	0.750	0.735	0.740
Shannon_H	1.055	1.494	1.352	1.471
Evenness_e^H/S	0.957	0.891	0.966	0.871
Margalef	1.243	1.924	1.542	1.737

Benthic Macroinvertebrates

Benthic macroinvertebrate fauna, or more simply "benthos", are animals that are larger than 0.5millimeter (the size of a pencil dot) living on debris, logs and aquatic macrophytes or partially/wholly buried in the sediment. The benthic community is a very important component of the aquatic ecosystem, because it serves as important food for economically important fish and shellfish (Fagade, 1971; Fagade & Olaniyan, 1973), assists in the degradation of the organic component that sinks to the sediment, as well as serving for monitoring the condition of the sediment whenever the environment is impacted, because by their nature as slow moving or sessile animals they will either tolerate the pollution or die as residents of the receiving sediment.

A total of 7 species comprising 19 individuals of benthic macroinvertebrates from five taxonomic groups namely; Oligochaeta, Polychaeta, Diptera, Odonata and Decapoda were identified in this survey. Oligochaeta, Polychaeta, Odonata and Decapoda were all represented by a single species, while three species of Diptera was documented in this study. The checklist, distribution and abundance of benthic macroinvertebrates encountered in this study is presented in table 4.14.

Table 4.14: Benthos checklist, distribution and abundance

Species	Station 1	Station 2	Station 3	Control
Decapoda				
Caridina africana		1		1
Diptera				
Pentaneura sp			1	
Corynoneura sp	2			2
Tanypus sp		1		2
Odonata				
Lestes sp	1		1	1
Oligochaeta				
Nais sp		1	2	
Polychaeta				
Lycastopsis sp	1		2	
Total	**4**	**3**	**6**	**6**

Order Diptera was the most dominant taxonomic group encountered in this study in terms of abundance and species number, making up 42.1% of the benthic fauna. Figure 4.11 shows the relative abundance of the various taxonomic groups encountered in this study.

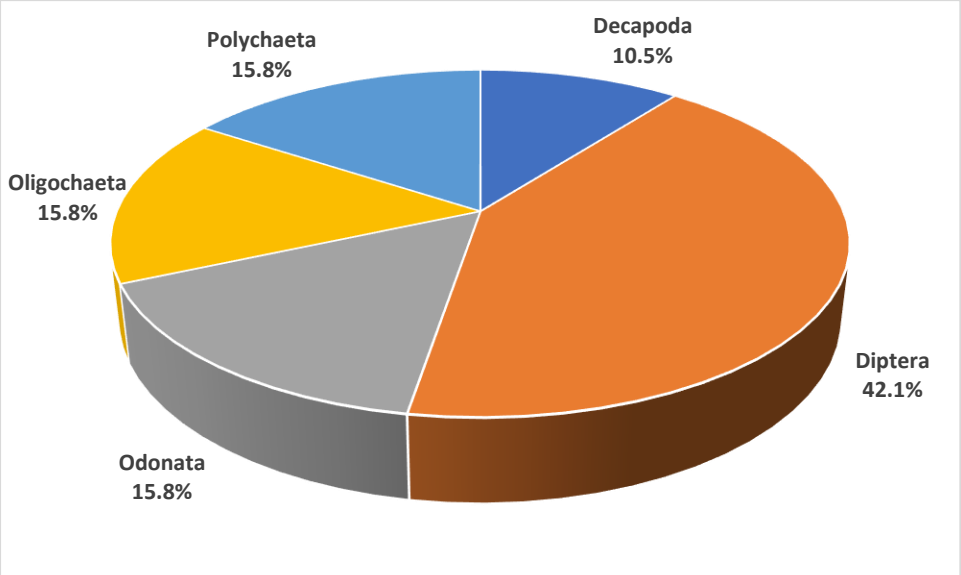


Figure 4.11: Relative abundance of benthic macroinvertebrates taxonomic groups

The spatial variation in the abundance of benthic macroinvertebrates encountered in the study is presented in figure 4.12. Although there was no significant difference in the abundance of benthos in the study area, abundance was typically higher in the control station. However, the abundance of benthos was generally low in the study, and a possible explanation for this is could be the stony nature of the sediment, which limits benthos occupation of the sediment as well as their breeding and food sources (Molokwu *et al*., 2014).

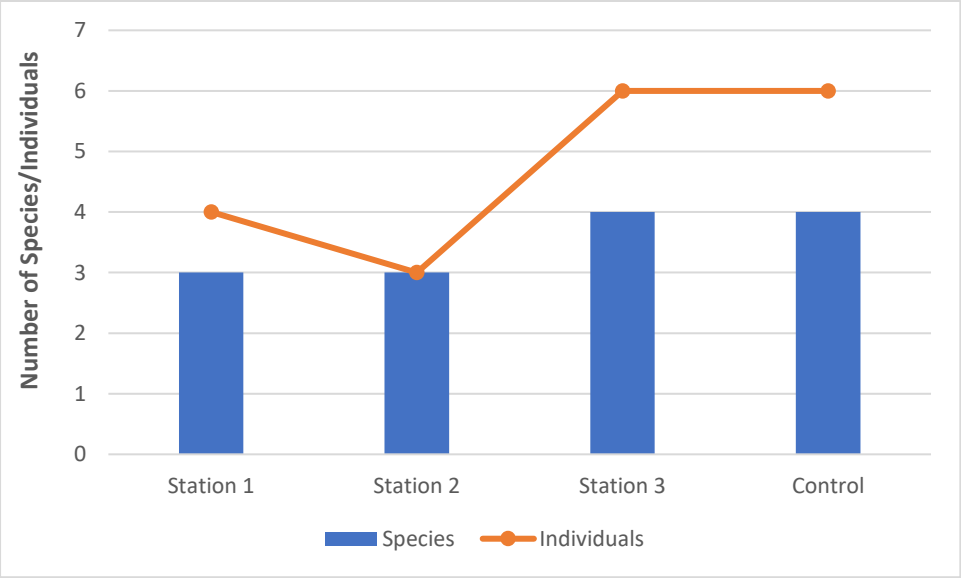


Figure 4.12: Spatial variation in number of species and abundance of benthos

The summary of diversity indices of benthic macroinvertebrates is presented in table 4.15a. Shannon_H index of diversity in this survey ranged from 1.040 to 1.330. These values indicate that the diversity of benthic macroinvertebrates was generally low in the study stations (Fernando, 1998). Simpson Index (1 – D) varied from 0.625 to 0.722. This index suggests that the communities were not stable and matured. The species richness index (Margalef Index) ranged from 1.443 to 1.674, reflecting the low abundance of benthos in the study area

Table 4.15a: Benthos diversity analysis

Diversity Indices	Station 1	Station 2	Station 3	Control
Species	3	3	4	4
Individuals	4	3	6	6
Simpson_1-D	0.625	0.667	0.722	0.722
Shannon_H	1.040	1.099	1.330	1.330
Evenness_e^H/S	0.943	1.000	0.945	0.945
Margalef	1.443	1.820	1.674	1.674

Fisheries Study
Fish fauna analysis

Methodology
The fish species from the area were collected with common fishing gears (cast net and gillnet), sorted, preserved with ice chest and transported to the laboratory for further analysis. In the laboratory, the fish specimens were identified with the aid of available literatures (Fischer *et al*., 1981; Schneider, 1990; Holden and Reed, 199l; Olaosebikan and Raji, 1998). Fish species were recorded and were classified to their family level.

Result
No fish was encountered in the seasonal pond/streams studied, however fisheries of the area, which is sparsely distributed, was established from review of previous literatures. Species distribution is an indication of where fish species occur or are located in the aquatic environment. This consists of the vertical aspect (surface, mid water and bottom) and the horizontal or lateral component such as convex, central

and the concave sections across the water body. Species distribution thus provides information on whether the fish species is pelagic, demersal etc.

Abundance in this context refers to the total catch in number or biomass of the species. Information on habitat and abundance, amongst others, are very vital for fisheries development and management. The species seldom caught in this area is listed in Table below. Fishing is not a notable profession of the area. The passive gear used includes traps, gillnets, long line and spear.

Table 4.15b: Fish species reported within the study area

S/No	Species Name	Family
1	*Chrysichthys nigrodigitatus,*	Claroteidae
2	*Clarias anguillaris,*	Clariidae
3	*Tilapia zillii,*	Cichlidae
4	*Mormyrus rume,*	Mormyridae
5	*Mormyrus macrophthalmus*	Mormyridae
6	*Mormyrus tapirus*	Mormyridae
7	*Oreochromis niloticus,*	Cichlidae
8	*Schilbe mystus,*	Schilbeidae
9	*Siluranodon auritus,*	Schilbeidae
10	*Tilapia dageti*	Cichlidae
11	*Hemichromis fasciatus.*	Cichlidae
12	*Arius heudeloti,*	Ariidae
13	*Labeo coubie,*	Cyprinidae
14	*Alestes chaperi,*	Alestidae

- ***Land Use**:*

Land use activities include agriculture (farming) with the major crops as cassava, oil palm and maize. There are also residential, educational, health and other facilities within the entire area.

4.4.6 Vegetation Cover and Wildlife

Composition of floral species on the study site:

Vegetation sampling was conducted using systematic sampling procedure. The vegetation of the proposed site was assessed using a 1 m square meter quadrat to estimate herbaceous flora of the plot. The vegetation of the site was randomly assessed for floristic identification using a 1m square meter quadrat because it was mainly composed of herbaceous plants. All species were identified to species level following Akobundu and Agyakwa (1987), and Hutchinson and Dalziel, (1968). Families and common names of plant species were provided also. At each sampling point, the floral diversity and population density of key economic species composition were obtained. Rare, exotic, invasive and endangered species were listed.

Samples of plants that could not be identified in the field were collected, pressed and carried to the herbarium for further identification. The health status of the vegetation was visually determined. Where a disease symptom was noticed, samples of the plant organ(s) were taken to the laboratory for identification of causative organism(s).

Data Analyses

Shannon-Weiner indices, Margalef index (as a measure of species richness), Dominance and Evenness indices using the PAST software (Harmer, 2001) were calculated.

Result

The entire vegetation transects in the study area fell under two (2) major ecotypes; farm plots and secondary forest regrowths. The farm plots were dominated by members of the Euphorbiaceae e.g Cassava (*Manihot esculentus*, crantz) and Arecaceae e.g Oil palm (*Elaeis guineensis*, Jacq.) and a few shrubs scattered around major farm plots. Similarly, the secondary regrowth forest composed of a discontinuous array of floristic composition with no definite pattern in the strata. Trees, shrubs, herbs and sedges recorded a good representation. A synopsis of the vegetation characteristics of the study area is highlighted in this subsection **(Plates 4.10 & 4.11).**

Secondary Forest Regrowth

Secondary forestation is common in some areas where forest patches have been lost by the slash-and-burn method, a component of some shifting cultivation systems of agriculture. Secondary forests may have also arise from forest that has been harvested heavily or over a long period of time, forest that is naturally regenerating from fire and from abandoned pastures or areas of agriculture.

Secondary forests will re-establish by the process of succession. Openings created in the forest canopy allow sunlight to reach the forest floor. An area that has been cleared will first be colonized by pioneer species. Even though some species loss may occur with primary forest removal, a secondary forest can protect the watershed from further erosion and provides habitat. Secondary forests may also buffer edge effects around mature forest fragments and increase connectivity between them. They may also be a source of wood and other forest products.

This vegetation type showed a discontinuous array of floristic composition with no definite pattern in the strata. The upper stratum of the vegetation was dominated by the Mesophanerophytes i.e. plants about 8-30m high and the Epiphytes, Chamaephytes, Hemicrytophytes, Cryptophytes and Therophytes occupied the lowest stratum. The absence of a high litter level i.e. plant debris in the forest regrowth may be attributed to rainfall patterns. Furthermore, *Elaeis guineensis* and *Raphia hookerii* were well distributed around secondary regrowths forest in the study area. Also, shrubs and herbs were also represented and include: *Acacia* spp., *Cnestis ferruginea, Combretum* spp., *Triumfetta rhomboidea, Aspilia africana, Costus lucanusianus, Neptunia oleracea, Chromolaena odorata, Mimosa pudica, Urena lobata, Sida acuta, and Scoparia dulcis*. Similarly, grasses and a few sedges dominated the ground layer and include: *Panicum maximum, Selaginella myosurus, Sporobolus pyramidalis, and Kyllinga nemoralis*.

Farm Plots

The floristic composition, numerical abundance of staple food crops in the study area and the abundance indices are presented in **Table 4.16.** The farm plots in the study area comprise mainly staple food crops which are subsistent in nature. Dominant staple food crops in the study area include Cassava (*Manihot esculentus,* crantz) and

Oil palm (*Elaeis guineensis*, Jacq.). Others are Yam (*Dioscorea* spp., De Wild), Maize (*Zea mays,* Linn.), Plantain (*Musa paradisiaca.* Linn.) and *Abelmoschus esculentum* (L.) Moench.

Table 4.16a: Floristic Composition and Growth Form in the Secondary Forest Regrowth

Sl No	**Scientific Name**	**Family**	**English Name**	**Growth Form**	**Economic importance**	**Braun Blanquet cover values**							**Frequency of occurrence (%)**	**Abakaliki**
						T1	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**		
1	*Ceiba pentandra* (Linn.) Gaertn.	Bombaceae	Silk cotton	Tree	Medicinal	5	3	-	5	5	-	-	55	+
2	*Ficus exasperata* Vahl.	Moraceae	Sand paper plant	Shrub	Medicinal	5	-	3	3	3	-	2	75	+
3	*Bambusa vulgaris* Schrad.	Poaceae	Indian bamboo	Shrub		3	5	5	-	5	5	5	40	+
4	*Voacanga africana* Stapf.	Apocynaceae		Tree		5	5	5	-	5	5	5	50	+
5	*Ricinodendron heudelotii* (Baill.) Heckel.	Euphorbiaceae		Tree		-	-	-	3	-	-	5	30	-
6	*Gmelina arborea* Roxb.	Verbenaceae	Cameline	Tree		5	-	5	5	5	5	-	50	-

S/ No	**Scientific Name**	**Family**	**English Name**	**Growth Form**	**Economic importance**	**Braun Blanquet cover values**							**Frequency of occurrence (%)**	**Abakaliki**
						T1	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**		
7	*Spondias mombin* Linn.	Anacardiaceae	Hug plum	Tree		3	5	-	-	4	-	3	60	+
8	*Anthocleista vogelii* Planch.	Loganiaceae	Cabbage plant	Tree		5	5	5	5	-	-	5	60	+
9	Cleistopholis patens (Benth.) Engl & Diels.	Annonaceae	Salt & oil tree	Tree		5	-	-	-	-	5	5	40	-
10	*Elaeis guineensis* Jacq.	Arecaceae	Oil palm tree	Tree	Food	3	-	5	3	3	-	3	70	+
11	*Raphia hookeri* Mann & Wendland	Arecaceae	Wine palm	Tree	Food	3	-	5	3	3	-	3	70	+
12	*Acacia* spp.Mill.	Fabaceae		Shrubs		3	2	2	1	2	2	4	90	+
13	*Cnestis ferruginea* DC	Connaraceae		Shrub		1	5	2	2	2	2	1	90	+
14	*Combretum* spp. Loefl.	Combretaceae		Shrub	Medicine	2	2	2	-	2	3	1	90	+

S/ No	Scientific Name	Family	English Name	Growth Form	Economic importance	Braun Blanquet cover values							Frequency of occurrence (%)	Abakaliki
						T1	T2	T3	T4	T5	T6	T7		
15	Triumfetta rhomboidea Jacq.	Tiliaceae	Chinese bur	Herb									50	+
16	*Aspilia africana* C.D Adams	Compositae			Medicine	2	1	-	1	1	1	1	90	+
17	*Costus lucanusianus* J.Braun & K. Schum	Costaceae	Ginger lily	Shrub		5	3	2	5	5	-	4	70	+
19	*Chromolaena odorata* (L.) R.M. King & Robinson	Asteraceae	Siam weed	Herb	Medicine	1	2	3	1	-	-	2	90	+
20	*Mimosa pudica* Linn.	Fabaceae-mimo	Sensitive plant	Herb		1	2	3	1	-	-	2	90	+
21	*Urena lobata* Linn.	Malvaceae	Caesar weed	Shrub		3	1	-	2	1	2	-	70	+
22	*Sida acuta* Burn .F.	Malvaceae	Broom weed	Herb		3	2	1	-	-	2	2	90	+

S/No	Scientific Name	Family	English Name	Growth Form	Economic importance	Braun Blanquet cover values							Frequency of occurrence (%)	Abakaliki
						T1	T2	T3	T4	T5	T6	T7		
23	*Scoparia dulcis* Linn.	Scrophulariaceae	Sweet broom weed	Herb		5	-	2	2	1	2	-	80	+
24	*Panicum maximum* Jacq.	Poaceae	Guinea grass	Herb		3	-	2	1	1	3	3	90	+
25	*Selaginella myosurus* (Sw.) Alston.	Selaginellaceae	Fern/club moss	Herb		1	-	2	1	2	-	1	90	+
26	*Sporobolus pyramidalis* P. Beauv.	Poaceae	Cat tail grass	Herb		1	2	1	1	1	-	-	90	+
27	*Kyllinga nemoralis*. Rottb.	Cyperaceae		Herb		2	1	2	2	-	2	2	90	+
28	*Dryopteris filix-mas* (Linn.) Schott.	Dryopteridaceae	Male fern	Herb		4	4	1	1	3	-	1	70	+

Source: Fieldwork 2020

Table 4.16b: Key Utility Plant Species in the Study Area

Sl No	**Scientific Name**	**Family**	**Common names**	**Utility**	**Frequency of occurrence (%)**	**Braun Blanquet cover values**							**Abakaliki**
						T1	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	
1	*Ananas comosus,* L.	Bromeliaceae	Pineapple	Food	60	4	-	-	4	4	-	-	-
2	*Zea may,* L.	Poaceae	Maize	Food	75	3	3	-	4	-	-	3	+
3	*Dioscorea sp*, De Wild.	Dioscoreaceae	Yam	Starch (food)	55	4	5	4	-	-	3	-	-
4	*Elaeis guineensis*, Jacq.	Arecaceae	Oil palm	Oil, wine, alcohol	80	2	1	1	-	3	2	-	+
5	*Manihot esculenta,* Crantz	Euphorbiaceae	Cassava	Starch (food)	95	1	1	1	1	2	-	1	+
6	*Musa paradisiaca.* L.	Musaceae	Plantain	Food	35	5	4	-	5	-	-	5	+
7	*Raphia hookeri* Mann & Wendland	Arecaceae	Palm wine tree	Wine palm	65	2	3	-	-	-	4	3	+
8	*Pleurotus tuberregium*	Pleurotaceae	Mushroom	Food	25	5	-	-	5	-	-	-	+

S/ No	Scientific Name	Family	Common names	Utility	Frequency of occurrence (%)	Braun Blanquet cover values							Abakaliki
						T1	T2	T3	T4	T5	T6	T7	
	Singer 1951												
10	*Abelmoschus esculentum* (L.) Moench.	Malvaceae	Okra	Condiment	75	2	-	3	3	3	-	1	+
11	*Colocasia esculenta* (L.) Schott	Araceae	Cocoyam	Food	50	4	-	4	4	-	-	-	+
12	*Telfairia occidentalis* Hook.f.	Cucurbitaceae	Fluted Pumpkin	Food and medicine	80	1	3	-	-	3	3	2	+

**The criteria for selecting key plant species were based on crops of viable economic importance to community within the study area*

Plate 4.9: Cassava farmland in the study area

***Vigna gracilis* dominated area**

Tridax procumbens

***Regrowth A*rea**

Typical Physiognomy of the area

Plate 4.10: Some of the vegetation observed within the project area

Fauna

The fauna species of the project site is enumerated based on the presence of the species and observation of their faeces and reports from residents and hunters using questionnaire. The wildlife status of the project location is a reflection of the vegetation/habitat type of the area. The proximity of the proposed site to a busy road with noise affected the sighting and detection of wildlife in the plot.

The well branched trees are habitats to avifauna species, crawling reptiles, arboreal primates, arthropods, molluscs and small mammals. The ecological homogeneity provided by the large Palm tree populations implies that a uniform range of species are observable of large areas.

Nevertheless, four animal species were mentioned as forbidden, either for reasons of culture, taboo, religion personal dislike or on health grounds. These include; Tortoise, Monkey, Gorilla and Python.

Table 4.17: Forbidden animals reported in the study area

Common Names	Scientific Name	Conservation status
Tortoise	*Geochelore eleganus*	Least concern
Monkey	*Cercopithecus mona*	Endangered
Gorilla	*Gorilla*	Critically endangered
Python	*Python sabae*	Least concerned

The wildlife species of the study area have been well documented (Ita 1984; Happold, 1987; Anadu and Green 1990; Powell 1993, 1995, 1997; Akani *et al*. 1999, 2004, 2008).

The data shows that a total of 81 vertebrate wildlife species are presently resident in the area and its environs. This comprises:

- 28 mammalian species;
- 16 avian species;

- 20 reptilian species.

Animals that are labelled "rare", "threatened" or "endangered" are protected by law. Most nations have promulgated laws that protect conservation -reliant species which for example, forbids hunting, restricts land development or creating perseveres. Some animal species are protected from hunting, poaching and trading because their numbers are small and the produce no surplus harvest. For example, the Gorilla (Gorilla gorilla), has a gestation period of nine months and nurses its young ones for over six years. A loss of a mother or a baby therefore is critical to the already depleted population of these species.

Nigeria is a signatory to international laws and a member of bodies such as CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) which discourages illegal trans -border trades on endangered animal and plant products such as Ivory of Elephants, hides of yellow Antelopes etc.

- ***Amphibia***

Several breeding grounds for amphibians were spotted and their croaking sound and calls were rampant. The bulk of the amphibians recorded were from the streams and wet grasses in the area. The commonest of the amphibian fauna was the African toad; *Bufo regularis* AM/88 followed by the true frog, *Rana temporaris* (AM/89). Other amphibians of note, but which were not ubiquitous, were the *Ptychadena* sp., *Dicroglosus occipitalis,* and the Goliath frog (*Gigantorina goliath*).

- ***Aves***

The study area has a large and diverse population of avian species especially around Farmlands and bush fallows/secondary forest regrowth. High vocalisations were heard during the sampling survey in all the vegetation types of the study area. Dominant avian species identified in the study area include: Night jar (*Caprimulgus vociferous),* Pied Hornbill (*Tockus fasciatus), Plate below shows representative birds of the project area.*

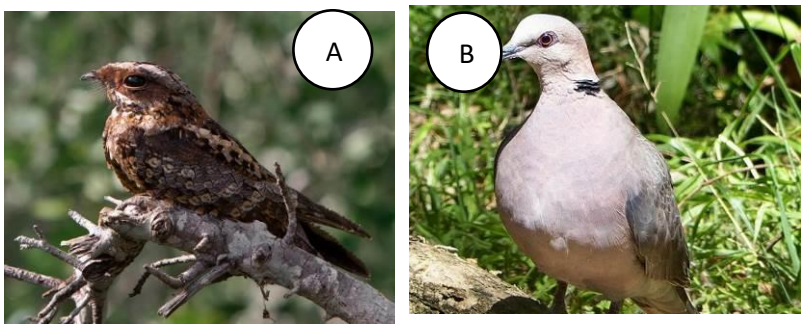


Plate 4.11: Representative birds of the project site : A: Caprimulgus vociferous, B: Streptopelia semitorguata

Table below shows checklist of avian species found and reported in the study area.

Table 4.18: A Checklist of Avian Species in the Study Area

BIRDS	STATUS IN STUDY AREA	LOCAL NAMES	IUCN	WCMC	ACT 11 of 1985	NUMBER SEEN	MODE OF DETECTION
Caprimulgidae				++			
Night jar – *Caprimulgus vociferus*	C			++	-	1	Direct sighting
Cuculidae							
Apodidae							
Red-Tailed Greenbul - *Criniger Calurus*	C			+	-	-	Questionnaire
Fringillidae							
Columbidae							
Green Fruit - Pigeon - *Treron a calva*	C			+	-	-	Questionnaire
Red eyed dove - *Streptopelia semitorguata*	C			++	-	-	Questionnaire
Laughing Dove - *Prinia subflava*	C			+++	-	1	Direct sighting
Ploceidae							
Black - headed weaver - *Ploceus melanocephalus*	C			+	-	-	Questionnaire
Blue Plantain-eater- *Corythaeola cristata*	C			+	-	-	Questionnaire
Estrildidae							
Orange - cheeked waxbill - *Estrilda melpoda*	C			+	-	-	Questionnaire
Numididae							
Helmeted Guineafowl - *Numida meleagris*	C			++	-	-	Questionnaire

Crested Guineafowl - *Guttera pucherani*	C			+	-	-	Questionnaire
Ardeidae							
Olive-bellied sunbird - *Cinnyris chloropygius*	C			+	-	-	Questionnaire
Olive sunbird - *Cinnyris olivacea*	C			+	-	-	Questionnaire
Carmelite sunbird - *Chalcomitra fuliginosa*	C			+	-	-	Questionnaire
Turdidae							
Hirundinidae							
Lesser striped swallow - *Hirundo abyssinica*	C			+	-	-	Questionnaire
Common house martin - *Delichon urbica*	C		EN	-	-	-	Questionnaire
Motacillidae							
Lappet-faced vulture – *Torgos tracheliotus*	C			+	-	-	Questionnaire

KEY: C=Common, EX=Extinct, R: Rare, EN: Endangered, NU= Not uncommon (Animals or birds that will be seen by anybody who makes effort to search for it in the area), A=Abundant, IUCN= International Union for the conservation of nature, WCMC= National Ranking in WCMC's 1988 Nigeria Biodiversity Report: + = Few; ++ = Common; +++ = Abundant, Decree/Act 11 = Ranking in Federal Endangered Species Act 11 of 1985 (Schedules 1 – 2)

Table 4.19: A checklist of reptiles in the study area

REPTILES	STATUS IN STUDY AREA	IUCN	WCMC	ACT 11 of 1985	MODE OF DETECTION
Testudinidae					
Serrale hinge-back tortoise - *Kinixys erosa*	C		+	-	Questionnaire
Boidae					
Royal Python - *Python regius*	EX		+	-	Questionnaire
Python sebae (African Rock Python)					
Calabaria reinhardtii (Calabar Python)					
Python sebae (African Rock Python)					
Elapidae					
Green Mamba - *Dendroaspis viridis*	C		+++	1	Questionnaire
Spitting Cobra - *Naja nigricollis*	NU		+	-	Questionnaire
Black Cobra - *Naja melanoleuca*	NU		+	-	Questionnaire
Colubridae					
Red-lined snake - *Bothrophthalmus lineatus*	NU		+	-	Questionnaire
Emerald snake - *Gastropyxis smaragdina*	C		+	-	Questionnaire
W. African house snake -	C		+	1	Questionnaire

Boaedon virgatum.					
Viperidae					
Burrowing Viper - *Atractaspis spp*	NU		+	-	Questionnaire
Carpet Viper - *Echis carinatus*	NU	EN	+	-	Questionnaire
Gaboon Viper - *Bitis gabonica*	NU		+	-	Questionnaire
Agamidae					
Agama Lizard - *Agama*	C		+++	-	Direct sighting
Scincidae					
GREY Skin - *Mabuya blandingi*	C		+	-	Questionnaire
Mabuya affinis (Blanding's snake)					
Lygosoma fernandi (Red/Fire Skink)					
Chamaeleontidae					
Chameleon - *Chamaeleo gracilis*	C		+	-	Questionnaire
Pelomedusidae					
West African Black forest turtle - *Pelusios niger*	C		+	-	Questionnaire

Table 4.20: Checklist of Mammalian Fauna in the Study Area

ANIMALS	STATUS IN STUDY AREA	IUCN	WCMC	ACT 11 of 1985	MODE OF DETECTION
HOMINIDAE					
Mona monkey - *Cercopithecus mona*	C		+	-	Questionnaire
Pata monkey - *Erythrocebus patas*	C	EX	+	1	Questionnaire
White-nose monkey- *Cercopithecus nicititans*	C				Questionnaire
Dwarf Galago - *Galagoides demidovii*	C				Questionnaire
Sciuridae					
Giant forest-Squirrel - *Protexerus stangeri*	C		+	-	Questionnaire
Black rat - *Rattus*	C				Direct sighting
Shaggy rat - *Dasymys incomtus*	C				Questionnaire
Striped mouse - *Hybomys vittatus*	C				
Cricetidae					
Palm Squirrel - *Epixerus ebii*					Questionnaire
Red-legged Sun Squirrel - *Helioscuirus rufobrachium*	C			1	Questionnaire
Hystricidae	C			-	
Brush - tailed porcupine - *Atherurus africanus*	C		+	-	Questionnaire
Muridae					
Giant rat - *Cricetomys gambianus*	C		+++	-	Questionnaire

Thryonomidae					Questionnaire
Thryonomys swinderianus - Cane rat or Grass cutter	C		+	-	Questionnaire
Atherurus africanus - Brush tailed Porcupine	C		-	2	Questionnaire
Mustelidae					
Forest Gene - *Genetta poensis*	C		+	-	Questionnaire
Leopard – *Panthera pardus*	EX				Questionnaire
Fox - *Aonyx capensis*	EX				
Carnidae					
Palm civet Serval - *Nandinia biotata*					
Bovidae					
Bush - buck - *Tragelaphus scriptus*	C		+	-	Questionnaire
Sitatunga - *Tragelaphus spekei*	C		++	-	Questionnaire
Blue duker Kob - *Kobus kob*					Questionnaire
Warthog - *Potamocherus porcus*	EX				Questionnaire
Bate's Pygmy Antelope - *Neotragus batesi*	C				Questionnaire
Herpestidae					
Marsh mongoose - *Atilax paludinosus*	EX		-	1	Questionnaire
Leporidae					
Bush rabbit – *Lepus capensis*	C		+++	-	Questionnaire

Manidae					
Long-tailed pangolin - *Uromanis tetradactyle*	C		+	-	Questionnaire
Tree pangolin - *Phataginus tricuspis*	C		+	-	Questionnaire
CHIROPTERA (Bats)					
Free - tailed Bat - *Tadarida pumila*	NU		+	-	Questionnaire
Viverridae					
Viverra civetta (African Civet Cat)	C				Questionnaire
Genetta poensis (Forest Genet)	C				Questionnaire
Nandinia binotata (Two-spotted Palm Civet)	C				Questionnaire
Herpestes ichneumon (Egyptian mongoose)	C				Questionnaire

KEY: C=Common, EX=Extinct, R: Rare, EN: Endangered, NU= Not uncommon (Animals or birds that will be seen by anybody who makes effort to search for it in the area), A=Abundant, IUCN= Internatioal Union for the conservation of nature, WCMC= National Ranking in WCMC's 1988 Nigeria Biodiversity Report: + = Few; ++ = Common; +++ = Abundant, Decree/Act 11 = Ranking in Federal Endangered Species Act 11 of 1985 (Schedules 1 – 2)

Soil fauna

The contributions of the soil microfauna (protozoa and nematodes) to the rhizosphere ecological functions cannot be underplayed. The microfauna in the rhizosphere play an important role in the release of nutrients available to plants, accumulation and stabilization of soil organic carbon, hormonal effects on roots and microbial diversity and functional stability, multi trophic interactions above the ground and bioremediation of contaminated soils.

Other predominant soil microfauna include; spiders, soldier ants, earthworms, beetles and beetle larva. Most of these microfauna feed on decaying plant material and debris although centipedes, soldier ants and larger species of spiders feed on other soil microfauna. However, the larger members of this fauna group such as the ground squirrel and wild rabbit help to produce good soil structure through their burrowing and casting.

Macro fauna

The abundance of termites and ants are clearly visible by the numbers of termites and ant hills. Some of the termites' hills are over a meter tall. Crickets' mounds appear occasionally where soil texture is very soft. These mounds could be mistaken as nearly cultivated agricultural sites. The crickets' mounds occur at average of a mound per quadrat. Other macro faunal organisms present are; spiders, slugs, soldier ants beetles and caterpillars. These animals burrow into the soil thereby aiding soil aeration and drainage. In addition, some organic materials pass through these burrows. Most macro fauna consume decaying plants materials and organic debris but centipedes, soldier ants and spiders mainly feed on micro faunal organisms.

Macro fauna biodiversity

Seven species of termites where found in the grasslands. Their total abundance was 210m2 while biomass was at 0.6gm-2. The dominant trophic group was the soil feeders, mastotermes, (320m2 and 0.4 gm-2) although the wood feeders, nasutitermes, (11m2 and 0.1gm-2) were not properly estimated due to their arboreal nature of nesting. Only three of the seven species of the soil feeders constructed epigeal nests (mounds).

The abundance of Tse fly (*Glossina morsitans)* in the study area explains the reason for the neglect of the derived (Hursey and Slingenbergh (1991) savannah area in livestock rearing and development. These biting flies are the vectors of the disease Trypanosomiasis which is fatal to man and grazing herds. The Tse fly lives in the trees and shrub covers.

4.5 Socio- Economic Environment

This section focuses on the socio-economic environment and characteristics of the state and people living in the project area. It also presented the consultations held with the stakeholders.

4.5.1 Brief Description of the State

Ebonyi State is one of the 36 states of Nigeria. It was one of the six states created in 1996 by the then federal military government of General Sani Abacha. It was created from parts of both Enugu State and Abia State, which were the Abakaliki division from Enugu State and the Afikpo division from Abia State respectively. It is located in the south eastern part of Nigeria. It is called the “Salt of the Nation” because of its large salt deposits. It shares borders with Benue State to the North, Enugu State to the west, Imo and Abia States to the south and Cross River State to the east. It has a land area of about 5,935 square Km and a population of 2,176, 947. (NPC 2006). Ebonyi State population is largely rural, with an average rurality index of 75%. The State capital and largest town is Abakaliki. The second largest town is Afikpo. Other towns are Ikwo, Izzi, Onicha, Edda, Onueke, Ezzamgbo, Nkalagu, Uburu, Ishiagu, Amasiri and Okposi.

The state is divided into thirteen (13) local government areas (LGAs) and 77 Development Centres. For Political reasons, Ebonyi State, like other States in Nigeria are divided into three Senatorial Zones with the respective local government councils outlined below :Ebonyi North comprises Abakaliki, Ebonyi, Ishielu, Ohaukwu and Izzi LGAs; Ebonyi

Central comprises Ikwo, Ezza North and Ezza South LGAs while Ebonyi South – comprising Afikpo North, Afikpo South, lvo, Ohaozara and Onicha LGAs

4.5.2 Towns & Villages

The towns and villages that make up Ebonyi State have unique characters and attractions. The major towns of Ebonyi State are briefly discussed below.

- **Abakaliki**

Abakaliki is the capital of Ebonyi State and the largest town in the State. It is located at the intersection of Enugu, Afikpo and Ogoja Roads. Before it became state capital in 1996, Abakaliki was the headquarters of the Old Ogoja Province. The original inhabitants of Abakaliki were primarily the Izzi, a predominantly agrarian Igbo-speaking people. With time, people from neighboring villages including the Ezza, Ikwo, Onicha and Ngbo people, as well as migrants and traders from other towns gradually settled in Abakaliki.

Before it became the State capital, Abakaliki was a small town known for its overflowing food markets. The people of Abakaliki and their neighbors were predominantly farmers who took advantage of the abundant and fertile soils to produce rice, fruits, vegetables, livestock and non-food items like limestone, rocks and gravel. Since it became state capital, Abakaliki has grown into a much larger town with modern facilities and a workforce that includes a growing number of civil servants, service providers and migrant workers.

- **Afikpo**

Afikpo is the second largest town in Ebonyi State and the headquarters of Afikpo North Local Government Area. Twenty-two villages make up present-day Afikpo and include Ozizza, Ohaisu, Nkpoghoro and Itim. Afikpo is the birthplace of several accomplished Nigerian men and women. A notable example is the late Dr. Akanu Ibiam of Uwana, one of the first Igbo medical doctors and former Governor of the Eastern Region. Afikpo is a mecca of ancient Igbo tradition and ceremonial (now antique) masks which have been carefully preserved by the state tourism board. Several archeological findings support the

claim that Afikpo civilization existed as far back as the Neolithic age. Mainly farmers and traders, Afikpo is considered a major producer of agricultural products in Nigeria. These include yam, palm produce, maize, groundnut, plantain, banana, cassava, fruits and vegetables. The Akanu Ibiam Federal Polytechnic Uwana is located in Afikpo. So is the Mater Misericordia Specialist Hospital. Mater Misericordia Hospital School of Nursing and Midwifery was one of the first nursing schools established in Nigeria by Irish missionaries and Dr. Akanu Ibiam.

- **Onueke Town**

Onueke is the headquarters of Ezza South Local Government Area and the ancestral headquarters of the Ezza nation, one of the most populous clans in Ebonyi State. Ezza people live in virtually all three senatorial zones of Ebonyi State and beyond, but are concentrated in Ezza North, Ezza South, Onicha, Ishielu and Ohaukwu Local Government Areas. The traditional Ezzas in these areas still return to Onueke to offer sacrifices to the graves of their progenitors: Ezekuna and his wife, Anyigo Ezekuna. Coincidentally, Sacred Heart Parish, Onueke, also serves as the headquarters of Christianity for Ezza Catholics.

Onueke used to be the headquarters of the old Ezzikwo Division. It was also the headquarters of the old Ezza Local Government Area. Presently, it doubles as the headquarters of Ezza South Local Government Area and Ebonyi Central Senatorial Zone comprising Ezza South, Ezza North, Ishielu and Ikwo Local Government Areas.

- **Ishiagu**

Ishiagu is a town in Ivo Local Government Area and is comprised of seventeen villages. The communities that make up present day Ishiagu cite a common ancestry and function as a homogeneous village group despite historical evidence indicating that the original settlers migrated from different locations at different times. The people of Ishiagu are famous for crafts in pottery and attract patronage from different parts of the country and beyond. They are also mostly farmers, traders and civil servants. The town is blessed

with abundant and fertile farmland. The Federal College of Agriculture, a research and training institution is located in Ishiagu.

4.5.3 History of the State

Historically, the geographical area today known as Ebonyi State is formerly a part of the old Ogoja Province which had Abakaliki as a government station for the administration of the surrounding localities in the then Eastern Region. With Nigeria's independence in 1960, the area attained a Provincial status comprising of three Divisions namely: Abakaliki, Afikpo and Obubara. Following the splitting of the former East Central State into Imo and Anambra States in 1976 by the Federal Government of Nigeria, Abakaliki Province was balkanized into two with Abakaliki Division as an appendage of Anambra State while Afikpo Division was attached to Imo State.

In 1991, another State creation exercise took place, giving birth to Abia and Enugu States within the Igbo heartland. On account of that exercise, the Local Government Areas, which constituted the former Abakaliki Division, were placed in Enugu State while the ones in the former Afikpo Division were made part of Abia State. That was the situation until October 1996 when Ebonyi State was created.

4.5.4 Political Administration

There are well-recognized leadership structures that oversee the political administration of the State led by the Executive Governor. For Political reasons, the three Senatorial Zones have representatives at the National Assembly at the Federal level just as there is also the State Assembly with honourable members representing respective constituencies.

The Local Government Areas (LGAs) of Ebonyi State have Chairmen who are responsible to the Executive Governor of the State. The leadership organization is such that the executive, legislative and judiciary functions of the government are well integrated.

At the informal level, there is the traditional administration headed by the Eze or King who is generally addressed as His Royal Highness (H.R.H) in the communities and Chief or village heads at the kindred level. The village heads function to ensure peace and justice in the area and also exercise administration and judicial authority over their community.

The traditional heads are elected from eligible males. Eligibility is determined by age (minimum of 35 years) and standing/integrity. Additionally, the candidate must come from particular families, considered royal families. Occupants hold office for life except deposed by the community. They could be deposed by the community if they are believed to be working against the community's interest, if he commit a heinous crime or became incapacitated by ill health. The Chief are appointed by their respective villages to oversee the affairs of the village and represent them in community matters. Chiefs are also all adult males and they remained in office for life, except removed by their kindred.

The roles of these organs of society are clearly defined and there were no indications of role conflicts. These organs could play significant roles in information dissemination and community mobilization before, during and after the proposed project.

4.5.5 Social Organizations

Community social organizations exist in all communities of the study area, with the ultimate aim of community development. Prominent are the Women groups and the Youth Associations which organize routine sanitation exercises. Apart from the ubiquitous credit and thrift societies which exist to ensure availability of revolving funds for members' economic advancement, these communities also boast of cooperative groupings. Also important are the age-grades and church-based societies. Not much community development activities have been achieved by these social groupings because of the depressed economic situation in the area. However, there is a high level of cooperative tendency which cause the people to speak with one voice and bear allegiance to their groupings of affiliation.

The socio-cultural groups play very significant roles in the maintenance of law and order in all communities, and they also provide a sense of belonging for the average indigenous resident.

4 5.6 Population

According to the Nigeria 2006 Population Census, Ebonyi State has a population of 2,176, 947 spread across 5,935 square kilometers. In 2016 using a projected population growth rate of 2.5%, the population of Ebonyi State was 2,880,400 making it one of the smallest State in Nigeria.

The study area is Abakaliki which is the state capital and one of the 13 Local government Areas of the State. It has a land mass of about 113.14km3 and a total of seventy-eight thousand (78,000) households with an estimated population of 208, 654 (NPC 2009). The area offers accommodation to indigenes and non-indigenes of Ebonyi State. The residents are government workers, farmers, businessmen, traders, workers of private sectors, students, apprentice etc. The study area was divided into four zones namely: Abakaliki East, Abakaliki West, Abakaliki North and Abakaliki South.

The Stadium project is aimed at improving the economic and social wellbeing of not only the Local Governments and State but also South East region and the country at large. The communities directly affected by the project are the Agbaja and Inyimagu communities (Table 4.21).

Table 4.21: Population of Abakaliki and the Host communities the project area

S/N	Name of Community	Population
1	Abakaliki	149,683
2	Agbaja	37,000
3	inyimagu	29,000

Source: National Population Commission of Nigeria (web)

4.5.7 The People and Ethnic Composition

The people of Ebonyi State are of Igbo stock. However, there are also non-Igbo speaking indigenes. The non-Igbo speaking people of the state include the Okpotos and the Ntezis in Ishielu Local Government Area.

4.5.8 Languages

English is widely spoken as the second language, and a visitor will be under stood anywhere in the state, if he can speak English language or its local variant, the pidgin. There are ten primary languages spoken in Ebonyi State: Afikpo, Mgbo, Izzi, Ezza, Edda, Ikwo, Kukele, Legbo, Mbembe, Okposi, Uburu and Oring. These languages are all subgroups of the Igbo language and are commonly spoken throughout the State

4.5.9 Education

Much importance is attached to education in Ebonyi State especially since the advent of democracy. The government is generally in control of most of the educational institutions (except commercial and preprimary schools).

However, recently a number of the post primary schools were returned to the voluntary agencies that originally established them especially the churches. The commercial and preprimary schools are owned by private or voluntary agencies such as religious organisations. The state has 539 primary schools and 85 post primary schools.

Ebonyi State is home to six prominent higher institutions of learning: Ebonyi State University, Abakaliki (EBSU); Alex Ekwueme Federal University Ndufu Alike Ikwo (AE-FUNAI); Akanu Ibiam Federal Polytechnic, Unwana; Federal College of Agriculture, Ishiagu; Ebonyi State College of Education Ikwo (EBSCOEI) and College of Health Sciences, Ezzamgbo and the newly approved Federal College of Education, Isu.

4.5.10 Land Area

With a land area of about 5,935 sq. km, Ebonyi State is popularly known as the 'Salt of the Nation' apparently because of the large deposits of salt water in the state. The State shares a border with Benue State to the North, Enugu State to the west, Imo and Abia States to the south and Cross River State to the east.

4.5.11 Culture and Festival

Ebonyi State is richly endowed culturally. The traditional mode of dressing for the men is an over flowing jumper or long sleeve shirt worn over a George wrapper tied around the waist and flowing down to the ankles. This is complemented with a cap and a walking stick for support and defense.

For the women, the traditional dress is a blouse over an Abada or George wrapper around the waist. This outfit goes with a headgear, earrings and necklaces. Two important traditional festivals are observed every year: the masquerade and the New Yam Festivals. The masquerade is a very important and colourful institution, and features the Omaba Ekpe and Ogbodu masquerades.

The New Yam festival is known by various names, such as Joku, lhejoku or Njoku ji. The festival marks the end of the farming season and ushers in the harvest and consumption of the new yam.

There are a variety of colourful dances in the State. The notable ones are the "Nkwa Umuagbogho" of Ehugbo, "Nkwa Nwite" of Ehugbo, "Oji anya lere" of Amasiri, "Uri" and "Akpoha lgurube" and the "Dibugwu" cultural dances of Ogbu Edda. Traditional industries and works of art include blacksmithing at Ezza and pottery works at Ishiagu in lvo LGA, mat weaving at Oshiri in Onicha LGA, Basket and broom production at Ntezi in Ishielu LGA. Other works of art produced in the State include carved doors and stools, walking sticks, traditional flutes, wooden mortars and pestles.

4.5.12 Tourism in Ebonyi

Ebonyi State is indeed blessed with many places endowed with naturally beautiful features. The environment is unique in nature and, hence, attracts people for sightseeing and relaxation. Some of these places are fully developed while others are receiving attention from both the State and Federal governments. The following are some of the tourism destinations within the State.

1. The Amusement Park: This Park is wonderfully made as a relaxation spot especially for children. It is well equipped to serve the purpose. It is a place you cannot afford to miss as a visitor to Ebonyi State. It is also located at Abakaliki, the capital of Ebonyi State.
2. Amanchor Cave: The cave is located at Amanchor in Afikpo South. The Cave is about 4 kilometers long. Plans are underway to develop this cave, as it is capable of attracting visitors to the site from within and outside the country.
3. The Golden Sand Beaches at Ndibe, Ozizza and Unwana (all in Afikpo zone of the State) and Oferekpe Beach in Ikwo LGA of the State are all tourism destinations in the State.
4. Mkpuma Ekwa Oku Rocks: These are rocks naturally shaped like eggs. These rock formations have been there for ages. They are located at Ndieze Community in Izzi Local Government Area.
5. Okposi Salt Lake: This is located at Okposi in Ohaozara LGA. The economic importance of this lake is enormous. It has served as the economic base for most of the rural women in the area. It was believed to be the only means of livelihood left during the Nigerian civil war.
6. Abakaliki Greater Rice Husks: This is located at Abakaliki, the State capital, precisely at the rice mill industry. During rice production, the rice husks are piled into heaps, which make them look like sand dunes in the desert.
7. Slave Market/Route at Ezza North/South: This is one of the legacies of the infamous trade on human cargo that took place In Africa.

4.5.13 Economy

The people of Abakaliki and their neighbors were predominantly farmers who took advantage of the abundant and fertile to produce rice, fruits, vegetables, livestock and non-food items like limestone, rocks and gravel – all of which are abundant throughout the area. Since it became state capital, Abakaliki has grown into a much larger town with modern facilities and a workforce that includes a growing number of civil servants, service providers and migrant workers who commute to work from neighboring towns and states.

The economy of the communities is highly private sector driven. There is a high level of dependence on natural resources for livelihood sustenance. In essence farming and capture fisheries remain the most important economic activities in the surveyed communities. The women also exploit the mangrove forest for firewood and other non-timber forest produce (mushroom, wild fruits and vegetables etc.). They also process garri and rice. The major female activity is however marketing of products.

The identified activities are mainly primary production activities like farming, fishing, hunting and production of palm wine. Commerce and provision of services like petty trading, artisanship practices and employment in the civil/public services were also identified. The largest proportions of household members in the area are engaged in farming, fishing and next to these are the proportions of household members engaged in trading. Artisanship practices inclusive of electrical repairs, carpenter, plumber and tailoring. Civil service employees in the communities are limited mostly to teachers, LGA workers, state civil servants and health workers.

Apart from farming and fishing, trading in palm oil, plantain, garri, vegetables etc had also been a significant livelihood activity in the study area.

Most of the farm and products intended for sale are dried (smoked) and transported to markets, especially in Abakaliki and other part of eastern region. The market day varies from one community to another and during this market period goods are sold and bought

by the traders. A wide variety of goods including food stuff, electronics and household wares are sold in the communities.

The markets apart, there is considerable daily sales of goods in the communities. This type of selling is conducted from a variety of places. Some are petty traders who can only afford to sell a few things like sweets, biscuits, bread, fruits, etc from table tops usually located in the front of their houses. Some others can afford to rent proper shops and sell from such places. This latter group usually have larger shop space and also stock more goods. There are also traders that tend to sell a wide variety of items like clothing, shoes and bags, electrical fittings, alcoholic and non-alcoholic beverages and stationery, among others. Many of the indigenous petty traders are women. Traders deal with a wide variety of goods and also operate on different scales and so their incomes are also very varied.

Residents commonly engage in more than one livelihood activity. Engaging in multiple livelihood activities provides household members complementary sources of income. In many cases it is an indication that each of these activities only provides a subsistence income. It is expected that the proposed road project will significantly affect farming activities in the communities.

4.5.14 Agriculture

Agriculture is a major industry in Ebonyi State. An estimated 85%t of the population earn their living from one form of agricultural activity or another. If the phrase 'Salt of the Nation' had not been adopted to describe the uniqueness of Ebonyi State among other states in Nigeria, another choice would have been: 'Food basket of the Nation'.

This is because Ebonyi State's agricultural productivity is one of the highest in Nigeria. The popular Abakaliki brand of rice is cultivated throughout the state and is being exported to different parts of the country.

Other food crops grown in large quantities include yam, cassava, maize, cocoyam, cowpea and groundnut. Cash crops such as oil palm, cashew, cocoa and rubber are also vigorously cultivated. The presence of large arable land, rivers and streams has made farming very attractive.

Fishing is also carried out on commercial scale, particularly along the Aboine River which crosses the north central parts of the state and the Cross River which passes the southern part of the state.

Livestock farming is also popular in Ebonyi State. This includes the traditional rearing of animals such as goats, pigs, chicken, cows, horses and pets. There are cattle ranching in Onicha, Ohaozara and Ishielu LGAs.

Ebonyi State government's agricultural development programme is three pronged: a. Direct public participation through the establishment of agro based industries, tree crop plantations, irrigation and the provision of fertilizers and seeds; Ebonyi state boast of a high capacity fertilizer blending plant in the State capital.

Public participation in commercial private agricultural production, operated as joint ventures in large-scale crop, livestock and fish farming with farmers and other private entrepreneurs, both local and foreign; and Small holder agricultural production, in which government seeks to emphasize the role of the small holders.

Ebonyi State has eleven officially gazetted forest reserves and many sacred grooves which protect the rich biodiversity in the state. The Akanto game reserve (with an area of about 450 hectares) is a protected area where endemic wildlife species are conserved.

4.5.15 Industrial sector

The State has several food processing factories including dozens of rice mills, including State owned modernized rice mill clusters situated in each of the three senatorial zones,

many quarry factories located in all the zones of the state (Onuebonyi, Okworoeka, Ikwo, Umuoghara, Akpuoha, Amasiri, Ishiagu, Nkalagu etc), a fertilizer blending plant, one of Nigeria's largest poultries (Nkali Poultry) and one of Nigeria's foremost cement factories (the Nigerian Cement Company at Nkalagu). There is also a newly constructed pipes production factory at Ishieke and Waste recycling plant in Umuoghara.

There is a huge prospect for industrial sector in the state as the construction of an industrial layout is underway in Uburu in Ohaozara LGA of the state. Traditional industries and works of art include blacksmithing at Ezza and pottery works at Ishiagu in Ivo LGA. Other works of art produced in the State include carved doors and stools, walking sticks, traditional flutes, wooden mortars and pestles.

Plate 4.12: Modern Motorized Rice mill in Ebonyi State

4.5.16 Mineral Resources and Mining Sector

The state is blessed with mineral resources such as lead, limestone, zinc and marble. Ebonyi is called “the salt of the nation” for its huge salt deposit at the towns of Okposi and Uburu. Ebonyi State has had a vibrant quarrying industry that dates back to the 1950s (Chima et al., 2010). Angela Akanwa et al (2017) noted that over time it has experienced a considerable increase in quarrying operations with about 400 private operators producing over 100,000 metric tons of stone materials per annum (Ministry of Solid Minerals, 2007). There is a surplus supply of these natural resources in the State due to its geologic formation (Edet et al. 2011). It has triggered the excavation and exploitation of quarry resources. It has also brought about economic benefits as employment, direct contracts, purchase of locally-produced goods, foreign exchange earnings and development projects in the host communities where the stones are quarried (Sosa et al., 2001, Bradshaw, 2005 and Bridge, 2008).

A BAG OF LEAD FROM IKWO

A LUMP OF LEAD

Plate 4.13: Stone crushing site Ebonyi State

Plate 4.14: Okposi Salt Lake (Mmahi Ezi)

Plate 4.15: Uburu Salt Lake (Mmahi)

4.5.17 Urban and Rural Development and Problem of Urban Primary

Besides the urban areas of Abakaliki, Afikpo and Onueke, the headquarters of the other local government areas are functional and effective 'central places' Most of these falls within the countryside, each with its own requisite infrastructure, indicative of the wide scope of incipient urbanization which is generally taking root in the state. Recently, some Local Government Areas are added to the already existing State recognized Urban areas. They are Ohaozara, Ivo and Afikpo North.

Rural development programmes of the Ebony State government lay emphasis road construction and rehabilitation, aimed at improving access to the hitherto marginally exploited farmlands for the evacuation of agricultural produce to urban markets. The state has secured approval for the reconstruction and rehabilitation of long abandoned Ebonyi Ring Road which ease the suffering rural farmers and dwellers. Rural electrification

schemes are also pursued as an essential infrastructure for successful small scale and cottage industrial schemes.

In addition, various agricultural innovations are being put in place and farmers are encouraged to go into large scale farming through the adoption of these innovations, which include tractor hiring schemes for tilling; irrigation; land consolidation for extensive and intensive farming; seed and livestock breeding and multiplication; and fish farming.

Water resources improvement programmes have been instituted to provide clean and safe water in the villages. The provision of Primary Health Care (PHC) facilities and the development of effective rural information delivery system are other important facets of the state's rural development programme.

Effective communal involvement through Community Development Associations (or Town Unions), and Age Grades are also encouraged to promote rural development in Ebonyi State.

4.5.18 Settlement patterns

Settlement patterns in the urban areas often take the form of distinct neighbourhoods or quarters. Some of these neighbourhoods are of high density, while others are of medium and low densities in varying degrees of admixture. Rural settlements are dispersed over much of the farmlands.

In almost every community, however, there are vast unoccupied areas set aside as farmlands and somewhat removed from the settlement. The village is the traditional unit of settlement in most Igbo speaking communities. The dispersed pattern of village settlement is traditional among the people of southeastern Nigeria. Each homestead is made up of houses in an oblong form around a compound.

The hut of the head of the household is separated from those of his wives and adult members of the household. Compounds are often walled most times with traditional fence trees known as “Ogbu” thus separating one compound from the other. Traditional houses are built of local materials, such as clay for the walls and mat or thatch for the roofs. Increased affluence in some communities has led to the introduction of cement bricks, western architectural design concepts and the use of corrugated sheets, into the construction of village homes.

4.5.19 Women and Youth in Community Development

The women and youth groups play important roles in the communities, and serve to bring their members together as well as intervene in their welfare. The women’s primary role is to advice the CDU and council of Chiefs on matters concerning women in the communities. Women are not involved in the day to day administration of the communities or hold positions in the organs of traditional administration seat or participate with the men in taking community decisions. They had their separate meetings and their decisions were transmitted to the CDUs and traditional councils. This cultural inhibition is a clear indication of gender inequality in the communities.

4.5.20 Religion

Residents of area are mostly Christians. There are various Christian denominations with worship places spread across the community. Christian denominations in the community include Catholic Church, Anglican Church of Nigeria, Living Faith Church, and Assemblies of God Church. Just as many in parts of the world dominated by Christendom, main Christian festivals of Christmas and Easter are celebrated across the State and host communities.

Traditional worship practices are carried out by few adherents mostly the elderly and major communal deities and shrines are located in the study area. 93% of the residents are Christian adherents, while 6% and 1% are Moslems and traditional worshippers respectively.

Socio-cultural demands and the demands of living with people from different backgrounds have helped shaped society's moral codes and norms. This condition has given rise to prohibition of some perceived harmful practices with a view to ensuring security of life and property and fostering harmonious co-existence and habitation.

These prohibited practices include desecration of shrines and places of worship, committing suicide, having sexual intercourse with a married woman who is not one's wife or with a blood relative and cannibalism. The communities expect all residents to abide by the society's moral code. Residents generally abide by these restrictions because the communities enforce them and they also believe that violation attracts dire consequences. These may lead to banishment or warrant performance of expensive appeasement and cleansing rituals on offenders. There are no communal restrictions on religious beliefs and worship. Residents are at liberty to pursue their religious beliefs and interests.

4.5.21 Infrastructural Facilities

The study reveals that there are remarkable infrastructural facilities abound in the state capital.

Plate 4.16: Ebonyi State Secretariat

Plate 4.17: Ecumenical Center Completed In 2019

Plate 4.18: Shopping Mall nearing Completion

a. Public Water and Electrification

Public water and electrification are very much dysfunctional in the communities. Majority of the communities are using dug well in the project area. But most of the few water bore holes constructed in the communities but most of them are not working largely because the water produced is deemed unfit for consumption by communities' residents, usually because of colouration. Similarly, most of the communities have electrification facilities but do not have electricity because there are no functional transformers. Some of these transformers break down often and maintaining them has been a major problem for these communities.

b. Transportation

The main means of transportation among communities in the study area is by road with the use of cars, commercial tricycle and motorcycle and bicycles. Many households have access to motorcycles and bicycles which they used to go about their daily business especially farming but many could not afford one but resort to trekking. As at the time of this study many transport companies have suspended their activities due to government's restriction of inter-state travel in order to contain COVID-19 pandemic. Movement within the city is done by either commercial tricycle or motorcycle where private car is not available.

	
Peace Mass Transit	**Peace Mass Transit**

	
Romchi Mass Transit	**GUO Motors**
	
Ifesinachi Industries Limited	**Keke and Okada doing their business**

Plate 4.19: Transportation System in Abakaliki

c. Feeder Roads

Many feeder roads link the airport from villages and communities. They are of varied sizes and nature. A proposed major airport road is a straight double lane concrete paved road that runs from the busy Abakaliki – Afikpo road to the project site. There is also a minor access road that linked the popular Eke-Imoha market to the Airport project site. Another important road will link Airport to the soon to be constructed ring road. No tarred road connects the airport road at the moment.

	
Shopping Mall tunnel	**Nkaliki Junction, Abakaliki**
	
Afikpo Road, Abakaliki	**Abakaliki – Enugu Expressway**

	
Water works Road, Abakaliki	**Ezza Road, Abakaliki**
	
Akanu Ibiam Flyover, Spera en Deo Roundabout	**Senator Offia Nwali Flyover, Presco Junction**

	
Union Bank Round About	**Vanco Junction**

Plate 4.20: Road Network in Abakaliki, Stadium project site

d. Housing

During the survey, most houses visited are for commercial purposes meaning that the occupants are not the owners but they are living on rent as tenants. They are mostly upstairs of 1-4 storey buildings built in flats formats. Other buildings are bungalows built for those of lower income. Duplexes are sighted in different parts of the city mostly occupied by their owners. Most of the buildings are fenced for security reasons. Most of the buildings are modern buildings while very old buildings are common sight Additionally, there is a positive correlation between Housing type and income of the people. Plate 4.21 shows the houses in city and its environs.

Plate 4.21: Housing setting in Abakaliki

e. Markets

The state capital- Abakaliki hosts the biggest daily market in the state (the Abakpa market). Traders in this market were recently moved to the newly completed Saint Margret Umahi International Market. Almost every Local Government Area has a major market most of which hold on specific market days every 4 or 5 days. There are also some small neighbourhood market for mainly food items

The only major markets in close proximity to the project site is the Eke Imoha market in Onueke, However, there are scattered open small markets, stores and kiosks where people sell various food item and provisions. Evening markets are present in these areas where agricultural products and food items are sold.

Saint Margret Umahi International Market

Small make-shift market Opposite Abakaliki LG council

Ukwu Akparata Street Market

Shops along the street

Shopping plaza

Plate 4.22: Different Markets at the project host communities

4.6 Socio-Demographic Characteristics of Respondents in the Project Area

4.6.1 Age and Sex of Respondents

The average age of the respondents was 25 with a range of 15- 60years (Fig 4.14). It is noteworthy to say that 80% of the respondents are within the 16-55 years age bracket We chose this age bracket because sporting activities are particularly interesting to the youth. They are the immediate beneficiaries of the proposed project. This indicates a very young, active and productive group of the population being drawn to the capital city either

by birth, education, greener pasture or other unavoidable circumstances. 72% of the respondents were male, while the remaining 28% were females (Fig. 4.7). In Ebonyi, women are involved in agricultural practices such as such as clearing, weeding, planting and harvesting. However, some women own parcels of farmland, either by inheritance or purchase.

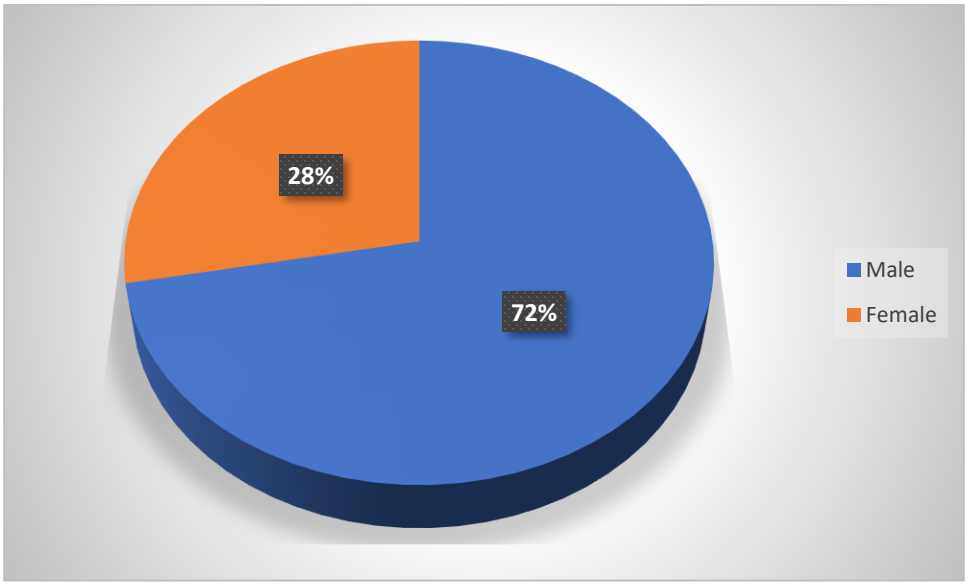


Figure 4.13: Sex of the respondents

4.6.2 Marital Status and Number of Children of Respondents.

Fig 4.8a depicts that Majority (62%) of the respondents are married and 20% of the respondents were single, and others (widows and widowers) represented 18% of the respondents. Fig 4.8b also shows that respondents having 3 to 4 children and 5 to 6 children were predominant 56%. 12% of the respondents also had 1 to 2 children, 22% has 6 children and above. While 10% of the respondents had no children.

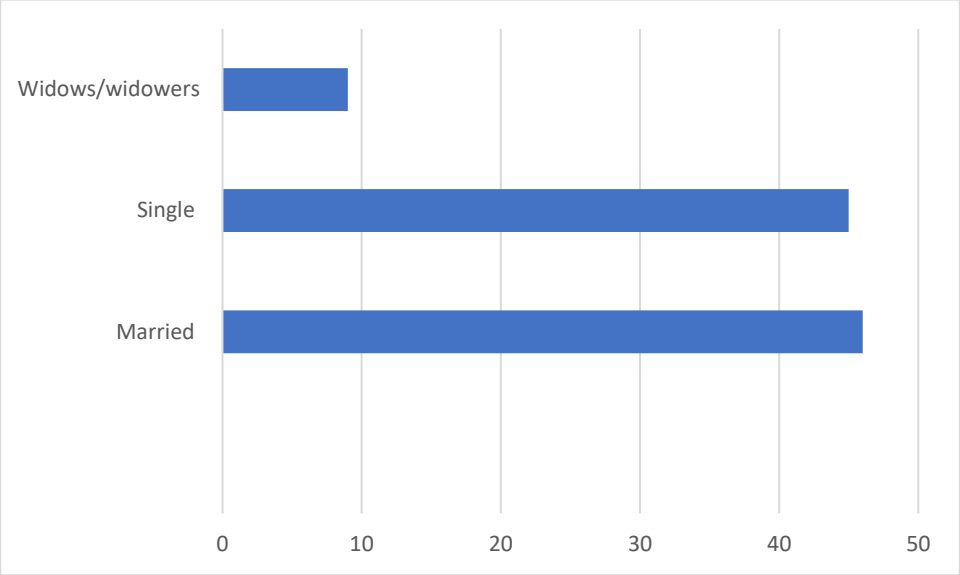


Figure 4.14a: Marital Status

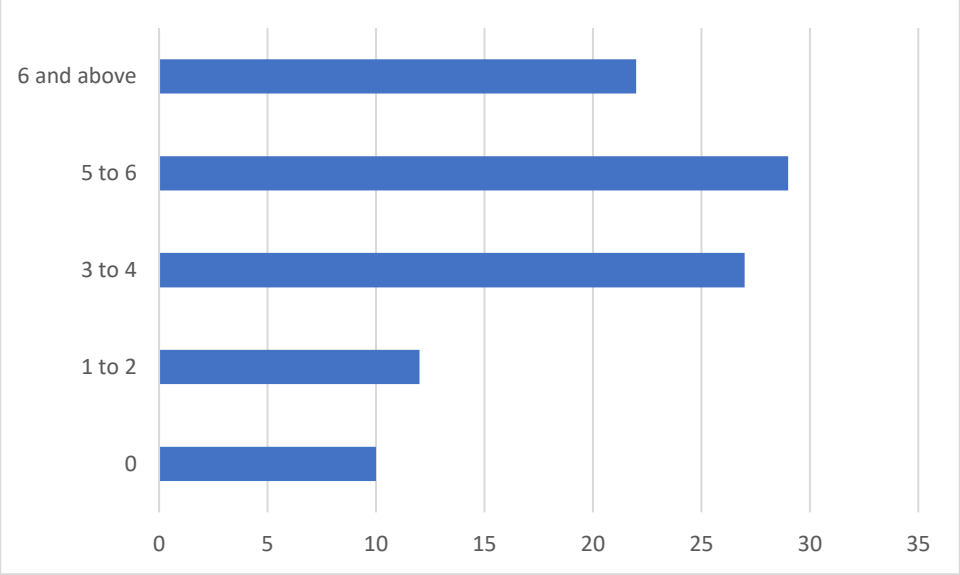


Figure 4.14b: Number of Children of Respondents.

4.6.3 Religion of Respondents

Majority 91% of the respondents are Christians, while 8% of the respondents practice traditional religion and 1% other religion. The predominant tribe along this corridor are the

Igbos 96%, other tribes 4% identified along this corridor are alien settlers from other regions of the country (Fig. 4.4).

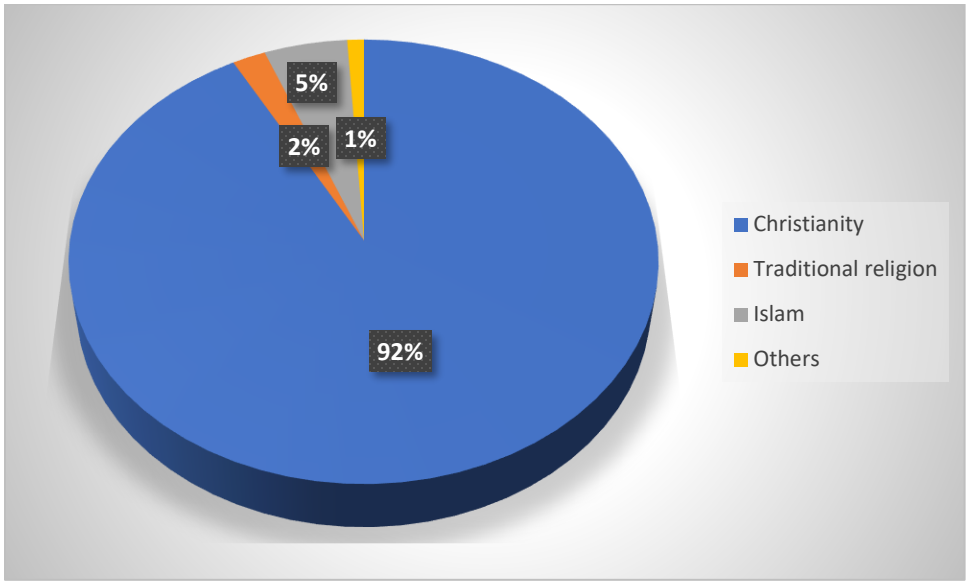


Figure 4.15a: Religion of respondents

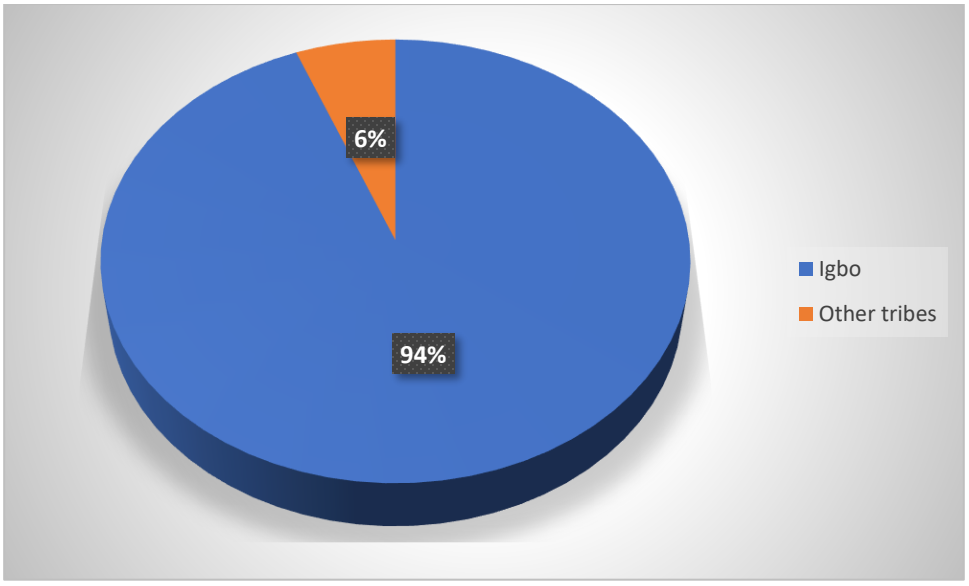


Figure 4.15b: Tribe of respondents

Presbyterian Church

Methodist Church

St John Catholic Church

Plate 4.23: Pictures of Religious Centres within the host communities

4.6.4 Educational Attainment of the Respondents

The study revealed that 26% of the respondents had primary education, 50% had secondary education while 9% had tertiary education. 15 % of the respondents had no formal education (Fig, 4.10).

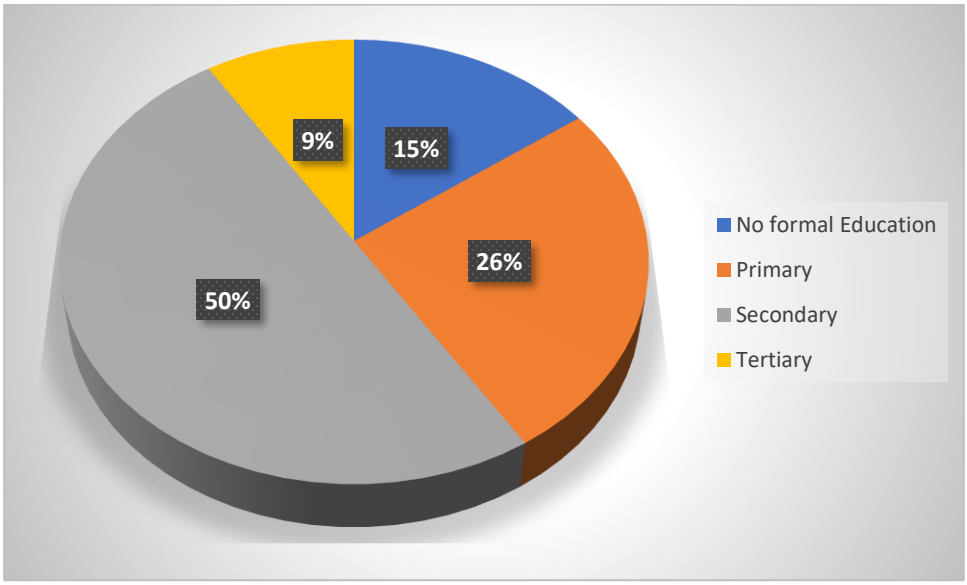
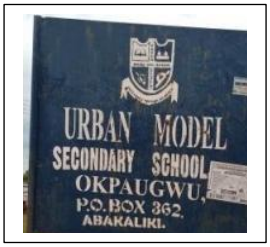


Figure 4.16: Educational Attainment of Respondent



St John Primary and secondary School

Ezzikwo Primary School

Holy Ghost Foundation School, Abakaliki

EBSU Staff Nursery/Primary School, Abakaliki

Plate 4.24: Some Primary and Secondary Schools in Agbaja and Inyimagu communities, Abakaliki LGA

4.6.5 Distribution of Respondents by Occupation and Income

Fig.4.1a and 4.11b depicts the primary occupation of the respondents and their average monthly income in Naira. It shows that (30%) of the respondents were farmers, 20% were civil servants , 15% are traders, 10% are artisans while 25% are students , as identified among other occupation in the project communities. 35% of the respondents earn monthly income of between 30,001-60,000.00 (35%) per month, followed by those with an income of 60,000 and above 25%. Then those that earn between N15,001– N30,000.00 (22%) while those that earn N1,000.00-15,000.00 is placed at 18%..

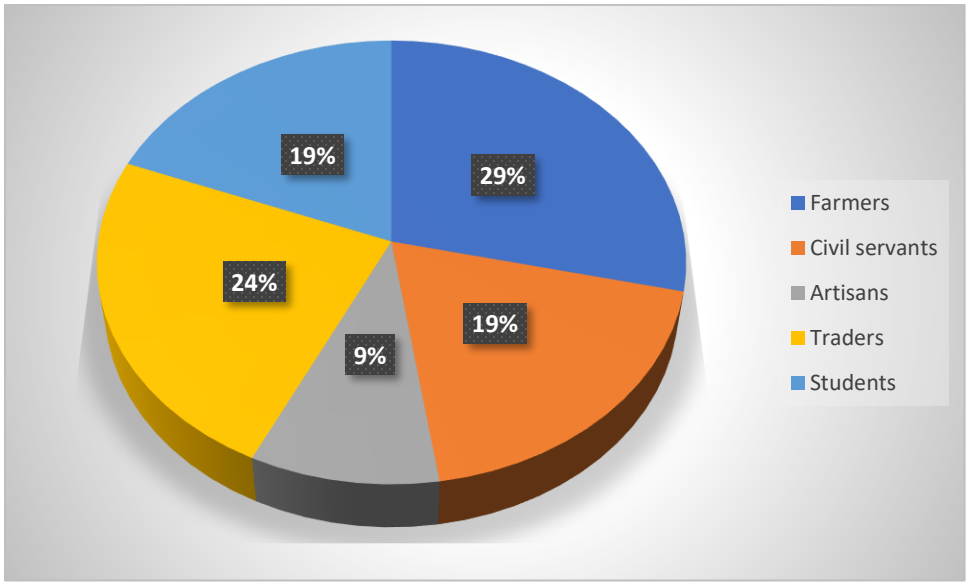


Figure 4.17a: Primary Occupation
Source: Field Survey, March., 2020

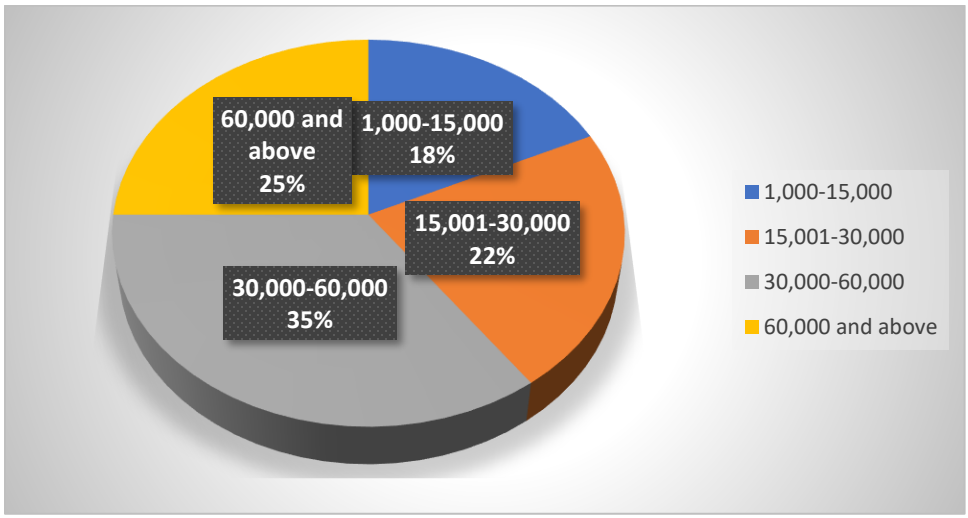


Figure 4.17b: Average Monthly Income of Respondents

Source: Field Survey, March., 2020

4.6.6 Marriage Practice and Household Size

The study revealed that household range from 2 (8%) - 10 (3%). This means that the family sizes are generally moderately sized. Some families are polygamous in nature hence many children. Households in the areas surveyed were combination of nuclear and extended family structure. The fertility of this area is fairly high since the household size varies from 5-9 and 10 and above for polygamous families. Life expectancy in the communities is in tandem with the national average which stands at 50.

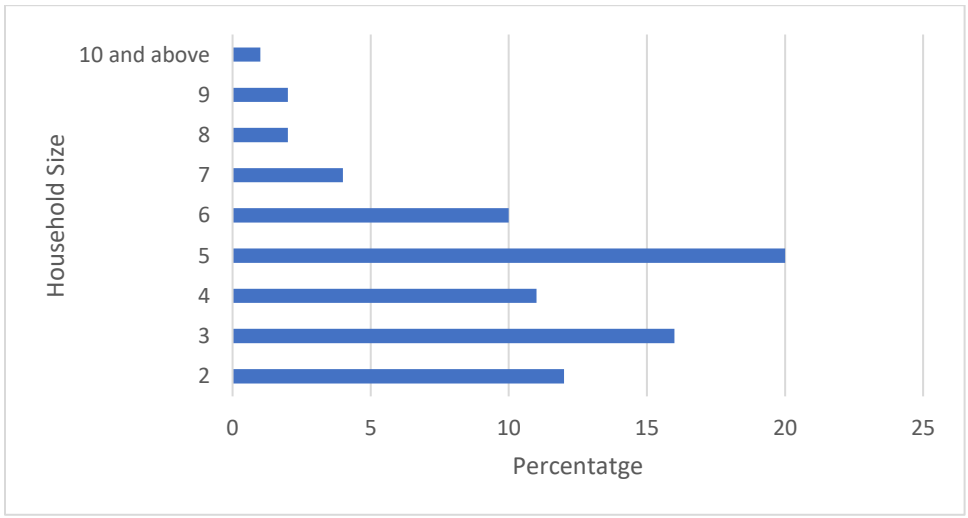


Figure 4.18: Household Type in the Project Area

4.6.7 Sources of Energy Available to Households

The available sources of energy for cooking household meals and for lighting in the communities are kerosene, firewood and electricity.

Most households about 38% use firewood to cook their meals while 57% uses kerosene while 5% uses cooking gas. For lighting, a significant proportion of households about 65% depend on their kerosene lamps, while 15% rely on the public light provided by PHCN in the area and 34% uses private power generating set to augment the public light in the area

4.6.8 Desirability of the Project by Respondents

76% of the respondents noted that the project is desirable as it is going to provide enhanced economic activities and reduce unemployment. They saw sport as a unifying activity that curbs youth restiveness and other negative vices. 15% thinks that there are other amenities are of urgent need that sporting facilities but agreed that the development that comes with an international stadium could as well bring other desirable amenities.

4.6.9 Preferred Forms of Mitigation Measures

The project land has been in the custody of Nigerian Armed Forces until 2007 when it was reclaimed by the Administration Chief Martins Elechi and illegal occupants evacuated. This project is taking place 13 years later after the then occupants have been resettled. As at the time of this study there no occupants or claimants to any asset that could be affected by the project. Therefore, since there are no Project Affected Persons (PAPS), there is no issue of mitigation measures.

4.7 Transport and Traffic Studies

4.7.1 Transport

Ebonyi State can be accessed either by road or by water. The latter is along the Cross River in the Afikpo area. The state has established the Ebonyi Transport Service (EBOTRANS) with a fleet of buses. Many other transport companies have also established in the state and are very active. Other private vehicles operators doing intra

and interurban services ply virtually every part of the state. It also has a well-developed road network that links up important centres of agriculture, trade and industry.

The reconstruction and rehabilitation of the 198km Ring Road which is underway will be boost transportation activities I the state remarkably. Efforts have also been made to open up feeder and community roads leading into food producing areas of the state and linking up neighbouring villages and small towns. The current state government is constructing a minimum of 20km in each of the 13 LGAs. Taxi cabs, buses and motor cycles ('Okada' or Inaga') are mostly responsible for urban transportation. In the rural areas, the most widely used transportation modes are motor cycles, bicycles and human porterage. (Appendix 4.8)

4.8 Health Assessment

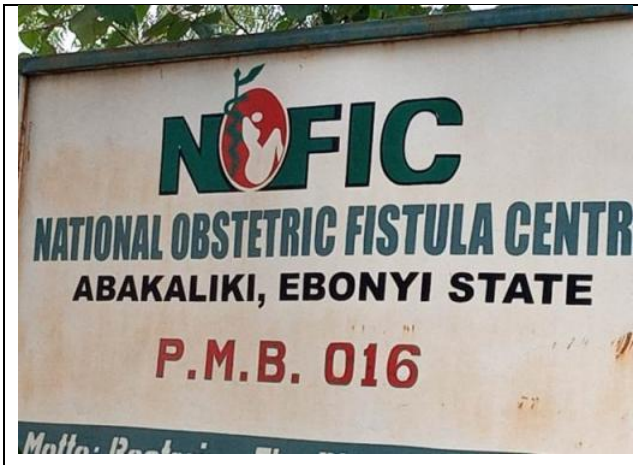
4.8.1 Health Care Delivery/ Health sector

Ebonyi State government has consistently pursued a policy of good health for all. The result is that, today, there is hardly any local government area in the state without a general hospital or some standard healthcare institution, to cater for the health needs of the people. Maternal and Child Care Centers are also established by the state government to take Medicare to the rural dwellers. In these centers services such as treatment of Malaria for mother and child, Family planning and testing and treatment of HIV patients are done at no cost.

In addition to the government owned hospitals and health centres, there are other medical centres owned and managed by voluntary organizations, especially missionary agencies. Ebonyi has two major hospitals – Federal Teaching Hospital Abakaliki 1(FETHA1) and the Federal Teaching Hospital Abakaliki 2 (FETHA2) – both in Abakaliki. The State also has three general hospitals located in Onueke, Onicha and Enohia Itim (near Afikpo). These are complemented by several private hospitals and clinics in various towns and villages. The State also has three schools of nursing at Uburu, Afikpo and Edda.

Federal Teaching Hospital

Ebonyi State also prides herself of some special health institutions namely: National Obstetric Fistula Center and National virology center. National Obstetric Fistula Centre, Abakaliki is a national Centre dedicated to the treatment, rehabilitation, training, research, etc on Vesico Vaginal Fistula (VVF), Prolapse, Cervical and Breast Cancer screening (for women), Prostate Cancer (for men). It is one of three such centers in Nigeria while the virology center is a 27-bed facility situated in FETHA The center has the isolation section for treatment of Lassa fever cases, laboratory section and dialysis section.



National Obstetric Fistula Center

National Lassa Fever Center

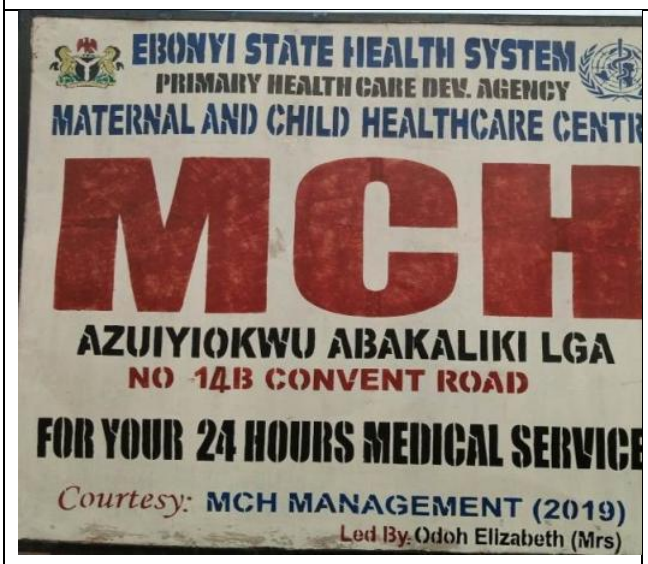


Plate 4.25: Hospital and Health Centre around the proposed project Area

4.8.2 Quality of Life

To understand the quality of life vis-à-vis the health situation of the people, the respondents were asked some questions related to life. Table 4.22 indicates the respondents' response to issues regarding the Quality of Life. For instance, the available sources of energy for cooking household meals and for lighting in the are Cooking gas, electricity, kerosene, and firewood and dust oven for those in rural area. Most households about 35% use cooking gas to cook their meals while 65% uses kerosene. For lighting, a significant proportion of households about 65% depend on their kerosene lamps, while 15% rely on the public light provided by National Grid in the area and 34% uses private power generating set to augment the public light in the area

Table 4.22: Quality of life attributes

S/No	Quality of Life Attribute	Proportion (%)
1	**Waste Disposal (Refuse)**	
	Government designated collection points	85
	Dumping in the dug pit	10
	Dumping in the bush or stream	5
2	**Sources of Water for Domestic Use**	
	River/Stream	2
	Rain water	19
	Bore hole	53
	Dug well	18
	Pipe borne water	**8**
3	**Energy Source for Household Cooking**	
	Firewood	20
	Kerosene	30
	Cooking gas	40

	others	10
4	**Energy Source for Household Lighting**	
	Kerosene lamp	7
	Public electricity	85
	Private electricity generator	7
	Candle/Torch	**1**

4.8.3 Water Source

The study reveals that government of Ebonyi state has made a tremendous effort in providing sustainable water supply to the inhabitants of the state. However, the water schemes (Oferekpe, Ukawu and Ezillo water scheme) are yet to commence full operation. For now, majority of the people (51%) obtain their water from boreholes. Azuiyiokwu and Iyiudele river in the city of Abakaliki are only fit for washing and not for other domestic purposes. Few locals close to the project site make use of dug wells or walk a distance for borehole water. Rain water is also harvested and stored during rainy season to be used during dry season by residents (17%). Only 8% of the respondents use boreholes as source of water supply.

Table 4.23: SOURCE OF WATER SUPPLY

Dug wells	**18%**
boreholes	**53%**
Rain water	**19%**
Stream	**2%**
Pipe borne water	**8%**

	
Dug well	**Borehole for commercial purpose**
	
Rain water harvesting	**Borehole water storage for commercial purpose**

Plate 4.26: Source of water supply at the project area

4.8.4 Waste Management

This refers to the way unwanted or unusable materials, which are disposed of by primary users are treated, handled or disposed. In Abakaliki the state capital and other urban towns within the state, the state government has a very good waste management policy. Each household collect

their wastes and send to an approved collection point for the area. The collection points are evacuation on daily basis and taken to a central dumpsite at Umuoghara close to the pulverization plant where the wastes are sorted for future pulverization and recycling. The Rice Mill dumpsite is located within the premises of the popular Abakaliki rice mill, along old Ogoja road (now Sam Egwu way) Abakaliki.. The major waste disposed here is rice husk which are produced from the mills.

The residents of the communities who live in villages create their dug-out refuse dumps which serves as compost manure for agricultural purposes. While others in more developed areas dump their refuse at specific designated places along the road to be evacuated by workers of Ministry of Environment. While some burn their waste depending on the type. There is a very stringent law against indiscriminate dumping of refuse which causes sewage blockage. About 65.74% (majority) of the respondents) dump the wastes they generate in their houses in the bins (strategically placed in the communities) provided by agencies authorized by government to dispose of them.

Plate 4.27: Ebonyi Waste Pulverisation Plant at Umuoghara

4.8.5 Health Problems

The common health problems among the population are Malaria (56%), and Typhoid (28%), Rheumatism (14%) urinary tract infection (7%), stomach ulcer (8%) and sexually transmitted infection (7%).

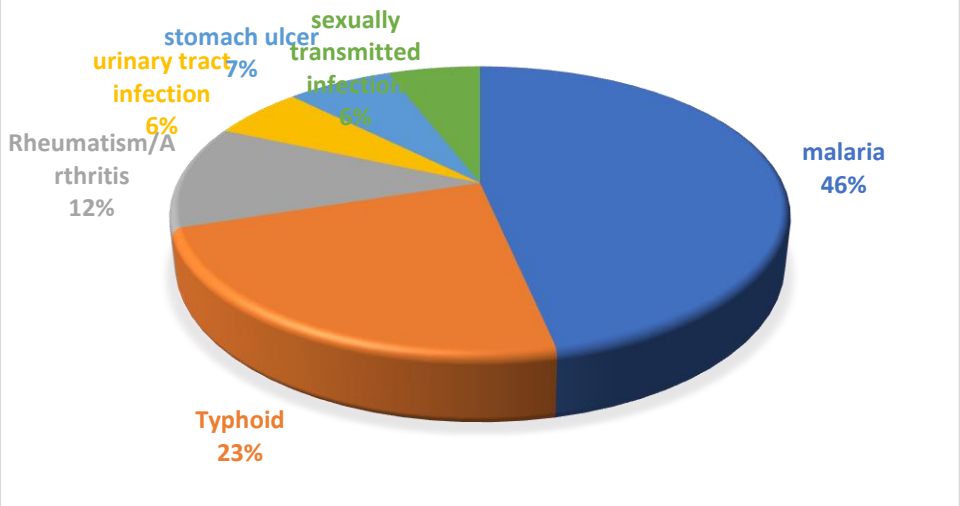


Figure 4.19: Health Problems of people in the project area

4.8.6 Prevalence of Water Borne Diseases in the Communities

The survey shows that the prevalent water borne diseases in the communities as reported by the respondents are diarrhea (34%), typhoid (38%), abdominal pains (19.76%), blood in the urine, river blindness, (23.8%) (Fig.4.15). Members of the host communities lack health facilities to care for numerous health challenges of the people. Open defecation and lack of clean drinking water may be a contributing factor.

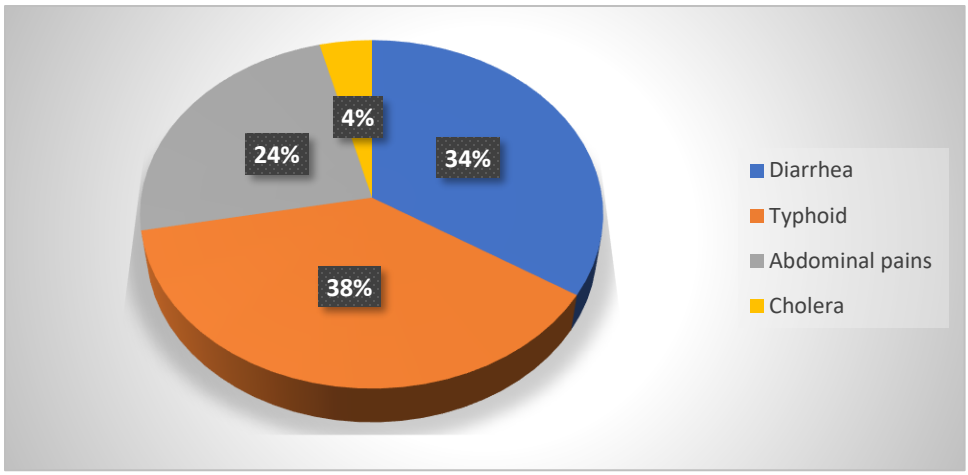


Figure 4.20: Prevalence Rates of Some Common Water-borne Diseases in the Communities

4.8.7 Nutritional status and health of the respondents in the community

The food items consumed by the respondents in the communities are starchy staples such as cassava (and its bye-products like *garri, starch, fufu* or *Santana* etc) plantain, cocoyam, rice, beans and yams. Animal protein foods are fish, chicken, and bush meat from antelopes, grass-cutter and giant rats. In some local communities wild rats are eaten. Animals such as domestic fowls and goats are also reared for meat. The people also eat lots of vegetables and fruits (e.g. vegetables are used for production of the local common soup).

4.8.8 Personal Cleanliness and Hygiene

On personal cleanliness and hygiene, the respondents claimed to have good hygiene practices and good sanitation in the communities. The study reveals that most of the

people in rural communities' practice open defection and use unclean water both for cooking and drinking. Most respondents (80%) claimed to wash their hands before and after meals and after going to toilet, and all still claimed to sweep their floors as well as take bath every day, while some (10%) remember washing their hands only before and after meal. They

4.8.9 Household Expenditure on Health

The Fig. 4.16 below shows the total expenditure of household in the community on healthcare in a month. (35%) spend between 0-1000, (25%) between 1000-2000, (20%) between 2000-3000, (12%) between 3000-4000, and (8%) above 4000.

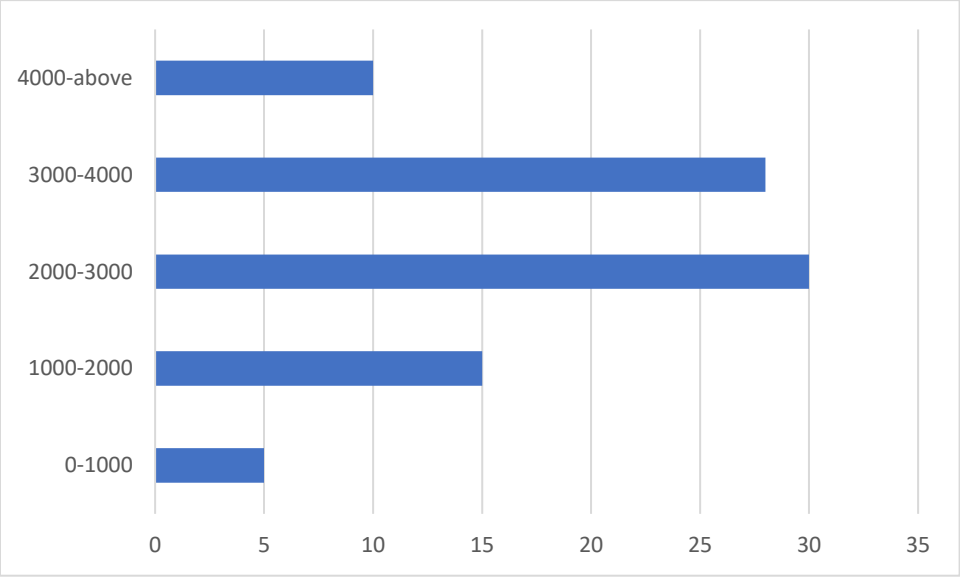


Figure 4.21: Monthly Household Expenditure on Health

4.9 Public Consultation/Stakeholders' Engagement

4.9.1 Introduction

Stakeholders' engagement is an important component of EIA process aimed at providing an opportunity to involve and ensure participation of all groups of the society in the planning and implementation of a project depending on the stakeholders' willingness and

participation. The consultation/stakeholders' engagement established at the inception of the project preparation by the State Government was further enriched in the course of the preparation of this safeguard instrument. This is because it is recognized that one key factor that exists in all successful approaches to project development and implementation is participation of and by relevant stakeholders. The more direct involvement of the local level people in the planning and management processes, the greater the likelihood that resource use and protection problems will be solved as well as the likelihood of development opportunities occurring in a balanced way and to the broad benefit of all communities in the project area.

A two-way communication was ensured between the State represented by the Ministry of lands and the public. With this it was possible to build understanding and improve in decision-making by actively involving relevant stakeholders, especially the project affected persons and groups with a view to reducing the likelihood for conflicts.

4.9.2 The Objectives of Consultations

The objectives of the engagement are as outlined below"

1. Gather inputs, views and concerns; and take account of the information and views of the public in the project design and in decision making.
2. Obtain local and traditional knowledge that may be useful for decision-making;
3. Facilitate consideration of alternatives, mitigation measures and trade-offs and ensure that important impacts are not overlooked and benefits maximized;
4. Reduce conflict through the early identification of contentious issues;
5. Provide an opportunity for the public to influence the designs and implementation in a positive manner;
6. Improve transparency and accountability in decision-making; and Increase public confidence in the project.

4.9.3 Stakeholder Engagement Approach and Outcomes

In order to obtain the views representative of a broad spectrum of the stakeholder including those in disadvantaged positions, a multi-pronged approach was followed by reaching out to every segment of the identified stakeholders announcing the project and the opportunity to participate both verbally and in writing, electronically and in print media. In other words, the opportunity to comment and to raise issues for evaluation was announced to the broadest range of stakeholders.

Especially for the communities, Arnstein's (1969) "ladder of engagement", which describes basic forms of public consultation at the bottom, rising to full public participation at the top was adopted and these include:

- Informing - telling participants about some decision which has already been taken (for example explaining the reasons for, or benefits of, something contentious or criticised);
- Consulting - seeking participants' ideas or views as an input to some decision which the council/government will take;
- Deciding together - sharing the decision with the community; giving the community some real power; and
- Supporting community decisions - allowing the community to make the decision with the council/government at most providing advice or comment.

At the early stage, capacity of all stakeholders was enhanced with the manner and level of background information conveyed to them which were presented in no technical language and generally made sufficiently clear. Empowering the stakeholders through this manner of information transfer enabled them to participate meaningfully and to the best of their ability as much as reasonably possible.

Furthermore, general meetings were coupled with an "open-house" component where small groups of lay people were briefed in the language that was considered ‘’lay’ to reach their minds and hearts for meaningful contributions.

4.9.4 The Stakeholders Consulted

Stakeholders, for the purpose of this project were defined as all those people and institutions that have an interest in the successful planning and execution of the project. This includes those positively and negatively affected by the project.

The wide range of stakeholders identified ranged from members of the local communities with limited levels of education and specific cultural values to others with relatively high levels of education, skills and understanding.

Specifically, the key stakeholders identified and consulted in the area included leaders in the communities, individual people who own asset that will be directly or indirectly affected and business owners. Table 4.24 contains the schedule of the public meetings held across the corridor

Table 4.24: Schedule of Public Meetings held on 12/02/2020

Project	**Ebonyi International Stadium**
Venue of the meeting	**Abakaliki LGA Headquarters Conference Hall, Nkaliki**
Communities Met	**Agbaja and Inyimagu communities**
Issues Discussed	Traditional governance, belief systems, environmental problems and community efforts at solving them, perceptions and concerns about the proposed project, suggested mitigation and enhancement measures, community, needs of the project in the community, and development prospects.
	Overview of the project and the EIA study, social structures, infrastructural network, livelihoods, environmental problems and community efforts at solving them, perceptions and concerns about

	the proposed project, suggested mitigation and enhancement measures, community, needs and development prospects.
	Traditional governance, belief systems, environmental problems and community efforts at solving them, perceptions and concerns about the proposed project, suggested mitigation and enhancement measures, community, needs of the project in the community, and development prospects.
	Livelihoods, income levels and expenditure patterns, employment situations in households. Perceptions, concerns and expectations of women about the proposed project.

4.9.5 Summary of Outcome of Public Consultations

The meetings were properly documented with main issues of concern, contributions, queries and opinions summarized in Appendix 4.7. Suffice it to say that opinions and responses/how the issues were addressed or would be addressed by the project are shown in Table 4.25.

Table 4.25: Summary of Outcome of Public Consultations

Stakeholders	Response/How Project Address the Issues
Expectations of the People about proposed Project: • We are happy that this type of project will be close to us. We long to have this come to reality so that we have the opportunity to meet with some sports stars.	• It's good to hear you say that. We shall communicate your feeling to The Governor. • That is one of the objectives of the project and with this your positive mindset, the project will come to reality.

• This will be a great boost to the sporting activities in the state which will bring employment opportunities to our teeming youths thereby reducing crime and restiveness. • Increase in economic activities in the communities after project execution and better living condition due to urbanization. • When this project is completed Ebonyi state will be a center of attraction as tourist will be trooping in and out of Ebonyi for sports and other activities. • The government should count on our support for the actualization of this project.	• Your understanding of the project is impressive. • We thank you for your support from inception
The Expressed Fears of the People They have only two fears. First is whether the state will have enough resources to complete the project lest it be abandoned along the way and having their hope dashed' Secondly, they wonder if the sudden influx of people would not translate into increase in crime and other negative vices that may the security of residents into jeopardy.	• We will communicate your fears to His Excellency the Governor. You will get answer in our subsequent meeting. • When youths see opportunity to improve their lives they tend to keep themselves busy and productive. Adequate sensitizing with be carried out to ensure that positive impact of the project far outweigh the negative impact.
Requests of the Communities	• Your requests have been noted and

• We plead with our amiable Governor to please form a football club for the state now so that they will strong to compete nationally and internationally when the stadium is ready. • Ebonyi indigenes should be considered first in the economic benefit of the facilities such in employment, in sports academy and provision of other ancillary services to the facility. • We do not know much about any negative impact of the project but we hope that if any the government will give priority to the physical and social wellbeing of members of the communities	shall be communicated to the appropriate quarters.

CHAPTER FIVE

ASSOCIATED AND POTENTIAL ENVIRONMENTAL IMPACTS

5.1 Introduction

The key objective of an ESIA is to predict changes (adverse or beneficial, whole or partial) in the ecological and socio-economic environment resulting from a proposed development project or activity as well as recommend mitigation measures to minimize, eliminate or offset those aspects that adversely impact on the environment.

The assessment approach generally involves matching the various activities of the project (as described in **Chapter 3** of this report) with the components of the existing environment. Consequently, the interaction may lead to changes in or impacts on the environment, hence mitigation measures are proffered to reduce, offset, or ameliorate such changes. The assessment of the associated and potential impacts of the proposed International Olympic Stadium activities as well as the mitigation measures required for reducing the identified significant and residual impacts to as low as reasonably practicable is presented in subsequent sections.

5.2 Impact Assessment Methodology

The overall intent of the ESIA study is to identify and characterise all the associated and potential impacts or effects that will be caused by the proposed International Olympic Stadium activities. Though there are several approaches for the prediction and evaluation of project environmental impacts, the ISO 14001 method was selected for this study. The ISO 14001 method is simple to apply, provides a high level of detail, and relies on limited data. The process and pathways followed in the identification and assessment of the associated and potential impacts of the proposed project are illustrated in **Figure 5.1**.

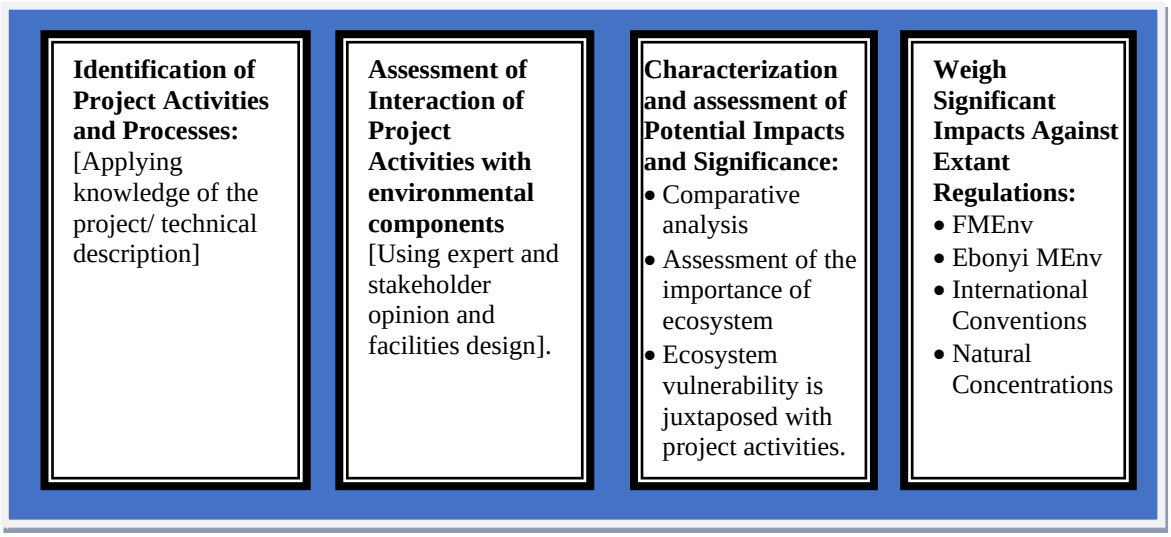


Figure 5.1: Impact Evaluation Process

5.3 Summary of Environmental Impact Indicators

The environmental impact indicators are easily observable parameters that will indicate change/deviation, which can be used to monitor the various environmental components. Those considered in this study are summarized in **Table 5.1.**

Project Activities

The activities anticipated in the proposed Stadium project and its existing facilities' modifications cover all the anticipated phases including construction, operation/maintenance, and decommissioning. The anticipated activities of each of these phases include:

A. Pre-Construction phase activities

- Land take for the stadium
- Mobilisation (transport) to the site (equipment, personnel and construction modules)
- Energy requirements (provision of energy for construction)
- Labour requirements
- Site Preparation (vegetation and land clearing)
- Excavation of the land area

Table 5.1: Environmental Components and Potential Impact Indicators

S/No	Environmental Components	Impact Indicators
1	Air Quality and Noise	SPM, NO_X, SO_2, CO, VOCs, NH_3, H_2S, and Noise
2	Soil/Agriculture	Soil type, Soil pH, TOC, Soil nutrients, Total Heterotrophic bacteria and fungi, Hydrocarbon Utilizing bacteria and fungi and Coliform, Hydrocarbon Utilizer; topography
3	Surface Water Quality	Dissolved and suspended solids, pH, BOD, COD, turbidity, toxicity, Pb, Cd, As, Ni, Fe, Hg, Mg.and Total Heterotrophic bacteria and fungi, Hydrocarbon Utilizing bacteria and fungi and Coliform, Hydrocarbon Utilizer
4	Groundwater quality	Dissolved and Suspended solids, Turbidity, pH, BOD, COD, Toxicity, Pb, Cd, As, Ni, Fe, Hg, Mg. and Total Heterotrophic bacteria and fungi, Hydrocarbon Utilizing bacteria and fungi and Coliform, Hydrocarbon Utilizer
5	Socio-economic/Health	Needs and concern of host communities/third party concerns; opportunities for employment; income level; health risks; waste streams, Handling, Treatment, and disposal; access to household water; access to roads; access to transport; opportunities for contracting and procurement; respect for labour rights; respect for human rights

B. Construction phase activities

- Piling
- Site fabrication (welding) and coating
- Construction of Main Bowl of the stadium
- Construction of Car park
- Installation of electric poles and transformers
- Backfilling

- Commissioning stadium
- Demobilization

C. The operational phase activities are

- Operations/ maintenance

D. The decommissioning activities include

- Demolition and Evacuation

5.4 Impact Identification and Evaluation

To adhere strictly to general guidelines for an Environmental and Social Impact Assessment (ESIA) process, the following basic steps were adopted for the identification and evaluation of impacts in this study:

- Impact identification;
- Impact qualification;
- Impact rating; and
- Impact description

5.4.1 Impact Identification

Impact identification aims to account for the entire potential and associated biophysical, social, and health impacts making sure that both significant and insignificant impacts are accounted for. The anticipated impacts were determined based on the interaction between project activities and environmental sensitivities. The identified potential impacts during the different phases of the proposed project are listed in **Table 5.2.**

Table 5.2: Identified Project Impacts of the Proposed Stadium

Impacts	Phase		
Acceleration of erosion	√		
Acidification of soil and water	√		√
Alteration of local topography	√		
Alteration of the soil profile	√		√
Blockage of drainage pattern	√		√

Impacts	Phase		
Blockage of roads/motorways	√		√
Burns/injuries from welding sparks	√	√	√
Change in land use	√	√	√
Change in water quality	√	√	√
Contamination of groundwater	√	√	√
Contamination of surface water and soil	√	√	√
Damage to communication cables	√		
Exposure to heat and light	√		√
Exposure to welding flash	√	√	√
Impairment of air quality	√	√	√
Improved aviation business		√	
Improved livelihood	√	√	√
Increased demand for social infrastructure	√	√	√
Increased surface water turbidity	√		√
Increase in incidence of STI's including HIV	√	√	√
Increase in income	√	√	√
Increase in price of locally sourced materials	√		
Increase in social vices	√	√	√
Increased opportunity for business and employment	√	√	√
The influx of migrant workers and camp-followers	√		√
Injuries and death from falling objects	√		√
Interference with road and water transportation	√	√	√
The kidnapping of workers and visitors on site	√	√	√
Land utilized for temporary base camps/restriction on land use	√		√
Legal issues	√	√	√
Loss of land	√	√	
Loss of employment/ income			√
Noise and vibration nuisance	√	√	√
Road accidents	√	√	√
Worksite accidents	√	√	√

5.4.2 Impact Qualification

The identified impacts of the project were qualified using four criteria including:

- Positive or negative
- Short-term or long-term
- Reversible or irreversible
- Direct or indirect

Negative impacts are those that adversely affect the biophysical, health, and social environments, while positive impacts are those, which enhance the quality of the environment. For this study, the short term means a period less than three months while any period greater than three months was considered long term. Reversible/irreversible meant whether the environment can either revert to previous conditions or remain permanent when the activity causing the impact is terminated.

5.4.3 Impact Rating

This stage involves the evaluation of the impact to determine whether or not it is significant. The quantification scale of 0, 1, 3, and 5 were used. The ratings are as adapted from the International Organization for Standardization (ISO) 14001–Environmental Management System Approach. The criteria and weighting scale used in evaluating significance are:

- Legal/regulatory requirements (L)
- Risk factor (R)
- Frequency of occurrence of impact (F)
- Importance of impact on an affected environmental component (I),
- Public perception/interest (P)

5.4.3.1 Legal /Regulatory Requirements (L)

This asks the question ‘is there a legal/regulatory requirement or a permit required?’ The scoring is as follows:

0= There is no legal/regulatory requirement

3= There is a legal/regulatory requirement

5= There is a legal/regulatory requirement and permit required

The legal/regulatory requirements were identified based on national laws/guidelines/standards (FMEnv, FAAN, NCAA, Ebonyi State Ministry of Environment, etc) relating to the project activity.

5.4.3.2 Risk (R)

This uses a matrix based on the interaction of the probability of occurrence of the impact **(Table 5.3)** against consequences **(Table 5.4).** The matrix **(Figure 5.2)** is referred to as the Risk Assessment Matrix (RAM). Five probability categories interacted against four groups of consequences. The resultant outcomes were given scores with colour-coding. High-risk categories are red; intermediate risk, yellow and low risk, green as follows:

1=Low risk (green)
3=Intermediate risk (yellow)
5=High risk (red)

5.4.3.3 Frequency of Impact (F)

The frequency of impact refers to the number of occurrences of impact. The frequency of impact was determined using historical records of occurrence of impacts, and consultation with experts and local communities. The criteria for rating the frequency of impacts are outlined in **Table 5.5.**

5.4.3.4 Importance of Affected Environmental Component and Impact (I)

The importance of the affected environmental components was determined through consultation and consensus of opinions. This was also further facilitated by information on experiences on the impacts of already existing facilities in the proposed project area. The rating of the importance of impacts is summarized in **Table 5.6.**

Table 5.3: Probability of Occurrence

Probability Category	Definition
A	Possibility of Repeated Incidents
B	Possibility of Isolated Incidents
C	Possibility of Occurring Sometime

D	Not Likely to Occur
E	Practically Impossible

Table 5.4: Consequence Categories

Consequence Category	Considerations			
	Safety / Health	**Public Disruption**	**Environmental Aspects**	**Financial Implications**
I	Fatalities / Serious Impact on Public	Large Community	Major/Extended Duration/Full-Scale Response	High
II	Serious Injury to Personnel / Limited Impact on Public	Small Community	Serious / Significant Resource Commitment	Medium
III	Medical Treatment for Personnel / No Impact on Public	Minor	Moderate / Limited Response of Short Duration	Low
IV	Minor Impact on Personnel	Minimal to None	Minor / Little or No Response Needed	None

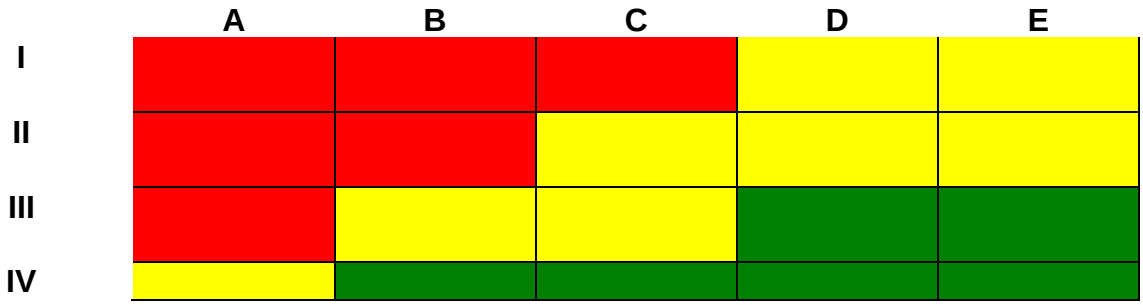


Figure 5.2: Risk Assessment Matrix

5.4.3.5 Public Perception (P)

The consensus of opinions among the project stakeholders was used to determine the public perception of the potential impacts and the criteria applied are as summarized in **Table 5.7**.

The combination of the five impact rating weights formed the basis for judging the level of significance of each impact. A matrix displaying the combination based on the ISO 14001 tool

The final ratings of the identified impacts are presented in **Tables 5.8 - 5.10.** In this study, medium and highly significant negative impacts were judged to require mitigation, and all positive impacts required enhancement.

Table 5.5: Frequency Rating and Criteria

Frequency	Rating	Criteria
Low	1	Rare, not likely to happen within project lifespan
Medium	3	Likely to happen ≥ 5 years
High	5	Very likely to happen throughout the project lifespan

Table 5.6: Importance Criteria

Importance	Rating	Criteria
Low	1	• Imperceptible outcome • Insignificant alteration in value, function, or service of impacted resource. • Within compliance, no controls required
Medium	3	• Negative outcome • Measurable reduction or disruption in value, function, or service of impacted resource • Potential for non-compliance
High	5	• Highly undesirable outcome (e.g., impairment of endangered species and protected habitat). • Detrimental, extended animal behavioural change (breeding, spawning, moulting). • Major reduction or disruption in value, function, or service of impacted valued ecosystem resource. • Impact during an environmentally sensitive period.

		• Continuous non-compliance with existing statutes

Table 5.7: Public Perception Criteria

Public Perception	Rating	Criteria
Low	1	• No risk to human health, acute and/or chronic • No possibility of life endangerment for residents, associated communities • A minor reduction in social, cultural, economic values • The unlikely adverse perception among the population
Medium	3	• The limited incremental risk to human health, acute and/or chronic. • Unlikely life endangerment for residents, abutting communities. • Some reduction in social, cultural, economic value • Possibility of adverse perception among the population. • Potential for non-compliance
High	5	• The elevated incremental risk to human health, acute and/or chronic. • Possibility of life endangerment for residents, abutting communities • Major reduction in social, cultural, economic value • Continuous non-compliance with statutes. • Any major public concern among the population in the study area.

Table 5.8: Impact Value and Rating Colour Code

Impact value	Cut off values	Impact Rating
L+R+F+I+P	<8	Low
L+R+F+I+P	≥8 but <15	Medium
L+R+F+I+P	≥15	High
F + I	>6	
P	= 5	
Positive		Positive

Table 5.9: Potential and Associated Impacts of the Proposed Project – Pre-Construction Phases ***Where L= Legal/Regulatory Requirement, R = Risk, F= Frequency, I = Importance, P = Public Interest/ Perception***

Project Phase	Project Activity	Description of Impact	Impact Qualification								Impact Quantification							Impact Rating
			Positive	Negative	Direct	Indirect	Short term	Long-term	Reversible	Irreversible	L	R	F	I	P	Total	F+I	
	Land Take for Stadium	Loss of land		√	√		√	√	√		3	3	3	3	3	15	6	H
		Change in land use		√	√			√	√		3	1	5	1	1	11	6	M
		Legal issue		√	√			√	√		3	1	5	1	1	11	6	M
	Mobilisation (transport) to the site (equipment, personnel, and construction modules)	Road traffic accidents		√	√		√	√	√		3	3	3	3	3	15	6	H
		Noise nuisance		√	√		√		√		3	3	1	1	1	9	2	M
		Impairment of air quality		√	√		√		√		3	3	1	1	1	9	2	M
		Loss of biodiversity		√	√		√	√	√		3	3	3	3	3	15	6	H
	Energy consumption (provision of	Impairment of air quality		√	√		√		√		3	3	1	1	1	9	2	M
		Noise and vibration nuisance		√	√		√		√		3	3	1	1	1	9	2	M
		Increased opportunity for	√		√		√		√		-	-	-	-	-	-	-	P

	energy for pre-construction activities)	business and employment																
		Contamination of soil by waste oil		√	√		√		√		3	1	3	1	1	9	4	M
	Site Preparation – land clearing, removal of vegetation, Land excavation for foundations, and Surfacing of feeder roads	Acceleration of erosion		√	√		√		√		3	1	3	1	1	9	4	M
		Alteration of local topography		√	√		√		√		3	1	3	1	1	9	4	M
		Blockage of drainage pattern		√	√		√		√		3	1	3	1	1	9	4	M
		Contamination of soil by run-offs		√	√	√	√		√		3	1	1	1	1	7	2	L
		Impairment of air quality		√	√	√	√		√		3	1	3	1	1	9	4	M
		Noise and vibration nuisance		√		√		√	√	√	3	5	3	5	5	21	8	H
		Worksite accidents		√		√		√	√	√	3	5	3	5	5	21	8	H
		Security/artificial light at night		√	√		√		√		0	1	3	1	1	6	4	L
		Habitat alteration		√	√			√		√	3	5	5	5	5	23	10	H

Table 5.10: Potential and Associated Impacts of the Proposed Project – Construction Phases- ***Where L= Legal/Regulatory, R = Risk, F= Frequency, I = Importance, P = Public Interest/ Perception***

Project Phase	Project Activity	Description of Impact	Impact Qualification								Impact Quantification							Impact Rating
			Positive	Negative	Direct	Indirect	Short term	Long-term	Reversible	Irreversible	L	R	F	I	P	Total	F+I	
	Transport activities during construction	Road traffic accidents		√	√		√		√		3	5	5	5	5	23	10	H
		Noise nuisance from steaming engines/ heavy vehicles.		√	√		√		√		3	3	3	1	3	13	4	M
		Impairment of air quality – emission from Heavy vehicles		√	√		√		√		3	1	1	1	3	9	2	M
	Construction and Casting of the plinths for stadium Main Bowl/administrative office/car park	Loss of vegetal cover with possible impact on biodiversity loss.		√	√	√	√	√	√		3	3	3	3	3	15	6	H
		Noise and vibration nuisance.		√	√		√		√		3	5	3	1	3	15	4	H
		Kidnapping of workers		√	√			√		√	3	5	5	5	5	23	10	H
		Waste generation from excavated materials.		√	√		√		√		3	5	3	1	3	15	4	H
		Impairment of air quality		√	√	√	√		√		3	5	3	3	1	15	6	H

		Contamination in the event of oil spills from equipment and machinery.		√	√			√	√		5	3	3	5	1	17	8	H
		Waste generation from excavated materials.		√	√		√		√		5	1	1	3	1	11	4	M
	Fabrication of structural fittings (welding)	Burns/injuries from welding sparks.		√	√			√	√		3	5	3	5	1	17	8	H
		Exposure to welding flash		√	√		√		√		3	5	3	5	1	17	8	H
		Waste Management - The potential effects will be of aesthetics as well as a nuisance of wastes such as metal cuttings		√	√		√		√		5	1	1	3	1	11	4	M
	Construction of 30,000 seating capacity main Bowl (Track and field	Waste Management - The potential effects will be of aesthetics as well as a nuisance of wastes such as metal cuttings, paper cartons, drums, paper, wood, etc.		√	√		√		√		3	5	3	1	3	15	4	H

	events)/ construction of Office complex, Courts, Car park, etc	Impairment of air quality		√	√	√	√		√		3	5	3	3	1	15	6	H
		Noise and vibration nuisance		√		√		√	√	√	3	5	3	5	5	21	8	H
		Worksite accidents		√		√		√	√	√	3	5	3	5	5	21	8	H
	Water utilization for concrete-weight	Changes in surface hydrology from water utilization for construction.		√	√		√		√		0	1	1	1	1	4	2	L
	Coating	Contamination of soil by paints and coating as a result of spillage.		√	√		√		√		3	5	3	5	1	17	8	H
		Hazardous waste generation from coating operations such as metals.			√	√		√		√	3	5	3	5	1	17	8	H
	Backfilling	Surface water may be polluted due to increased erosion, runoff from the construction site, and contamination in the event of oil spills from equipment and			√	√		√		√	3	5	3	5	1	17	8	H

		machinery.															
		Waste Management - The potential effects will be of aesthetics as well as a nuisance. Wastes shall mainly come from discarded packaging materials such as metal cuttings and empty plastic containers. Poor disposal methods can lead to environmental problems due to their non-biodegradable nature. Most of the packaging wastes are expected to be reused.			√	√		√		√	3	5	3	5	1	17	8	H
		Alteration of hydrological patterns resulting in temporary or permanent flooding, soil erosion, and destruction of biodiversity.			√	√		√		√	3	5	3	5	1	17	8	H
		Habitat alteration		√	√		√		√		5	1	1	3	1	11	4	M

		Worksite accidents			√	√		√		√	3	5	3	5	1	17	8	H
		Increase in communicable disease (including STDs and HIV/AIDS).		√	√		√		√		5	1	1	3	1	11	4	M
		Changes in surface hydrology from water utilization for construction		√	√		√		√		3	1	1	1	1	7	2	L
	Installation of Transformers, Floodlights, scoreboard and electric pole	<u>Electrocution</u>: Tall equipment could have contact with high tension cables causing electrocution hazard. Construction workers can also be exposed during lightings installation.			√	√		√		√	3	5	3	5	1	17	8	H
		Tripping/falling from heights as a result of Climbing and working on electric poles			√	√		√		√	3	5	3	5	1	17	8	H
	Site demobilization	Road traffic accidents		√	√			√		√	3	3	2	3	3	14	5	M

Table 5.11: Potential and Associated Impacts of the Proposed Project –Operation

Project Phase	Project Activity	Description of Impact	Impact Qualification								Impact Quantification							Impact Rating
			Positive	Negative	Direct	Indirect	Short term	Long term	Reversible	Irreversible	L	R	F	I	P	Total	F+I	
Operation/ Maintenance	Operation of Stadium during sporting activities	Noise: Noise pollution will be produced by Generator set and spectators within the stadium during sporting activities.		√	√			√		√	3	5	5	5	5	23	10	H
		Air pollution from generating set during sporting activities.		√	√	√	√		√		3	3	3	3	3	15	6	H
		Kidnapping of spectators		√	√			√		√	3	5	5	5	5	23	10	H
		Road traffic accident during sporting activities.		√	√			√		√	3	5	5	5	5	23	10	H
		The collapse of seating stand during sporting activities.		√	√			√		√	3	5	5	5	5	23	10	H
		Generation of Waste during		√	√	√	√		√		3	3	3	3	3	15	6	H

Project Phase	Project Activity	Description of Impact	Impact Qualification								Impact Quantification							Impact Rating
			Positive	Negative	Direct	Indirect	Short term	Long term	Reversible	Irreversible	L	R	F	I	P	Total	F+I	
		operation of the stadium.																
		Light: Artificial light from the stadium can attract animals either directly or indirectly. Light pollution can also affect animals' rhythms of waking, sleeping, and hibernation. This impact will occur every night until the end of life of the stadium.		√	√			√		√	3	5	5	5	5	23	10	H
	Maintenance of Stadium	Generation of Waste during maintenance of the stadium.		√	√	√	√		√		3	3	3	3	3	15	6	H
		Soil/ groundwater contamination due to fuel/ oil		√	√		√		√		0	1	5	1	1	8	6	M

Project Phase	Project Activity	Description of Impact	Impact Qualification								Impact Quantification							Impact Rating
			Positive	Negative	Direct	Indirect	Short term	Long term	Reversible	Irreversible	L	R	F	I	P	Total	F+I	
		spill																
		Impairment of air quality – emission from Generator		√	√		√		√		0	1	5	1	1	8	6	M
		Security threat and the threat from major accidents related to the fires and explosions at the facility and potential accidental releases of diesel when refilling the storage tank		√	√			√		√	3	5	5	5	5	23	10	H
		Worksite accidents		√	√			√		√	3	5	5	5	5	23	10	H
		Electrocution: Tall equipment could have contact with high tension cables causing electrocution hazard.			√	√		√		√	3	5	3	5	1	17	8	H

Project Phase	Project Activity	Description of Impact	Impact Qualification								Impact Quantification							Impact Rating
			Positive	Negative	Direct	Indirect	Short term	Long term	Reversible	Irreversible	L	R	F	I	P	Total	F+I	
		Construction workers can also be exposed during lightings installation/maintenance																
		Tripping/falling from heights as a result of Climbing and working on electric poles.			√	√		√		√	3	5	3	5	1	17	8	H
		The threat of Naturally Occurring Radioactive Material (NORM) to the environment.		√	√			√		√	5	5	5	5	5	25	10	H
	Repainting of rusted and corroded structural fittings	Contamination of soil by paints and coating as a result of spillage.		√	√		√		√		3	5	3	5	1	17	8	H
		Hazardous waste generation from coating operations such as			√	√		√		√	3	5	3	5	1	17	8	H

Project Phase	Project Activity	Description of Impact	Impact Qualification								Impact Quantification							Impact Rating
			Positive	Negative	Direct	Indirect	Short term	Long term	Reversible	Irreversible	L	R	F	I	P	Total	F+I	
		metals																
	Transport activities during operation	Road traffic accidents		√	√		√		√		0	1	5	1	1	8	6	M
	Recruitment of stadium personnel from the stakeholder communities	Employment generation: Personnel will be recruited from the community. This employment will cause an increase in the earnings of the affected persons.	√		√		√		√		-	-	-	-	-	-	-	P

Table 5.12: Potential and Associated Impacts of the Proposed Project – Decommissioning

Project Phase	Project Activity	Description of Impact	Impact Qualification								Impact Quantification							Impact Rating
			Positive	Negative	Direct	Indirect	Short term	Long term	Reversible	Irreversible	L	R	F	I	P	Total	F+I	
Decommissioning	Demolition and Evacuation	Interference with road transportation		√	√		√		√		3	3	3	1	3	13	4	M
		Noise and vibration nuisance		√	√		√		√		3	3	3	1	3	13	4	M
		Impairment of air quality		√	√	√	√		√		3	1	3	3	1	11	6	M
		Contamination of groundwater/ surface water		√	√	√	√		√		3	1	3	3	1	11	6	M
		Contamination of soil		√	√	√	√		√		3	1	3	3	1	11	6	M
		The threat of Naturally Occurring Radioactive Material (NORM) to the environment.		√	√			√		√	5	5	5	5	5	25	10	H
		Poor disposal of wastes generated during this phase		√	√	√	√		√		3	1	3	3	1	11	6	M
		Loss of job		√	√	√	√		√		3	1	3	3	1	11	6	M
		Kidnapping of workers		√	√			√		√	0	5	5	5	5	20	10	H

Project Phase	Project Activity	Description of Impact	Impact Qualification								Impact Quantification							Impact Rating
			Positive	Negative	Direct	Indirect	Short term	Long term	Reversible	Irreversible	L	R	F	I	P	Total	F+I	
		Injury/fatalities in workforce /communities		√	√	√	√		√		3	1	3	3	1	11	6	H
		Electrocution: Tall equipment could have contact with high tension cables causing electrocution hazard. Workers can be exposed during the decommissioning phase.		√	√	√	√		√		3	1	3	3	1	11	6	H
		Tripping/falling from heights as a result of Climbing and working on electric poles		√	√	√	√		√		3	1	3	3	1	11	6	H
		Third-Party Agitation due to Employment Issues and Loss of Benefits as Host Communities.		√	√	√	√		√		3	1	3	3	1	11	6	M

5.4.4 Cumulative Impacts

Cumulative impacts are changes to the environment that are caused by certain activity in combination with other past, present, and future human activities.

The concept of cumulative effects is an important one. It holds that while impacts may be small individually, the overall impact of all environmental changes affecting the receptors taken together can be significant. When a resource is nearing its tolerance threshold, a small change can push it over. The objective of the cumulative impact assessment is to identify the environmental and/or socio-economic aspects that may not on their own constitute a significant impact but when combined with impacts from past, present, or reasonably foreseeable future activities associated with this and/or other projects result in larger and more significant impacts.

Cumulative impacts arising from this proposed International Olympic Stadium shall be minimal because the project shall be executed with the latest more environmentally safe available technology which shall reduce greenhouse house effect and climate change.

5.5 Summary of Impacts as They Relate to the Various Phases

The potential positive and negative impacts rated either high or medium are further herein described as arguments underlying the assessment.

5.5.1 Pre-Construction and Construction Phases

The negative medium impacts in this phase are: change in land and water usage, while during Mobilisation (transport) to the site (equipment, personnel, and construction modules) there will be noise nuisance and interference with road transportation. Energy requirements (provision of energy for construction) will result in negative medium impacts from impairment of air quality and noise and vibration nuisance with labour requirements activity resulting in negative medium impacts from an increase in the incidence of STI's/ HIV, increased demand on social infrastructure and influx of migrant workers/followers.

The site preparation (vegetation and land clearing), excavation of the land area, and backfilling activities will lead to high impacts from the acceleration of erosion, exposure to heat, light, and radiation, welding flash impairment of air quality, and noise/vibration

nuisance. The phase impacts with high negative significant ratings also include road accidents from mobilisation, injuries, and death from falling objects and worksite accidents from the site preparation.

The phase's positive impacts are increasing in income from mobilisation; increased opportunity for business and employment from energy requirements; increased opportunity for business and employment, increase in income and improved livelihood from labour requirements; an increase in income from demobilization.

5.5.1.1 Permitting

Permitting is the process of obtaining permission of communities/ individuals and relevant government agencies on issues related to the project.

5.5.1.2 Acceptance of project and cooperation/participation from communities and government.

Prior to the commencement of the project, extensive stakeholder consultations will be carried out with communities, State and Local Government agencies, NGOs/CBOs to enlist their support, cooperation, and participation in the project. The occurrence of this rated as medium and the impact positive.

5.5.1.3 Third-Party Agitations

Land take sometimes could lead to community agitation due either to compensation issues, or stakeholder identification, or incoherence in leadership hierarchy and/or from boundary recognition between communities. The impact was described as direct, negative, short-term, local, reversible, and rated moderate.

5.5.1.4 Construction of a temporary on-site facility

During the construction phase, there will be a need for a temporary on-site facility. The temporary on-site facility will be for mobilization, transfer, and logistics. Equipment shall be transferred from this location. The effect is expected to be short term, negative and reversible therefore low.

5.5.1.5 Loss of land usage

The land that shall be used for the project shall not be available for any other possible project in the entire lifespan of the proposed plant to maintain the stadium integrity. The non-availability of this land and the change in its use due to the proposed project directly impacts on land availability in the host area and to last the entire life of the proposed stadium anticipated to be about 40 years thus qualified the impacts to be rated long term. However, this land can be returned to the owner after the life-span of the project if desired thus the impacts are rated reversible. Application of the impacts quantification elements qualified it to be rated medium.

5.5.1.6 Blockage of road access to other users

Movement of materials, equipment, and personnel in preparation for the proposed project is anticipated to result in increased road traffic volume on the road leading in and out of the area thus may worsen the traffic situation around the area. However, these impacts are expected to last the period of mobilization to the site, storage of construction materials, site preparation for stadium construction and installation activities. The impacts are short-term, negative, reversible, with the direct impact thus rated medium.

5.5.1.7 Conflicts/ Third party agitations over employment issues

Because all available local labour cannot possibly be engaged for the project, conflicts and agitations could arise over the distribution of employment slots to individuals and communities. This impact is direct, negative, short-term, reversible, and rated moderate.

5.5.1.8 Influx of job seekers into communities, thereby exerting pressure on infrastructure

The influx of job seekers into the communities for employment opportunities could exert additional pressure on limited community resources such as water supply, available food sources, and housing. This impact is rated direct, negative, short-term, local reversible, and moderate.

5.5.1.9 Destruction of Vegetation (Medicinal, Economic and Food)/Loss of Wildlife Habit

The natural vegetation of the land take will largely be removed to create space for the construction of the permanent structures. Nevertheless, since not all areas will be put to secondary use, any remaining vegetation, either for aesthetic beauty or as a green area on the land take will benefit from continuous tendering. These could serve a good purpose as indicators of environmental change.

5.5.1.10 Loss of species and their ecosystem services

This is the primary impact. Many native species will be cleared from the land take. Some will be lost to trampling. Unless prevented, some species would be lost to soil contamination. Also, since the land will be under continuous anthropogenic traffic and associated pressure, the sandbank will be lost for the most part. Ecosystem services being currently provided by the species, such as erosion control, modification of hydrological cycle, shelter to wildlife, and carbon sequestration will be negatively impacted upon.

Secondary impact includes an increase in ambient temperature and heat, weather modification, the prevalence of particulate matter suspended in the atmosphere. These might further put any plant species and wildlife near the plot at risk of impaired ecology and physiology, leading to stunted growth and reduced productivity.

The removal of the vegetation on the acquired land will lead to the loss of any medicinal, economic, or food crops in the area. The wildlife that used this vegetation for habitat would also be deprived of them. The impact will be direct, negative, long term, local, irreversible and is rated high.

5.5.1.11 Impairment of air quality/ Noise and vibration nuisance

Operations and activities of mobile and stationary plants to be involved in the transportation of construction materials, energy requirements, site preparation, onsite construction and installation, land excavation, backfilling, completion of the project, commissioning and demobilization project activities may generate noise and vibration while emissions from the plants and associated dust suspensions may cause impaired air quality. All these are direct, with negative impact to last the period of construction activities thus the short term. Though they are reversible, their level of impact caused them to be

rated medium. Table 5.13 shows the air emission per day per fleet. Heavy-duty equipment and other related large machinery may produce noise levels as high as 91 decibels weighted to 'A' scale (dBA). Table 5.14 shows the typical construction equipment and their associated noise level.

Table 5.13: Air emission per day per fleet

Compound	Weight (metric tons)
Carbon dioxide	1.05
Carbon monoxide	0.458
Hydrocarbons	0.35
Nitrogen oxides	0.126
Particulates	0.17
Sulphur oxides	0.727

Source of emission factors http//:www.epa.gov/region09/air/marine vessel/pfds/tanimar/pdf

Table 5.14: Construction Equipment Noise level

Equipment Type	Noise Level at 50feet (dBA)
Backhoe	85
Tractor	80
Truck	91
Chipper	85
Chainsaw	76

5.5.1.12 Road traffic accidents

Increase in traffic volume anticipated on the major road leading to the facility during the mobilization, demobilization, stadium construction, and operation of the project. There is the possibility of traffic accidents involving **Ebonyi State government** vehicles alone or **Ebonyi State government** engaged contractors and third-party vehicles during mobilization and demobilization and operation phases. Since some of these accidents may result in death which is negative, direct, and irreversible, they are rated high.

5.5.1.13 Injuries and death/worksite accidents

During site preparation, onsite construction, and installation of the stadium components as well as land excavation, there can be worksite accidents and injuries/death from falling objects on site. Also, accidents could occur as a result of tripping or falling from a height. Some of these accidents may result in the death of victims which is negative, direct, and irreversible, thus rated high.

5.5.1.14 Employment/contracting and an increase in income

Procurement of construction materials, transportation, labour requirements, and installation of the stadium modules and machinery activities will create employment/contracting as well as an increase in income opportunities thus improving the economic power of the people in the proposed host environment. These impacts are positive ratings.

5.5.1.15 Improved sporting activities

The major aim of this proposed project is to boost local, national, and international sporting activities, sporting talent hunting, and nurturing. If the project is completed, it is expected that this aim will be completely achieved and improved sporting activities in Ebonyi State and Nigeria at large. These impacts are of positive rating.

5.5.1.16 Kidnapping of workers and visitors on site

The kidnapping of workers and visitors on site are among the major security concerns in Nigeria now. During movements and working as required in the construction phase, personnel and company contractor may be victims of kidnappers. Some of these attacks may result in the death of victims which is negative, direct, and irreversible, thus rated high.

5.5.1.17 Solid, Liquid, and Hazardous Waste Management

It is expected that construction activities could generate both hazardous and non-hazardous wastes. The potential effects will be of aesthetics as well as a nuisance. Non-hazardous waste will mainly come from excavated soils and debris woodpiles, discarded packaging materials such as paper cartons, and empty plastic water bottle, cans containers while hazardous wastes could come from grease trap pumping, used oil, waste lubricants, paints, maintenance-related wastes, used air and liquid filtration media, and empty or partially full chemical containers. Although the impact of this non-hazardous

waste is expected to be minimal, poor disposal methods can lead to environmental problems due to their non-biodegradable nature. The impact will be short term, negative and irreversible, so considered medium. However, hazardous wastes are expected to be high if they are not treated and disposed of well which can lead to environmental problems due to their non-biodegradable nature. The impact can be long term, negative and irreversible, so considered high.

5.5.2 Operation/Maintenance Phase

This phase of the proposed stadium is anticipated to have high ratings negative impacts including noise, vibration nuisance as well as impairment of air quality. The positive impacts ratings in the phase include increased opportunity for business and employment and an increase in income and improved livelihood. However, the activities of the operation phase which could have negative impacts shall include vehicular movement during sporting activities, the kidnapping of spectators, tripping and falling from height during maintenance and waste generation, etc.

5.5.2.1 Impairment of air quality

Normal operations and activities of the proposed project during this phase may be sources of air pollution from the supporting equipment including generating set during sporting activities, maintenance of these generating sets, and also refilling of the storage tank. These activities may result in air emission of suspended particulates matters (SPM), carbon monoxide (CO), oxides of nitrogen ($NO_{X)}$, hydrocarbons (HC), and sulphur dioxide (SO_2). Though the quantities of these emissions will be determined by emission inventory with ground-level concentrations to be quantified using emission dispersion modeling, the volume of diesel to be handle made them rated high.

5.5.2.2 Discharge of Wastewater

During the operation of stadium activities, the operation wastewater which may include stormwater may contain an anti-fouling agent. The impacts are short-term, negative, reversible, with the direct impact thus rated medium.

5.5.2.3 Noise and Vibration

Operations and maintenance of generating sets, noise from spectators during sporting activities could affect the environment. Though the levels of noise to be released from

these supporting facilities will be determined by Noise Map, a noise dispersion modeling tool. The impact was rated as direct, negative, short-term, local, reversible, and medium.

5.5.2.4 Waste generation

It is expected that during the operation of the stadium, the regular sporting activities and maintenance of the stadium could generate both hazardous and non-hazardous wastes. The potential effects will be of aesthetics as well as a nuisance. Non-hazardous waste will mainly come from discarded packaging materials such as paper cartons, and empty plastic water bottle, cans containers while hazardous wastes could come from grease trap pumping, lead-acid storage batteries, used oil, waste lubricants, paints, maintenance-related wastes, used air and liquid filtration media, and empty or partially full chemical containers. Although the impact of this non-hazardous waste is expected to be minimal, poor disposal methods can lead to environmental problems due to their non-biodegradable nature. The impact will be short term, negative and irreversible, so considered medium. However, hazardous wastes are expected to be high if they are not treated and disposed of well which can lead to environmental problems due to their non-biodegradable nature. The impact can be long term, negative and irreversible, so considered high.

5.5.2.5 Kidnapping of workers and visitors on site

Kidnapping is among major security concerns in Nigeria now. During sporting activities or events, spectators, sporting figures or personnel may be victims of kidnappers. Some of these attacks may result in the death of victims which is negative, direct, and irreversible, thus rated high.

5.5.2.6 Road traffic accidents

Increase in traffic volume anticipated on the major road leading to the facility during operation of the stadium, there could be accidents from the movement of the vehicle in and out of the stadium during sporting activities. Since some of these accidents may result in death which is negative, direct, and irreversible, they are rated high.

5.5.2.7 Injuries and death/worksite accidents

During operation and maintenance of the stadium, there could be accidents from falling objects on-site, tripping, or falling from a height, collapsed of seating stand which could

lead to stamped. Also, there could be electrocution as a result of tall equipment coming in contact with high tension cables. Some of these accidents may result in the death of victims which is negative, direct, and irreversible, thus rated high.

5.5.2.8 Employment/contracting and an increase in income

Sporting activities will create employment/contracting as well as an increase in income opportunities thus improving the economic power of the people in the proposed host environment. This impact is a positive rating.

5.5.2.9 Light pollution

The proposed Stadium will cause artificial light (or light pollution). *Light pollution* from stadium lighting system can attract animals either directly or indirectly (e.g. they attract insect prey which, in turn, attract bats and birds – and their predators). This can affect migration patterns where animals travel off-course because they are attracted to light. Once they arrive at the light source, birds may circle the source, become disoriented and exhausted, and collide with structures or other disoriented birds. Light pollution can also affect animals' rhythms of waking, sleeping, and hibernation.

5.5.3 Decommissioning Phase

At the end of this project which is anticipated to be 40 years by design, there will be decommissioning. In this phase, interference with road transportation and impairment of air quality are the two medium ratings anticipated while the kidnapping of workers and visitors on site is a high rating negative impact.

5.5.3.1 Impairment of air quality

Dismantling, removal, and site clean-up at the end of the proposed project may require the use of heavy machinery with activities that may open the soil surface. Decommissioning activities of the stadium to be involved at this stage may generate emissions and associated dust suspensions may cause impaired air quality. These were identified as direct which will last the period of decommissioning activities. Though they were considered reversible, their levels caused them to be of medium ranking.

5.5.3.2 Kidnapping of workers and visitors on site

The kidnapping of workers and visitors on site are among the major security concerns in Nigeria now. During movements as required in decommissioning, personnel and company

contractor may be victims of kidnappers. Some of these attacks may result in the death of victims which is negative, direct, and irreversible, thus rated high.

5.5.3.3 Solid, Liquid, and Hazardous Waste Management

Decommissioning activities will generate wastes such as excavated soils and debris woodpiles, fuels, lube oils, chemicals, and solid wastes from the demolition camp. Leaching from waste oil could result in groundwater contamination. The solid and hazardous waste generated during the decommissioning activities will be managed using the best management practices. The impact of hazardous waste management will be negative, short-term, localized, reversible, and medium. Ebonyi State Ministry of Environment approved waste vendors shall be contacted for all waste-related issues.

5.5.3.4 Increased opportunity for employment and contracting resulting in increased income level.

The process of decommissioning will involve the repair of damaged roads, removal of structures, and restoration of the campsite. These activities could increase opportunities for employment and contract. The impact was rated as direct, positive, short-term, local, and reversible.

5.5.3.5 Injuries and death/worksite accidents

During decommissioning, demolition of stadium components, as well as land excavation, could lead to worksite accidents and injuries/death. Also, an accident could occur as a result of tripping or falling from a height. Some of these accidents may result in the death of victims which is negative, direct, and irreversible, thus rated high.

5.5.3.6 Nuisance (Noise, emission, Vibration, etc) from heavy machinery.

The process of decommissioning could also result in the generation of noise, vibration, etc. from heavy equipment. The impact was rated as direct, negative, short-term, local, reversible, and medium.

5.5.3.7 Third-Party Agitation due to Employment Issues and Loss of Benefits as Host Communities.

As decommissioning activities start and come to an end, there could be agitation by the third parties from loss of employment and contracting opportunities. The impact was direct, negative, short-term, local, and reversible, with the medium rating.

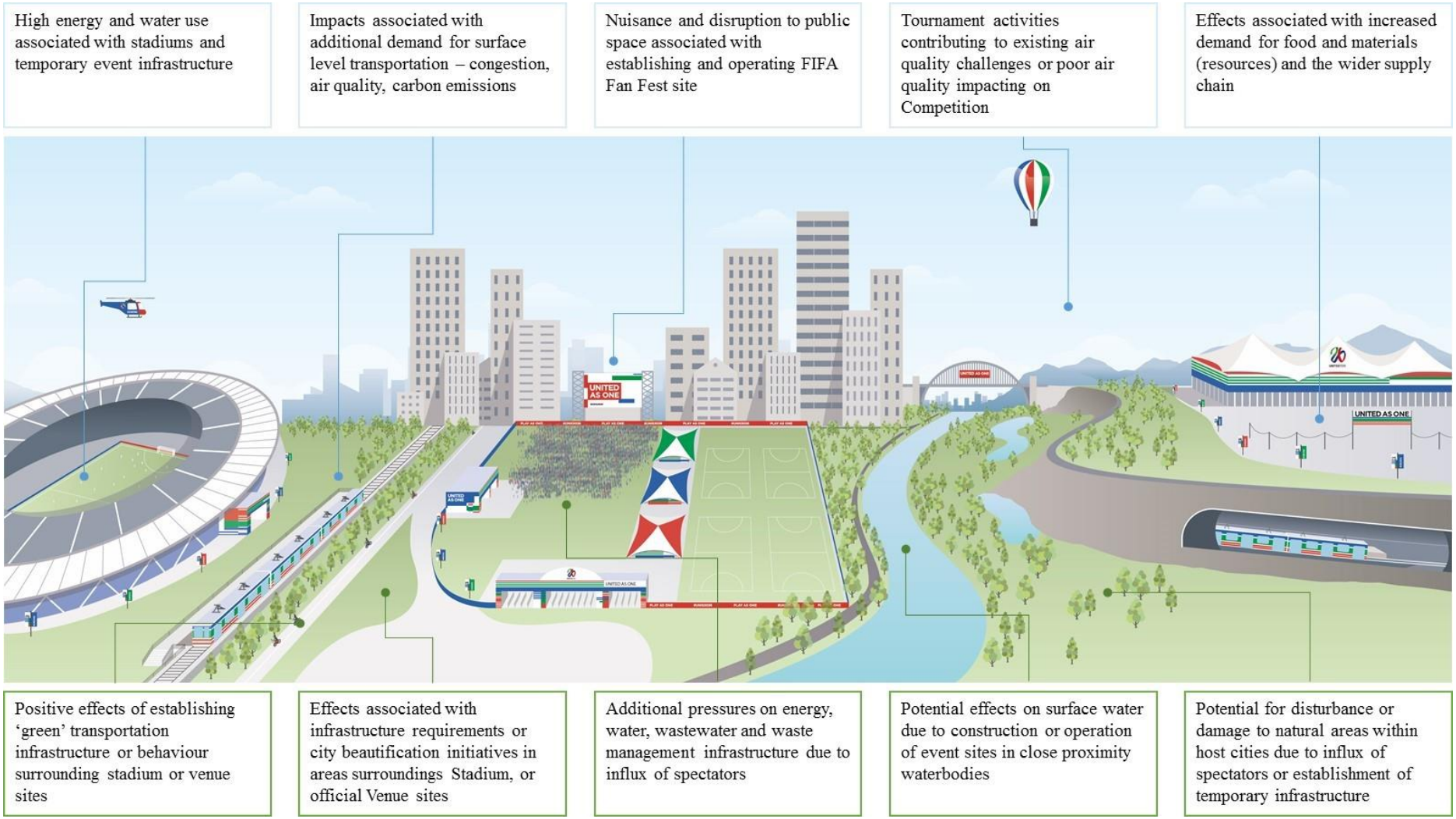


Figure 5.3: Summary of Potential impacts of the proposed Project

It is noteworthy to state that the beneficial impacts to be realized, could be emphasized as a justification of this viable Project. Major potential adverse impacts have been identified and evaluated. Except for the few significantly adverse impacts, most of the ratings for all project phases were low to medium. This is a good indication that the overall adverse impact of the Project on the various components of the environment would be minimal.

The significance of these impacts could as well be minimized to acceptable levels if adequate mitigation measures are put in place; allowing the project to be implemented in an environmentally sustainable manner. Sound and cost-effective mitigation measures for the identified negative impacts are therefore presented in the next chapter.

CHAPTER SIX

MITIGATION MEASURES

6.1 Background Information

This chapter provides mitigation measures that will be taken by the Ebonyi State Government against identified impacts to ensure the environmental sustainability of its proposed International Olympic Stadium in Ebonyi State. The impact identification and evaluation process showed that components of the biophysical, health, and social environments will be impacted both positively and negatively. Several measures are hereby proposed to mitigate the impacts of the facility to an acceptable residual impact level.

The HSE design and operation objectives of the facilities are to implement all cost-effective measures to reduce the risks and impacts of routine or major hazards including accidents. Thus, the steps taken in the HSE process for the proposed Stadium include the following:

- design based on codes, standards, and regulations
- improved operation based on quantitative risk assessment and
- best international practice

6.2 Criteria for Selection of Mitigation Measures

Selection of mitigation measures for the identified impact is based on the following considerations:

a) Engineering design of the Stadium,
b) The practicability of the measures,
c) Regulatory requirements (FMEnv, Ministry of Sport, FIFA, IAAF), and
d) Industry and international best practices.

6.3 Mitigation Measures

Mitigation measures are actions taken to minimized negative impacts, while also enhance positive ones. Mitigation measures are often implemented continuously throughout the project's life span. These measures aim to improve the environmental

sustainability of the project. Mitigation measures are recommended for the project identified impacts on:

a) Environment
b) Occupational safety and health
c) Community health and safety.

The comprehensive mitigation measures encapsulating the project phases from pre-construction to construction, operation, and decommissioning are presented in ***Table 6.1*** below. Following the adoption of mitigation measures, residual impacts are also presented.

Table 6.1: Mitigation Measures of the Proposed Project Activities – Pre-Construction Phase

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
Land Take for the Stadium	Loss of land Change in land use Legal issue	H	This impact, although negative is reversible, the probability of the impact arising is also low because Ebonyi State Government already has an allocation, where the project will be situated. The percentage of environmental significance is less than 25%, therefore the impact significance is described as low. However, the Ebonyi State Government shall ensure: ✓ continuous consultation and engagement with host communities and other stakeholders shall be maintained to forestall unrest in line with the company's grievance mechanism. ✓ that proper land acquisition procedure is followed and payment of all land dues to any concerned stakeholder	**L**
Mobilisation (transport) to the site (equipment,	Road traffic accidents	H	To prevent road accident, Ebonyi State Government shall ensure: • compliance with journey management policy • Vehicles are pre-mobbed and pre-mobilization/compliance	M

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
personnel, and construction modules)			certificate issued. • The use of PPEs at sites; daily pep talk, carry out job hazard analysis. • Ensure that all traffic rules are obeyed by the drivers. • Speed breakers at sections traversing communities. • Conformance with road traffic laws in line with the Federal Road Safety Commission (FRSC) safety requirements. • All safety incidents will be reported and investigated. Corrective actions will also be implemented.	
	Noise nuisance	M	Ebonyi State Government shall ensure: • Regular maintenance of vehicles. • Vehicles are turned off when not in use. • Vehicles are fitted with effective silencers.	L
	Impairment of air quality	M	Ebonyi State Government shall ensure: • Engine to comply with international standards for exhaust gases; Maintenance of engines and exhaust gas check;	L

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
			Adoption of engine-off policy at the construction site • that nose masks and earmuffs are worn by site workers during excavation • that water shall be sprayed on construction sites to reduce dust levels, especially during the dry season. • there is regular maintenance of the generators; • generators are switched off when not in use • dust control and dust recovery machinery are used • Construction materials and earth will be fully covered during transportation to the construction site by road; •	
	Loss of biodiversity	H	▪ Strictly regulating heavy equipment traffic ▪ Restricting the number of traffic lanes and limiting the movement of the machinery to the worksite and to the marked access way. ▪ Implement good housekeeping practice on-site.	L

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
			▪ Storing and handling of the hazardous waste following approved WMP. ▪ Selecting vehicles suited for erodible soil. ▪ Limiting activities in erodable soil.	
Energy consumption (provision of energy for pre-construction activities)	Impairment of air quality	M	Ebonyi State Government shall ensure that: • there is regular maintenance of the generators; • generators are switched off when not in use	L
	Noise and vibration nuisance	M	Ebonyi State Government shall ensure that: • electric power generators are fitted with effective silencers; • there shall be regular maintenance of the generators; • noise barriers are erected • generators are switched off when not in use; • soundproof electric power generators are engaged • Provision of rubber padding/ noise isolators to DG sets and construction machines	L
	Contamination of soil	M	Ebonyi State Government shall ensure:	L

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
			• Soil disturbance shall be kept to the minimum required for operation and safety. • Oil spill containment shall be provided to prevent an oil spill from getting to the soil. • Implement good housekeeping practice on-site. • Storing and handling hazardous waste following approved WMP.	
Site Preparation – land clearing, removal of vegetation, Land excavation for foundations, and Surfacing of feeder roads	Acceleration of erosion	M	Ebonyi State Government shall: • Stabilize soil within the well location and campsite mechanically using compactors to reduce erosion potential • Mechanically stabilize the soil to reduce the potential for erosion • Avoid excavation and burial in the steeply sloped ground and avoid the creation of great breaks. • Provide for the placement of siltation ponds in areas subject to heavy erosion.	L

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
			• Select vehicles suited for erodible soil. • Limiting activities in erodable soil.	
	Alteration of local topography	M	• Ebonyi State Government shall ensure: • re-grading of the sites, then replacing the layer of topsoil that was previously put. • restoring the operational site by restoring the original profile of the topography and the soil • strictly regulating heavy equipment traffic • restricting the number of traffic lanes and limiting the movement of the machinery to the worksite and to the marked access way.	L
	Blockage of drainage pattern	M	Ebonyi State Government shall ensure that: • Strict environmental policy shall be ensured • Regular cleaning of the drainage shall be ensured • The drainage network shall be covered	L
	Contamination of soil	M	Ebonyi State Government shall:	L

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
			• Ensure that soil disturbance shall be kept to the minimum required for operation and safety. • Ensure that oil spill containment is provided to reduce oil spill from getting to the soil. • Implement good housekeeping practice on-site. • Store and handle hazardous waste following approved WMP. • Place filtration berms and sediment barriers. • Use methods that minimises perturbation to the aquatic environment. Avoid spills prohibiting refuelling near a waterway.	
	Impairment of air quality	M	Ebonyi State Government shall ensure that: • only pre-mobbed equipment is used; • all equipment is controlled; • equipment engines are turned off when not in use • Ebonyi State Government shall ensure that all construction	L

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
			equipment shall be in proper operating condition and fitted with factory standard silencing features if appropriate • Ebonyi State Government shall provide and enforce the use of PPE (e.g. nose masks and ear muffs) • Ebonyi State Government shall construct soundproofing walls around stationary power generating sources • Use of the cleanest fuel economically available shall be adopted • Combustion technology and pollution control technology, which are all interrelated, shall be evaluated very carefully upstream of the project to optimize the project's environmental performance; • Use of loading and unloading equipment that minimizes the height of fuel drop to the stockpile to reduce the generation of fugitive dust and installing of cyclone dust collectors; • Use of water spray systems to reduce the formation of	

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
			fugitive dust from solid fuel storage in arid environments; • Use of enclosed conveyors with well designed, extraction and filtration equipment on conveyor transfer points to prevent the emission of dust;	
	Noise and vibration nuisance	H	Ebonyi State Government shall ensure that: • equipment is fitted with effective silencers; • there shall be regular maintenance of equipment; • equipment is switched off when not in use; • vibration containment be made for equipment which is likely to cause vibration; and • noise barriers are erected.	L
	Worksite accidents	H	Ebonyi State Government shall ensure that: • workers and visitors are properly kitted (use of appropriate PPEs) • use of warning signs • non-consumption of alcoholic beverages on work site	M

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
			• Clinic / first aid kit shall always be available within the site	
	Habitat Alteration	H	Ebonyi State Government shall: ▪ Use methods that minimises perturbation to the aquatic environment. ▪ Avoid spills prohibiting refuelling near waterways. ▪ Minimise destruction or modification of the vegetation cover by restoring vegetation at the end of the work.	L

Table 6.2: Mitigation Measures of the Proposed Project Activities– Construction Phase

Project Activity	**Description of Impacts**	**Rating before Mitigation**	**Mitigation/Control Measures**	**Rating after Mitigation**
Transport activities during construction	Road traffic accidents	H	To prevent road accident, Ebonyi State Government shall ensure: • compliance with journey management policy. • Vehicles are pre-mobbed and pre-mobilization/compliance certificate issued. • the use of PPEs at sites; daily pep talk, carry out job hazard analysis • ensure that all traffic rules are obeyed by the drivers • Speed breakers at sections traversing communities • Conformance with road traffic laws in line with the Federal Road Safety Commission (FRSC) safety requirements. • All safety incidents will be reported and investigated. Corrective actions will also be implemented	M
	Noise nuisance	M	Ebonyi State Government shall ensure: • regular maintenance of vehicles	L

			• Vehicles are turned off when not in use • Vehicles are fitted with effective silencers.	
	Impairment of air quality – emission from trucks	M	Ebonyi State Government shall ensure: • Engine to comply with international standards for exhaust gases; • Maintenance of engines and exhaust gas check; Adoption of the engine of policy at the construction site. • that nose masks and earmuffs are worn by site workers during excavation • The use of the cleanest fuel economically available shall be adopted. • Combustion technology and pollution control technology, which are all interrelated, shall be evaluated very carefully upstream of the project to optimize the project's environmental performance; • Use of loading and unloading equipment that minimizes the height of fuel drop to the stockpile to reduce the generation of fugitive dust and installing of cyclone dust collectors; • Use of water spray systems to reduce the formation of	L

			fugitive dust from solid fuel storage in arid environments; • Use of enclosed conveyors with well designed, extraction and filtration equipment on conveyor transfer points to prevent the emission of dust	
Construction and Casting of the plinths for stadium Main Bowl/administrative office/car park	Loss of vegetal cover with possible impact on biodiversity loss	H	Ebonyi State Government shall: ▪ Provide siltation pond in areas of heavy erosion ▪ Place filtration berms and sediment barriers. ▪ Use methods that minimises perturbation to the aquatic environment. ▪ Avoid spills prohibiting refuelling near waterways. ▪ Minimise destruction or modification of the vegetation cover by restoring vegetation at the end of the work.	M
	Impairment of air quality	H	Ebonyi State Government shall ensure: • there is regular maintenance of the engines; • engines are switched off when not in use • engines to comply with international standards for exhaust gases; • Maintenance of engines and exhaust gas check; • that nose masks and earmuffs are worn by site workers during excavation.	L

			• Use of the cleanest fuel economically available shall be adopted • Combustion technology and pollution control technology, which are all interrelated, shall be evaluated very carefully upstream of the project to optimize the project's environmental performance;	
	Noise and vibration nuisance	H	Ebonyi State Government shall ensure that: • Machine engines are fitted with effective silencers; • regular maintenance of machine/ engines are performed; • engines are switched off when not in use; • soundproof electric power generators are engaged • the use of PPEs is encouraged • vibration containment shall be made for generators and machines	L
	Contamination in the event of oil spills from equipment and machinery	H	• Oil spill containment shall be provided to reduce oil spill from getting to the soil and surface. • there shall be regular maintenance of the equipment and machinery.	M
	Kidnapping of workers	H	Ebonyi State Government shall ensure that both contractor and Ebonyi State Government personnel develop a high level of security consciousness both within and outside the	M

			work area • Daily security reports shall be reviewed by the Ebonyi State Government Project Manager • A special security force shall be established and deployed for the project. This shall include deploying some of Ebonyi State Government police to strengthen security in the area • Ebonyi State Government shall ensure that a liaison to foster a partnership with the community to guarantee security for the project is established and sustained • To beef up security for the project, Ebonyi State Government shall support government authorities by assisting with equipment e.g. patrol vehicles, to ensure improved security • Ebonyi State Government shall ensure that safety workshops to identify, evaluate and recommend contingency plans for all security risks are regularly organized • Ebonyi State Government shall ensure that there is a police station/post within and around the facility	
	Waste generation from excavated materials	H	Ebonyi State Government shall ensure that: • all other wastes generated including environmentally deleterious	L

			materials generated by construction activities will be disposed of offsite in an appropriate, legal, and safe manner. • generation of all wastes are minimized as much as practically possible • Unsuitable excavated materials shall be systematically carried away from areas prone to erosion; • Reuse waste materials wherever possible and use designated disposal sites; • Used oil and lubricants shall be recovered and reused or removed from the site in full compliance with the national and local regulations; • Oil wastes, debris, and/or other waste materials must not be burned; • Optimize the reuse of soil and construction waste; • All the construction camps and facilities shall be dismantled and removed from the site unless otherwise desired by the local public; • the site shall be restored to a condition in no way inferior to the condition prior to the commencement of work.	

			• safety measures while disposing of wastes are followed; • introduction of foreign soil and synthetic materials is avoided; • disposal of construction and related waste materials at designated and approved waste dump site; • waste management plan in road planning and contract specifications is incorporated; • there is a collaboration with relevant waste management agencies to enforce appropriate sanitation and other bye-laws.	
Fabrication of structural fittings (welding)	Burns/injuries from welding sparks	H	• Ebonyi State Government shall ensure that workers and visitors are properly kitted. • Use of experienced/competent workers. • Pipe joining techniques such as welding shall meet international standards.	M
	Exposure to welding flash	H	• Ebonyi State Government shall ensure that workers and visitors are properly kitted (appropriate PPEs are used).	L
	Waste generation from construction activities such as metal cuttings	M	Ebonyi State Government shall ensure that: • all other wastes generated including environmentally deleterious materials generated by construction activities will be disposed of offsite in an appropriate, legal, and safe manner.	L

			• generation of all wastes are minimized as much as practically possible. • Unsuitable excavated materials shall be systematically carried away from areas prone to erosion; • Reuse waste materials wherever possible and use designated disposal sites. • Used oil and lubricants shall be recovered and reused or removed from the site in full compliance with the national and local regulations. • Oil wastes, debris, and/or other waste materials must not be burned. • Optimize the reuse of soil and construction waste. • All the construction camps and facilities shall be dismantled and removed from the site unless otherwise desired by the local public. • The site shall be restored to a condition in no way inferior to the condition prior to the commencement of work. • Safety measures while disposing of wastes are followed. • Introduction of foreign soil and synthetic materials is avoided;	

			• Disposal of construction and related waste materials at designated and approved waste dump site; • Waste management plan in road planning and contract specifications is incorporated; • There is a collaboration with relevant waste management agencies to enforce appropriate sanitation and other bye-laws.	
Construction of 30,000 seating capacity main Bowl (Track and field events)/ construction of Office complex, Courts, Car park, etc	Waste Management - The potential effects will be of aesthetics as well as a nuisance of wastes such as metal cuttings, paper carton, drums, paper, wood, etc.	H	Ebonyi State Government shall ensure that: • all other wastes generated including environmentally deleterious materials generated by construction activities will be disposed of offsite in an appropriate, legal, and safe manner. • generation of all wastes are minimized as much as practically possible • Unsuitable excavated materials shall be systematically carried away from areas prone to erosion; • Reuse waste materials wherever possible and use designated disposal sites; • Used oil and lubricants shall be recovered and reused or removed from the site in full compliance with the national and local regulations; • Oil wastes, debris, and/or other waste materials must not be	L

			burned; • Optimize the reuse of soil and construction waste; • All the construction camps and facilities shall be dismantled and removed from the site unless otherwise desired by the local public; • the site shall be restored to a condition in no way inferior to the condition prior to the commencement of work. • safety measures while disposing of wastes are followed; • introduction of foreign soil and synthetic materials is avoided; • disposal of construction and related waste materials at designated and approved waste dump site; • waste management plan in road planning and contract specifications is incorporated; there is a collaboration with relevant waste management agencies to enforce appropriate sanitation and other bye-laws.	
	Impairment of air quality	H	Ebonyi State Government shall ensure: • there is regular maintenance of the engines; • engines are switched off when not in use • engines to comply with international standards for exhaust gases; • Maintenance of engines and exhaust gas check; • that nose masks and earmuffs are worn by site workers during	L

			excavation • Use of the cleanest fuel economically available shall be adopted • Combustion technology and pollution control technology, which are all interrelated, shall be evaluated very carefully upstream of the project to optimize the project's environmental performance;	
	Noise and vibration nuisance	H	Ebonyi State Government shall ensure: ✓ Regular maintenance of mobile and immobile equipment to ensure improved machine efficiency and complete combustion of fuel. ✓ Monitoring of the air quality during the construction phase at least 3 times. ✓ Ensure workers use hearing protectors.	L
	Worksite accidents	H	Ebonyi State Government shall ensure that: ✓ workers and visitors are properly kitted (use of appropriate PPEs) ✓ use of warning signs ✓ non-consumption of alcoholic beverages on work site ✓ Clinic / first aid kit shall always be available within the site	L

Backfilling	Surface water may be polluted due to increased erosion, runoff from a construction site, and contamination in the event of oil spills from equipment and machinery.	H	Ebonyi State Government shall ensure that: • Soil disturbance shall be kept to the minimum required for operation and safety to reduce erosion • Oil spill containment shall be provided to reduce oil spill from getting to the soil and surface • there shall be regular maintenance of the equipment and machinery • Mechanically stabilising the soil to reduce the potential for erosion • Avoiding excavation and burial in the steeply sloped ground and avoiding the creation of great breaks • Providing for the placement of siltation ponds in areas subject to heavy erosion. • Selecting vehicles suited for erodible soil. • Limiting activities in erodable soil • After the work, levelling the disturbed soil and quickly seeding or replanting bushes to control soil erosion.	M

	Waste Management - The potential effects will be of aesthetics as well as a nuisance. Wastes shall mainly come from discarded packaging materials such as metal cuttings and empty plastic containers. Poor disposal methods can lead to environmental problems due to their non-biodegradable nature. Most of the packaging wastes are expected to be reused	H	Ebonyi State Government shall ensure that: • toilets are created at the site. • the site remains clean, well maintained, and free of hazards, with the thoughtful location of litter bins. • Proper disposal of solid waste from construction activities and labour camps. • storage of lubricants, fuels, and other hydrocarbons in self-contained enclosures. • sanitation arrangements at worksites/facilities to avoid the release of wastewater and sewage to the environment. • Minimum wastes are generated. • Reuse waste materials wherever possible and use designated disposal sites. • Used oil and lubricants shall be recovered and reused or removed from the site in full compliance with the national and local regulations. • Oil wastes, debris, and/or other waste materials shall not be burned. • safety measures are followed while disposing of wastes.	L

	Alteration of hydrological patterns resulting in temporary or permanent flooding, soil erosion, and destruction of biodiversity	H	• Mechanically stabilising the soil to reduce the potential for erosion • Avoiding excavation and burial in the steeply sloped ground and avoiding the creation of great breaks • Providing for the placement of siltation ponds in areas subject to heavy erosion • Selecting vehicles suited for erodible soil • Limiting activities in erodable soil • At the completion of the work, levelling the disturbed soil and quickly seeding or replanting bushes to control soil erosion.	L
	Habitat alteration	M	Ebonyi State Government shall: • Implement good housekeeping practice on-site. • Store and handle hazardous waste following approved WMP • Ebonyi State Government shall ensure the use of appropriate PPEs • Ebonyi State Government shall ensure that backfilling is followed by mechanical compaction to retain the original level. • Ebonyi State Government shall re-vegetate the soils with indigenous grasses, sedges, etc to check the incidence of flooding.	L

	Worksite accidents	H	Ebonyi State Government shall ensure that: • workers and visitors are properly kitted (use of appropriate PPEs) • use of warning signs • non-consumption of alcoholic beverages on work site • Clinic / first aid kit shall always be available within the site	L
	Increase in communicable disease (including STDs and HIV/AIDS)	M	• Health awareness lectures shall be given to workers on the mode of transmission of STIs (including HIV/AIDS) • As much as possible provide psychological support to persons living with HIV. • Ebonyi State Government shall ensure immunization of the workforce against as appropriate. • Regular spraying of work sites Provision of insecticide-treated nets to field workers to reduce the incidence of malaria. • Awareness campaign shall be carried out to enlighten the communities /field workers on the common communicable diseases and the health implications of drug and alcohol abuse, unprotected sex, prostitution, and the need to sustain cultural values. • Ebonyi State Government shall assist the activities of the state	L

			action committee on STIs/HIV/AIDS as part of her stakeholders' engagement plan. • Ebonyi State Government shall ensure site clinic is provided to take care of minor illnesses for all construction workers	
Water utilization for concrete-weight	Temporary change in land use but the land will be returned to its original use after completion of works and subsequent sand filling	M	• Ensure prompt landscaping/reclamation of degraded lands. • Rehabilitate Excavation sites by filling. • Ugly scars left around sites shall be levelled and landscaped. • Plant shrubs/grasses to be planted to check erosion. • Develop embankment on steep slopes to protect them from erosion. • Stone pitch to protect slopes where necessary • New structures such as signboards, billboards for the project shall be removed after construction. Those required such as direction or warning signs shall be properly placed.	L
Coating	Contamination of surface water and soil by paints and coating as a result of spillage	H	• Using of engineering controls (containment, automatic alarms, and shut-off systems) commensurate with the nature of hazard; • Implementing management controls (procedures, inspections, communications, training, and drills) to address residual risks that have not been prevented or controlled through engineering measures.	L

			• Safe ventilation for storage of volatile materials shall be provided; • Access to areas containing paint substances shall be restricted and controlled; • Paints shall be stored on the impervious ground undercover; the area shall be constructed as a spill tray to avoid the spread of accidental spills.	
	Hazardous waste generation from coating operations such as metals	H	• Good housekeeping shall be instituted and maintained • hazardous wastes shall be collected, stored, and disposed of appropriately in line with FMEnv standard at an approved disposal site	L
Installation of Transformers, Floodlights, scoreboard and electric pole	Electrocution: Tall equipment could have contact with high tension cables causing electrocution hazard. Construction workers can also be exposed during lightings installation.	H	Ebonyi State Government shall ensure: ✓ Use of signs, barriers (e.g. locks on doors, use of gates, use of steel posts surrounding towers to prevent public and workers contact with potentially dangerous equipment; ✓ it provides and enforces the use of PPE; ✓ Conduit type of wiring shall be adopted instead of the surface to prevent shock. ✓ Only allowing trained and certified workers to install, maintain, or	L

			repair electrical equipment; ✓ Deactivating and properly grounding live power distribution lines before work is performed on, or close to, the lines; ✓ Ensuring that live-wire work is conducted by trained workers with strict adherence to specific safety and insulation standards. Qualified or trained employees working on transmission or distribution systems should be able to achieve the following: ✓ Distinguish live parts from other parts of the electrical system ✓ Determine the voltage of live parts ✓ Understand the minimum approach distances outlined for specific live line voltages ✓ Ensure proper use of special safety equipment and procedures when working near, or on, exposed energized parts of an electrical system; ✓ Workers should not approach an exposed, energized, or conductive part even if properly trained unless: ✓ The worker is properly insulated from the energized part with gloves or other approved insulation; or ✓ The energized part is properly insulated from the worker and any other conductive object;	

			✓ All electrical installations shall be performed by certified personnel and supervised by an accredited person. ✓ Strict procedures for de-energizing and checking of electrical equipment should be in place before any maintenance work is conducted. If de-energizing is not possible, electrical installations should be moved or insulated to minimized the hazardous effects; ✓ Before excavation works, all existing underground cable installations should be identified and marked. Drawings and plans should indicate such installations; ✓ discharge. In cases where maintenance work has to be performed on energized equipment, a strict safety ✓ procedure should be in place and work should be performed under constant supervision; ✓ Personnel training should be provided in revival techniques for victims of electric shock.	
	Tripping/falling from heights as a result of Climbing and working on electric poles	H	Ebonyi State Government shall ensure 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 before undertaking work	L

			• 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 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. • When operating power tools at height, require that workers use a second (backup) safety strap; • An approved tool bag should be used for raising or lowering	

			tools or materials to workers on structures.	
Site demobilization	Road traffic accidents	M	Ebonyi State Government shall ensure: • enforcement of the use of PPEs • daily pep talk is carried out • job hazard analysis is carried out • compliance with journey management policy	L

Table 6.3: Mitigation Measures of the Proposed Project Activities – Operation/Maintenance

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
Operation of Stadium during sporting activities	Noise: Noise pollution will be produced by Generator set and spectators within the stadium during sporting activities	H	Mitigation measures to reduce the noise footprint of the project include: ✓ there is regular maintenance of generators. ✓ engines are switched off when not in use. ✓ Noise monitoring systems that monitor the noise level of the stadium. ✓ Soundproof walls shall be installed at the spectators stand. ✓ The use of Renewable Energy such as wind and solar systems.	M
	Air pollution from generating set during sporting activities	H	Ebonyi State Government shall ensure: • there is regular maintenance of generators; • engines are switched off when not in use • engines to comply with international standards for exhaust gases; • Maintenance of engines and exhaust gas check; • Use of the cleanest fuel economically available shall be adopted.	L

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
			• The use of a hybrid system shall also be considered	
	The kidnapping of spectators /sporting figure/personnel	H	• Ebonyi State Government shall ensure that spectators, sporting figures, and personnel develop a high level of security consciousness both within and outside the stadium. • Daily security reports shall be reviewed by the stadium authority • Special security forces shall be established and deployed during sporting activities. This shall include deploying some of Ebonyi State Government police, Nigeria Civil Defence Corps (NCDC) to strengthen security in the area. • To beef up security for the project, Ebonyi State Government shall assist with equipment e.g. patrol vehicles, to ensure improved security. • Ebonyi State Government shall ensure that there is a police station/post within and around the facility.	M
	Road traffic accident	H	To prevent road accident, Ebonyi State Government shall ensure:	M

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
	during sporting activities		• compliance with journey management policy • ensure that all traffic rules are obeyed by the drivers • Speed breakers at sections traversing communities • All vehicles will be parked in the designated parking area only. • Road crossings will be well marked and signaled. • Informatory and warning signages will be retro-reflective type provided, clearly visible in the night. • Marshals shall be deployed to guide the vehicles and stop vehicles to avoid traffic jams at the arrival and departure of the Ebonyi International Olympic Stadium.	
	The collapse of seating stand during sporting activities	H	Ebonyi State Government shall ensure: • Test structures for integrity before undertaking work. • The number of spectators is not more than the available seats. • Safety personnel and Protective equipment are readily available during all sporting activities.	L

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
			• Direct spectators to their appropriate sitting stand during sporting activities. • Entrance and exits shall be properly labelled for easy access. • Unsafe acts shall be guided against during and after sporting activities. • The unsafe condition within the stadium which could pose danger to the spectators shall be handled as soon as discovered.	
	Generation of Waste during operation of the stadium (Sporting activities)	H	• Good housekeeping shall be instituted and maintained. • hazardous wastes shall be collected, stored, and disposed of appropriately in line with FMEnv standard at an approved disposal site. • Properly labeled waste bins shall be located at appropriate areas within the stadium premises. • Waste shall be disposed of through approved waste managers regularly	L

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
			• Cleaning of the stadium Main Bowl and other courts should be carried out immediately after all the sporting activities are over for that day before another one the following day (especially during weekends or when sporting activities will take weeks)	
	Light: Artificial light from the stadium can attract animals either directly or indirectly. Light pollution can also affect animals' rhythms of waking, sleeping, and hibernation. This impact will occur every night until the end of life of the stadium	H	Mitigation measures to be implemented by Ebonyi State Government include: Light Spectrum: Although all light has some effects on wildlife and habitats, certain spectra are more damaging. Full-spectrum light, which has blue and ultraviolet wavelengths, shall not be used. Ultraviolet light is highly attractive to insects and birds, it shall be avoided as well.	L
	Road traffic accidents as a result of transportation	H	To prevent road accident, Ebonyi State Government shall ensure: • compliance with journey management policy	L

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
	activities during facility operation		• Vehicles are pre-mobbed and pre-mobilization/compliance certificate issued. • the use of PPEs at sites; daily pep talk, carry out job hazard analysis • ensure that all traffic rules are obeyed by the drivers • Speed breakers at sections traversing communities • All vehicles will be parked in the designated parking area only; • Road crossings will be well marked and signaled. • Informatory and warning signages will be retro-reflective type provided, clearly visible in the night. • Marshals will be deployed to guide the vehicles and stop vehicles to avoid traffic jams at the arrival and departure of the Ebonyi International Olympic Stadium.	
Maintenance of Stadium	Generation of Waste during maintenance of the stadium	M	• Good housekeeping shall be instituted and maintained • hazardous wastes shall be collected, stored, and disposed of appropriately in line with FMEnv standard at an	L

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
			approved disposal site. • Properly labeled waste bins shall be located at appropriate areas within the stadium premises • Waste shall be disposed of through approved waste managers regularly. Cleaning of the stadium Main Bowl and other courts should be carried out immediately after all the sporting activities are over for that day before another one the following day (especially during weekends or when sporting activities will take weeks) Waste generated during Generators maintenance should be disposed of immediately accordingly.	
	Soil/ groundwater contamination due to fuel/ oil spill	M	Provision of secondary containment for storage tanks	L
	Impairment of air quality – emission from Generator	M	Ebonyi State Government shall ensure: • There is regular maintenance of generators.	L

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
			• Engines are switched off when not in use. • Engines to comply with international standards for exhaust gases. • Maintenance of engines and exhaust gas check. • Use of the cleanest fuel economically available shall be adopted.	
	The security threat to stadium properties and the threat from major accidents related to the fires and explosions at the facility and potential accidental releases of diesel when refilling the storage tank	H	• Ebonyi State Government shall ensure that there is a police station/post within and around the facility to protect stadium properties • Limiting the areas that may be potentially affected by accidental releases by: o Defining fire zones and equipping them with a drainage system to collect and convey accidental releases of flammable liquids to a safe containment area including secondary containment of storage tanks. o Installing fire/blast partition walls in areas where appropriate separation distances cannot be achieved	L

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
			• By providing firefighting equipment around the stadium	
	Worksite accidents	H	Ebonyi State Government shall ensure that: ✓ workers and visitors are properly kitted (use of appropriate PPEs) ✓ use of warning signs ✓ non-consumption of alcoholic beverages on work site ✓ Clinic / first aid kit shall always be available within the site	L
	Electrocution: Tall equipment could have contact with high tension cables causing electrocution hazard. Construction workers can also be exposed during lightings installation/maintenance	H	Ebonyi State Government shall ensure: ✓ Use of signs, barriers (e.g. locks on doors, use of gates, use of steel posts surrounding towers to prevent public and workers contact with potentially dangerous equipment. ✓ it provides and enforces the use of PPE. ✓ Conduit type of wiring shall be adopted instead of the surface to prevent shock. ✓ Only allowing trained and certified workers to install, maintain, or repair electrical equipment. ✓ Deactivating and properly grounding live power distribution	L

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
			lines before work is performed on, or close to, the lines; ✓ Ensuring that live-wire work is conducted by trained workers with strict adherence to specific safety and insulation standards. Qualified or trained employees working on transmission or distribution systems should be able to achieve the following: ✓ Distinguish live parts from other parts of the electrical system ✓ Determine the voltage of live parts ✓ Understand the minimum approach distances outlined for specific live line voltages ✓ Ensure proper use of special safety equipment and procedures when working near, or on, exposed energized parts of an electrical system; ✓ Workers should not approach an exposed, energized, or conductive part even if properly trained unless: ✓ The worker is properly insulated from the energized part with gloves or other approved insulation; or	

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
			✓ The energized part is properly insulated from the worker and any other conductive object; ✓ All electrical installations shall be performed by certified personnel and supervised by an accredited person. ✓ Strict procedures for de-energizing and checking of electrical equipment should be in place before any maintenance work is conducted. If de-energizing is not possible, electrical installations should be moved or insulated to minimized the hazardous effects; ✓ Before excavation works, all existing underground cable installations should be identified and marked. Drawings and plans should indicate such installations; ✓ discharge. In cases where maintenance work has to be performed on energized equipment, a strict safety ✓ procedure should be in place and work should be performed under constant supervision; ✓ Personnel training should be provided in revival techniques for	

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
			victims of electric shock.	
	Tripping/falling from heights as a result of Climbing and working on electric poles	H	Ebonyi State Government shall ensure 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 before 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 use of	L

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
			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. • When operating power tools at height, require that workers use a second (backup) safety strap. An approved tool bag should be used for raising or lowering tools or materials to workers on structures.	
	The threat of Naturally Occurring Radioactive Material (NORM) to the environment (soil, water,	H	Ebonyi State Government shall ensure: • Regular maintenance or servicing of production equipment as at when due; • Regular NORM monitoring programs to detect materials	L

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
	and air)		and equipment with NORM; • carrying out personal dosimetry for external radiation exposures to confirm that exposures fall into the range expected from external radiation surveillance monitoring; • measuring airborne radioactive dust during maintenance activities to check that the assumptions upon which respirator selections were made are accurate – or if respirators are needed at all; • a surface contamination survey in a workshop to confirm that NORM contamination controls are working; • sampling and analysis of waste streams to confirm that they remain within regulatory limits; • materials used in NORM control procedures, such as gloves, plastic sheeting, disposable coveralls, etc. if an area, materials, or equipment is affected by NORM • At equipment cleaning facilities, scale/sludge shall be removed by reaming; high-pressure water blasting; or a	

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
			process called "rattling," where a high-speed rotating device is inserted into the pipe to break up and loosen the scale. Then the waste generated shall be handled by FMEnv approved Waste Manager to be disposed of at an approved disposal site.	
Repainting of rusted and corroded structural fittings	Contamination of soil by paints and coating as a result of spillage	H	• Using of engineering controls (containment, automatic alarms, and shut-off systems) commensurate with the nature of hazard; • Implementing management controls (procedures, inspections, communications, and training) to address residual risks that have not been prevented or controlled through engineering measures. • Safe ventilation for storage of volatile materials shall be provided; • Access to areas containing paint substances shall be restricted and controlled; • Paints shall be stored on the impervious ground	L

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
			undercover; the area shall be constructed as a spill tray to avoid the spread of accidental spills.	
	Hazardous waste generation from painting	H	• Good housekeeping shall be instituted and maintained • hazardous wastes shall be collected, stored, and disposed of appropriately in line with FMEnv standard at an approved disposal site. • PPEs must be used by workers who are handling paint	L

Table 6.4: Mitigation Measures of the Proposed Project Activities – Decommissioning

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation
Demolition and Evacuation	Interference with road transportation	M	• Ebonyi State Government shall monitor the nos of trucks per day to know if there is a need to create other access roads. • Ebonyi State Government shall develop a transport management plan specifying routes, speeds, times of travel, and key roads/waterways in terms of local services. • Consideration shall be given to avoid reliance on public transport and contractors shall be required to use private vehicles.	L
	Noise and vibration nuisance	M	Ebonyi State Government shall ensure that: • electric power generators are fitted with effective silencers;	L

			• there shall be regular maintenance of vehicles and generators; • generators and vehicles are switched off when not in use; • soundproof electric power generators are engaged • PPEs are used	
	Impairment of air quality	H	Ebonyi State Government shall ensure: • Engine to comply with international standards for exhaust gases; Maintenance of engines and exhaust gas check; Adoption of engine-off policy at the construction site. • that nose masks and earmuffs are worn by site workers during excavation. • that water shall be sprayed on construction sites to reduce dust levels, especially during the dry season.	L
	Contamination of surface and Groundwater & soil by the oil spill	M	Ebonyi State Government shall ensure: • Soil disturbance shall be kept to the minimum required for operation and safety. • Oil spill containment shall be provided to reduce oil spill from getting to the soil and surface/ groundwater.	L

			• Follow FMEnv guidelines on waste management • Cleanup in compliance with relevant national and International guidelines, involving the removal of the waste, etc. • Restore the to a condition in no way inferior to the condition prior to the commencement of work.	
	Poor disposal of wastes generated during this phase	H	• Ebonyi State Government shall treat and dispose of all wastes following regulatory requirements and best practice using approved contractors. • Ebonyi State Government shall ensure that none of these wastes are disposed of into any water body or on land. • follow safety measures while disposing of wastes. • Ebonyi State Government shall keep all waste consignment, treatment, and disposal records for regulatory verification • Proper disposal of solid waste from labour camps; • storage of lubricants, fuels, and other hydrocarbons in self-contained enclosures;	M

			• sanitation arrangements at worksites/facilities to avoid the release of wastewater to the environment • All other wastes generated including environmentally deleterious materials generated by construction activities will be disposed of offsite in an appropriate, legal, and safe manner. • There is a minimum generation of waste. • Unsuitable excavated materials shall be systematically carried away from areas prone to erosion; • Reuse waste materials wherever possible • Wastes shall be segregated, stored, and disposed of by an accredited state waste collector.	
	The threat of Naturally Occurring Radioactive Material (NORM) to the environment	H	Ebonyi State Government shall ensure: • Regular maintenance or servicing of production equipment as at when due; • Regular NORM monitoring programs to detect materials and equipment with NORM; • carrying out personal dosimetry for external radiation exposures to confirm that exposures fall into the range	M

			expected from external radiation surveillance monitoring; • measuring airborne radioactive dust during maintenance activities to check that the assumptions upon which respirator selections were made are accurate – or if respirators are needed at all; • a surface contamination survey in a workshop to confirm that NORM contamination controls are working; • sampling and analysis of waste streams to confirm that they remain within regulatory limits; • materials used in NORM control procedures, such as gloves, plastic sheeting, disposable coveralls, etc. if an area, materials, or equipment is affected by NORM. • Equipment with NORM shall be recycled or incinerated at an approved recycled or incinerated center as the case may be.	
	Loss of job	H	Ebonyi State Government shall • Counsel worker who losses job. • Give enough notice • Assist staff that are likely to lose jobs in skill acquisition • Assist in setting small scale business	L

	Injury/fatalities in workforce /communities	H	Ebonyi State Government shall • Ensure Safety awareness training for the workforce. • Emergency response procedures shall be put in place and enforced • to ensure the use of PPE. • Provide first aid and clinic on site.	L
	Electrocution: Tall equipment could have contact with high tension cables causing electrocution hazard. Workers can be exposed during the decommissioning phase.	H	Ebonyi State Government shall ensure: ✓ Use of signs, barriers (e.g. locks on doors, use of gates, use of steel posts surrounding towers to prevent public and workers contact with potentially dangerous equipment. ✓ It provides and enforces the use of PPE. ✓ Conduit type of wiring shall be adopted instead of the surface to prevent shock. ✓ Only allowing trained and certified workers to install, maintain, or repair electrical equipment. ✓ Deactivating and properly grounding live power distribution lines before work is performed on, or close to, the lines. ✓ Ensuring that live-wire work is conducted by trained workers with strict adherence to specific safety and insulation standards. Qualified or trained employees working on	L

			transmission or distribution systems should be able to achieve the following: ✓ Distinguish live parts from other parts of the electrical system. ✓ Determine the voltage of the live parts. ✓ Understand the minimum approach distances outlined for specific live line voltages. ✓ Ensure proper use of special safety equipment and procedures when working near, or on, exposed energized parts of an electrical system. ✓ Workers should not approach an exposed, energized, or conductive part even if properly trained unless: ✓ The worker is properly insulated from the energized part with gloves or other approved insulation. ✓ The energized part is properly insulated from the worker and any other conductive object. ✓ All electrical installations shall be performed by certified personnel and supervised by an accredited person. ✓ Strict procedures for de-energizing and checking of electrical equipment should be in place before any maintenance work is conducted. If de-energizing is not possible, electrical	

			installations should be moved or insulated to minimized the hazardous effects; ✓ Before excavation works, all existing underground cable installations should be identified and marked. Drawings and plans should indicate such installations; ✓ discharge. In cases where maintenance work has to be performed on energized equipment, a strict safety ✓ procedure should be in place and work should be performed under constant supervision; Personnel training should be provided in revival techniques for victims of electric shock.	
	Tripping/falling from heights as a result of Climbing and working on electric poles	H	Ebonyi State Government shall ensure 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 before 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,	L

			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 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. • When operating power tools at height, require that workers use a second (backup) safety strap; An approved tool bag should be used for raising or lowering tools or materials to workers on structures.	

	The kidnapping of workers and visitors on site	H	• Ebonyi State Government shall ensure that both contractor and Ebonyi State Government personnel develop a high level of security consciousness both within and outside the work area. • Daily security reports shall be reviewed by the Ebonyi State Government Project Manager. • A special security force shall be established and deployed for the project. This shall include deploying some of Ebonyi State Government police to strengthen security in the area. • Ebonyi State Government shall ensure that a liaison to foster a partnership with the community to guarantee security for the project is established and sustained. • To beef up security for the project, Ebonyi State Government shall support government authorities by assisting with equipment e.g. patrol vehicles, to ensure improved security. • Ebonyi State Government shall ensure that safety workshops to identify, evaluate and recommend contingency plans for all security risks are regularly	M

			organized • Ebonyi State Government shall ensure that there is a police station/post within and around the facility	
	Third-Party Agitation due to Employment Issues and Loss of Benefits as Host Communities.	M	• Assist staff that are likely to lose jobs in skill acquisition • Assist in setting small scale business	L

6.4 Summary of Residual Impacts after Mitigation

Residual Effects can be considered as those that remain significant following the application of mitigation measures, although they are likely to have been reduced in magnitude as a result of the mitigation measure implemented.

Overall, on balance, with the provision of the proposed mitigation measures as outlined in Tables 6.1 to 6.3, the positive impacts of the scheme will considerably outweigh the negative impacts. The public as a whole will benefit from the completion of the project. Once the mitigation measures outlined are implemented, the residual impact of construction and operation on the different elements identified will not be significant.

An overall mitigation measure is to undertake a Job Hazard Analysis, to enable each worker to assess the risks associated with the job and work safely using procedural guidelines in handling equipment and the facilities.

6.4.1 Community Unrest

Baseline

Widespread youth restiveness is common in the project area. However, issues about employment, supplies, contracts, and MOUs if not well managed would likely elicit community unrest and kidnapping.

Mitigation

As a mitigation measure, the Ebonyi State Government shall establish and maintain channels of communication with the communities during all phases of the project.

Furthermore, the Ebonyi State Government shall require contractors to hire local labour where feasible. Ebonyi State Government shall also ensure that its contractors adopt transparent approaches in matters of employment.

Ebonyi State Government shall also honour all MOU items agreed with the local communities. Also, there will be the presence of a police station/post within and around the facility.

From the foregoing, the impact rating should drop from high to medium, since it is impossible to eliminate all sources of community disagreements in a project such as this.

6.4.2 Influx of People

The influx of labour and camp followers is anticipated to increase the pressure on services and infrastructure. Currently, these facilities are inadequate and further pressure on them if not well managed could lead to further deterioration.

Mitigation

Contractors shall provide adequate accommodation with standard facilities to their migrant workforce to reduce anticipated pressure on community facilities. Medical facilities (clinic) and emergency rescue and medrescue/medevac procedures shall be provided at the worksites.

The impact is considered to be of *medium* significance, but following mitigation, it should drop to *low*. It will not be eliminated because some of the workers may want to remain to seek employment in the gas plant.

6.4.3 Increase in Cost of Living / Inflation

The cost of living is likely to be high as a result of a rise in income and economic activities. The attendant inflation will cut across all phases of the project to varying degrees.

Mitigation

Ebonyi State Government shall support skills development and sustainable economic enhancement of the local communities through training, complemented by the formation of cooperatives and the introduction of micro-credit schemes.

Inflation is of *medium* significance and after mitigation, it will drop to *low.* This is because, at the end of the project activities, it is expected that the local economy will stabilise. Also, those that acquired skills may likely migrate to other areas in search of better opportunities. Furthermore, inflation is a national phenomenon and responds to other factors that originate outside the project area.

6.4.4 Increase in Social Vices

With an influx of migrant workers of diverse characters, there is the potential for an increase in social vices such as stealing, drug abuse, alcoholism, and sexual promiscuity.

Mitigation

Ebonyi State Government shall carry out sustained campaigns to raise awareness and achieve behavioural modification amongst the workforce. Ebonyi State Government shall also enforce the alcohol and drug policy of the company at all her worksites. Access control shall also be maintained at the work and campsites.

The rating after mitigation will drop from *medium* to *low* and not eliminated since behaviour change is a difficult process.

6.5 Enhancing Positive Impacts

6.5.1 Job Creation

This project is expected to create jobs during different phases. There will be opportunities for both skilled and unskilled employment. It is also expected that most of the local workers will acquire relevant skills during the various project phases.

To enhance job creation opportunities throughout the life of the project, Ebonyi State Government shall ensure the participation of contractors from host communities. Also, the Ebonyi State Government shall promote the acquisition/ improvement of skills that will better equip the members of the host communities and enhance their chances for better employment elsewhere.

6.5.2 Business / Economic Opportunities

Movement of the workforce during the different project phases will increase local economic and business activities, especially for food vendors, retailers, transporters, etc. This will promote entrepreneurship and income generation capabilities of the local populace. To sustain stable economic growth, the Ebonyi State Government shall support the local economy through its various economic empowerment programmes.

6.6 Greenhouse Gas / Climate Change Analysis

Sports stadia are some of the most complex and intricate buildings constructed throughout the world. These buildings can be extremely high energy users and take up many acres of city or countryside space. It is imperative that sustainable concepts and strategies, in design, construction, and operations, are used to help protect our environment, and contribute to the communities who house them. This greenhouse gas (GHG)/ climate change analysis was prepared to support Ebonyi State International Olympic Stadium environmental review process and provide information regarding potential impacts on global climate change associated with the construction and operation of the project and the mitigation measures.

GHG emissions have the potential to adversely affect the environment because such emissions contribute, on a cumulative basis, to global climate change. Global climate change also has the potential to result in sea level rise (resulting in flooding of low-lying areas), affect rainfall and snowfall (leading to changes in water supply and runoff), affect

temperatures and habitats (affecting biological and agricultural resources), and result in many other adverse effects.

GHGs are present in the atmosphere naturally, are released by natural and anthropogenic sources, and are formed from secondary reactions taking place in the atmosphere. Natural sources of GHGs include the respiration of humans, animals, and plants, decomposition of organic matter, and evaporation from the oceans. Anthropogenic sources include the combustion of fossil fuels, waste treatment, and agricultural processes. The following are GHGs that are widely accepted as the principal contributors to human-induced global climate change:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulfur Hexafluoride (SF_6)
- Nitrogen Trifluoride (NF_3)

Emissions of CO_2 are byproducts of fossil fuel combustion. CH_4 is the main component of natural gas and is associated with agricultural practices and landfills. N_2O is a colorless GHG that results from industrial processes, vehicle emissions, and agricultural practices. HFCs are synthetic chemicals used as a substitute for chlorofluorocarbons in automobile air conditioners and refrigerants. PFCs are produced as a byproduct of various industrial processes associated with aluminum production and the manufacturing of semiconductors. SF_6 is an inorganic, odorless, colorless, nontoxic, nonflammable GHG used for insulation in electric power transmission and distribution equipment and semiconductor manufacturing. NF_3 is used in the electronics industry during the manufacturing of consumer items, including photovoltaic solar panels and liquid-crystal-display (i.e., LCD) television screens.

Global warming potential (GWP) is a concept developed to compare the ability of each GHG to trap heat in the atmosphere relative to CO_2. The GWP of a GHG is based on several factors, including the relative effectiveness of gas to absorb infrared radiation and length of time (i.e., lifetime) that the gas remains in the atmosphere ("atmospheric lifetime"). The United Nations Environment Programme reports, "Building and managing a sports facility and operating an event uses energy and can contribute to air pollution, greenhouse gas emissions and waste generation, as well as to ozone-layer depletion, habitat and biodiversity loss, soil erosion and water pollution." The impacts include damage to fragile ecosystems, noise and light pollution, energy use and emissions, soil and water pollution, and waste generation.

To reduce the effect of greenhouse gas emissions from the activities of the proposed Olympic Stadium, Ebonyi State shall implement groundbreaking green initiatives to promote sports and environmental sustainability. Many venues across the globe have joined the sustainability movement to protect the environment. The opportunities to do so are many: there are ways to reduce carbon emissions, reduce noise pollution, establish sustainable water systems that reduce water usage, and the use of solar and wind energy for electricity.

1) Water Preservation – Water usage in stadiums can be absurdly high. This is because water is needed to irrigate the fields (for those using real grass), clean the venue, and in the washroom facilities. Ebonyi State Olympic Stadium shall reduce water depletion by implementing green initiatives such as rainwater collection, water harvesting, and recycling.

2) Energy Preservation – The use of alternative energy sources decreases energy usage. The use of solar and wind to power stadiums is becoming more and more frequent. Ebonyi State Government shall adopt the use of Solar system type of renewable energy to support electricity from the national grid and generating sets for the proposed Olympic Stadium. Another energy preservation that the proposed Olympic Stadium shall adopt is the use of green roofs and walls. Green roofs are

another excellent way to reduce energy consumption, reduce the number of greenhouse gases emitted, and help reduce the heat island effect. A green roof can help lower the indoor temperature by up to 5°F, which can lead to an energy saving of 5% (Energy Star 2005). Green walls can provide the same cooling effect as green roofs and also add a layer of architectural design and uniqueness to a stadium.

3) Low Pollution – The use of green building materials results in lower waste and pollution in the environment. Ebonyi State government shall use recycled materials, such as paper and plastics during the construction of the proposed Olympic stadium.

4) Financial Benefits – Green projects are essentially cheaper to sustain and operate. Expect lower water, energy, maintenance, and insurance premium costs. The value of the project will also appreciate over time.

5) Reduced Health Risks to the Community – Building with toxin-free materials reduce the risk of potential health issues, such as asthma and cancer. Green stadiums also go through a commissioning process that reduces other safety hazards, such as a fire.

CHAPTER SEVEN

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

7.1 Background Information

Ebonyi State Government has established a comprehensive Environmental and Social Management Plan (ESMP) to achieve its corporate health, safety, and environment (HSE) policy objectives and to fulfill its regulatory compliance requirements to FMEnv, FIFA, and IAAF. This ESMP is developed to help fulfill the requirements for environmental protection as stipulated in *FIFA Stadium Safety and Security Regulations.* The ESMP provides the procedures and processes that will be used to check, monitor, and continually improve the effectiveness of the recommended mitigation and enhancement measures.

7.2 Purpose & Scope

The purpose of this ESMP is to establish the Stadium operational requirements and plan to ensure it delivers its stated business objective in an environmentally responsible manner. The ESMP includes a series of associated sub-plans relating to:

- Waste Management.
- Transport and Journey Management
- Environment Monitoring including;
  - Air Quality
  - Ground Water and Soil Monitoring
  - Greenhouse gases
  - Noise
- Emergency Response.
- Environmental Auditing.
- Risk Assessment & Disaster Management Plan

7.3 Features of the ESMP

To accomplish its objectives, the ESMP considered each environmental, social, and health impact of the project as well as the parameters for their monitoring. The

ESMP translates the recommended mitigation and monitoring measures into specific actions that will be carried out by Ebonyi State Government in collaboration with FIFA and IAAF. ESMP is an integral part of business management. To this end, the Ebonyi State Government shall put in place measures to enforce compliance throughout the project life. It outlines the actions necessary to attain this goal and describes the means, time frames, and designation of responsibility required for compliance and conformance. The ESMP:

- identifies and discusses the management and implementation of commitments to stakeholders, as identified in the report;
- discusses how to implement the mitigating/amelioration measures, as identified in the report;
- designed and implements an appropriate post-ESIA monitoring;
- identified the action parties and provide a time frame for implementation of issues identified;
- is accompanied by a fiscal plan for implementation of mitigating measures and monitoring; and
- puts in place a systematic procedure of obtaining all necessary regulatory approvals/permits for all the aspects of the project.

7.4 Roles and Responsibility

Ebonyi State Government assigns roles and responsibilities about the effective implementation of ESMP requirements as appropriate. This is supported by job descriptions, resource planning, budgeting, and appropriate delegation of authority. Ebonyi State Government's leadership and governance cycle are described in ***Figure 7.1*** below.

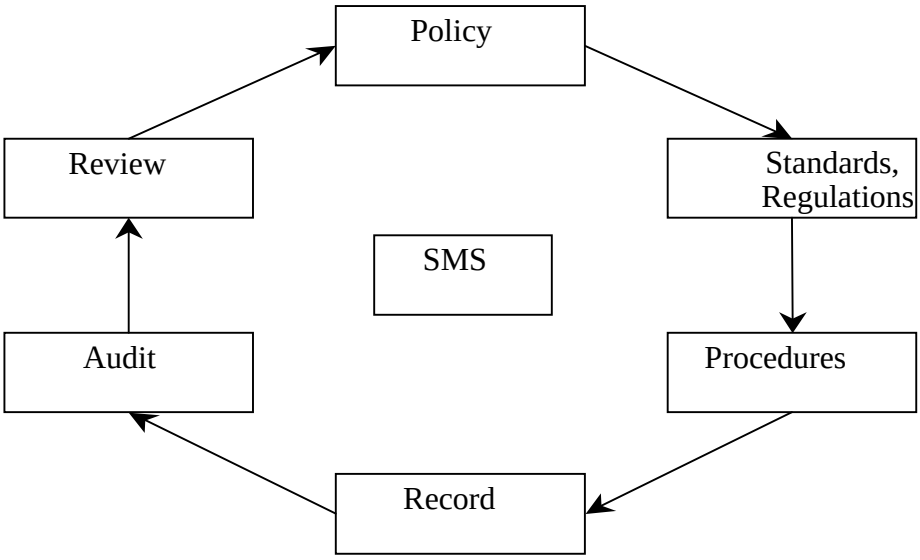


Figure 7.1: Ebonyi State Government leadership and governance circle

7.4.1 Management Commitment

The Management's commitment and responsibility are detailed in the company's Health, Safety, and Environmental (HSE) policy. The company operates in strict compliance with all the provisions of its HSE policy which specifies the need for adherence to national standards and guidelines by the company and its contractors. The HSE policy of Ebonyi State Government states that projects are planned and executed in a manner that achieves the following:

- preserves the health, safety, and security of its employees, contractors, and all members of the public who may be affected by its operations;
- minimizes the impact of its operations on the environment; and
- be sensitive to the needs and concerns of Ebonyi State Government host communities

7.4.2 HSE Organisation Structure

Ebonyi State Government has an HSE organisation structure ***(Figure 7.2)*** that describes the various departments, responsibilities, and responsible parties that will help achieve its overall environmental objective. The HSE department is primarily responsible for environmental, safety, security, and occupational health management. The ESMP is administered by the HSE department.

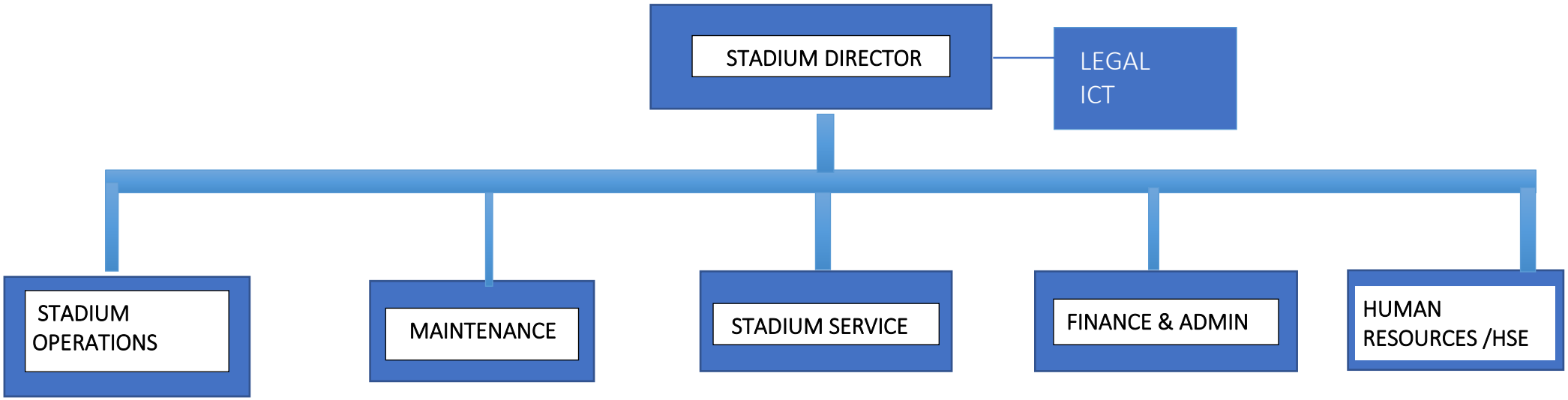


Figure 7.2: Stadium HSE Organogram

7.4.3 Contractor Management

Ebonyi State Government has engaged contractors to carry out the various project activities. The contractors are responsible for performing all work in compliance with relevant national and international HSE legislation and regulations, and in conformance with Ebonyi State Government's HSE MS requirements; and with Ebonyi State Government's technical and quality specifications. As a contractual requirement, the Contractor will 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.

7.5 Implementation

7.5.1 Employee Training

Ebonyi State Government shall establish, as and where appropriate, environmental training and awareness programs, environmental campaigns, and initiatives for its staff and contractors to support the implementation of this ESMP. In the event of any significant change, and/or updates identified by any management stream or system; the Ebonyi State Government Management of Change (MOC) process shall capture such impacts on training effectiveness and efficiency, and shall provide trainers with a description of such changes that affect training information or programmes, so that employee training may be kept up to date.

7.5.2 Environmental Awareness Programs

Ebonyi State Government shall establish and regularly provide Environmental awareness programs and campaigns that address trends, priorities, and issues relevant to the operation/ development phase. Ebonyi State Government shall also contribute to the environmental wellbeing through such campaigns (e.g. clean the earth day, save a drop of water, noise and stress, energy consumption, reuse reduce and recycle, etc.). Ebonyi State Government shall introduce studies and sufficient research material and reports on common environmental issues that include;

- Global warming

- Air, land, water pollution
- Wildlife
- New technologies, practices, and innovation at work
- Obsolete methodologies
- Security.

7.5.3 Documentation

Ebonyi State Government will control HSE documentation, including plans (e.g., the ESMP); associated procedures; and checklists, forms, and reports, through a formal company procedure. The document control procedure also describes the processes that Ebonyi State Government and the Contractor will employ for official communication of both hardcopy and electronic (through the intranet) document deliverables. Also, it describes the requirement for electronic filing and posting and assignment of a document tracking and control number (including revision codes).

The Ebonyi State Government Document Control Officer is 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 Ebonyi State Government 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 HSE documentation and describe these systems in their respective HSE Plans/ Site-Specific HSE Plans.

7.5.4 Operational Control Procedures

Each potentially significant impact identified by the ESIA shall have an operational control associated with it that specifies appropriate procedures, work instructions, best management practices, roles, responsibilities, authorities, monitoring, measurement, and record-keeping for avoiding or reducing impacts. Operational controls are monitored for compliance and effectiveness regularly through a monitoring and auditing procedure described in the ESMP.

7.6 Community Engagement Policy

Introduction

Community is made up of the people who live, work, visit, or invest in the Agbaja-Unuhu and Enyima-Agu Communities where the proposed project will be situated. Community Engagement is the process through which the community is informed about and/or invited to contribute, through consultation or involvement, to proposals or policy changes relating to Agbaja-Unuhu and Enyima-Agu Communities, events, strategic plans, issues, and projects.

Purpose

The Ebonyi State Government Engagement Plan will ensure that:

- Ebonyi State Government has the opportunity to consider the input of a wide range of communities' members before making decisions;
- Communities' members are allowed to contribute to the planning and development process.

The plan will:

- Establish a standard process for community engagement;
- Ensure that the process is implemented by Ebonyi State Government staff and some key members of the community;
- Ensure that inclusive and efficient consultation is undertaken at all times;
- Ensure that the community is kept informed of decisions emanating from community engagement.

The Plan contains three key strategies:

1. Inform
2. Consult
3. Involve

Each strategy has a specific goal, a commitment to the community, and a set of methodologies.

Scope

This Community Engagement Plan relates to many activities undertaken by the Ebonyi State Government which will have an effect on the communities except for notifications concerning statutory notifications. Where legislative requirements exist, which address specific information/consultation processes, the legislative requirements take precedence.

Benefits

There are several benefits of having a Community Engagement Plan, including:

- Commits Ebonyi State Government to be open and accountable.
- Assists Ebonyi State Government to plan services that better meet community needs.
- Enables the Ebonyi State Government to prioritize services and make better use of resources.
- Allows a broader range of views to be expressed and more information to be assembled before making decisions.
- Sees the Ebonyi State Government and the community working together to achieve balanced decisions.
- Offers opportunities for the community to contribute to and influence outcomes which directly affect their lives.
- Ensures an open and familiar process that becomes easier for community members to participate in.

Community Engagement Strategy 1: Inform

Information dissemination is the primary form of community engagement. To be able to actively engage in their communities and Ebonyi State Government's decision-making processes, the community requires information in a variety of ways to reach all sections of the community.

Goal

To provide the communities with appropriate information regarding Ebonyi State Government services, events, strategic plans, issues, and projects.

Commitment to the Communities

We will keep you informed, ensuring that information is easy to access, relevant to the issue, and easy to understand using clear, jargon-free language.

Methodology: How

By making up-to-date information available on the Ebonyi State Government's processes, meeting agendas/minutes, services, projects and on how residents may feedback any issues, concerns, and suggestions for service improvements and ensuring that all information is in a form that is accessible to all groups in the Community i.e., people with disabilities, people with computer literacy difficulties, young people, the aged and, people from diverse cultural backgrounds.

Methods can include;

- **Advertising - Newspapers** - both local and state. Other publications can be considered dependent on the target group.
- **Advertising - Radio** - both local and regional.
- **Public Meetings / Forums** - at various locations / localities, as appropriate.

When

Ongoing, as Ebonyi State Government events, strategic plans, issues, and projects are scheduled.

Who

Entire communities, noting that communities' members need to be aware of the methods that are in use.

Communities Engagement Strategy 2: Consult

The consultation takes place when feedback is required to:

- *The development of new policies, strategies, and plans;*
- *The review and evaluation of existing policies, strategies, and plans;*
- *The planning and development of new services and infrastructure;*
- *The review and evaluation of existing services and infrastructure;*
- *Issues which impact on or are of concern to the community, including:*

- *Broad community issues i.e. Communities Safety;*
- *Specific communities' issues i.e. Seniors and Youth; and*
- *Area issues i.e. traffic management and land-use changes*

Goal

To capture communities' input on strategic plans, directions, issues, priorities, and projects.

Commitment to the Communities

We will listen to you, consider your ideas and keep you informed about what input was received, an analysis of this input, and the final decision/s reached.

Methodology: How

Consultation mechanisms will be chosen that take account of the primary stakeholders and are accessible to the communities. Communities' consultation techniques will vary depending on who is being consulted and the nature and complexity of the issue. Available resources will also determine the type of techniques that can be utilised i.e. the timeframe, funds, and staff available.

A range of consultation techniques will be utilised to ensure greater participation levels. These will include;

- **Consultative Workshops:** open to the community with the aim of briefing interested residents on specific projects and getting their feedback.
- **Focus Groups:** open by invitation to specific groups with relevant experience of the issue at hand.
- **Surveys/Questionnaires:** a series of relevant questions regarding a subject, with the collated replies available for consideration and distribution. These may be conducted via mail, email/web, or in person, for example, venues could include but are not limited to homes/schools/businesses / community meetings to ensure the inclusion of community members who may not normally be able to participate in community engagement.

When

Ebonyi State Government will ensure that the communities are consulted on issues which impact on or are of concern to the communities promptly to allow adequate community comment to occur and be analysed to inform decision making processes.

Who

All communities' members who are identified as being directly impacted will be consulted, with the whole community being informed. Stakeholders shall vary according to the issue, but could include residents, ratepayers, businesses, volunteers, those who visit or work in the municipality, other service providers/agencies, community groups, other levels of government, peak bodies, etc. It could also include particular groups within the community, i.e., older people, families, children, youth, different ethnic groups, business people, people with a disability, etc.

7.7 Checking and Corrective Action

The objective of the inspection and monitoring activities described in this section is to verify compliance with the ESMP. The inspection and monitoring approach will also be reflected in the Contractor's HSE procedures. Contractors will be responsible for implementing the Ebonyi State Government's environmental and social commitments in the field daily. Auditing of the monitoring and inspection activities by the Contractor and by Ebonyi State Government provides the mechanism by which Ebonyi State Government ensures that it remains compliant with regulatory commitments as well as its HSE standards and policies.

The *inspection* activities described in this ESMP refer to qualitative monitoring, e.g., visual inspections. The *monitoring* activities described in this ESMP refer to empirical monitoring (e.g., measurements).

7.7.1 Inspection

Inspections shall be conducted by Staff, Contractor's HSE department daily. The results of the inspection and monitoring activities shall be made available to Ebonyi

State Government every week or more frequently if requested by the Ebonyi State Government Head HSE.

7.7.2 Monitoring

Monitoring shall 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. Concerning the significant impacts identified in the ESIA, Ebonyi State Government has developed a program to monitor the effectiveness of the mitigation measures. The program describes what effect is to be measured and the frequency.

In conjunction with monitoring of the effectiveness of specific mitigation measures, the Ebonyi State Government has developed a program to monitor for compliance with relevant regulatory standards. This program also ensures that staff is meeting contractual obligations concerning work practices and design specifications. Monitoring is carried out by Ebonyi State Government HSE department and/or by Supervisors and Contractors according to their contractual obligations. The parameters to be measured during the Stadium activities along with the frequency of monitoring are provided in **Tables 7.1 – 7.5** below.

Table 7.1: Environmental and Social Management Plan (ESMP) of the International Olympic Stadium – Pre-Construction Phase

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
Land Take for the Stadium	Loss of land, Change in land use and Legal issue	H	Ebonyi State Government shall ensure: ✓ continuous consultation and engagement with host communities and other stakeholders shall be maintained to forestall unrest in line with the company's grievance mechanism. ✓ that proper land acquisition procedure is followed and payment of all land dues to government and any concerned stakeholder	**L**	Stakeholder engagement document	Ebonyi State Government	During Pre-Construction
Mobilization (transport) to the site (equipment, personnel, and construction modules)	Road traffic accidents	H	To prevent road accident, Ebonyi State Government shall ensure: • compliance with journey management policy • Vehicles are pre-mobbed and pre-mobilization/compliance certificate issued. • the use of PPEs at sites; daily pep talk, carry out job hazard	M	Site inspection/ stakeholder engagement report Inventory of approved journey management	Ebonyi State Government	During Pre-Construction

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
			analysis • ensure that all traffic rules are obeyed by the drivers • Speed breakers at sections traversing communities		forms		
	Noise nuisance	M	Ebonyi State Government shall ensure: • regular maintenance of vehicles • Vehicles are turned off when not in use • Vehicles are fitted with effective silencers.	L	Site inspection report Compliance monitoring report	Ebonyi State Government	During Pre-Construction
	Impairment of air quality	M	Ebonyi State Government shall ensure: • Engine to comply with international standards for exhaust gases; Maintenance of engines and exhaust gas check; Adoption of engine-off policy at the construction site • that nose masks and earmuffs are worn by site workers during excavation • that water shall be sprayed on	L	Site inspection report Compliance monitoring report	Ebonyi State Government	During Pre-Construction

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
			construction sites to reduce dust levels, especially during the dry season.				
	Loss of biodiversity	H	• Strictly regulating heavy equipment traffic • Restricting the number of traffic lanes and limiting the movement of the machinery to the worksite and to the marked access way • Implement good housekeeping practice on-site. • Storing and handling of the hazardous waste following approved WMP • Selecting vehicles suited for erodible soil. • Limiting activities in erodible soil	L	Site inspection report Compliance monitoring report	Ebonyi State Government	During Pre-Construction
Energy consumption (provision of energy for pre-construction	Impairment of air quality	M	Ebonyi State Government shall ensure that: • there is regular maintenance of the generators;	L	Site inspection report Compliance monitoring report	Ebonyi State Government	During Pre-Construction

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
activities))			• generators are switched off when not in use • dust control and dust recovery machinery are used				
	Noise and vibration nuisance	M	Ebonyi State Government shall ensure that: • electric power generators are fitted with effective silencers; • there shall be regular maintenance of the generators; • the noise barrier is erected • generators are switched off when not in use; • soundproof electric power generators are engaged	L	Site inspection report Compliance monitoring report	Ebonyi State Government	During Pre-Construction
	Contamination of soil	M	Ebonyi State Government shall ensure: • Soil disturbance shall be kept to the minimum required for operation and safety • Oil spill containment shall be provided to reduce oil spill from	L	Site inspection report Compliance monitoring report	Ebonyi State Government	During Pre-Construction

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
			getting to the soil. • Implement good housekeeping practice on-site. • Storing and handling hazardous waste following approved WMP.				
Site Preparation – land clearing, removal of vegetation, Land excavation for foundations, and Surfacing of feeder roads	Acceleration of erosion	M	• Ebonyi State Government shall stabilize soil within the well location and campsite mechanically using compactors to reduce erosion potential • Mechanically stabilizing the soil to reduce the potential for erosion. • Avoiding excavation and burial in the steeply sloped ground and avoiding the creation of great breaks. • Providing for the placement of siltation ponds in areas subject to heavy erosion	L	Site inspection report Compliance monitoring report	Ebonyi State Government	During Pre-Construction

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
			• Selecting vehicles suited for erodible soil • Limiting activities in erodible soil				
	Alteration of local topography	M	• Re-grading the sites, then replacing the layer of topsoil that was previously put. • Restoring the operational site by restoring the original profile of the topography and the soil • Strictly regulating heavy equipment traffic • Restricting the number of traffic lanes and limiting the movement of the machinery to the worksite and to the marked access way	L	Site inspection report	Ebonyi State Government	During Pre-Construction
	Blockage of drainage pattern	M	Ebonyi State Government shall ensure that: • Strict environmental policy shall be ensured • Regular cleaning of the	L	Site inspection report	Ebonyi State Government	During Pre-Construction

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
			drainage shall be ensured • The drainage network shall be covered				
	Contamination of soil	M	Ebonyi State Government shall: • Ensure that soil disturbance shall be kept to the minimum required for operation and safety. • Ensure that oil spill containment is provided to reduce oil spill from getting to the soil. • Implement good housekeeping practice on-site. • Store and handle hazardous waste following approved WMP. • Place filtration berms and sediment barriers. • Use methods that minimises perturbation to the aquatic environment.	L	Compliance monitoring report	Ebonyi State Government	During Pre-Construction

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
			• Avoid spills prohibiting refuelling near a waterway.				
	Impairment of air quality	M	Ebonyi State Government shall ensure that: • only pre-mobbed equipment is used; • all equipment is controlled; • equipment engines are turned off when not in use • all construction equipment shall be in proper operating condition and fitted with factory standard silencing features if appropriate. • it provides and enforces the use of PPE (e.g. nose masks and ear muffs) • it constructs soundproofing walls around stationary power generating sources. • Use of the cleanest fuel economically available shall be	L	Compliance monitoring report	Ebonyi State Government	During Pre-Construction

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
			adopted • Combustion technology and pollution control technology, which are all interrelated, shall be evaluated very carefully upstream of the project to optimize the project's environmental performance; • Use of loading and unloading equipment that minimizes the height of fuel drop to the stockpile to reduce the generation of fugitive dust and installing of cyclone dust collectors; • Use of water spray systems to reduce the formation of fugitive dust from solid fuel storage in arid environments; • Use of enclosed conveyors with well designed, extraction and filtration equipment on				

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
			conveyor transfer points to prevent the emission of dust;				
	Noise and vibration nuisance	H	Ebonyi State Government shall ensure that: • equipment is fitted with effective silencers; • there shall be regular maintenance of equipment; • equipment is switched off when not in use; • Vibration containment be made for equipment which is likely to cause vibration • noise barriers are erected	L	Site inspection report Compliance monitoring report	Ebonyi State Government	During Pre-Construction
	Worksite accidents	H	Ebonyi State Government shall ensure that: • workers and visitors are properly kitted (use of appropriate PPEs) • use of warning signs • non-consumption of alcoholic beverages on work site	M			

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
			• Clinic / first aid kit shall always be available within the site				
	Habitat Alteration	H	Ebonyi State Government shall: • Use methods that minimizes perturbation to the aquatic environment. • Avoid spills prohibiting refuelling near a waterway. • Minimise destruction or modification of the vegetation cover by restoring vegetation at the end of the work	L	Site inspection report	Ebonyi State Government	During Pre-Construction

Table 7.2: Environmental and Social Management Plan (ESMP) of the International Olympic Stadium – Construction Phase

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
Transport activities during construction	Road traffic accidents	H	To prevent road accident, Ebonyi State Government shall ensure: • compliance with journey management policy • Vehicles are pre-mobbed and pre-mobilization/compliance certificate issued. • the use of PPEs at sites; daily pep talk, carry out job hazard analysis • ensure that all traffic rules are obeyed by the drivers • Speed breakers at sections traversing communities • Conformance with road traffic laws in line with the Federal Road Safety Commission (FRSC) safety requirements. • All safety incidents shall be reported and investigated. Corrective actions will also be	L	Site inspection/ stakeholder engagement report Inventory of approved journey management forms	Ebonyi State Government/ Ebonyi State Ministry of Environment/FMEnv	During Construction

			implemented				
	Noise nuisance	M	Ebonyi State Government shall ensure: • regular maintenance of vehicles • Vehicles are turned off when not in use • Vehicles are fitted with effective silencers.	L	Site inspection report Compliance monitoring report	Ebonyi State Government/Ebonyi State Ministry of Environment/FMEnv	During Construction
	Impairment of air quality – emission from trucks	M	Ebonyi State Government shall ensure: • Engine to comply with international standards for exhaust gases; • Maintenance of engines and exhaust gas check; Adoption of the engine-off policy at the construction site. • that nose masks and earmuffs are worn by site workers during excavation. • Use of the cleanest fuel economically available shall be adopted. • Combustion technology and pollution control technology, which are all interrelated, shall be evaluated very carefully upstream of the project to optimize the	L	Site inspection report Compliance monitoring report	Ebonyi State Government/Ebonyi State Ministry of Environment/FMEnv/	During Construction

			project's environmental performance; • Use of loading and unloading equipment that minimizes the height of fuel drop to the stockpile to reduce the generation of fugitive dust and installing of cyclone dust collectors. • Use of water spray systems to reduce the formation of fugitive dust from solid fuel storage in arid environments. • Use of enclosed conveyors with well designed, extraction and filtration equipment on conveyor transfer points to prevent the emission of dust.				
Construction and Casting of the plinths for stadiu	Loss of vegetal cover with possible impact on biodiversity loss	H	Ebonyi State Government shall: ▪ Provide siltation pond in areas of heavy erosion. ▪ Place filtration berms and sediment barriers. ▪ Use methods that minimizes perturbation to the aquatic environment. ▪ Avoid spills prohibiting refuelling	L	Site inspection report Compliance monitoring report	Ebonyi State Government	During Pre-Construction and Construction

m Main Bowl/administrative office/car park			near a waterway. ▪ Minimise destruction or modification of the vegetation cover by restoring vegetation at the end of the work.				
	Impairment of air quality	H	Ebonyi State Government shall ensure: • there is regular maintenance of the engines; • engines are switched off when not in use • engines to comply with international standards for exhaust gases; • Maintenance of engines and exhaust gas check; • that nose masks and earmuffs are worn by site workers during excavation • Use of the cleanest fuel economically available shall be adopted • Combustion technology and pollution control technology, which are all interrelated, shall be evaluated very carefully upstream of the project to optimize the project's environmental performance;	L	Site inspection report Compliance monitoring report	Ebonyi State Government/Ebonyi State Ministry of Environment/FMEnv	During Construction
	Noise and vibration	H	Ebonyi State Government shall ensure that: • Machine engines are fitted with effective	L	Compliance	Ebonyi State Government/Ebonyi	During Constructio

	nuisance		silencers; • regular maintenance of machine/ engines are performed; • engines are switched off when not in use; • soundproof electric power generators are engaged • the use of PPEs is encouraged • vibration containment shall be made for generators and machines		monitoring report	State Ministry of Environment/FMEnv	n
	Contamination in the event of oil spills from equipment and machinery	H	• Oil spill containment shall be provided to reduce oil spill from getting to the soil and surface • there shall be regular maintenance of the equipment and machinery.	L	Site inspection report Compliance monitoring report	Ebonyi State Government/Ebonyi State Ministry of Environment/FMEnv	During Construction
	The kidnapping of workers and visitors on site	H	• Ebonyi State Government shall ensure that both contractor and Ebonyi State Government personnel develop a high level of security consciousness both within and outside the work area • Daily security reports shall be reviewed by the Ebonyi State	M	Security report	Ebonyi State Government/Ebonyi State Ministry of Environment/Nigeria Police Force Police/NSDC	

			Government Project Manager • A special security force shall be established and deployed for the project. This shall include deploying some of Ebonyi State Government police to strengthen security in the area • Ebonyi State Government shall ensure that a liaison to foster a partnership with the community to guarantee security for the project is established and sustained. • To beef up security for the project, Ebonyi State Government shall assist with equipment e.g. patrol vehicles, to ensure improved security. • Ebonyi State Government shall ensure that safety workshops to identify, evaluate and recommend contingency plans for all security risks are regularly organized • Ebonyi State Government shall ensure that there is a police station/post within and around the facility.				

	Waste generation from excavated materials	H	Ebonyi State Government shall ensure that: • all other wastes generated including environmentally deleterious materials generated by construction activities shall be disposed of offsite in an appropriate, legal, and safe manner. • generation of all wastes are minimized as much as practically possible. • Unsuitable excavated materials shall be systematically carried away from areas prone to erosion. • Reuse waste materials wherever possible and use designated disposal sites; • Used oil and lubricants shall be recovered and reused or removed from the site in full compliance with the national and local regulations; • Oil wastes, debris, and/or other waste materials must not be burned; • Optimize the reuse of soil and construction waste; • All the construction camps and facilities shall be dismantled and removed from the site unless otherwise desired by the local public;	L	Site inspection report Waste Management report Waste tracking records	Ebonyi State Government/Ebonyi State Ministry of Environment/FMEnv	During Construction

			• the site shall be restored to a condition in no way inferior to the condition before the commencement of work. • safety measures while disposing of wastes are followed; • introduction of foreign soil and synthetic materials is avoided; • disposal of construction and related waste materials at designated and approved waste dump site; • waste management plan in road planning and contract specifications is incorporated; • there is a collaboration with relevant waste management agencies to enforce appropriate sanitation and other bye-laws.				
Site fabrication (welding)	Burns/injuries from welding sparks	H	• Ebonyi State Government shall ensure that workers and visitors are properly kitted • Use of experienced/competent workers • Pipe joining techniques such as welding shall meet international standards	L	Site inspection report Compliance monitoring report	Ebonyi State Government	During Construction
	Exposure to	H	• Ebonyi State Government shall	L	Site inspection	Ebonyi State	During

	welding flash		ensure that workers and visitors are properly kitted (appropriate PPEs are used)		report Daily Progress report	Government	Construction
	Waste generation from construction activities such as metal cuttings	M	Ebonyi State Government shall ensure that: • all other wastes generated including environmentally deleterious materials generated by construction activities shall be disposed of offsite in an appropriate, legal, and safe manner. • generation of all wastes are minimized as much as practically possible. • Unsuitable excavated materials shall be systematically carried away from areas prone to erosion; • Reuse waste materials wherever possible and use designated disposal sites; • Used oil and lubricants shall be recovered and reused or removed from the site in full compliance with the national and local regulations; • Oil wastes, debris, and/or other waste materials must not be burned; • Optimize the reuse of soil and	L	Site inspection report Waste Management report Waste tracking records	Ebonyi State Government/Ebonyi State Ministry of Environment/FMEnv	During Construction

			construction waste; • All the construction camps and facilities shall be dismantled and removed from the site unless otherwise desired by the local public; • the site shall be restored to a condition in no way inferior to the condition before the commencement of work. • safety measures while disposing of wastes are followed; • introduction of foreign soil and synthetic materials is avoided; • disposal of construction and related waste materials at designated and approved waste dump site; • waste management plan in road planning and contract specifications is incorporated; • there is a collaboration with relevant waste management agencies to enforce appropriate sanitation and other bye-laws.				
Construction of 30,00	Waste Management - The potential effects will be	H	Ebonyi State Government shall ensure that: • all other wastes generated including environmentally deleterious materials generated by construction activities will	L	Waste Management report Waste tracking	Ebonyi State Government/Ebonyi State Ministry of Environment/FMEn	During Construction

0 seating capacity main Bowl (Track and field events)/ **construction of Office complex, Courts, Car park, etc.**	of aesthetics as well as a nuisance of wastes such as metal cuttings, paper carton, drums, paper, wood, etc		be disposed of offsite in an appropriate, legal, and safe manner. • generation of all wastes are minimized as much as practically possible. • Unsuitable excavated materials shall be systematically carried away from areas prone to erosion; • Reuse waste materials wherever possible and use designated disposal sites; • Used oil and lubricants shall be recovered and reused or removed from the site in full compliance with the national and local regulations; • Oil wastes, debris, and/or other waste materials must not be burned; • Optimize the reuse of soil and construction waste; • All the construction camps and facilities shall be dismantled and removed from the site unless otherwise desired by the local public; • the site shall be restored to a condition in no way inferior to the condition before the commencement of work. • safety measures while disposing of		records Compliance monitoring report	v	

			wastes are followed; • introduction of foreign soil and synthetic materials is avoided; • disposal of construction and related waste materials at designated and approved waste dump site; • waste management plan in road planning and contract specifications is incorporated; • there is a collaboration with relevant waste management agencies to enforce appropriate sanitation and other bye-laws.				
	Impairment of air quality	H	Ebonyi State Government shall ensure: • there is regular maintenance of the engines; • engines are switched off when not in use • engines to comply with international standards for exhaust gases; • Maintenance of engines and exhaust gas check; • that nose masks and earmuffs are worn by site workers during excavation • Use of the cleanest fuel economically available shall be adopted	L	report Compliance monitoring report	Ebonyi State Government/Ebonyi State Ministry of Environment/FMEnv	During Construction

			✓ Combustion technology and pollution control technology, which are all interrelated, shall be evaluated very carefully upstream of the project to optimize the project's environmental performance;				
	Noise and vibration nuisance	H	Ebonyi State Government shall ensure: ✓ Regular maintenance of mobile and immobile equipment to ensure improved machine efficiency and complete combustion of fuel. ✓ Monitoring of the air quality during the construction phase at least 3 times. ✓ Ensure workers use hearing protectors	L	Site inspection report Compliance monitoring report	Ebonyi State Government/Ebonyi State Ministry of Environment/FMEnv	During Construction
	Worksite accidents	H	Ebonyi State Government shall ensure that: ✓ workers and visitors are properly kitted (use of appropriate PPEs) ✓ use of warning signs ✓ non-consumption of alcoholic beverages on work site ✓ Clinic / first aid kit shall always be available within the site	L	Daily/weekly security report	Ebonyi State Government/Ebonyi State Ministry of Environment/FMEnv	During Construction

Backfilling	Surface water may be polluted due to increased erosion, runoff from a construction site, and contamination in the event of oil spills from equipment and machinery	H	Ebonyi State Government shall ensure that: • Soil disturbance shall be kept to the minimum required for operation and safety to reduce erosion • Oil spill containment shall be provided to reduce oil spill from getting to the soil and surface • there shall be regular maintenance of the equipment and machinery • Mechanically stabilising the soil to reduce the potential for erosion • Avoiding excavation and burial in the steeply sloped ground and avoiding the creation of great breaks • Providing for the placement of siltation ponds in areas subject to heavy erosion • Selecting vehicles suited for erodible soil • Limiting activities in erodible soil • After the work, levelling the disturbed soil and quickly seeding or replanting bushes to control soil erosion.	M	Site inspection report	Ebonyi State Government	During Construction

	Waste Management - The potential effects shall be of aesthetics as well as a nuisance. Wastes shall mainly come from discarded packaging materials such as metal cuttings and empty plastic containers. Poor disposal methods can lead to environmental problems due to their non-biodegradable nature. Most of the packaging wastes are	H	Ebonyi State Government shall ensure that: • toilets are created at the site. • the site remains clean, well maintained, and free of hazards, with the thoughtful location of litter bins • Proper disposal of solid waste from construction activities and labour camps; • storage of lubricants, fuels, and other hydrocarbons in self-contained enclosures; • sanitation arrangements at worksites/facilities to avoid the release of wastewater and sewage to the environment • Minimum wastes are generated • Reuse waste materials wherever possible and use designated disposal sites; • Used oil and lubricants shall be recovered and reused or removed from the site in full compliance with the national and local regulations; • Oil wastes, debris, and/or other waste materials shall not be burned; • safety measures are followed while	L	Waste Management report Waste tracking records Site inspection report	Ebonyi State Government	During Construction

	expected to be reused		disposing of wastes;				
	Alteration of hydrological patterns resulting in temporary or permanent flooding, soil erosion, and destruction of biodiversity	H	• Mechanically stabilising the soil to reduce the potential for erosion. • Avoiding excavation and burial in the steeply sloped ground and avoiding the creation of great breaks. • Providing for the placement of siltation ponds in areas subject to heavy erosion. • Selecting vehicles suited for erodible soil. • Limiting activities in erodible soil • After the work, levelling the disturbed soil and quickly seeding or replanting bushes to control soil erosion.	L	Site inspection report Compliance monitoring report	Ebonyi State Government/Ebonyi State Ministry of Environment/FMEnv	During Construction
	Habitat alteration	M	Ebonyi State Government shall: • Implement good housekeeping practice on-site. • Store and handle hazardous waste following approved WMP. • Ebonyi State Government shall ensure the use of appropriate PPEs	L	Site inspection report Compliance monitoring report	Ebonyi State Government/Ebonyi State Ministry of Environment/FMEnv	During Construction

			• Ebonyi State Government shall ensure that backfilling is followed by mechanical compaction to retain the original level. • Ebonyi State Government shall re-vegetate the soils with indigenous grasses, sedges, etc. to check the incidence of flooding.				
	Worksite accidents	H	Ebonyi State Government shall ensure that: • workers and visitors are properly kitted (use of appropriate PPEs) • use of warning signs • non-consumption of alcoholic beverages on work site • Clinic / first aid kit shall always be available within the site	L	Site inspection report Compliance monitoring report	Ebonyi State Government/Ebonyi State Ministry of Environment/FMEnv	During Construction
	Increase in communicable disease (including STDs and HIV/AIDS)	M	• Health awareness lectures shall be given to workers on the mode of transmission of STIs (including HIV/AIDS) • As much as possible provide psychological support to persons living with HIV • Ebonyi State Government shall ensure immunization of workforce against as appropriate	L	Site inspection report	Ebonyi State Government/Ebonyi State Ministry of Environment/FMEnv	During Construction

			• Regular spraying of work sites Provision of insecticide-treated nets to field workers to reduce the incidence of malaria • Awareness campaign shall be carried out to enlighten the communities /field workers on the common communicable diseases and the health implications of drug and alcohol abuse, unprotected sex, prostitution, and the need to sustain cultural values • Ebonyi State Government shall assist the activities of the state action committee on STIs/HIV/AIDS as part of her stakeholders' engagement plan. • Ebonyi State Government shall ensure site clinic is provided to take care of minor illnesses for all construction workers				
Water utilization for concrete -weight	Temporary change in land use but the land shall be returned to its	M	• Ensure prompt landscaping/reclamation of degraded lands. • Rehabilitate Excavation sites by filling.	L	Site inspection report	Ebonyi State Government/Ebonyi State Ministry of Environment/FMEnv	During Construction

	original use after completion of works and subsequent sand filling		• Ugly scars left around sites shall be leveled and landscaped. • Plant shrubs/grasses to be planted to check erosion. • Develop embankment on steep slopes to protect them from erosion. • Stone pitch to protect slopes where necessary • New structures such as signboards, billboards for the project shall be removed after construction. Those required such as direction or warning signs shall be properly placed.				
Coating	Contamination of surface water and soil by paints and coating as a result of spillage	H	• Using of engineering controls (containment, automatic alarms, and shut-off systems) commensurate with the nature of hazard; • Implementing management controls (procedures, inspections, communications, training, and drills) to address residual risks that have not been prevented or controlled through engineering	L	Site inspection report Compliance monitoring report	Ebonyi State Government/Ebonyi State Ministry of Environment/FMEnv	During Construction

			measures. • Safe ventilation for storage of volatile materials shall be provided; • Access to areas containing paint substances shall be restricted and controlled; • Paints shall be stored on impervious ground undercover; the area shall be constructed as a spill tray to avoid the spread of accidental spills				
	Hazardous waste generation from coating operations such as metals	H	• Good housekeeping shall be instituted and maintained • hazardous wastes shall be collected, stored, and disposed of appropriately in line with FMEnv standard at an approved disposal site.	L	Waste Management report Waste tracking records Compliance monitoring report	Ebonyi State Government/Ebonyi State Ministry of Environment/FMEnv	During Construction
Installation of Transformers, Floodlig	<u>Electrocution</u>: Tall equipment could have contact with high tension	H	Ebonyi State Government shall ensure: ✓ Use of signs, barriers (e.g. locks on doors, use of gates, use of steel posts surrounding towers to prevent public and workers contact with potentially	L	Inventory of approved journey	Ebonyi State Government	Construction

hts, scoreboard and electric pole	cables causing electrocution hazard. Construction workers can also be exposed during lightings installation.		dangerous equipment; ✓ it provides and enforces the use of PPE; ✓ Conduit type of wiring shall be adopted instead of the surface to prevent shock. ✓ Only allowing trained and certified workers to install, maintain, or repair electrical equipment; ✓ Deactivating and properly grounding live power distribution lines before work is performed on, or close to, the lines; ✓ Ensuring that live-wire work is conducted by trained workers with strict adherence to specific safety and insulation standards. Qualified or trained employees working on transmission or distribution systems should be able to achieve the following: ✓ Distinguish live parts from other parts of the electrical system ✓ Determine the voltage of live parts ✓ Understand the minimum approach distances outlined for specific live line voltages ✓ Ensure proper use of special safety equipment and procedures when		management forms		

			working near, or on, exposed energized parts of an electrical system; ✓ Workers should not approach an exposed, energized, or conductive part even if properly trained unless: ✓ The worker is properly insulated from the energized part with gloves or other approved insulation; or ✓ The energized part is properly insulated from the worker and any other conductive object; ✓ All electrical installations shall be performed by certified personnel and supervised by an accredited person. ✓ Strict procedures for de-energizing and checking of electrical equipment should be in place before any maintenance work is conducted. If de-energizing is not possible, electrical installations should be moved or insulated to minimize the hazardous effects; ✓ Before excavation works, all existing underground cable installations should be identified and marked. Drawings and plans should indicate such				

			installations; ✓ discharge. In cases where maintenance work has to be performed on energized equipment, a strict safety ✓ procedure should be in place and work should be performed under constant supervision; ✓ Personnel training should be provided in revival techniques for victims of electric shock.				
	Tripping/falling from heights as a result of Climbing and working on electric poles	H	Ebonyi State Government shall ensure 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 before 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	L	Site inspection/ stakeholder engagement report Inventory of approved journey management forms	Ebonyi State Government/ Ebonyi State Ministry of Environment/FMEnv	During Construction

			• 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 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. • When operating power tools at height, require that workers use a second (backup) safety strap;				

			• An approved tool bag should be used for raising or lowering tools or materials to workers on structures.				
Site demobilization	Road traffic accidents	M	Ebonyi State Government shall ensure: • enforcement of the use of PPEs • daily pep talk is carried out • job hazard analysis is carried out • compliance with journey management policy	L	Site inspection report Compliance monitoring report	Ebonyi State Government/Ebonyi State Ministry of Environment/FMEnv	During Construction

Table 7.3: Environmental and Social Management Plan (ESMP) of the International Olympic Stadium – Operation/Maintenance

Project Activity	**Description of Impacts**	**Rating before Mitigation**	**Mitigation/Control Measures**	**Rating after Mitigation**	**Parameters for Monitoring**	**Action Party**	**Monitoring Frequency**
Operation of Stadium during sporting activities	Noise: Noise pollution will be produced by Generator set and spectators within the stadium during sporting activities	H	Mitigation measures to reduce the noise footprint of the project include: ✓ there is regular maintenance of generators; ✓ engines are switched off when not in use	M	Site inspection report Compliance monitoring report	Ebonyi State Ministry of Environment/FIFA/IAAF	During Operation

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
			✓ Noise monitoring systems that monitor the noise level of the stadium. ✓ Soundproof walls shall be installed at the spectators stand. ✓ The use of Renewable Energy such as wind and solar systems.				
	Air pollution from generating set during sporting activities	H	Ebonyi State Government shall ensure: • there is regular maintenance of generators; • engines are switched off when not in use • engines to comply with international standards for exhaust gases;	L	Site inspection report Compliance monitoring report	Ebonyi State Ministry of Environment/FIFA/IAAF	During Operation

Project Activity	**Description of Impacts**	**Rating before Mitigation**	**Mitigation/Control Measures**	**Rating after Mitigation**	**Parameters for Monitoring**	**Action Party**	**Monitoring Frequency**
			• Maintenance of engines and exhaust gas check; • Use of the cleanest fuel economically available shall be adopted • The use of a hybrid system shall also be considered				
	The kidnapping of spectators /sporting figure/personnel	H	• Ebonyi State Government shall ensure that spectators, sporting figure, and personnel develop a high level of security consciousness both within and outside the stadium • Daily security reports shall be reviewed by the stadium authority • Special security forces shall be established and deployed during	M	Site inspection report Compliance monitoring report	Ebonyi State Ministry of Environment/Nigerian Police Force/NSDC	During Operation

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
			sporting activities. This shall include deploying some of Ebonyi State Government police, Nigeria Civil Defence Corps (NCDC) to strengthen security in the area • To beef up security for the project, Ebonyi State Government shall assist with equipment e.g. patrol vehicles, to ensure improved security • Ebonyi State Government shall ensure that there is a police station/post within and around the facility				
	Road traffic accident during	H	To prevent road accident, Ebonyi State Government	M	Site inspection	Ebonyi State Ministry of Environment/FIFA/IAAF	During Operation

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
	sporting activities		shall ensure: • compliance with journey management policy • ensure that all traffic rules are obeyed by the drivers • Speed breakers at sections traversing communities • All vehicles will be parked in the designated parking area only; • Road crossings will be well marked and signalled. • Informatory and warning signages will be retro-reflective type provided, clearly visible in the night. • Marshals shall be		report Compliance monitoring report		

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
			deployed to guide the vehicles and stop vehicles to avoid the traffic jam at the arrival and departure of the Ebonyi International Olympic Stadium.				
	The collapse of seating stand during sporting activities	H	Ebonyi State Government shall ensure: • Test structures for integrity before undertaking work. • The number of spectators is not more than the available seats. • Safety personnel and Protective equipment are readily available during all sporting activities. • Direct spectators to	L	Site inspection report Compliance monitoring report	Ebonyi State Ministry of Environment/FIFA/IAAF	During Operation

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
			their appropriate sitting stand during sporting activities. • Entrance and exits shall be properly labelled for easy access. • Unsafe act shall be guided against during and after sporting activities. • The unsafe condition within the stadium which could pose danger to the spectators shall be handled as soon as discovered				
	Generation of Waste during operation of the stadium (Sporting	H	• Good housekeeping shall be instituted and maintained.. • hazardous wastes shall be collected,	L	Waste Management report Waste tracking	Ebonyi State Ministry of Environment/FIFA/IAAF	During Operation

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
	activities)		stored, and disposed of appropriately in line with FMEnv standard at an approved disposal site. • Properly labelled waste bins shall be located at appropriate areas within the stadium premises • Waste shall be disposed of through approved waste managers regularly. • Cleaning of the stadium Main Bowl and other courts should be carried out immediately after all the sporting activities are over for that day before another one the following day		records Compliance monitoring report		

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
			(especially during weekends or when sporting activities will take weeks)				
	Light: Artificial light from Runway and aircraft can attract animals either directly or indirectly. Light pollution can also affect animals' rhythms of waking, sleeping, and hibernation. This impact will occur every night until the end of life of the Runway.	H	Mitigation measures to be implemented by Ebonyi State Government include: Light Spectrum: Although all light has some effects on wildlife and habitats, certain spectra are more damaging. Full-spectrum light, which has blue and ultraviolet wavelengths, shall not be used. Ultraviolet light is highly attractive to insects and birds, it shall be avoided as well.	L	Site inspection report Compliance monitoring report	Ebonyi State Ministry of Environment/FIFA/IAAF	During Operation

Project Activity	**Description of Impacts**	**Rating before Mitigation**	**Mitigation/Control Measures**	**Rating after Mitigation**	**Parameters for Monitoring**	**Action Party**	**Monitoring Frequency**
	Road traffic accidents as a result of transportation activities during facility operation	H	To prevent road accident, Ebonyi State Government shall ensure: • compliance with journey management policy • Vehicles are pre-mobbed and pre-mobilization/compliance certificate issued. • the use of PPEs at sites; daily pep talk, carry out job hazard analysis • ensure that all traffic rules are obeyed by the drivers • Speed breakers at sections traversing communities • All vehicles shall be parked in a designated parking area only;	L	Site inspection report Compliance monitoring report	Ebonyi State Ministry of Environment/FIFA/IAAF	During Operation

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
			• Road crossings shall be well marked and signalled. • Signages with information and warnings shall be retro-reflective type provided, clearly visible in the night. • Marshals shall be deployed to guide the vehicles and stop vehicles to avoid traffic jams at the arrival and departure of the Ebonyi International Olympic Stadium.				
Maintenance of Stadium	Generation of Waste during maintenance of the stadium	M	• Good housekeeping shall be instituted and maintained • hazardous wastes shall be collected,	L	Waste Management report Waste tracking records	Ebonyi State Ministry of Environment/FIFA/IAAF	During Operation

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
			stored, and disposed of appropriately in line with FMEnv standard at an approved disposal site • Properly labelled waste bins shall be located at appropriate areas within the stadium premises • Waste shall be disposed of through approved waste managers regularly Cleaning of the stadium Main Bowl and other courts		Compliance monitoring report		

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
			should be carried out immediately after all the sporting activities are over for that day before another one the following day (especially during weekends or when sporting activities will take weeks) ✓ Waste generated during Generators maintenance should be disposed of immediately accordingly				
	Soil/ groundwater contamination	M	✓ Provision of secondary containment for	L	Site inspection report	Ebonyi State Ministry of Environment/FIFA/IAAF	During Operation

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
	due to fuel/ oil spill		storage tanks		Compliance monitoring report		
	Impairment of air quality – emission from Generator	M	Ebonyi State Government shall ensure: • there is regular maintenance of generators; • engines are switched off when not in use • engines to comply with international standards for exhaust gases; • Maintenance of engines and exhaust gas check; Use of the cleanest fuel	L	Site inspection report Compliance monitoring report	Ebonyi State Ministry of Environment/FIFA/IAAF	During Operation

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
			economically available shall be adopted				
	The security threat to stadium properties and the threat from major accidents related to the fires and explosions at the facility and potential accidental releases of diesel when refilling the storage tank	H	• Ebonyi State Government shall ensure that there is a police station/post within and around the facility to protect stadium properties • Limiting the areas that may be potentially affected by accidental releases by: o Defining fire zones and equipping them with a drainage system to collect and convey	L	Site inspection report Compliance monitoring report	Ebonyi State Ministry of Environment/FIFA/IAAF	During Operation

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
			accidental releases of flammable liquids to a safe containment area including secondary containment of storage tanks; ○ Installing fire/blast partition walls in areas where appropriate separation distances cannot be achieved ○ By providing firefighting equipment				

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
			around the stadium				
	The threat of Naturally Occurring Radioactive Material (NORM) to the environment (soil, water, and air)	H	Ebonyi State Government shall ensure: • Regular maintenance or servicing of production equipment as at when due; • Regular NORM monitoring programs to detect materials and equipment with NORM; • carrying out personal dosimetry for external radiation exposures to confirm that exposures fall into the range expected from external radiation surveillance monitoring; • measuring airborne radioactive dust during maintenance activities	L	Site inspection report Compliance monitoring report	Ebonyi State Ministry of Environment/FIFA/IAAF	During Operation

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
			to check that the assumptions upon which respirator selections were made are accurate – or if respirators are needed at all; • a surface contamination survey in a workshop to confirm that NORM contamination controls are working; • sampling and analysis of waste streams to confirm that they remain within regulatory limits; • materials used in NORM control procedures, such as gloves, plastic sheeting, disposable				

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
			coveralls, etc. if an area, materials, or equipment is affected by NORM • At equipment cleaning facilities, scale/sludge shall be removed by reaming; high-pressure water blasting; or a process called "rattling," where a high-speed rotating device is inserted into the pipe to break up and loosen the scale. Then the waste generated shall be handled by FMEnv approved Waste Manager to be disposed at an approved disposal site.				

7.8 Performance Indicator Monitoring

7.8.1 Environmental Monitoring Program

Environmental monitoring programs for the Stadium shall be implemented to address all activities that have been identified to have potentially significant impacts on the environment, during both normal operations and upset conditions (emergencies and consequent flaring). Environmental monitoring activities shall be based on direct or indirect indicators of emissions, wastewater, and resource use applicable to the project, and for point sources of emissions which will include both concentration and mass flow rate of pollutants.

Monitoring frequency shall be sufficient to provide representative data for the parameter being monitored. Monitoring shall be conducted by trained individuals following suitable and appropriate monitoring and record-keeping procedures and using regularly calibrated and suitably maintained equipment. Monitoring data shall be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. The proposed operation phase monitoring programme is provided in ***Table 7.4*** below. However, during construction, the surveillance programme will exclude wastewater and emissions monitoring.

Table 7.4: Environmental Monitoring Programme for Ebonyi State Government International Olympic Stadium

Component	Type	Monitoring Parameter	Source point / Sampling point	Monitoring Frequency	Responsibility
Environment					
Emissions	Flue gases	Carbon dioxide (CO2), nitrogen oxides (NOx), sulphur oxides (SOx), carbon monoxide (CO), and particulate matter (PM), Hydrogen sulphide (H_2S)	Bitumen Blowing Unit (BBU), Fluid Catalytic Cracking Unit (FCCU), Residue Catalytic Cracking Unit (RCCU), sulfur recovery unit (SRU),	Weekly and 3-year Audit	Consultant/ HSE
	Fugitive emission	H; CH4; VOCs, PAHs; NH3, CO, CO_2, SO_2 and SO_3, NOx, MTBE, ETBE, TAME, HF, and H2S.	Valves and machinery seals; Blending tanks, Pumps, Wastewater Treatment Systems, Bitumen storage tanks, Vapor recovery unit vents	Weekly and 3-year Audit	Consultant/ HSE
Nuisance	Ambient	Noise level, odour, vibration, radiation	Within site and 2km radius	Weekly and 3-year Audit	Consultant/ HSE
Surface water	Rivers, streams, ponds, etc. (2km radius)	pH, Hydrocarbons (BTEX, TPH, PAH, THC), Temperature, Conductivity, Chloride, Turbidity, TDS, BOD_5, COD, THC, DO, Total hardness, Heavy metals, *E. coli* and *Enterococci*	Upstream, midstream, and downstream	Quarterly (Compliance monitoring) and 3-year Audit	Consultant/ HSE
Groundwater	Shallow	Temperature, hydrocarbons	Boreholes and wells	Quarterly	Consultant,

Component	Type	Monitoring Parameter	Source point / Sampling point	Monitoring Frequency	Responsibility
	wells and boreholes (2km radius)	(BTEX, TPH, PAH, THC), pH, Electrical Conductivity, Total Solids, Dissolved Oxygen, Total Hydrocarbon Content, BOD_5, COD Sulphate, Nitrate, Phosphate, phenol, heavy metals, Total coliform, and Faecal Coliform bacteria		(Compliance monitoring)	HSE
Rainwater and stormwater	Rainwater and stormwater	Precipitation rate, pH, TDS, acidity, alkalinity, colour, hardness, etc.	Stormwater (Point of discharge from the facility)	Quarterly (Compliance monitoring), 3-year Audit	Consultant, HSE
Sanitary sewage	-	Residual chlorine, pH, TSS, DO, BOD5, Total Coliform, and Faecal coliform	Sanitary sewage treatment plant (SSTP)	Post-treatment	Consultant/ HSE
Air quality	Ambient air	Particulate matter, C_XH_Y, SOx, CO, VOC, NOx, Noise, H_2S, NH_3.	Established sampling points and 2km radius of the Stadium	Weekly and 3-year Audit	Consultant/ HSE
Traffic	Vehicular traffic	Vehicular volume count, origin and destination survey	Established observation points and 20km radius of the Stadium	3-year audit	Consultant, HSE/ Logistics
Safety and health					

Component	Type	Monitoring Parameter	Source point / Sampling point	Monitoring Frequency	Responsibility
	Occupational safety and health	Lost time injury (LTI), Lost time injury frequency (LTIF), Medical cases, Fatality, etc.	Within site	Daily	HSE
	Community health	The oil spill, fire, explosion, benzene concentration, vehicular accident, accidental chemical release, or other major hazards	Stakeholder communities	Daily	HSE

7.9 Emergency Response Plan

Preparation of an Emergency Response Plan (ERP) and access to specialist equipment is essential for the safety of Ebonyi State International Olympic Stadium personnel, assets, the public, and to minimise the severity of an incident. The ERP will address wherever possible environmental considerations and include:

- Define the command and control system for response and rapid dissemination of critical information to affected parties.
- Evaluate response preparedness including support facilities for firefighting, and operational procedures for the handling of equipment and chemicals.
- Clean up and disposal procedures.
- Coordination with mutual aid groups such as telecommunication, Police, and state fire service.
- Staff awareness and training.
- Integrate the plan with the Ebonyi State International Olympic Stadium emergency response plan.

7.10 Environmental Auditing

Ebonyi State Government Operations Unit shall schedule environmental audits to assess its performance with regards to the requirements of this ESMP. The internal auditing objectives of Ebonyi State Government are to:

- Review existing operations/activities environmental and occupational health aspects to determine where improvements could be made.
- Review compliance with FIFA/IAAF and FMEnv regulations.
- Identify hazards and take preventive and corrective actions.
- Assess the effectiveness of Ebonyi State Government policy, responsibilities spread, current initiatives success rates such as the provision of regular supervision and environmental awareness campaigns and programs, tolerance management enforcement, and hazard control.
- Appraise the environmental performance of the company.
- Heighten awareness of Ebonyi State International Olympic Stadium personnel on the importance of sound environmental management.

- Ensure that Ebonyi State International Olympic Stadium does not detrimentally impact the environment.
- Review community affairs

Environmental auditing programs include:

- Compliance auditing, including auditing of any terms and conditions associated with the Ebonyi State International Olympic Stadium approvals and permits.
- Auditing of the Environmental Management Plan.
- Auditing of the Environment Monitoring.
- Auditing of any drills or actual responses associated with the ERP

Stadium Safety Unit shall develop a schedule for the audit of Ebonyi State International Olympic Stadium operations. The timing of audits shall be adjusted based on environmental risks identified.

7.11 Reporting

Ebonyi State International Olympic Stadium shall keep regulatory authorities informed of the project performance concerning HSE matters by way of written status reports and face-to-face meetings. It shall prepare annual reports on environmental and social performance and submit the same to relevant regulators. In addition to regular reporting, official notification shall be made to the government for any of the following:

- Significant modifications to this ESMP or the ESIA;
- Significant design, routing, or implementation changes;
- Results of environmental monitoring;
- Community incidents; and
- Safety incidents or accidents.

Ebonyi State International Olympic Stadium will make accessible to government authorities, or provide upon request appropriate documentation of HSE related activities, including internal inspection records, training records, and reports. Subcontractors are also required to provide HSE performance reporting to the Stadium Authority regularly through weekly and monthly reports.

7.12 Regulatory Oversight

Communications between the Ebonyi State International Olympic Stadium management and government regulatory agencies shall be instituted through a variety of mechanisms, including written reports and memos, as well as informal and formal meetings. Meetings will include regularly scheduled sessions as well as additional meetings called on and as the need arises. At the field level, formal meetings with government regulatory agency representatives shall be held as needed to discuss scheduling/planning issues, current areas of concern, and emerging HSE and socioeconomic issues.

At the management level, formal meetings are expected to be held, but on a less frequent basis. Informal meetings and communications will also hold as necessary. Concerning formal meetings, the HSE Manager will meet with government regulatory agency representatives to review HSE and socioeconomic performance based on the analysis of internal HS-EMS and field reports. These meetings can be expected to include discussion of upcoming work plans and coordination issues and resolution of problems that could not be adequately addressed at the field level. At the field level, government regulatory agency field representatives will inform appropriate Ebonyi State International Olympic Stadium representatives if compliance concerns arise. At the management level, regularly scheduled meetings will hold between HSE Managers and the appropriate government regulatory agency representative to review HSE performance, areas of concern, and emerging issues.

7.13 Fiscal Plan for the ESMP

To effectively implement the environmental and social management measures suggested as part of the ESMP, an estimated budget has been made by Ebonyi State Government for the project components. Please see the budget section in **Tables 7.10** below.

Table 7.5: Budget for the ESMP

Component	Type	Monitoring Parameter
Emissions	Flue gases, gas flaring	Carbon dioxide (CO_2), nitrogen oxides (NOx), sulphur oxides (SOx), carbon monoxide (CO), and particulate matter (PM), Hydrogen sulphide (H_2S)
	Fugitive emission	H; CH_4; VOCs, PAHs; NH_3, CO, CO_2, SO_2 and SO_3, NOx, MTBE, ETBE, TAME, HF, and H_2S.
Budget	***₦4,500,000.00***	
Wastewater (Influent and effluent)	Process wastewater	Quantity, pH, Temperature, Heavy metals, TDS, Hydrocarbons (BTEX, TPH, PAH, THC), H_2S, NH_3, organic sulphur compounds (R-S-H mercaptans), organic acids, and phenol.
	Hydrostatic test fluid	Inhibitor, Ferrous, TDS, pH
	Sanitary sewage	Residual chlorine, pH, TSS, DO, BOD_5, Total Coliform, and Faecal coliform
Budget	***₦3,500,000.00***	
Air quality and Nuisance	Nuisances	Noise level, odour, vibration, radiation
	Ambient air quality	Particulate matter, C_XH_Y, Sox, CO, VOC, NOx, Noise, H_2S, NH_3, etc.
Budget	***₦1,500,000.00***	
Surface water	Rivers, streams, seasonal ponds, etc	pH, Hydrocarbons (BTEX, TPH, PAH, THC), Temperature, Conductivity, Chloride, Turbidity, TDS, BOD_5, COD, THC, DO, Total hardness, Heavy metals, *E. coli* and *Enterococci*
Groundwater	Boreholes	Temperature, hydrocarbons (BTEX, TPH, PAH,

Component	**Type**	**Monitoring Parameter**
		THC), pH, Electrical Conductivity, Total Solids, Dissolved Oxygen, Total Hydrocarbon Content, BOD_5, COD Sulphate, Nitrate, Phosphate, phenol, heavy metals, Total coliform, and Faecal Coliform bacteria
Rainwater and stormwater	Rainwater and stormwater	Precipitation rate, pH, TDS, acidity, alkalinity, colour, hardness, etc.
Budget	***₦3,500,000.00***	
Traffic	Vehicular traffic	Vehicular volume count, origin and destination survey
Budget	***₦2,500,000.00***	
Safety and health		
	Occupational safety and health	Lost time injury (LTI), Lost time injury frequency (LTIF), Medical cases, Fatality, etc.
	Community health	Fire, explosion, vehicular accident, accidental chemical release, or other major hazards
Budget	***₦7,000,000.00***	

CHAPTER EIGHT

DECOMMISSIONING AND RESTORATION PLAN

8.1 Background Information

The life span of any proposed project is hinged on several considerations. It is important to put in place plans to recover and/or restore the project site to its original state after the project is closed or decommissioned. This requires a good understanding of all the environmental components of the project on the ecosystem during its lifespan (50 years). At the decommissioning stage, the facility is taken out of its current operational use with the isolation of its units. When a project has undergone this process, it is then abandoned or modified for reuse. This Chapter presents the Ebonyi State International Olympic Stadium decommissioning and abandonment plan.

8.2 Outline of Planning and Implementation Programme

1) Ebonyi State Government shall commence activities related to decommissioning, at least, one (1) year before abandonment,
2) Determine the scope of decommissioning,
3) Engagement and due consultation of stakeholders (including FMEnv, FIFA, IAAF, communities, Ebonyi State Government, etc.) shall be instituted,
4) Put in place a Decommissioning Plan Report for review and approval by FMEnv/ FIFA/IAAF. The plan shall include:
    - identification of all components of the project that will be disengaged, removed, or exhumed;
    - method(s) for removal or re-use of any project unit/ material if applicable;
    - effort being put in place to mitigate any environmental impacts associated with the decommissioning process; and
    - appropriate site remediation/rehabilitation programme
5) Ensure the safety of operation, taking into consideration all appropriate international conventions, regulatory requirements, and corporate policies.

6) Remove all structures (surface and sub-surface structures) with due regard for the protection of the environment.

8.3 Decommissioning and Restoration Principle

At decommissioning, all units buried or fixed on land shall be removed entirely. All wastes items arising from the decommissioning process shall be managed in line with the Stadium Waste Management Plan (WMP). Decommissioning shall be carried out in line with the standard decommissioning procedure. Ebonyi State Government shall:

- avoid any significant adverse effect on the environment; and
- Provide a platform for reuse of decommissioned items locally in line with its WMP

8.4 Site Remediation and Restoration

Following decommissioning and abandonment, Ebonyi State Government will carry out site remediation and restoration work as part of the project's environmental management programmes. This will entail:

1) A survey of the decommissioned site for contamination as part of a conceptual site model and a strategy plan.
2) Evaluation of the site hydrology and geology.
3) Preparation of a site assessment report to be approved by FMEnv and FIFA, IAAF.
4) Interim action or remediation is designed to confirm the applicability and feasibility of one or more potential remedial options.

Finally, the site shall be monitored for compliance and performance to confirm the effectiveness of the remedial measures. At the end of the site abandonment, the following useful documentation shall be reviewed:

1) The initial Decommissioning and Restoration Plan.
2) The abandonment operations conducted in the field, along with changes to plan necessitated by field conditions.
3) Route of lighting conduits.

4) Soil test reports.
5) Final Stadium ESIA Report.

8.5 Post Decommissioning Impact Assessment

Before abandonment, a post decommissioning Impact Assessment Report shall be prepared to detail the state of the environment after remediation. The report shall be submitted to FMEnv/ FIFA/IAAF, after which a joint site visit shall be done by a team of Ebonyi State Government, FIFA, IAAF, FMEnv, NCAA, Community, Consultant, and other stakeholders. The table below shows the comprehensive Environmental and Social Management Plan (ESMP) of the International Olympic Stadium during the Decommissioning Phase.

Table 8.1: Environmental and Social Management Plan (ESMP) of the International Olympic Stadium – Decommissioning

Project Activity	Description of Impacts	Rating before Mitigation	Mitigation/Control Measures	Rating after Mitigation	Parameters for Monitoring	Action Party	Monitoring Frequency
Demolition and Evacuation	Interference with road transportation	M	• Ebonyi State Government shall monitor the no of trucks per day to know if there is a need to create other accessible roads. • Ebonyi State Government shall develop a transport management plan specifying routes, speeds, times of travel, and key roads/waterway in terms of local services. • Consideration shall be given to avoid reliance on public transport and contractors shall be required to use private vehicles.	L	Inventory of approved journey management forms	Ebonyi State Government/Delta State Ministry of Environment/FMEnv	During Decommissioning
	Noise and vibration nuisance	M	Ebonyi State Government shall ensure that: • electric power generators are fitted with effective silencers; • there shall be regular maintenance of vehicles and generators. • generators and vehicles are switched off when not in us.	L	Compliance monitoring report	Ebonyi State Government /Ebonyi State Ministry of Environment/FMEnv/ FIFA/IAAF	During Decommissioning

			• soundproof electric power generators are engaged • PPEs are used				
	Impairment of air quality	H	Ebonyi State Government shall ensure: • Engine to comply with international standards for exhaust gases; Maintenance of engines and exhaust gas check; Adoption of engine-off policy at the construction site. • that nose masks and earmuffs are worn by site workers during excavation. • that water shall be sprayed on construction sites to reduce dust levels, especially during the dry season.	L	Compliance monitoring report	Ebonyi State Government /Ebonyi State Ministry of Environment/FMEnv/ FIFA/IAAF	During Decommissioning
	Contamination of surface and Groundwater & soil by the oil spill	M	Ebonyi State Government shall ensure: • Soil disturbance shall be kept to minimum required for • operation and safety • Oil spill containment shall be provided to reduce oil spill • from getting to the soil and surface/ groundwater • Follow FMEnv guidelines on waste management • Cleanup in compliance with relevant national and	L	Compliance monitoring report	Ebonyi State Government /Ebonyi State Ministry of Environment/FMEnv/ FIFA/IAAF	During Decommissioning

			• international guidelines, involving the removal of the waste, etc • Restore the to a condition in no way inferior to the condition • before the commencement of work.				
	Poor disposal of wastes generated during this phase	H	• Ebonyi State Government shall treat and dispose of all wastes following regulatory requirements and best practice using approved contractors. • Ebonyi State Government shall ensure that none of these wastes are disposed of into any water body or on land. • follow safety measures while disposing of wastes. • Ebonyi State Government shall keep all waste consignment, treatment, and disposal records for regulatory verification. • Proper disposal of solid waste from labour camps. • storage of lubricants, fuels, and other hydrocarbons in self-contained enclosures.	M	Site inspection report Waste Management Policy/ tracking sheet	Ebonyi State Government /Ebonyi State Ministry of Environment/FMEnv/ FIFA/IAAF	During Decommissioning

			• sanitation arrangements at worksites/facilities to avoid the release of wastewater to the environment. • All other wastes generated including environmentally deleterious materials generated by construction activities will be disposed of offsite in an appropriate, legal, and safe manner. • There is a minimum generation of waste. • Unsuitable excavated materials shall be systematically carried away from areas prone to erosion; • Reuse waste materials wherever possible • Wastes shall be segregated, stored, and disposed of by an accredited state waste collector				
	The threat of Naturally Occurring Radioactive Material (NORM) to the environment	H	Ebonyi State Government shall ensure: • Regular maintenance or servicing of production equipment as at when due; • Regular NORM monitoring programs to detect materials and equipment with NORM;	M	Site inspection report Waste Management Policy/ tracking sheet	Ebonyi State Government /Ebonyi State Ministry of Environment/FMEnv/ FIFA/IAAF	During Decommissioning

			• carrying out personal dosimetry for external radiation exposures to confirm that exposures fall into the range expected from external radiation surveillance monitoring; • measuring airborne radioactive dust during maintenance activities to check that the assumptions upon which respirator selections were made are accurate – or if respirators are needed at all; • a surface contamination survey in a workshop to confirm that NORM contamination controls are working; • sampling and analysis of waste streams to confirm that they remain within regulatory limits; • materials used in NORM control procedures, such as gloves, plastic sheeting, disposable coveralls, etc. if an area, materials, or equipment is affected by NORM. • Equipment with NORM shall				

			be recycled or incinerated at an approved recycled or incinerated center as the case may be				
	Loss of job	H	Ebonyi State Government shall • Counsel worker who loses their job. • Give enough notice • Assist staff that are likely to lose their job in skill acquisition. • Assist in setting small scale business.	L	Contract documents/ list of community members employed	Ebonyi State Government /Ebonyi State Ministry of Environment/FMEnv/ FIFA/IAAF	During Decommissioning
	Injury/fatalities in workforce /communities	H	Ebonyi State Government shall • Ensure Safety awareness training for the workforce. • Emergency response procedures shall be put in place and enforced • Ensure the use of PPE. • Provide first aid and clinic on site	M	Progress/site inspection report	Ebonyi State Government /Ebonyi State Ministry of Environment/FMEnv/ FIFA/IAAF	During Decommissioning
	<u>Electrocution</u>: Tall equipment could have contact with high tension cables	H	Ebonyi State Government shall ensure: ✓ Use of signs, barriers (e.g. locks on doors, use of gates, use of steel posts surrounding towers to prevent public and workers contact with potentially dangerous	L	Progress/site inspection report	Ebonyi State Government /Ebonyi State	During Decommissioning

	causing electrocution hazard. Workers can be exposed during the decommissioning phase		equipment; ✓ it provides and enforces the use of PPE; ✓ Conduit type of wiring shall be adopted instead of the surface to prevent shock. ✓ Only allowing trained and certified workers to install, maintain, or repair electrical equipment; ✓ Deactivating and properly grounding live power distribution lines before work is performed on, or close to, the lines. ✓ Ensuring that live-wire work is conducted by trained workers with strict adherence to specific safety and insulation standards. Qualified or trained employees working on transmission or distribution systems should be able to achieve the following: ✓ Distinguish live parts from other parts of the electrical system ✓ Determine the voltage of live parts. ✓ Understand the minimum approach distances outlined for specific live line voltages. ✓ Ensure proper use of special safety equipment and procedures when working near,			Ministry of Environment/FMEnv/ FIFA/IAAF	

			or on, exposed energized parts of an electrical system. ✓ Workers should not approach an exposed, energized, or conductive part even if properly trained unless: ✓ The worker is properly insulated from the energized part with gloves or other approved insulation; or ✓ The energized part is properly insulated from the worker and any other conductive object; ✓ All electrical installations shall be performed by certified personnel and supervised by an accredited person. ✓ Strict procedures for de-energizing and checking of electrical equipment should be in place before any maintenance work is conducted. If de-energizing is not possible, electrical installations should be moved or insulated to minimize the hazardous effects; ✓ Before excavation works, all existing underground cable installations should be identified and marked. Drawings and plans should indicate such installations;				

			✓ discharge. In cases where maintenance work has to be performed on energized equipment, a strict safety ✓ procedure should be in place and work should be performed under constant supervision; Personnel training should be provided in revival techniques for victims of electric shock.				
	Tripping/falling from heights as a result of Climbing and working on electric poles	H	Ebonyi State Government shall ensure 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	L	Progress/site inspection report	Ebonyi State Government /Ebonyi State Ministry of Environment/FMEnv/ FIFA/IAAF	During Decommissioning

			(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 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. • When operating power tools at height, require that workers use a second (backup) safety strap; • An approved tool bag should be used for raising or lowering tools or materials to workers				

			on structures.				
	The kidnapping of workers and visitors on site	H	• Ebonyi State Government shall ensure that both contractor and Ebonyi State Government personnel develop a high level of security consciousness both within and outside the work area. • Daily security reports shall be reviewed by the Ebonyi State Government Project Manager. • A special security force shall be established and deployed for the project. This shall include deploying some of Ebonyi State Government police to strengthen security in the area. • Ebonyi State Government shall ensure that a liaison to foster a partnership with the	M	Progress/site inspection report	Ebonyi State Government /Ebonyi State Ministry of Environment/FMEnv/ Nigeria Police Force/NSDC	During Decommissioning

			community to guarantee security for the project is established and sustained. • To beef up security for the project, Ebonyi State Government shall support by assisting with equipment e.g. patrol vehicles, to ensure improved security • Ebonyi State Government shall ensure that safety workshops to identify, evaluate and recommend contingency plans for all security risks are regularly organized • Ebonyi State Government shall ensure that there is a police station/post within and around the facility				
	Third-Party Agitation due to employment	M	• Assist staff that are likely to lose the job in skill acquisition. • Assist in setting small scale business	L	Contract documents/ list		During Decommissio

	Issues and Loss of Benefits as Host Communities.				of community members employed	Ebonyi State Government /Ebonyi State Ministry of Environment/FMEnv/ FIFA/IAAF	ning

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CHAPTER NINE

CONCLUSION AND RECOMMENDATIONS

9.1 Background Information

The project ESIA study shows that with the application of the recommendations built into the environmental and social management plan and other provisions incorporated therewith, the construction and operation of The Ebonyi State International Olympic Stadium will be carried out with minimal impacts on the environment.

9.2 Conclusion

The Ebonyi State International Olympic Stadium Environmental and Social Impact Assessment (ESIA) draft report was prepared *following the Environmental Impact Assessment (EIA) Act CAP E12, LFN 2004.* The study area baseline environmental description was based on two seasons of field sampling consolidated by a review of previous studies on the same environment.

The goal of the ESIA process was to get to a position where the Project does not have any major residual impacts on the environment, certainly not ones that would endure into the long term or extend over a large area. Therefore, following the application of mitigation measures, the residual impacts became short-term, mostly localized, and reversible. Similarly, recommendations were also proffered for the beneficial impacts of the projects to enhance/sustain them.

To establish the project's operational requirements aimed at ensuring it delivers its stated business objective in an environmentally responsible manner, an Environmental and Social Management Plan (ESMP) was developed. The ESMP translated the mitigation/enhancement measures to action points. Similarly, performance indicators monitoring and audit programmes were recommended. This is to ensure that all impact indicators for the various environmental components are within statutory limits throughout the project life.

9.3 Recommendations

9.3.1 Management Action Plan

Ebonyi State Government will adhere to the following management recommendations to ensure sustainability and continual environmental performance of the project. Therefore, the Ebonyi State Government shall:

- Always support green initiative in all phases of the proposed International Stadium to reduce the effect of greenhouse gas emission
- Implement the Environmental and Social Management Plan (ESMP) designed for the project through its phases of development covering construction, operation, and decommissioning. The ESMP shall also be reviewed as the need may arise;
- Develop and implement a standard Environmental Management System (EMS) such as ISO 14001:2015 EMS and ISO 14064-1:2006 on *Greenhouse gases* for the project.
- Develop and implement a standard Safety Management System (SMS) in line with FIFA and IAAF standards for sports activities,
- Implement the project's waste management plan (WMP)
- Implement the project's performance indicator monitoring programme as recommended. Monitoring (inspection and measurements) shall be carried out at least three (3) times during the construction phase, and during operation, quarterly.
- Carry out a 3-year post-ESIA environmental auditing. The audit shall be carried out by a competent third-party person to ensure objectivity.
- Develop and implement a public complaint and grievance redress system to effectively handle the stakeholders' concerns.
- Provide adequate resources for the management of the project's environmental aspects (including noise, air emissions, birds strike, etc.)
- Obtain relevant regulatory permits and approvals before the commencement of the project, and as when due.

9.3.2 Operations Action Plan

The following specific environmental management and pollution control action will be implemented:

- Implement scheduled inspection and maintenance of mobile and immobile equipment
- Implement noise and emissions mitigation measures as recommended
- Prevent and control of accidental releases of liquids and spill response plans,
- Maintain a good housekeeping practice.

The ESIA shows that there is no potentially significant negative residual impact following the application of mitigation measures. To this end, Ebonyi State Government hereby solicits for the approval of the ESIA Report by FMEnv, while appropriate mitigation measures and post ESIA monitoring will be carried out following implementation.

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APPENDICES

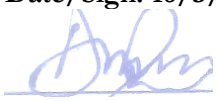
Appendix 4.0 -Chain of Custody for Wet and Dry Seasons

CHAIN OF CUSTODY TRACKING FORM

Project Name: **Ebonyi State International Stadium**
Submitted By: **Natural Capital Eco**
Received: **Anila Resources Limited**
Date of collection of samples: **14th -15th March, 2020**
Date of receipt of samples: **16th March, 2020**

Sample ID	Quantity	Sample Description	Type of analysis required
Groundwater Samples			
GW1, GW2	5	Groundwater sample in 1litre pre-cleaned polythene bottles fixed with HNO_3	Heavy Metals: Cu, Pb, Fe, Ni, Ba, Zn, Cr, V, Mn, Cd, Hg
		Groundwater sample in1 litre pre-cleaned glass bottles and preserved by the addition of 2 ml concentrated sulphuric acid	Oil and grease, THC
		Groundwater sample in 500ml plastic bottle	Physico chemical: Colour, turbidity, salinity, hardness, COD, phosphate, SO_4, NO_3, TSS
		Groundwater sample in 25 ml sterilized glass bottles.	Microbiology
		Groundwater sample in 300 ml amber-colored bottles	BOD
Control 1	5	Groundwater sample in 1litre pre-cleaned polythene bottles fixed with HNO_3	Heavy Metals: Cu, Pb, Fe, Ni, Ba, Zn, Cr, V, Mn, Cd, Hg
		Groundwater sample in1 litre pre-cleaned glass bottles and preserved by the addition of 2 ml concentrated sulphuric acid	Oil and grease, THC
		Groundwater sample in 500ml plastic bottle	Physico chemical: Colour, turbidity, salinity, hardness, COD, phosphate, SO_4, NO_3, TSS
		Groundwater sample in 25 ml sterilized glass bottles.	Microbiology
		Groundwater sample in 300 ml amber-colored bottles	BOD
Soil Sample			
EA/TS 1 - TS 17	2	Soil Samples wrapped in plastic	Chemical: Heavy metals- V, Ni, Fe, Pb, Cu, Zn,PH, moisture

			content, sulphate, sulphite, nitrite, THC
		Soil Samples wrapped in foil	Microbiology: Total heterogenic bacteria, fungi, total hydrocarbon bacteria (THB), faecal coliforms
EA/SS 1 – SS17	2	Soil Samples wrapped in plastic and covered with black plastic bag	Chemical: Heavy metals- V, Ni, Fe, Pb, Cu, Zn,PH, moisture content, sulphate, sulphite, nitrite, THC
		Soil Samples wrapped in foil and covered with black plastic bag	Microbiology: Total heterogenic bacteria, fungi, total hydrocarbon bacteria (THB), faecal coliforms
EA/TS Control 1 Control 2 Control 3	2	Soil Samples wrapped in plastic	Chemical: Heavy metals- V, Ni, Fe, Pb, Cu, Zn,PH, moisture content, sulphate, sulphite, nitrite, THC
		Soil Samples wrapped in foil	Microbiology: Total heterogenic bacteria, fungi, total hydrocarbon bacteria (THB), faecal coliforms
EA/SS Control 1 Control 2 Control 3	2	Soil Samples wrapped in plastic and covered with black plastic bag	Chemical: Heavy metals- V, Ni, Fe, Pb, Cu, Zn,PH, moisture content, sulphate, sulphite, nitrite, THC
		Soil Samples wrapped in foil and covered with black plastic bag	Microbiology: Total heterogenic bacteria, fungi, total hydrocarbon bacteria (THB), faecal coliforms

Prepared By: **Daniel Ayim**	**Transferred By:** **Daniel Ayim**	**Received By:** Adeosun Taofeeq	**Regulator (FMEnv):**
Date/Sign: 15/3/2020	**Date/Sign: 16/3/2020** 	**Date/Sign: 16/3/2020** 	**Date/Sign: 15/3/2020**

Remarks: *All the samples collected on the field which were witnessed by FMEnv representative were preserved with ice chests before taken to Anila Resources Limited, Lagos for analysis. The samples were then stored adequately in designated freezers at <4°C prior to analysis*

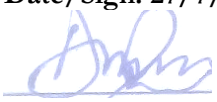
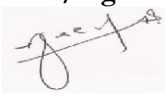
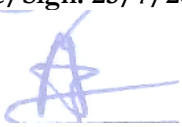
CHAIN OF CUSTODY TRACKING FORM

Project Name: **Ebonyi State International Stadium**
Submitted By: **Natural Capital Eco**
Received: **Anila Resources Limited**
Date of collection of samples: **23rd-24th July, 2020**
Date of receipt of samples: **27th July, 2020**

Sample ID	Quantity	Sample Description	Type of analysis required
Groundwater Samples			
GW1, GW2	5	Groundwater sample in 1litre pre-cleaned polythene bottles fixed with HNO_3	Heavy Metals: Cu, Pb, Fe, Ni, Ba, Zn, Cr, V, Mn, Cd, Hg
		Groundwater sample in1 litre pre-cleaned glass bottles and preserved by the addition of 2 ml concentrated sulphuric acid	Oil and grease, THC
		Groundwater sample in 500ml plastic bottle	Physico chemical: Colour, turbidity, salinity, hardness, COD, phosphate, SO_4, NO_3, TSS
		Groundwater sample in 25 ml sterilized glass bottles.	Microbiology
		Groundwater sample in 300 ml amber-colored bottles	BOD
Control 1	5	Groundwater sample in 1litre pre-cleaned polythene bottles fixed with HNO_3	Heavy Metals: Cu, Pb, Fe, Ni, Ba, Zn, Cr, V, Mn, Cd, Hg
		Groundwater sample in1 litre pre-cleaned glass bottles and preserved by the addition of 2 ml concentrated sulphuric acid	Oil and grease, THC
		Groundwater sample in 500ml plastic bottle	Physico chemical: Colour, turbidity, salinity, hardness, COD, phosphate, SO_4, NO_3, TSS
		Groundwater sample in 25 ml sterilized glass bottles.	Microbiology
		Groundwater sample in 300 ml amber-colored bottles	BOD
Soil Sample			
EA/TS 1 - TS 17	2	Soil Samples wrapped in plastic	Chemical: Heavy metals- V, Ni, Fe, Pb, Cu, Zn,PH, moisture

			content, sulphate, sulphite, nitrite, THC
		Soil Samples wrapped in foil	Microbiology: Total heterogenic bacteria, fungi, total hydrocarbon bacteria (THB), faecal coliforms
EA/SS 1 – SS17	2	Soil Samples wrapped in plastic and covered with black plastic bag	Chemical: Heavy metals- V, Ni, Fe, Pb, Cu, Zn,PH, moisture content, sulphate, sulphite, nitrite, THC
		Soil Samples wrapped in foil and covered with black plastic bag	Microbiology: Total heterogenic bacteria, fungi, total hydrocarbon bacteria (THB), faecal coliforms
EA/TS Control 1 Control 2 Control 3	2	Soil Samples wrapped in plastic	Chemical: Heavy metals- V, Ni, Fe, Pb, Cu, Zn,PH, moisture content, sulphate, sulphite, nitrite, THC
		Soil Samples wrapped in foil	Microbiology: Total heterogenic bacteria, fungi, total hydrocarbon bacteria (THB), faecal coliforms
EA/SS Control 1 Control 2 Control 3	2	Soil Samples wrapped in plastic and covered with black plastic bag	Chemical: Heavy metals- V, Ni, Fe, Pb, Cu, Zn,PH, moisture content, sulphate, sulphite, nitrite, THC
		Soil Samples wrapped in foil and covered with black plastic bag	Microbiology: Total heterogenic bacteria, fungi, total hydrocarbon bacteria (THB), faecal coliforms
Surface Water Samples			
SW 1, SW2, SW3	5	Surface water sample in 1litre pre-cleaned polythene bottles fixed with HNO_3	Heavy Metals: Cu, Pb, Fe, Ni, Ba, Zn, Cr, V, Mn, Cd, Hg
		Surface water sample in1 litre pre-cleaned glass bottles and preserved by the addition of 2 ml concentrated sulphuric acid	Oil and grease, THC
		Surface water sample in 500ml plastic bottle	Physico chemical: Colour, turbidity, salinity, hardness, COD, phosphate, SO_4, NO_3, TSS
		Surface water sample in 25 ml sterilized glass bottles.	Microbiology
		Surface water sample in 300 ml amber-colored bottles	BOD
SW Control 1	5	Surface water sample in 1litre pre-cleaned polythene bottles fixed with HNO_3	Heavy Metals: Cu, Pb, Fe, Ni, Ba, Zn, Cr, V, Mn, Cd, Hg
		Surface water sample in1 litre pre-cleaned glass bottles and preserved by the	Oil and grease, THC

		addition of 2 ml concentrated sulphuric acid	
		Surface water sample in 500ml plastic bottle	Physico chemical: Colour, turbidity, salinity, hardness, COD, phosphate, SO_4, NO_3, TSS
		Surface water sample in 25 ml sterilized glass bottles.	Microbiology
		Surface water sample in 300 ml amber-colored bottles	BOD
Sediment Samples			
SED 1 SED 2 SED3	2	Sediment Samples wrapped in foil and covered with black plastic bag	Chemical: Heavy metals- V, Ni, Fe, Pb, Cu, Zn,PH, moisture content, sulphate, sulphite, nitrite, THC
		Sediment Samples wrapped in black plastic bag	Microbiology: Total heterogenic bacteria, fungi, total hydrocarbon bacteria (THB), faecal coliforms
SED Control 1	2	Sediment Samples wrapped in foil and covered with black plastic bag	Chemical: Heavy metals- V, Ni, Fe, Pb, Cu, Zn,PH, moisture content, sulphate, sulphite, nitrite, THC
		Sediment Samples wrapped in black plastic bag	Microbiology: Total heterogenic bacteria, fungi, total hydrocarbon bacteria (THB), faecal coliforms

Prepared By: **Daniel Ayim**	**Transferred By:** **Daniel Ayim**	**Received By:** Adeosun Taofeeq	**Regulator (FMEnv):**
Date/Sign: 27/7/2020	**Date/Sign: 27/7/2020** 	**Date/Sign: 27/7/2020** 	**Date/Sign: 25/7/2020** 

Remarks: *All the samples collected on the field which were witnessed by FMEnv representative were preserved with ice chests before taken to Anila Resources Limited, Lagos for analysis. The samples were then stored adequately in designated freezers at <4°C prior to analysis*

APPENDICES 4.1-4.6

APPENDIX 4.1: SAMPLING COORDINATES

APPENDIX 4.1A: SAMPLING COORDINATES FOR SOIL, AIR QUALITY, NOISE, AND VEGETATION STUDY

S/N	Sample ID	Sampling Coordinate	
		N	E
1	ESS/AQ,N,S,V1	6.28699	8.10524
2	ESS/AQ,N,S,V2	6.28730	8.10578
3	ESS/AQ,N,S,V3	6.28755	8.10747
4	ESS/AQ,N,S,V4	6.28751	8.10780
5	ESS/AQ,N,S,V5	6.28529	8.10664
6	ESS/AQ,N,S,V6	6.28962	8.10792
7	ESS/AQ,N,S,V7	6.28992	8.10739
8	ESS/AQ,N,S,V8	6.28932	8.10668
9	ESS/AQ,N,S,V9	6.28970	8.10750
10	ESS/AQ,N,S,V10	6.28920	8.10642
11	ESS/AQ,N,S,V11	6.29108	8.10824
12	ESS/AQ,N,S,V12	6.29117	8.10802
13	ESS/AQ,N,S,V13	6.29054	8.10842
14	ESS/AQ,N,S,V14	6.29179	8.11579
15	ESS/AQ,N,S,V15	6.29013	8.11512
16	ESS/AQ,N,S,V16	6.29090	8.11430
17	ESS/AQ,N,S,V17	6.29121	8.11769
18	ESS/AQ 18	6.28771	8.13013
19	ESS/AQ19	6.29126	8.10334
20	ESS/AQ20	6.29068	8.10376
21	ESS/AQ1	6.29177	8.10399
22	ESS/AQ22	6.29183	8.10340
23	ESS/AQ,N,S,V Control 1	6.29020	8.10411
24	ESS/AQ,N,S,V Control 2	6.28648	8.13764
25	ESS/AQ,N,S,V Control 3	6.28798	8.15442

Source: Natural Eco Capital Fieldwork, 2020

APPENDIX 4.1B: SAMPLING COORDINATES FOR SOIL, AIR QUALITY, NOISE, AND VEGETATION STUDY

S/N	Sample ID	Sampling Coordinate	
		N	E
1	ESS/AQ,N,S,V1	6.2941	8.1073
2	ESS/AQ,N,S,V2	6.2941	8.1073
3	ESS/AQ,N,S,V3	6.2439	8.1074
4	ESS/AQ,N,S,V4	6.2938	8.1071
5	ESS/AQ,N,S,V5	6.2939	8.1077
6	ESS/AQ,N,S,V6	6.2938	8.1079
7	ESS/AQ,N,S,V7	6.2937	8.1082
8	ESS/AQ,N,S,V8	6.2944	8.1095
9	ESS/AQ,N,S,V9	6.2945	8.1095
10	ESS/AQ,N,S,V10	6.2944	8.1077
11	ESS/AQ,N,S,V11	6.2943	8.1103
12	ESS/AQ,N,S,V12	6.2943	8.1108
13	ESS/AQ,N,S,V13	6.2938	8.1109
14	ESS/AQ,N,S,V14	6.2930	8.1108
15	ESS/AQ,N,S,V15	6.2928	8.1109
16	ESS/AQ,N,S,V16	6.2920	8.1109
17	ESS/AQ,N,S,V17	6.2918	8.1108
18	ESS/AQ 18	6.2913	8.1108
19	ESS/AQ19	6.2910	8.1108
20	ESS/AQ20	6.2908	8.1108
21	ESS/AQ1	6.2904	8.1108
22	ESS/AQ22	6.2903	8.1108
23	ESS/AQ,N,S,V Control 1	6.2870	8.1106
24	ESS/AQ,N,S,V Control 2	6.2873	8.1087
25	ESS/AQ,N,S,V Control 3	6.2881	8.1088

Source: Natural Eco Capital Fieldwork, 2020

APPENDIX 4.1C: GROUNDWATER SAMPLING COORDINATES (DRY SEASON)

SAMPLE ID	NORTH	EAST
Gw1 Borehole -Stadium	6.28821	8.10210
Gw2 Borehole -Stadium	6.29802	8.11049
GW Borehole- Stadium Control	6.29909	8.11218

Source: Natural Eco Capital Fieldwork, 2020

APPENDIX 4.1D: GROUNDWATER SAMPLING COORDINATES (WET SEASON)

SAMPLE ID	NORTH	EAST
Gw1 Borehole -Stadium	6.28649	8.10195
Gw2 Borehole -Stadium	6.30075	8.11435
GW Borehole- Stadium Control	6.28824	8.10208

Source: Natural Eco Capital Fieldwork, 2020

APPENDIX 4.1F: SAMPLING STATIONS FOR HYDROBIOLOGY STUDIES WITH THEIR COORDINATES (WET SEASON)

SAMPLE ID	**N**	**E**
SW1 (Upstream)	6.300535	8.11856
SW2 (Midstream)	6.300485	8.11789
SW3 (Downstream)	6.300652	8.12021
SW4 -Control	6.294108	8.10255

Source: Natural Eco Capital Fieldwork, 2020

APPENDIX 4.2A: AIR QUALITY, NOISE AND MICROCLIMATE DATA FOR THE STUDY AREA (DRY SEASON)

S/N	Sample ID	Sampling Coordinate			Toxic Gases, GHGs and Particulates								Noise dB(A)		Microclimates			
		N	E	SOx (ppm)	VOC (ppm)	NOx (ppm	NH_3 (ppm)	H_2S (ppm)	CO (ppm)	CO_2 (ppm)	SPM (ug/m^3) 2.5	SPM (ug/m^3) 10	Min	Max	Temp (ºC)	RH (%)	WS (m/s)	WD
1	ESS/AQ1	6.28699	8.10524	0.0	1.78	0.0	0.0	0.2	1.80	230	32.0	69.4	39.9	67.3	30.5	69.6	1.0	NE
2	ESS/AQ2	6.28730	8.10578	0.0	1.71	0.0	.0.	0.4	1.00	231	50.1	195.0	43.5	68.0	31.8	65.5	1.7	SW
3	ESS/AQ3	6.28755	8.10747	0.0	1.69	0.0	0.0	0.4	0.80	301	50.6	194.4	42.5	59.0	31.2	60.5	1.3	SW
4	ESS/AQ4	6.28751	8.10780	0.0	1.46	0.0	0.0	0.4	0.10	267	34.6	68.8	40.0	67.7	31.2	66.3	1.3	NE
5	ESS/AQ5	6.28529	8.10664	0.0	1.20	0.0	0.0	0.4	0.10	200	47.5	79.6	43.4	61.4	31.5	66.7	2.0	NW
6	ESS/AQ6	6.28962	8.10792	0.0	0.96	0.0	0.0	0.4	1.10	200	54.3	100.4	44.5	63.7	31.8	69.8	3.0	NE
7	ESS/AQ7	6.28992	8.10739	0.0	0.91	0.0	0.0	0.4	0.0	237	50.4	91.7	42.2	65.9	30.5	58.7	2.8	NE
8	ESS/AQ8	6.28932	8.10668	0.0	0.80	0.0	0.0	0.4	0.10	250	50.8	56.1	41.3	68.7	31.2	61.5	1.1	NE
9	ESS/AQ9	6.28970	8.10750	0.0	0.88	0.0	0.0	0.4	0.50	311	47.5	98.4	44.1	61.3	33.1	68.5	2.0	NE
10	ESS/AQ10	6.28920	8.10642	0.00	0.83	0.00	0.00	0.4	0.60	278	29.1	41.3	38.7	64.4	31.4	61.1	2.2	NE
11	ESS/AQ11	6.29108	8.10824	0.0	0.80	0.0	0.0	0.4	0.10	287	49.7	89.3	41.3	65.4	30.8	59.6	1.9	NE
12	ESS/AQ12	6.29117	8.10802	0.0	0.74	0.0	0.0	0.5	0.20	267	36.6	77.2	44.8	64.3	31.8	59.9	1.2	NE
13	ESS/AQ13	6.29054	8.10842	0.0	0.73	0.0	0.0	0.4	0.0	230	38.7	69.3	37.6	62.1	31.3	59.0	1.7	NE
14	ESS/AQ14	6.29179	8.11579	0.0	0.50	0.0	0.0	0.4	0.9	290	55.3	113.2	49.4	60.4	31.6	61.6	1.9	NE
15	ESS/AQ15	6.29013	8.11512	0.0	0.63	0.0	0.0	0.5	0.10	301	23.7	67.4	43.0	61.9	29.9	58.5	2.0	NE
16	ESS/AQ16	6.29090	8.11430	0.0	0.68	0.0	0.0	0.5	1.00	300	32.3	87.7	32.7	62.3	30.1	56.4	2.4	NE
17	ESS/AQ17	6.29121	8.11769	0.0	0.70	0.0	0.0	0.5	0.80	350	29.4	54.3	42.8	60.7	30.6	57.6	2.3	NE
18	ESS/AQ 18	6.28771	8.13013	0.0	0.69	0.0	0.0	0.5	0.10	368	31.4	61.3	36.6	66.0	30.2	54.5	1.8	NE

S/N	Sample ID	Sampling Coordinate			Toxic Gases, GHGs and Particulates								Noise dB(A)		Microclimates			
19	ESS/AQ19	6.29126	8.10334	0.00	1.89	0.00	0.00	0.4	0.10	298	34.1	81.3	38.7	64.4	31.4	61.1	2.2	NE
20	ESS/AQ20	6.29068	8.10376	0.0	2.80	0.0	0.0	0.4	0.40	277	27.7	79.3	41.3	65.4	30.8	59.6	1.9	NE
21	ESS/AQ21	6.29177	8.10399	0.0	1.74	0.0	0.0	0.5	0.20	300	23.6	57.2	44.8	64.3	31.8	59.9	1.2	NE
22	ESS/AQ22	6.29183	8.10340	0.0	1.99	0.0	0.0	0.4	0.10	302	28.7	59.3	37.6	62.1	31.3	59.0	1.7	NE
23	ESS/AQ Control 1	6.29020	8.10411	0.00	2.88	0.00	0.00	0.4	0.10	200	29.1	73.3	38.7	64.4	31.4	61.1	2.2	NE
24	ESS/AQ Control 2	6.28648	8.13764	0.0	0.74	0.0	0.0	0.4	0.10	230	33.6	90.6	47.5	60.9	30.8	59.8	0.6	NE
25	ESS/AQ Control 3	6.28798	8.15442	0.0	0.69	0.0	0.0	0.0	0.50	222	36.2	69.7	39.3	64.5	30.0	17.2	1.1	NE

Source: Natural Eco Capital Fieldwork, 2020 *Detection limit for NO_2 = 0.10ppm; Detection limit for SO_2 = 0.10ppm; Detection limit for CO = 1ppm*

APPENDIX 4.2B: AIR QUALITY, NOISE AND MICROCLIMATE DATA FOR THE STUDY AREA (WET SEASON)

S/N	Sample ID	Sampling Coordinate		Toxic Gases, GHGs and Particulates									Noise Db(A)		Microclimates			
		N	E	SOx (ppm)	VOC (ug/m^3)	NOx (ppm	NH_3 (ppm)	H_2S (ppm)	CO(ppm)	CO_2 (ppm)	SPM (ug/m^3) 2.5m	SPM (ug/m^3) 10m	Min	Max	Temp (^oC)	RH (%)	WS (m/s)	WD
1	ES AQ1	6.2941	8.1073	0.000	0.000	0.000	1.020	0.000	0.000	300	9.50	12.61	49.5	60.0	29.0	72.0	1.702	SW
2	ES AQ2	6.2941	8.1073	0.000	0.000	0.000	0.141	0.000	0.010	296	6.60	10.16	50.3	61.4	29.0	71.7	0.624	W
3	ES AQ3	6.2439	8.1074	0.000	0.000	0.000	0.010	0.000	0.001	278	4.60	16.17	50.6	65.4	28.8	72.6	1.142	SSW
4	ES AQ4	6.2938	8.1071	0.001	0.001	0.001	0.100	0.000	0.000	321	10.40	11.30	50.8	68.3	29.1	72.1	1.201	SW
5	ES AQ5	6.2939	8.1077	0.000	0.000	0.000	0.020	0.000	0.000	306	3.60	10.25	51.3	68.1	29.1	71.9	3.000	SW
6	ES AQ6	6.2938	8.1079	0.000	0.001	0.000	1.024	0.000	0.000	314	7.22	11.00	49.3	61.6	29.3	71.7	2.46	SSW
7	ES AQ7	6.2937	8.1082	0.000	0.000	0.000	0.240	0.000	0.000	281	7.76	10.69	49.6	62.4	29.0	62.5	1.27	SSW
8	ES AQ8	6.2944	8.1095	0.000	0.010	0.000	1.421	0.000	0.000	318	10.26	14.51	54.2	65.8	29.2	62.3	2.16	SSW
9	ES AQ9	6.2945	8.1095	0.000	0.000	0.000	1.024	0.000	0.000	375	8.45	10.40	53.8	70.7	29.1	62.1	1.70	SW
10	ES AQ10	6.2944	8.1077	0.000	0.000	0.000	0.127	0.000	0.000	297	9.70	14.51	53.1	67.9	29.3	62.0	4.00	SW
11	ES AQ11	6.2943	8.1103	0.000	0.000	0.000	0.210	0.000	0.001	301	10.00	14.24	55.6	74.0	29.5	62.0	3.45	SSW
12	ES AQ12	6.2943	8.1108	0.000	0.001	0.000	0.101	0.001	0.001	316	11.10	22.25	68.6	75.6	29.5	62.2	2.80	SW
13	ES AQ13	6.2938	8.1109	0.000	0.001	0.000	0.106	0.000	0.000	307	11.41	14.20	55.5	70.1	29.6	62.1	3.84	SW
14	ES AQ14	6.2930	8.1108	0.001	0.001	0.000	1.201	0.000	0.000	289	10.21	14.15	55.9	67.4	29.7	60.9	1.97	SW
15	ES AQ15	6.2928	8.1109	0.000	0.001	0.000	1.206	0.000	0.000	319	12.60	15.75	53.8	62.7	30.0	60.9	1.26	SSW

S/N	Sample ID	Sampling Coordinate		Toxic Gases, GHGs and Particulates									Noise Db(A)		Microclimates			
16	ES AQ16	6.2920	8.1109	0.000	0.001	0.000	1.020	0.000	0.002	320	10.21	13.17	58.0	79.8	30.0	61.9	1.460	SW
17	ES AQ17	6.2918	8.1108	0.000	0.000	0.000	0.002	0.000	0.001	317	9.16	16.13	53.9	71.6	32.1	61.8	1.721	SSW
18	ES AQ18	6.2913	8.1108	0.000	0.000	0.000	0.001	0.000	0.000	296	10.15	12.03	51.8	79.8	30.0	61.7	4.10	NS
19	ES AQ19	6.2910	8.1108	0.000	0.100	0.000	1.017	0.000	0.001	289	11.00	12.65	52.9	67.9	30.0	61.9	2.47	SW
20	ES AQ20	6.2908	8.1108	0.000	0.000	0.001	1.106	0.000	0.001	322	6.58	14.02	57.1	70.2	30.0	61.7	1.24	SW
21	ES AQ21	6.2904	8.1108	0.000	1.000	0.000	1.001	0.100	0.000	306	7.64	9.01	53.4	68.3	30.0	61.5	0.96	SSW
22	ES AQ22	6.2903	8.1108	0.000	0.000	0.000	1.141	0.010	0.000	284	9.38	14.06	52.9	66.5	30.3	61.4	1.46	SW
23	ES AQ23 Contrl 1	6.2870	8.1106	0.000	0.000	0.000	0.262	0.000	0.000	310	10.61	12.84	51.8	65.7	30.4	61.7	2.15	SW
24	ES AQ24 Contrl 1	6.2873	8.1087	0.000	0.000	0.000	0.161	0.000	0.001	398	10.46	12.50	49.8	60.1	30.4	60.9	2.75	SW
25	ES AQ25 Contrl 1	6.2881	8.1088	0.000	0.000	0.000	1.204	0.000	0.001	391	12.36	14.76	50.8	65.9	30.5	60.7	3.14	SSW

Source: Natural Eco Capital Fieldwork, 2020 *Detection limit for NO_2 = 0.10ppm; Detection limit for SO_2 = 0.10ppm; Detection limit for CO = 1ppm*

APPENDIX 4.2C: NIGERIAN AMBIENT AIR QUALITY STANDARD (FMENV)

Pollutants	**Time of Average**	**Limit**
Particulates	Daily average of hourly values	0.250 mg/ $m^{3,}$ 250µg/m^3 (600*µg/m^3)
SO_x as SO_2	Daily average of hourly values	0.01ppm (26µg/m^3) 0.1ppm (260µg/m^3)
NO_x as NO_2	Daily average of hourly values (range)	0.04 – 0.06ppm (75-113µg/m^3)
Carbon Monoxide	Daily average of hourly values 8 - hourly range	10ppm (11.4mg/m^3) 20ppm (22.8mg/m^3)
Petrochemical Oxidants	Hourly value	0.66ppm
Non-Methane Hydrocarbon	Daily average of 3-hourly values	160µg/m^3
Noise	8 hours exposure	90 dB(A)
H_2S	IDHL	

NOTE: CONCENTRATION NOT TO BE EXCEEDED FOR MORE THAN ONCE A YEAR. SOURCE: FEPA (1991)

APPENDIX 4.2D: AMBIENT AIR QUALITY STANDARDS BY USEPA AND WHO

Pollutant [links to historical tables of NAAQS reviews]	**Primary/ Secondary**		**Averaging Time**	**Level**	**Form**
Carbon Monoxide (CO)	Primary		8 hours	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Lead (Pb)	primary and secondary		Rolling 3 month average	0.15 µg/m^3	Not to be exceeded
Nitrogen Dioxide (NO_2)	Primary		1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	primary and secondary		1 year	53 ppb	Annual Mean
Ozone (O_3)	primary and secondary		8 hours	0.070 ppm	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution (PM)	$PM_{2.5}$	Primary	1 year	12.0 µg/m^3	annual mean, averaged over 3 years
		secondary	1 year	15.0 µg/m^3	annual mean, averaged over 3 years
		primary	24 hours	35 µg/m^3	98th percentile, averaged over 3 years

		and secondary			
	PM_{10}	primary and secondary	24 hours	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)	Primary		1 hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	secondary		3 hours	0.5 ppm	Not to be exceeded more than once per year

SOURCE: USEPA (2016)

APPENDIX 4.3: GROUND WATER RESULT

APPENDIX 4.3A: RESULTS OF PHYSICAL, CHEMICAL AND MICROBIOLOGICAL PROPERTIES OF THE GROUNDWATER SAMPLED DURING THE WET SEASON.

Sample	Colour	Alkalinity	Conductivity	pH	Temperature	Total Hardness	COD	BOD	DO	Salinity	TSS	TDS	Turbidity	Redox Potential
	Pt/Co	mg/L	µs/cm		0C	mg/L	mg/L	mg/L	mg/L	ppt	mg/L	mg/L	NTU	mV
ESS GW 1	5	10	54.5	6.50	30.8	11	8.87	3.7	6.6	0.01	0.32	28.1	1.15	31
ESS GW 2	4	4	47.9	6.90	31.2	9	7.73	4	7.1	0.01	0.37	23.5	0.92	45
ESS GW Control	8	6	50.2	7.20	29.9	7	9.93	3.3	6.9	0.02	0.25	25.1	1.8	55
Min	4	4	47.9	6.5	30.8	9	7.73	3.7	6.6	0.01	0.32	9	0.92	31
Max	5	10	54.5	6.9	31.2	11	8.87	4	7.1	0.01	0.37	19	1.15	45
Average	4.5	7	51.2	6.7	31	10	8.3	3.85	6.85	0.01	0.345	14	1.035	38

Exchangeable Cations and Anions

Sample ID	Phosphate	Sulphate	Nitrate	Chloride	Carbonate	Ammonium	Potassium	Calcium	Magnesium	Sodium
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
ESS GW 1	<0.01	1.84	0.41	8.55	0	0.16	0.36	2.71	0.98	4.54
ESS GW 2	<0.01	1.16	0.34	6.49	0	0.12	0.41	2.34	0.84	2.75
ESS GW C	<0.01	0.86	0.31	5	0	0.11	0.16	1.26	0.65	1.97
Min	<0.01	1.16	0.34	6.49	0	0.12	0.36	2.34	0.84	2.75
Max	<0.01	1.84	0.41	8.55	0	0.16	0.41	2.71	0.98	4.54
Average	<0.01	1.5	0.375	7.52	0	0.14	0.385	2.525	0.91	3.645

Heavy Metals

Sample ID	Iron	Zinc	Manganese	Chromium	Lead	Copper	Cadmium	Mercury	Vanadium	Nickel	Barium
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
ESS GW 1	1.029	<0.001	<0.001	<0.001	<0.001	0.009	<0.001	<0.001	<0.001	<0.001	<0.001
ESS GW 2	0.635	0.14	<0.001	<0.001	<0.001	0.005	<0.001	<0.001	<0.001	<0.001	<0.001
ESS GW C	0.956	<0.001	<0.001	<0.001	<0.001	0.005	<0.001	<0.001	<0.001	<0.001	<0.001

Min	0.635	<0.001	<0.001	<0.001	<0.001	0.005	<0.001	<0.001	<0.001	<0.001	<0.001
Max	1.029	0.14	<0.001	<0.001	<0.001	0.014	<0.001	<0.001	<0.001	<0.001	<0.001
Average	0.832	0.14	<0.001	<0.001	<0.001	0.0095	<0.001	<0.001	<0.001	<0.001	<0.001

Organic

Sample ID	TPH	PAHs	Oil & Grease	THC
	mg/L	mg/L	mg/L	mg/L
ESS GW 1	<0.001	<0.001	<0.001	<0.001
ESS GW 2	<0.001	<0.001	<0.001	<0.001
ESS GW C	<0.001	<0.001	<0.001	<0.001
Min	<0.001	<0.001	<0.001	<0.001
Max	<0.001	<0.001	<0.001	<0.001
Average	<0.001	<0.001	<0.001	<0.001

Microbiology

Sample ID	THB	THF	HUB	HUF	Total Coliform
	cfu/ml (x103)	cfu/ml (x102)	cfu/ml (x101)	cfu/ml (x101)	MPN/100ml
ESS GW 1	2.3×10^3	1.2×10^2	Nil	Nil	Nil
ESS GW 2	2.1×10^3	1.0×10^2	Nil	Nil	Nil
ESS GW C	2.2×10^3	1.4×10^2	Nil	Nil	Nil
Min	2.1×10^3	1.0×10^2	Nil	Nil	Nil
Max	2.3×10^3	1.2×10^2	Nil	Nil	Nil
Average	22	11	Nil	Nil	Nil

Source: Natural Eco Capital Fieldwork, 2020

APPENDIX 4.3B: RESULTS OF PHYSICAL, CHEMICAL AND MICROBIOLOGICAL PROPERTIES OF THE GROUNDWATER SAMPLED DURING THE DRY SEASON.

Sample	Colour	Alkalinity	Conductivity	pH	Temperature	Total Hardness	COD	BOD	DO	Salinity	TSS	TDS	Turbidity	Redox Potential
	Pt/Co	mg/L	µs/cm		0C	mg/L	mg/L	mg/L	mg/L	ppt	mg/L	mg/L	NTU	mV
ESS GW 1	1	Nil	76.6	6.76	24.5	20.00	8.00	1.80	3.87	0.05	ND	38.3	<0.01	125.5
ESS GW 2	1	Nil	51.2	6.94	24.5	16.00	8.00	1.91	3.94	0.03	ND	25.6	<0.01	141.2
ESS GW C	1	Nil	65.6	7.38	24.6	16.00	8.00	1.85	3.90	0.04	ND	32.8	<0.01	123.3
Min	1	Nil	51.2	6.76	24.5	16	8	1.8	3.87	0.03	ND	25.6	<0.01	125.5
Max	1	Nil	76.6	6.94	24.5	20	16	1.91	3.94	0.05	ND	38.3	<0.01	141.2
Average	1	Nil	63.9	6.85	24.5	18	12	1.855	3.905	0.04	ND	31.95	<0.01	133.35

Exchangeable Cations and Anions

Sample ID	Phosphate	Sulphate	Nitrate	Chloride	Carbonate	Ammonium	Potassium	Calcium	Magnesium	Sodium
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
ESS GW 1	0.163	6.713	1.339	12.55	4.81	0.353	0.814	8.14	0.163	6.713
ESS GW 2	0.172	2.823	1.384	8.37	3.21	0.371	0.621	5.43	0.172	2.823
ESS GW C	0.156	5.143	1.304	10.46	3.21	0.277	0.714	6.79	0.156	5.143
Min	0.163	2.823	1.339	8.37	3.21	0.353	0.621	5.43	0.163	2.823
Max	0.172	6.713	1.384	12.55	4.81	0.371	0.814	8.14	0.172	6.713
Average	0.1675	4.768	1.3615	10.46	4.01	0.362	0.7175	6.785	0.1675	4.768

Heavy Metals

Sample ID	Iron	Zinc	Manganese	Chromium	Lead	Copper	Cadmium	Mercury	Vanadium	Nickel	Barium
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
ESS GW 1	0.321	0.144	0.211	0.025	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
ESS GW 2	0.300	0.127	0.195	0.014	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
ESS GW C	0.292	0.122	0.207	0.016	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Min	0.3	0.127	0.195	0.014	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Max	0.321	0.144	0.211	0.025	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Average	0.3105	0.1355	0.203	0.0195	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Organic				
Sample ID	TPH	PAHs	Oil & Grease	THC
	mg/L	mg/L	mg/L	mg/L
ESS GW 1	<0.001	<0.001	<0.001	<0.001
ESS GW 2	<0.001	<0.001	<0.001	<0.001
ESS GW C	<0.001	<0.001	<0.001	<0.001
Min	<0.001	<0.001	<0.001	<0.001
Max	<0.001	<0.001	<0.001	<0.001
Average	<0.001	<0.001	<0.001	<0.001

Microbiology					
Sample ID	THB	THF	HUB	HUF	Total Coliform
	cfu/ml (x103)	cfu/ml (x102)	cfu/ml (x101)	cfu/ml (x101)	MPN/100ml
ESS GW 1	2.11	1.00	ND	ND	<1.8
ESS GW 2	2.50	2.00	ND	ND	1.8
ESS GW C	2.00	1.00	ND	ND	<1.8
Min	2.11	1	ND	ND	<1.8
Max	2.5	2	ND	ND	1.8
Average	2.305	1.5	ND	ND	1.8

Source: Natural Eco Capital Fieldwork, 2020

APPENDIX 4.4: SOIL RESULT

APPENDIX 4.4A: DESCRIPTIVE STATISTICS OF PHYSICO-CHEMICAL AND MICROBIAL PROPERTIES OF THE SOILS SAMPLED AT THE PROJECT AREA (DRY SEASON)

Physico-chemical

Sample ID	pH	Temp.	Cond.	Redox Pot.	TOC	Soil Characterization				
						Colour	Permeability	Texture	Grain size	Porosity
	-		µs/cm	mV	%	Visual		-	mm	%
SS1 (0-15cm)	5.58	26.4	75.45	100.2	1.25	Brown	Moderate	Sandy	0.1-2	67
SS1 (15-30cm)	5.80	25.9	79.50	105.5	1.31	Brown	Moderate	Sandy	0.1-2	68
SS2 (0-15cm)	6.10	25.8	83.50	109.4	1.15	Light Brown	Moderate	Sandy	0.1-2	66
SS2 (15-30cm)	6.05	26.0	60.20	110.8	1.22	Light Brown	Moderate	Sandy	0.1-2	66
SS3 (0-15cm)	5.30	26.1	74.50	113.5	0.93	Brown	Moderate	Sandy	0.1-2	67
SS3 (15-30cm)	5.10	26.1	90.05	114.0	1.04	Brown	Moderate	Sandy	0.1-2	67
SS4 (0-15cm)	5.60	25.9	62.50	110.5	1.84	Brown	Moderate	Sandy	0.1-2	66
SS4 (15-30cm)	5.73	25.8	60.10	120.0	1.87	Brown	Moderate	Sandy	0.1-2	66
SS5 (0-15cm)	6.00	25.7	65.35	140.2	1.29	Brown	Moderate	Sandy	0.1-2	66
SS5 (15-30cm)	6.10	26.0	80.10	130.5	1.37	Brown	Moderate	Sandy	0.1-2	67
SS6 (0-15cm)	6.30	26.2	82.20	110.2	1.49	Brown	Moderate	Sandy	0.1-2	66
SS6 (15-30cm)	6.20	25.9	80.40	116.0	1.62	Brown	Moderate	Sandy	0.1-2	66
SS7 (0-15cm)	5.72	25.8	70.50	120.0	1.60	Brown	Moderate	Sandy	0.1-2	63
SS7 (15-30cm)	5.90	25.6	81.0	112.5	1.66	Brown	Moderate	Sandy	0.1-2	64
SS8 (0-15cm)	5.80	25.7	55.10	151.5	1.29	Brown	Moderate	Sandy	0.1-2	68
SS8 (15-30cm)	5.70	25.7	60.25	140.5	1.76	Brown	Moderate	Sandy	0.1-2	69
SS9 (0-15cm)	6.01	25.8	65.70	120.5	1.84	Brown	Moderate	Sandy	0.1-2	65
SS9 (15-30cm)	6.10	25.6	63.45	119.0	1.95	Brown	Moderate	Sandy	0.1-2	64
SS10 (0-15cm)	6.01	25.7	51.37	110.0	1.26	Brown	Moderate	Sandy	0.1-2	64
SS 10 (15-30cm)	6.20	25.8	55.89	120.0	1.38	Brown	Moderate	Sandy	0.1-2	63
SS11 (0-15cm)	5.90	25.8	62.19	115.5	1.11	Brown	Moderate	Sandy	0.1-2	66

Sample ID	pH	Temp.	Cond.	Redox Pot.	TOC	Soil Characterization				
						Colour	Permeability	Texture	Grain size	Porosity
	-		µs/cm	mV	%	Visual		-	mm	%
SS11 (15-30cm)	5.85	25.9	65.00	118.2	1.69	Brown	Moderate	Sandy	0.1-2	64
SS12 (0-15cm)	5.80	25.7	53.16	129.8	1.16	Brown	Moderate	Sandy	0.1-2	67
SS12 (15-30cm)	5.69	25.5	57.20	137.5	1.24	Brown	Moderate	Sandy	0.1-2	66
SS 13 (0-15cm)	5.90	25.6	78.50	140.5	1.04	Brown	Moderate	Sandy	0.1-2	68
SS 13 (15-30cm)	6.10	25.7	87.00	139.0	13.1	Brown	Moderate	Sandy	0.1-2	66
SS 14 (0-15cm)	6.01	25.8	64.00	115.0	1.84	Brown	Moderate	Sandy	0.1-2	65
SS 14 (15-30cm)	6.10	25.8	68.20	113.5	1.87	Brown	Moderate	Sandy	0.1-2	67
SS 15 (0-15cm)	5.90	26.0	61.35	120.0	1.22	Brown	Moderate	Sandy	0.1-2	66
SS 15 (15-30cm)	5.95	26.1	65.90	125.7	1.32	Brown	Moderate	Sandy	0.1-2	66
SS 16 (0-15cm)	5.80	25.9	50.10	130.2	0.93	Brown	Moderate	Sandy	0.1-2	68
SS 16 (15-30cm)	5.68	25.9	52.10	135.5	1.04	Brown	Moderate	Sandy	0.1-2	69
SS 17 (0-15cm)	6.10	25.8	50.50	114.0	1.13	Brown	Moderate	Sandy	0.1-2	67
SS 17 (15-30cm)	6.20	26.0	63.40	118.2	1.87	Brown	Moderate	Sandy	0.1-2	68
SS C1 (0-15cm)	5.78	26.1	62.50	120.5	1.84	Brown	Moderate	Sandy	0.1-2	65
SS C1 (15-30cm)	5.92	25.8	61.90	122.0	1.95	Brown	Moderate	Sandy	0.1-2	69
SS C2 (0-15cm)	5.80	26.2	64.00	133.0	1.37	Brown	Moderate	Sandy	0.1-2	64
SS C2 (15-30cm)	5.67	25.8	78.50	139.0	1.29	Brown	Moderate	Sandy	0.1-2	68
SS C3 (0-15cm)	5.80	25.9	65.00	140.0	1.25	Brown	Moderate	Sandy	0.1-2	65
SS C3 (15-30cm)	5.90	25.8	67.20	130.0	1.31	Brown	Moderate	Sandy	0.1-2	69

Exchangeable Cations and Anions

Sample ID	Sulphate	Phosphate	Total-Nitroge	Nitrate	Nitrite	Carbonate	Ammonium	Sodium	Potassium	Calcium	Magnesium	CEC
	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
SS1 (0-15cm)	74.44	0.953	21.21	10.08	0.079	89.10	11.05	32.57	3.458	32.06	19.36	87.45
SS1 (15-30cm)	81.00	1.027	23.12	10.56	0.075	89.18	12.48	32.57	3.421	24.05	14.52	74.56
SS2 (0-15cm)	55.03	1.184	24.10	12.05	0.060	59.90	11.99	43.42	3.201	24.05	14.52	85.19
SS2 (15-30cm)	64.36	1.014	22.31	10.63	0.069	58.02	11.61	21.71	3.545	16.03	9.68	50.97
SS3 (0-15cm)	90.17	1.401	20.09	9.520	0.050	59.10	10.52	32.57	4.658	24.05	14.52	75.80
SS3 (15-30cm)	83.55	1.343	23.77	11.28	0.035	60.00	12.45	43.42	3.089	24.02	14.52	85.50
SS4 (0-15cm)	52.37	0.958	26.69	12.82	0.085	58.10	13.78	32.57	2.254	32.06	19.36	86.24
SS4 (15-30cm)	55.86	0.892	21.73	9.125	0.105	59.10	12.50	32.57	3.054	24.05	14.52	74.19
SS5 (0-15cm)	95.29	1.069	23.67	10.10	0.070	88.30	13.50	21.71	3.410	16.03	9.68	50.83
SS5 (15-30cm)	90.07	1.032	26.45	13.92	0.070	89.02	12.46	32.57	2.842	24.05	14.52	73.98
SS6 (0-15cm)	105.1	1.037	29.90	14.33	0.084	58.01	15.49	32.57	3.314	24.05	14.52	74.45
SS6 (15-30cm)	96.94	1.099	28.23	13.72	0.095	60.00	14.41	43.42	2.656	24.05	14.52	84.65
SS7 (0-15cm)	75.40	0.982	23.75	12.69	0.065	59.10	10.99	32.57	2.915	24.05	14.52	74.06
SS7 (15-30cm)	71.19	1.031	26.02	13.80	0.079	88.20	12.14	43.42	3.129	32.06	19.36	97.97
SS8 (0-15cm)	59.22	1.095	27.66	14.41	0.050	89.50	13.20	21.71	2.022	8.02	4.84	36.59
SS8 (15-30cm)	64.56	1.012	22.37	10.52	0.060	89.72	11.79	32.57	2.045	8.02	4.84	47.48
SS9 (0-15cm)	88.09	0.935	24.07	11.78	0.094	89.18	12.20	32.57	2.345	24.05	14.52	73.49
SS9 (15-30cm)	89.47	0.966	24.47	11.89	0.094	89.30	12.49	32.57	2.267	16.03	9.68	60.55
SS10 (0-15cm)	76.94	0.869	25.56	12.12	0.089	88.10	13.35	21.71	2.842	16.03	9.68	50.26
SS 10 (15-30cm)	88.07	0.913	25.70	11.96	0.084	89.02	13.66	32.57	2.626	8.02	4.84	48.06
SS11 (0-15cm)	85.09	1.018	23.03	10.47	0.070	59.05	12.49	32.57	3.454	24.05	14.52	74.59
SS11 (15-30cm)	79.36	0.979	26.43	12.83	0.079	58.10	13.52	32.57	2.140	32.06	19.36	86.13
SS12 (0-15cm)	84.26	0.978	26.45	14.25	0.103	60.00	12.10	21.71	2.325	8.02	4.84	36.90
SS12 (15-30cm)	75.77	0.903	26.08	13.02	0.099	58.87	12.96	21.71	2.584	8.02	4.84	37.15
SS13 (0-15cm)	85.69	1.208	26.30	12.24	0.090	59.09	13.97	43.42	2.304	24.05	14.52	84.29
SS13 (15-30cm)	91.05	1.134	24.05	10.11	0.100	60.00	13.84	54.28	2.879	24.05	14.52	95.73
SS 14 (0-15cm)	65.33	0.950	24.31	11.55	0.119	88.14	12.64	32.51	3.014	32.06	19.36	86.94
SS 14 (15-30cm)	57.35	1.059	23.19	10.21	0.104	89.45	12.88	32.57	2.924	24.05	14.52	74.06
SS 15 (0-15cm)	81.33	0.898	20.59	9.542	0.094	60.00	10.95	32.57	3.250	24.05	14.52	74.39
SS 15 (15-30cm)	76.43	0.853	22.19	10.69	0.079	59.45	11.42	21.71	3.008	16.03	9.68	50.43
SS 16 (0-15cm)	73.37	0.927	25.25	12.98	0.074	58.95	12.20	21.71	2.256	16.03	9.68	49.68
SS 16 (15-30cm)	80.46	0.973	22.69	10.74	0.089	58.10	11.86	32.57	2.102	24.05	14.52	73.24
SS 17 (0-15cm)	86.33	0.957	26.48	13.85	0.110	59.62	12.52	32.57	2.223	24.05	14.52	73.36

Sample ID	Sulphate	Phosphate	Total-Nitroge	Nitrate	Nitrite	Carbonate	Ammoniu m	Sodium	Potassiu m	Calciu m	Magnesiu m	CEC
	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
SS 17 (15-30cm)	90.26	1.016	26.16	12.47	0.129	60.00	13.56	21.71	2.521	16.03	9.68	49.94
SS C1 (0-15cm)	109.6	1.015	27.69	13.51	0.158	89.20	14.02	32.57	2.143	24.05	14.52	73.28
SSC1 (15-30cm)	110.2	0.994	23.51	10.58	0.179	88.67	12.75	32.51	2.317	32.06	19.36	86.25
SSC2 (0-15cm)	81.22	0.954	22.14	10.65	0.095	90.00	11.39	32.51	1.982	24.05	14.52	73.06
SSC2 (15-30cm)	75.44	0.882	23.53	11.07	0.104	89.47	12.36	43.42	2.199	24.05	14.52	84.19
SSC3 (0-15cm)	64.08	0.941	20.95	9.958	0.085	89.89	10.91	32.57	1.875	24.05	14.52	73.02
SSC3 (15-30cm)	69.84	0.897	22.89	10.60	0.105	88.74	12.18	32.51	2.145	24.05	14.52	73.23

Heavy Metals

Sample ID	Iron	Zinc	Chromium	Lead	Cadmium	Mercury	Vanadium	Nickel	Barium
	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
SS1 (0-15cm)	1.802	0.177	0.065	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS1 (15-30cm)	1.995	0.161	0.073	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS2 (0-15cm)	1.824	0.128	0.047	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS2 (15-30cm)	2.708	0.179	0.054	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS3 (0-15cm)	2.601	0.167	0.048	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS3 (15-30cm)	2.675	0.179	0.067	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS4 (0-15cm)	2.584	0.154	0.061	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS4 (15-30cm)	1.794	0.184	0.058	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS5 (0-15cm)	1.841	0.147	0.043	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS5 (15-30cm)	1.947	0.161	0.057	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS6 (0-15cm)	1.510	0.180	0.046	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS6 (15-30cm)	2.724	0.186	0.072	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS7 (0-15cm)	1.814	0.164	0.063	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS7 (15-30cm)	2.614	0.168	0.013	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS8 (0-15cm)	1.988	0.132	0.073	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS8 (15-30cm)	2.704	0.174	0.059	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS9 (0-15cm)	1.968	0.169	0.037	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS9 (15-30cm)	2.214	0.171	0.035	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Sample ID	Iron	Zinc	Chromium	Lead	Cadmium	Mercury	Vanadium	Nickel	Barium
	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
SS10 (0-15cm)	1.780	0.165	0.066	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS 10 (15-30cm)	1.994	0.171	0.064	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS11 (0-15cm)	2.621	0.174	0.044	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS11 (15-30cm)	2.871	0.180	0.057	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS12 (0-15cm)	1.621	0.151	0.050	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS12 (15-30cm)	1.884	0.163	0.055	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS 13 (0-15cm)	1.628	0.167	0.050	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS 13 (15-30cm)	1.914	0.170	0.061	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS 14 (0-15cm)	1.701	0.171	0.076	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS 14 (15-30cm)	1.910	0.190	0.084	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS 15 (0-15cm)	1.617	0.165	0.062	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS 15 (15-30cm)	1.716	0.182	0.072	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS 16 (0-15cm)	1.671	0.154	0.068	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS 16 (15-30cm)	1.801	0.169	0.071	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS 17 (0-15cm)	2.599	0.156	0.076	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS 17 (15-30cm)	2.743	0.175	0.081	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS C1 (0-15cm)	2.143	0.153	0.058	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS C1 (15-30cm)	2.440	0.168	0.063	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS C2 (0-15cm)	1.875	0.155	0.062	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS C2 (15-30cm)	1.794	0.162	0.067	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS C3 (0-15cm)	1.641	0.157	0.058	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SS C3 (15-30cm)	2.104	0.165	0.069	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Organics

Sample ID	TPH(total)	BTEX	THC	Oil and Grease
	mg/Kg	mg/Kg	mg/Kg	mg/Kg
SS1 (0-15cm)	<0.001	<0.001	<0.001	<0.001
SS1 (15-30cm)	<0.001	<0.001	<0.001	<0.001
SS2 (0-15cm)	<0.001	<0.001	<0.001	<0.001
SS2 (15-30cm)	<0.001	<0.001	<0.001	<0.001
SS3 (0-15cm)	<0.001	<0.001	<0.001	<0.001
SS3 (15-30cm)	<0.001	<0.001	<0.001	<0.001
SS4 (0-15cm)	<0.001	<0.001	<0.001	<0.001
SS4 (15-30cm)	<0.001	<0.001	<0.001	<0.001
SS5 (0-15cm)	<0.001	<0.001	<0.001	<0.001
SS5 (15-30cm)	<0.001	<0.001	<0.001	<0.001
SS6 (0-15cm)	<0.001	<0.001	<0.001	<0.001
SS6 (15-30cm)	<0.001	<0.001	<0.001	<0.001
SS7 (0-15cm)	<0.001	<0.001	<0.001	<0.001
SS7 (15-30cm)	<0.001	<0.001	<0.001	<0.001
SS8 (0-15cm)	<0.001	<0.001	<0.001	<0.001
SS8 (15-30cm)	<0.001	<0.001	<0.001	<0.001
SS9 (0-15cm)	<0.001	<0.001	<0.001	<0.001
SS9 (15-30cm)	<0.001	<0.001	<0.001	<0.001
SS10 (0-15cm)	<0.001	<0.001	<0.001	<0.001
SS 10 (15-30cm)	<0.001	<0.001	<0.001	<0.001
SS11 (0-15cm)	<0.001	<0.001	<0.001	<0.001
SS11 (15-30cm)	<0.001	<0.001	<0.001	<0.001
SS12 (0-15cm)	<0.001	<0.001	<0.001	<0.001
SS12 (15-30cm)	<0.001	<0.001	<0.001	<0.001
SS 13 (0-15cm)	<0.001	<0.001	<0.001	<0.001
SS 13 (15-30cm)	<0.001	<0.001	<0.001	<0.001
SS 14 (0-15cm)	<0.001	<0.001	<0.001	<0.001
SS 14 (15-30cm)	<0.001	<0.001	<0.001	<0.001
SS 15 (0-15cm)	<0.001	<0.001	<0.001	<0.001
SS 15 (15-30cm)	<0.001	<0.001	<0.001	<0.001

Sample ID	TPH(total)	BTEX	THC	Oil and Grease
	mg/Kg	mg/Kg	mg/Kg	mg/Kg
SS 16 (0-15cm)	<0.001	<0.001	<0.001	<0.001
SS 16 (15-30cm)	<0.001	<0.001	<0.001	<0.001
SS 17 (0-15cm)	<0.001	<0.001	<0.001	<0.001
SS 17 (15-30cm)	<0.001	<0.001	<0.001	<0.001
SS C1 (0-15cm)	<0.001	<0.001	<0.001	<0.001
SS C1 (15-30cm)	<0.001	<0.001	<0.001	<0.001
SS C2 (0-15cm)	<0.001	<0.001	<0.001	<0.001
SS C2 (15-30cm)	<0.001	<0.001	<0.001	<0.001
SS C3 (0-15cm)	<0.001	<0.001	<0.001	<0.001
SS C3 (15-30cm)	<0.001	<0.001	<0.001	<0.001

Microbiology

Sample ID	THB	THF	HUB	HUF	Feacal coliform	SRB
	(cfu/g) $x10^4$	(sfu/g) $x10^3$	cfu/g $x10^1$	sfu/g $x10^1$	MPN/100ML	(cfu/g) $x10^1$
SS1 (0-15cm)	6.70	5.00	ND	ND	13	ND
SS1 (15-30cm)	5.50	3.00	ND	ND	11	ND
SS2 (0-15cm)	8.00	3.00	ND	ND	14	ND
SS2 (15-30cm)	6.00	5.00	ND	ND	17	ND
SS3 (0-15cm)	3.05	2.00	ND	ND	12	ND
SS3 (15-30cm)	4.95	3.00	ND	ND	17	ND
SS4 (0-15cm)	5.00	2.05	ND	ND	13	ND
SS4 (15-30cm)	7.30	5.00	ND	ND	11	ND
SS5 (0-15cm)	3.40	1.50	ND	ND	17	ND
SS5 (15-30cm)	3.50	1.00	ND	ND	20	ND
SS6 (0-15cm)	5.30	3.50	ND	ND	11	ND
SS6 (15-30cm)	7.50	3.00	ND	ND	14	ND
SS7 (0-15cm)	7.05	4.05	ND	ND	13	ND

Sample ID	THB	THF	HUB	HUF	Feacal coliform	SRB
	(cfu/g) $x10^4$	(sfu/g) $x10^3$	cfu/g $x10^1$	sfu/g $x10^1$	MPN/100ML	(cfu/g) $x10^1$
SS7 (15-30cm)	6.50	4.50	ND	ND	14	ND
SS8 (0-15cm)	6.00	4.50	ND	ND	17	ND
SS8 (15-30cm)	6.05	3.00	ND	ND	25	ND
SS9 (0-15cm)	7.50	1.05	ND	ND	11	ND
SS9 (15-30cm)	7.00	5.00	ND	ND	25	ND
SS10 (0-15cm)	8.10	3.05	ND	ND	17	ND
SS 10 (15-30cm)	8.50	3.00	ND	ND	13	ND
SS11 (0-15cm)	5.05	2.15	ND	ND	11	ND
SS11 (15-30cm)	3.90	2.50	ND	ND	26	ND
SS12 (0-15cm)	3.95	2.05	ND	ND	21	ND
SS12 (15-30cm)	2.05	1.05	ND	ND	17	ND
SS 13 (0-15cm)	4.60	3.50	ND	ND	21	ND
SS 13 (15-30cm)	6.40	2.15	ND	ND	11	ND
SS 14 (0-15cm)	6.00	5.40	ND	ND	14	ND
SS 14 (15-30cm)	5.50	2.50	ND	ND	17	ND
SS 15 (0-15cm)	3.50	1.00	ND	ND	11	ND
SS 15 (15-30cm)	4.10	2.00	ND	ND	15	ND
SS 16 (0-15cm)	5.50	2.50	ND	ND	11	ND
SS 16 (15-30cm)	5.00	2.50	ND	ND	26	ND
SS 17 (0-15cm)	4.50	2.00	ND	ND	11	ND
SS 17 (15-30cm)	5.00	4.00	ND	ND	20	ND
SS C1 (0-15cm)	5.00	4.80	ND	ND	17	ND
SS C1 (15-30cm)	5.35	3.30	ND	ND	13	ND
SS C2 (0-15cm)	4.00	2.85	ND	ND	21	ND
SS C2 (15-30cm)	1.45	3.00	ND	ND	17	ND
SS C3 (0-15cm)	2.00	1.50	ND	ND	11	ND

Sample ID	THB	THF	HUB	HUF	Feacal coliform	SRB
	(cfu/g) $x10^4$	(sfu/g) $x10^3$	cfu/g $x10^1$	sfu/g $x10^1$	MPN/100ML	(cfu/g) $x10^1$
SS C3 (15-30cm)	7.00	2.00	ND	ND	25	ND

SUMMARY TOP SOIL RESULT

	SS1 (0-15cm)	SS2 (0-15cm)	SS3 (0-15cm)	SS4 (0-15cm)	SS5 (0-15cm)	SS6 (0-15cm)	SS7 (0-15cm)	SS8 (0-15cm)	SS9 (0-15cm)	SS10 (0-15cm)	SS11 (0-15cm)	SS12 (0-15cm)	SS 13 (0-15cm)	SS 14 (0-15cm)	SS 15 (0-15cm)	SS 16 (0-15cm)	SS 17 (0-15cm)	Control	Min	Max	Average	St Dev
pH	5.58	6.1	5.3	5.6	6	6.3	5.72	5.8	6.01	6.01	5.9	5.8	5.9	6.01	5.9	5.8	6.1	5.79	5.1	6.2	5.65	0.55
Temp.	26.4	25.8	26.1	25.9	25.7	26.2	25.8	25.7	25.8	25.7	25.8	25.7	25.6	25.8	26	25.9	25.8	25.96	25.5	26.1	25.8	0.3
Cond.	75.45	83.5	74.5	62.5	65.35	82.2	70.5	55.1	65.7	51.37	62.19	53.16	78.5	64	61.35	50.1	50.5	66.38	52.1	90.05	71.075	18.975
Redox Pot.	100.2	109.4	113.5	110.5	140.2	110.2	120	151.5	120.5	110	115.5	129.8	140.5	115	120	130.2	114	130.9	105.5	140.5	123	17.5
TOC	1.25	1.15	0.93	1.84	1.29	1.49	1.6	1.29	1.84	1.26	1.11	1.16	1.04	1.84	1.22	0.93	1.13	1.54	1.04	13.1	7.07	6.03
Colour	Brown	Light Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	0
Permeability	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	0
Texture	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	0
Grain size	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0
Porosity	67	66	67	66	66	66	63	68	65	64	66	67	68	65	66	68	67	66.2	63	69	66	3
Sulphate	74.44	55.03	90.17	52.37	95.29	105.1	75.4	59.22	88.09	76.94	85.09	84.26	85.69	65.33	81.33	73.37	86.33	88.11	55.86	96.94	76.4	20.54
Phosphate	0.953	1.184	1.401	0.958	1.069	1.037	0.982	1.095	0.935	0.869	1.018	0.978	1.208	0.95	0.898	0.927	0.957	0.96	0.853	1.343	1.098	0.245
Total-Nitrogen	21.21	24.1	20.09	26.69	23.67	29.9	23.75	27.66	24.07	25.56	23.03	26.45	26.3	24.31	20.59	25.25	26.48	23.56	21.73	28.23	24.98	3.25
Nitrate	10.08	12.05	9.52	12.82	10.1	14.33	12.69	14.41	11.78	12.12	10.47	14.25	12.24	11.55	9.542	12.98	13.85	11.15	9.125	13.92	11.5225	2.397

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Nitrite	0.079	0.06	0.05	0.085	0.07	0.084	0.065	0.05	0.094	0.089	0.07	0.103	0.09	0.119	0.094	0.074	0.11	0.12	0.035	0.129	0.082	0.047
Carbonate	89.1	59.9	59.1	58.1	88.3	58.01	59.1	89.5	89.18	88.1	59.05	60	59.09	88.14	60	58.95	59.62	89.45	58.02	89.72	73.87	15.85
Ammonium	11.05	11.99	10.52	13.78	13.5	15.49	10.99	13.2	12.2	13.35	12.49	12.1	13.97	12.64	10.95	12.2	12.52	12.29	11.42	14.41	12.915	1.4 95
Sodium	32.57	43.42	32.57	32.57	21.71	32.57	32.57	21.71	32.57	21.71	32.57	21.71	43.42	32.51	32.57	21.71	32.57	34.72	21.71	54.28	37.995	16.285
Potassium	3.458	3.201	4.658	2.254	3.41	3.314	2.915	2.022	2.345	2.842	3.454	2.325	2.304	3.014	3.25	2.256	2.223	2.1	2.045	3.545	2.795	0.75
Calcium	32.06	24.05	24.05	32.06	16.03	24.05	24.05	8.02	24.05	16.03	24.05	8.02	24.05	32.06	24.05	16.03	24.05	25.65	8.02	32.06	20.04	12.02
Magnesium	19.36	14.52	14.52	19.36	9.68	14.52	14.52	4.84	14.52	9.68	14.52	4.84	14.52	19.36	14.52	9.68	14.52	15.49	4.84	19.36	12.1	7.26
CEC	87.45	85.19	75.8	86.24	50.83	74.45	74.06	36.59	73.49	50.26	74.59	36.9	84.29	86.94	74.39	49.68	73.36	77.96	37.15	97.97	67.56	30.41
Iron	1.802	1.824	2.601	2.584	1.841	1.51	1.814	1.988	1.968	1.78	2.621	1.621	1.628	1.701	1.617	1.671	2.599	1.98	1.716	2.871	2.2935	0.5775
Zinc	0.177	0.128	0.167	0.154	0.147	0.18	0.164	0.132	0.169	0.165	0.174	0.151	0.167	0.171	0.165	0.154	0.156	0.16	0.161	0.19	0.17 55	0.0145
Chromium	0.065	0.047	0.048	0.061	0.043	0.046	0.063	0.073	0.037	0.066	0.044	0.05	0.05	0.076	0.062	0.068	0.076	0.06	0.013	0.084	0.0485	0.0355
Lead	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
Cadmium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
Mercury	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
Vanadium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
Nickel	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
Barium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
TPH(total)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
BTEX	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
THC	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
O;G	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
THB	6.7	8	3.05	5	3.4	5.3	7.05	6	7.5	8.1	5.05	3.95	4.6	6	3.5	5.5	4.5	3.56	2.05	8.5	5.27	3.2

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THF	5	3	2	2.05	1.5	3.5	4.05	4.5	1.05	3.05	2.15	2.05	3.5	5.4	1	2.5	2	3.09	1	5	3	2
HUB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0
HUF	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0
Feacal coliform	13	14	12	13	17	11	13	17	11	17	11	21	21	14	11	11	11	15.8	11	26	18.5	7.5
SRB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0

SUMMARY SUB SOIL RESULT

	SS1 (15-30cm)	**SS2 (15-30cm)**	**SS3 (15-30cm)**	**SS4 (15-30cm)**	**SS5 (15-30cm)**	**SS6 (15-30cm)**	**SS7 (15-30cm)**	**SS8 (15-30cm)**	**SS9 (15-30cm)**	**SS 10 (15-30cm)**	**SS11 (15-30cm)**	**SS12 (15-30cm)**	**SS 13 (15-30cm)**	**SS 14 (15-30cm)**	**SS 15 (15-30cm)**	**SS 16 (15-30cm)**	**SS 17 (15-30cm)**	**Control**	**Min**	**Max**	**Average**	**Std ev**
pH	5.8	6.05	5.1	5.73	6.1	6.2	5.9	5.7	6.1	6.2	5.85	5.69	6.1	6.1	5.95	5.68	6.2	5.81	5.1	6.2	5.65	0.55
Temp.	25.9	26	26.1	25.8	26	25.9	25.6	25.7	25.6	25.8	25.9	25.5	25.7	25.8	26.1	25.9	26	25.91	25.5	26.1	25.8	0.3
Cond.	79.5	60.2	90.05	60.1	80.1	80.4	81	60.25	63.45	55.89	65	57.2	87	68.2	65.9	52.1	63.4	67.16	52.1	90.05	71.075	18.975
Redox Pot.	105.5	110.8	114	120	130.5	116	112.5	140.5	119	120	118.2	137.5	139	113.5	125.7	135.5	118.2	132.48	105.5	140.5	123	17.5
TOC	1.31	1.22	1.04	1.87	1.37	1.62	1.66	1.76	1.95	1.38	1.69	1.24	13.1	1.87	1.32	1.04	1.87	1.45	1.04	13.1	7.07	6.03
Colour	Brown	Light Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	0
Permeability	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	0
Texture	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	0
Grain size	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0.1-2	0
Porosity	68	66	67	66	67	66	64	69	64	63	64	66	66	67	66	69	68	66.87	63	69	66	3
Sulphate	81	64.36	83.55	55.86	90.07	96.94	71.19	64.56	89.47	88.07	79.36	75.77	91.05	57.35	76.43	80.46	90.26	81.48	55.86	96.94	76.4	20.54
Phosphate	1.027	1.014	1.343	0.892	1.032	1.099	1.031	1.012	0.966	0.913	0.979	0.903	1.134	1.059	0.853	0.973	1.016	0.94	0.853	1.343	1.098	0.245
Total-Nitrogen	23.12	22.31	23.77	21.73	26.45	28.23	26.02	22.37	24.47	25.7	26.43	26.08	24.05	23.19	22.19	22.69	26.16	22.76	21.73	28.23	24.98	3.25

Nitrate	10.56	10.63	11.28	9.125	13.92	13.72	13.8	10.52	11.89	11.96	12.83	13.02	10.11	10.21	10.69	10.74	12.47	10.67	9.125	13.92	11.5225	2.3975
Nitrite	0.075	0.069	0.035	0.105	0.07	0.095	0.079	0.06	0.094	0.084	0.079	0.099	0.1	0.104	0.079	0.089	0.129	0.12	0.035	0.129	0.082	0.047
Carbonate	89.18	58.02	60	59.1	89.02	60	88.2	89.72	89.3	89.02	58.1	58.87	60	89.45	59.45	58.1	60	89.37	58.02	89.72	73.87	15.85
Ammonium	12.48	11.61	12.45	12.5	12.46	14.41	12.14	11.79	12.49	13.66	13.52	12.96	13.84	12.88	11.42	11.86	13.56	11.98	11.42	14.41	12.9115	1.495
Sodium	32.57	21.71	43.42	32.57	32.57	43.42	43.42	32.57	32.57	32.57	32.57	21.71	54.28	32.57	21.71	32.57	21.71	34.71	21.71	54.28	37.9995	16.285
Potassium	3.421	3.545	3.089	3.054	2.842	2.656	3.129	2.045	2.267	2.626	2.14	2.584	2.879	2.924	3.008	2.102	2.521	2.1	2.045	3.545	2.795	0.75
Calcium	24.05	16.03	24.02	24.05	24.05	24.05	32.06	8.02	16.03	8.02	32.06	8.02	24.05	24.05	16.03	24.05	16.03	25.65	8.02	32.06	20.04	12.02
Magnesium	14.52	9.68	14.52	14.52	14.52	14.52	19.36	4.84	9.68	4.84	19.36	4.84	14.52	14.52	9.68	14.52	9.68	15.49	4.84	19.36	12.1	7.26
CEC	74.56	50.97	85.5	74.19	73.98	84.65	97.97	47.48	60.55	48.06	86.13	37.15	95.73	74.06	50.43	73.24	49.94	77.95	37.15	97.97	67.56	30.41
Iron	1.995	2.708	2.675	1.794	1.947	2.724	2.614	2.704	2.214	1.994	2.871	1.884	1.914	1.91	1.716	1.801	2.743	1.97	1.716	2.871	2.2935	0.5775
Zinc	0.161	0.179	0.179	0.184	0.161	0.186	0.168	0.174	0.171	0.171	0.18	0.163	0.17	0.19	0.182	0.169	0.175	0.16	0.161	0.19	0.1755	0.0145
Chromium	0.073	0.054	0.067	0.058	0.057	0.072	0.013	0.059	0.035	0.064	0.057	0.055	0.061	0.084	0.072	0.071	0.081	0.06	0.013	0.084	0.0485	0.0355
Lead	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
Cadmium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
Mercury	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
Vanadium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
Nickel	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
Barium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
TPH(total)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
BTEX	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
THC	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
O;G	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0
THB	5.5	6	4.95	7.3	3.5	7.5	6.5	6.05	7	8.5	3.9	2.05	6.4	5.5	4.1	5	5	3.89	2.05	8.5	5.27	3.2

																					5	25
THF	3	5	3	5	1	3	4.5	3	5	3	2.5	1.05	2.15	2.5	2	2.5	4	2.62	1	5	3	2
HUB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0
HUF	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0
Feacal colifor m	11	17	17	11	20	14	14	25	25	13	26	17	11	17	15	26	20	17.13	11	26	18.5	7.5
SRB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0

Source: Natural Eco Capital Fieldwork, 2020

Note:
LOD= limit of Detection
C= Control
ND=Not Detected

APPENDIX 4.4B: DESCRIPTIVE STATISTICS OF PHYSICO-CHEMICAL AND MICROBIAL PROPERTIES OF THE SOILS SAMPLED AT THE PROJECT AREA (WET SEASON)

SUMMARY TOP SOIL RESULT

Parameters	TS1	TS2	TS3	TS4	TS5	TS6	TS7	TS8	TS9	TS10	TS11	TS12	TS13	TS14	TS15	TS16	TS17	Min	Max	Mean	StDev	TSC1	TSC2	TSC3
pH	4.38	4.12	4.70	4.53	4.40	4.88	5.08	5.41	4.93	4.83	5.00	4.52	4.92	5.30	5.16	5.15	4.14	5.16	4.12	4.84	0.45985 2	5.20	5.57	4.12
EC	108	64	41	44	41	50	85	53	27	39	66	853	109	48	69	65	119	109	27	73	75.7337 9	76	41	100
Temp	27.2	27	27.1	26.8	27	27	26.9	27.1	27.1	26.9	27.1	26.8	26.9	27	27.2	27	26.9	27.1	26.8	26.98	0.12961 5	27.1	26.9	26.9
Nitrite	0.052	0.036	0.046	0.075	0.066	0.049	0.052	0.066	0.082	0.105	0.069	0.072	0.046	0.095	0.082	0.046	0.043	0.082	0.036	0.052	0.01643 9	0.046	0.049	0.039
Chloride	10.64	3.55	1.77	3.55	7.09	3.55	7.09	7.09	7.09	1.77	7.09	159.53	10.64	3.55	7.09	7.09	17.73	10.64	1.77	9.57	20.1223 9	7.09	3.55	10.64
Sulphate	13.15	5.27	2.64	5.27	10.52	5.27	10.52	7.89	10.52	2.64	789.00	233.86	13.15	5.27	7.89	7.89	18.41	18.41	2.64	11.4	21.1117 3	7.89	5.27	13.15
TOC	1.64	1.37	0.90	0.98	0.96	0.43	0.94	0.59	0.35	1.21	1.09	1.13	1.09	0.27	0.66	0.47	0.94	1.21	0.27	0.58	0.377	1.05	0.20	1.05
Total Phosphorous	0.019	0.013	0.016	0.026	0.023	0.017	0.019	0.023	0.028	0.040	0.024	0.025	0.016	0.033	0.028	0.016	0.015	0.028	0.013	0.018	0.00540 9	0.016	0.017	0.014
Ammonium	0.21	0.14	0.18	0.30	0.26	0.19	0.21	0.26	0.32	0.41	0.27	0.28	0.18	0.37	0.32	0.18	0.17	0.32	0.14	0.2	0.06449 9	0.18	0.19	0.16
Nitrate	0.71	0.49	0.62	1.02	0.88	0.66	0.71	0.88	1.11	1.41	0.93	0.97	0.62	1.28	1.11	0.62	0.58	1.11	0.49	0.7	0.22131 7	0.62	0.66	0.53
Total Nitrogen	0.16	0.11	0.14	0.23	0.20	0.15	0.16	0.20	0.25	0.32	0.21	0.22	0.14	0.29	0.25	0.14	0.13	0.25	0.11	0.16	0.05006 6	0.14	0.15	0.12
Oil & Grease	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bulk density	1.42	1.66	2.17	2.27	2.07	2.10	1.99	1.93	2.32	2.31	1.92	1.82	2.29	1.98	2.05	2.10	1.84	2.29	1.42	2.05	0.22526	1.92	2.13	1.88

Porosity	25.3	37.4	18.1	14.3	21.9	20.8	24.9	27.2	12.5	12.8	27.5	31.3	13.2	25.3	22.6	20.8	30.6	30.6	12.5	21.9	7.12131	27.5	19.6	29.1
Percent Carbon	1.26	1.05	0.69	0.75	0.74	0.33	0.72	0.45	0.27	0.93	0.84	0.87	0.84	0.21	0.51	0.36	0.72	0.93	0.21	0.43	0.291527	0.81	0.15	0.81
CEC	13.84	10.59	8.85	11.95	10.24	5.74	9.20	9.86	15.33	13.96	7.48	13.31	17.57	9.04	10.41	14.44	12.92	9.20	10.24	12.06	2.968301	13.04	13.31	17.21
Sand	2	5	79	75	79	84	84	82	79	80	84	84	79	81	83	81	86	84	2	72.12	25.15762	81	86	78
Silt	85	77	14	18	13	9	7	10	12	8	4	6	9	9	7	7	4	4	85	17.56	23.13626	8	6	11
Clay	13	18	7	7	8	7	9	8	9	12	12	10	12	10	10	12	10	7	18	10.32	4.115532	11	8	11
Cu	6.21	7.89	5.69	9.43	10.53	6.43	3.29	5.47	0.86	2.45	3.64	2.31	1.10	0.69	2.05	3.52	0.46	0.46	10.53	3.39	3.044775	1.90	0.75	1.03
Fe	12651	17605	9533	9760	7465	9438	8778	6463	3658	7489	5109	7134	6182	6340	6562	33615	7160	3658	33615	7866	5972.799	3149	4999	5563
Ni	4.45	7.32	1.12	2.64	0.55	0.52	0.23	0.21	0.40	1.94	2.45	2.10	0.57	1.44	3.40	1.56	0.64	1.56	7.32	1.44	1.669898	1.26	0.55	0.63
Zn	20.18	15.39	21.45	13.25	17.70	23.42	13.22	30.10	21.45	13.20	29.45	20.11	30.84	19.60	34.25	26.49	19.58	13.20	34.25	20.66	7.054775	18.88	17.80	15.35
Pb	2.19	2.85	1.45	1.32	4.57	0.86	3.86	0.75	2.11	3.29	1.46	2.10	2.18	3.26	1.74	0.77	2.15	0.75	4.57	1.98	1.185974	3.25	0.89	0.73
Mn	28.40	39.35	59.75	12.31	7.03	20.43	9.40	12.77	6.60	8.16	16.40	16.84	10.86	14.33	12.19	7.43	11.03	6.60	59.75	14.93	11.82064	14.28	10.10	7.11
Cd	0.86	0.23	0.30	0.12	1.07	0.60	0.78	0.55	0.16	1.25	0.46	1.32	0.45	0.30	0.79	1.10	1.07	0.12	1.32	0.56	0.392458	0.32	0.25	0.26
Cr	0.90	2.75	1.00	0.80	1.35	2.35	1.68	2.30	1.26	2.59	3.39	3.09	1.86	1.67	2.58	3.11	0.54	0.54	3.39	1.73	0.971006	1.00	1.97	0.99
Ba	1.18	2.15	1.30	1.86	0.34	1.52	0.95	1.24	0.42	1.35	1.44	2.65	0.88	2.65	1.32	1.04	0.85	0.34	2.65	1.28	0.690994	1.00	0.78	0.86
V	<0.001	0.14	0.06	<0.001	0.14	0.12	<0.001	0.09	0.17	<0.001	<0.001	<0.001	0.07	0.13	<0.001	<0.001	0.20	<0.0001	0.20	0.11	0.031241	<0.001	<0.001	<0.001
Hg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.001	<0.001	0	<0.001	<0.001	<0.001

Na	2.36	1.78	1.59	1.80	1.98	2.98	2.44	1.12	0.91	1.24	1.93	0.53	1.06	1.50	0.85	0.60	0.71	0.53	2.98	1.26	0.690754	0.54	1.21	1.89
K	1.01	0.36	1.19	0.43	0.19	1.20	0.10	0.33	0.22	0.23	1.18	0.12	0.41	0.47	0.18	1.11	0.25	0.10	1.20	0.62	0.481811	0.18	0.46	0.34
Ca	4.46	3.64	2.86	2.21	5.86	1.22	3.89	2.20	2.91	2.23	3.99	1.90	4.86	2.16	2.35	2.57	3.76	1.22	5.86	3.48	1.236175	4.24	3.44	5.77
Mg	2.01	1.81	3.21	1.51	2.21	2.34	2.77	1.21	1.29	1.26	1.38	0.76	1.24	0.91	1.03	1.16	1.20	1.38	3.21	1.63	0.742356	1.08	1.20	2.21
TPH(total)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BTEX	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
THC	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
THB	6.5×10^4	7.6×10^4	9.7×10^4	5.2×10^4	6.4×10^4	7.3×10^4	5.8×10^4	6.6×10^4	10.1×10^4	6.8×10^4	4.5×10^4	6.4×10^4	3.2×10^4	5.7×10^4	6.1×10^4	4.0×10^4	6.8×10^4	10.1	9.7	9.4	0.351188	4.8×10^4	4.9×10^4	7.6×10^4
THF	4.3×10^3	5.3×10^3	6.2×10^3	3.2×10^3	7.0×10^3	6.8×10^3	5.6×10^3	5.3×10^3	3.2×10^3	4.6×10^3	3.3×10^3	3.7×10^3	4.8×10^3	3.6×10^3	4.0×10^3	5.2×10^3	7.6×10^3	3.2	7.6	5.4	2.2	4.0×10^3	4.0×10^3	4.0×10^3
HUB	1.2×10^2	1.0×10^2	0.4×10^2	1.5×10^2	1.4×10^2	1.3×10^2	1.6×10^2	1.4×10^2	0.8×10^2	1.7×10^2	1.0×10^2	1.0×10^2	1.7×10^2	0.2×10^2	1.2×10^2	0.7×10^2	2.0×10^2	0.2	2	1.1	0.9	2.2×10^2	0.2×10^2	1.7×10^2
HUF	0.4×10^2	0.7×10^2	Nil	0.5×10^2	0.6×10^2	1.0×10^2	1.0×10^2	1.0×10^2	0.2×10^2	1.1×10^2	0.7×10^2	0.6×10^2	1.0×10^2	Nil	0.4×10^2	0.3×10^2	1.1×10^2	0	1.1	0.55	0.55	1.4×10^2	Nil	0.9×10^2

SUMMARY SUB SOIL RESULT

Parameters	**SS 1**	**SS 2**	**SS 3**	**SS 4**	**SS 5**	**SS 6**	**SS 7**	**SS 8**	**SS 9**	**SS 10**	**SS 11**	**SS 12**	**SS 13**	**SS 14**	**SS 15**	**SS 16**	**SS 17**	**Min**	**Max**	**Mean**	**StDev**	**SSC1**	**SSC2**	**SSC3**
pH	4.43	4.08	4.64	4.54	4.30	5.12	5.15	5.24	4.64	4.81	5.14	4.54	4.82	5.29	5.21	5.34	4.50	4.08	5.34	4.86	0.63592	5.34	5.46	4.19
EC	69	68	43	42	42	30	39	127	27	49	46	421	58	35	51	45	75	27	421	113	207.162	90	32	72
Temperature	26.8	27.1	26.9	27	27	26.8	26.7	27.1	27	26.8	27.1	26.9	27	26.9	27.1	27.2	27.1	26.7	27.2	27.00833	0.25226	27.1	27.1	27
Nitrite	0.049	0.030	0.043	0.059	0.062	0.043	0.049	0.062	0.059	0.089	0.059	0.052	0.043	0.092	0.069	0.036	0.039	0.03	0.092	0.059	0.03102	0.039	0.043	0.033
Chloride	7.09	7.09	7.09	1.77	1.77	1.77	1.77	17.73	3.55	3.55	3.55	106.35	7.09	1.77	3.55	3.55	7.09	1.77	106.35	17.21	56.4525	10.64	1.77	7.09

Sulphate	7.89	7.89	7.89	2.64	2.64	2.64	2.64	18.41	5.27	5.27	5.27	110.37	7.89	2.64	5.27	5,27	10.52	2.64	5.27	3.96	1.315	10.52	2.64	7.89
TOC	0.98	1.13	0.78	0.23	0.39	0.16	0.47	0.23	0/16	1.17	0.94	1.01	0.51	0.23	0.39	0.16	0.43	0.16	0.98	0.79	0.42922	0.31	0.08	0.47
Total Phosphorous	0.018	0.011	0.015	0.021	0.022	0.015	0.017	0.022	0.021	0.030	0.021	0.019	0.015	0.031	0.024	0.013	0.014	0.011	0.031	0.021	0.01	0.014	0.015	0.012
Ammonium	0.19	0.12	0.17	0.23	0.25	0.17	0.19	0.25	0.23	0.35	0.23	0.21	0.17	0.36	0.27	0.14	0.16	0.12	0.36	0.23	0.12014	0.16	0.17	0.13
Nitrate	0.66	0.40	0.58	0.80	0.84	0.58	0.66	0.84	0.80	1.19	0.80	0.71	0.58	1.24	0.93	0.49	0.53	0.4	1.24	0.79	0.42036	0.53	0.58	0.44
Total Nitrogen	0.15	0.09	0.13	0.18	0.19	0.13	0.15	0.19	0.18	0.27	0.18	0.16	0.13	0.28	0.21	0.11	0.12	0.09	0.28	0.18	0.09504	0.12	0.13	0.10
Oil & Grease	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001
Bulk density	1.54	1.92	2.37	2.03	2.09	2.18	2.08	2.15	2.34	2.15	1.94	2.20	1.88	2.41	2.13	2.12	2.02	1.54	2.15	2.02	0.3213	1.99	2.12	1.96
Porosity	41.9	27.5	10.6	23.4	21.1	17.1	21.5	18.7	11.7	18.7	26.8	17.0	29.1	9.10	19.6	20.0	23.8	9.1	41.9	23.3	16.4491	24.9	20.0	26.0
Percent Carbon	0.75	0.87	0.60	0.18	0.30	0.12	0.36	0.18	0.12	0.90	0.72	0.78	0.39	0.18	0.29	0.12	0.33	0.12	0.9	0.57	0.39154	0.24	0.06	0.36
CEC	14.16	8.95	9.58	9.84	12.61	6.98	7.50	10.69	15.47	10.73	8.24	16.50	15.27	12.78	11.23	15.06	10.20	6.98	16.5	12.11	4.76479	10.54	15.89	16.20
Sand	3	11	63	80	76	85	85	85	81	78	85	87	76	82	84	82	84	3	87	75.21	45.4776	78	83	84
Silt	76	74	29	15	15	12	9	8	10	3	5	2	16	8	8	8	5	2	76	14.13	39.6884	11	7	4
Clay	21	15	8	5	9	3	6	7	9	19	10	11	8	10	8	10	11	3	21	10.33	9.0515	11	10	12
Cu	4.84	8.46	7.99	6.84	8.83	5.83	2.85	4.10	0.56	1.99	5.82	3.16	0.97	1.68	2.11	0.87	1.58	0.56	8.83	3.36	4.20622	0.86	0.27	0.54
Fe	13303	11965	10973	8591	8310	9390	6230	7520	6463	8108	4362	9925	7921	4198	4958	2759	8640	2759	13303	8088	5272.1	3064	3988	4991
Ni	2.68	5.48	0.79	2.02	0.37	0.18	0.47	0.23	0.18	1.02	1.94	0.43	1.85	0.26	2.57	1.52	0.33	0.18	5.48	1.57	2.74804	1.84	0.40	0.20
Zn	19.67	14.00	22.81	10.84	15.39	19.67	15.35	33.92	15.77	34.39	18.50	15.72	28.76	21.48	35.83	23.30	20.22	10.84	35.83	20.82	12.5791	16.35	18.62	16.49
Pb	3.00	0.97	0.87	3.28	2.99	0.94	4.00	0.80	3.25	2.91	2.00	1.26	1.90	2.80	1.32	1.06	1.38	0.8	4	2.04	1.61344	3.17	1.09	0.40
Mn	33.65	32.80	28.35	9.69	10.55	18.36	5.30	11.40	7.32	10.10	14.52	12.66	8.59	15.07	8.52	8.08	9.95	5.3	33.65	15.24	14.3843	12.38	9.46	8.56
Cd	0.54	0.33	1.20	0.53	1.33	0.21	0.32	0.18	0.37	0.84	0.19	1.10	0.65	0.22	0.65	1.25	0.87	0.18	1.33	0.58	0.58381	0.47	0.31	0.19
Cr	0.79	2.54	1.95	0.94	1.60	3.00	1.74	3.20	1.32	4.20	2.16	2.50	2.00	0.90	2.17	0.78	0.86	0.78	4.2	1.83	1.75194	1.45	0.54	0.68
Ba	0.91	2.43	0.90	2.14	0.40	1.69	0.70	0.86	0.64	1.20	2.19	2.47	1.02	2.50	1.25	0.97	1.24	1.25	2.5	1.3	0.7077	1.20	0.63	0.92
V	<0.001	0.09	<0.001	0.12	0.08	0.11	<0.001	0.11	0.10	<0.001	<0.001	<0.001	0.10	0.10	<0.001	0.11	<0.001	<0.001	<0.001	<0.001	0	<0.001	<0.001	<0.001

Hg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0001	0	<0.001	<0.001	<0.001
Na	2.73	1.45	1.63	0.76	1.14	2.74	0.97	1.21	0.81	1.66	0.85	1.09	1.79	0.92	0.72	0.66	0.58	0.58	2.74	1.36	1.0938	0.68	1.13	0.79
K	1.13	0.22	0.65	0.16	1.25	1.11	1.31	0.36	0.20	0.11	0.22	0.33	0.50	0.32	1.14	0.15	0.16	0.11	1.31	0.6	0.60335	1.13	1.57	1.28
Ca	4.33	3.99	4.98	3.28	4.94	2.02	2.06	2.87	3.12	4.40	1.68	2.87	3.79	2.28	2.41	2.32	3.81	1.68	4.98	3.33	1.65	2.54	4.87	3.86
Mg	1.97	2.29	2.32	1.64	1.28	1.11	1.16	3.25	1.34	2.56	0.49	2.21	0.19	1.26	0.96	1.20	1.65	0.19	3.25	1.58	1.53213	1.19	1.32	2.27
TPH(total)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BTEX	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
THC	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
THB	4.6×10^4	5.2×10^4	7.2×10^4	3.8×10^4	4.8×10^4	4.3×10^4	4.4×10^4	5.1×10^4	7.3×10^4	6.5×10^4	3.6×10^4	4.5×10^4	2.4×10^4	3.2×10^4	3.8×10^4	3.2×10^4	5.1×10^4	2.4	7.3	4.85	2.45	2.6×10^4	2.8×10^4	4.7×10^4
THF	3.2×10^3	3.8×10^3	4.1×10^3	3.0×10^3	5.3×10^3	4.2×10^3	3.8×10^3	4.2×10^3	5.0×10^3	5.2×10^3	4.2×10^3	5.6×10^3	2.2×10^3	2.9×10^3	2.8×10^3	4.6×10^3	5.2×10^3	2.2	5.6	3.9	1.7	6.8×10^3	5.6×10^3	2.2×10^3
HUB	0.6×10^2	0.7×10^2	1.0×10^2	0.3×10^2	0.8×10^2	0.6×10^2	0.7×10^2	0.2×10^2	1.0×10^2	1.3×10^2	1.2×10^2	1.8×10^2	0.8×10^2	Nil	0.9×10^2	Nil	0.8×10^2	0	1.8	0.9	0.9	0.5×10^2	1.3×10^2	0.7×10^2
HUF	0.2×10^2	0.2×10^2	0.8×10^2	Nil	0.2×10^2	Nil	0.2×10^2	Nil	0.8×10^2	1.0×10^2	0.7×10^2	1.2×10^2	0.2×10^2	Nil	0.3×10^2	Nil	0.3×10^2	0	1.2	0.6	0.6	0.2×10^2	0.4×10^2	0.3×10^2

Source: Natural Eco Capital Fieldwork, 2020

Note:

LOD= limit of Detection

C= Control

ND=Not Detected

APPENDIX 4.5: SURFACE WATER SAMPLES (WET SEASON)

Physico-chemical

Sample	Colour	Alkalinity	Conductivity	pH	Temp.	Total Hardness	COD	BOD	DO	Salinity	TSS	TDS	Turbidity	Redox Potential
	Pt/Co	mg/L	µs/cm		^{0}C	mg/L	mg/L	mg/L	mg/L	psu	mg/L	mg/L	NTU	mV
SW 1	1	Nil	91.1	6.33	24.6	25.0	8.00	1.83	4.22	0.06	0.06	45.5	0.1	45.5
SW 2	1	Nil	72.9	6.38	24.6	20.0	8.00	1.95	4.40	0.05	0.95	36.5	1.8	36.5
SW 3	1	Nil	72.6	6.26	24.6	20.0	8.00	2.21	4.63	0.04	1.10	36.3	2.1	36.3
SW C	1	Nil	69.8	6.07	24.6	16.0	8.00	2.10	4.56	0.04	1.24	34.9	2.4	34.9
Min	**1**	**Nil**	**72.6**	**6.26**	**24.6**	**20**	**8**	**1.83**	**4.22**	**0.04**	**0.06**	**36.3**	**0.1**	**36.3**
Max	**1**	**Nil**	**91.1**	**6.38**	**24.6**	**25**	**8**	**2.21**	**4.63**	**0.06**	**1.1**	**45.5**	**2.1**	**45.5**
Average	**1**	**Nil**	**81.85**	**6.32**	**24.6**	**22.5**	**8**	**2.02**	**4.425**	**0.05**	**0.58**	**40.9**	**1.1**	**40.9**

Exchangeable Cations and Anions

Sample ID	Phosphate	Sulphate	Nitrate	Chloride	Calcium	Ammonium	Potassium	Sodium	Carbonate	Magnesium
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
SW 1	0.168	6.452	1.832	16.73	4.81	0.509	1.358	10.86	Nil	2.90
SW 2	0.164	6.974	1.364	12.55	4.81	0.341	1.202	8.14	Nil	2.90
SW 3	0.175	6.432	1.370	8.37	3.21	0.346	1.148	5.43	Nil	1.94
SW C	0.176	4.718	1.869	6.27	3.21	0.564	1.031	4.07	Nil	1.94
Min	**0.164**	**6.432**	**1.364**	**8.37**	**3.21**	**0.341**	**1.148**	**5.43**	**Nil**	**1.94**
Max	**0.175**	**6.974**	**1.832**	**16.73**	**4.81**	**0.509**	**1.358**	**10.86**	**Nil**	**2.9**
Average	**0.1695**	**6.703**	**1.598**	**12.55**	**4.01**	**0.425**	**1.253**	**8.145**	**Nil**	**2.42**

Heavy Metals

Sample ID	Iron	Zinc	Manganese	Copper	Chromium	Lead	Cadmium	Mercury	Vanadium	Nickel	Barium
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
SW 1	0.621	0.410	0.214	0.147	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SW 2	0.578	0.431	0.233	0.135	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

SW 3	0.419	0.478	0.219	0.132	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SW C	0.522	0.422	0.217	0.133	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Min	**0.419**	**0.41**	**0.214**	**0.132**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
Max	**0.621**	**0.478**	**0.233**	**0.147**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
Average	**0.52**	**0.444**	**0.2235**	**0.1395**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**

Organics

Sample ID	PAHs	TPH	Oil & Grease	THC
	mg/L	mg/L	mg/L	mg/L
SW 1	<0.001	<0.001	<0.001	<0.001
SW 2	<0.001	<0.001	<0.001	<0.001
SW 3	<0.001	<0.001	<0.001	<0.001
SWC	<0.001	<0.001	<0.001	<0.001
Min	**<0.001**	**<0.001**	**<0.001**	**<0.001**
Max	**<0.001**	**<0.001**	**<0.001**	**<0.001**
Average	**<0.001**	**<0.001**	**<0.001**	**<0.001**

Microbiology

Sample ID	THB	THF	HUB	HUF	Feacal coliform
	cfu/ml ($x10^3$)	sfu/ml ($x10^2$)	cfu/ml ($x10^1$)	sfu/ml ($x10^1$)	MPN/100ML
SW 1	4.11	2.15	ND	ND	3.6
SW 2	3.24	2.00	ND	ND	3.6
SW 3	3.18	1.87	ND	ND	2.0
SWC	3.11	134	ND	ND	2.0
Min	**3.18**	**1.87**	**ND**	**ND**	**2**
Max	**4.11**	**2.15**	**ND**	**ND**	**3.6**
Average	**3.645**	**2.01**	**ND**	**ND**	**2.8**

SUMMARY OF SURFACE WATER DATA

Sample		SW 1	SW 2	SW 3	SW C	Min	Max	Average	Stdev
Colour	Pt/Co	1	1	1	1	**1**	**1**	**1**	**0**
Alkalinity	mg/L	Nil	Nil	Nil	Nil	**Nil**	**Nil**	**Nil**	**0**
Conductivity	µs/cm	91.1	72.9	72.6	69.8	**72.6**	**91.1**	**81.85**	**9.25**
pH		6.33	6.38	6.26	6.07	**6.26**	**6.38**	**6.32**	**0.06**
Temp.	^{0}C	24.6	24.6	24.6	24.6	**24.6**	**24.6**	**24.6**	**4.35E-15**
Total Hardness	mg/L	25	20	20	16	**20**	**25**	**22.5**	**2.5**
COD	mg/L	8	8	8	8	**8**	**8**	**8**	**0**
BOD	mg/L	1.83	1.95	2.21	2.1	**1.83**	**2.21**	**2.02**	**0.19**
DO	mg/L	4.22	4.4	4.63	4.56	**4.22**	**4.63**	**4.425**	**0.205**
Salinity	psu	0.06	0.05	0.04	0.04	**0.04**	**0.06**	**0.05**	**0**
TSS	mg/L	0.06	0.95	1.1	1.24	**0.06**	**1.1**	**0.58**	**0.52**
TDS	mg/L	45.5	36.5	36.3	34.9	**36.3**	**45.5**	**40.9**	**0**
Turbidity	NTU	0.1	1.8	2.1	2.4	**0.1**	**2.1**	**1.1**	**1**
Redox Potential	mV	45.5	36.5	36.3	34.9	**36.3**	**45.5**	**40.9**	**4.6**
Phosphate	mg/L	0.168	0.164	0.175	0.176	**0.164**	**0.175**	**0.1695**	**0.0055**
Sulphate	mg/L	6.452	6.974	6.432	4.718	**6.432**	**6.974**	**6.703**	**0.271**
Nitrate	mg/L	1.832	1.364	1.37	1.869	**1.364**	**1.832**	**1.598**	**0.234**
Chloride	mg/L	16.73	12.55	8.37	6.27	**8.37**	**16.73**	**12.55**	**4.18**
Calcium	mg/L	4.81	4.81	3.21	3.21	**3.21**	**4.81**	**4.01**	**0.8**
Ammonium	mg/L	0.509	0.341	0.346	0.564	**0.341**	**0.509**	**0.425**	**0.084**
Potassium	mg/L	1.358	1.202	1.148	1.031	**1.148**	**1.358**	**1.253**	**0.105**
Sodium	mg/L	10.86	8.14	5.43	4.07	**5.43**	**10.86**	**8.145**	**0**
Carbonate	mg/L	Nil	Nil	Nil	Nil	**Nil**	**Nil**	**Nil**	**0**
Magnesium	mg/L	2.9	2.9	1.94	1.94	**1.94**	**2.9**	**2.42**	**0.48**
Iron	mg/L	0.621	0.578	0.419	0.522	**0.419**	**0.621**	**0.52**	**0.101**
Zinc	mg/L	0.41	0.431	0.478	0.422	**0.41**	**0.478**	**0.444**	**0.034**
Manganese	mg/L	0.214	0.233	0.219	0.217	**0.214**	**0.233**	**0.2235**	**0.0095**
Copper	mg/L	0.147	0.135	0.132	0.133	**0.132**	**0.147**	**0.1395**	**0**
Chromium	mg/L	<0.001	<0.001	<0.001	<0.001	**<0.001**	**<0.001**	**<0.001**	**0**
Lead	mg/L	<0.001	<0.001	<0.001	<0.001	**<0.001**	**<0.001**	**<0.001**	**0**

Cadmium	mg/L	<0.001	<0.001	<0.001	<0.001	**<0.001**	**<0.001**	**<0.001**	**0**
Mercury	mg/L	<0.001	<0.001	<0.001	<0.001	**<0.001**	**<0.001**	**<0.001**	**0**
Vanadium	mg/L	<0.001	<0.001	<0.001	<0.001	**<0.001**	**<0.001**	**<0.001**	**0**
Nickel	mg/L	<0.001	<0.001	<0.001	<0.001	**<0.001**	**<0.001**	**<0.001**	**0**
Barium	mg/L	<0.001	<0.001	<0.001	<0.001	**<0.001**	**<0.001**	**<0.001**	**0**
PAHs	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0**
TPH	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0**
Oil & Grease	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0**
THC	mg/L	0.095	0.058	0.053	0.044	**0.053**	**0.095**	**0.074**	**0.021**
THB	cfu/ml ($x10^3$)	4.11	3.24	3.18	3.11	**3.18**	**4.11**	**3.645**	**0.465**
THF	sfu/ml ($x10^2$)	2.15	2	1.87	134	**1.87**	**2.15**	**2.01**	**0.14**
HUB	cfu/ml ($x10^1$)	ND	ND	ND	ND	**ND**	**ND**	**ND**	**0**
HUF	sfu/ml ($x10^1$)	ND	ND	ND	ND	**ND**	**ND**	**ND**	**0**
Feacal coliform	MPN/100ML	3.6	3.6	2	2	**2**	**3.6**	**2.8**	**0.8**

Appendix 4.6: SEDIMENT SAMPLES (WET SEASON)

Table 22: Physico-chemical

Sample ID	Conductivity	pH	Redox Potential	TOC	Salinity	Particle Size		
	µs/cm		mV	%	psu	Soil	Clay	Silt
						%	%	%
SED 1	135	6.02	120.1	1.23	0.09	87	8	5
SED 2	139	6.19	113.5	1.19	0.09	90	7	3
SED 3	87.6	5.70	125.0	1.06	0.06	88	8	4
SED C	131	5.52	151.5	1.76	0.09	90	7	3
Min	**87.6**	**5.7**	**113.5**	**1.06**	**0.06**	**87**	**7**	**3**
Max	**139**	**6.19**	**125**	**1.23**	**0.09**	**90**	**8**	**5**
Average	**113.3**	**5.945**	**119.25**	**1.145**	**0.075**	**88.5**	**7.5**	**4**

Table 23: Exchangeable Cations and Anions

Sample ID	Phosphate	Sulphate	Nitrate	Chloride	Ammonium	Calcium	Potassium	Sodium	Carbonate	Magnesium
	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
SED 1	1.209	134.6	14.85	50.20	15.49	16.03	3.777	32.57	90.00	9.68
SED 2	1.042	139.6	14.01	50.20	14.64	24.05	4.214	32.57	89.47	14.52
SED 3	1.112	120.0	14.16	33.47	15.43	40.08	5.451	43.42	89.89	24.20
SED C	1.078	97.22	14.20	50.20	15.85	32.06	5.147	32.57	88.74	19.36
Min	**1.042**	**120**	**14.01**	**33.47**	**14.64**	**16.03**	**3.777**	**32.57**	**89.47**	**9.68**
Max	**1.209**	**139.6**	**14.85**	**50.2**	**15.49**	**40.08**	**5.451**	**43.42**	**90**	**24.2**
Average	**1.1255**	**129.8**	**14.43**	**41.835**	**15.065**	**28.055**	**4.614**	**37.995**	**89.735**	**16.94**

Table 24: Heavy Metals

Sample ID	Iron	Zinc	Copper	Chromium	Lead	Cadmium	Mercury	Vanadium	Nickel	Barium
	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
SED 1	2.147	0.542	0.141	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SED 2	2.125	0.413	0.121	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SED 3	2.146	0.487	0.107	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SED C	2.201	0.461	0.112	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Min	**2.125**	**0.413**	**0.107**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**

Max	**2.147**	**0.542**	**0.141**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
Average	**2.136**	**0.4775**	**0.124**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**

Table 25: Organics

Sample ID	PAHs	BTEX	Oil & Grease	THC	Phenols
	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
SED 1	<0.001	<0.001	<0.001	<0.001	<0.001
SED 2	<0.001	<0.001	<0.001	<0.001	<0.001
SED 3	<0.001	<0.001	<0.001	<0.001	<0.001
SED C	<0.001	<0.001	<0.001	<0.001	<0.001
Min	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
Max	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
Average	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**

Table 26: Microbiology

Sample ID	THB	THF	HUB	HUF	Feacal coliform	SRB
	cfu/g ($x10^3$)	sfu/g($x10^2$)	cfu/g ($x10^1$)	sfu/g($x10^1$)	MPN/100ML	cfu/g ($x10^1$)
SED 1	4.30	2.00	ND	ND	11	ND
SED 2	5.00	3.30	ND	ND	12	ND
SED 3	5.00	4.30	ND	ND	8.2	ND
SED C	8.05	1.05	ND	ND	9.1	ND
Min	**4.3**	**2**	**ND**	**ND**	**8.2**	**ND**
Max	**5**	**4.3**	**ND**	**ND**	**12**	**ND**
Average	**4.65**	**3.15**	**ND**	**ND**	**10.1**	**ND**

Table 27: SUMMARY OF SEDMENT RESULT

Sample ID			SED 1	SED 2	SED 3	SED C	Min	Max	Average	Stdev
Conductivity	µs/cm		135	139	87.6	131	**87.6**	**139**	**113.3**	**25.7**
pH			6.02	6.19	5.7	5.52	**5.7**	**6.19**	**5.945**	**0.245**
Redox Potential	mV		120.1	113.5	125	151.5	**113.5**	**125**	**119.25**	**5.75**
TOC	%		1.23	1.19	1.06	1.76	**1.06**	**1.23**	**1.145**	**0.085**
Salinity	psu		0.09	0.09	0.06	0.09	**0.06**	**0.09**	**0.075**	**0.015**
Particle Size	Soil	%	87	90	88	90	**87**	**90**	**88.5**	**1.5**
	Clay	%	8	7	8	7	**7**	**8**	**7.5**	**0.5**
	Silt	%	5	3	4	3	**3**	**5**	**4**	**1**
Phosphate	mg/Kg		1.209	1.042	1.112	1.078	**1.042**	**1.209**	**1.1255**	**0.0835**
Sulphate	mg/Kg		134.6	139.6	120	97.22	**120**	**139.6**	**129.8**	**9.8**
Nitrate	mg/Kg		14.85	14.01	14.16	14.2	**14.01**	**14.85**	**14.43**	**0.42**
Chloride	mg/Kg		50.2	50.2	33.47	50.2	**33.47**	**50.2**	**41.835**	**8.365**
Ammonium	mg/Kg		15.49	14.64	15.43	15.85	**14.64**	**15.49**	**15.065**	**0.425**
Calcium	mg/Kg		16.03	24.05	40.08	32.06	**16.03**	**40.08**	**28.055**	**12.025**
Potassium	mg/Kg		3.777	4.214	5.451	5.147	**3.777**	**5.451**	**4.614**	**0.837**
Sodium	mg/Kg		32.57	32.57	43.42	32.57	**32.57**	**43.42**	**37.995**	**5.425**
Carbonate	mg/Kg		90	89.47	89.89	88.74	**89.47**	**90**	**89.735**	**0.265**
Magnesium	mg/Kg		9.68	14.52	24.2	19.36	**9.68**	**24.2**	**16.94**	**7.26**
Iron	mg/Kg		2.147	2.125	2.146	2.201	**2.125**	**2.147**	**2.136**	**0.011**
Zinc	mg/Kg		0.542	0.413	0.487	0.461	**0.413**	**0.542**	**0.4775**	**0.0645**
Copper	mg/Kg		0.141	0.121	0.107	0.112	**0.107**	**0.141**	**0.124**	**0.017**
Chromium	mg/Kg		<0.001	<0.001	<0.001	<0.001	**<0.001**	**<0.001**	**<0.001**	**0**
Lead	mg/Kg		<0.001	<0.001	<0.001	<0.001	**<0.001**	**<0.001**	**<0.001**	**0**
Cadmium	mg/Kg		<0.001	<0.001	<0.001	<0.001	**<0.001**	**<0.001**	**<0.001**	**0**
Mercury	mg/Kg		<0.001	<0.001	<0.001	<0.001	**<0.001**	**<0.001**	**<0.001**	**0**
Vanadium	mg/Kg		<0.001	<0.001	<0.001	<0.001	**<0.001**	**<0.001**	**<0.001**	**0**
Nickel	mg/Kg		<0.001	<0.001	<0.001	<0.001	**<0.001**	**<0.001**	**<0.001**	**0**
Barium	mg/Kg		<0.001	<0.001	<0.001	<0.001	**<0.001**	**<0.001**	**<0.001**	**0**
PAHs	mg/Kg		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0**
BTEX	mg/Kg		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0**
Oil & Grease	mg/Kg		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0**
THC	mg/Kg		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0**
THB	cfu/g ($x10^3$)		4.3	5	5	8.05	**4.3**	**5**	**4.65**	**0.35**
THF	sfu/g($x10^2$)		2	3.3	4.3	1.05	**2**	**4.3**	**3.15**	**1.15**
HUB	cfu/g ($x10^1$)		ND	ND	ND	ND	**ND**	**ND**	**ND**	**0**

HUF	sfu/g(x10^1)	ND	ND	ND	ND	**ND**	**ND**	**ND**	**0**
Feacal coliform	MPN/100ML	11	12	8.2	9.1	**8.2**	**12**	**10.1**	**1.9**
SRB	cfu/g (x10^1)	ND	ND	ND	ND	**ND**	**ND**	**ND**	**0**

Note:
LOD= limit of Detection; C= Control; ND=Not Detected

Appendix 4.7 -Scoping Report

ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT

SCOPING REPORT

OF THE PROPOSED EBONYI STATE INTERNATIONAL OLYMPIC STADIUM

BY

EBONYI STATE GOVERNMENT OF NIGERIA

MINISTRY OF SPECIAL PROJECTS

Centenary City, Abakaliki

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SECTION ONE: GENERAL INTRODUCTION

1.1 Background

Ebonyi State Government intends to construct an International Olympic Stadium covering an extent of 40 hectares at Abakaliki Local Government Area of Ebonyi State. The objective of the proposed International Olympic Stadium is to boost the development of sports at the state level with excellent sporting facilities with the highest standard in football, Athletics and other sports. The excellent facilities shall also be used for hosting local, national and international sporting activities. They shall be used for participation training of athletes, coaches and sporting officials. They can also be used for sporting talent hunting and nurturing. They are designed as multifunctional facilities for sporting and non-sporting activities such as social, political and religious gatherings. With the development of these modern and standard facilities and infrastructure, sports can be used to attract attention of the world to Ebonyi State

Towards enhancing the environmental and social benefits of the project and at the same time avoiding, preventing and mitigating the arising negative impacts, the Ebonyi State Government has embarked on the preparation of an Environmental and Social Impact (ESIA) of the proposed project.

1.2 Aim of the ESIA

The primary aim of the ESIA study is to determine the baseline (biophysical, socioeconomic and health) conditions of the proposed project environment, assess any associated/potential impacts of the project on the environment and proffer appropriate mitigation measures for negative impacts. The ESIA study is designed in line with the procedures provided in the Environmental Impact Assessment (EIA) Act. CAP E12, LFN 2004.

1.3 Objectives of the ESIA Study

The main objective of the ESIA study for the proposed project is to proactively evaluate the potential environmental and social impacts and other associated impacts (including health and socio-economic impacts on the environment) of the proposed development. This is to ensure that the planned activities exert minimal impacts on the environment and nearby communities. Therefore, the specific objectives of the ESIA are to:

- Determine the baseline conditions of the environment (biophysical, social and health).
- Assess the potential environmental, social and health impacts of the proposed project on the biophysical, social and health components of the environment.
- Identify and evaluate the potential socio-economic effects of the project on the communities including impacts on cultural properties, social infrastructures and natural resources.
- Proffer appropriate mitigation measures for negative impacts and make recommendations aimed at sustaining the beneficial impacts of the projects on the environment;
- Establish the baseline environmental condition of the project area through literature research and field sampling;
- Laboratory analysis of samples collected during the field sampling/survey;
- Determine and document the sources of impact from the project activities around the proposed site and identify the environmental, social and health components, which are critical to the impacts;
- Develop cost effective Environmental and Social Management Plan (ESMP) as well as provide recommendations for monitoring and management activities; and
- Produce an ESIA Report to be submitted to the Federal Ministry of Environment (FMEnv) or any international funding agencies.

1.4 Scope of the study

The following activities shall be carried out:

i. ESIA Field Sampling/Survey (Two seasons as recommended by FMEnv)
ii. Stakeholder/community engagement.
iii. Laboratory analysis of samples.
iv. Socio-economic and health impact assessment of the project area.
v. Development of effective mitigation, enhancement and control measures.
vi. Development of a comprehensive Environmental and Social Management Plan (ESMP) which will include remediation, monitoring and decommissioning/abandonment plans.
vii. Development of remediation plan after decommissioning, closure or abandonment.
viii. Preparation & submission of Draft ESIA Report.
ix. Preparation of Final ESIA Report.
x. Facilitation procurement of provisional approval (where applicable) & ESIA certificate

1.5 Project Location

The proposed project area falls on longitude 8.01671, latitude 6.29332 for point A, longitude 8.10666, latitude 6.28987 for point B, longitude 8.10661, latitude 6.28661 for point C and longitude 8.11158, latitude 6.28388 for point D. This location cuts across 2 communities namely: Agbaja-Unuhu and Enyima-agu communities in Abakaliki Local Government Area of Ebonyi State.

1.6 Overview of the Proposed Project

Ebonyi State Government intends to construct an International Olympic Stadium covering an extent of 40 hectares at Abakaliki Local Government Area of Ebonyi State. The objective of the proposed International Olympic Stadium is to economically and socially revitalize the state and the entire region at large.

The stadium master plan includes but not limited to the following facilities:

1. 30,000 seating capacity main Bowl (Track and field events)
2. Olympic size swimming pool
3. Indoor Sports hall
4. Volleyball courts
5. Basketball courts
6. Handball courts
7. Tennis courts
8. Squash courts
9. Hockey court
10. Technical building
11. Main Bowl training pitches

Main bowl features

1. Reception halls
2. Accreditation room
3. Two Seminar rooms
4. Stadium manager's office
5. Ten Administrative offices
6. Security room
7. Protocol rooms

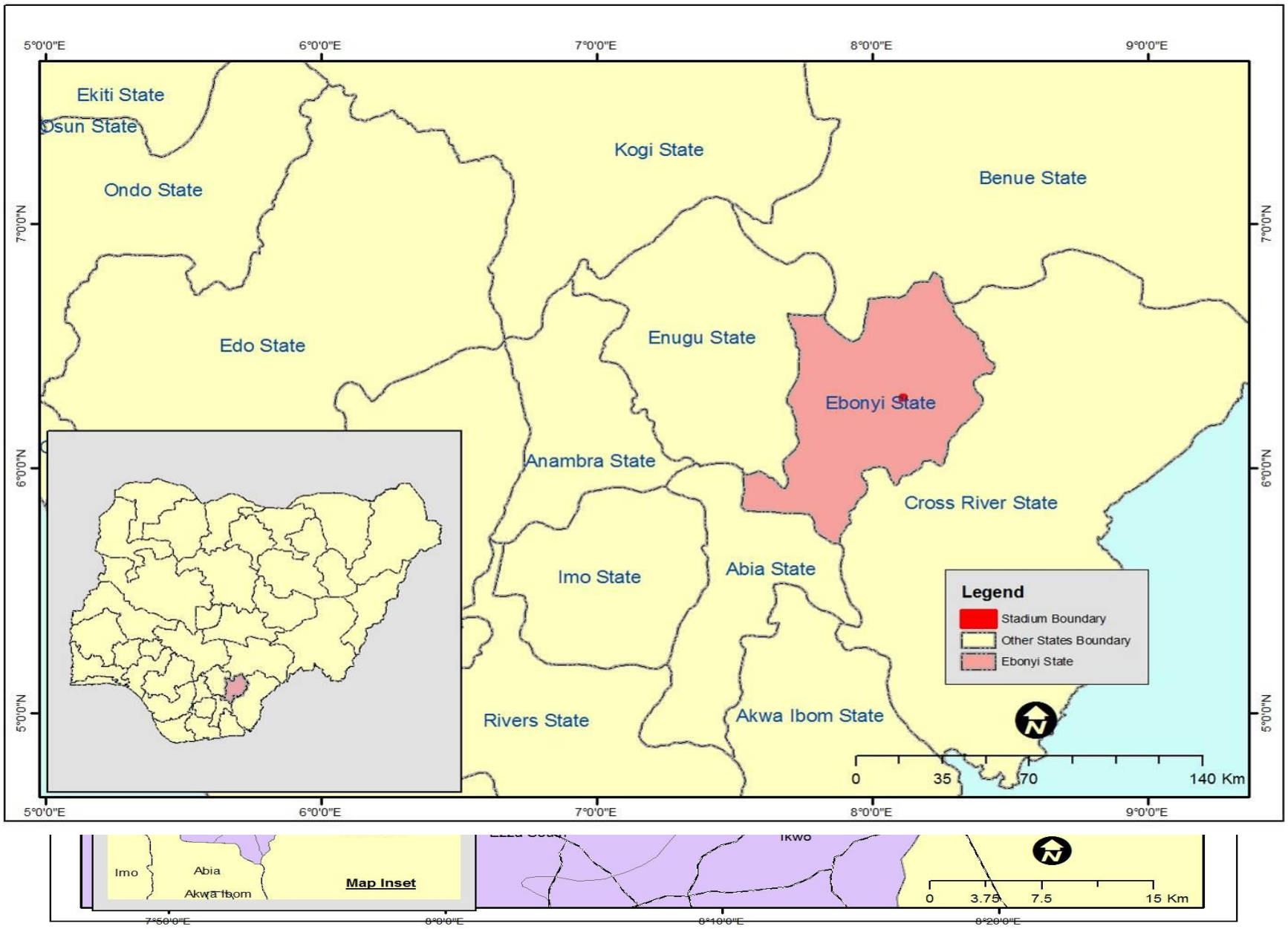
8. Worship area
9.Four players' changing rooms
i. Lockers rooms
ii. Physiotherapy rooms
iii. Jacuzzi baths
iv. Sauna baths
v. 14 showers each (x4)
vi. Foot basins
vii. Cold Store
viii. Dry stores
ix. Equipment stores
10. Match officials changing rooms
11. Four match review rooms
12. Two mixed zones
13. Doping room/Laboratory
14. Referees changing rooms
15. Clinic
a. Two private wards
b. Consultant's/Doctors' room
c. Clinic reception
d. Two toilets
e. Ambulance bay
16. VIP lounges
17. Restaurants
18. Offices
19. Lounge
20. Secretary
21. Dining room
22. Podium
23. State box
24. Restaurants
25. VIP lounges
26. Two conference rooms
27. Two meeting rooms
28. Post-match interview room
29. Lettable spaces
30. Police station with holding cells
31. Event management office
32. Dressing room for ball boys (kids)
33. Media centre (media working area)
34. Media tribune
35. Flash interview positions
36. Accreditation office for media
37. General Spectators' area (Able and Disable)
38. Ticketing
39. Shops
40. Shops (Kiosks)
41. Twenty-two lettable shops
42. Public toilets (Males and Females)
43. Twenty-two corporate and hospitality suites
44. Control rooms
45. Technical room

46. Camera platform
47. Standard FIFA pitch
48. 8-lane IAAF standard tracks

1.7 The Project Activities

The project activities will broadly cover the following areas:

- **Pre-construction activities include**
  - site preparation,
  - engineering design,
  - materials delivery etc.
- **Construction activities include**
  - construction of stadium complex
  - construction of Main bowl, office complex,
  - installation of various components (floodlight, power generation equipment etc.)
  - civil works.
- **Operational activities include**
  - operation of the Stadium,
  - Management and Maintenance of the Stadium
- **The decommissioning activities include**
  - Removal of Stadium components for relocation or sale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Enugu State
Ebonyi State
Anambra State
Cross River State
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Abia State
Rivers State
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3.75
7.5
15 Km
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8°0'0"E
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Figure 1:1 Administrative Map of Nigeria showing Ebonyi State and the project location

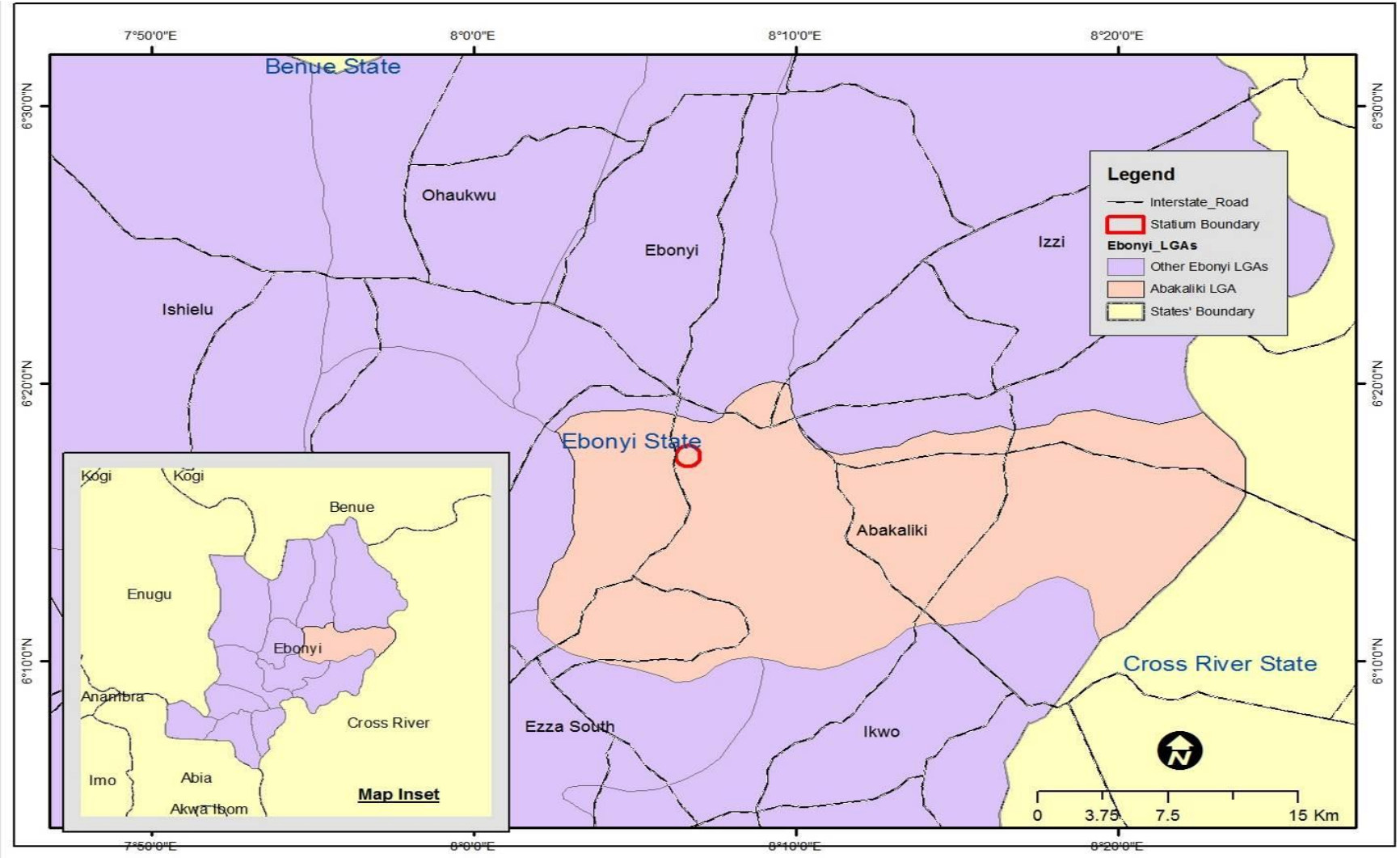


Figure 1:2 Map of Abakaliki showing the project location

1.8 Project Alternatives

The identification and investigation of alternatives is a key aspect of the ESIA process. Therefore, all reasonable and feasible alternatives were identified and assessed during the scoping phase to determine the most suitable alternatives to consider and assess during the ESIA phase. The preferred project alternatives are highlighted and presented here.

Alternatives can typically be identified according to:

a) Technology alternatives;
b) Site/Location alternatives

For any alternative to be considered feasible such an alternative must meet the need and purpose of the development proposal without presenting significantly high associated impacts. The alternatives are described and the advantages and disadvantages are presented. It is further indicated which alternatives are considered feasible from a technical as well as environmental perspective.

Incremental alternatives typically arise during the ESIA process and are usually suggested as a means of addressing identified impacts. These alternatives are closely linked to the identification of mitigation measures and are not specifically identified as distinct alternatives. This section provides information on the development footprint alternatives, as well as the type of activity, activity layout, technological and operational aspects of the activity.

Alternative 1: Technology Alternatives

The proposed International Olympic Stadium shall strictly adhere to international and national terminal engineering design, construction standards and codes of practices which shall be adopted at all stages of the proposed project development to ensure the technical viability of the project. During operational stage, the proposed Stadium shall enable access to modern and standard sports facilities which will help the youth of the state to channel their energy into positive and productive uses with the prospect of projecting the state into national and International limelight through hosting and participation in sports competitions.

Alternative 2: Site/ Location Alternatives

Several alternative sites for the Stadium location were evaluated. Selection of the preferred location for the Stadium was based on the following criteria (amongst others);

a) Transport: Proximity to the major road;
b) Sensitive area (Many of the existing environmental resources/values are not of prime importance) The project site: (1) does not contain any valuable ecological resources (either terrestrial or aquatic), (2) does not contain any items of archaeological significance or historical importance, (3) is not subject to floods or seismic disturbances, (4) is not heavily populated; The unit shall be located at least a radial distance of 3km away from any human habitation and (5) is not the location of significant mineral resources or mining activities.
c) Availability of already acquired land*:* Taking the proposed development to another location will mean that a new land will have to be acquired. Shifting the project to another location will incur additional cost on investment because new land has to be purchased, new business strategy needs to be adopted, etc. This action plan will also result in loss of time. The necessary approval for the current site has been obtained and all required fees have been paid by the Ebonyi State Government.

1.9 Methodology for the ESIA Study

The main steps in any impact assessment procedure are as follows:

- Scoping study to collect all available information related to the development, familiarize the team with the study areas, identify and scope issues, and develop focused work plans for the rest of the ESIA (which has been carried out).
- Baseline description and surveys are carried out to provide a description of the environmental and social character of the project zone of influence and wider area of influence likely to be affected by the development.
- Characterise the identified relevant natural and manmade processes which may change the character of the site.
- Identify and describe the possible interactions between the proposed development and both existing and future conditions.
- Determine the direct and indirect, adverse, beneficial short- and long-term impacts as well as cumulative and transboundary impacts (if applicable)
- Recommendations are then made to avoid, minimise or mitigate adverse impacts and enhance positive impacts. Alterations to the design of the development can then be reassessed and the effectiveness of mitigation proposals determined.
- Identify during the course of the assessment process any uncertainties inherent in the methods used, impact predictions made and conclusions drawn.
- Outline Follow up monitoring/actions (implementation plan) to ensure recommendations in the ESIA report are properly introduced and managed during the project lifetime

1.10 Scoping Report and Technical Approach And Methodology

This Report constitutes the Scoping Report. The report follows a preliminary investigation into the environmental opportunities and constraints presented by the Project. This report identifies the issues that the Environmental and Social Impact Assessment (ESIA) will need to address and the scope of the assessment required to ensure that the ESIA and the report comply with the requirements of the Federal Ministry of Environment (FMENV) and that of the World Bank.

Scoping is a preliminary task within the ESIA process and provides a mechanism for consulting on and agreeing the content and methodology of the subsequent ESIA at an early stage in the process. Definition of the scope is dependent upon the current state of knowledge about the design of the project and how it is proposed to be implemented. ESIA is part of the iterative design process and it is likely that changes in the design will arise out of this process. These changes may in turn necessitate modifications in the approach to the ESIA.

The scoping stage sets the context for the detailed assessment that follows and ensures that it conforms to the requirements of the relevant regulation and policy. In particular there are clear advantages in defining the environmental issues as early as possible to obtain consensus on the proposed way forward.

The scoping process assists to:

- Provide a description of the proposed scheme and to inform the key stakeholders;
- Identify the topics and issues that are proposed to be the focus of the ESIA;
- Eliminate those topics and issues not requiring further consideration and which would therefore not be taken further in the ESIA;
- Define the technical, spatial and temporal scope of the study for each of the topics and issues to be considered;
- Define the approach to, and methodologies for, conducting the baseline studies;

- Define the approach to, and methodologies for, predicting environmental impacts and for evaluating the significance and severity of environmental effects;
- Identify the methods to be adopted for incorporation of mitigation and other environmentally driven modifications into the design; and,
- Define the consultation strategy to be applied to the ESA process.

1.10.1 Scoping Issues Definition

In order to properly define the key issues relating to the proposed project in relation to the project activities and the environmental and social context, temporal and spatial dimension becomes very useful. These are highlighted below:

a. Temporal Scope

The temporal scope of the ESIA for the proposed remedial work phase (and operation phase) will be outlined and assessed accordingly in the ESIA. The temporal scope will also take into account the time of day during which works are undertaken, notably whether they are undertaken during daytime, evening or night-time periods (using available project scheduling). Thus, the baseline scenario will consider the present and future, during construction and operation periods

b. Spatial Scope

The geographical coverage of the ESIA will take into account the following factors:

- the physical extent of the works to be undertaken within the application site boundary;
- the nature of the baseline environment and the manner in which impacts are likely to be propagated beyond the application site boundary; and
- the pattern of administrative boundaries which provide the planning and policy context for the Project.

1.10.2 Consultation and Scoping Workshop

These include Meetings and consultations with Project Staff, consultants, communities, relevant government agencies, etc.

As a part of the process, a Scoping Workshop was conducted on January 29, 2020. Key stakeholders that participated in the Workshop included representatives of the communities, officials from Federal and Ebonyi State Government ministries and agencies, non-governmental organisations security agencies. Appendix 1 shows the attendance sheet of everyone that participated.

Table 1:1 provides a matrix of participants' comments/observations and the responses compiled at the workshop

Table 1:1 Stakeholders' Comments

Stakeholders' Questions/Comments/Observations		**Project/Consultants' Responses**
1	Concerns of air pollution raised	The proponent responded that Other sources of pollution such emissions from equipment and vehicles are also expected to be within limits as new/modern construction equipment will be mobilized to site. Additionally, the ESIA study phase will critically assess air pollution and proffer appropriate mitigations

Stakeholders' Questions/Comments/Observations		Project/Consultants' Responses
2	Concern of groundwater pollution	Specialist studies will be conducted to address these issues in the ESIA.
3	Corporate Social Responsibilities (CSRs)	Ebonyi State Government will keep to the Community Development Agreement (CDA) signed between it and the host communities.
4	During the Consultant's presentation, more emphasis was laid on positive impacts than the negative impacts. Please explain	Adequate time was not devoted to dwell on the associated negative impacts as much as done for the positive impacts because of time constrained towards the end of the presentation. It should be noted however, that specialist studies will be conducted to address all associated and potential impacts during the ESIA study. The ESIA Draft Report will also be available to the public for scrutiny.
5	What is the company's plan for air pollution, most especially, dust management?	The Consultant said that as shown in the presentation slides, dust will be controlled by spraying of water during operation. The Draft ESIA Report will also include and Environmental Management Plan (EMP) that will enumerate management strategies, responsibilities, and Environmental Monitoring Programme (EMPr). The EMPr will ensure planned monitoring of environmental components such as air quality, groundwater and surface water qualities to ensure any change in the quality of environment is tracked early and curtailed. In addition, a 3-year Environmental Audit (EA) will also be instituted in line with regulatory requirements.
6	Will the ESIA Report be available to the public?	Yes the readiness of the state government to appreciate all the communities affected by this proposed project Assurance of the community that the ESIA study phase will address all the concerns raised by the host communities

SECTION TWO: BASELINE CONDITION

2.0 Introduction

2.1 Defining the Baseline Conditions

Based on the scoping, the area of focus for the characterising the baseline conditions have been identified and are outlined in Table 2.1

Table 2.1: Indicative Parameters for Baseline Characterisation

S/No	Components	Parameters
1	**Physical Environment**	Hydrology and Water Resources, Existing Hydrometric Network Rainfall and Other Climatic Parameters, Climate Change, Agroecozone, Surface Water, Floods, Groundwater/Hydrogeology Water Quality, Geology, Soils and Topography, Geomorphology Soils
2	**Biological Environment**	Habitats and Vegetation, Wildlife, Birds, Mammals, Reptiles an Amphibians, Other Animals, Wildlife Pests, Aquatic Ecology an Fisheries. Phytoplankton and Zooplankton, Fish

3	**Social and Economic Context**	The Project affected communities and People, Socio-economic Profile of Project Area, Demography, Household Size and Population Density, Infrastructure and Settlements, Land Tenure Livelihoods and the Agricultural System, Income, Cultivation and Crops, Existing Irrigation Practices, Education, Gender Differentiation, Incomes & Poverty, Social Organisation, Traditional Savings Systems), Vulnerable Groups, People's Perception of the Project, Cultural Heritage, Livestock Husbandry, Fisheries and Other Income Sources, Energy, Domestic Water Supply and Use
4	**Health and safety**	Construction health, safety and labour welfare, Disease ecology (vector habitat), Introduction of diseases, Water & sanitation at household and community level, Communicable and Non-communicable diseases, Nutrition, Disease prevention and control Health service capacity, Pest Management issues including current pest management methods; Public Health and disease; analysis of disease vectors; Anticipated liquid, solid (including waste) and gaseous emissions, and sources of nuisances including noise, dust and safety hazards (at construction and operation stages). waste management

2.2 Establishment of Study Zone, Sampling Design and Strategy

- Proper delineation of impact (study) zone (Boundary) plays an important role before proceeding for baseline data generation
- Generally, the impact zone for the proposed project can be classified as:
  - Core Zone/project command area (PCA) - Host and Proximate area where the proposed activities is to take place – *area of highest risk*
  - buffer Zone - Moderately affected area – moderate risk
  - Unaffected Zone (not be at risk of serious damage to environment, life, health and property.
- For the purposes of the study, the following boundaries (not totally exclusive of others) shall be defined for different subject areas:
  - For irrigation water management, soils, and drainage: The Project Command Area (PCA) and dam shore zone.
  - For hydrology and watershed management: (i) the catchments of the watercourses crossing the PCA, excluding the other connecting rivers, (ii) the connecting River above and below the dam
  - For ecological issues: the PCA/"core study area"), the surrounding areas and Rivers, and all the floodplains.
  - For fisheries issues: the rivers crossing the PCA and all the surrounding rivers.
  - For social assessment including health and cultural heritage: the PCA plus the settlements
  - adjacent to the PCA with strong social and economic ties to the people and resources within the PCA.
  - For transboundary issues: this shall be further identified.
  - For social assessment including health and cultural heritage: the PCA plus the settlements adjacent to the PCA with strong social and economic ties to the people and resources within the PCA.

2.3 Desk Study/Literature

To acquire background information on the environmental characterization of the project area, an extensive literature review shall be done. This includes information from previous studies around the project area and of areas with similar environmental characteristics. Thus, large number of

existing publications, reports and maps that are available are being acquired, studied, analyzed and interpreted for a robust definition of the legal and administrative policy framework, environmental characterization, etc.

Data shall be collected from existing reports, maps, notes, publications and any other type of written/electronic material (GIS/Remote Sensing) from different sources (Ministry, Department and Agencies). Relevant documents prepared for the project, ESIAs prepared for other recent World Bank projects in Nigeria and elsewhere (other countries) in like magnitude and other relevant documents, reports, publications that bear relevance to the ESIA/project are being are being reviewed

2.4 Data Quality Issues and Chain-Of-Custody Record

To minimise technical uncertainty good quality data shall be ensured through quality checks in the sampling protocols. Data quality can be described in terms of:

- Completeness: the extent to which sufficient data are collected to adequately define the characteristics of the environment
- Relevance: the extent to which the data are relevant
- Reliability: the extent to which measurements or observations accurately reflect true site conditions
- Clarity: the extent to which it is clear why, what, where and how the data have been obtained and what significant information gaps may exist.

A Chain-Of-Custody Record shall be completed during the field work detailing:

- time of sampling,
- sampling interval, and
- signed by the person collecting the sample.

2.5 Sampling Equipment

The list of sampling equipment to be used for the field survey is provided below

- Water Sampling Equipment
- Line and messengers
- Garmin GPS
- Sony DSC-H1Digital Camera
- Stopwatch
- Sample bottles, preservatives and labels
- Water Quality Meters
- Disposable gloves
- Split spoons
- Plankton tow net 64 µm pore size (#25)
- Tow net sample bucker with a 61 µm pore size metal screen
- Flowmeter
- Weights 10-20 Ibs.
- Safety Glasses
- Thermometers
- Turbidity meters
- Field Log Book
- Chain of Custody forms
- pH meters
- Coolers with ice chests (Appropriately labeled)
- Water level meter
- Conductivity bridges
- Custody seals
- Field data sheets
- Decontamination equipment
- Formalin (37% formaldehyde)
- 500 ml plastic sample bottles
- Maps
- Safety equipment
- Tape measure
- Soil Sampling Kit (Soil Auger, trowel, etc.)
- Sediment Sampling Equipment
- Van Veen Grab Sampler
- Sony DSC-H1Digital Camera
- Ziploc plastic bags
- Trowels
- Extension rods
- Steel cable
- Plankton and Macro-benthos Sampling Equipment (Tape measure, Stainless steel, plastic, or other appropriate

- Safety line for sample bucket
- Lines for attaching weights
- Garden hose with attached water source
- Spray bottle
-
- Repipettor with 10 mL delivery capability
- Graduated cylinder 15 – 100mL capacity
- Sample jar labels
- Decontamination supplies
- Spatula
- Scoop

homogenization bucket, bowl or pan, appropriate size sample containers (Plastics / Bottles), re-sealable plastic bags

- Spade or shovel

Table 2:2 Sampling Strategy for Some Environmental and Social Components with Indicative Number of Samples

Component	Activities	Parameters	Method	Location	Indicative No of Samples
Climate and Meteorological Studies	Description of the ambient temperature of the project location and the establishment of unusual conditions of the extreme temperatures, frequency and the extent of temperature inversion, etc. Determination of historical patterns of winds, wind speed/velocity, wind direction. Descriptions of humidity and precipitation, etc.	Temperature, Rainfall, Wind Speed and Direction, Humidity, etc.	Secondary Data from NIMET, Literature survey Field studies (rain gauge, thermograph, and wind vane)	Site & Immediate Vicinity	Minimum of 30years period from NIMET, and field data will be within and around the site
Water Resources	Water, sediment, benthic, fish and plankton samples will be collected for laboratory analysis, ecological and microbiological investigation. Baseline surveys and desk study surface	**a. Surface Water** ▪ Solids ▪ Physico-chemical parameters ▪ Salinity ▪ Heavy metals ▪ Organic compounds, and ▪ Microbiological characteristics **c. Groundwater** ▪ Solids ▪ Physico-chemical parameters ▪ Salinity ▪ Heavy metals ▪ Organic compounds, and ▪ Microbiological characteristics	**a. Flood Risks** ▪ Hydrological studies ▪ Flood event maps ▪ Flood hazard maps ▪ Vulnerability maps **b. Surface Water** ▪ Water sampler ▪ Current meter ▪ pH meter, DO meter, TDS meter ▪ Nephalometer, temperature and conductivity meter **c. Groundwater** • Groundwater monitoring boreholes	Proposed site and area of influence	Surface water samples: 3 and 1 control Groundwater Samples: 3 and 2 controls
Geomorphology	Survey of the topography, drainage pattern and flood characteristics and potentials as well as the geomorphic features in the area. Baseline surveys and desk study will be the primary means of evaluation of flood risk	▪ Elevation, ▪ Slope ▪ Aspect ▪ Curvature ▪ Drainage system ▪ Geomorphologic mapping **Flood Risks** ▪ Historic events ▪ Processes (type of floods) ▪ Parameter estimation (probability, impact) ▪ Risk assessment ▪ Depth of inundation ▪ Duration ▪ Extend ▪ Rising velocity ▪ Current velocity (pressure)	▪ Topographical/drainage analyses ▪ Data on present land use ▪ Data on persons effected ▪ Data on buildings, industries and infrastructure ▪ Hot spots ▪ Hydrological studies ▪ Flood event maps ▪ Flood hazard maps ▪ Vulnerability maps ▪	Proposed site and area of influence	Generic

Table 2:2 Sampling Strategy for Some Environmental and Social Components with Indicative Number of Samples

Component	Activities	Parameters	Method	Location	Indicative No of Samples
Soil Study/ Sediments	Targeted sampling is used when the assessor has good *a priori information on the locations* of known or likely contaminants. a. The soil/sediment study shall entail collection of Soil/sediment samples which shall be analyzed for the relevant parameters. Also the classification of the soil in the area, landuse capability, the vulnerability to erosion, handling and reinstatement practices, etc shall be considered.	a. For both Soil and Sediment: ▪ Chemical and physical (**Microbiology** **Biology** ▪ Macro Benthic Organisms (Flora/Fauna) ▪ Grain size distribution (Species diversity, species abundance (population density and community structure), species dominance/frequency of occurrence	▪ On the basis of the findings of the Desk Study, a site investigation will be undertaken by a combination of trial pits and boreholes, with samples correctly collected and stored prior to analysis at a suitable approved laboratory ▪ The procedures for sampling will follow appropriate internationally recognised standards such as CLR 11 ▪ Sampling shall be done at two depths (0-15cm and 15-30cm representing surface (top) and subsurface (sub) soils, respectively. Random soil samples shall also be collected from alternate cells. a. Soil samples with soil auger into aluminium foil b. Sediments samples with Day Grab sampler into aluminium foil	Proposed site and area of influence River/stream /swampy areas within and nearby	Soil (17) Sediments (3 and 1 control) where applicable
Ecology and Nature Conservation	An on-site survey will be undertaken to identify any sensitive species in the surrounding area. Relevant locations will be mapped, and measures proposed to preserve or mitigate or relocate, as appropriate. Identification of key habitats, tolerance, buffer zones will be made for aquatic species.	**a. Terrestrial Species and Habitats** ▪ Fauna ▪ Flora **b. Marine Species and Habitats** ▪ Fauna ▪ Flora ▪ Phytoplankton ▪ Zooplankton ▪ Fish Species and Fisheries	▪ Chemical toxicity ▪ Microbiological characteristics ▪ Key informant interviews ▪ Focus group discussions ▪ Transects ▪ Quadrants ▪ Questionnaires ▪ Direct observations, and ▪ Field identification ▪ Observation, collection, interviews ▪ Collection with Day Grab ▪ Collection with plankton net ▪ Laboratory analyses	Proposed site and area of influence	Generic
Air Quality, Dust and Climate Change	Air quality measurements shall be carried out within and around the site. Parameters to be measured shall include: Gases, Trace elements and anions, Suspended particulate matters, and Wind direction. Thus the ambient air quality and emission plumes and fall-out characteristics shall be determined. Air samples shall be taken around the proposed site.	▪ Sulphur Oxides (SOx) ▪ Nitrogen Oxides (NOx) ▪ Carbon monoxides (CO) ▪ Hydrogen Sulphide (H2S) ▪ Hydrocarbon (HC) ▪ Volatile Organic Carbon (VOC) ▪ Ammonia (NH3) Suspended Particulate Matter (SPM)	▪ MultiRAE Lite Air monitor ▪ TSI Dust Trak ▪ Literature survey Field studies	Proposed site and area of influence	23 and 2 controls

Table 2:2 Sampling Strategy for Some Environmental and Social Components with Indicative Number of Samples

Component	Activities	Parameters	Method	Location	Indicative No of Samples
	Following a baseline assessment of site conditions, qualitative predictive measures will be used to estimate likely impacts on air quality, dust and climate. Dispersion modeling will be carried out.				
Noise and Vibration	The present Noise and vibration levels of the site shall be determined also at the established locations for air quality studies.	Noise level and vibration	Digital sound level meter	Proposed site and area of influence	23 stations and 2 controls
Waste Management & Sanitation	Estimation of type and quantity; characteristics of discharges (e.g. wastewater, emission, and solid waste); Dispersal and fate of all waste to be generated	▪Characterisation and quantification of waste ▪Classification of waste streams –	▪ Physical examination ▪ Inventory and walk-over survey	Proposed site and area of influence	Generic
Traffic and Transport	Forecast traffic impact associated with the Project. Determine the improvements that are necessary to accommodate the Project The outcome is to ensure reasonable traffic conditions on streets during and after the construction of the Project.	▪ Establishment of base traffic conditions: ○ Description of road network and intersections adjacent to site and at access points ○ Counts during peak-impact hours ▪ Site Traffic Generation ▪ Site Traffic Distribution ▪ Non-Site Traffic Projections: ○ Loading dock locations and access	- ▪ Two-week observation duration for establishment of base traffic conditions ▪ Observations on three occasions, at varying times of day	Proposed site and area of influence	Generic
Landscape and Visual	Site plans and outlines will be visually examined to determine the proposed impact on the existing landscape.	Scenery/aesthetics/housekeeping	Visual assessment including photographs of the existing industrial uses	Proposed site and area of influence	Generic
Archaeology and Cultural Heritage and Socio Economics	The Project has the opportunity to bring substantial local benefits. The following will be undertaken: Determination of the existing social and economic conditions of the primary host communities. Predict the impacts of the project activities on the socio-economic activities of the communities. Develop measures to strengthen the beneficial impacts and reduce or avoid the adverse ones Provide a plan to manage the identified social and economic adverse impacts.	Not applicable on Archeology Data on occupation, social behaviour, education, cultural norms and heritage will be collated. Indicative parameters include: ▪ Education ▪ Cultural norms ▪ Population ▪ Security	Based on the existing site use, this will be determined by desk study ▪ Oral interviews (key informant interviews; focus group discussion ▪ Direct observation (walk through survey to evaluate host community setting, infrastructure, etc) ▪ Administration of structured questionnaires ▪ Collection of secondary data As outlined within best practice from the World Health Organisation, female participation will	Proposed site and area of influence	Generic

Table 2:2 Sampling Strategy for Some Environmental and Social Components with Indicative Number of Samples

Component	Activities	Parameters	Method	Location	Indicative No of Samples
		▪ Income, employment and unemployment rate in the community ▪ Settlement pattern ▪ Infrastructure change ▪ Access to communication facilities and transport ▪ Sense of place/wellbeing /aesthetic value ▪ Attitudes toward the development	be ensured to provide a robust assessment of social, and economic impact in relevant communities.		
Occupational Health and Safety	Determination of present health status of the community around especially from available medical records from hospitals and/or direct interview. Site-specific Risk Assessment undertaken and harmonized with any available risk registers.	▪ Accidents ▪ Exposure to nuisance ▪ Level of disease vectors ▪ Exposure to STD/HIV/AIDS ▪ Mortality and Morbidity rate ▪ Physical activity ▪ Hygiene ▪ Exposure to commercial sex workers ▪ Access to primary, ;secondary and traditional health care ▪ Access to emergency services	▪ Key informant interviews ▪ Focus group discussion ▪ Administration of structured questionnaires and interviews ▪ Walk - through survey and collection of secondary data ▪ Risk Assessment	Proposed site and area of influence	Generic
Public Health	The health baseline will be developed using primary and secondary information sources. The primary information will be obtained directly from the communities that will be affected by the project through the organization of focal group meetings and questionnaires. Identifications of the existing health conditions of the area, Predicting of the health impacts of the project on the people, Development of mitigation measures for the identified significant impacts, Provision of recommendation and plan for the management of the health impacts.	▪ Births ▪ Mortality ▪ Disease occurrence ▪ Hospital admissions	▪ Secondary data (health records) ▪ Key informant interviews ▪ Focus group discussion ▪ Administration of structured questionnaires ▪ Physical examination of volunteers (optional) ▪ As outlined within best practice from the World Health Organisation, female participation will be ensured to provide a robust assessment of social, economic and health of relevant communities.	Proposed site and area of influence	Generic

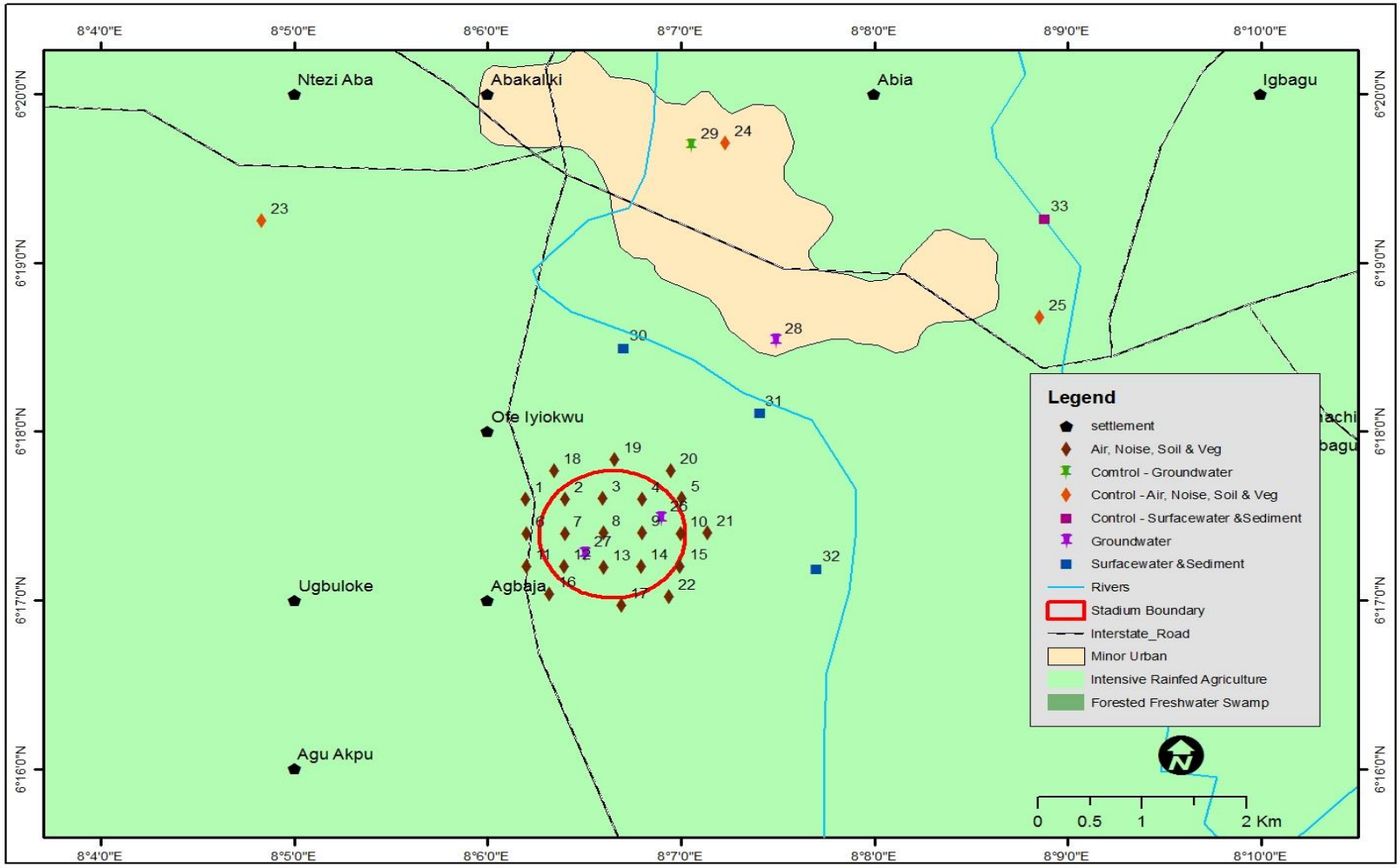


Figure 2.1: Sampling Locations Map

Figure 2.2a: Aerial Site Layout of The Stadium

Figure 2.2b: Aerial Site Layout of The Stadium

Figure 2.2c: Aerial Site Layout of The Stadium

SECTION THREE: PROPOSED POTENTIAL IMPACTS

3.1 INTRODUCTION

Following identification of all project activities, biophysical, socio-economic and health receptors have been identified. The key inputs for the identification of receptors included: literature and legislative review, environmental, Socioeconomic and Health baseline conditions and Stakeholder consultation.

3.2 Identified Receptors of the Potential Impacts of Remedial Works

Table 3.1 lists the identified project biophysical, socio-economic and health receptors.

Table 3.1: Identified Project Environmental and Socio-economic Receptors

Environmental Receptor	Remark
Biophysical Components	
Climate	Associated effects on climatic pattern (local and global effects)
Air	Air quality (including gases with global warming potential (GWP)) in and around the proposed project sites.
Noise	Noise disturbance in and around the proposed project development sites
Groundwater / Aquifers	The groundwater resources and aquifers of areas in which project activities are proposed to occur.
Surface Water and sediment quality	The surface waters and sediment in creeks and rivers in areas around which project activities are proposed to occur.
Soil	The soils of areas in and around the proposed project development sites
Subsurface Geology	The subsurface structures and rock strata of terrestrial areas in which project activities are proposed to occur.
Landscape / Topography	The geomorphological land forms and terrain of areas in which project activities are proposed to occur.
Hydrobiology (plankton/benthos)	Plankton living in the water column and benthos organisms living in and/or on the benthic sediments in which project activities are proposed to occur.
Terrestrial Flora	Plant species that occur in the inland areas in which project activities are proposed to occur.
Terrestrial Fauna (Wildlife)	Animal species that occur in the inland areas in which project activities are proposed to occur.
Socioeconomic Components	
Land Use	Existing uses (e.g. herding/grazing, farming, industrial) of the land areas in which project activities are proposed to occur.
Local and National Employment Base	The total number of fishing jobs (temporary, part-time, fulltime) within the project area
Utilities	The utilities (source of water) of areas in which project activities are proposed to occur.
Transport	The road transport systems (i.e. physical network and vehicles that use them) of the areas in which project activities are proposed to occur.
International procurement	International economies that benefit from project related expenditure through the procurement of goods and services outside of Nigeria
Waste management	Waste management practices in the area
Health Components	
Health Indicators	Mortality rate; Morbidity rate; Life expectancy etc
Vector Related Diseases	Malaria, *Schistosomiasis*, dengue, *Onchocerciasis*, yellow fever etc

Sexually transmitted infection HIV/AIDS	HIV/AIDS, Syphilis, Gonorrhoea, *Chlamydia, Hepatitis* B
Hazards and risk	Road-traffic related, spills and releases, construction (project-related) etc
Health services infrastructure and capacity	Physical infrastructure, staffing levels and competencies, technical capabilities of health care facilities at district levels; program management delivery systems; coordination and alignment of the project to existing national- and provincial-level health programs (for example, TB, HIV/AIDS), and future development plans

Source: Natural Eco Capital (2020)

3.3 Identifying Project Activities and Biophysical, Socio-Economic and Health Aspects

Identified project activities, and biophysical, socio-economic and health, receptors were integrated into matrices with the activities on the y-axis and receptors on the x-axis, and a matrix was compiled for each of the project elements (Table 3.1). Each matrix was subsequently assessed to identify every possible case of potential activity-receptor interaction. Where it was considered that an activity-receptor interaction was possible, the cell was marked denoting an identified environmental aspect.

SECTION FOUR: IMPACT ASSESSMENT METHOD

4.1 Introduction

This section describes methods to be to undertake the assessment of impact of the remedial works (described under construction, operation and maintenance and decommissioning activities). The potential impacts of the proposed development on each environmental and social component have been assessed by the following three methods; significance assessment, risk assessment or compliance assessment. Figure 4.1 shows how each method was applied to the impact assessment process, which is reflected in the structure of each the subsequent relevance. Significance assessment was adopted where an understanding of the vulnerability of the environmental receptor was important to the assessment. For example; an understanding of the sensitivity of ecosystems in their current state provides a sound basis for determining the severity of potential impacts. Potential impacts that arise through the management of materials and substances (e.g., waste) are more appropriately assessed using the principle of risk management. Compliance assessment was adopted for environmental aspects regulated by statutory guidelines, e.g., air quality and noise.

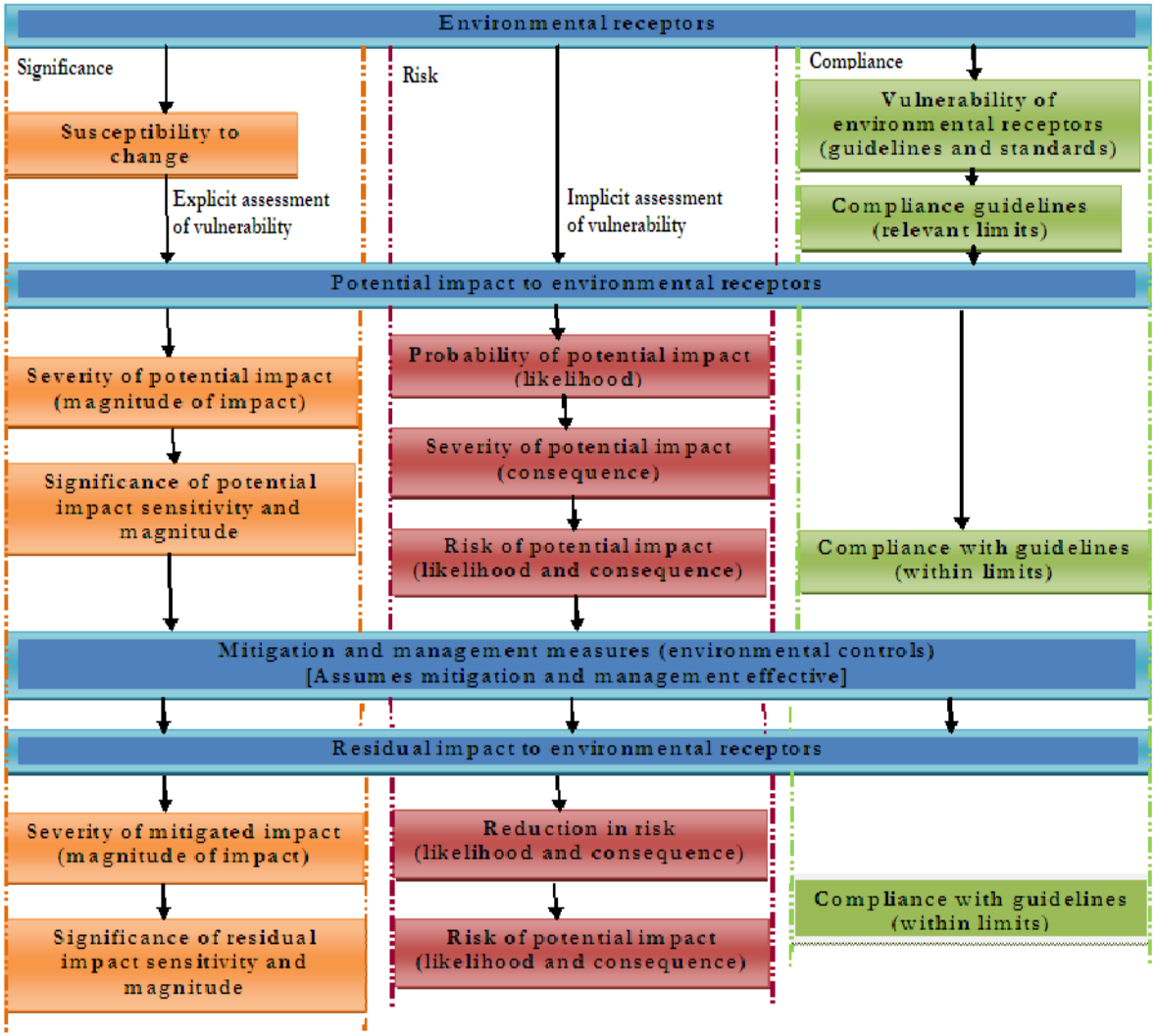


Fig 4.1: Method to Apply Impact Assessment Process

4.2 SIGNIFICANCE ASSESSMENT METHOD

An explicit assessment of the vulnerability of the environmental and social receptor is the basis of the significance assessment method. This method shall assume that the impact will occur and that the worst case will be identified and assessed. The significance of the impact shall be assessed by considering the vulnerability or sensitivity of the environmental and social receptors and the magnitude of the impact before and after the application of mitigation and management measure.
The significance of the residual impact shall be assessed assuming successful implementation of proposed mitigation and management measures.

4.2.1 Sensitivity of an Environmental and Social Receptor

The sensitivity of an environmental and social receptor shall be determined from its susceptibility or vulnerability to threatening processes, and as a consequence of its intrinsic value. Archetype attributes that define sensitivity shall be revised to reflect the specific focus of this study. The model attributes of sensitivity are:

- **Conservation status:** Assigned by government (including statutory and regulatory authorities) or recognized international organizations through legislation, regulations and international conventions
- **Intactness:** An assessment of how intact an environmental and social receptor is. It is a measure (with respect to characteristics or properties) of an environmental and social receptor's existing condition, particularly its representativeness.
- **Uniqueness or rarity:** An assessment of an environmental and social receptor's occurrence, abundance and distribution within and beyond its reference.
- **Resilience to change**: An assessment of the ability of an environment and social receptor to adapt to change without adversely affecting its conservation status, intactness, uniqueness or rarity.
- **Replacement potential:** An assessment of the potential for a representative or equivalent example of the environmental and social value to be found to replace any losses.

Applying these attributes enables the sensitivity of an environmental and social receptor to be ranked as high, moderate or low. Table 4.1 lists the model criteria to be adopted for sensitivity.

Table 4.1: Criteria for Determining the Sensitivity of Environmental and social Receptors

Sensitivity	Description
High	- The environmental and social value is listed on a recognized or statutory state, national or international register as being of conservation significance. - The environmental and social value is intact and retains its intrinsic value - The environmental and social value is unique to the environment in which it occurs. It is isolated to the affected system/area, which is poorly represented in the region, territory, country or the world. - The environmental and social value is has not been exposed to threatening processes, or there has not been a noticeable impact on the integrity of the environmental and social value. Project activities would have an adverse effect on the value.
Moderate	- The environmental and social value is recorded as being at a regional level, and may have been nominated for listing on recognized or statutory registers. - The environmental and social receptor is in a moderate to good condition despite it being exposed to threatening processes. It retains many of its intrinsic characteristics and structural elements - The environmental and social receptor is relatively well represented in the area in which it occurs but its abundance and distribution are limited by threatening processes.

	- Threatening processes have reduced the environmental and social receptor's resilience to change. Consequently, changes resulting from project activities may lead to degradation of the prescribed receptor. - Replacement of unavoidable losses is possible due to abundance and distribution of the environmental and social receptor.
Low	- The environmental and social receptor is not listed on any recognized or statutory register. It might be recognized locally by relevant suitably qualified experts or organizations, e.g., historical societies. - The environmental and social receptor is in a poor to moderate condition as a result of threatening processes which have degraded its intrinsic value - The environmental and social receptor is not unique or rare, and numerous representative examples exist throughout the area - The environment receptor is abundant and widely distributed throughout the host areas. - There is no detectable response to change or change does not result in further degradation of the environmental and social receptor - The abundance and wide distribution of the environmental and social receptor ensures replacement of unavoidable losses is assured.

Source: Natural Eco Capital (2020)

4.2.2 Magnitude of impact

The magnitude of an impact on an environmental and social receptor is an assessment of the geographical extent, duration and severity of the impact. These attributes are defined as follows:

- Geographical extent an assessment of the spatial extent of the impact where the extent is defined as site, local regional or widespread (meaning state wide or national or international).
- Duration the timescale of the effect, i.e., if it is short (less than 1 years), medium (1-20 years) or long (more than 20 years) term.
- Severity an assessment of the scale or degree of change from the existing condition, as a result of the impact. This could be positive or negative.

Applying these attributes enables the magnitude of an impact to be ranked as high, moderate or low. Table 4.2 lists the model criteria adopted for determining the magnitude of impacts.

Table 4.2: Criteria for Determining the Magnitude of Impacts

Magnitude	Description
High	An impact that is widespread, long lasting and results in substantial and possibly irreversible change to the environmental and social receptor. Avoidance through appropriate design responses or the implementation of site specific environmental and social management controls are required to address the impact
Moderate	An impact that extends beyond the area of disturbance to the surrounding area but is contained within the region where the project is being developed. The impacts are short term and result in changes that can be ameliorated with specific environmental and social management controls
Low	A localized impact that is temporary or short term, and either unlikely to be detected or could be effectively mitigated through standard environmental and social management controls.

Source: Natural Eco Capital (2020)

4.2.3 Significance of an Impact

The significance of an impact on an environmental receptor is determined by the sensitivity of the receptor itself and the magnitude of the impact it experiences. The model significance

assessment matrix (Table 4.3) shows how, using the criteria above, the significance of an impact is determined.

Table 4:3 Significance assessment matrix

	Sensitivity of Environmental Receptor		
Magnitude of impact	**High**	**Moderate**	**Low**
High	**Critical**	**High**	**Moderate**
Moderate	**High**	**Moderate**	**Low**
Low	**Moderate**	**Low**	**Negligible**

The classifications (major, high, moderate, low and negligible) for assessing significance of an impact are as follows:

- **Major significance of impact:** Arises when an impact will potentially cause irreversible or widespread harm to an environmental and social receptor that is irreplaceable because of its uniqueness or rarity. Avoidance through appropriate design responses is the only effective mitigation.
- **High significance of impact:** Occurs when the proposed activities are likely to exacerbate threatening processes affecting the intrinsic characteristic and structural elements of the environmental and social receptor. While replacement of unavoidable losses is possible, avoidance through appropriate design responses is preferred in order to preserve the environmental and social receptor's intactness or conservation status.
- **Moderate significance of impact:** Although reasonably resilient to change the environmental and social receptor would be further degraded due to the scale of the impact or its susceptibility to further change. The abundance of the environmental receptor ensures that it is adequately represented in the region, and that replacement, if required is achievable.
- **Low significance of impact:** Occurs where an environmental and social receptor is of local importance and temporary and transient changes will not adversely affect its viability, provided standard environmental and social management controls are implemented.
- **Negligible significance of impact:** Where impact on the environmental and social receptor will not result in any noticeable change in its intrinsic value; hence the proposed activities will have negligible effect on its viability. This typically occurs where activities occur in industrial or highly disturbed areas.

4.3 RISK ASSESSMENT METHOD

Risk assessment method described in ISO 14001 Impact Identification and Evaluation Methodology; and Hazard and Effect Management Process (HEMP) tool shall be adopted in the risk assessment method for this ESIA report. Qualitative risk assessment will be used to assess the likelihood of harm to the environment and social resource from construction, operation and maintenance, and decommissioning activities, and the consequences of those impacts. Quantitative risk assessment will be used to evaluate aspects of the hazards and risks associated with the proposed development.

Model qualitative criteria developed to rank the likelihood and consequence of potential impacts are set out in Table 4.4 and Table 4.5 respectively.

Table 4.4: Qualitative Criteria for Impact Likelihood

Descriptor	Description	Rank
Almost certain or common	Will occur, or is of a continuous nature, or likelihood is unknown. There is likely to be an event at least once a year or grater (up to 10 times per year). It often occurs in similar environments. The event is expected to occur in most circumstances.	5

Likely Likely, has occurred in recent history	There is likely to be an event on average every one to five years. Likely to have been a similar incident occurring in similar environments. The event will probably occur in most circumstances.	4
Possible Possible, has occurred in the past but not common	The event could occur. There is likely to be an event on average every 5 to 20 years.	3
Unlikely Unlikely or uncommon	The event could occur but is not expected. May have heard it discussed as a possibility but an extremely unusual one, a rare occurrence (once per 100 years).	2
Rare Rare or practically impossible	The event may occur in exceptional circumstances. Very rare occurrence (once per 1,000 years). Unlikely that it has occurred elsewhere and, if it has occurred, it is regarded as unique.	1

Source: Natural Eco Capital (2020)

Table 4.5 Qualitative Criteria for Consequence

Descriptor	Description	Rank
Severe Widespread serious long term effect	Extreme permanent changes to the environment, major public outrage, or the consequences are unknown. Serious environmental and social harm that causes actual or potential environmental and social impacts that are irreversible or of high impact or widespread. Likely prosecution by regulatory authorities.	5
Major Wider spread, moderate to long term effect	Substantial and significant changes that will attract public concern are only partially able to be rehabilitated, or it is uncertain if they can successfully be rehabilitated. Actual or potential environmental and social harm either temporary or permanent, requiring immediate attention. Possible prosecution by regulatory authorities.	4
Moderate Localized, short term to moderate effect	Significant changes that may be rehabilitated with difficult. Direct or indirect environmental and social impacts beyond location (on site or off site). Repeated public concern. Reportable to the government.	3
Minor Localized, short term to moderate effect	Some limited consequence but no significant long term changes, may be easily rehabilitated	2
Negligible No impact or no lasting effect	Possible impacts but without noticeable consequence. Temporary or short term reversible environmental and social impact, localized event, location of little environmental and social value	1

Source: Natural Eco Capital (2020)

The level of risk of each environmental and social impact shall be determined by combining likelihood and consequence in a matrix. Table 4.6 shows the impact significance with associated impact rating derived from ISO 14001 Impact Identification and Evaluation Methodology, Table 4.7 below illustrates all possible product results for the five consequence and likelihood categories.

Table 4.6: Qualitative risk assessment matrix

Consequence					Increasing Probability				
					1	2	3	4	5
Severity	People	Assets	Environment	Reputation	Never heard of incident in industry (0-20%)	Incident has occurred in industry (21-40%)	Incident has occurred in (41-60%)	Happens several times per year (61-80%)	Happens several times per year in asset/ facility (81-100%)
5	Multiple Fatalities	Extensive damage	Massive effect	International impact	**5**	**10**	**15**	**20**	**25**
4	Single Fatality	Major damage	Major effect	National impact	**4**	**8**	**12**	**16**	**20**
3	Major Injury	Localized damage	Localized effect	Considerable impact	**3**	**6**	**9**	**12**	**15**
2	Minor Injury	Minor damage	Minor effect	Limited impact	**2**	**4**	**6**	**8**	**10**
1	Slight Injury	Slight damage	Slight effect	Slight impact	**1**	**2**	**3**	**4**	**5**
0	No injury	No damage	No effect	No impact	**0**	**0**	**0**	**0**	**0**

Source: ISO 14001 Impact Identification and Evaluation Methodology.

Table 4.7: Degree of Impact Significance

Ranking (consequence *x* likelihood)	Significance
>16	Critical
9-16	High
6-8	Medium
2-5	Low
<2	Negligible
The positive impacts of the proposed project activities on all valued receptive components shall be rated as beneficial (+);	

Source: Natural Eco Capital (2020)

4.4 COMPLIANCE ASSESSMENT METHOD

Statutory guidelines set out in environmental and social protection policies and other regulatory documents are designed to protect the relevant environmental and social receptors. The guidelines include an implicit assessment of the vulnerability of the environmental value through the setting of limits or thresholds or by providing the framework for determining the vulnerability of an environmental receptor e.g., indicators of ecosystem health, as evidenced by water quality standards.

4.4.1 Impact Qualification

The Impact qualification shall classify the impacts as direct (D) or indirect (I), adverse/negative (N) or beneficial/positive (P), short term (S) or long term (L), reversible (R) or irreversible (IR).

- Adverse impacts are those, which impact negatively on the environment and social resources.
- Beneficial impacts are those, which enhance the quality of the biophysical, health and social environments.
- Local impacts are limited to the immediate surroundings while the widespread impacts go far beyond the immediate area the impact is occurring.
- Short term means a period of time less than three months while any period greater than three months is considered long term.

- Reversible/irreversible is meant whether the impact can either be reverted to previous conditions or remains permanent once the activity causing the impact is terminated.

4.5 Some Identified Potential Impacts

Based on the initial site reconnaissance survey and available literatures and consultation that have been initiated, some potential impacts have been identified (Table 4.8. The level of significance of these impacts shall be weighed as the study progresses. However

Table 4.8: Likely Impacts As Identified in the Reconnaissance Survey

S/No	Potential Issue/Activity	Description of Potential Impact	Qualification				Remarks
			N	L	M	H	
	Construction Phase						
1.	Mobilization	• Movement of equipment	X				
2.	Contractor's Camps	• Temporary loss of land and impacts of inadequate physical and social management of camps and workforce • Construction workers are often involved in risky behaviour off-site and therefore potentially subject to high rates of HIV transmission.			X		
3.	Spoil Disposal	• Improper location and treatment of spoil dumps			X		
4.	Waste Management and Pollution	• Improper disposal of solid and liquid waste Spills and inadequate clean-up				X	
5.	Dust	• Dust nuisance or hazard			X		
6.	Loss of habitat	• Direct loss of habitat			X		
7.	Impacts on Wetlands/Hydrobiology	• Habitat impacts due to channelisation, construction in rivers • and wetlands, invasive species				X	
8.	Construction Access & Traffic	• Unsafe access routes and construction traffic hazards			X		
9.	Construction Materials	• Permanent loss of land and H&S hazards of operation and closure of borrow pits and quarries Hazards from toxic materials • Procurement from non-environmentally and socially responsible suppliers				X	
10.	Impacts on wildlife	• Disturbance and exploitation of wildlife during construction			X		
	Social	•					
11.	Cultural Heritage	• Impacts on known & unknown physical heritage		X			
12.	Rapid Change	• Social dislocation and social resistance/ Disruption of social network	X				
13.	Land Loss	• Permanent loss of land and other assets	X				
14.	Land Redistribution	• Disruption of livelihoods due to reallocation and consolidation of land	X				

Table 4.8: Likely Impacts As Identified in the Reconnaissance Survey

S/No	Potential Issue/Activity	Description of Potential Impact	Qualification				Remarks
			N	L	M	H	
15.	Irrigation within Settlements	• Disruption of settlements & associated impacts & health hazards		X			
16.	Disruption of Existing Agriculture	• Disruption of crop and livestock production by construction activities			X		
17.	Disruption of Access	• Disruption of existing access due to new channels			X		
18.	Employment	• Disruption of existing access					+
	Health & Safety						
19.	Health & Safety of Workers	• Hazards to workers				X	
20.	Health & Safety of Public	• Hazards to public			X		
21.	Flooding during Construction	• Hazards to workers and community from floods				X	
	Operation Phase						
22.	Agricultural Feasibility	• Potential delay in irrigated agriculture development		X			
23.	Agricultural Sustainability	• Delayed uptake of benefits due inability to meet on-farm soil water management needs labour, equipment and skills		X			
24.	Ecology	• Habitat degradation • Ongoing impacts on globally important • birds • Impacts on other wildlife • Introduction of invasive species • Reduced agrobiodiversity				X	
25.	Fish	• Barriers to fish passage and other impacts • Fish pass constraint and fish entrainment in canal system • Impact of water pollution on fish				X	
26.	Social change	• Cultural constraints on social and economic change		X			
27.	Gender and Vulnerable	• Impacts on women and Vulnerable		X			
28.	Livestock Husbandry	• Impacts of transformation of livestock • husbandry system		X			
29.	Energy	• fuelwood and energy	X				
30.	Access	• Restricted wet season access, barrier • effects on new channels	X				
31.	Benefits and Equity	• Inequitable distribution of benefits - • incomes & employment • Price reductions in local markets and		X			

Table 4.8: Likely Impacts As Identified in the Reconnaissance Survey							
S/No	Potential Issue/Activity	Description of Potential Impact	Qualification				Remarks
			N	L	M	H	
		• associated impacts on rain-fed producers					
32.	Health	• Extended malaria season • Increased schistosomiasis • Changes in other diseases • Impacts of continuing low health status • on beneficiaries' ability to benefit from • project • Inadequate water, sanitation and • hygiene reducing project benefits • Safety hazards			X		

4.6 Cumulative Impacts Assessment

Cumulative impact assessment will address potential cumulative impacts that may arise from the incremental impact of the proposed Project when added to other closely related past, present and probable future projects.

The methodology employed to identify and document this impact is in accordance with the *IFC Good Practice Handbook on Cumulative Impact Assessment and Management* (IFC, World Bank Group), **Significant risk for cumulative impacts/limited leverage;** this allows for projects where "the development under consideration is immersed in an environment where the cumulative impacts are evident but the issues are complex, many actors are already involved, and the solution is clearly beyond any individual project sponsor" as applicable to this ESIA project. In this scenario, mitigation measures commensurate with the magnitude and significance of the impacts will be documented in the ESMP.

The impacts shall be identified along the following lines:

- Identification of present and future activities within the directly and indirectly impacted areas that are relevant to the project;
- Identification of potential sensitive receptors (environmental and social) that may be affected;
- Recommendation of mitigation measures that apply to the identified cumulative impacts within the ESMP

The potential cumulative impacts identified according to environmental and social parameters are presented below:

4.7 Mitigation Measures

Based on the inferences from the Consultation/participation with various stakeholders and the general public mitigation measures shall be drawn against the impacts that would be identified. In proposing a strategy for the implementation of social mitigation measures, experience suggests that certain cardinal principle will be adopted as follows:

- Care will be taken to ensure that proposed measures are accepted widely
- Proposed mitigation measures will assign specific responsibility to parties,
- Measures will be couched in a manner that they are easily incorporated into policies pertaining to social investment strategy and public consultation and disclosure plan

Generally, in the suggestion of the mitigation measures, the reduction of potential impacts to levels which are As Low as Reasonably Practicable (ALARP) would involve balancing reduction in risk against the time, trouble, difficulty and cost of achieving it.
All identified environmental and social impacts, which can be eliminated or minimized to an acceptable level, shall be complemented by option and measures to avoid, minimize or mitigate such harmful effects. This shall involve, for example, from recommendation of practical measures for rehabilitation to restore impaired features, environmental awareness programmes for operational staff, etc. Ways to enhance the beneficial ones shall be documented in the ESIA.

The principle that shall guide the approach to mitigation measure development is outlined in Table 4.9

Table 4.9: Approach to Mitigation Measure Development

	Mitigation Measure	***Practice***
1	Seek Alternatives to avoid particular impacts.	Consider alternatives to a proposed project activity. Examine alternative ways to achieve the objectives to maximize benefits and minimize undesirable impacts.
2	Arrange Compensation where particular impacts are unavoidable.	Restore damaged resources, such as, water source, forest. Proper rehabilitation scheme, such as, skills training, new employment. Adequate compensation payments to affected persons for damage or loss of property, livelihood and provision of rehabilitation measures.
3	Take Corrective Measures to reduce unavoidable effects.	Consider corrective measures to reduce adverse impacts to acceptable standards, such as, remove spoil material during construction, assist in school expansion to handle influx of labourers' children, and others.
4	Implement Preventive Measures to avoid some impacts altogether.	Pre-preparation for minimizing adverse impacts, such as, implement health education program, initiate public awareness programs.

4.8 Reporting

The ESIA Reports shall be prepared and submitted in the course of this project. The Reports will include the following:

i. Draft Report; and
ii. Final Report

The Report structure and format will follow that of the FMenv Standards. This format will include the following sections and chapters:

- Table of Contents
- List of Tables, Figures and Plates
- List of Abbreviations and Acronyms
- ESIA Preparers/Project Team
- Acknowledgments
- Executive Summary
- Chapter One: Introduction
- Chapter Two: Project Justification and Alternatives
- Chapter Three: Project and Process Description
- Chapter Four: Description of the Environment
- Chapter Five: Associated and Potential Impacts
- Chapter Six: Mitigation Measures
- Chapter Seven: Environmental and Social Management Plan
- Chapter Eight: Decommissioning and Restoration Plans
- Chapter Nine: Recommendation and Conclusion
- References
- Appendices

4.9 Conclusion

Ebonyi State Government is prepared to carry out an ESIA study for its proposed International Olympic Stadium at Abakaliki. This ToR/SoW document, which outlines the study methodology, scope of work and the environmental parameters that will be measured, is thus submitted. Ebonyi State Government therefore, requests the Ministry's kind approval of this ToR/SoW.

APPENDIX I
(SCOPING WORKSHOP ATTENDANCE SHEETS)

EBONYI STATE INTERNATIONAL OLYMPIC STADIUM

ENVIRONMENTAL IMPACT ASSESSMENT SCOPING WORKSHOP

ATTENDANCE SHEET

LOCATION: ABAKALIKI LG HEADQUARTERS **DATE: 29TH JANUARY 2020**

S/N	NAME	ORGANIZATION/ COMMUNITY	POSITION	PHONE NO	SIGN
1	Hon Nwofuwa Ben	Ofemtumo	State PDP Ass. Dissec	08065967000	
2	Hon Omiri [illegible] Vincent	Amachi	Ex-Officio PDP	07039523295	
3	Nkwuda Izuchukwu	Edda	Sup. Agric	08160353383	
4	Hon Nwokeocha Fidelis	Amachi	State [illegible]	08023127081	
5	Hon John Nwafor	Amagu	–	08037228863	
6	Chief Alegu Francis	Amagu	✓	07036674030	
7	John Nwoke	Amagu	PA	08170182263	
8	Hon Kenneth Nwova	[illegible]	STA	08039583110	
9	Hon Ngele Bernard	Amagu	Councillor	09038740672	
10	Engr. E.R. Ibiam	Fire Service	Director	08032554317	
11	Nweke Simon	Fire Service	D Director	08065468257	
12	Orie Frederick	"	F/19	07063792666	
13	Aligwe Ifeoma U.	Abakaliki	[illegible]	08161209173	
14	Regina Egbedike	Abakaliki	SWA		
15	Otta Judith C.	Abakaliki	Edu/S.W	08036588751	
16	Ogbonna Ann Chidiebere	Abakaliki	Edu/Swa	07035368882	
17	Florence Ononogbu	Abakaliki	Education	08626777A7	
18	Uchenna Edeh N.	Abakaliki	Finance Dept.	07033016632	
19	Elom Ngozi E.	Abakaliki	PRO.	08084[illegible]	
20	Uguru Elizabeth			0581818818	
21	Nkwoede Linda	Abakaliki	HEO Ak	08061339042	
22	Nwachukwu	"	P.P.S	070[illegible]391129	
23	Uchey Doris	A.	Edu/SW	07067538992	
24	Igube Agatha	Abakaliki	Edu.	—	
25	Alaka Salome D	✓	Edu.	08038953340	
26	Igwe Jane U.	✓	—	—	
27	Nwofoke Sunday	ENYI [illegible]	PG	07030848788	
28	Okemini, Sunday	1221 Umuhu	S A	07037124921	
29	Nweza Stephen	Amachi	S A	08081325991	
30	Augustine Alegu	Amagu	Town Union President	07036181632	
31	Ugbala Simon	Acharamuku	Agric	08105313408	
32	Nwazunku Emmanuel	Nsetic	INT.	07031675559	

S/N	NAME	ORGANIZATION/ COMMUNITY	POSITION	PHONE NO	SIGN
1	UGO CHIKAODI	Amegu Com	HASWO	07081586349	
2	Okoro Amarachi	Abakaliki	SCA	0803760882	
3	Uguru Chima	Abakaliki	SDPA	08082946892	Chima
4	Tiums Emma	Abakaliki	DAO	0803533716	
5	Nwode Joy	Abakaliki	FD	0706300950	
6	Iboko Vera-C	Agbaja	ACAO	08037448420	
7	Nwdaynago Ben	Abakaliki	SA	08068508034	
8	Adeoga Grace	Amegu Com	CWA	07031031970	
	Ekpe Paul	Amagu Com	CWA	07061223062	P
9	Nwachukwu Hillary	Amudu Comm	PRPSI	07033901211	
10	Nwentuo Oluchi	Abakaliki	HASWO	08037805958	
11	Nwonyeophu Judy	Magu Com	WAI	08160867215	
12	Odumike Godwin	Abakaliki	SAA	08100751191	Goo
13	Nweke Godwin	Izzi Umuhu	CWA	08034926869	
14	Ngamgbo Chinasa	Ikwo	SWO	08062271110	
15	Ngbose, Uchechukwu	Enyigba	ED.	08164062127	
16	Michael Ayogu	Abakaliki	PWD	[illegible]	
17	Uche Paul S.	Abakaliki	A.S.	08124056370	
18	Rt.Hon. Val. Okike	SSA Stadium	SSA Stadium	08083805201	
19	Emmanuel Nwafor	Attorney	P/A7	08126002082	
20	Nwankwo Stephen	Abakaliki	MNFPIC	07034458335	Uchu

EBONYI STATE INTERNATIONAL OLYMPIC STADIUM

ENVIRONMENTAL IMPACT ASSESSMENT SCOPING WORKSHOP

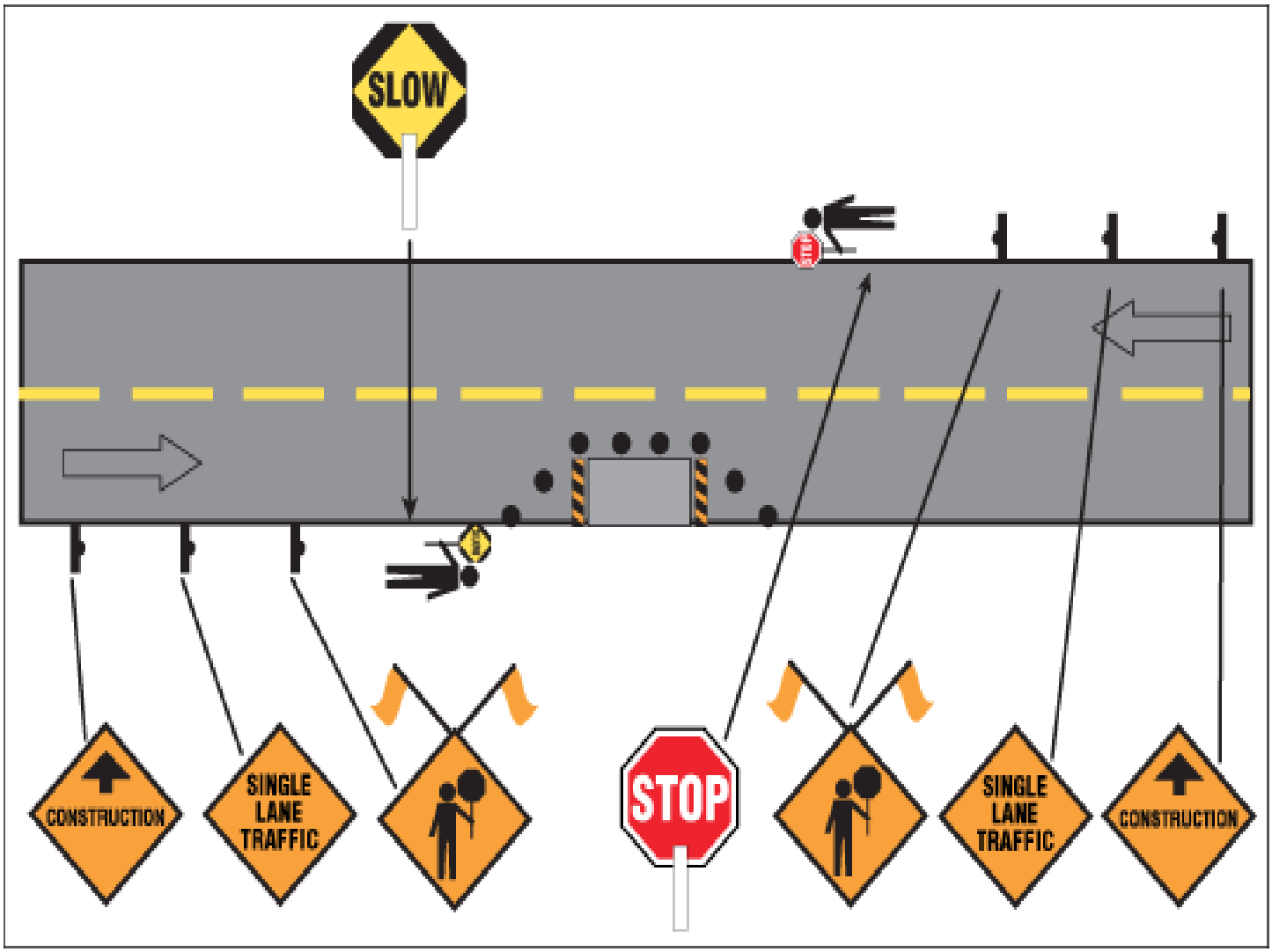
ATTENDANCE SHEET

LOCATION: ABAKALIKI LG HEADQUARTERS **DATE: 29TH JANUARY 2020**

S/N	NAME	ORGANIZATION/ COMMUNITY	POSITION	PHONE NO	SIGN
1	OROKE REGINA M	AMAGU	BCS (ADP)	08066836476	[signature]
2	HRH Eze Stephen U. Ukpa	Ohipuitu MD	Residential	08837514	[signature]
3	V Michael Nwobashi	Enyigba	✓	08034305490	[signature]
4	Fidelis Nwonumeny	Amagu	✓	08063879248	NFidels
5	Nwigwe G N	NIS		07069443534	[signature]
6	Ndubuisi G I	✓		07012572865	[signature]
7	Nwogbo E James	Ohofekure	farm	08069575515	[signature]
8	Orji Uzoamaka	Abakaliki LG		08138257861	[signature]
9	Inah Emmanuel	Abakaliki L.G.A	Staff	08033625635	[signature]
10	ALI BESSINA O.	Abakaliki L.G.A	Staff	08140805006	[signature]
11	Uhuo Perpetua	Abakaliki	Staff	08037084328	[signature]
12	Eboji Nkechinyo	Abakaliki	Staff	07036077932	[signature]
13	Chukwu Onyinyechi	Abakaliki L.G.A	Staff	08035582626	[signature]
14	Chijioke Chituike	Abakaliki LG	Stakeholder	08065684192	[signature]
15	Okonkwo Joseph	Abakaliki LGA	staff	07039290731	[signature]
16	MBAM UDOKA	Abakaliki LGA	Staff	07039728031	[signature]
17	ONUOHA DAVID -U	ABAKALIKI L.GA	STAFF	07069516332	[signature]
18	OCHINYA JOHN	ABAKALIKI LG	Supervisor	08069665964	[signature]
19	Hon mrs Akpa chika maria		Councillor	08034304264	[signature]
20	Akpata Michael	Amagu umuhu	Stakeholder	07084981925	[signature]
21	Nwuda Fidelia	Abakaliki LG	Staff	08030968547	[signature]
22	Oko-obasi Ndidi	Abakaliki LG	STAFF	07028432328	[signature]
23	Nwueke Stella	Abakaliki LG	STAFF	09038028590	[signature]
24	B. M. Ezeoke		✓	08050960321	[signature]
25	NJOKU CHINYERE	ABAKALIKI LG	ADMIN. OFF	08030889584	[signature]
26	Nneka Nwonumara	Abakaliki	✓	07038740124	[signature]
27	Nwandiagu Ogechi H	Abakaliki	Staff	08165899059	[signature]
28	Nwode Esther	Abakaliki	Staff	0806424...	[signature]
29	Ukpa Cyprian .N.	Abakaliki	Staff	07032207871	[signature]

S/N	NAME	ORGANIZATION/ COMMUNITY	POSITION	PHONE NO	SIGN
1	ACP UMA I. ORJI	NPF, STATE COMMAND EBONYI STATE	Asst. Commr of Police Ops	08069689356	[signature]
2	Hon. Ukpe Samson	Abakaliki	Super	08034546044	[signature]
3	Hon. Eze Henry O	Abakaliki	Supervisor	08033857009	[signature]
4	DSC ISU ALEXANDER	NSCDC, EB.	OC Special Duties	08035499589	[signature]
5	ARIGBO FRIDAY J	Neighbourhood [illegible]	Supervisor NHW	08037727830	[signature]
6	Nweze Ada	Abakaliki LGA	Admin Sec	08065865784	[signature]
7	HON EMEKA NWITE	ABAKALIKI	COUNCIL	08039584840	[signature]
8	Nweke mary	Abakaliki	Health	07061130844	[signature]
9	[illegible] Theresa	Abakaliki	Adm	0806[illegible]	[signature]
10	Anthony Oroke	Abakaliki	Works	07031136345	[signature]
11	Igboke Augustina	Abakaliki	Admin	0706639622[illegible]	[signature]
12	Nwokeochi Eunice	Abakaliki	Admin	07082811444	[signature]
13	Sunday Nworo	✓ ✓	Works	09097173003	[signature]
14	Ugwu Ndukwe	✓ ✓		08066938624	[signature]
15	Nkwuda Sunday E	Abakaliki	GRA	08067995678	[signature]
16	Ogiji, Godwin	✓	CCO	0805[illegible]	[signature]
17	Mba Joseph	✓	CSWO	0818885[illegible]	[signature]
18	N. UCHENNA GODSWILL	NSCDC A.T. DIVISION	DPO	08038916985	[signature]

Appendix 4.8 -Traffic Management Plan



TRAFFIC MANAGEMENT PLAN

FOR

EBOYI STATE INTERNATIONAL OLYMPIC STADIUM

Authorisation and Control

The only controlled copy is printed copy and each copy of the TMP, shall be stamped "Site Copy" in green ink. The TMP shall be subject to review and shall be amended to reflect any changes in the Project requirements and re-issued accordingly.

The TMP shall be identified by the applicable (internal) project number/document number, description and revision status and shall be signed and dated by the relevant Stadium personnel and approved by the Management.

Table of Contents

1 Introduction

1.1 Background Information

This document defines the strategies for management of the traffic impact of Ebonyi State International Olympic Stadium. The traffic management strategy for Ebonyi State International Olympic Stadium located in Abakaliki LGAs, Ebonyi State is one of minimizing, where at all possible, the interfaces between the public and Stadium's transport induced traffic. Ebonyi State Government recognises that an effective management of traffic impacts on its transport routes is critical to the success of its project and has therefore developed this Traffic Management Plan (TMP) document for its operations.

1.2 Purpose

The TMP describes how Ebonyi State Government proposes to manage vehicular traffic during the construction and operation phases of its Stadium so that the project objectives are fully realised without any significant impact to the existing traffic of the transport routes. This TMP, therefore seeks to ensure the certainty of the delivery of the prescribed road user requirements including provision of a safe environment, and minimising impacts on the road networks relevant to the project.

1.3 Scope

The plan details the Project's transport and traffic management framework (including processes and tools) involved with transport and traffic management during the project's operation phase. Any incident or issue arising directly or indirectly from an interface between operational activities and the general public will be managed with the requirements as stipulated in this plan. Ebonyi State Government is committed to upholding its statutory and administrative requirements in accordance with conditions stipulated in the relevant regulatory approvals.

2 Legislative and Other Requirements

2.1 Overview

Key traffic management legislation, codes of practice, guidelines (for Nigeria and Ebonyi state)

and international standards and corporate requirements relevant to the transportation and traffic management of the Ebonyi State International Olympic Stadium will be tracked and reviewed continually to ensure compliance.

2.2 Legal and Administrative Framework

Relevant legal and administrative requirements have been reviewed as part of the TMP. Applicable legislations include:

- Road Traffic Act Cap 548 Laws;
- Revised Nigerian Highway Code 2016;
- Admiralty Jurisdiction Act 1991;
- The Federal Ministry of Sport;
- National Sports Policy of Nigeria (2009);
- Fédération Internationale de Football Association (FIFA)
- FIFA Stadium Safety and Security Regulations
- International Association of Athletics Federations (IAAF)

3 Project Transport Management Framework

3.1 Transport Safety Policy

This plan describes how the transport management responsibilities for the project will be managed within the requirements and constraints imposed by the Ebonyi State Government corporate governance framework, business standards and policies as documented in the Ebonyi State Government Environmental Management System (EMS).

Ebonyi State Government will adopt ISO 39001:2012 Traffic Management System (TMS) which specifies requirements for a road traffic safety (RTS) management system to enable it, as an organisation that interacts with the road traffic system, to prevent death and reduce serious injuries such as fire and explosions related to road traffic crashes which it can influence. The requirements in ISO 39001:2012 include development and implementation of an appropriate RTS policy, development of RTS objectives and action plans, which take into account legal and

other requirements to which the organisation subscribes, and information about elements and criteria related to RTS that the organization identifies as those which it can control and those which it can influence. Therefore, Ebonyi State Government wishes to:

- sustainably improve road traffic safety performance;
- establish, implement, maintain and improve a road traffic safety (RTS) management system; and
- assure itself of conformity with its stated road traffic safety (RTS) policy; (RTS) objectives and (RTS) targets

3.2 Objectives and Targets

Ebonyi State Government's objectives with respect to the TMP are as follows:

- Safety and health above all else for employees, contractors and the general public.
- Ensuring road users are given consideration during all phases of the project works.
- Planning and managing all vehicle routes.
- Plan and stage all work effectively to avoid road occupancy, potential impacts and minimise conflict points on the existing road network.
- Ensure any delays are kept to a minimum.
- Minimise disruption to businesses.
- Limit obstructions and restrictions, and when unavoidable provide alternatives to maintain access for local community, transport operators including movement of dangerous goods.
- Actively liaise with key stakeholders including road authorities (Federal Road Safety Corps, FRSC; Ebonyi State Traffic Management Authority, Police, Local Councils, emergency service agencies and transport operators to ensure they are informed about proposed changes to the road network, including but not limited to specific information provided to the local community.
- Obtain when required all approvals and licenses such as road occupancy or Speed Zone Authorisation and Traffic Signals.
- Minimise disturbance to the environment.

3.3 Roles and Responsibilities

The management of this project will be organised under the control of the Commissioner of Special Projects. Ebonyi State Government will manage all matters requiring communication or coordination with other contractors, thus ensuring there is always 'one point of contact' during the course of the project. Formal lines of communication between project personnel will be shown in an organisation chart. These may be supplemented by informal lines of communication to facilitate efficiency and effectiveness of the management team.

3.3.1 Positions Description

Position descriptions including definitions of responsibility which will be developed for all Ebonyi State Government staff on the project. All project staff associated with developing, implementing, operating and managing traffic control will undertake the appropriate training to fulfil their duties, whether:

- Authorised Traffic Marshal/Controller training,
- Traffic Control at Worksite Planning, and
- Design and Audit Traffic Control Plans.

To further enrich the knowledge of transport contractor/personnel, Ebonyi State Government will prepare induction information, tool box notices, and conduct training sessions on road safety and traffic management issues for the concerned persons. All articulated vehicle Drivers will be made to undergo training at government approved training institutes.

3.3.2 Resource Monitoring

Project staffing requirements and the proposed duration for each position is determined by the Project Manager and the Manager Operations. During operation, staff numbers and their responsibilities will be subject to change. The Project Manager will assign duties to personnel based on their experience so that the necessary activities are completed properly and in a timely manner.

If at any time during the project the Project Manager considers resources inadequate for the work to be done, the perceived inadequacy will be discussed with the Manager Operations to determine a solution.

3.4 Safety, Health and Environmental Work Method Statements (SHEWMS)

SHEWMS will be prepared for all transport and traffic activities associated with the project. The aspects of an activity detailed in a SHEWMS include safety and health, environmental, quality and community matters. A SHEWMS will be prepared and reviewed considering all the stakeholders associated with the activity in accordance with the process set out in the Safety and Health Management Plan and will involve;

- Identification of safety hazards and statutory compliance requirements relevant to the proposed activity;
- Consideration of consequences, likelihood of incidents occurring and risk, and
- General control and communication measures with all the stakeholders involved (including detailed written descriptions, diagrams, drawings or sketches and technical data as appropriate)

4 Risk Management

4.1 Risk Management Overview

The Ebonyi State Government project risk program will include and address issues associated with traffic management and includes where appropriate the risks associated with public roads. Traffic risk management for this project will involve a systematic method of identifying, analysing and controlling the risks associated with the project's activities or processes, to minimise loss and maximise opportunities. The basis of the program is a risk assessment, complemented by regular inspections and assessment of employee and/or contractor SHEWMS.

Traffic risk analysis for this project involves both quantitative assessment of commercial risk and qualitative assessment of risks that could significantly impact upon project objectives and targets and strategies to control or minimise them. By monitoring the implementation of the controls put

in place, Ebonyi State Government will ensure that the desired outcomes are achieved. Responsibility for maintaining an up-to-date risk register will be assigned to the HSE Manager and regular risk review meetings will help track identification of new risks, treatment of existing risk and closeout of identified traffic risks that no longer concern the project. The process of continued traffic risk management would include:

- Regular communication with stakeholders on effectiveness of TMP;
- Regular inspection and monitoring of the network
- Revision of the TMP as required in consultation with the Ebonyi State Traffic Management Authority and FRSC Traffic Committee.

The Project Manager will identify and analyse the projects major traffic risks. Once determined the details of the various major risks and control measures will be documented. Formal risk assessments will be conducted to identify the potential route safety and traffic management risks associated with the Project. Identification of these risks will require input from all key stakeholders including; FRSC, Ebonyi State Traffic Management Authority, Ministry of Special Projects, Emergency Service agencies and Local Council(s). A traffic risk management workshop / forum will be held by Ebonyi State Government to obtain stakeholder input prior to the commencement of operation.

Other identified key stakeholders that will be consulted include:

- Nigerian Association of Road Transport Owners (NARTO),
- Nigeria Police

4.2 Hazard Identification & Risk Assessment:

Hazards associated with traffic management shall be identified and a written risk assessment will be completed. The risk assessment shall be carried out by a competent person and be included as part of the SHEWMS. The risk assessment will consider the following:

- Competence of persons operating vehicles
- Road users and the general public (including pedestrians),

- Existing roads dynamism,
- Stability and suitability of vehicles being used,
- Movement of petroleum products and other dangerous materials/chemicals,
- Safety controls,
- Site issues.

4.2.1 Signage

Upon agreement with stakeholders, Ebonyi State Government intends to erect temporary signage as defined on selected points along the roads. The agreed signage and speed restrictions will advise traffic of delivery routes, speed limits and warnings / advice at areas of concern (schools, dense community settlements, markets, road crossings and busy junctions, etc.).

Careful consideration will be given to the signage of the road, worksite and truck part. Selection of signage will be appropriate to Nigeria and international standards and shall consider;

- Safety of road users and the public;
- Protection of workers;
- Provision of adequate warning of changes in surface conditions;
- Requirements for adequate and advanced instruction for road users and their safe guidance through, around, or past the worksite;
- Safe access and egress to and from the worksite/truck park;
- Basic principles are to be observed in the use and erection of selected signage. Such signage and devices shall:
    a) be appropriate to the conditions at the road;
    b) be erected and displayed before work commences and on all approaching sides;
    c) not be obscured or obscure other devices;
    d) not pose a hazard to public, workers, pedestrians or vehicles;
    e) be regularly checked and maintained is in a satisfactory condition; and
    f) remain in place

5 Project Transport and Traffic Plan

5.1 Itinerary and Route Distribution

The Ebonyi State Government project's transport system will involve two forms of transportation highlighted below:

1) Delivery of construction materials during construction phase.
2) Road transport for vehicles during operation phase

This TMP has been developed based on the information currently available to Ebonyi State Government and the preferred route may be adapted in future stages albeit following consultation with the appropriate authorities. The traffic management principles to be applied on this project will ensure:

- the provision of a safe environment for road users and workers;
- the overall impacts on road users is kept to a minimum;
- access is maintained for the local community, transport operators, (including over-dimension load movements) & commercial developments; and
- road users and local communities are regularly informed in relation to the changed traffic conditions

5.2 Transport Management Issues

Ebonyi State Government recognises that effective management of traffic impacts on the road network is critical to the success of its project. It is fully appreciated that the local roads are the property of Federal and State government, any upgrade that will be carried out in the existing road network will be done by a consortium following due consultation with the two tiers of government.

In identifying the traffic control requirements defined in this document, the following issues have been considered:

- Offloading, loading and parking;
- Over size and over mass loads;
- The increase of heavy and light vehicular traffic; and

- Emergency response and preparedness.

5.3 Onsite Traffic Management

5.3.1 Site Access and Egress

Access routes within the site/truck park will be developed to ensure a safe interface between pedestrian and vehicular traffic during construction and a state-of-the -art -park during operation phase of the Stadium. Ebonyi State Government is committed to continuous improvement on the following issues in its efforts to achieve a safe working environment.

- Operating a state-of-the-art Park.
- Planning and managing pedestrian and vehicle routes.
- Eliminate, where possible, reversing operations.
- Protection of the staff, contractors, visitors and community.
- Safe driving and working practices.
- Provision of signs and barriers.
- Traffic control personnel

5.3.2 Vehicle Parking and Access

The Park is expected to completely eliminate indiscriminate parking along the road side.

5.3.3 Speed Limit

5.3.3.1 Site Speed Limits

Site speed limits of 10 km/h are to be used for the main access road and movement in and around the active work areas shall also be limited to 10 km/h. Speed signs shall be erected at the site entrance with repeater signs within the site. Speed signs shall also be erected at the entrance to individual work zones or where conditions have changed.

5.3.4.2 Offsite Speed Limit

In line with the *Revised Nigerian Highway Code of 2016*, all articulated vehicle exceeding 3t max laden weight shall maintain 40 km/h max on highways. Drivers are to observe the posted

speed limits, with speed adjusted appropriately to suit the road environment and prevailing weather conditions.

5.4 Haulage Hours

Tentatively, working hours for all articulated vehicles (tankers, trailers and trucks) is 24hours.

5.5 Emergency Services Access

Emergency access to the site shall be provided at the Main Gate/Site Entrance and shall be maintained at all times. All Emergency Services will be informed of the access and egress locations and shall be issued a Site Plan or other acceptable form of documentation following approval.

6 Existing Traffic Condition

6.1 Dilapidation Survey

The volume of traffic is assessed to reduce which is the focal point. As the trucks disperse to the various directions as indicated above, less volume of traffic is expected away from source. Based on this scenario, the existing road infrastructures conditions is limited to Abakaliki Road. Beyond these location, the project's traffic impact becomes insignificant. Therefore, Abakaliki main roads are particularly important to this project.

The aforementioned express way is currently single carriage ways, which is a constraint on the transport routes for the Stadium, others include pot holes, blind spots, narrow portions, busy junctions, etc.

7 Implementation of Controls

7.1 Induction of Personnel

During construction, all drivers and personnel are to undergo a general Site Induction and Training. On completion of induction, all drivers will be made to sign a copy of **DECLARATION FORM** *(see **Appendix I**)*. The Site Induction will incorporate the necessary

training requirements. Topics to be covered will include:

- Project overview and values,
- Management policies;
- Revised Highway Code (2016),
- Defensive driving;
- Emergency preparedness and response; and petroleum products basic chemistry and hazards analysis,
- Assembly points (in the case of evacuation)
- Safety, Health and Environmental Management requirements;
- Vehicle and pedestrian access restriction on-site,
- The concept and importance of due diligence including the practices and procedures;
- Details of the TMP and the responsibilities of employees, contractors and subcontractors;
- Management practices and procedures necessary to ensure compliance with relevant Acts and Regulations.

Drivers must have undergone standard training in any government approved training institutes leading to issuance of appropriate class of Driver Licence by the Federal Road Safety Commission (FRSC).

7.2.1 Toolbox Meeting

Toolbox meeting shall be conducted by the tanker park Superintendent prior to undertaking any work activity and in accordance with the process described in the project Safety and Health Management Plan. Specific transport management items and topics that shall be given/considered for discussion shall include:

- Daily scope of work and associated vehicle management;
- Weather observations/ forecast (particularly heavy rain, wind and fog); and
- Project incidents and/or feedback on any issues that have recently occurred

7.3 Weekly Safety Meeting

Safety Meetings shall be conducted on weekly basis or on needs basis in accordance with the project Safety and Health Management Plan. Safety discussions relating to transport management risks and opportunities associated with the project may cover as required;

- Project objectives and targets and Project Key Performance Indicators (KPI);
- Key community issues relating to public interfacing with the site e.g. traffic and change management;
- Fatigue management; and
- Safety Incidents and Alerts from Ebonyi State government.

7.4 Issues and Alerts Bulletins

7.4.1 Project Traffic Alerts

A Project Alert is a tool used for communicating the initial findings from an incident. Following the investigation and reporting of any traffic incident whether internally or externally related to the project, the Safety Officer and or Engineer will determine whether a Project Alert shall be generated to convey details of the incident and relevant corrective action required to prevent the incident recurring. Distribution of the Project Alert will be through weekly meetings or toolbox talks and via display on all project site or truck park noticeboards.

8 Review and Monitoring

8.1 Inspection of Traffic Control Measure

Traffic movements on and off-site will require continuous monitoring to ensure compliance to this TMP. Regular checks will be made by Traffic Coordinator to ensure that speed restrictions are adhered to by all associated with the project. Checks will be made in particular at the key areas of concern including settlements, road interceptions, bad portions on roads, etc.

8.2 Project Internal Audits

The Project Manager is responsible for ensuring an audit program is developed and

implemented. The Project Manager will prepare an audit plan for the project that ensures:

- Transport management performance on the project is audited against regulatory and international standards such as ISO 39001:2012 which specifies requirements for a road traffic safety (RTS) management system. The Project Management System and all relevant transport management legislation, code of practices and guidelines shall be followed;
- All major contractors and suppliers are audited at an early stage of their works and at critical times throughout the project.

Traffic audits are planned and conducted in accordance with Ebonyi State government procedures by trained and experienced persons who are independent of the routine performance or management of the work activities. The findings of audits are discussed with representatives from the company or area being audited and actions agreed to address any deficiencies. Traffic audit reports are distributed to the concerned parties audited and project staff responsible for the management of the activities.

8.3 Plan Review

The management review process will ensure sufficient information is gathered over the term of the project to allow management to undertake an effective review, including the results of monitoring activities and any corrective actions implemented.

Ebonyi State government proposes to review this TMP inclusive of access routes, controls, and audit requirements etc. on a yearly basis (or as required by the concerned government authority). Any TMP review related with off-site activities will have to be carried out with due consultation with stakeholders including government agencies, Drivers e,t,c.

9 Traffic Performance Report

9.1 Project Reporting Requirements

Project Transport management performance will be reported as follows:

- Monthly Progress Report**:** Traffic management performance will be addressed in the Monthly Progress Report or as required (this will include monitoring results and updates)
- SH&E Incident Management System: Incident reporting will be conducted using the third-party consultant for SH&E Incident Management System using HSE software (to enable manage its compliance obligations and business processes associated with traffic health and safety management). Copies of reports relating to incidents or potential incidents (near misses) will be sent to the Project Manager.
- Audit Reports

10 Incident Management

10.1 Manage Incidents

All personnel and drivers/contractor employees are required to report **ALL** road incidents and near misses to the Project Manager immediately. The Project Manager will notify the Management as required. The reporting of incidents is classified into five classes relating to the severity or potential:

- ***Class 3***: Damage which temporarily inconveniences a person (first aid, medical treatment) and or public traffic.
- ***Class 2***: Damage which temporarily alters a person's future (lost time injury from which the individual fully recovers) and or public traffic.
- ***Class 1***: Damage which permanently alters a person's future (fatality, quadriplegia, paraplegia, amputee, back injury, disfigurement, psychological disturbance). This also include long time impact to the road network
- ***PC1:*** Potential Class 1
- ***EPC1***: Elevated Potential Class1 are PC1 incident which satisfy the following criteria:
  a) Potential for a fatality or multiple injuries/accident;
  b) No defences were in place or all defences had been breached (excluding PPE, safety belt) an actual event occurred where there was an uncontrolled release of energy only chance prevented an actual incident occurring.

The Project Manager and or nominated representative will discuss and agree recommended preventative action, then assign responsibility and timeframe for completion. All incident report details will be entered into the SH&E Incident Management System.

11 Stakeholder Consultation

11.1 Communication List

Identified traffic stakeholders to be consulted on continual basis are presented in ***Table 1*** below.

Table1: Communications list

Organisation	**Name**	**Title**	**Phone Number and email address**
Transport		Transport Coordinator	
HSE		HSE Manager	
PR		PRO	
Ebonyi State Ministry of Environment		Director General	
FRSC	-	Zonal Command	
Police	-	Ebonyi State Command	

11.2 Public Notice and Community Relations

Ebonyi State government understands the importance of community and stakeholder engagement and intends to build upon the work that has already been undertaken during the project's Environmental and Social Impact Assessment (ESIA) study. Maintaining the good relationships that have been built amongst the stakeholders will be achieved by ongoing communication/consultation.

Ebonyi State government acknowledges and respects the needs of others. It is committed to minimising inconvenience and as such intend to close out any issues or complaints as soon as possible following notification. In the event that Community Consultation Committee meetings are established then Ebonyi State government will ensure a representative is in a attendance to listen, report and action the wishes and concerns of the community.

11.3 Notification of Incidents (occurring off-site)

Should the Site Superintendent or Project Manager receive notice of any incidents requiring attendance off-site, they will contact all relevant authorities and personnel to arrange such attendance / investigations. These incidents will be registered in the HSE record, investigated and close out actions listed. These incidents will be reported in the Monthly Progress Report issued to the management.

11.4 Emergency Services Contact Numbers

The relevant Emergency Services Contact Details are as follows:

Table 2: Emergency service contact directories

Public Emergency Unit	**Phone Number**	**Districts**
Police		Ebonyi State Command
Ambulance		Ebonyi State Hospitals Management Board
Fire		Ebonyi State Fire Service

12 Quality Control

Quality control and quality assurance (QA/QC) measure for the TMP include the following:

- *Identify:* Identify unsafe Drivers before they have a collision by soliciting feedback from

concerned motorists with our **'How Am I Driving'** stickers & truck identification numbers and phone number to contact by the observers.

- *Notify:* Notify Ebonyi State government Leading Hand & the driver automatically of compliments, complaints, and safety issues reported by concerned motorists.
- *Modify*: Modify unsafe driving behaviour before an incident or accident occurs with the help of training & consultation with all Drivers
- *Quantify*: Quantify the effectiveness of the Code of Conduct ***(Appendix II)*** by monitoring community feedback and any incidents or accidents.

REFERENCES

Australian Roads and Maritime Services, ARMS

Revised Nigerian Highway Code 2016, http://frsc.gov.ng/

APPENDICES

APPENDIX I

EBONYI STATE GOVERNMENT DECLARATION FORM

I, the undersigned, hereby agree to abide by Ebonyi State government Truck Driver Code of Practice in a safe manner. I have read and understood the requirements outlined in the attached document and will, to the best of my ability, comply and assist with their implementation, requirements and ongoing administration.

The subject document to which this declaration relates is attached as part of the overall document and signing of this declaration confirms that signee has read and understood the entire document:

TRUCK DRIVER
Full Name:
Organisation:
Signature:
Date:

EBONYI STATE GOVERNMENT
Company Witness:
Date:

APPENDIX II

DRIVER CODE OF CONDUCT

2 Driver Code of Conduct

2.1 General Requirements

Heavy vehicle drivers must:

1) Have undertaken a Site Induction carried out by an approved qualified person under the direction of the Stadium management;
2) Hold a valid driver's licence for the class of vehicle that you operate;
3) Operate the vehicle in a safe manner within and external to the proposed Stadium site;
4) Comply with the direction of authorised site personnel when within the site;

2.2 Heavy Vehicle Speed

Increased speed means not only an increased risk of crashing but also increased severity if a crash occurs. A study undertaken for the Australian Transport Safety Bureau found that travelling 10 km/h faster than the average traffic speed can be more than double the risk of involvement in a casualty crash. (Source: Australian Roads and Maritime Services, ARMS).

The speed limit within the construction site is 20 km/h which is to be strictly maintained. The speed limit for the haul road leading up to the retail outlets is 40 kp/h. Drivers are to observe the posted speed limits, with speed adjusted appropriately to suit the road environment and prevailing weather conditions, to comply with the standard road rules. The vehicle speed must be appropriate to ensure the safe movements of the vehicle based on the vehicle configuration.

2.3 Heavy Vehicles Driver Fatigue

Fatigue is one of the biggest causes of crashes for heavy vehicle drivers. Ebonyi State government will adopt any of the following fatigue management schemes:

1) Standard Hours of Operation

2) Basic Fatigue Management (BFM)
3) Advanced Fatigue Management (AFM)

All heavy vehicle drivers operating out of the Stadium site are to be aware of their adopted fatigue management scheme and operate within its requirements.

2.7 Breakdowns and Incidents

In the case of a breakdown the vehicle must be towed to the nearest breakdown point as soon as possible. All breakdowns must be reported to the contractor company management and the vehicle protected. To ensure that traffic impacts are minimised in the event of an incident, rapid response from the company is required. In order to ensure rapid response to incidents drivers must contact his employer (contractor) as soon as the stranded vehicle and load is safely secured.

Drivers are to ensure that when passing pedestrians/cyclists a safe separation distance exists between trucks and pedestrians as well as a reduction in speed if appropriate.

Contact Numbers (Road)

1) FRSC
2) State Fire Service
3) Police

2.3 Safety Inspection

All new sub-contractors' trucks and trailers must be pre-mobilised and periodically pass a safety inspection by Ebonyi State government qualified truck mechanics before commencing any work on behalf of Ebonyi State government or Contractor Company.