ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) DRAFT REPORT
FOR THE PROPOSED ROAD REHABILITATION SUBPROJECT AT ABA, ABIA STATE

By

ABIA STATE INTEGRATED INFRASTRUCTURE DEVELOPMENT PROJECT (ABSIIDP)
ABIA STATE GOVERNMENT OF NIGERIA

With Support From
AFRICA DEVELOPMENT BANK (AFDB)

Submitted to
FEDERAL MINISTRY OF ENVIRONMENT, MABUSHI ABUJA

AUGUST, 2022

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
(ESIA) DRAFT REPORT

FOR THE

ROAD REHABILITATION SUBPROJECT
IN ABA,

ABIA STATE, NIGERIA

SUBMITTED TO THE
FEDERAL MINISTRY OF ENVIRONMENT, ABUJA

BY
THE ABIA STATE INTEGRATED INFRASTRUCTURE
DEVELOPMENT PROJECT (ABSIIDP),
ABIA STATE

PREPARED BY

ENVIPLAN INTERNATIONAL LIMITED
Kaduna, Nigeria
Email: enviplaninternational@yahoo.com

AUGUST 2022

LIST OF PREPARERS

Name	Qualification	Role
Dr. Itua Eugene	*Ph.D. Environmental Management*	Team Lead/Environmental Expert
Prof Owolabi Ajayi	*Ph.D, Geology*	Project Manager
Amadi Chineze	*M.Sc. Environmental Resources Management*	HSE & Water expert
Eromhonsele Okooboh	*M.Sc. Environmental Management*	Socio-economics expert
Ogenyi Timothy E.	*B.Sc. Environmental Management*	Ecologist
Ayogbami Lemo	*B.Sc. Microbiology*	Air quality and Noise expert

ACKNOWLEDGEMENT

Abia State Government sincerely appreciates the representatives of the Federal Ministry of Environment, Abia State Ministry of Works, African Development Bank for the unflinching supports they gave throughout the assessment study. The contributions of the Abia State Integrated Infrastructural Development Project and Enviplan study team (the ESIA Consultant) are also generously recognised and appreciated.

TABLE OF CONTENTS

List of Tables x
List of Figures xii
List of Maps xiii
List of Plates xiii
List of Boxes xiii
List of Acronyms xiv
EXECUTIVE SUMMARY .... **Error! Bookmark not defined.**
CHAPTER ONE 1
INTRODUCTION 1
1.2 Project Location 1
Table 1.1: Aba priority roads 1
Figure 1.1: Map of Nigeria showing Abia State and the road locations 3
Figure 1.2: Map of Abia state showing the roads location 4
1.4 Objectives of the ESIA 5
1.5 Scope of the EIA 6
1.6 The EIA Preparation Approaches 7
1.7 Policy, Legal and Administrative Framework 8
1.7.1 Introduction 8
1.7.2 Federal Institutions 9
1.7.3 State Institutions 10
1.7.4 Local Government 12
1.7.4 Policy, Legal and Administrative Framework 12
1.7.4.1 Federal Policy/Legislations 12
1.7.4.2 Nigerian Social Legislation 18
1.7.4.3 State Policies, Legislations and Standards 20
1.7.4.4 Local Government Regulations 21
1.7.5 Multilateral Environmental Agreements 21
1.7.6 Development Partners (DP) Safeguards System 24
1.7.7 International Best Practice Standard and Guidelines 24
1.7.8 Health and Safety 25
1.7.9 AfDB'S Integrated Safeguards System - Policy Statement and Operational Safeguards25
1.7.10 Making the EIA Responsive to Good Practice 27
1.7.11 Proposed Project and Applicable Environmental Standards 29
1.7.12 Summary of the Institutional Analysis 29
PROJECT JUSTIFICATION 31
2.1 Need for the Project 31
2.2 Objectives of the Project 31
2.3 Benefits of the Project 32
2.4 Value of the Project 36
2.5 Envisaged Sustainability 36
2.6 Analysis of Project Alternatives 37
2.7 Project Options 39
2.7.1 No Project Option 39
2.7.2 Delayed Project Option 39
2.7.3 Upgrading of the Proposed Roads (The Acceptable Option) 40
2.7.4 Site Location Option 40
2.8 Alternative Technology 41
2.8.1 Alternative Alignments 42

CHAPTER THREE 44
PROJECT DESCRIPTION 44
3.0 Introduction 44
3.1. Project Location 44
3.2. Overview Description of Project 48
3.3 Project Design 56
3.4 Project Components and Ancillary facilities 56
The Project components would include the following: 56
The ancillary facilities will include the following: 56
3.5 Engineering/Geometric Design 57
3.6.4 Terrain Classification 64
3.6.5 Horizontal Alignment 64
3.6.6 Vertical Alignment 64
3.6.7 Cross-Section Elements 64
3.7 Pavement Structure Design 66
3.7.1 General 66
3.7.2 Pavement Design Life 67
3.7.3 Pavement Structure Thickness 67
3.8 Hydraulic Design 69
3.8.1 General 69
3.8.2 Modelling Bridge Design 70
3.8.3 Hydraulic Design Modelling of Box Culverts 70
3.9 Bridges and Structures 73
3.10 Construction Method and Materials 77
3.10.1 Design of Culverts (Minor Drainage Structures) 78
3.10.2 Box Culvert 78
3.10.3 Components of Box Culverts 78
3.11 Project Phases 79
3.11.2 Construction Phase 79
3.11.3 Closure of Construction Phase 80
3.11.4 Operation and Maintenance Phase 80
3.11.5 Decommissioning Phase 81
CHAPTER FOUR 86
DESCRIPTION OF THE PROJECT ENVIRONMENT 86
4.0. Introduction 86
4.1 Study Approach and Method of Baseline Data Acquisition 86
4.1.1 Data Coding, Manipulation and Documentation 87
4.1.2 Quality Assurance 88
4.1.3 Sample Collection and Handling 88
4.1.4 Laboratory Analyses 88
4.1.5 Statistical Analysis 88
4.1.6 Socio-Economic studies 88
4.2 Physical Description of Project Areas 91
4.2.1 Climate and Rainfall 91
4.2.2 Meteorology, Air Quality and Noise 96
4.2.3 Topography or Terrain 103
4.2.4 Drainage System 104
4.2.5 Geology 106
4.2.6 Groundwater and Surface Water Quality 108

Table 4.15: Water Data / Log for Aba 108
4.3. Biological Description of the Project Area 119
4.3.1. Aquatic Ecology........ 119
4.3.2. Fisheries 128
4.3.3. Wildlife 129
4.4. Social economic Baseline of Aba 141
Demography of the Study area 142
4.5 Traffic Studies and Traffic Forecast 158
Objectives of Traffic Count 158
Methodology for Traffic Count 158
Location of Traffic Count Stations 158
Vehicle Classification 159
Timing of Traffic Counts 159
Traffic Data Collection 160
Baseline Traffic........ 160
Traffic Data Results and Analysis........ 164
Average Daily Traffic (ADT) 164
Historic Traffic Factor (Seasonal Conversion Factor) 167
Origin and Destination Report 167
Volume of Diverted Traffic 167
Traffic Growth and Forecast 179
4.5 Public Consultations 179
4.5.1 Introduction........ 179
4.5.2 The Objectives of Consultations........ 180
4.5.3 Stakeholder Engagement Approach and Outcomes........ 180
4.5.3.1 The Stakeholders Consulted........ 181
4.5.3.2 Summary of Outcome of Public Consultations........ 183
4.5.4 Communities along the proposed road project and identified benefits to locals 185
4.5.5 Communication and Stakeholder Engagement Plan........ 187
CHAPTER FIVE 190
ASSOCIATED AND POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS........ 190
5.1 Introduction 190
5.2 Impact Assessment 190
5.2.1 Impact Identification and Evaluation........ 190
5.3 Environmental Components and Impact Indicators 191
5.4 Impact Identification and Evaluation 191
5.4.1 Project Benefits........ 194
5.4.2 Negative Impacts 194
5.5. Summary of Significant Impacts 202
5.5.1. Significant Positive Impacts 202
5.5.2. Significant Negative Impacts........ 202
5.5.3 Detailed Description of Some Specific Impacts 206
5.5.3.1 Biophysical Impacts........ 206
5.5.3.2 Socio-Economic Impacts 209
5.5.3.3 Health and Safety Impact........ 210
5.6. Impact on Persons and Assets........ 212
5.7. Impact on Vulnerable Group 212
5.8. Cultural Property (Archaeological and cultural sites) 213
5.9 Irreversible Changes........ 213

5.10 Cumulative/Secondary Impacts 214
5.11 Environmental justice 214
5.12 Climate Change Impact 214
CHAPTER SIX 216
6.0 Impacts Mitigation/Enhancement Measures 216
6.1 Mitigation Measures Hierarchy 216
6.2 Projects Impacts Mitigation Measures 216
6.3 Enhancement Measures for Positive Impacts and Reduction/Avoidance of Negative Impacts 225
6.3.1 Project Concept 225
6.3.2 Construction and Control of Earthworks 226
6.3.3 Neighbourhood Effects Management 226
6.3.4 Mainstreaming Women, Youth and PWDs Issues 226
6.3.5 Waste Management Plan 227
6.3.6 Social Integration and Participation 227
6.3.7 Communication, Information and Monitoring 228
6.3.8 Grievance Redress Mechanism 228
Figure 6.5: Ways to mitigate vulnerabilities and minimise consequences of Climate Risk 230
CHAPTER SEVEN 235
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN 235
7.1. Introduction 235
7.2. Environmental and Social Mitigation and Monitoring Plan 236
7.3. Institutional Arrangement 236
7.4 Institutional Capacity Building & Training Plan 239
7.5 Waste Management Plan 242
7.5.1 Waste Generation 243
7.5.2 Waste Handling 244
7.6 Gender Management Plan 246
7.7.1 The Hazard Effect Management Process 247
7.7.3 Environmental Hazards Management (EHM) for Proposed Project 247
Principles to Manage Hazards 248
7.7.4 Environmental Hazard Management Procedure 250
7.8 Environmental Monitoring and Auditing Plan 253
7.8.1 Objectives of the Monitoring Plan 253
7.8.2 Parameters to Monitor 254
Parameters 258
Method & Where 258
7.9 Implementation Schedule 261
7.10 Reporting 262
7.10.1 Reporting Procedures 262
7.10.2 Record Keeping and Control 263
7.11 Cost Estimates for ESMP Implementation 263
7.12 ESIA Disclosure 264
CHAPTER EIGHT 265
CONCLUSION 265
8.1. Conclusion 265
8.2. Recommendations 266
Bibliography 267
APPENDICES 270

List of Tables

Table	Content	Page
2.1	Abia State Environmental Policies, Legislation and Standards	**21**
2.2	African Development Bank Environmental Safeguards	**27**
2.3	A Summary of the procedure of Nigeria's EIA and AfDB ESIA	**28**
3.1	List of proposed Roads for Rehabilitation in Aba	**36**
3.2	Relation ADT and Functional Class of the road	**42**
3.3	Design Standard for Collector Roads	**43**
3.4	Design Standard for Arterial Roads	**44**
3.5	Minimum Width of Surfacing for Two Lane Highway	**46**
3.6	Side and Back Slope table	**47**
3.7	Proposed AC Pavement Thickness for Aba City Roads	**49**
3.8	Proposed DBST Pavement thickness for Aba City Roads	**49**
3.9	Freeboard recommendation (AASHTO Design Manual)	**51**
3.10	Summary Bridge and Multiple Box Culvert Specification and Design Criteria	**55**
3.11	Major Box Drainage Multiple Box Culvert for Aba City Road Segment	**57**
3.12	Bridges opening of the Aba road segments	**57**
3.13	The conceptual project schedule for the project	**62**
3.14	Project Justification, highlighting project benefits to the host communities of project location	**64**
4.1	Sampled Communities in the Study Area	**71**
4.2	Climate Station	**73**
4.3	Statistical Summary of Rainfall Data	**74**
4.4	Results of the Kolomogorov-Simirnov Test	**76**
4.5	Aba Rainfall Intensity – Duration Frequency	**76**
4.6	Estimates of parameters of the IDF Equation for Rainfall Zone VI of Nigeria	**77**
4.7	Rainfall-Intensity-Duration-Frequency Table for Abia State based on NHM Method	**77**
4.8	Air pollution data of cities in Abia	**78**
4.9	Breakpoints for the AQI	**80**
4.10	The results of *in situ* meteorological, air quality and noise level analysis	**81**
4.11	Descriptive statistics of Measured Parameters from the Table (4.10)	**81**
4.12	Nigerian Ambient Air Quality Standards**	**84**
4.13	WHO Air Quality Guidelines	**85**
4.14	US National Ambient Air Quality Standards (NAAQS)	**85**
4.15	Water Data / Log for Aba	**87**
4.16	Results of analysis of groundwater samples from different local governments during the fieldwork in Oct, 2021	**88**
4.17	Summary of Groundwater Quality Parameters sampled during the Field investigation, July 2021	**89**
4.18	Physio-chemical qualities of surface waters in Aba, October, 2021	**90**
4.19	Summary of physico-chemical qualities of surface waters in Aba, October, 2021	**92**
4.20	Soil Stratification (Percussion Drilling)	**95**
4.21	Stratigraphy	**95**

4.23	Phytoplankton species Composition, Distribution and Abundance across the sampled stations	**99**
4.24	Diversity of phytoplankton across the sampled stations	**100**
4.25	Zooplankton species Composition, Distribution and Abundance across the sampled points	**101**
4.26	Diversity of zooplankton across the sampled stations	**102**
4.27	Spatial variation in benthic macrofauna Composition, Distribution and Abundance across the sampled points	**104**
4.28	Diversity in benthic macrofauna across the sampled points	**105**
4.29	Checklist of fish species in the study area	**106**
4.30	Floristic Composition along Eme/Okpara Road site	**107**
4.31	Floristic Composition along Amaogwugwu Road site	**108**
4.32	Flora features within the Proposed Roads for Rehabilitation in Aba	**109**
4.33	Checklist of wildlife and other invertebrate fauna common in the study area	**113**
4.34	Protected Area System of Abia State	**117**
4.35	Traffic Study for Aba City Road Sections	**136**
4.36	Measured Traffic Flow Aba City (Average Daily Traffic)	**138**
4.37	(Average Daily Traffic (ADT) * Adjustment Factor) Aba Zone	**140**
4.38	Potential Diverted Traffic in Aba Town	**141**
4.39	Travel time to estimate Generated Traffic Factor for Aba City	**143**
4.40	Estimate of Generated Traffic Factors from the travel Time (Aba City)	**144**
4.41	Generated Traffic Aba City	**148**
6.1	Environmental Components and Impact Indicators	**156**
6.2	Risk Assessment Matrix	**158**
6.3	Criteria for scoring or rating	**160**
6.4	Impact Value and Rating	**161**
6.5	Summary of Project Phase-Specific Potential Impacts of the Environmental Issues	**167**
6.6	Summary of Potential and Associated Impacts of Proposed Road Construction Scheme Project	**172**
6.7	Health Risk Assessment	**180**
6.8	Vulnerable Group	**182**
6.9	Mitigation Measures on Significant Impacts	**185**
6.10	Environmental and Social Impacts, Mitigation and Enhancement	**198**
7.1	Environmental Hazard Management Matrix	**211**
8.1	Risk and Responsibilities of Institutions	**215**
8.2	Training Modules on Environmental and Social Management	**218**
8.3	Estimated Waste Generation – Rehabilitation Phase	**222**
8.4	Some Waste Disposal Option	**223**
8.5	Waste Consignment Record Template	**224**
8.6	Environmental and Social Management and Monitoring Plan	**227**
8.7	Contractor's Training Programme	**243**
8.8	Proposed Training Programme for the Implementation of ESMP	**244**
8.9	ESMP Implementation Schedule	**246**
8.10	Internal and External Monitoring	**247**
8.11	Reporting Procedures	**247**
8.12	Contractual Measures	**249**

8.13	Estimated Budget for the Implementation of ESMP	**249**
8.14	Disclosure Procedure	**250**
9.1	Schedule of Public Meeting Held	**253**
9.2	Summary of Outcome of Public Consultation	**255**
9.3	Benefit of the Roads to the Communities when Rehabilitated	**256**
9.4	Summary of Stakeholders Engagement	**259**

List of Figures

Figure	Content	Page
2.1	Overview of Nigeria EIA Process	**16**
3.1	Box Culvert in Let And Out Let 02	**52**
3.2	Box Culvert in Let And Out Let 01	**53**
4.1	Longterm Rainfall Station at Aba Station	**74**
4.2	Annual Rainfall Station at Aba Station	**75**
4.3	Maximum Annual Rainfall around Abia State	**76**
4.4	Rainfall Intensity-Duration Frequency Curve for Abia State	**78**
4.5	Diagram showing the size distribution in micrometres of various types of atmospheric particulate matter. It also shows the different types of particulates in the atmosphere	**84**
4.6	Spatial variation in the abundance of phytoplankton across the sampled stations	**99**
4.7	Percentage species composition of the major groups of phytoplankton encountered	**100**
4.8	Spatial variation in the abundance of zooplankton across the sampled stations	**102**
4.9	Percentage abundance of the major groups of zooplankton encountered	**102**
4.10	Percentage Composition of Plankton encountered in the Study	**103**
4.11	Spatial variation in benthic macrofauna abundance across the sampled points	**105**
4.12	Percentage abundance of the insect orders encountered in the study area	**105**
4.13	Participation of respondents based on gender	**122**
4.14	Participation of respondents based on Age	**123**
4.15	Marital status of respondents for the baseline studies	**123**
4.16	Education attainment of respondents	**125**
4.17	Effect of Project and willingness to accommodate project	**131**
4.18	Preferred Forms of Mitigation Measures	**132**
4.19	Type of Affected Persons and Asset	**132**
4.20	Type of Business/Income Loss	**133**
7.1	Principles to Manage Hazards	**209**

List of Maps

Map	Content	Page
1.1	Map of Nigeria Showing Abia State	**3**
1.2	Map of Abia State showing Aba LGAs	**4**
3.1	Map of Nigeria Showing Abia State	**32**
3.2	Map of Abia State showing Aba LGAs	**33**
3.3	Abia Boundary Showing Location of Aba	**34**
3.4	Geographical Location of Aba and Neighbour Communities	**35**
3.5	Base Map for the location of Proposed Roads in Aba	**38**
4.1	Map of Aba	**72**
4.2	Rainfall Station	**73**

List of Plates

Plate	Content	Page
3.1	Some Roads in Aba	**39**
4.1	Some Endangered Specie of Wildlife	**112**
4.2	Some Roads in Aba	**118**
4.3	Farmlands along Some Roads	**118**
4.4	Some Shrines	**119**
4.5	Some Rivers in Aba	**120**
4.6	Rural Electrification in Aba	**120**
4.7	Types of Residential Building in Some Rural Communities in Aba Axis	**121**
4.8	Some Public Facilities in the communities	**126**
4.9	Health Centres in Aba Road Axis	**127**
4.10	Evidence of Indiscriminate Waste Disposal Across Host Communities in Aba	**129**
4.11	Cross Section of Sources of Water Supply in Selected host Communities Aba	**130**
9.1	Some of the Stakeholders at Public meetings	**254**

List of Boxes

Box	Content	Page
1	Some National Legal Instruments on Environment	**18**

List of Acronyms

%	percent
AASHTO	American Association of State Highway and Transportation Officials
ABSIIDP	Abia State Integrated Infrastructural Development Project
AbWSC	Abia State Water and Sewage Corporation
ACIL	American Council of Independent Laboratories
ADT	Average Daily Traffic
AfDB	African Development Bank
AIDS	Acquired Immune Deficiency Syndrome (AIDS)
ALARP	As Low As Reasonably Practicable
APHA	American Public Health Association
AQI	Air Quality Index (US)
ASEPA	Abia State Environmental Protection Agency
ASTM	American Society for Testing and Materials
BKP	Break point
BOD	Biochemical Oxygen Demand
CAD	Computer Aided Design
CBO	Community Based Organization
CESA	Cumulative Equivalent Standard Axle
CESMP	Construction ESMP
cT	Tropical Continental
dB(A)	Decibels (A-weighted)
DBST 3.8	Double Bituminous Surface Treatment
DO	Dissolved Oxygen
DP	Development Partners
DPR	Department of Petroleum Resources
E&S	Environment and Safety
EA	Environmental Assessment (Audit)
EHM	Environmental Hazards Management
EHS	Environment, Health and Safety
EHS-MP	Environment, Health and Safety Management Plan
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EMS	Environmental Audit and Environmental Management System
EQ	Equator Principle
ESF	Environmental and Social Framework
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FEPA	Federal Environmental Protection Agency
FERMA	Federal Road Maintenance Agency
FGD	Focus Group Discussion
FMEnv	Federal Ministry of Environment
FPMU	Federal Project Management Unit
FRIN	Forestry Research Institute of Nigeria
FRN	Federal Republic of Nigeria
FRSC	Federal Roads Safety Commission
GBV	Gender Based Violence

GHG	Green House Gas(es)
GIIP	Good International Industry Practice
GPS	Geographical Positioning Systems
GRI	Global Reporting Initiative
GRM	Grievance Redress Mechanism
GTF	Generated Traffic Factor
HA	Hydrological Area
HGV	Heavy Goods Vehicle
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome
HMP	Hazards Management Program
HSE	Health, Safety and Environment
IEE	Initial Environmental Evaluation
IFC	International Finance Corporation
ILO	International Labour Organization
IPAN	Institute of Public Analysts of Nigeria
IPCC	Intergovernmental Panel on Climate Change
IPV	Intimate Partner Violence
ISO	International Organization for Standardization
ISS	Integrated Safeguards System
ITCZ	Inter Tropical Convergence Zone MPH
ITD	Inter-Tropical Discontinuity
ITF	Inter-Tropical Front
JHA	Job Hazard Analysis
KII	Key Informant Interviews
km	Kilometer
LFN	Laws of the Federation of Nigeria
LGA	Local Government Authority
LRFD	Load and Resistance Factor Design
LT-EDS	Long-Term Low Emissions Development Strategy
LTI	Lost Time Injuries
LTV	Long Term Vision
LVR	Low Volume Road
m	meter
m^3/s	Cubic meters per second
MDA	Ministries, Departments and Agencies
MGV	Medium Goods Vehicle
mm	millimeter
MoW	Ministry of Works
mT	Tropical Maritime
N	Nigerian Naira
NAAQS	National Ambient Air Quality Standards (US)
NDC	Nationally Determined Contributions
NEP	National Environmental Policy
NESREA	National Environmental Standards and Regulations Enforcement Agency
NGO	Non-Governmental Organization
NIMET	Nigerian Meteorological Services Agency
NOSCP	National Oil Spill Contingency Plan
NOSDRA	National Oil Spill Detection and Response Agency
NTU	Nephelometric Turbidity Units

OECD	Organization for Economic Cooperation and Development
OHS	Occupational Health and Safety
OHSP	Occupational Health and Safety Plan
OS	Operational Safeguards
OSHP	Occupational Health and Safety Plan
PAC	Project Affected Communities
PAP	Project Affected Persons
PAPs	Project Affected Persons
PCU	Passenger Car Unit
PDO	Project Development Objective
PM	Particulate Matter
PPE	Personal Protective Equipment
ppm	Parts per Million
QALS	Quality Analytical Laboratory Services
RAM	Risk Assessment Matrix
RAP	Resettlement Action Plan
RoW	Right of Way
SDG	Sustainable Development Goal
SEP	Stakeholder Engagement Plan
SLS	Serviceability Limit State
SMART	Specific, Measurable, Achievable and Relevant Time based
SME	Small and Medium Enterprises
SPIU	State Project Implementation Unit
SPM	Suspended Particulate Matter
STD	Sexually Transmitted Diseases
STDs	Sexually Transmitted Diseases
STI	Sexually Transmitted Infections
TDS	Total Dissolved Solids
TMP	Traffic Management Plan
ToR	Terms of Reference
Tr	Return Period
TSDF	Treatment, Storage and Disposal Facility
TSS	Total Suspended Solids
ULS	Ultimate Limit State
UN	United Nations
UNCED	United Nations Conference on the Environment and Development
UNEP	United Nations Environment Programme
UNFCCC	United Nations Climate Change Conference
US$	United States Dollars
USA	United States of America
VAPP	Violence Against Persons (Prohibition) Act
VEC	Valued Environmental Component
VOCs	Volatile Organic Compounds
WHO	World Health Organization
WIM	Warsaw International Mechanism
WMO	World Meteorological Organization
WMP	Waste Management Plan

EXECUTIVE SUMMARY

ES 1.0 INTRODUCTION

ES 1.1 Project Background

The Abia State Government, through the State Ministry of Works and Abia State Integrated Infrastructure Development Project (ABSIIDP), seeks to invest in the following six infrastructural subprojects in the State, namely:

- **31 priority roads in Aba, with a combined distance of 199.69 km;**
- 19 priority roads in Umuahia, with a combined distance of 92 km;
- One gully erosion control site in Umuahia;
- One erosion control site in Aba;
- One Waste Transfer Station in Umuahia; and
- One Integrated Waste Management facility in Aba.

This Environmental and Social Impact Assessment (ESIA) report covers the **31 priority roads in Aba, with a combined distance of 199.69 km in length** proposed for the road rehabilitation, collectively described herein as "Aba Roads," cutting across 10 Local Government Areas (LGAs) in Abia State. The dilapidated nature of the designated periurban, urban and rural roads has made commuting in the urban and rural areas, the evacuation of farm produce from the hinterland difficult; impede access to solid waste collection and transport. The erosion sites are encroaching fast on the adjoining roads.

The aim of the ESIA study is to proactively evaluate the associated, potential and cumulative environmental (including beneficial and adverse) impacts of the proposed project. This is to ensure that the planned activities The scope of the ESIA encompassed the identification of valued environmental components which describe the elements of the physical, biological, or socio-economic environment, including the air, water, soil, terrain, vegetation, wildlife, fish, birds and land use and persons that may be affected by the proposed project. The assessment was conducted in Aba, Abia State, Nigeria.

ES 1.2 The Project Proponent

The Project proponent is the Abia State Integrated Infrastructure Development Project (ABSIIDP), on behalf of the Abia State Government. with the support of the African Development Bank (AfDB). Under the supervision of the ABSIIDP which is also the State Project Implementation Unit (SPIU), the Abia State Ministry of Works shall undertake the implementation of the project in the State. The Ministry of Works has the responsibilities to ensure wholesome development of all government infrastructure on behalf of the State Government.

ES 1.3 Proposed Project Location

The identified (31) road project is located within Aba City, covering Aba South, Aba North, Osisioma, Ugwunagbo, Obingwa, Isialangwa North, Ukwa East, Umuahia South, Isialangwa South, and Ikwuano LGAs, in Abia State, South-East Nigeria.

Abia State is located in the south-eastern part of Nigeria (Fig. 1.1). The State is known for its commercial activities centered at Aba, which was formerly a British Colonial Government outpost. The entire state lies approximately between latitudes 4º48'N and 6 º02'N and Longitudes 7º09'E and 7º58'E of the Greenwich Meridian. On the north and the northeast, the state is bounded by Enugu and Ebonyi states respectively. The eastern boundary is occupied by the Cross River State, while the southeast border is shared by Akwa Ibom State. Rivers State occupies the southern and southwest boundaries. The western and northwest Imo and Anambra States respectively. The entire

State is divided into seventeen (17) administrative units called Local Government Authorities (LGAs).

Abia state has Aba as its commercial capital and the proposed 31 roads are located in and around Aba, as listed in Table below. Coordinates of each road are in Chapter 3.

Table ES1: Aba priority roads

S/N	Aba City Roads	Minimum Design Width (m)	Actual Road Span (km)
1.	Asa Road – Port Harcourt Road	25	7.68
2.	Faulks Road	25	4.59
3.	Ohanku Road – Owerre Aba	25	6.61
4.	Omuma Road	14	2.14
5.	Ikot Ekpene Road	25	6.82
6.	Mbubo Umuogele Amachi Mgbokonta	14	12.72
7.	Umuala Mbawsi Eziala Osusu Okpuala Ngwa	14	12.64
8.	Omoba – Umuaja Amaede Ndiolumbe	14	8.17
9.	Mbawsi Layout – Ururuka	14	1.88
10.	Glass Factory Road	14	3.59
11.	Umuomiaukwu Agburike Umuomainta	14	4.83
12.	Uratta – Ugwuati	14	9.59
13.	Crystal Park Junction - Obohia Road	14	20.27
14.	Immaculate Avenue – ITF Rod Bridge	14	1.52
15.	Umuaro Nenu Road	14	4.76
16.	Eziama Ntigha – Nsirimo – Ubakala	14	9.06
17.	Mgboko –Omoba Umuezeukwu Mbawsi Road	14	8.06
18.	Ibeme Ndiakata- Nlagu Onicha Ngwa	14	2.81
19.	Pepple Road - Akpu Road	14	1.2
20.	Umuokpo- Owo Ahiafor Link Road	14	4.3
21.	Owerre Aba – Osusu Umuelendu – Osusuaku	14	4.01
22.	Umuojima Amapuife Eberi Omuma	14	9.98
23.	Umuimo Carol Pee. Ministry of Agric. Shopping Mall	14	1.48
24.	Ugwuati – Umuiku	14	4.01
25.	Isicourt- Ururuka Umuosu Umuala Umunkpeyi	14	20.6
26.	Ama Emereole – Ekeonyeugba –Umokoromiri-Eketa	14	7.25
27.	Ajiwe – Brass	14	0.64
28.	Ahunanya – Immaculate	14	0.87
29.	Oron Road – Elizabbeth Avenue – Sports Club	14	0.7
30	Umuala - Umuakwu - Ohuhu Nsulu – Oloko Ikwuano	14	13.56
31	Itungwa – Agburukwe road	14	3.35
	Total length of priority roads in Aba		**199.69**

Source: ABSIIDP, 2022

ES 1.4 The Need for ESIA

The road upgrade activities on the selected roads will involve medium-sized civil engineering works entailing earthworks, provision of lateritic base, side drains, concrete culverts and river crossing infrastructure.

The proposed project activities are likely to induce environmental and social impacts that could be positive and/or negative. To harness the potential positive impacts and avoid or reduce the potential negative impacts, this Environmental and Social Impact Assessment (ESIA) (also known as Environmental Impact Assessment (EIA)) has been prepared.

The ESIA provided the framework for gathering and documenting information and views on the environmental and social consequences of the proposed activities so that the importance of the impacts and the scope of enhancing, modifying and mitigating them can be properly evaluated and beneficial decisions made. The ESIA i*nter alia*, contains an Environmental and Social Management Plan (ESMP) which consist of mitigation, monitoring, and institutional measures to be undertaken during implementation and maintenance of the intervention work to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels.

It is the requirement of the Environmental Impact Assessment (EIA) Act No 86 (1992) of Nigeria (Act CAP E12 LFN 2004) and Integrated Safeguards System of the AfDB to prepare before financing of the proposed Project. Thus, with this ESIA obtaining the necessary approvals prior to the implementation of the project to ensures that the potential environmental and social impacts associated with the development and implementation of the proposed project are identified, assessed and managed properly with a view to ensuring the sustainability is possible.

Meanwhile it should be noted that the proposed road networks for the rehabilitation/upgrading traverse a wide geographical area; and will not include land-take. Although no anticipated physical displacement due to the Project activities, economic displacement could result. As a result, a separate Resettlement Action Plan (RAP) that has been prepared as a standalone, yet complimentary to this ESIA to manage involuntary resettlement or displacement that could result from the implementation of the intervention work on this. The *RAP will* ensure the distribution of benefits and opportunities in the communities and among project affected persons or groups through differentiated measures specially designed to cater to their needs and that of ensuring sustainability. It is advised for further information on the RAP cross-references could be made.

ES 1.5 Objectives of the ESIA

The primary purpose of the ESIA was to assess and predict potential adverse environmental and social impacts of the project and to develop suitable mitigation measures, which have been documented in the Environmental and Social Management Plan (ESMP) and Resettlement Action Plan (RAP).

The specific objectives are outlined below:

- Establishment of the existing state of the physical and social environment.
- Identification of the project-sensitive components of the existing physical and social environment within the project area and area of influence.
- Appraisal of the project activities including construction (site preparation and installation), operations and decommissioning that may result in significant modification of any human or natural environmental resources.
- Determination of existing environmental risk of the site/effect of the proposed operational activities on the environment.
- Identification of any impacts that cannot be avoided, and outline ways of enhancing the beneficial ones.
- Recommendation of measures to avoid, ameliorate, or mitigate the identified impacts.

- Establishment of an appropriate Environmental Management Plan (the "EMP") or Environmental and Social Management Plan (the "ESMP") to verify and improve the accuracy of the EIA predictions, control levels for the life of the project; and
- Preparation of a detailed EIA report, presenting clear and concise and information on the environmental impact of the proposed project activities.

ES 1.6 ESIA Preparation Approaches

The ESIA Report was prepared in a manner consistent with applicable African Development Bank (AfDB) Integrated Safeguards System (ISS) and the Environmental Impact Assessment (EIA) Act No 86 (1992) of Nigeria (Act CAP E12 LFN 2004). The approach followed the path of: screening and scoping exercise, literature review, stakeholder consultation and engagement, field visits, identification of potential impacts and mitigation measures and development of environmental and social management plan

The ESIA report contains the following 8 Chapters, viz: Chapter 1: Introduction, Chapter 2: Project Justification and Alternatives, Chapter 3: Project Description, Chapter 4: Description of the Project Environment; Chapter 5: Associated and Potential Impacts; Chapter 6: Mitigation/Enhancement Measures; Chapter 7: Environmental and Social Management Plan; Chapter 8: Conclusion; with the relevant appendices.

ES 1.7 Existing Policy, Legal and Administrative Frameworks

The institutional and regulatory framework was comprehensively analyzed to take into consideration environmental and social protection policies/strategies with the Project's sector (erosion control), relevant standards/norms and E&S Health and safety,

Administrative frameworks

In Nigeria, the power of regulation of all environmental matters is vested in the Federal Ministry of Environment (FMEnv).

The State Governments are also encouraged to set up their Ministries of Environment and Environmental Protection Agencies to maintain good environmental quality around related pollutants under their control. Thus there is the State Ministry of Environment with an agency named the Abia State Environmental Protection Agency (ASEPA).

The Local Governments liaise and cooperate with the Federal and State Ministries of the Environment to achieve healthy or better management of the environment within their domains with the relevant bye-laws.

Legal instruments

Development Partners/Agencies such as the AfDB and other financial organizations interested in development projects have sets of environmental and social Safeguards policies and instruments which must be complied with by the borrower (Nigeria) before these institutions invest in or fund them.

To this end, the duty and responsibility for environmental and social protection and management related to project execution in various sectors of the Nigerian economy come under the following mandate:

- Current Federal, State, Local and relevant acts, rules, regulations and standards, and the common law of the Federal Republic of Nigeria (FRN);

- International environmental agreements and treaties ratified by the Federal Republic of Nigeria; and
- Safeguard Policies of supporting/development partners like AfDB's ISS

Below is an outline of relevant regulatory instruments to this ESIA relating to the Federal, State and International arenas.

Environment-related regulatory instruments

At the National level, some of the Environment-related regulatory instruments include: National Policy on Environment, 1989 (revised 2016), Environmental Impact Assessment (EIA) ACT 86 (CAP E12, LFN 2004), EIA Procedure and Charges Regulations 2021, National Guidelines for Environmental Audit in Nigeria, Guidelines and Standards for Environmental Pollution Control 1991, National Guidelines on Environmental Management Systems, Endangered Species (Control Of International Trade And Traffic) Act , No. 11 of 20th April, 1985 which provides for the conservation and management of Nigeria's wild life and the protection of some of her endangered species in danger of extinction as a result of over-exploitation, as required under certain international treaties to which Nigeria is a signatory, The National Environmental Standards and Regulations Enforcement Agency (NESREA) and Regulations Gazetted as supplementary to NESREA Act, Nigeria Climate Act, 2021, etc.

At the State level, the relevant instruments include Abia State Basic Environmental Law No. 1, Abia State Policy on Environment, Abia State Flood and Erosion Control and Soil Conservation, Abia Riverine Area Management Policy, Abia State Watershed Management Policy, Abia State Flood and Erosion Control Management Support System, Abia State Flood Control and Water Conservation, Abia State Waste Management Law and Waste Management (Enforcement and Offences) Provisions Regulations, Abia State Environmental Protection Agency Law, Cap50, Vol. 2, Laws of Abia State, Abia state Ministry of Physical Planning and Urban Development Law and Abia State Environmental Protection Agency Law Cap 14 of July 1994.

Social protection-related regulatory instruments

In consideration of social legislation, the acts and policies relevant to the proposed Project include Labour Act Cap L1, LFN 2004, Violence Against Persons (Prohibition) Act, 2005, National Gender Policy, 2006, Land Use Act of 1978, **CAP 202, LFN 2004**, Nigerian Urban and Regional Planning Act, CAP N138, LFN 2004 and National Policy on Child Labour (2013).

Sector-related regulatory instruments

Oversight of all transport related policy and development falls under the Federal Ministry of Transport with the equivalent at the State level. Some of the relevant instruments for roads development in Nigeria include, Nigeria Integrated Infrastructure Master Plan (2014-2043), 2021 updated Nigeria Nationally Determined Contributions, Federal Roads Safety Commission (FRSC) Act CAP 141 Laws of the Federation of Nigeria (LFN) 2004 and Federal Highways Act, CAP 135.

Health and safety

The relevant instruments include the National Policy on Occupational Safety and Health, revised in 2020, which has the chief goal of facilitating the improvement of occupational health and safety performance of all workers in all sectors of economic activity, and the National Health Policy 2016 which, *among other things,* has the goal to significantly reduce the burden of non-communicable diseases in Nigeria in line with the targets of the 3rd Sustainable Development Goal.

Some of the relevant international instruments on good international industry practice in Health and safety which will be of benefit to the proposed Project include the International Labour Standards on Occupational Safety and Health such as **the Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187)**, Occupational Safety and Health Convention, 1981 (No. 155) and its Protocol of 2002, Occupational Health Services Convention, 1985 (No. 161), and **Working Environment (Air Pollution, Noise and Vibration) Convention, 1977 (No. 148)**.

International policies and standards- protocols signed by Nigeria

Several Conventions, Protocols and Treaties that promote the maintenance of a viable environment and achieve sustainable development have been endorsed by Nigeria. They are applicable to the proposed Project based on the environmental and social dimensions alongside the inherent health and safety implications such as Paris Accord, Aarhus, 1998, United Nations Guiding Principles on the Human Environment, and Agenda 21 – United Nations Conference on Environment and Development. About the Project, the Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts (WIM), which provides the mechanism to implement Article 8 of the Paris Agreement, is of significance as this encourages "Parties" to recognize the importance of averting, minimizing and addressing loss and damage associated with the adverse effects of climate change, including extreme weather events and slow onset events, and the role of sustainable development in reducing the risk of loss and damage in Paragraphs 48–52 (Loss and Damage) of Decision -/CP.21. Also of relevance is the Sendai Framework for Disaster Risk Reduction 2015-2030 which aims to achieve the substantial reduction of disaster risk and losses in lives, livelihoods and Health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries over the next 15 years. Alongside all these instruments are Voluntary International Standards such as Equator Principles and ISO26000, Guidance on Social Responsibility are Applicable.

African Development Bank (AfDB) policies

As part of the international environmental and social requirements of project financing institutions, AfDB policies are usually considered. For the AfDB, borrowers/ clients, such as in the case of the proposed project, are required to comply with her safeguards requirements during project preparation and implementation as enshrined in her Integrated Safeguards Systems (ISS), which sets out the basic tenets that guide and underpin the Bank's approach to environmental and social safeguards. The ecological and social safeguards of the Bank form the cornerstone of the Bank's support for inclusive economic growth and environmental sustainability in Africa.

To achieve the goals and optimal functioning of the ISS, the Bank adopted five OSs, namely: Environmental and Social Impact Assessment (OS1), Involuntary resettlement, land acquisition, population displacement, and compensation (OS2), Biodiversity and ecosystems services (OS3), Pollution Prevention and Control, Green House Gases, Hazardous Materials and Resources Efficiency (OS4), Labour Conditions, Health and Safety (OS5).

The proposed project triggers these OSs in the following ways:

- The proposed gully erosion treatment activities are likely to result in impacts such as raising dust due to soil movement, noise from equipment and clearance of vegetation and thus triggered OS.1, which has led to the preparation of an ESIA with the ESMP to manage the impacts identified. The proposed project will displace people's assets; this has necessitated the preparation of a Resettlement Action Plan. Thus, OS.2 is triggered.
- The proposed project will not require extensive land clearance of vegetation and removal of Biodiversity. Thus OS 3 is not triggered.

- OS 4: Pollution Prevention and Control, Greenhouse Gases, Hazardous Materials and Resource Efficiency has not been triggered, although there are provisions for avoiding and preventing pollution and ensuring water efficiency during project implementation activities as captured in the ESMP; and
- The project would demand or necessitate the deployment of qualified civil engineers and other experts, including various technicians, and a reasonable labour force to work. The related labour conditions, Health and Safety, need to be managed, and the measures on these have been included in the ESMP; hence it could be said that OS 5 is triggered.

It is worthy to say here that the principles inherent in the safeguard requirements of the AfDB ISS are in tandem with the EIA procedures and processes of the FMEnv and shall guide the project implementation. However, in the event of divergence between them, the most beneficial, environmentally, and socially speaking, shall take precedence in executing the project and utilising the ESIA instrument.

Summary of the institutional and regulatory framework analysis

The analysis of the applicable policies and regulatory framework reveals no shortage of regulatory instruments for environmental and social management, including health and safety issues relating to the proposed project. In summary, the following was shown:

- The Federal and the State Ministries of Environment provide overarching guidance, which includes policies and legal and regulatory framework.
- The State have a good governance framework and laws to back up and manage the environmental and social safeguard issues. The State has considerable experience in the ESIA process and safeguards issues. In addition to the EIA Act, critical environmental laws and guidelines in the State would support monitoring and enforcement.
- The Local Government Authorities are charged with direct responsibility to manage these issues in their domain, although largely lacking the technical, financial and personnel capacity to fulfil this obligation effectively. Hence, they have been identified as one of the training target groups. State government support in the execution of the proposed project is assured; and
- Without doubt, there will be a need to continually strengthen the capacity of project staff and that of the State Ministry of Environment and other relevant actors charged with implementing this ESIA and other attendant safeguards instruments through in-depth training courses in environmental and social management risk.

ES 2.0 Project Justification

Since road transportation is the main transportation mode in the state, once rehabilitated, the roads will help facilitate economic growth while improving local capacity, work and business opportunities, and livelihoods. This is also anticipated to reduce poor safety and security records on the roads, remove undue stress for travelers and afford them more comfortable ride.

Need for the Project

The prioritized roads if reconstructed will;

- Promote economic development, extend trade, and improve state's competitiveness through an efficient and affordable integrated transport system;
- Encourage and remove all barriers towards the private sector participation in the development, provision, maintenance, operation, and upgrading of transport infrastructure and services;
- Promote the use of public transport over private cars;
- To create flyover intersection to reduce accidents and save travel time;

- Promote a culture of maintenance and continuous upgrading of transport infrastructures and services;
- Promote competition and efficiency and cost reduction of transport services in and around Aba;
- Improve the safety, security, reliability, quality and speed of movement of goods and people, at state and local government and community levels;
- Develop transport infrastructure that ensures environmental sustainability and internationally accepted standards;
- Support LGAs and the state capital territory in the development and promotion of urban transport systems and local government developing and promoting rural accessibility; and
- Plan for the integration of 10 LGA headquarters with light gauge railway programme and to later integrate this to the national railway programme.

Objectives of the Project

The main objectives of the road reconstruction include the followings:

- Increase travel efficiency and productivity;
- Improve the quality of the environment;
- Improve the quality of life and social standard;
- Increase and spread economic activity throughout the villages and towns connected;
- Remove poor safety and security records on the road that affect travelers journeying on it;
- Remove undue stress for travelers;
- Afford comfortable ride for those who take the routes;
- Provide adequate facilities in terms of sidewalks which is simply non-existing; and
- Reduce carbon footprint and increase general environmental aesthetics due to adequate maintenance of the road and provision of greenery on the corridor which could readily absolve carbon.

ES 2.2 Project Alternatives

The project alternatives included the different means of completing the project while still meeting the purpose of the proposed activity. Based on the nature of the proposed project which entails rehabilitation of existing roads and construction of drainage infrastructure the following project alternatives or scenarios were given consideration: scenario 1: no action/do nothing option; scenario 2: delayed project option, scenario 3: construction of new roads, scenario 4: upgrading of the proposed roads and scenario 5: site location option.

These alternative options were comparatively evaluated based on various key aspects that include:

- **Environment** - release of emissions and discharge of substances into the environment in the course of work, the impacts on various environmental aspects, and likelihood of avoiding these by not going ahead with the proposed project;
- **Social** - the influence of the proposed project and related activities on standards of living and general quality of life. It also includes possible conflicts that may arise due to influx of people and the consequent social changes that may arise;
- **Public Health** - the possibilities of improved or degenerative health conditions as people congregate within and around the proposed project site and environs;
- **Economics** - likely costs and gains of investment, construction, operations and maintenance of the proposed plant and associated facilities, as well as the additional costs or savings due to the option under consideration;

- **Safety and Security** - this includes potential safety and security exposures and expenses that are associated with the proposed project with due consideration to the work location, personnel and activities;
- **Regulatory, corporate and stakeholder requirements** - this considers government, legal, corporate and stakeholders' expectations. It also includes permits, licenses and monitoring requirements;
- **Technical feasibility** - ease and acceptability of proposed construction technology with respect to existing technologies;
- **Synergy** - ability of the option to provide better access through which the roads pass; and
- **Effectiveness in meeting the proposed project objectives** – immediate infrastructure that drives economic growth.

After a thorough analysis of all the Options, Scenario 4 was chosen as it was adjudged the most optimal in the light of the set criteria and will also meet timely implementation, considering the challenges the roads' situation give at present to the communities. Although there are environmental and social implications associated with the improvement alternative, appropriate mitigation measures are stipulated in the Environmental and Social Management Plan (ESMP) of the ESIA and the Resettlement Action Plan (RAP) which would ensure minimization and compensation for the impacts. The RAP, prepared as a standalone, is complementary to the ESMP and focuses on managing involuntary resettlement or displacement that could result from the implementation of the proposed project. The ESMP consists of mitigation, monitoring, and institutional measures to be undertaken during implementation and maintenance of the project to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels.

ES 3 PROJECT DESCRIPTION

ES 3.1 Project Overview Description of Location

The road transport intervention activities in Abia State will involve the rehabilitation and/or reconstruction of 31 roads in Aba segment spanning about 198.58 kilometres across the 10 Local Government Areas (LGA) of the state and as listed in Table 3.1

All the roads networks are largely interconnected making the planned project to have potential to create state-wide impact. The road upgrade activities on the selected roads will involve medium-sized civil engineering works entailing earthworks, provision of lateritic base, side drains, concrete culverts and river crossing infrastructure. The affected roads will be upgraded to flexible bituminous pavement standard surface finishing, having a carriageway width of 7.3 meters (for single lanes) and 1.5 meters wide concrete drainage with slab covers to serve as walkway. Drainages will be rehabilitated where they already exist

The roads are in dilapidation and the predominant issues challenging them include:

- Erosion and pot-hole vulnerability putting the roads in dilapidated conditions
- Flat topography leading to serious drainage challenges resulting in perennial flooding and erosion
- Narrow portions of roads
- Poor management of water-shed and waste which has negatively affected the urban road infrastructure imitation in the effective and efficient transportation of agricultural produce, and access to markets.

The identified roads for rehabilitation are presented in Table below: Some of the project roads that exhibit these road difficulties are shown in Plate 3.1.

Table ES2: List of Proposed Roads for Rehabilitation in Aba

Road ID	Section of the road	Current Status	Coordinates	Length Km	Location/Local Government Area
1	Asa Road-Port Harcourt	Dilapidated Pavements	0315027-0319479 0560457-0565299	7.78	Aba south
2	Faulks Road	Built up area; fail portions	03176931-0314713 0564707-0566619	4.59	Aba south
3	Ohanku Road-Owerre Aba	Dilapidated Pavements. Built-up area	0319940-03208115 0554086 – 0563896	6.61	Aba South
4	Omuma Road	Fail portions; Intervention ongoing	0315706- 0318335 0564424-0565129	2.14	Aba South
5	Ikot Ekpene Road	Dilapidated Pavements; Built-up area	0319591-0325482 0564991-0565691	6.82	Obingwa
6	Mbubo Umuogele Amachi Mgbokonta	Earth Road	0333713- 0334509 0594563- 0595230	12.72	Isiala Ngwa South & North
7	Umuala Nbawsi Eziala Osusu Okpuala Ngwa	Dilapidated Pavements	03225847-0330387 0594196 -0595924	12.64	Isi Ala-Ngwa North
8	Omoba-Umuaja Amaede Ndiolumbe	Earth Road	0324698- 0331032	8.17	Isi Ala-Ngwa South
9	Mbawsi Layout-Ururuka	Dilapidated Pavements	0327651- 0331850 0595407-0597752	1.87	Isi Ala-Ngwa North
10	Glass Factory Road	Earth Road	0320659- 0321184 0566591-0570801	1.64	Obingwa & Aba North
11	Umuomiaukwu Agburike Umuomainta	Earth Road	0324294- 0326793 0595941 -0599892	4.83	Isi Ala-Ngwa North
12	Uratta-Ugwuati	Earth Road	0308408- 0314646 0559708-0562268	9.58	Aba South & Ukwa west
13	Crystal Park Junction-Obohia Road	Dilapidated Pavements	0317135 -0318683 0555153-0564042-	22.05	Aba South & Ugwunagbo
14	Immaculate Avenue-ITF Road Bridge	Earth Road	0318029- 0318662 0567384-0568149	1.52	Aba North
15	Umuaro Nenu Road	Earth Road	0331375- 0335289 0579695- 0583459	4.76	Obingwa
16	Eziama Ntigha-	Earth Road	0319997- 0325347	9.07	Isi ala-Ngwa

Road ID	Section of the road	Current Status	Coordinates	Length Km	Location/Local Government Area
	Nsirimo-Ubakala		0601022-0604947		North & Umuahia South
17	Mgboko-Omoba Umuezeukwu Mbwawsi Road	Earth road	0321322- 0324021 0573317-0582722	6.85	Obingwa, Isi Ala-Ngwa South & North
18	Ibeme Ndiakata-Nlagu Onicha Ngwa	Earth road	0335196- 0336751 0561474- 0568326	2.82	Obingwa
19	Pepple Road-Akpu Road	Earth Road	0321484-0321726 0564007-0564991	1.20	Obingwa
20	Umuokpo-Ahiafor Link Road	Failed portions; Intervention on going	0331472-0333611 0567374-0570724-	4.30	Obingwa
21	Owerra Aba-Osusu Umuelendu-Osusuaku	Dilapidated Pavements	0305248 -0312055 0566814-0568733	4.01	Osisioma
22	Umuojima Amapuife Eberi Omuma	Dilapidated Pavements	0314837 -0317330 0568108- 0568645	9.98	Osisioma & Ukwa West
23	Umuimo Carol Pee. Ministry of Agric. Shopping Mall	Dilapidated Pavements	0307680- 0308376 0559701-0563393-	1.49	Osisioma
24	Ugwuati-Umuiku	Dilapidated Pavements	0307680- 0308376 0559701-0563393	4.01	Ukwa west
25	Isicourt-Ururuka Umuosu Umuala Umunkpeyi	Dilapidated Pavements	0331827- 0333640 0594082-0604693	20.62	Umuahia South & Isi Ala-Ngwa South & North
26	Ama Emereole-Ekeonyeugba-UmokoromiriEketa	Dilapidated Pavements	0318731 -0321751 0585138- 0587543	7.25	Isi Ala-Ngwa South
27	Ajiwe-Brass	Dilapidated Pavements	0317917 -0317980 0566840 – 0567380	0.63	Aba North
28	Ahunanya-Immaculate	Earth Road	0317967 -0318277 0567809-0568014	0.88	Aba North
29	Oron Road-Elizabbeth Avenue-Sports Club	Dilapidated Pavements	0318397 -0318869 0566201- 0566706	0.70	Aba North
30	Umuala-Umuakwu-Ohuhu-Nsulu-Oloko Ikwuano	Dilapidated Pavements	0330380- 0338079 0593027- 0596380	13.70	Isi Ala-Ngwa North & Ikwuano
31	Itungwa-Agburukwe Road	Dilapidated Pavements	0330168- 0333582 0574175- 0575718	3.35	Obingwa
	Total length (Km)			**198.58**	10

Project area of influence

The project area of influence includes Right of Ways (RoWs) of the road corridors to be rehabilitated, infrastructure and surrounding areas. The project area of influence also includes nearby communities, businesses, and other legal and/or natural persons directly and/or indirectly depending on project implementation.

ES 3.2 Project Design

The proposed Aba roads have been designed to use the existing route alignments as much as possible to limit Environmental and Safety (E&S) footprint of the project. The route allows for a design which meets the *Draft Low Volume Roads (LVRs) Manual, 2016, Federal Ministry of Agriculture and Rural Development*, which was developed to adequately cater for the specific needs of rural roads in Nigeria, without any impediment and minimal re-alignment. Using the Draft LVR Manual approach, the project roads are expected to fulfill an access function, whereby the existing alignment is retained. Thus, the existing alignment dictates the travel speed (and hence, the horizontal and vertical alignments) depending on the terrain and existing roadside development. In cases where there are potential safety issues such as sharp crests and blind curves, appropriate countermeasures will be applied/installed on a site-specific basis.

Road function is basically related to the most common types and purposes of travel, trip and character of service the roads provide. The character of service can broadly be understood as mobility, access and a mixture of Mobility and Access.

For mobility, high or continued speed are desirable and variable or low speeds undesirable, for land access, low speeds are desirable and high speeds undesirable.

Once the function of a road is established, then appropriate design criteria can be applied to encourage the use of the road as intended. Design features that can convey the level of functional classification to the driver include width of roadway, continuity of alignment, spacing of intersection, frequency of access points, building setbacks, alignment and grade standards, and traffic controls.

In the Nigeria context road classification is based on the function of the road it serves. In line with this the Federal Republic of Nigeria Highway Manual part 1: design, 2013, has classified the existing roads based on the function they serve. It has also set terms on which future road classification should base.

ES 3.3 Project Components and Ancillary facilities

The Project components would include the following:

- Road surface (paved or graded).
- Road reserve ("hard shoulder").
- Crossings (e.g. bridges, culverts).
- Drainage and erosion control structures.
- Safety and security measures (e.g. barriers and fencing).
- Other elements (e.g. signage).

The ancillary facilities will include the following:

- Lay-bys or service areas.
- Temporary construction facilities (e.g. workshops, laydown areas, working corridors outside the road reserve, workers' accommodation, and borrow pits)
- Security posts.
- Access roads within and between temporary facilities and the road being developed.

- Landscaping features, etc.

ES 3.4 Construction Activities and Materials
Construction activities will include:

- Establishing temporary access to work and ancillary areas, demarcating clearance zones, establishing access control.
- For road upgrading, erection of temporary diversions where needed to manage existing traffic.
- Clearance and leveling of the corridor, and major earthworks where required (e.g. cuttings, embankments).
- Location and development of borrow pits (and possibly quarries), import of materials, e.g. gravel, clay, bitumen.
- Sourcing and establishing of a water supply from surface and/or groundwater.
- Improvement of existing drainage and introduction of new road drainage, including culverts if required.
- Surfacing and sealing of the carriageway, including use of bitumen mixing plants where the road is to be sealed.

Construction Method and Materials
The design consideration has assumed to make use of all available technology and resources which include simple technique, available construction materials and labor input. In this line, the structures are mainly to be constructed using Reinforced Concrete and concrete.
Accordingly, all super structural and sub-structures elements are to be of Reinforced Concrete,

- Reinforcement Steel: - The steel produce grade 60-reinforcement steel for diameter of bar equal to and greater than 20mm, and grade 40 steel for those less than 20mm diameter. The minimum yield strength of grade 60 reinforcement steel is 420Mpa, while that of grade 40 is 300Mpa. These and other strength parameters are used in the design of the superstructures of the bridges. Minimum clear cover of reinforcing bars is recommended and shown on drawings.
- Concrete: -Design parameters of C-30 concrete are used in the structural computations of superstructure of the bridges. These strength parameters are with a compressive strength of 30mpa for 150mm cube samples and 25mpa for 150mm cylindrical samples and for the plain concrete leveling at under all substructures C-15 class of concrete is used with strength parameters of a compressive strength of 15mpa for 200mm cube samples and 10mpa for 150mm cylindrical samples which is also specified on design Drawings and technical specifications to be attained during construction stage. Resistance factors are recommended on the design manuals to account the Imperfection in production of these construction materials. Accordingly, the appropriate resistance factors for shear and bending moment of structural components were taken during the design of these components.

Availability of naturally occurring construction materials such as water, fine aggregates and crushed stone aggregates were also investigated in various locations (Table 3.3). The locations presented sources of various materials such as **Quarry Stone for asphalt, cement concrete and base course.** Aggregates of these shall be purchased and stockpiled from existing quarries from popular construction market, at Amasiri Ebonyi State. The aggregates meet requirements for use in asphalt, cement concrete, base course and masonry work.

During earthworks, it is estimated that topsoil will be stripped from the bulk earthwork areas. In addition, it is expected there will be some material unsuitable for engineered fill, imported material and material due to relocated as part of cut to fill bulk earthworks. All stockpiles will be located within the bulk earthwork areas or just outside, but within the catchment of the erosion and sediment control devices.

Prior to earthworks activities commencing, adequate perimeter and open channel drain controls must be installed to prevent sediment from entering the permanent and intermittent streams running through the site. Principal perimeter controls for this site include the installation of two construction entrances, silt fences and diversion drains/bunds.

A temporary water supply will be made available to the areas so that vehicle wheels can be washed prior to leaving the site, if necessary. All sediment laden water from wheel washing is to be directed into runoff diversion channels and into one of the decanting earth bunds prior to discharge to the intermittent stream.

ES 3.5 Description of Project Phases

The project activities shall be carried out in phases of project life cycle i.e., mobilization or pre-construction, construction, and closure of construction phases:

Mobilization or Pre-construction Phase

This phase involves planning, Feasibility study & Engineering Design, Procurement of Works, securing various types of bonds & insurances, possession of site, land acquisition; land clearing, organizing the work site, construction of camp and site workshop; scheduling, initiating project resource requirement, organizing essential resources, land dispossession and property evaluation; relocation and compensation arrangements.

Construction Phase

This is the implementation phase, where the project plan is put into motion and the work of the project is performed practically on site. It is essential to maintain control and communicate as needed during each implementation stages. Progress should be continuously monitored and appropriate adjustments are made and recorded as variances from the original plan.

Throughout the project implementation, people carry out the tasks, and progress information is being reported through regular project team meetings. The project manager uses this information to preserve control over the direction of the project by comparing the progress reports with the project plan to measure the performance of the project activities.

The plan should be updated and available on a regular basis. Status reports should always highlight the probable end point in terms of cost, schedule, and quality of deliverables. Each project deliverable produced should be reviewed for quality and measured against the acceptance criteria. When deliverables have been produced and the Employer has agreed on the final solution, the project is said to be ready for closure.

In this phase, the project shall include all associated activities during construction work such as (a) Scarification of failed sections (b) Provision of Stone Base (c) provision of Prime Coat (d) Asphalt Overlay/construction (e) Reinstatement of Shoulders (f) Construction of concrete lined drains and earth Drains and (g) Bridge Construction and maintenance.

The detail works are as follows:

Site Clearance and Earthworks

- Site Clearance on either side of road up to limits of construction width of all bush, grass and trees including topsoil
- Vegetation Clearing viz; cutting of bush, grass, shrub and trees etc. on either side of the roadway and/or median
- Scarification of failed sections of existing asphaltic surface

Cutting of potholes to rectangular shapes

Excavation of burrow pits etc.

Culverts and Drains

- Demolition of failed pipe Culverts
- Removal of Debris
- Excavation and backfilling works for pipe, box, culverts and side drains
- Laying of cast in situ/precast RC pipes and concrete box culvert
- Concrete works

Pavement and Surfacing

- Provision, spread and compacting of base and sub base material Laying of prime Coat
- Surface dressing
- Laying of Asphaltic concrete binder

Ancillary works like installing sign posts, guide posts, KM posts, grassing of embankments

Closure of Construction Phase

During the final closure, the importance is on providing the final deliverables to the customer, that is:

- Movement and demolition of temporary construction facilities,
- Handing over project documentation to the business
- Restoration of borrow pits,
- Conducting tests after completion,
- Various inspections and remedial work on defective works
- Termination of the temporary workers' employment
- Clean up and waste management,
- Termination of supplier contracts
- Releasing project resources
- Communicate the closure of the project to all stakeholders.

Operation and Maintenance Phase

Following construction, the road will become operational. During this phase, the road and ancillary infrastructures will be monitored and maintained by the SPIU to ensure sustainability. The SPIU has sensitized all communities along the road to form road maintenance groups. Maintenance equipment will be made available to this group for light maintenance activities including cleaning and vegetation control along the shoulders and around culverts and other drainage structures culverts. Only large scale maintenance activities will be handled by the SPIU following routine monitoring.

Decommissioning Phase

It is highly unlikely that the road infrastructure would be abandoned and decommissioned. It will most likely be upgraded or rehabilitated. Therefore, decommissioning is not extensively considered within this ESIA. In the unlikely event that the Abia State government decides to abandon and decommission the road in the future, an abandonment, decommissioning and closure plan should be developed taking into consideration the most cost effective and practicable methods, legal requirements and industry practices at that time. This plan should be submitted to the SMEnv and other relevant regulatory agencies for approval, at least 6 months before scheduled abandonment and decommissioning.

ES 3.6 Project Waste Management

The bulk of waste generation is envisaged during construction and decommissioning phases. During operation, the project is not expected to generate significant quantity of waste, other than the routine waste that running water in the drainage lines convey in the course of movement downstream and from the normal maintenance of the project site.

ES 3.7 Project Schedule

Following completion of construction works over a period of three years, the project-life of the project will be about 20 years. The road project construction is expected to start by the end of year 2022 and will be accomplished at the end of 2025. The project, therefore, will be opened for traffic by the middle of 2025. As the service year (design life) of the project is 20 years, the traffic demand is projected to the year 2044.

ES 3.8 Major environmental and social issues and challenges of the project

The proposed roads are in dilapidation and the predominant issues challenging them include:

- Erosion and pot-hole vulnerability putting the roads in dilapidated conditions;
- Flat topography leading to serious drainage challenges resulting in perennial flooding and erosion;
- Narrow portions of roads; and
- Poor management of watershed and waste which has negatively affected the urban road infrastructure limitation in the effective and efficient transportation of agricultural produce, and access to markets.

.

ES 4 DESCRIPTION OF THE PROJECT ENVIRONMENT

ES 4.1 Methodology

A strategic approach was adopted in establishing the environmental and social baseline status of the study area. This involved obtaining the environmental characteristics through field data gathering exercise (observation, onsite measurements, and sample collection) as well as laboratory analysis of collected samples. Socioeconomic Environment was also assessed in relation to land tenure, land use, community health, historical and cultural heritage, religion, demographics, income, economic livelihood, culture, education, employment, infrastructure and social services, community structure/administration, social organizations/institutions. The tools included use of checklists, photography, Geographical Positioning Systems (GPS), structured interview guide/questionnaires, Focus Group Discussion (FGD) among others. All data collected were analyzed for production of the report. Data gathering exercise was carried out from May 2, 2021 to June 28, 2021 using a multidisciplinary approach involving professionals. The field exercise involved field sampling, sample collection and preservation as well as in situ observations and measurements of concerned indicators. Sample preservations were done on site prior to laboratory analysis.

ES 4.2 The Watershed and Catchment Area

The watershed refers to the area of the land that comprises a set of streams or rivers that drain into a larger water body like an ocean or a river. In the context of this project, the watersheds refer to the dividing ridge between drainage areas and comprise upland areas of the collections of all the waters through the gully erosion channel downstream). The watersheds of the gully drain into natural drainage channels and roadside drains. The watersheds with the sub-watersheds form the outlets of natural and artificial drains directing flood to the gullies. The sub-catchments have a mild slope varying in the range from 1.4 to 20%. They can be classified as rolling to steep terrain (Appendix 2). The Obingwa sites have different gullies and flow to the Main Gully. At Obingwa, drainage channels pass through the village but at the downstream sections of the channels. Generally, the drainage from the village flows from northeast to southwest.

ES 4.3 Climate

The climate of the project area is humid tropics (semi-hot equatorial). Rainfall is significant most of the year, and the short dry season has little effect. The climate is characterized by the rainfall season from March to October, with the highest rainfall recorded in August. From available records, the average annual rainfall of 322 mm and the average annual temperature in Aba is 25.6 °C | 78.2 °F. The climate is essentially controlled by latitudinal locations, and the prevailing (seasonal) winds. The annual rainfall based on the station data at Aba varies from a minimum of 917 mm to 2285 mm.. The wind direction was predominantly South-westerly.

ES 4.4 Air Quality and Noise Level

The project area's significant sources of air pollutants were vehicle emissions and dust from the adjoining untarred road. The air quality parameters, NO2 (0.004 – 0.006 µg/m3), SO2 (0.004-0.006 µg/m3), CO (<0.01 µg/m3), NH3 (<0.01 µg/m3), VOCs (level less than 0.01 µg/m3) showed a general trend of acceptable values against FMEnv standards as most of the pollutants measured were either not detectable or below the regulatory values. The particulate matters (PM2.5) ranging from 42.2 – 60.2 µg/m3note to be below the set limits of 250 µg/m3,

The noise levels with a range of 46.8 – 54.8 dB(A) and a mean of 51.1 dB(A) were generally found to be below the NESREA prescribed limit of 60 dB(A) during the day and 50 dB(A) in the night for residential areas mixed with small scale production and commercial activities.

ES 4.5 Topography or Terrain

The topography of the project area is generally low-lying in the southern part of the state and moderately high plains with elevations ranging between 55.697 - 121.458m above sea level. The average height in the entire state is about 88.58m above mean sea level.

ES 4.6 Geology

There are two principal geological Formations in the state namely; Bende-Ameki and the Coastal Plain Sands otherwise known as Benin Formation. The Bende-Ameki formation of Eocene to Oligocene age consists of medium-coarse grained white stones. The late Tertiary-Earl Quaternary Benin formation is the most predominant and completely overlies the Bende-Ameki formation with a South west ward dip. The formation is about 200m thick. The lithology is unconsolidated fine-medium-coarse grained cross bedded sands occasionally pebbly with localized clay and shale.

A variety of landforms exist dominated by flat and lowlying land, generally less than 120m above sea-level. The rock system is divided into three namely, Upper Coal Measure, False-Bedded Sand Stones, and Lower Coal Measure. The Upper Coal Measure formation is the largest geological formation in this region and is comprised mainly of coarse grains, alternating sediments of grey sands, dark shale which contains sands of impure coal in place of vertical horizon.

ES 4.7 Soil

The project area is made up mainly of *hydromorphic soils* which consist of reddish brown gravely and pale coloured clayey soil. The soil is rich for agriculture and it supports the growth of yam, cassava, maize, rice, etc. The soil material from the gully site could be classed as silty sand derived from weathered sandstone and limestone in the area. The soil material graded from dark brown to reddish yellow with lenses of grey sandy silt of moderately void ratio. These parameters make the soil in the area very erodible.

The soil texture varies from loamy sand in the surface layer to sandy clay loam down the profile. Chemically, the soil of the project area is deficient in basic cations with aluminum saturation being greater than 83%. The soils are moderately acidic (pH 4.5 – 4.9) and low in organic carbon, total

nitrogen and available phosphorus. Total nitrogen and organic carbon are medium and available phosphorus is low in this soil. The mineralogy of clay sized particles showed a dominance of kaolinite in both soils with some quantities of montmorillonite that increased down the profile.
During the present study, detailed location specific route soils survey and laboratory testings were carried out for the design of all the proposed roads in Aba. At Aba, a total of two hundred and eighteen samples **(218 Nos**) were obtained with hand auger/manual trial pitting at the selected locations, for geotechnical investigations. Evaluation of the characteristics of the soils along the proposed alignment and the general features along the formation was carried out by observation and augering/manual trial pitting to the depth of 0.0 -1.5m along the route. The static water level was observed to be deeper than the depth of all the trial pits. The materials observed along the formation were laterite, and laterite with Pebbles. This was observed between 0.0 -1.5m in the trial pits.

ES 4.8 Groundwater and Surface Water Quality
For groundwater, the values of chemical parameters were found to be within the WHO standard for drinking water. There are no traces of metallic ions, and the water is not contaminated. Groundwater had <1 NTU turbidity, low conductivity, and a slightly acidic pH (6.69). The surface water quality from Aba/Osisioma had relatively high turbidity (38.2 NTU) and alkaline pH (7.85). Other parameters were within the normal range for surface waters in southern Nigeria. The water samples were well oxygenated with dissolved oxygen (DO) values ranging from 5.6 to 7.5 mg/l, which can support aquatic life. The low level of ammonium nitrogen and biochemical oxygen demand (BOD) indicates the low level of biodegradation and organic pollution.

ES 4.9 Flora and Fauna
The project area and its surroundings are in the secondary succession Rainforest with a mix of few forest flora. The site is a community of regenerating secondary plants, which has been left to fallow with some pockets of active and abandoned farmlands, and extensive land being badly eroded. The important cultivated plants around the area are Maize (*Zea mays*), Cassava (*Manihot esculenta*), Beans (*Vigna unguiculata*), white yam (*Dioscorea esculenta*), vegetables, pepper (*Capsicum* spp.) and fruits such as Mango (*Mangifera indica*), Oranges (*Citrus* spp.), and Cashew (*Anacardium occidentale*). The most important naturally occurring useful plants are the locust bean plant (*Parkia biglobosa*), economic timbers such as *Afzelia*sp., respondenter plant (*Gmelina* plant) and *Daniella oliverii* (Butter plant), *Lophira lanceolate*(Ironwood). Economic trees in the cashew include oil palm, oil bean, icheku, banana, and oha.

Fauna animals found include giant rats (*Cricetomys Gambians*), ground squirrel (*Xerus erythropus*) and greater cane rat (*Thryonomys swinderianus*), grass cutters, antelopes and pigs. Smaller animals such as lizards and skinks and larger ones like the monitor lizards were sighted, including several migratory birds, during the field survey, while some were seen foraging. The wildlife in the area is said to be significantly reduced because of the people's excessive hunting and farming activities.

ES 4.10 Conservation Concerns and Land Use/Land Cover
No protected area is marked explicitly for wildlife, and there are no Game Reserves.
The land use in the watersheds is characterized by settlements, shrublands, woodlands, forests, narrow roads, lawns, etc.

ES 4.11 Socioeconomics
Aba is a major urban settlement and commercial centre in a region that is surrounded by small villages and towns. Aba is well known for its craftsmen and also the most populous city in the South Eastern Nigeria. As of 2016, Aba had an estimated population of 2,534,265. The state's

slogan is "God's own State". Aba North and Aba south make up the popular commercial city: Aba which is known for business, creativity and industrialization.
Aba is the commercial city of the state. Aba is situated on a plain with Aba River Valley on its eastern side as the only prominent physical feature. Aba is one of the railway stations on the eastern railway. It has the largest concentration of people in the state. It is the largest commercial centre in the state with the famous Ariaria Market sited west of the town, close to the Port-Harcourt-Enugu Expressway. Besides, there is the Ngwa Market, the Cemetery Market and virtually every street in Aba has its share of the business activities for which the town is known. There is a good number of both public and private industrial establishments as well as financial institutions.
As a result of the primate role enjoyed by Aba in the hierarchy of settlements in the state, enormous environmental problems have become manifest. These include refuse heaps, traffic congestion, overcrowding of residential areas, dearth of infrastructures and the pollution of water bodies.

Demography of the Study area

National Census of Nigeria carried out in 1991 puts the population of Abia State at 1,976,805 consisting of 920,268 males and 956,434 females. In 2006, total population was 2,845,380 consisting of 1,430,298 males and 1,415,082 females (Figure 4.34). Projected to 2017, the population would be 3,766,150 consisting of 1,875,503 males and 1,890,647 females (Table 5.15). In almost all local government areas of Abia State, the population of females is more than that of males except in Aba area (Aba North and Aba South LGAs) where the population of males is more than that of females.

Overview of Study Area

The study was conducted in communities along the 31 roads proposed for construction in Aba South, Aba North, Osisioma, Ugwunagbo, Obingwa, Isialangwa North, Ukwa East, Umuahia South, Isialangwa South, and Ikwuano LGAs, Abia State.
The project is expected to impact 3781 PAPs of which 874 are female and 2253 are male while 654 of the PACs were not identified as they were absent during social survey and property enumeration in their area.
Data from the educational attainment of the PAPs shows that more than 60% of the identified PAPs have formal education and this will make PAPs' training and technology transfer quite easy. Data obtained showed there are more PAPs (293) with higher education within the Omoba – Umuaja Amaede Ndiolumbe Road.
Data from the social census indicates that there are more PAPs within the ages of 45-54 (897), followed by the PAPs within 55-64 age bracket (824) and no PAP is underage (<15 years).

Stakeholders' consultations

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. These consultations enabled interested and affected parties to contribute their concerns (views, and opinions on the proposed development).
Stakeholders' engagement meetings were held in October 28, 2021, and June 6, 2022 as well as during the during the census for the RAP which took place between April 5-30 April, 2022. At the meetings, the overview of the proposed project and appreciation of ESMP were presented. Furthermore, the challenges that could impede the implementation of the project and the support needed from all parties to ensure effective project and successful implementation were also discussed with the stakeholders. *Appendix IV contains a list of those consulted and when as well as the summary of the outcomes of the meetings*.
Below the key outcomes/opinions synchronised from the stakeholders' consultations are outlined:

- The project is a welcome development and will assist in alleviating the suffering of the citizenry on the various roads to be rehabilitated
- The communities are ready to give maximum cooperation to the contractor, especially in terms of security;
- The stakeholders are willing to give up their land and property for this development as long as they will be fully compensated. Nevertheless, they also noted that caution should be exercised in land take especially for the detours and campsites adding that land taken for such purposes should not only be compensated but also be rehabilitated and returned to the rightful owners upon completion of the project.
- The youth should be given special consideration in employment and make them useful to help in the provision of security and safety of materials and personnel.
- The project implementation activities should include the stakeholders and ensure a coordinated approach in addressing compensation and resettlement issues as they affect various parties especially the local communities.

These observations and opinions have been noted and are taken care of in the mitigation measures or principle enshrined in the ESMP and RAP, making them to support in efficient project delivery in an environmentally benign, socially acceptable and culturally appropriate way.

Project Impact on Asset

Many (46%) of the respondents believe that the project will affect their buildings or structures, while 34% are certain that it will take their land. 10% of the respondents along this corridor believe the project will affect their farm, and 7% are of the opinion that it will affect their business premises and 3% think it will cause disturbancers and disruptions to their businesses.

Majority (93%) agreed and are ready to evacuate their site or shift backward for the civil work, while few (7%) of the respondents were not agreeable to the option of giving up their site except adequate mitigation measure is ensured.

Type of Affected Persons and Asset

Sixty percent (60%) of the respondents mentioned affected entity will be individuals, 20% mentioned households, vulnerable persons make up 10% of the respondents, 7% of the respondents are corporate entities.

Majority of the affected asset 88% are trading structures/shops, 4% of the affected structure are residential, and other 8% are business grounds

Agriculture

The vegetation and climate of Aba support most tropical crops. The city has fertile soil which grows mostly root crops and tree crops. Cash tree crops include oil palm, raffia palm, rubber, citrus fruits and kola nuts. Cash crops grown include rice, cassava, yam, cocoyam and maize. Pig and Fish farming is another cash spinning agro-business in the State while goats, chicken and snails are reared within households.

Mineral Resources

Abia State is blessed with natural resources which include crude oil found in oil fields at Imo River, Obuzo, Owaza, Ngboko, Nkali, Odogwa, Obeakpu and Isimir; lime stone in Ewe-Arochukwu LGA and southwestern part of Isuikwato LGA; natural gas; kaolin, lead, zinc, laterite, bentonite clay, tar sand, phosphate and recently (about five months before this baseline study), gold and uranium were discovered at Amafor community in addition to other mineral resources located in the State.

Industry

The area has a number of industries which include: the Nigeria Breweries Plc, Aba; Golden Guinea Breweries Plc; Aba textile Mills Plc, Aba; International Glass Industries Plc (IGI), Aba; Ogwe Golden Chicken Farms Limited, Ogwe; Aba Palm Limited, Ohambele; Unilever Plc, PZ Plc Aba; International Equitable Association Limited, Aba; Guinness Nigeria Plc, Osisioma, etc. Many other small and medium scale industrial set ups in the state also contribute to the vibrant commercial nature of the State.

Aba is surrounded by oil wells which separate it from the city of Port Harcourt. A 30 kilometres (19 mi) pipeline powers Aba with gas from the Imo River natural gas repository. Its major economic contributions are Textiles and Palm Oil along with pharmaceuticals, plastics, cement, and cosmetics. This trade makes the Ariaria International Market the second largest market in Nigeria after the Onitsha Main Market. There is also a Heineken brewery, a glass company and distillery within the city. Finally, it is famous for its handicrafts.

Infrastructure

Infrastructural facilities and services in Aba in terms of availability and sustainability can be said to be fair but not to good enough for economic advancement.

Roads within the urban centers are fair, such as in Aba main. The main arterial routes are tarred and maintained. But within the high density built – up areas, the roads are characterized by potholes and lack of side drains, and standard setbacks. Traffic congestion characterizes the arterial routes within the big cities where tricycles (Keke NAPEP), and other street users hold sway. Interstate and intercity roads are fair, but not good enough. For instance, the waterside overhead bridge and axis are normally jam packed in the evenings owing to traffic, this could be resolved when other road networks are accessible.

Potable water supply is basically from boreholes dug in private and public owned buildings within the cities, especially in Aba. But within the suburbs and rural areas, potable water supply and its infrastructure is poor for various communities along the project roads. About 90% of the state population rely on boreholes, hand dug wells, rain water and streams. Most of the potable water is sourced from boreholes. There are over 2000 boreholes in Aba municipality alone.

Health facilities are 85% adequate in Abia State. This is evident because almost all host communities have an accessible primary healthcare centre within its catchment. Power supply in Abia State is vested in the Enugu Electrical Distribution Company. Generally, electricity supply in the State is unreliable and epileptic. This has encouraged the use of personal/private generators or use of the trending solar panels by households and organizations. However, host communities surveyed all had transformers sited in different locations of the communities. That implies that if the Electrical Company provides power, they would have access to electricity supply. Apart from Ofeme community where they have issues with staff the electrical distribution company, so they have not had light for over a year as indicated by their youth president.

Settlement and Land Use in Abia State is essentially for agriculture as an agrarian State. But it is relatively urbanized compared with some states in Nigeria. The settlement pattern is nucleated (clustered) having a Town Square with large trees around where cultural activities and meetings are held in the rural communities along the project roads. Land use in the cities and towns are mixed; Residential, commercial, Industrial, Civic and Agriculture in the outskirts. They acquisition of land is majorly through inheritance and outright purchase. It also available to the citizens of these communities, as socio-cultural beliefs do not permit female citizens the rights-to-own landed properties.

Types of buildings in Aba are made up of sophisticated to simple buildings of concrete work and aluminum and or corrugated roofing sheets. The suburbs and rural areas generally house concrete buildings with corrugated zinc sheets, and very few mud houses with corrugated zinc sheets. In very rare cases, the building roofs are made of rafia or palm fronts, thatched roofs on huts. However, it shows civilization has also robbed-off on the options of buildings/houses in the host communities.

Livelihood Options of Respondents

The average Ibo man is business oriented. Fifty percent (50%) of surveyed respondents are into businesses which include buying and selling of various goods and services such as building materials, clothing & textiles, food, home accessories, etc. 23% are also civil servants who are gainfully employed in the different MDAs across the state. 20% are farmers who are experts in areas such as poultry, piggery, fish ponds, different areas of crop farming, etc. while the remaining 7% accounts for artisans.

A cross tabulation shows that those in the civil service are also in one way or the other part of the business men/women distribution. This is owing to the fact that a good percentage of them also own business outlets in form of farms, rendering services, contractors and/or supplies of various materials, etc.

It was also observed that there are jobs determined by gender. For example, cutting down palm fruits from the tree is majorly a man's role while the haulage is a woman's duty. Hunting is mainly a man's role while planting of vegetables is a woman's task. Therefore, livelihood options sometimes depend on socio-cultural perceptions/belief. The feminist theory definitely do not have a place in certain cultural practices within the Ibo ethnic group.

Waste disposal strategies

The method of disposing waste has a lot to do with the health of a community. 95% of waste witnessed across host communities were indiscriminately disposed. This could lead to an epidemic illness such as diarrhea, cholera, and other communicable diseases. It also shows that there are no proper waste management within host communities. In most of the host communities, no campaign have been made on how to properly dispose waste.

Means of Transport and Ownership Status of Respondents

The predominate means of transportation in host communities in Abia state is tricycle and commercial buses which records 60% mode of mobility. 30% of the means of transportation are private owned cars and the remaining 10% could account for other means such as motor-cycles and bicycles. This indicates that commercial transport operators are the most reliable and cost effective means of movement. However, there seems to a predominance private owned cars in Aba because it a civil servant orientated catchment

Obviously, the road construction projects would be beneficial not to households alone but would stimulate increased economic activities in Aba.

Water supply

Most of the surveyed respondents (80%) across affected host communities claim that dug borehole is their source of water supply. Where there are no boreholes, residents walk 10-15mins from their house in search of houses that would permit them to fetch from their taps. Some philanthropists living amongst these communities, sometimes extends their hands of assistance by installing tap heads outside their premises so that those in search of water can have access to water without accessing their compounds. The story is not different in the rural host communities, 100% of the respondents have storage cans of different sizes to store water either from borehole or rain water. However, there are few rural communities that have access to community boreholes installed either by their Community Development Committee or by a notable politician within their fold.

ES 5.0 Potential Impacts and Mitigation/Enhancement Measures

Beneficial and adverse impacts of various components of the selected project alternative on the physical, biological and human (social, cultural and economic) environments were identified as due to the proposed project. Based on the Risk Assessment Matrix (RAM) used for identifying significant environmental aspect/impact s which were classified as Low, Medium and High, indicating increasing likelihood of occurrence of such risk in the proposed project the impact results were obtained.

ES 5.1 Summary of Identified impacts

The proposed project is envisaged to have many positive environmental and social impacts. While some of these are a function of the reasons or objectives of the project, others are a function of how the project is designed to meet its goals, as earlier discussed.

Project Benefits

The project is envisaged to have a range of positive environmental and social impacts. Some of these are a function of the objectives of the project, while others are a function of the way in which the project is designed to meet its objectives. The major benefits will occur in the form of improved erosion management and gully reclamation which will provide for:

- Reduced loss of infrastructure, mainly the roads and other assets
- Reduced loss of agricultural land and productivity from soil loss caused by surface erosion.
- Reduced risks of floods (due to reduced siltation)
- Progressively restored vegetative cover, improved environmental conditions and more humid local microclimates. This results in increased vegetation cover for wildlife and carbon sequestration.
- Environmental improvements due to land stabilization measures which preserve the landscape and biodiversity.

Negative Impacts

The proposed project activities unfortunately are also likely to exert adverse impacts on the social and physical environment within which it is executed. Based on the design of the project, these impacts can be divided into two, namely: short-term construction-related impacts and long-term unavoidable impacts due to use the use and maintenance of the reclaimed areas highlighted below:
Short-term construction-related impacts typical of construction activities of six months duration such as:

- Increased level of noise and dust nuisance during the preparation of site, and trucking materials to sites.
- Generation, temporary storage and disposal of waste from the labor camp. These may cause dust emissions, erosion, littering, damage to soil.
- Contamination of soil and groundwater by stored fuel, lubricants, paints; and refueling of vehicles.
- Traffic disruption
- Increase in public and occupational health and safety issues within the vicinity of the site and possible increase in communicable diseases such as COVID 19
- Use of resources, runoff of flood, increase in social vices, etc.

Long-term unavoidable impacts due to the operation which are likely to come out in the form of:

- Direct impacts: emissions and pollution due to traffic and transport of goods, for instance

- Indirect impacts: changes in economic structure, trade and transportation systems, Impact on the people's lifestyle, social values, and the "rebound effect,"

The construction activities are one-time activities and not permanent ones, about six months. Although the proposed construction activity does not envisage any large-scale construction activities, impacts associated with the activities are rated to be moderate on severity and "minor" on duration.

All these impacts can sufficiently be mitigated based on the measures designed correspondingly. Nevertheless, unless good construction management practices are followed, construction activities can cause serious environmental pollution, ecological degradation and health and safety concerns to both workers and the public.

With regard to occupational Health and Safety, some workers will be recruited for construction activities and workers' camp will be constructed. These will include non-skilled workers, operators and drivers as well as surveyors and construction supervisors. Since the works will be relatively small scale and expected to be completed within six months, large numbers of workers are not expected. However, safety and health impacts will be also expected.

A more project specific potential negative impacts and the level of impacts that could emanate from the project are summarized in Table 5.3.

Increase in public and occupational health and safety issues within the vicinity of the site, such as the increased risk of trips, falls, injuries, accidents and spread of diseases such as COVID 19 amongst the contractors, pedestrians, passengers and staff at the project level as well as at the community level. The workers recruited for construction activities will include engineers, operators, surveyors, and drivers with non-skilled workers exposed to occupational health and safety risks and hazards. Since the construction work will be relatively small and expected to be completed within six months, large numbers of workers are not likely. However, safety and health impacts will also be expected.
Concerning the phases of the project implementation, the construction phases will include one-time activities and not permanent ones of six months. The proposed project activity will not involve any large-scale construction hence impacts associated with the project are mainly rated moderate on severity and minor on duration. Nevertheless, unless good construction management practices are followed, construction activities could cause severe environmental pollution, ecological degradation and health and safety concerns to workers and the public.

For the operational stage, the project design life is anticipated to be about 40 years, with routine maintenance to ensure durability. No impacts are expected. However, where the treated gully erosion site is left unattended in terms of care and allowed, for instance, to accumulate debris such as plastics.

Impacts due to decommissioning will result from the removal of camps, cabins, equipment, etc., after treatment of the gully erosion site, for which the significant impacts have been identified as short-term noise and dust raising. The project area, the land where these activities will take place or be removed from, will be revegetated; thus, no adverse negative impact is anticipated.

Positively, the project is envisaged to have a range of positive environmental and social impacts. Some of these are a function of the objectives of the project, while others are a function of the way in which the project is designed to meet its objectives. The project beneficiaries are the population of poor rural -urban communities lacking all-weather roads currently and severely constrained access to economic opportunities (agricultural inputs, markets, rural-urban linkages) to social services (health and education). This scenario is expected to change for the better with the proposed project.

As a rule of the thumb, conversely, it is anticipated that the road project during rehabilitation would exert some negative impacts on the social and physical environment within which they are implemented.

These impacts can be divided into two, namely:

- Short-term construction related impacts such as environmental impacts on air quality, waste generation, disruption of traffic, and health and safety impacts. Unless good construction management practices are followed, construction activities can cause serious environmental pollution, environmental degradation and health and safety concerns to both workers and the public.
- Long-term and permanent activities of the operation phase leading to recurring but avoidable impacts which consist mainly of waste generation, air quality degradation in the event of use of diesel generators and noise.

Environmental justice

The road will be patronized by persons of all social strata, irrespective of the income. Moreover, especially for the poor, this is considered to be a well-targeted intervention to meet their basic transport needs to increase their well-being. Therefore, any adverse effects of this project would not be predominately borne by the low-income population.

Furthermore, disproportionately high and adverse human health or environmental effects on minority and low-income populations are not anticipated on this project since the road corridor cuts across different towns and villages that vary widely in income levels. No particular towns or villages would be affected by the physical environmental impacts differently than another.

Climate Change Impact

World Bank (2018) notes that considering a variety of climate change scenarios, most projections indicate that Africa's climate will be very different from what it is today; however, there is no consensus as to the nature, intensity, and geographic distribution of those changes. However, quantifying the broader impact of climate-related traffic disruptions shows that when climate events shut down or reduce the capacity of a road, the consequences on supply chains, economic output, and access to services will vary widely based on local factors such as the volume of traffic on a particular road or the existence of alternative routes. On high-traffic roads, even relatively mild changes in climate could severely affect people and the economy—making the case for adaptation particularly strong.

While the roads are particularly vulnerable to climate stressors such as higher temperatures, increased precipitation, or flooding, when rehabilitated well with quality materials, good and proper drains, well greened and increased maintenance and more frequent rehabilitation is not likely to contribute or degrade due to climate change.

ES 6.0 Project Potential Impact Mitigation Measures

The measures proposed are specific, measurable, achievable and relevant to the proposed intervention and time based (SMART). The measures also considered the environmental laws in Nigeria, and internationally and the principles of sustainable development and best available technology.

In Table 4 a summary of the potential impacts associated with the project, together with corresponding mitigation measures. The Table outlines mechanism for enhancing the mitigation measures or reducing the major and moderate adverse impacts have been developed. A Mechanism for enhancement of positive impacts and reduction/avoidance of negative impacts has been developed in relation to the Project Concept and design, Construction and Operation, Control of Earthworks and Erosion and Sediment Control Plan, Managing the Treated Gully and Terminal End of the Spillway, Control of Water Quality, Waste Management, Controlled Gully Maintenance and management, Neighbourhood Effects Management.

Table ES3: Mitigation Measures for Potential Impacts

S/No	Activities Envisaged/Impacts	Mitigations (Planning and Design (P&D), Construction (C), or Operation and Maintenance (O&M))
General Planning and designing existing roads		
1	Project Preparation (Planning & Design)	• Incorporation of environmental concerns in project preparation to avoid impacts in construction and operation stages • Avoidance of roads through sensitive areas as reserved forests/sanctuaries/wetlands etc • Compliance with legal requirements. • Chose or develop design standards for each facet of construction and related activities—road bed, road surface, drainage, erosion control, re-vegetation, stream crossing, sensitive areas, steep slopes, material extraction, transport and storage, construction camps, decommissioning (P&D) • Provide plans to identify, protect, and use sensitive habitats (P&D) • Take into account problems in soil and slope stability and local weather and natural phenomena—flooding, heavy rain, drought (P&D)
		• Develop an erosion control plan for all projects (P&D)
2	Route planning	• Take into account problems in soil and slope stability and local weather and natural phenomena—flooding, heavy rain, mudslides, drought (P&D) • Avoid gradients greater than 10 percent and long straight downhill stretches (P&D) (C) • Identify sites for temporary and permanent storage of excavated material and construction materials. Where excavated material will not be reused decide how it will be disposed of or shaped (P&D) (C) • Avoid environmentally sensitive areas, such as wetlands, and sites near protected areas or relatively under graded forests. Explore possible compromise alternatives—a narrow, improved trail across protected area lands that provides access to foot, bicycle, or motorcycle traffic while constructing main access roads around these areas (P&D) (C) • Avoid constructing roads through forest areas, if possible. If clearing is unavoidable, protect or restore forests elsewhere in the drainage basin as close as possible to those lost (P&D) • Minimize aesthetic and scenic impacts by avoiding roads that cut long straight paths across valleys and plains. Instead, hide roads beneath forest cover to minimize adverse aesthetic effects, and provide meanders where feasible (P&D) • • If sensitive areas cannot be avoided, involve ecologists and engineers in designing road, construction camp, quarries, and other areas (P&D) (C)
3	Construction contracts	• Select or develop guidelines and procedures to be applied to each facet of road construction or rehabilitation and incorporate them into contracts with construction companies—site clearing, bed and surface construction, drainage, fuel and material usage, quarry site management, construction camp and work site operating procedures, including worker safety • Include incentives for adhering to guidelines and penalties for violating them

4	Maintenance agreements	• Finalize maintenance agreements with local communities before beginning construction. All parties must clearly understand and be committed to terms of the agreement, such as who will do what work, when, how frequently, for what compensation, and within what limits
5	Sloped areas and raised roads	• Stabilize slopes by planting vegetation. Work with agronomists to identify native species with the best erosion control properties, root strength, site adaptability, and other socially useful properties. Set up nurseries in project areas to supply necessary plants. Do not use non-native plants. Use soil stabilizing chemicals or geo-textiles (fabrics) where feasible and appropriate (P&D) (C) • Minimize use of vertical road cuts even though they are easier to construct and require less space than flatter slopes. The majority of road cuts should have no more than a 0.75:1 or 1:1 slope to promote plant growth. Vertical cuts are acceptable in rocky landscapes and in well-cemented soils (P&D) (C) • Install drainage ditches or berms on uphill slopes to divert water away from roads and into streams (P&D) (C) • Install drainage turnouts at more frequent intervals and check dams to reduce ditch erosion (P&D) (C) • If possible, use higher grade gravel that is much less prone to erosion (P&D) (C) • If very steep sections cannot be avoided, provide soil stabilizers or surface with asphalt or concrete (P&D) (C)
Planning and designing existing- Existing Roads (Reconstruction/Repair/Realignment)		
1	Road surface is below grade of surrounding	• Raise road surface with stable fill material. Grade with in-slope, out-slope, or cambered shape. Install sufficient cross-drains ditches, and settling ponds (P&D) (C) (O&M) road
2	Road is steeply sloped and eroding	• Consider realigning the road section so that it conforms to preferred design parameters described above. Decommission original road sections after realignment (P&D) (C) (O&M)
3	Deteriorated road surface	• Determine cause of deterioration. If heavily used, find a means of reducing traffic or upgrade road to more durable surface— gravel, asphalt, or concrete (P&D) (C) (O&M)
4	High-speed driving	• Realign road sections to meander; curving roads deter speeding (P&D) • Add speed bumps in villages or populated areas (C)
5	Road Sections with multiple tracks/off-road driving	• Generally caused by either muddy/flooded roadway or highly deteriorated roadway. Maintain or upgrade road so section no longer floods or becomes muddy (P&D) (O&M) • Raise the road bed or define the roadway with rocks. Realign the road to a better area. Avoid very flat terrain (P&D) (O&M)
6	Road section must be realigned	• Remove surface and loosen soil of previous track to accelerate regeneration of vegetation. Block access with rocks, branches, roadblocks, and signs. Narrow tracks usually re-vegetate naturally with no noticeable scars. Wider roads may require planting and reseeding (C) (O&M)

• Construction		
1	Site Preparation	• Relocation of utilities, common property resources and cultural properties • Avoidance of affect on roadside vegetation
2	Construction Camps	• Avoidance of sensitive areas for location of construction camps • Infrastructure arrangements for workers and construction Equipment
3	Borrow Areas	• Avoidance of agriculture lands as borrow areas • Redevelopment of borrow areas
4	Compacting	• Water the road immediately before compacting to strengthen the road surface, otherwise traffic will soon beat back the road surface to pre-bladed condition (P&D) (C) • When possible, delay compacting until the beginning of the wet season or when water becomes more available (P&D) (C
5	Blasting	• Minimize blasting (P&D) (C) • Take safety precautions to protect being injured by flying or falling rock
6	Topsoil Salvage, Storage & Replacement	• Topsoil removal from areas temporarily/permanently used for construction • Reuse of topsoil at areas to be revegetated and in agriculture lands
7	Quarry Management	• Redevelopment of quarries in case new quarries are setup for the Project
8	Water for Construction	• Extraction of water in water scarce areas with consent of community • Scheduling construction activities as per water availability
9	Slope Stability and Erosion Control	• Slope stability along hill roads • Protection of land on hill side from stability loss due to cutting • Protection of lands on valley side from debris due to construction • Adequacy of drainage for erosion control • Geological/geomorphological studies conducted to investigate and recommend best available options. • Civil engineering structures and bio-engineering measures used. • Measures taken to avoid undercutting of slope toes. • Quarrying prohibited in river beds, where flood discharge is significant.
10	Road surface Help or be adverse to road user Comfort	• Stabilize the road surface with gravel, murram, and other rocky surfacing material • Elevate road surface (measure from base of wheel tracks) above side channel water) (P&D) (C) • Clearly define the type of road surface shape and drainage method—in-sloped, out-sloped, or cambered/crown roadway— be used for each section of roadway (P&D) (C)
11	Waste Management	• Slope stability along hill roads • Protection of land on hill side from stability loss due to cutting • Protection of lands on valley side from debris due to construction • Adequacy of drainage for erosion control

12	Water Bodies/ Perennial and Intermittent rivers and streams	• Avoidance from cutting due to alignment • Protection of embankment slopes in case of alignment on embankments
13	Wetlands	• Avoid routing through these areas (see "Route planning" above for additional guidance) (P&D) • Minimize cuts and fills and compensate for impact by protecting other wetlands (P&D) (C) • Take special precautions to prevent dumping of debris, oil, fuel, sand cement, and similar harmful materials (C) • Use elevated porous fills (rock-fills) or multiple pipes to maintain natural groundwater and near-surface flow • patterns (C)
14	Drainage	• Conduct of hydrological investigations during project preparation • Provision of longitudinal and cross drainage as per requirements • Proper location of drainage outfall • Install drainage structures during rather than after construction. Most erosion associated with roads occurs in the first year after construction. Delaying installation of drainage features greatly increases the extent of erosion and damage during the first year (P&D) (C) • Clearly define the type of road surface shape and drainage method—in-sloped, out-sloped, or crown roadway— to be used for each section of roadway. Use outside ditches control surface water when necessary, but keep in mind that they concentrate water flow and require the road to be at least a meter wider. Install structures, such as berms or ditches, to divert water off the road before it directly reaches live stream channels (P&D) (C) • Install diversion structures, such as cross drains, drivable, rolling dips, or water bars, to move water off the road frequently and minimize concentration of water (P&D) (C) • Install drainage crossings to pass water from uphill to downhill. If using culvert pipes, at least roughly design them using the Rational Formula or back-calculate using Manning's Formula and high-water mark before or during construction to determine the anticipated flow, and select the correct size of pipe. Where flows are difficult to determine, use structures—such as fords, rolling dips, and overflow dips—that can accommodate any flow volume and are not susceptible to plugging (P&D) (C) • Stabilize outlet ditches (inside and outside) with small stone riprap or vegetative barriers placed on contour to dissipate energy and to prevent the creation or enlargement of gullies (P&D) (C) • Extend runout drains far enough to allow water to dissipate evenly into the ground (P&D) (C) • Visually spot check for drainage problems, such as accumulation of water on road surfaces, immediately after first heavy rains and at the end of the rainy season. Institute appropriate corrective measures (C)
15	Construction Plants &	• Maintenance of machinery and equipment to avoid pollution

	Equipment Management	• Minimize use of heavy machinery (P&D) (C) • Set protocols for vehicle maintenance, such as requiring that repairs and fueling occur elsewhere or over impervious surface such as plastic sheeting. Prevent dumping of hazardous materials, and capture leaks or spills with drop cloths or wood shavings. Burn waste oil that is not reusable or readily recyclable and does not contain heavy metals and are flammable. Prohibit use of waste oil as cooking fuel (P&D) (C) • Investigate and use less toxic alternative products (P&D) (C) • Prevent fuel tank leaks by a) monitoring and cross-checking fuel level deliveries and use, b) checking pipes and joints for leaks c) tightening generator fuel lines, d) preventing over-filling of main storage and vehicle tanks
16	Spoil disposal	• Minimize spoil by balancing cut and fill wherever possible • Safe tipping areas identified and enforced. • Spoil traps constructed. • Land owner compensated.
17	Hazardous materials	• Checks to ensure that storage is good and that there are no losses or leaks. • Checks to ensure that protective clothing and safety measures are used.
18	Tree Plantation	• Avoidance of impact on trees • For every single felled tree , two trees of local species will be planted by the project authorities • Encourage growing of trees on roadside
19	Natural Habitats	• Identification of natural habitats • Management measures for roads passing through natural habitats (EMP) • Structure of management plan
20	Dust	• Speed controlled using speed bumps. If water is available, the road surface can be sprayed on a frequent schedule. • Permanent speed bumps installed in villages and bazaars to reduce traffic speeds in inhabited areas. • • Bitumen surface constructed in bazaars, with speed controls. • Dense vegetation planted on roadside.
21	Noise	• Work schedule to minimize disturbance. • Alight public when loud noise will be generated
22	Worker's Health & Safety	• Provision of Personal • Protective Equipment to workers • Provision of basic necessities to workers
23	Public Health and Safety at Construction Site	• Public safety while travel along construction sites • Public safety during operation of the road • Traffic safety measures installed, such as warning signs, delineators and barriers. • Awareness of road safety raised among affected communities.

		• Road safety audits carried out and recommendations implemented. • Contractor develop an acceptable construction site Environment, Health and Safety Plan. • Reducing construction site risks to the workers and the public – safety rules for work operations shall be instituted by the Contractor, including, but not limited to; location of plant equipment away from sensitive locations (hospitals, schools, etc.), equipment operation procedures, safety barriers, warning signs, first aid and medical kits and procedures, and safety training for the workers. • Reducing health risks from compound living conditions and interaction with the community – employee rules and information campaigns shall be instituted by the Contractor on health practices and communicable diseases. The Contractor shall also ensure that prevention and treatment facilities are made available to his employees. • Covid 19HIV/AIDS awareness and treatment – in collaboration with the National HIV/AIDS Coordination Agency
24	Cultural Properties/ Graveyards and Sacred Areas	• Avoidance of impacts due to project • Protection of boundaries from impacts due to construction • Relocation in case impacts are unavoidable • Avoid disturbance through: (i) adjustments to alignments; and/or (ii) drainage and other design measures to avoid excessive runoff or erosion onto the graveyard or burial
25	Land use and resettlement issues	• Manage in line with the RAP prepared for the project
26	Local people excluded from project activities	• Designs incorporate methods within the skills of local people. • Contractors encouraged using local labor wherever possible.
27	Promises made to local people during feasibility and planning phases	• Checks to ensure that the promises are fulfilled; if they prove to be not possible, reasonable alternatives must be negotiated
28	Road Closure and Detours	• Contractor install and maintain warning signs • Avoid collision with construction vehicles between work sites and gravel pits. • Speed restrictions. • Road closures, where unavoidable, plan in close collaboration with the Community.
30	Chance Finds of Cultural Resources	• Specify procedures for archaeological "chance finds" during the course of construction activities in contract document
Operation and Maintenance		
1	Road maintenance	• Monitor and maintain drainage structures and ditches including culverts. Clean out culverts and side channels and runouts when they begin to fill with sediment and lose their effectiveness (O&M)

		• Fill mud holes and potholes with good quality gravel; remove downed trees and limbs obscuring roadways (O&M) • Use water from settling basins and retention ponds for road maintenance (O&M • Ensure a combined approach, with a private contractor performing mechanized maintenance and subcontracting labor-intensive maintenance to the communities. • Ensure Maintenance contracts that is performance-based with penalties in case of non-compliance with the agreed standards (e.g. flouting safety rules, number of potholes per km of roads). • Conduct gender study to assess the challenges and opportunities for the mainstreaming of gender concerns in the use of, access to and maintenance of roads
Decommissioning		
1	Decommissioning	• Break up old road surface and soil. Remove and dispose of surfacing material if necessary and loosen soil of previous track to accelerate regeneration of vegetation • Reshape eroded or culled surfaces with out-sloping, or add cross drains or water bars so water will no longer follow the course of the roadway Re-vegetate as needed. Narrow tracks will usually re-vegetate naturally with no noticeable scars or impact on the environment, but wider roads may require active planting and reseeding (O&M) • Block access with rocks, branches, roadblocks, and signs

ABSIIDP/SPIU will be responsible for the implementation

ES 7.0 Environmental and Social Management Plan (ESMP)

In order to ensure that mitigation measures and environmental and social management objectives are integrated into the project planning and design based on identified impacts, this Chapter on the Environmental and Social Management Plan (ESMP) has been developed. It provides specific description of the impacts identified, mitigation measures as well as the institutional arrangements, i.e. who is responsible for carrying out the mitigating and monitoring measures (for operation, supervision, enforcement, monitoring of implementation, remedial action, financing, reporting and staff training).

The ESMP has been developed to meet international and national standards on E&S performance. It details the mitigation measures the SPIU and their contractors will be committed to implement throughout project implementation including timing for actions, monitoring and responsibilities. The ESMP is implemented throughout the project life-cycle.

This ESMP has been developed to identify the environmental and social management and mitigation actions required to implement the road project in accordance with the AfDB/World Bank's Performance Standards and the requirements of applicable Nigerian legislation and environmental policies. It summarizes the potential impacts associated with the proposed project and sets out the management measures required at all phases of project development. The ESMP is to be utilized by the State Project Implementation Unit (SPIU) and the contractors commissioned by the Client for the project and will form the basis of the site-specific management plan that will be prepared by the contractors as part of their construction methodology.

The approach to carry out the Environmental and Social Management Plan shall include assessing adherence with national regulations and management of implementation site. In terms of communications, the team responsible for ESMP monitoring (team in SPIU) will cause to be forwarded to FMEnv and the Bank's Environmental experts monthly and quarterly regular Reports depending on which aspect being monitored and level of sensitive demanded.

The major indicators to be measured will include:

- The state of biological conditions
- The state of physical environment
- The state of key social concerns eg as it relates to project beneficiaries
- All operational and environmental problems encountered
- Suggested options to address the problems
- The status of social performance line with measures adopted

The method of implementation of the ESMP monitoring programme shall be carried at two layers based on the intensity and specificity expected.
Layer 1: Monitoring (Control) mission from the AfDB which will be looking at the validity of claims and conclusions and effectiveness of mitigation measures among other things. This layer of monitoring will be done along with FME in Abuja with the support of NESREA.
Layer 2: Monitoring of site activities which will be done regularly by the Monitoring Team (SPIU) guided by the stipulations of the national and district level environmental standards as contained the relevant laws of Nigeria.

It is suggested that the Layer 1 monitoring (Control) mission be undertaken every six months. In their missions they will target measuring project performance using the above environmental monitoring indicators which will reflect the Nigeria's goals of Environmental Monitoring and that of AfDB.
The Layer 1 mission will carry out the following roles: (i) to review the contractor's detailed worksite ESMP and its specific procedures; (ii) to appraise the adverse effects determined; (iii) monitoring if the proposed measures to mitigate the negative impacts were actually carried out in the implementation phase (iv) to determine how effective the mitigation measures are in addressing the adverse effect; (iv) to ascertain the extent of reach and sustainability of the achievements recorded from the mitigation measures applied; (v); monitoring the recommended measures; (vii) proposing remedies in the event of occurrence of major impacts; and (viii) conducting environmental compliance and assessment at the end of the project.

ES 7.1 ESMP implementation
The ESMP is instituted for the proposed project to ensure that impact mitigation; control and recovery measures are well implemented. The ESMP is designed to commit SPIU to operate with little or no long-term negative impacts on the project. This ESMP shall be updated and revised on a regular basis throughout the project's life cycle. It should be noted that for effectiveness, specific plans have been designed to ensure mitigation measures prescribed and others that might not have been foreseen now are implemented as summarised in Table 5.

Since contractors will implement the project on behalf of the SPIU, the Contractor (s) will be required to develop a Construction ESMP (CESMP) to ensure compliance with the requirement of the ESMP, the country system and AfDB ISS before construction works begin. The range of contractors' responsibilities in this regard include managing their direct, indirect and cumulative impacts of their activities from construction as well as impacts of their workforce and compliance with health, safety and labour requirements. In addition they will be expected to comply with specific Project HSE policies, regulations and standards through a self-verification programme by: undertaking Pre-construction Surveys and HSE assessments to identify and manage HSE risks and impacts; performing Contractor HSE inspections and audits; performing Contractor HSE Monitoring and reporting; and putting to put in place corrective and remedial measures for non-conformance and have an incident notification and Emergency and Risk Response Management Plan.

For the ESMP to be implemented as envisaged by the contractors, relevant aspects shall be integrated into the project design and tender documents. Using this approach, the mitigation measures will automatically become part of the project construction and operation phase. By including in the contract or in specific items in the Bill of Quantities, the cost of implementation should be covered under the normal engineering supervision provisions of the contract.
Examples of clauses that should be incorporated into contracts with construction companies include:
1. Construction contracts should:

- Select or develop guidelines and procedures to be applied to each facet of road construction or rehabilitation—site clearing, bed and surface construction, drainage, fuel and material usage, quarry site management, construction camp and work site operating procedures, including worker safety.

2. Maintenance agreements should ensure:

- Finalization of maintenance agreements with local communities before beginning construction.

Maintenance contracts that are performance-based with penalties in case of non-compliance with the agreed standards (e.g., flouting safety rules, number of potholes per km of roads). All parties must clearly understand and be committed to terms of the agreement, such as who will do what work, when, how frequently, for what compensation, and within what limits

ES 7.2 Site Inspection and Maintenance

To continually achieve the benefits of the gully treatments, site inspection and monitoring programme shall be ensured with the following objectives:

- The gully erosion treatment and control plan (getcp) are appropriate for the site and is implemented effectively;
- The gully erosion treatments are appropriately maintained; and
- Identify any works at the site that may be contributing to environmental harm.

Once the gully treatment/remediation work has been completed, a monthly walk through or site inspection should be conducted to ascertain the following:

- All measures have been implemented in the field and erosion controlled adequately;
- Sediment and other pollutants such as plastics are not being transported off-site or into critical areas on-site;
- Any improper installation or any repairs necessary to complete the job is noted at this time and work completed;
- Critical points such as disturbed areas of the site are identified and repairs effected;
- Control measures are in good operating condition until the area they protect has been completely stabilized and the construction activity is completed;
- Crews are to immediately repair the erosion and sediment control measures;
- Appropriate materials and equipment should be kept on hand to enable a quick and rapid response; and
- Exposed areas must be stabilized and inspected before a site is left in an inactive state.

Maintenance Problems

The most frequent cause of failure is lack of preventative practices and poor maintenance of treatments administered. Erosion prevention and sediment control must be inspected regularly and operated and maintained using specific procedures to perform properly. Installation mistakes can also impair the performance of the measures. Inspectors should pay particular attention to maintenance problems and installation mistakes during inspections.

ES 7.3 Vegetation Establishment Monitoring

Monitoring for vegetation establishment should be conducted in accordance with local requirements. Vegetation should be monitored monthly to evaluate the following type of vegetation that is growing (as compared to the type of vegetation that was planted), the density of vegetation that is growing, including the percent of ground that is covered.

Based on regular evaluations of established vegetation, recommendations should be made as to whether the vegetation is growing well, or whether additional measures should be taken, such as over seeding, fertilizing, irrigation, etc. Vegetation monitoring should continue until the vegetation reaches maturity and is providing the anticipated erosion control effectiveness.

ES 7.4 Inspections Responsibility and Frequency

Inspections oversight rest with the SPIU supported by the Ministry of Works with local knowledge, policies and procedures.

All measures must be inspected by the SPIU/contractor in accordance with any schedule required by the SPIU and Ministry of Works and before any predicted, significant rainfall.

During gully treatment, contractor's inspector must have the ability to call out worker after rainfall events. The inspector should record any damages or deficiencies in the control measures on an inspection report form. The damage or deficiencies should be corrected as soon as practicable after the inspection but in no case later than 7 days after the inspection. Any changes that may be required to correct deficiencies should also be made as soon as practicable after the inspection but in no case later than 7 days after the inspection.

Inspections of erosion control works should be conducted by a person clearly identified as responsible for this role and may be the project manager, site supervisor or principal contractor representative etc. All inspection details should be formally documented, filed and made available for inspection as required by PMU and relevant authorities.

It is recommended that during the gully erosion treatment inspection should be carried out in the following manner:

- At least daily during rainfall events;
- At least weekly, even if the works are not being conducted;
- Within 24 hours of a forecasted rainfall or storm event; and
- Once every six months after implementation.

The project specific E&S management and monitoring plan has been designed as indicated in Table 6.6. Overall monitoring for the ESMP shall be conducted by trained individuals who can carry out the monitoring and record-keeping effectively using properly calibrated and maintained equipment on behalf of the SPIU and/or contractor. External monitoring will be carried out by the Federal and State Ministry of Environment.

ES 7.5 Environmental Monitoring and Auditing Plan

Environmental and Social Monitoring Plan provides specific means to ensure that the activities of the project during construction and operation comply with the applicable environmental and social standards and practices. This calls for a systematic observation and measurement of selected environmental variables.

In order to effectively and efficiently implement this EMP, a system for monitoring and auditing has been built into the overall management plan. Monitoring and auditing assist in the examination of management, employee knowledge, programme responsibilities, records and effectiveness.

Specifically, this shall help to:

- Improve environmental and social management practices;
- Check the efficiency and quality of the environmental management processes;
- Establish the scientific reliability and credibility of the EMP for the project and
- Provide the opportunity to report the results on safeguards and impacts and proposed mitigation measures implementation

The Environmental and social monitoring activities shall be based on direct or indirect indicators of emissions, and resource use applicable to the road project. Monitoring frequency shall be sufficient to provide representative data for the parameter being monitored. Monitoring shall be conducted by trained individuals who can carry out the monitoring and record-keeping effectively using properly calibrated and 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. As part of monitoring programme, visual inspections and quality monitoring for light attenuation shall be conducted daily, for instance, during construction.
Inspections oversight should rest with the PMU supported by the Ministry of Works with local knowledge, policies and procedures.

However, the Safeguard Officer of the PMU shall ensure routine inspections are carried out especially during the rehabilitation control and may be the contractor's project manager, site supervisor or principal contractor representative etc. All inspection details should be formally documented, filed and made available for inspection as required by PMU and relevant authorities.

Table ES4: Environmental and Social Monitoring Plan

S/No	Activity/ Issue	Mitigation Measure Implementation	Monitoring Activity	Frequency	Monitoring Responsibility	Budget *
Environmental and Social Monitoring Plan Construction Phase (Pre- Construction)						
1	Erection of contractor construction camp	• Contractor to identify suitable camp site in consultation with SPIU/ relevant MDAs • Contractor obtain approval for camp site from members of the public/Local government	• Retain a record of discussions • Retain a record of approval	• After each discussion • Once	**FMEnv SMEnv SPIU/ Contractor**	**0.1m**
2	Materials testing	• SPIU to include requirement for independent materials testing in contracting documents • SPIU to ensure that Contractor complies with requirements	• Retain copy of contracting documents with the requirement • Check record of materials testing	• Once • When materials are delivered	**FMEnv SMEnv SPIU Site Engineers**	
3	Operation of Contractor construction camp	• Inclusion of requirement for regular watering of camp site and construction sites in contracting documents • Contractor to implement approved Contractor work plan • submit monthly reports on Contractor implementation of approved work plan and mitigation measures • Establish and maintain public complaints register • Include the following requirements for worker facilities in contracting documents - Covered rubbish bins for scraps - Adequately stocked first aid medical kits - Trained person to provide first aid assistance if required • Include requirement in contracting documents for Contractor to provide facilities for disposal of solid and liquid wastes • Contractor to undertake regular disposal of solid and liquid wastes undertake frequent regular monitoring to ensure compliance with requirements	• Retain copy of contracting documents with the requirement • Maintain record of implementation activities • Daily monitoring • Ensure all complaints are recorded in the register • Maintain a record of working hours • Maintain a record of discussions with local members of the public in relation to requests for extension of working hours • Maintain a record of any agreements for extension of working hour • Retain copies of contracting documents	• Once • Daily during dry weather condition • Daily • Monthly • As required • Once • As required • As required • Daily and weekly	**FMEnv SMEnv SPIU** **Contractor** **SPIU Site Supervisor**	

S/No	Activity/ Issue	Mitigation Measure Implementation	Monitoring Activity	Frequency	Monitoring Responsibility	Budget *
			with requirement • Retain copies of waste disposal dockets • Maintain a photographic record of disposal activities • Maintain documentary record of monitoring activities			
4	Heavy machinery operation	• Ensure contracting documents include specifications relating to type, weight and operation of heavy machinery	• Retain copy of contracting documents on project files • Include reference in acceptance advice • Maintain record of inspections and public complaints	• Once • Once • Weekly	**SPIU/Contractor**	
5	Excavation generally	• Include requirement in contracting document for Contractor to remove and dispose of surplus material at approved sites • Include the following requirements for Contractors in the contracting documents: - Provide temporary services acceptable standard where required - Undertake permanent repair works for disrupted services within specified times - Provide warning and safety signs in local language at excavation sites - Provide PPE for site workers	• Maintain photographic and documentary record of Contractor material disposal activities • Retain copy of approved list on project files • Retain copy of contracting documents on project files • Retain copy of contracting documents on project files • Maintain duplicate copies record of Contractor performance • Maintain photographic and documentary record of Contractor performance	• Daily • Once	**FMEnv** **SMEnv** **SPIU** **SPIU/Contractor**	

S/No	Activity/ Issue	Mitigation Measure Implementation	Monitoring Activity	Frequency	Monitoring Responsibility	Budget *
6		• Ensure that requirements relating to spill management and debris are included in contracting documents • Ensure that Contractor addresses spill management and debris removal as criteria for acceptable Contractor work plan • Ensure that Contractor to promptly attend to any spills	• Retain copy of contracting documents on project files • Maintain photographic and documentary record of Contractor performance	• Once • Daily	**FMEnv SMEnv SPIU/Contractor**	
7	Social issues	• Continual undertake public consultation • Conclude all resettlement issues that may arise • SPIU to include requirement for continual stakeholder consultations and public enlightenment in contracting documents	• Retain copies of minutes of discussions	• After each discussion	**FMEnv SMEnv SPIU/Contractor**	
8	Health and Safety Issues	a) SPIU to include requirement for contract document need for contractor to mount in advance of the construction work awareness campaign relevant to health and safety and adequate project signs to warn pedestrians and motorists of construction activities, diversions, etc. provided at appropriate points.	• Retain copy of contracting documents on project files • Maintain photographic and documentary record of Contractor performance	• Once	**FMEnv SMEnv SPIU/Contractor**	
9	Traffic Safety and Traffic Management	a) SPIU to include requirement for contract document need for contractor b) to ensure public safety, and meet traffic safety requirements for the operation of work to avoid accidents. c) be responsible for the safety along the related to the site, d) provide and maintain necessary barricades, suitable and sufficient flashlights, flagmen, danger signals, and signs. e) Submit weekly activities schedule and the locations of his work along the	• Retain copy of contracting documents on project files • Maintain photographic and documentary record of Contractor performance • Records of accident plan •	• Once	**FMEnv SMEnv SPIU/Contractor**	

*<u>*No budget as these are part of the overall contractual arrangement between SPIU and Contractors</u>*

Table b: Summary of Environmental and Social Monitoring Plan during Construction and Operation

Component	Parameters	Method & Where	Frequency	Responsible*	Cost (N)
Material sites	No of people living at/near the sites have been information No of sites excavated	Evidence of meeting/records filed visual assessment of site During and a	Before excavation during construction and after abandonment		
Air quality	Dust	Visual Observation at location of activities	Every day during construction		
	PM, SO_2, CO, NO_X , CO_2	Ambient air monitoring using standard method of sampling and analysis at established sampled locations for the baseline data	Monthly during construction and any other item incident relating to pollution are noticed (where visual observations indicate unpleasant scenario)		
Noise	Level (dB-A)	Disturbance/pinch	Everyday during construction		
	Level	Sensor measurement at established sampled locations for the baseline data	annually		
Erosion	Top soil movement/ground cutting Control and retention of disturbed soil at earthwork	Visual assessment	Routinely during construction and when erosive forces are observed		
Water Quality	Turbidity	Standard method of sampling and analyses at established sampled locations for the baseline data	Where it is established that construction caused impact		
			Annually		
Soil Quality	pH, Conductivity, Heavy Metals, TOC, Total Hydrocarbons, Cations	Sampling and analyses at designated locations	• monthly during construction; • Quarterly during the first 3 years of operation; •Biannually Subsequently		
Vegetal Cover	Lawn/vegetation growing well & maintained	Visual assessment, No of tree removed/planted	Routinely and growth		
General Waste Management	Reduction, Segregation protocols, proper handling, storage, treatment, and transportation	Visual Assessment, General Aesthetics, hazard free environment along the	Routinely, Daily		

Component	Parameters	Method & Where	Frequency	Responsible*	Cost (N)
	Contractor to develop waste management plans and provide appropriate facilities during operation				
Training	Responsible HSE behaviour and culture	General HSE Awareness and specific training for workers and investors	Routinely and as need arises		
Socio-economics including displacement	Project benefit opinions, Lifestyle, no of livelihoods opportunities created, income, gender characteristics, no of women participating in watershed management programs, etc	Questionnaires, direct observations and interviews.	Once in two years		
Land use changes	Emerging land use trends along the project during construction and operation	Absence of encroachment No of fines, changing social and economic development	Six monthly		
Climate Change	GHG Emission	Inventory	Once in three years		
Circular Economy and Waste Management	Amount of waste avoided/recovered and reused No of eco-chains or by-product exchanges created to encourage utilization of by-products among industries	Across the facility zones	During construction and operational life monitored quarterly during construction and annually during operation		
Health & Safety	Incidents	Hazard assessment	Before Start of work and routinely		
Environmental & Social Audit	Assessment of Mitigation, monitoring & Other management measures	Presence of Audit Report	Once in two years		
Total					4,500,000.00

**SPIU has the primary responsibility* *^ for a typical road*

ES 7.5 Implementation Schedule

- The provisional time schedule for preparing contract documents, awarding of tenders and start of construction has to be taken into consideration in the implementation schedule for the ESMP.
- The contractor is expected to prepare and submit a plan of action covering the means by which the construction related environmental and social mitigation measures recommended in the ESMP will be implemented once a notice to proceed is received.
  The contractor shall strictly follow the Action plan, mitigation action required at the pre-construction phase which would have been implemented

The key elements of the implementation schedule plans which are shown in Table ES4 are as listed below:

- Preparation and submission of the Action plan;
- Nominating Environmental Management Representative;
- Finalizing site and layout plans for construction camps/temporary yards incorporating environmental requirements;
- Preparation and submission of construction schedule;
- Implementation of mitigation and enhancement measures;
- Environmental auditing (Ministry of Works and Transport , Consultant /FMEnv);
- Monitoring and reporting on EMP implementation (Ministry of Works and Transport, FMEnv & consultant).

Table ES4: ESMP Implementation Schedule

S/N	Activity Description	Responsible	Pre-Construction	Construction	Post Construction (Operation)
1.	Disclosure of Environmental Assessment Report	ABSIID			
2.	Allocating Budget for EMP	ABSIID			
3.	Appointing Support Staff for EMP	ABSIID			
4.	Review and Approval of Contractor's EMP and Safety Plan	ABSIID			
5.	Finalizing site and layout plan of construction plan	ABSIID			
6.	Implementation of Mitigation Measures	ABSIID, Environmental Consultant &FMEnv			

7.	Supervising EMP Implementation	ABSIID & Environmental consultant										
8.	Environmental Auditing	ABSIID, Environmental Consultant &FMEnv										
9.	Monitoring & Reporting on EMP Implementation	ABSIID, Environmental Consultant &FMEnv										
10.	Environmental Training	ABSIID, & Environmental Consultant										

ES 7.6 Reporting Procedures

The reporting procedures presented in Table ES5 have been developed in order to ensure that the SPIU is able to receive feedback from the implementation of the ESMP on an ongoing basis and to take rapid corrective actions if there are issues of non-conformance.

Table ES5: Reporting Procedures

Phase	Responsibility	Deliverables	Frequency	Accountability
Preconstruction	Safeguard Unit	Report of monitoring activities including any specific events	Once	SPIU, also SME & FMEnv on request
Construction	Safeguard Unit	Two (2) monitoring Reports. First to be prepared mid-way into the civil works and the other upon completion of all construction activities.	Twice	SPIU, also SME & FMEnv on request
	Safeguard Unit	Additional Reports according to specific conditions e.g. Accidents, serious environmental/social impacts	Once	SPIU, also SME & FMEnv on request
Completion of Construction and demobilization of contractor from site	Safeguard Unit	Final Monitoring Report including all monitoring activities Throughout project implementation	Once	SPIU. Report to be archived and made Lender, SME & FMEnv on request

ES 7.7 Record Keeping and Control

It is mandatory that the contractor keeps records of ongoing mitigation activities. These records may include site monitoring plan, HSE Policy, Site Specific HSE Plan, Waste Management Plan, Traffic Control Plan, Emergency response and preparedness procedures, site instructions, training records, complaints records, incident report, Inspection, maintenance and equipment calibration records. These documents are to be made available to the Safeguard Unit as the need arises.

In the same vein, the Safeguard Unit is to keep records to provide evidence of monitoring activities and effectiveness of the monitoring plan. The site monitoring Plan identified problems/corrective actions and monitoring Reports highlighted in subsection 7.6.1 are to be kept by the Safeguard unit and be made available to relevant regulators upon request. In addition, all significant communications with FMEnv, Abia SME and other relevant authorities should be documented and kept. These documents are required to track performance in order to achieve and demonstrate compliance with the monitoring plan and applicable regulatory requirements.

ES 7.8 Cost Estimates for ESMP Implementation

The total cost of mitigation by the Contractor will be included in the contract as part of the implementation cost by the Contractor. The breakdown of cost is presented in Table ES6.

Table ES6: Indicative Budget for Implementation of Measures

Item	Responsibility	Cost Estimate in Nigerian Naira (N)	Cost Estimate in US Dollars (US$) *
Mitigation	Contractor	11,900,000	
	SPIU	8,750,000	
Monitoring	SPIU, MDAs	4,250,000	
Capacity Building	SPIU,	2,800,000	
Cost for GRM	SPIU	2,850,000	
Sub- Total		27,750,000	
	10% of Sub- Total	2,775,000	
Total		**30,525,000**	**61,050.00**

*1 US$ =N500. Cost estimates are for ESMP implementation for each road except for Capacity Building cost which covers ESMP implementation for the entire project.

ES 8 CONCLUSION

The Environmental and Social Impact Assessment of the road project revealed that the project will have significant economic benefits for the local, state and national economy. There will be both positive and negative impacts due to the construction activities and normal operations of the road in case of all suggested alignments. The proposed road rehabilitation project will have significantly beneficial impacts on the rural adjoining communities and respective LGAs and the State at large as it will undoubtedly improve accessibility to communities, markets, farms and agro-processing centres in the project areas. Other benefits include improvement in rural road network, accessibility to rural communities, markets, farms and agro-processing centers in the State, increase in agricultural output as the road will ultimately facilitate easy access for farm inputs, extension services, primary and secondary (urban) markets. Improvement in agricultural productivity will translate to economic empowerment, poverty reduction and sociocultural wellbeing of the benefiting communities. Another contribution of the proposed road rehabilitation project to the overall socio-economic wellbeing of the benefiting region is the provision of employment opportunities, income generating sources, skills acquisition, settlement development and other multiplier effects.

The road transport intervention activities on 31 Rural Roads in Aba, Abia State is environmentally and socially feasible for implementation provided the recommended mitigation and monitoring measures are implemented, and the proposed implementation arrangements are upheld by all with relevant roles and responsibilities. The ESIA of the proposed project shows that the project can be achieved and operated with minimal negative impacts on the surrounding environment and humans by strict adherence and implementation of the recommended mitigation measures. The ESIA has also developed an Environmental and Social Management Plan (ESMP), which incorporates various mitigation measures that will eliminate or reduce the potential impacts of the proposed project on the environment. Mitigation measures were subsequently developed for adverse impacts based on industry best practices, available technology and HSE considerations.

The ESMP shall be implemented and maintained throughout the duration of the project with the adverse impacts mitigated to as low as reasonably practicable levels. Impact mitigation monitoring shall also be carried out with the involvement of regulators to check compliance with the ESMP.

The benefits of improved access roads in rural areas far outweigh the short-term and often reversible impacts. Thus, the proposed project can be executed within the ambit of sustainable development and this will therefore form the basis for the actual project implementation.

CHAPTER ONE
INTRODUCTION

1.1 Project Background

Abia State Infrastructure Development Project (ABSIIDP) seeks a loan from the African Development Bank (AfDB) towards funding the proposed integrated infrastructure development in six investment subprojects, namely:

- **i. 31 priority roads in Aba, covering 199.69 km;**
- ii. 19 priority roads in Umuahia, covering 92 km;
- iii. One erosion control site in Umuahia;
- iv. One erosion control site in Aba;
- v. One waste transfer station in Umuahia; and
- vi. One waste management facility in Aba.

This Environmental and Social Impact Assessment (ESIA) report covers the **31 priority roads in Aba, with a combined distance of 199.69 km in length** proposed for the road rehabilitation, collectively described herein as “Aba Roads,” cutting across 10 Local Government Areas (LGAs) in Abia State. The dilapidated nature of the designated periurban, urban and rural roads has made commuting in the urban and rural areas, the evacuation of farm produce from the hinterland difficult; impede access to solid waste collection and transport. The erosion sites are encroaching fast on the adjoining roads.

1.2 Project Location

The identified (31) road project is located within Aba City, covering Aba South, Aba North, Osisioma, Ugwunagbo, Obingwa, Isialangwa North, Ukwa East, Umuahia South, Isialangwa South, and Ikwuano LGAs, in Abia State, South-East Nigeria (Figure 1.1, 1.2).

Abia state has Aba as its commercial capital and the proposed 31 roads are located in and around Aba, as listed in Table 1.1. Coordinates of each road are in Chapter 3.

Table 1.1: Aba priority roads

S/N	Aba City Roads	Minimum Design Width (m)	Actual Road Span (km)
1.	Asa Road – Port Harcourt Road	25	7.68
2.	Faulks Road	25	4.59
3.	Ohanku Road – Owerre Aba	25	6.61
4.	Omuma Road	14	2.14
5.	Ikot Ekpene Road	25	6.82
6.	Mbubo Umuogele Amachi Mgbokonta	14	12.72
7.	Umuala Mbawsi Eziala Osusu Okpuala Ngwa	14	12.64
8.	Omoba – Umuaja Amaede Ndiolumbe	14	8.17
9.	Mbawsi Layout – Ururuka	14	1.88
10.	Glass Factory Road	14	3.59
11.	Umuomiaukwu Agburike Umuomainta	14	4.83
12.	Uratta – Ugwuati	14	9.59
13.	Crystal Park Junction - Obohia Road	14	20.27

S/N	Aba City Roads	Minimum Design Width (m)	Actual Road Span (km)
14.	Immaculate Avenue – ITF Rod Bridge	14	1.52
15.	Umuaro Nenu Road	14	4.76
16.	Eziama Ntigha – Nsirimo – Ubakala	14	9.06
17.	Mgboko –Omoba Umuezeukwu Mbawsi Road	14	8.06
18.	Ibeme Ndiakata- Nlagu Onicha Ngwa	14	2.81
19.	Pepple Road - Akpu Road	14	1.2
20.	Umuokpo- Owo Ahiafor Link Road	14	4.3
21.	Owerre Aba – Osusu Umuelendu – Osusuaku	14	4.01
22.	Umuojima Amapuife Eberi Omuma	14	9.98
23.	Umuimo Carol Pee. Ministry of Agric. Shopping Mall	14	1.48
24.	Ugwuati – Umuiku	14	4.01
25.	Isicourt- Ururuka Umuosu Umuala Umunkpeyi	14	20.6
26.	Ama Emereole – Ekeonyeugba –Umokoromiri-Eketa	14	7.25
27.	Ajiwe – Brass	14	0.64
28.	Ahunanya – Immaculate	14	0.87
29.	Oron Road – Elizabbeth Avenue – Sports Club	14	0.7
30	Umuala - Umuakwu - Ohuhu Nsulu – Oloko Ikwuano	14	13.56
31	Itungwa – Agburukwe road	14	3.35
	Total length of priority roads in Aba		**199.69**

Source: ABSIIDP, 2022

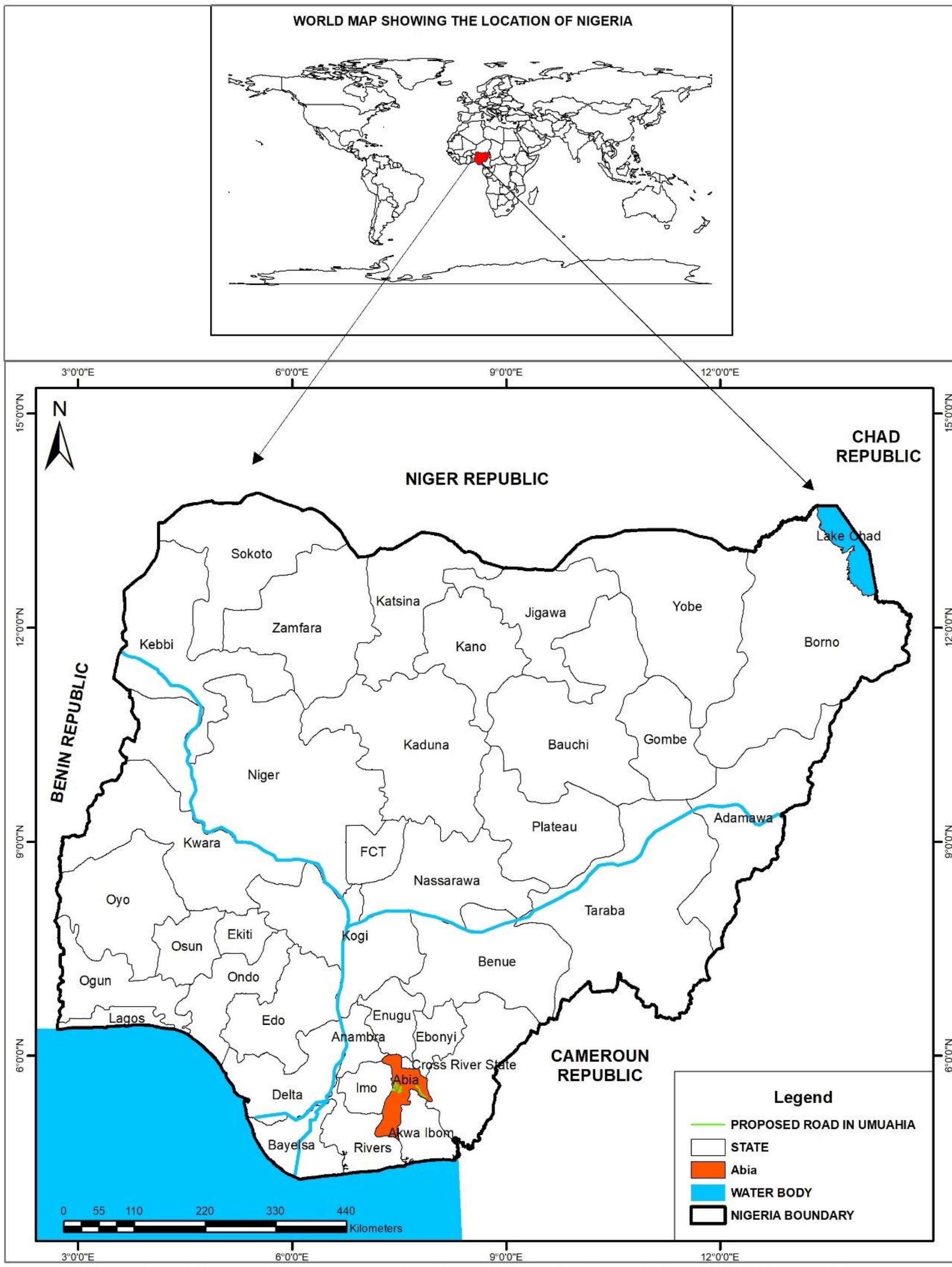
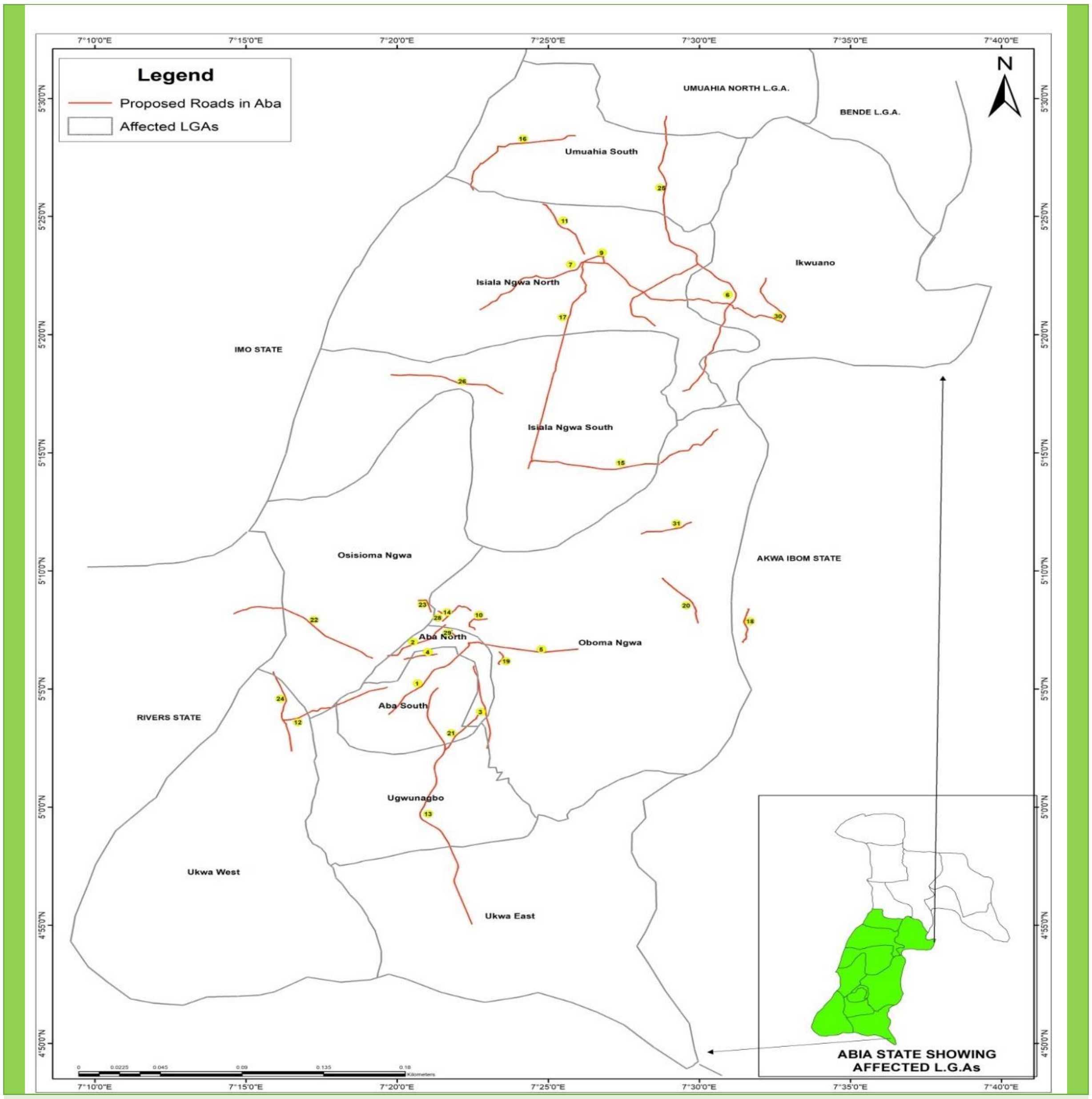


Figure 1.1: Map of Nigeria showing Abia State and the road locations



Key: *1..Asa Road – Port Harcourt Road (7.68km), 2. Faulks Road (4.59km), 3. Ohanku Road- Owerre Aba(6.61km), 4. Omuma Road (2.14km), 5. Ikot Epene Road (6.82km), 6. Moubo Umuogele Amachi Mgbokonta (12.72km), 7. Umuala Mbawsi Eziala Osusu Okpuala Ngwa (12.64km), 8. Omoba- Umuaja Ndiolumbe (8.17km), 9. Mbawsi Layout- Ururuka (1.88km), 10. Class Factory Road (3.59km), 11. Umuomiaukwu Agburike Umuomaint (4.83km), 12. Uratta – Ugwuati (9.59km), 13. Crystal Park Junction – Obohia Road (20.27km), 14. Immaculate Avenue – ITF Road Bridge (1.52km), 15. Umuaro Nenu Road (4.76km), 16. Eziama Ntigha – Nsirima - Ubakala (9.06km), 17. Mgboko – Omoba Umuezeukwu Mbawsi Road (8.06km), 18. Ibeme Ndiakata – Nlagu Onicha Ngwe (2.81km), 19. Pepple Road – Akpu Road (1.2km), 20. Umuokpo – Owo Ahiafor Link Road (4.3km), 21. Owerre Aba – Osusu Umuelendu – Osusuaku (4.01km), 22. Umuojima Amapuife Eberi Omuma (9.98km), 23. Umuimo Carol Pee. Ministry of Agri. Shopping Mall (1.48km), 24. Ugwuati – Umuiku 94.01km), 25. Isicourt – Ururuka Umuosu Umuala Umunkpeyi (20.6km), 26. Ama Emereole - Ekeonyeugba – Umokoromiri- Eketa (7.25km), 27. Ajiwe – Brass (90.64km), 28. Ahunaya – Immaculate (0.87km), 29. Oron Road – Elizabeth Avenue – Sport Club(0.7km), 30. Umuala – Umuakwu – Ohuhu Nsulu – Oloko Ikwuano (13.56), 31. Itungwa – Agburukwe Road (3.35km).*

Figure 1.2: Map of Abia state showing the roads location

1.3 The Need for ESIA

The road upgrade activities on the selected roads will involve medium-sized civil engineering works entailing earthworks, provision of lateritic base, side drains, concrete culverts and river crossing infrastructure.

The proposed project activities are likely to induce environmental and social impacts that could be positive and/or negative. To harness the potential positive impacts and avoid or reduce the potential negative impacts, this Environmental and Social Impact Assessment (ESIA) (also known as Environmental Impact Assessment (EIA)) has been prepared.

The ESIA provided the framework for gathering and documenting information and views on the environmental and social consequences of the proposed activities so that the importance of the impacts and the scope of enhancing, modifying and mitigating them can be properly evaluated and beneficial decisions made. The ESIA i*nter alia*, contains an Environmental and Social Management Plan (ESMP) which consist of mitigation, monitoring, and institutional measures to be undertaken during implementation and maintenance of the intervention work to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels.

It is the requirement of the Environmental Impact Assessment (EIA) Act No 86 (1992) of Nigeria (Act CAP E12 LFN 2004) and Integrated Safeguards System of the AfDB to prepare before financing of the proposed Project. Thus with this ESIA obtaining the necessary approvals prior to the implementation of the project to ensures that the potential environmental and social impacts associated with the development and implementation of the proposed project are identified, assessed and managed properly with a view to ensuring the sustainability is possible.

Meanwhile it should be noted that the proposed road networks for the rehabilitation/upgrading traverse a wide geographical area; and will not include land-take. Although no anticipated physical displacement due to the Project activities, economic displacement could result. As a result, a separate Resettlement Action Plan (RAP) that has been prepared as a standalone, yet complimentary to this ESIA to manage involuntary resettlement or displacement that could result from the implementation of the intervention work on this. The *RAP will* ensure the distribution of benefits and opportunities in the communities and among project affected persons or groups through differentiated measures specially designed to cater to their needs and that of ensuring sustainability. It is advised for further information on the RAP cross-references could be made.

1.4 Objectives of the ESIA

The aim of the ESIA study is to proactively evaluate the associated, potential and cumulative environmental (including beneficial and adverse) impacts of the proposed project. This is to ensure that the planned activities exert minimal impacts on the environment and the stakeholder communities.

The specific objectives are outlined below:

- Establishment of the existing state of the physical and social environment.

- Identification of the project-sensitive components of the existing physical and social environment within the project area and area of influence.
- Appraisal of the project activities including construction (site preparation and installation), operations and decommissioning that may result in significant modification of any human or natural environmental resources.
- Determination of existing environmental risk of the site/effect of the proposed operational activities on the environment.
- Identification of any impacts that cannot be avoided, and outline ways of enhancing the beneficial ones.
- Recommendation of measures to avoid, ameliorate, or mitigate the identified impacts.
- Establishment of an appropriate Environmental Management Plan (the "EMP") or Environmental and Social Management Plan (the "ESMP") to verify and improve the accuracy of the EIA predictions, control levels for the life of the project; and
- Preparation of a detailed EIA report, presenting clear and concise and information on the environmental impact of the proposed project activities.

1.5 Scope of the EIA

EIAs include environmental, social, and consultation elements which are integrated into the planning and decision-making process to avoid, reduce, or mitigate adverse impacts and to maximize the benefits of a proposed Project. The emphasis of the EIA is to produce robust environmental and social management plans which are able to effectively integrate the recommended mitigation measures identified in the EIA, during the life of the Project and at the time of project decommissioning.

Thus, the study includes the identification of valued environmental components (the "VECs") which include elements of the physical, biological or socio-economic environment, including the air, water, soil, terrain, vegetation, wildlife, fish, birds and land use that may be affected by a proposed project.

To develop the baseline status of the Project Site for the proposed sanitary landfill, the study consisted of a series of specific and interrelated tasks, which include:

- Extensive literature review to acquire background information on the environmental characterization and components within the study area;
- Fieldwork and laboratory analysis for the season that shall be approved by the Regulators to cover a number of subjects such as: Noise, Air quality, Water resources, Soil, Climatic and Meteorological conditions of the proposed project area, Socio economic and health impact studies, Waste Management studies, visual impacts, traffic risks, archaeology, biodiversity, etc.
- Identification of Associated and Potential Impact.
- Development of Mitigation Measures.
- Development of Environmental and Social Management Plans
- Report preparation and submission.

1.6 The EIA Preparation Approaches

This ESIA was prepared in accordance with Federal Ministry of Environment ("FMEnv") standard procedures for environmental assessment including the applicable AfDB ISS. The main approach/activity for preparing the ESIA include the following:

a. Screening and Scoping Exercise

As part of the project preparation, a feasibility report had been prepared. This provided the opportunity to understand the need for an ESIA based on the screening that had been carried out and the scope for the ESIA in consultation with the relevant stakeholders.

Suffice it to say that the scoping process enabled a preliminary assessment of the potential environmental and social impacts to be considered which have been further elaborated in the various Chapters of this report.

b Literature Review

Review of the existing baseline information and literature material was undertaken and gave deeper understanding of the project and the environmental and social conditions that exist in the proposed Project environment.

Among the documents that were reviewed in order to familiarize and deeply understand the project included: Nigeria's National laws and/or regulations on environmental assessments, feasibility report**,** AfDB ISS, Project document, etc.

c. Stakeholder Consultation and Engagement

A wide range of stakeholders which included local communities, CBAs and statutory bodies as well as other relevant organizations with social, environmental or economic responsibilities and varying interest were engaged through different methods of communications in order to appreciate their concerns, appreciation and support for the proposed project.

The consultation process with different stakeholders' public meetings, leaders in the communities, Focus Group Discussions, etc, latched onto the ongoing process earlier established by the state government with the stakeholders. These were invited or reached through direct contacts, electronic or print media.

At the various gatherings, suffice it to say that overview of the proposed project and appreciation of EIA were presented. Furthermore, the challenges that could impede the implementation of the project and the support needed from all parties to ensure effective project and successful implementation were also told to the stakeholders.

d. Field Visits

Field visits were made to gather relevant information on the baseline environmental and social conditions, in relation to the project implementation. The field work informed the preparation of the existing conditions and any anticipated changes before the start of the project. Attention was paid to the physical environment; biological environment and socio-economic and cultural environment, such as population, land use, planned development activities, community structure, employment and Labour market, sources and distribution of income and cultural properties.

e. Identification of Potential Impacts and Mitigation Measures

The potential impacts were identified through generic and specific assessment of the proposed project site for anticipated changes that could result in the light of the socio-environmental conditions (project-environment interactions)

Mitigation measures are proffered to either eliminate or minimize adverse environmental and social impacts of specific actions, projects or programs while also enhancing positive effects. The approach to mitigation is primarily based on preventive principles of anticipated impacts based on well-known negative outcomes of project-environment interactions.

f. Environmental and Social Management Plan

In order to ensure that environmental and social management objectives and actions are integrated into the Project planning and design based on identified impacts, an Environmental and Social Management Plan was developed. It provides specific description of the impacts identified, mitigation measures as well as the institutional arrangements, i.e., who is responsible for carrying out the mitigating and monitoring measures (for operation, supervision, enforcement, monitoring of implementation, remedial action, reporting) and staff training, Stakeholder Management Plan and Grievance Redress Mechanism, Budget and Schedule of Work, etc.

1.7 Policy, Legal and Administrative Framework

1.7.1 Introduction

This section concerns the policy, legal and administrative framework within which the ESIA is carried out. It presents the relevant environmental and social policies of Nigeria and AfDB (the Bank). It presents, also, the national legal requirements and related constraints (e.g. practices that may discriminate or exclude any stakeholder group) relevant to the project. It provides information on relevant international environmental/social agreements to which the country is a signatory.

Upfront, it should be noted that the purpose of this is to demonstrate that Abia State Government gives high premium to the legal instruments and is committed to joining other stakeholders towards the path of a sustainable development.

In 1999, the FMEnv took over FEPAs function. Today, the FMEnv is the primary authority for regulation and enforcement of environmental laws, specifically the National Environmental Policy (NEP), as revised in 1999, which remains the overarching legislative framework for environmental management in Nigeria.

The National Policy on Environment, 1989 (revised 1999), provides for "*a viable national mechanism for cooperation, coordination and regular consultation, as well as harmonious management of the policy formulation and implementation process which requires the establishment of effective institutions and linkages within and among the various tiers of government – Federal, State and Local Government*".

The following provides a summary of the Nigeria governmental entities with responsibility for environmental and social aspects of the project. Other government and administrative entities have environmental and social requirement, but these generally follow from EIA process. An analysis of government stakeholder has been conducted as part of the EIA.
Primary authority for regulation and enforcement of environmental laws rests with the FMENV.

1.7.2 Federal Institutions

i. National Council on Environment

This is the apex policy-making organ on environment.

The Council:

- ◊ The Council consists of the Minister of Environment, Minister of State for Environment, and State Commissioners of Environment
- ◊ Participates in the formulation, coordination, harmonization and implementation of national sustainable development policies and measures or broad national development.
- Meets regularly to
  1. Consider and receive States' reports on environmental management.
  2. Consider national environmental priorities and action plans as it affects Federal and State governments; and
  3. Exchange ideas and information where necessary with Federal Government on environmental issues.

ii. Federal Ministry of Environment (FMEnv)

1. Set up by Presidential Directive No. Ref. No. SGF.6/S.221 of October 12, 1999, and empowered with regulation of all environmental matters protecting, enhancing and preserving the Nigerian environment
2. In line with her mandate, developed far reaching legal instruments for achieving environmentally sound management of resources and sustainable development across all major sectors of the economy.
3. Regulatory instruments are enforced through the activities of the following agencies:
   - **i.** National Oil Spill Detection and Response Agency (NOSDRA) established under Act of 2006 as lead agency on oil spillage matter with clear mandate to administer the National Oil Spill Contingency Plan (NOSCP).
   - ii. National Environmental Standards and Regulations Enforcement Agency (NESREA) [with Gazette No. 92, Vol. 94 of 31st July, 2007 with responsibility for the protection and development of the environment, biodiversity conservation and sustainable development of Nigeria's natural resources in general and environmental technology, including coordination and liaison with relevant stakeholders within and outside Nigeria on matters of enforcement of environmental standards, regulations, rules, laws, policies and guidelines.

iii. National Park Service of Nigeria is responsible for preserving, enhancing, protecting and managing vegetation and wild animals in the national parks of Nigeria.

iv. Forestry Research Institute of Nigeria (FRIN) established to develop the nation's manpower, education, training for forestry and agricultural practices.

4. Developed the procedures for Environmental Impact Assessments (EIA) of all development projects in accordance with the provisions of the Environment Impact Assessment (EIA) Act. No. 86 of 1992 and managed by the Environmental Assessment (EA) Department with the following functions:

a. Implementation of the provisions of the Environmental Impact Assessment (EIA) Act of 1992 on development projects.

b. Ensure environmental sustainability of development projects through regulation of activities within the oil and gas, mining, infrastructure, agriculture, manufacturing sectors, etc.

c. Development of guidelines and standards for environmental quality monitoring, eco-labelling, etc; and Accreditation of environmental laboratories. Implementation of Environmental Audit and Environmental Management System (EMS) in Nigeria.

1.7.3 State Institutions

The State has a number of Ministries, Departments and Agencies (MDAs) relevant to the Project and these include the followings:

i. Abia State Ministry of Environment

The Ministry of Environment has the mandate to keep Abia State and its environs clean for healthy living and habitation. It had a VISION to serve as the primary vehicle for the execution of Government plans and programmes towards the rapid environmental transformation of Abia State for sustainable development and a MISSION to formulate policies and co-ordinate action on environmental protection and conservation of natural resources for sustainable development.

The statutory functions and responsibilities of the Ministry of Environment are as follows:

- Environmental Conservation.
- Solid Waste Management
- Environmental Assessment.
- Erosion/ Flood and Coastal Zone Management.
- Afforestation and wildlife Preservation.
- Pollution control and Environmental Health.
- Monitoring of Exploration and exploitation of Solid mineral deposits

The Ministry has an agency named the **Abia State Environmental Protection Agency (ASEPA).** The Abia State Environmental Protection Agency (ASEPA) has the mandate to put measures aimed at enhancing the cleanliness of the State and ensures the enforcement of the relevant laws including the use of mobile courts to prosecute defaulters.

ii. Ministry of Works

The related responsibilities assigned to the Ministry are as follows:

i) State roads and bridges (construction and maintenance);
ii) Regulation of traffic on State roads and bridges.
iii) Road safety measures and control.
iv) Infrastructural levies on transport, haulage and franchise;
v) Registration of contractors, auctioneers and renewal of licenses;
vi) Construction and repair of sewage and drainage systems;
vii) Road Transport Policy;
viii) Storage of explosives for road construction;

iii. Ministry of Lands Survey and Urban Planning

The related responsibilities assigned to the Ministry are as follows-

- Development and Maintenance of Open Spaces.
- Acquisition of lands for public purposes.
- Registration of title to lands.
- Mapping and Surveying
- Administration of Land Use Decree.
- Town and Country Planning;

iv. Ministry of Public Utilities and Water Supply

The related responsibilities assigned to the Ministry are as follows:

a) Water supply in the State;
b) Electricity Supply in the State;
c) Hydrological Surveys within the competence of the State.

v. Ministry of Works

The related responsibilities assigned to the Ministry are as follows:

1. State roads and bridges (construction and maintenance);
2. Regulation of traffic on State roads and bridges;
3. Road safety measures and control;
4. Vehicle Inspection;
5. Infrastructural levies on transport, haulage and franchise;
6. Registration of contractors, auctioneers and renewal of licenses;
7. Construction and repair of sewage and drainage systems;
8. Road Transport Policy;
9. Storage of explosives for road construction.

vi. Ministry of Local Government and Chieftaincy Affairs

The related responsibilities assigned to the Ministry are as follows:

1.0 Co-ordinate Local Government Matters.

2.0 Appraisal and monitoring Capital Projects of Local Governments;

1.7.4 Local Government

Like the State Government, the Local Government liaise and cooperate with the Federal and State Ministries of Environment to achieve a healthy or better management of the environment within their domains with the relevant byelaws. This is true of the host (10) Local Government Areas, where the proposed project is located.

1.7.4 Policy, Legal and Administrative Framework

Environmental protection and management as it relate to projects in various sectors of Nigerian economy are based on provisions of various relevant legal instruments and administrative frameworks. They include:

- Relevant laws, rules, regulations, guidelines and standards at National, State and Local Governments level.
- International Environmental agreements, treaties and conventions ratified by the Federal Republic of Nigeria.
- Development Partners policies such as that of the African Development Bank (AfDB) and/or International Finance Corporation.

These are highlighted below. Meanwhile, suffice it to say that the purpose of this is to demonstrate that the Project Proponent gives high recognition to the legal instruments and is committed to joining other stakeholders towards the path of a sustainable development. Specifically, the Project Proponent understands that environmental, social and economic are the three pillars of sustainable development and thus a review of the relevant polices and legal instruments will provide proper guidance in meeting the relevant tenets in the execution of the proposed project as regards environmental and social risks as well as health and safety risks of the Project.

Thus, is appropriate to say upfront that the ABSIIDP is committed to ensuring the best practice with regard to Environmental and social as well as health and safety risk management of all persons likely to be affected by the project activities, including employees, contractors working on sites, and visitors to the site and the environment itself.

The major national and international regulatory instruments relevant to the proposed project are outline below:

1.7.4.1 Federal Policy/Legislations

1. Constitution of the Federal Republic of Nigeria (1999)

This serves as the national legal order, which recognizes the importance of improving and protecting the environment and makes provision for it.

- Section 17 (1) CFRN 1999 says "exploitation of human or natural resources in any form whatsoever for reasons, other than the good of the community, shall be prevented."
- Section 20 makes it an objective of the Nigerian State to improve and protect the air, land, water, forest and wildlife of Nigeria.
- Section 12 establishes, though impliedly, that international treaties (including environmental treaties) ratified by the National Assembly should be implemented as laws in Nigeria.
- Section 33 and 34, which guarantee fundamental human rights to life and human dignity respectively, have also being argued to be linked to the need for a healthy and safe environment to give these rights effect.

2. National Policy on Environment

The National Policy on Environment, 1989 (revised 1999), provides for "a viable national mechanism for cooperation, coordination and regular consultation, as well as harmonious management of the policy formulation and implementation process which requires the establishment of effective institutions and linkages within and among the various tiers of government – federal, state and local government". Prior to the launching of this policy, there was no unified coordination of activities of the 3 tiers of government responsible for the environment.

The thrust of the policy is the achievement of sustainable development in Nigeria. Guidelines and strategies are therefore defined for:

1. Securing for all Nigerians a quality of environment adequate for their health and well-being.
2. Conserving and using the natural resources for the benefit of present and future generations.
3. Restoring, maintaining and enhancing the ecosystem and ecological processes essential for the preservation of biological diversity.
4. Raising public awareness and promoting understanding of the essential linkages between the environment, resources and development; and
5. Cooperation with other countries, international organizations and agencies to achieve optimal use of trans-boundary in order to prevent environmental recourses.

Further, the defined guidelines and strategies provide for the effective management of the environment in the following 14 major areas: Human population; Land use and soil conservation; Water resources management; Forestry, wildlife and protected areas; Marine and coastal area resources; Toxic and hazardous substances; Energy production and use; Air pollution; Noise pollution; Working environment (occupational health and safety); and Settlements, recreational space, greenbelts monuments and cultural property.

3. Environmental Impact Assessment (EIA) Act No. 86 of 1992 (now EIA Act CAP E12 LFN 2004) This act stipulates that the public or private sector of the economy shall not undertake or embark or authorize projects or activities without prior consideration, at an early stage of their environmental effects. The Act set out the procedures to follow in the execution of EIA in Nigeria (Fig. 1.5). Procedurally, before commencement of an ESIA, the FMEnv issues a letter of intent on notification by the proponent, to approve the terms of reference and ensure public participation.

The ESIA Act requires that development projects be screened taking cognizance of the nature, size, and sensitivity of the proposed project environment as well as the potential impacts of the Project.

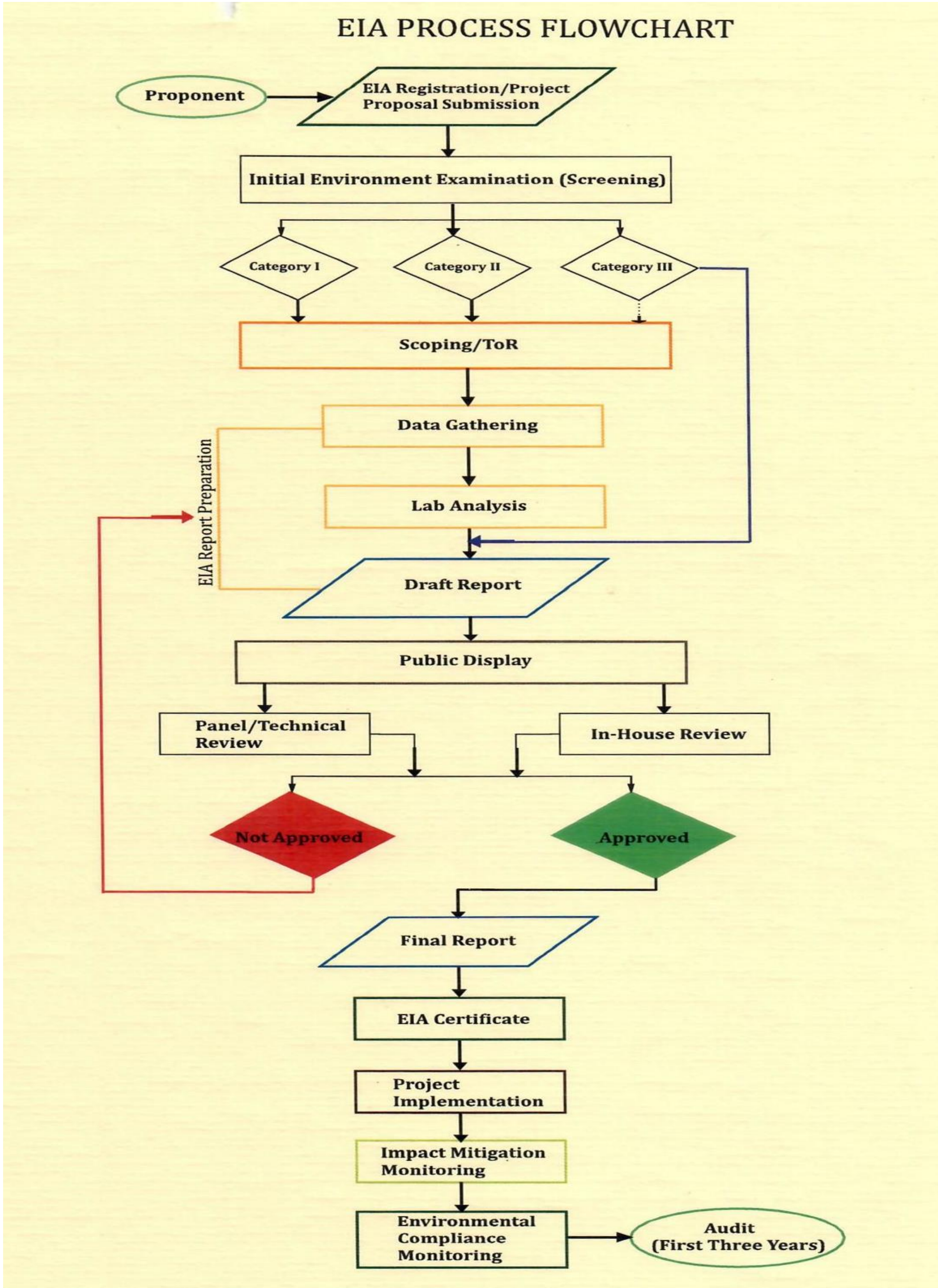
Based on the screening, a full, partial, or no ESIA may then be required, according to the following categories:

- Category I: projects that require a full ESIA.
- Category II: projects that may require only a partial ESIA, which will focus on mitigation and Environmental planning measures, but if located near an environmentally sensitive area then a full ESIA is required; or,
- Category III: projects considered having "essentially beneficial impacts" on the environment, thus only an Environmental Impact Statement is prepared.

This categorization is based on the environmental and social risks and impacts of a proposed in relation to the magnitude of the risks and impacts.

The proposed project has been assessed as Category I by the FMEnv based on the site visit/verification conducted by the representatives of Regulators.

Supplement to the EIA Act exist in the form of Sectoral Guidelines.



Source: Adopted from FMEnv, 2021

Figure 2. 1: Overview of the Nigeria EIA Process

4. National Environmental Standards and Regulations Enforcement Agency

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} as a parastatal of the Federal Ministry of Environment.

The bill for an act establishing the agency was signed and published in the Federal Republic of Nigeria Official Gazette No.92, Vol. 94 of 31st July 2007, By the NESREA Act; the Federal Environmental Protection Agency Act Cap F 10 LFN 2004 was repealed. NESREA has responsibility for the protection and development of the environment, biodiversity conservation and sustainable development of Nigeria's natural resources in general and environmental technology including coordination and liaison with relevant stakeholders within and outside Nigeria on matters of enforcement of environmental standards, regulations, rules, laws policies and guidelines.

NESREA has the mandate to enforce compliance with laws, guidelines, policies and standards on environmental matters.

1. Section 7 provides the Agency authority to ensure compliance with environmental laws, local and international, on environmental sanitation and pollution prevention and control through monitory and regulatory measures.
2. Section 8 (1)(K) empowers the Agency to make and review regulations on air and water quality, effluent limitations, control of harmful substances and other forms of environmental pollution and sanitation.
3. Section 27 prohibits, without lawful authority, the discharge of hazardous substances into the environment.

The Act also enables the Agency also:

A. Prohibit process and use of equipment or technology that undermine environmental quality.
B. Conduct field follow-up of compliance with set standards and take procedures prescribed by law against any violator.

1. Environmental Impact Assessment (EIA) Decree No. 86 of 1992
2. The National Guidelines and Standards for Environmental Pollution Control in Nigeria (March 1991), which is the basic instrument for monitoring and controlling industrial and urban pollution.
    1. In a notice in the Federal Government Official Gazette No. 92, Vol. 94 of 31st July 2007, the establishment of this Agency was published. The Agency, a parastatal under the supervision of the Federal Ministry of Environment was established by an Act of the National Assembly, National Environmental Standards and Regulations Enforcement Agency (Establishment) Act, 2007. The Agency has responsibility for the protection and development of the environment, biodiversity conservation and sustainable development of Nigeria's natural resources in general and environmental technology, including coordination and liaison with relevant stakeholders within and outside Nigeria on matters of enforcement of environmental standards, regulations, rules, laws, policies and guidelines.

Some NESREA regulations include:

2. National Environmental (**Sanitation and Wastes Control)** Regulations, 2009. S. I. No. 28. The purpose of this Regulation is to provides the legal framework for the adoption of sustainable and environment friendly practices in environmental sanitation and waste management to minimize pollution.
3. 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.
4. National Environmental **(Noise Standards and Control)** Regulations, 2009. S. I. No. 35. The main objective of the provisions of this Regulation is to ensure tranquility of the human environment or surrounding and their psychological well-being by regulating noise levels.
5. National Environmental (**Coastal and Marine Area Protection**) Regulations, 2010. S. I. No 18. This Regulation provides for the regulatory framework for the application of preventive, precautionary and anticipatory approaches so as to avoid degradation of the coastal and marine environment
6. National Environmental (**Construction Sector)** Regulations, 2010. S. I. No. 19. The purpose of these Regulations is to prevent and minimize pollution from Construction, Decommissioning and Demolition Activities to the Nigerian Environment.
7. 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.
8. 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.

Box 1 Some National Legal Instruments on Environment

5. Nigeria Climate Act, 2021

In 2021, Nigeria got a new Climate Change Act. This is the first legislation in the country's history dedicated to tackling climate change, and one of the first in Africa. The new Act establishes a powerful National Council on Climate Change, that will be a corporate entity, and make policies, regulations, guidelines, institute penalties (including fines).

The new Council, which will be chaired by the President, with the Vice President as Vice Chair, will also administer the new Climate Change Fund as well as oversee, working with relevant partners, the implementation of Carbon Emission Trading and a Carbon Tax in Nigeria.

It will also produce and revise Nigeria's National Climate Change Action Plan, every five years.
Under the Act, the Federal Ministry of Environment, working with the Federal Ministry of Budget and National Planning, is mandated to set a 'Carbon Budget' for Nigeria, which is basically the allowable/acceptable quantity of greenhouse gases in the country, per time. In addition, it will have a responsibility to conduct public communications and engagement on Climate Change and related matters in Nigeria.

The new Climate Change Act, 2021 requires private entity with at least 50employees to put in place a plan that will support in carbon reduction annually (Part VI, Section 24).

6. 2050 Long-Term Vision for Nigeria (LTV-2050)
Towards the Development of Nigeria's Long-Term Low Emissions Development Strategy (LT-LEDS, Nigeria developed the Long-Term Low Emission Vision to 2050. *(FINAL NIGERIA LT VISION_2050_Nov2021.pdf (unfccc.int))*. This vision which was developed by Natural Eco Capital Limited (a sister company of MDS), is designed to promote sustainable development and guarantee climate-proofed economic development. The LTV is in tandem with medium-term (2021-2025) and long-term (Agenda 2050) national development plans.
Nigeria's 2050 Long-Term Low Emission Vision document is a demonstration of the nation's commitment to play a leading role in the implementation of the Paris Agreement.

1.7.4.2 Nigerian Social Legislation
In the consideration of Nigerian social legislation, the acts and/or policies considered to be relevant to the proposed Project include:

1. Labour Act Cap L1, LFN 2004: The Labour Act is the primary law protecting the employment rights of individual workers. The Act covers protection of wages, contracts, employment terms and conditions, and recruitment; and classifies types of workers and special workers.

2. Violence Against Persons (Prohibition) Act, 2005: The Violence Against Persons (Prohibition) Act (VAPP) was passed into law in May, 2015. The Act was necessitated as a result of agitations for protection of persons against different forms of violence. The Act has strengthened advocacy against rape, female genital mutilation, partner battery, stalking, harmful widowhood practices while prohibiting all forms of violence, including physical, sexual, psychological, domestic, harmful traditional practices and discrimination against persons. It also provides maximum protection and effective remedies for victims and punishment of offenders.

3. National Gender Policy, 2006
Nigeria put together the National Gender Policy in 2006. Its overall goal is to promote the welfare and rights of Nigerian women and children in all aspects of life: political, social and economic. The policy seeks to plan, coordinate, implement, monitor and evaluate the

development of women in the county. In concrete terms, the National Gender Policy in Nigeria focus on:

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

4. Land Use Act of 1978, CAP 202, LFN 2004

The Land Use Act places the ownership, management and control of land in each state of the federation in the Governor. Land is therefore allocated with his authority for commercial, agricultural and other purposes. The Land Use Act of 1978 states that'… It is also in the public interest that the rights of all Nigerians to use and enjoy land in Nigeria and the Natural fruits thereof in sufficient quality to enable them to provide for the sustenance of themselves and their families should be assured, protected and preserved'. This implies that acts that could result in the pollution of the land, air, and waters of Nigeria negates this decree, and is therefore unacceptable.

5. Nigerian Urban and Regional Planning Act, *CAP N138, LFN 2004*

Aimed at overseeing a realistic, purposeful planning of the country to avoid overcrowding and poor environmental conditions

- Section 30 (3) requires a building plan to be drawn by a registered architect or town planner.
- Section 39 (7) establishes that an application for land development would be rejected if such development would harm the environment or constitute a nuisance to the community.
- Section 72 provides for the preservation and planting of trees for environmental conservation.

1.7.4.3 State Policies, Legislations and Standards

Abia State has a number of policies and pieces of legislations designed to promote a safe and clean environment as outlined in Table 1.1.

Table 1.1: Abia State Environmental Policies, Legislations and Standards

Instrument	Year	Focus
Abia State Basic Environmental Law No. 1.	2004 amended in 2013	This law creates the Abia State Environmental Protection Agency (ASEPA) and establishes the basic environmental sanitation practice for the State
Abia State Policy on Environment.	2010	This policy encourages community participation in environmental issues and ensures sustainable management of the Abia environment through cooperation with the Federal government of Nigeria.
Abia State Flood and Erosion Control and Soil Conservation	2010	This promotes sustainable land use management by minimizing soil erosion and flooding hazards
Abia Riverine Area Management Policy	2010	This policy is set to minimize riverine erosion and other forms of riverine degradation
Abia State Watershed Management Policy	2010	This policy enables the commencement of co-ordinated/holistic/integrated management of natural resources
Abia State Flood and Erosion Control Management Support System	2010	The policy supports a reliable up-to-date database and integrated management system as tools to support all erosion and control programs
Abia State Flood Control and Water Conservation	2010	This policy ensures the forecast, prevention, monitoring and flood management
Abia State Waste Management Law and Waste Management (Enforcement and Offences) Provisions Regulations	2002	Enforces the relevant Regulations
Abia State Environmental Protection Agency Law, Cap50, Vol. 2, Laws of Abia State	2006	ensures the compliance of any development project with Environmental Impact Statement (EIS), State planning permits and regulations guiding development;
Abia state Ministry of Physical Planning and Urban Development law	1999	guides planning principles and practice in the state

Table 1.1: Abia State Environmental Policies, Legislations and Standards		
Instrument	**Year**	**Focus**
Abia State Environmental Protection Agency Law Cap 14 of 27th July, 1994	1994	contains Solid Waste Management regulation with provisions on environmental standards and penalties for violation.

1.7.4.4 Local Government Regulations

The Local Government, without any specific laws on environmental management, is charged with the following responsibilities, inter alia:

I. Coordinating the activities of Local Government Council.
II. Maintenance of Law and Order in collaboration with Law Enforcement Agencies.
III. Collection of taxes and fees.
IV. Establishment and maintenance of cemeteries, burial grounds and homes for the destitute or infirm
V. Establishment, maintenance and regulation of markets, motor parks and public conveniences.
VI. Construction and maintenance of roads, streets, drains and other public highways, parks, and open spaces.
VII. Naming of roads and streets and numbering of houses.
VIII. Provision and maintenance of public transportation and refuse disposal.
IX. Registration of births, deaths and marriages.

1.7.5 Multilateral Environmental Agreements

Nigeria is a signatory to a number of conventions on sustainable development and is a member of various bilateral and multilateral organizations. Some of the relevant development partners in this project are African Development Bank, the World Bank and a number of United Nations agencies.

(i) United Nations Guiding Principles on the Human Environment

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.

(ii) The Rio Declaration on Environment and Development

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 with the goal of establishing 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.

The UN Conference on Environment and Development 1992, Principle 17 of the Final Declaration is dedicated to ESIA and states: *"Environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority."*

The consequence of this is that the United Nations agencies concerned in various ways with people and the environment adopted impact assessment as a central tool to support decision-making.

(iii) Agenda 21 – United Nations Conference on Environment and Development

The United Nations Conference on the Environment and Development (UNCED) in 1992 led to the adoption of Agenda 21, which recommends a set of measures for waste management.

The recommendations may be summarized as follows:

- Prevent and minimize waste production.
- Reuse or recycle the waste to the extent possible.
- Treat waste by safe and environmentally sound methods.
- Dispose of the final residues by landfill in confined and carefully designed sites.

Agenda 21 also stresses that any waste producer is responsible for the treatment and final disposal of its own waste; where possible; each community should dispose of its waste within its own boundaries.

(iv) Some Relevant Principles

1. ***The precautionary principle*** is a key principle governing health and safety protection. When the magnitude of a particular risk is uncertain, it should be assumed that this risk is significant, and measures to protect health and safety should be designed accordingly.
2. ***The duty of care principle*** stipulates that any person handling or managing hazardous substances or related equipment is ethically responsible for using the utmost care in that task.

***(v)* Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts (WIM)**

The Warsaw International Mechanism for Loss and Damage promotes the implementation of approaches to address loss and damage associated with climate change impacts, in a comprehensive, integrated and coherent manner (See decision 2/CP.19 for the details). The mechanism is established under the United Nations Framework Convention on Climate Change to assist developing countries that are particularly vulnerable to the adverse effects of climate change by:

- Enhancing knowledge and understanding of comprehensive risk management approaches to address loss and damage
- Strengthening dialogue, coordination, coherence and synergies among relevant stakeholders
- Enhancing action and support, including finance, technology and capacity-building

Through these functions, the mechanism implements Article 8 of the Paris Agreement.

Article 8 of the Paris Agreement notes that "Parties recognize the importance of averting, minimizing and addressing loss and damage associated with the adverse effects of climate change, including extreme weather events and slow onset events, and the role of sustainable development in reducing the risk of loss and damage."

The Paris Agreement in Paragraphs 48–52 (Loss and Damage) of Decision -/CP.21reaffirmed the Warsaw International Mechanism for Loss and Damage as the main vehicle under the UNFCCC process to avert, minimize and address loss and damage associated with climate change impacts, including extreme weather events and slow onset events.

(vi) Paris Climate Change Agreement

The Paris Climate Agreement represent that the climate deal or pact sponsored by the United Nations to bring the world's countries together in the fight against climate change. Participating nations made a historic pact on Dec. 12, 2015, in Paris, France, to adopt green energy sources, cut down on greenhouse gas emissions and limit the rise of global temperatures (as mentioned in the overall mission).

Under the Paris Agreement, which went into effect on Nov. 4, 2016, every country has an individual plan (or "Nationally Determined Contributions (NDC)") to tackle its greenhouse gas emissions

Nigeria's initial NDC captured five key sectors, namely: Energy(power), Transport, Industries, Oil and Gas, and Agriculture submitted to UNFCCC in 2015. Nigeria revised her NDC and submitted to UNFCCC in 2021 with two additional sectors (water and waste). This raised Nigeria's ambition by including emissions reductions from the waste sector (alongside water sector) for the first time and increasing its conditional contribution to 47% on international support with unconditional contribution still remain ing20% below business-as-usual by 2030.

(vii) UN Sustainable Development Goals

The Sustainable Development Goals (SDGs) (or Global Goals for Sustainable Development) are a collection of 17 global goals set by the United Nations Development Programme (Box 1.6). The formal name for the SDGs is: "Transforming our World: the 2030 Agenda for Sustainable Development," shortened to "2030 Agenda." The goals are broad and interdependent, yet each has a separate list of targets to achieve. Achieving all 169 targets would signal accomplishing all 17 goals. The SDGs cover social and economic development issues including poverty, hunger, health, education, global warming, gender equality, water, sanitation, energy, urbanization, environment and social justice.

1.7.6 Development Partners (DP) Safeguards System

Safeguards are powerful tools that help analysts to identify risk, help to reduce development costs and improve sustainability for projects. Towards the march to sustainable development, safeguards are seen to play a critical role in sustainable development, especially in protecting livelihoods and the environment and ensuring inclusive and green growth. A brief summary of the safeguards system of the potential development partners to which the project looks forward to for support are provided below:

1.7.7 International Best Practice Standard and Guidelines

International institutions provide guidance on their requirement for the EIA/ESIA process and place particular emphasis on achieving sustainable environmental social and health outcomes, such international institutions also provide environmental standard and limits for emission and discharges. The overall project design and its EIA are based on relevant guidelines published by World Bank and therefore are expected to meet the environmental requirement of international institutions.

a. Voluntary international standards

Voluntary international standards provide the frameworks and guidelines to improve governance and transparency of companies and governments. This is aimed at ensuring sustainable development for communities impacted, especially by the extractives industry. The main organizations which lead in the development of voluntary international standards include International Organization for Standardization (ISO), United Nations (UN), International Labor Organization (ILO), Organization for Economic Cooperation and Development (OECD) and Global Reporting Initiative (GRI).

International standards can be largely grouped into the following four categories: Certification Schemes, Codes, Standards and Guidelines, Initiatives, and International Frameworks. Examples include the Equator Principle and the Environmental Management System (ISO 14001) or Social Responsibility (ISO 26000) to which project could potentially voluntarily subscribe. Further information on these is awash on the internet. Thus, only EQ is further discussed below as the proposed project sees this as one of such standards to adhere.

b ISO26000, Guidance on Social Responsibility

The International Organization for Standard's ISO 26000 specifies standards for social responsibility. The guidance is broad in that it can be applied to any sector. Like other ISO standards, the guideline does not replace technical requirements.

1.7.8 Health and Safety

Some of the relevant international instruments on good international industry practice in health, and safety that will be of benefit to the proposed project are outlined below:

a. World Bank Group Environment, Health, and Safety (EHS) Guidelines

the World Bank Group Environmental, Health, and Safety Guidelines (known as the "EHS Guidelines") are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP) and are referred to in the World Bank's Environmental and Social Framework and in IFC's Performance Standards.

The EHS Guidelines contain the performance levels and measures that are normally acceptable to the World Bank Group, and that are generally considered to be achievable in new facilities at reasonable costs by existing technology.

The World Bank Group requires borrowers/clients to apply the relevant levels or measures of the EHS Guidelines. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects will be required to achieve whichever is more stringent.

An Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution exist that include information relevant to power transmission between a generation facility and a substation located within an electricity grid, in addition to power distribution from a substation to consumers located in residential, commercial, and industrial areas.

b. International Labour Standards on Occupational Safety and Health

The ILO Constitution sets forth the principle that workers must be protected from sickness, disease and injury arising from their employment. The ILO has adopted more than 40 standards specifically dealing with occupational safety and health, as well as over 40 Codes of Practice. Nearly half of ILO instruments deal directly or indirectly with occupational safety and health issues.

Some of the Key instruments on occupational safety and health include the following:

- Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187)
- Occupational Safety and Health Convention, 1981 (No. 155) and its Protocol of 2002
- Occupational Health Services Convention, 1985 (No. 161)
  Working Environment (Air Pollution, Noise and Vibration) Convention, 1977 (No. 148)

1.7.9 AfDB'S Integrated Safeguards System - Policy Statement and Operational Safeguards

In December 2013 the Bank unanimously adopted the Integrated Safeguards System (ISS), which is the cornerstone of its strategy to promote growth that is socially inclusive and environmentally sustainable. This, in turn, fully supports the Bank's Ten-Year Strategy 2013-2022.

The ISS promotes best practices and also encourages greater transparency and accountability. It provides a process for the people, especially the most vulnerable communities, to express their views by providing project-level grievance and redress mechanisms. The Bank's ISS has been developed through extensive consultations. In particular, five regional workshops—in Nairobi, Lusaka, Libreville, Abuja and Rabat—provided the Bank with an opportunity to listen to and address concerns raised by various stakeholders, including civil society. *It should be understood the ISS is currently undergoing stakeholders review processes across the continent.*

The AfDB has adopted a series of five Operational Safeguards (OS), outlined here below:

- OS1 sets out the Bank's overarching requirements for borrowers or clients to identify, assess, and manage the potential environmental and social risks and impacts of a project, including climate change issues.
- OSs 2-5 support the implementation of OS1 and set out specific requirements relating to different environmental and social issues, including gender and vulnerability issues, that are triggered if the assessment process reveals that the project may present certain risks.

The environmental and social assessment covers all relevant direct and indirect cumulative and associated facility impacts identified during the scoping phase, including any specifically covered in OSs 2-5, for which there are specific requirements:

- OS 2: Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation
- OS 3: Biodiversity and Ecosystem Services
- OS 4: Pollution Prevention and Control, Greenhouse Gases, Hazardous Materials and Resource Efficiency
- OS 5: Labour Conditions, Health and Safety

More broadly, these operational safeguards which have been triggered by the proposed project activities are outlined in Table 1.2.

Table 1.2 AfDB Integrated Safeguard System			
OPERATIONAL SAFEGUARDS TRIGGERED BY THE PROJECT	**YES**	**NO**	**TBD**
OS1 -Environmental Assessment	**X**		
The road transport intervention activities on 31 Rural Roads in Aba, Abia State include the clearing of existing vegetation for the road construction/rehabilitation, excavation, siting of camps. that may likely have significant environmental impacts such as loss of vegetation, soil erosion, siltation and release of petrochemicals These risks will be managed through implementation of mitigation measures elaborated in site specific Environmental and Social Impact Assessments (ESIAs)/Environmental and Social Management Plans (ESMPs).			
OS2 Involuntary Resettlement: Land Acquisition,	**X**		

Population Displacement and Compensation			
The road transport intervention activities on 31 Rural Roads in Aba, Abia State activities may require land acquisition or resettlements. The projects will carried out in existing road ways but may require expansion to accommodate road shoulders and creation of drainages, and as such there is the likelihood of a change in land status at this stage. If there will be changes to the scope of the project activities that result in land acquisition and/or land status change, the Bank's involuntary resettlement policies and procedures will be applied.			
OS3 Biodiversity and Ecosystem Services	**X**		
The road transport intervention activities on 31 Rural Roads in Aba, Abia State will involve initial clearing of vegetation and may cause initial degradation of natural vegetation and modified habitat. Also the development of Camp and excavation activities will impact on above ground and underground biodiversity. These risks will be managed through implementation of mitigation measures elaborated in site specific Environmental and Social Assessments (ESIAs)/Environmental and Social Management Plans (ESMPs).			
OS 4: Pollution Prevention and Control, Greenhouse Gases, Hazardous Materials	**X**		
The road transport intervention activities on 31 Rural Roads in Aba, Abia State may likely intensify the use of petrochemicals and other pollutants. The earth movement and heavy duty vehicular movement will create air pollution. Wastes from transportation system may also pollute water and soil. Sustainable construction measures and will be encouraged by the ABSIIDP, contractors and other stakeholders will be promoted. Soil and water quality will be monitored..			
OS 5 Labour Conditions, Health and Safety	**X**		
The Contractor shall comply with the Labour laws and Best Practice Occupational Health and Safety requirements.			

1.7.10 Making the EIA Responsive to Good Practice

In order to make the EIA responsive to the objectives of good practice, the Nigeria's EIA requirements and the AfDB ISS on ESIA **were** harmonized as far as possible (Table 2.2).

The principles inherent in the environmental and social standards of the DP Safeguard System on Environmental Assessment are in tandem with the FMEnv EIA procedures and processes. For instance, AfDB/IFC categorization of EA as A, B, & C corresponds in principle with the Nigeria EIA requirements of Category I, II and III, which in actual practice is done with regard to the level of impacts associated with a given project.

However, in the event of divergence between the two, FMEnv, on one hand, and the development safeguard system on the other hand, the more stringent, environmentally and socially speaking, shall take precedence in the execution of the project and utilization of the ESIA instrument for project implementation

Table 1.3: A Summary of the Procedure of Nigeria ESIA & AfDB ESIA

EIA/ESIA* Stages	NIGERIA EIA	AfDB ESIA	Remarks
EIA/ESIA	Environment Impact Assessment	Environmental and Social Impact Assessment	Mean but the same thing in this report
Notification/ Project proposal	Required	Required	TOR for concurrence/approval
Screening/ Categorisation	Category I, II, &III	1, 2, &3	Does the project require an ESIA? Corresponds in principle - done with regard to the level of impacts associated with a given project
Scoping (ToR)	Required	Required	What issues and impacts should the ESIA address?
Environmental baseline studies	Required	Required	Data gathering, Laboratory Analysis. Etc.
Assessment of Project Alternatives	Required with project justification	Required	Required for "A"; discussions of alternative for project sites; "do nothing" scenario
Description of Impact Assessment and Mitigation Measures	Required	Required	Ensures socio-environmental factors are carefully managed throughout the project cycle via mitigation, monitoring and institutional measures
Public consultation	Required	Required	All relevant information and the consultation findings considered in reaching a decision on the proposed project
Review/Disclosure	Required	Required	EIA/ESIA Report displayed at appropriate locations for relevant public members' comments. FMEnv may call for public session and display by the Bank
Environmental & Social Management Plans (ESMP)	Required	Required	
Monitoring and Auditing	Required	Required	feedback to the ESIA - Project situation versus after the project situation - Monitoring plan with specific indicators, frequency of measurements, estimated costs, institutional responsibilities

*EIA/ESIA in this report mean but the same thing in application

1.7.11 Proposed Project and Applicable Environmental Standards

Primarily, the proposed project is anticipated to generate emissions, noise and effluent during construction and the operation phases. The limits in relation to the amount and nature of the relevant parameters of these environmental components that must go into the environment have been set by various national government agencies (such as NESREA in Nigeria) and international bodies (such as IFC and WHO). These limits which are summarised in Appendix 1 will form the touchstone upon which the proposed project activities shall be judged.

The national standard shall take precedence over the international standards. However, where that of international standards are more stringent these shall prevail over the national standards. Also, where there are no technology-specific limits available locally/nationally, then generally, the IFC/WHO guideline limits shall be applied. This is because, for instance, the IFC (World Bank) Environmental, Health, and Safety (EHS) Guidelines are seen as technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP).

1.7.12 Summary of the Institutional Analysis

The analysis of the applicable policies and regulatory framework with regard to this ESIA and waste management generally reveals that there is no dearth of regulatory instruments for environmental and social management in the state and of the proposed project management. In summary, the following were revealed:

- The FMEnv and the State Ministries of Environment provide overarching guidance which include policies, legal and regulatory framework for waste management, national/state guidelines and plans, etc
- The State have good governance framework and laws to back up and manage the environmental and social safeguard issues. The State has considerable experiences in the ESIA process and safeguard issues. In addition to the EIA Act, there exist important environmental laws and guidelines in the state that would support monitoring and enforcement.
- Statutorily the Local Government Authorities are charged with direct responsibility for the management of refuse within their domains. However, they presently lack the technical, financial and personnel capacity to fulfil this obligation effectively. Hence the State government support in the provision of the proposed project.
- There are existing Policies, Legislations, Regulations, Acts, By-laws and Guidelines in the country that apply to environmental issues, sanitation and categories of solid and hazardous wastes. There are also statements supporting reuse, recycling and recovery.

- The inclusiveness clause in the national waste management policy places the onus for compliance on all persons, public or private, who are involved in, cooperate with or utilise waste services functions that take place within the boundaries of Nigeria.

Without doubt, there will be need to continually strengthen the capacity of project staff and that of the State Ministry of Environment and other relevant actors charged with implementing this EIA and other attendant safeguards instruments through in-depth training courses in environmental and social management risk.

1.8 Structure of the Report

This report is presented in nine Chapters, namely:

- Chapter One Introduction and Legal Framework
- Chapter Two Project Justification and Alternatives
- Chapter Three Project Description
- Chapter Four Description of Project Environment
- Chapter Five Associated and Potential Impacts
- Chapter Six Mitigation Measures
- Chapter Seven Environmental and Social Management Plan
- Chapter Eight Decommissioning/Abandonment
- Chapter Nine Conclusions
- References
- Appendices

CHAPTER TWO
PROJECT JUSTIFICATION AND ANALYSIS OF PROJECT ALTERNATIVES

2.0 Introduction

The Project's Development Objective (PDO) is to improve transport conditions and bring sustained access to the rural population, through rehabilitating and maintaining key rural transport infrastructure in a sustainable manner within the selected (31) roads in Aba, Abia State.

2.1 Need for the Project

The prioritized roads if reconstructed will;

- Promote economic development, extend trade, and improve state's competitiveness through an efficient and affordable integrated transport system;
- Encourage and remove all barriers towards the private sector participation in the development, provision, maintenance, operation, and upgrading of transport infrastructure and services;
- Promote the use of public transport over private cars;
- To create flyover intersection to reduce accidents and save travel time;
- Promote a culture of maintenance and continuous upgrading of transport infrastructures and services;
- Promote competition and efficiency and cost reduction of transport services in and around Aba;
- Improve the safety, security, reliability, quality and speed of movement of goods and people, at state and local government and community levels;
- Develop transport infrastructure that ensures environmental sustainability and internationally accepted standards;
- Support LGAs and the state capital territory in the development and promotion of urban transport systems and local government developing and promoting rural accessibility; and
- Plan for the integration of 10 LGA headquarters with light gauge railway programme and to later integrate this to the national railway programme.

2.2 Objectives of the Project

The main objectives of the road reconstruction include the followings:

- Increase travel efficiency and productivity;
- Improve the quality of the environment;
- Improve the quality of life and social standard;
- Increase and spread economic activity throughout the villages and towns connected;
- Remove poor safety and security records on the road that affect travelers journeying on it;
- Remove undue stress for travelers;

- Afford comfortable ride for those who take the routes;
- Provide adequate facilities in terms of sidewalks which is simply non-existing; and
- Reduce carbon footprint and increase general environmental aesthetics due to adequate maintenance of the road and provision of greenery on the corridor which could readily absolve carbon.

2.3 Benefits of the Project

The project will have positive impact on Abia's economy on the global scale. Modernization of the highway, will contribute to improvement of transportation and transit of goods to surrounding countries, which is a significant and growing contributor to GDP.

Table 2.2: Project Justification, highlighting project benefits to the host communities of project location

S/N	Aba Roads	Community(ies)	LGAs	Urban/Peri-Urban	Road justification/Objectives eg traffic decongestion, movement of food crops
1	Asa Road – Port Harcourt Road	Ogbor Onicha Nlagu	Aba South	Urban	Traffic Decongestion, major link road towards A3 expressway out of Aba town.
2	Faulks Road	Umule	Aba North - Osisioma	Urban	Traffic decongestion. Major route to and from Ariria international market in Aba.
3	Ohanku Road – Owerre Aba	Owerre-aba Abayi nchokoro Umuaja Ohunku	Aba South - Ugwunagbo	Urban	Traffic decongestion and ease of movement between high populated towns in Aba.
4	Omuma Road		Aba North	Urban	Traffic decongestion.
5	Ikot Ekpene Road		Aba South - Obingwa	Urban	Traffic decongestion an ease of movement out from Aba town.
6	Mbubo Umuogele Amachi Mgbokonta	Mbubo Umuogele Amachi Mgbokonta	Isialangwa North	Peri-Urban	Ease of movement of agricultural produce and linkage between highly populated towns.
7	Umuala Nbawsi Eziala Osusu Okpuala Ngwa	Umuala Nbawsi Eziala Osusu Okpuala Ngwa	Isialangwa North	Peri-Urban	Ease of movement of agricultural produce and linkage between highly populated towns.
8	Omoba – Umuaja Amaede Ndiolumbe	Omoba Umuaja Amaede Ndiolumbe	Isialangwa South	Peri-Urban	Ease of movement of agricultural produce and linkage between highly populated towns.
9	Mbawsi Layout – Ururuka	Nbawsi	Isialangwa North	Peri-Urban	Ease of movement of agricultural produce and linkage between highly populated towns.
10	Glass Factory Road	Okpulumobo Umungasi	Aba North	Urban	Ease of movement through industrial zones in Aba town.
11	Umuomiaukwu Agburike Umuomainta	Umuomiaukwu Agburike Umuomainta	Isialangwa North	Peri-Urban	Ease of movement of agricultural produce and linkage between highly populated towns.
12	Uratta – Ugwuati	Uratta Ugwuati	Osisioma – Ukwa East	Peri-Urban	Ease of movement of agricultural produce and linkage between highly

S/N	Aba Roads	Community(ies)	LGAs	Urban/Peri-Urban	Road justification/Objectives eg traffic decongestion, movement of food crops
					populated towns.
13	Crystal Park Junction - Obohia Road	Obohia Ohambele	Aba South – Ukwa East	Peri-Urban	Ease of movement of agricultural produce and linkage between highly populated towns.
14	Immaculate Avenue – ITF Rod Bridge	Umungasi	Aba North	Urban	
15	Umuaro Nenu Road	Umuaro Nenu	Obingwa	Peri-Urban	Ease of movement of agricultural produce and linkage between populated towns.
16	Eziama Ntigha – Nsirimo – Ubakala	Eziama Ntigha Nsirimo Ubakala	Umuahia South – Isialangwa North	Peri-Urban	Ease of movement of agricultural produce and linkage between populated towns.
17	Mgboko –Omoba Umuezeukwu Mbawsi Road	Mgboko Omoba Umuezeukwu Mbawsi	Obingwa – Isialangwa South – Isialangwa North	Peri-Urban	Ease of movement of agricultural produce and linkage between highly populated towns.
18	Ibeme Ndiakata- Nlagu Onicha Ngwa	Ibeme Ndiakata Nlagu Onicha Ngwa	Obingwa	Peri-Urban	Ease of movement of agricultural produce.
19	Pepple Road - Akpu Road		Aba South – Aba North		Ease of movement of agricultural produce.
20	Umuokpo- Owo Ahiafor Link Road	Umuokpo Owo Ahiafor	Obingwa	Peri-Urban	Ease of movement of agricultural produce and linkage between highly populated towns.
21	Owerre Aba – Osusu Umuelendu – Osusuaku	Owerre Aba Osusu Umuelendu Osusuaku	Aba South - Ugwunagbo	Peri Urban	Ease of movement of agricultural produce and linkage between highly populated towns.
22	Umuojima Amapuife Eberi Omuma	Umuojima Amapuife Eberi Omuma	Osisioma	Peri-Urban	Ease of movement of agricultural produce and linkage between highly populated towns.
23	Umuimo Carol Pee. Ministry of Agric. Shopping Mall	Umuimo	Aba North - Osisioma	Urban	Traffic decongestion.
24	Ugwuati – Umuiku	Ugwuati Umuiku	Ukwa East	Peri-Urban	Ease of movement of agricultural produce.

S/N	Aba Roads	Community(ies)	LGAs	Urban/Peri-Urban	Road justification/Objectives eg traffic decongestion, movement of food crops
25	Isicourt- Ururuka Umuosu Umuala Umunkpeyi	Isicourt Ururuka Umuosu Umuala Umunkpeyi	Umuahia South – Isialangwa North – Isialangwa South	Peri-Urban	Ease of movement of agricultural produce and linkage between highly populated towns.
26	Ama Emereole – Ekeonyeugba – Umokoromiri-Eketa	Ekeonyeugba Umokoromiri Eketa	Isialangwa South	Peri-Urban	Ease of movement of agricultural produce and linkage between highly populated towns.
27	Ajiwe – Brass		Aba North	Urban	Traffic decongestion.
28	Ahunanya - Immaculate	Umungasi	Aba North	Urban	Traffic decongestion.
29	Oron Road – Elizabbeth Avenue – Sports Club	Umungasi	Aba North	Urban	Traffic decongestion.
30	Umuala - Umuakwu - Ohuhu Nsulu – Oloko Ikwuano	Umuala Umuakwu Ohuhu Nsulu Oloko Ikwuano	Isialangwa North - Ikwuano	Peri-Urban	Ease of movement of agricultural produce and linkage between highly populated towns.
31	Itungwa – Agburukwe road	Itungwa Agburukwe	Obingwa	Peri-Urban	Poor drainage system along road which lead to the formation of GES 2. Ease of movement of agricultural produce.

2.4 Value of the Project

Abia State Government has received a loan from the African Development Bank (AfDB) for the upgrading of prioritized roads in the state. This cost includes the rehabilitation, basic and detailed engineering, civil and mechanical works, and operational cost. Its critical value is the contribution of the project to increased economic activities, employment generation and ease of movement within Abia State.

The evaluation of the economic returns and environmental, socio-economic cum health benefits has shown that in the long-term the project is desirable with good returns.

2.5 Envisaged Sustainability

Economic Sustainability

The Abia State Government through the Abia State Integrated Infrastructure Development Project (ABSIIDP) has received a loan from African development Bank (AfDB) towards the cost of carrying out Consultancy Services for Feasibility study, Environmental and Social Impact Assessment, detailed engineering design and preparation of Tender Documents, for the priority roads in Aba, Abia State. The State road networks are managed by the State Ministry of Works for the state roads and local government roads, while the Federal Ministry of Works and Federal Road Maintenance Agency (FERMA) manage the federal roads. The project will facilitate rural urban commuting and movement of goods, especially agricultural produce thus boosting economic activities in the project areas extending to other parts of Abia State. The project will ultimately lead to increase in internally generated revenue for the State thus increasing the ability to repay the loan. Therefore, the project is economically sustainable.

Technical Sustainability

- The state can boast of an assemblage of a team of professionals with impressive relevant experience that would be involved in the implementation of the project and would where necessary source for necessary technical expertise to ensure the sustainability of the project.
- The state shall employ Best Available Technology in the implementation of the project and adhere strictly to all relevant engineering codes and standards

Environmental Sustainability

- The project principles are based on cost reduction, minimization of negative environmental and social impacts and utilization of local skilled labour.
- Environmental, public safety and health considerations will be given adequate attention while appropriate mitigation measures and

Environmental Management Plan shall be carefully developed and implemented.

- The state will enforce its policy of compliance with statutory regulations and its own corporate guidelines on HSE, and at the same time, is committed to performance improvement. All project facilities shall be designed and constructed to keep environmental impacts at minimal and acceptable limits.
- All operations shall be carried out to conform to all relevant international, national and state regulations and Standards on the environment. Handling, storage and disposal of solid and liquid wastes shall be in accordance with the regulatory requirements and the company's relevant Standard Operational Procedures.

Social sustainability

The following are the social benefit of the proposed project

- Most community heads felt relieved that the realization of this project will restore people's trust in Government and by extension to them. This has a psychological effect on leadership, it is the hope of every head to be appreciated and reverenced by his followers but when the needs of his people are not met, he lacks the confidence in being in their leader because he is not seen in a good light.
- One of the problems of the bad roads also captured the children's inability to access their schools especially when it rains, it becomes difficult to risk being in school; even the teachers find it difficult to be at work. So, there is a high reduction of school attendance especially during rainy season to avoid devastating situations as death. Motorists and tricycles will be able to ply these routes after completion.
- The communities also expressed that the present conditions of the roads have contributed to reluctance of their sons and daughters who are outside the state due to visit home for social and economic engagement. What then is the essence of a society when families are deprived of reunions?
- The bad roads are now opportunity for crime such as armed robbery and kidnapping to excel. Affected communities lamented that instead of driving smoothly around these affected areas, they need to slow down to avoid accident. However, this increases hoodlums' operation to carrying out their nefarious activities.

2.6 Analysis of Project Alternatives

The proposed project entails rehabilitation of existing roads and construction of drainage infrastructure, hence limited project alternatives were available for considerations at the feasibility stage. The reasonable alternatives considered were however in terms of the route alignments and development options.

Alternatives are different means of completing the project while still meeting the purpose of the proposed activity. Furthermore, the alternatives' analysis is intended to address other means of completing the proposed project that could avoid or minimize adverse impacts that would be associated with the project.
Alternatives may include, but are not limited to, location or site alternatives, engineering or technology.
Project alternative options have been comparatively evaluated in this section. Each section provides due consideration of the benefits and disadvantages of the options. In addition, the technical, economic, environmental, safety, health, security and social impacts of the project were the major considerations.

The project option of reconstruction in the sites identified and analysed as planned with incorporation of all necessary environmental, social and economic values from the project onset is the best alternative adopted.

Key considerations for each project option evaluated are the implications of the proposed project activities or absence of it on various aspects such as:

- Safety and Security - this includes potential safety and security exposures and expenses that are associated with the proposed project with due consideration to the work location, personnel and activities.
- Environment - release of emissions and discharge of substances into the environment in the course of work, the impacts on various environmental aspects, and likelihood of avoiding these by not going ahead with the proposed project.
- Social - the influence of the proposed project and related activities on standards of living and general quality of life. It also includes possible conflicts that may arise due to influx of people and the consequent social changes that may arise.
- Public Health - the possibilities of improved or degenerative health conditions as people congregate within and around the proposed project site and environs.
- Economics - likely costs and gains of investment, construction, operations and maintenance of the proposed plant and associated facilities, as well as the additional costs or savings due to the option under consideration.
- Effectiveness in meeting the proposed project objectives - core project objectives include infrastructure development drive by the various tiers of Government of Nigeria.
- Regulatory, corporate and stakeholder requirements - this considers government, legal, corporate and stakeholders' expectations. It also includes permits, licenses and monitoring requirements.
- Technical feasibility - ease and acceptability of proposed construction technology with respect to existing technologies.

- Synergy - ability of the option to provide better access through which the road passes.

2.7 Project Options

Thus, based on the factors highlighted above, four possible integrated project development alternatives/scenarios were identified:

Scenario 1: No Action/Do nothing option
Scenario 2: Delayed project option
Scenario 3: Upgrading of the proposed road
Scenario 4: Site location option

These options or scenarios are discussed as follows:

2.7.1 No Project Option

The No Project Option entails not implementing the project, which will negate the aspirations of improved road network and transport infrastructure for the State. This will have a negative impact on the anticipated improved transport system on the corridor or elsewhere. In the first place, the value-added economic benefits that are expected to result from the investment would not be realized. In the second instance, the inconveniences associated with not implementing the project will persist with the economy stagnant.

In addition, the employment opportunities and monetary benefits associated with the project implementation would be lost. Also, not implementing the project would mean that users of roads would not enjoy transport system that make a positive contribution to the environmental, social and economic sustainability that it is intended to serve.
In other words, the populace would continue to suffer on the bad roads, delays in travel time, risk to lives in terms of accident and security, loss of potentially accruable revenue to the local and national economies, failure to generate employment opportunities as anticipated; and environmental degradation arising from vehicular emissions in traffic.

In all, all unfavourable socio-economic and environmental impacts associated with the project are all short-termed compared to the immense benefits accruable from the project in the long-term. In view of the sustainable nature and the socio-economic benefits of the project it is unarguably imperative that the no-project alternative is inferior in this case and should not be selected. This also will have a negative impact on the economy of the area, in particular, and Nigeria at large. Thus, maintaining *status quo* in terms of this particular project is not a desirable alternative. This alternative was therefore rejected.

2.7.2 Delayed Project Option

This option implies that the planned project will be delayed until a much later date. This option is usually taken under certain circumstances such as when conditions are unfavorable to project implementation such as in war situation, civil unrest, antagonistic public opinion, government policy, prevailing socio-economic condition or another, force majeure, or where the host community is deeply resentful of the project. Also, if the prevailing economic climate is not quite favorable to the project, then delayed project option may be feasible. While analysing this option, none of the listed circumstances existed. Indeed, both the economic and the political environment are most favorable for the execution of the project.

Therefore, the implication of delayed project option will mean that all the preliminary work and associated efforts/ costs incurred would have come to nothing. Also, because of inflationary trends, such a delay will result in unanticipated increase in project costs, which may affect the final net benefit from the project. These, and other related problems make it impracticable to adopt the delayed option.

2.7.3 Upgrading of the Proposed Roads (The Acceptable Option)

This option implies that the project will be implemented as planned. This option is considered the most economically, socially and environmentally viable as it will ensure the realization of the inherent benefits of the project, especially to the local farming communities. The project has the overwhelming support of the local communities as it will improve access to rural communities and farmlands with reduction in transport costs.

The project will also support increased agricultural production by facilitating easy access to inputs, extension services and markets. The project preparation as well as the feasibility studies carried out in the project area during the appraisal have shown that immediate project option is technically feasible, economically viable, environmentally sustainable and socially justified and is thus the preferred option.

The need for this project to go ahead in the proposed location outweighs the other options of 'no project,' delayed project or alternative locations. Thus it is recommended that the project be carried on as planned. Suggested mitigation measures should be put in place to minimize or eliminate potential negative environmental and social impacts of the proposed project.

In summary, the selected option is the most optimal, which encompasses choice location with timely implementation and the best available fuel for the project. Thus it is recommended that the project be carried on as planned. Adequate mitigation measures shall however be put in place to minimize or eliminate potential negative environmental and social impacts of the proposed project.

2.7.4 Site Location Option

Having considered the construction of the road as the most viable and preferred option, it is therefore pertinent to ensure an appropriate location.

The important factors that influence the site selection for this project include:

- Increase travel efficiency and productivity;
- Improve the quality of the environment;

- Improve the quality of life and social standard;
- Increase and spread of economic activity throughout the villages and towns connected.
- Remove poor safety and security records on the road that affect travelers journeying on it.
- Remove undue stress for travelers;
- Afford comfortable ride for those who take the route;
- Provide adequate facilities in terms of sidewalks which is presently non-existing; and
- Reduce carbon footprint and increase general environmental aesthetics due to adequate maintenance of the road and provision of greenery on the corridor which could readily absorb carbon.

Considering the above factors, it is apparent that the chosen location is economically, socially and technically viable.

The site selection criteria included the following, *inter alia*:

- Availability of adequate space for proposed realignment;
- Ease of land acquisition;
- Minimum possible infringement;
- Feasibility to cater to the required traffic projection;
- Connectivity

2.8 Alternative Technology

At project conceptualization, consideration was given to corridors that could have maximum positive economic impacts on the rural community.

The proposed corridor recognizes sensitivities associated with infrastructure costs which is demand responsive, and recognizes the impact in construction of the Roads. Given the budgetary constraints, there is a priority to focus on achieving maximum value form affordable investment which this road provides.

In addition, while there are other route options, the social costs, especially in terms of resettlement and compensation appear lesser on this corridor in comparison to other corridors.

Given the foregoing overwhelming advantages of the proposed corridor, it is unlikely that a better suited location is available at present. Thus, in terms of suitability of location, seeking an alternative will not be the most optimal option in this regard.

New Road Construction

Construction of a new road will consume more resources in every sense. This could include the fragmentation of natural habitats or even communities/settlement such that the environmental and social cost could be quite expensive in every sense.

In comparison to other mode of transport or creation of new corridors of transport the proposed project would 'quick-win' in every respect.

Rail Transportation

Rail-based transportation in Abia State has gone moribund. The rail right-of-way is often occupied with a haphazard array of merchants, traders and residences that negatively affect train speeds (average of 20 km/h) and operations. Overall, factors such as a lack of track maintenance, over-aged tracks, insufficient wagons, and the poor condition of trains contribute to the inadequacy of the existing passenger rail transport system in Nigeria.

For mass transit, Rail could be seen to win the contest for being the quickest, most comfortable, and highest capacity carrying public transit mode. This will require the reconfiguration of the entire route in the light of the proposed project. The cost of this will be colossal in terms of environmental and social impacts. For instance, this will involve displacement of a number of activities on the corridor such as means of livelihoods.

Water Transportation

Virtually all the connected villages and towns can only be accessed by roads since they are land-locked, restricting mobility via water. So this is not feasible.

The poor state of the road and unavailability of water and rail transport have placed excessive stress upon the people and could worsen if the proposed reconstruction of the road is not road is not done

Bicycle Infrastructure

This means of transport is still popular in some rural communities in Aba. This means of transportation is cheap to acquire and maintain. It is also safer when used in less busy roads. It easier to navigate dilapidated roads. Lack of bicycling facilities, increasing crime rate and poor security and the stigma of attaching poverty to bicycling. If adequate bicycling infrastructure was implemented as connection to the ring road, it may provide quick and convenient access and spur ridership.

Construction/rehabilitation of Existing Route

Construction/rehabilitation of the existing roads will ensure minimal disruption to the environment and socio-economic well-being of members of the affected communities. This alternative is adjudged to have much less environmental footprint as it will affect the least farmlands, crops and economic trees and other assets. It will rather facilitate more efficient movement of people, farm inputs and produce as well as access to markets. It will accommodate the existing and projected traffic demands, improve the transportation infrastructure of the region and promote economic development and social integration. Thus, this alternative is considered more viable for the project.

2.8.1 Alternative Alignments

Altering the existing route at this stage will extensively increase the footprint of the project as it will affect communities and farmlands along the new route. The attendant socioeconomic consequences will include involuntary displacement of people from their homes, farmers from their source of livelihood, removal of crops and economic trees. There will be the need to mitigate these effects by paying adequate compensation which will significantly increase the project cost. In addition, the implication of considering an alternative route at this stage will include abandoning the existing road and restoration of the environment which will also increase project cost. The design of an alternative alignment options will be more expensive as it will entail very high costs for land acquisition and compensation claims. This alternative will also be more disruptive to the environment, livelihood and wellbeing of affected communities and thus not considered viable for the project.

Specific to these project roads, no alternative routes are set and selected since it is desired that the alignment should follow as closely as possible, the existing road center line to avoid too much compensation as required by the ToR. However, some local alignment is made to meet the standard.

CHAPTER THREE
PROJECT DESCRIPTION

3.0 Introduction

This chapter provides a brief description of the proposed road rehabilitation intervention, including the nature of the project, components, project activities as well as locations of affected roads. It also describes the details of the proposed project such as the philosophy, phases, key equipment, key facilities, civil works, technical processes, anticipated waste streams and handling approach, raw material requirements, HSE considerations, personnel requirements and schedule.

3.1. Project Location

The identified (31) road project is located within Aba, covering Aba South, Aba North, Osisioma, Ugwunagbo, Obingwa, Isialangwa North, Ukwa East, Umuahia South, Isialangwa South, and Ikwuano LGAs, in Abia State, South-East Nigeria (Maps 3.1, 3.2).

Abia state has Aba as its commercial capital and the proposed 31 (periurban, urban and rural) roads are located in and around Aba, as listed in Table 3.1.

Abia State is located in the south-eastern part of Nigeria (Map. 3.1). The State is known for its commercial activities centered at Aba, which was formerly a British Colonial Government outpost. The entire state lies approximately between latitudes 4º48'N and 6 º02'N and Longitudes 7º09'E and 7º58'E of the Greenwich Meridian. The state is bounded on the north and the northeast by Enugu and Ebonyi states respectively while the eastern boundary is occupied by the Cross River State. Abia State shares boundary on the southeast part with Akwa Ibom State but with Rivers State on the southern and southwest side. However, the western and northwest borders are shared with Imo and Anambra States respectively. The entire State is divided into seventeen (17) administrative units called Local Government Authorities (LGAs).

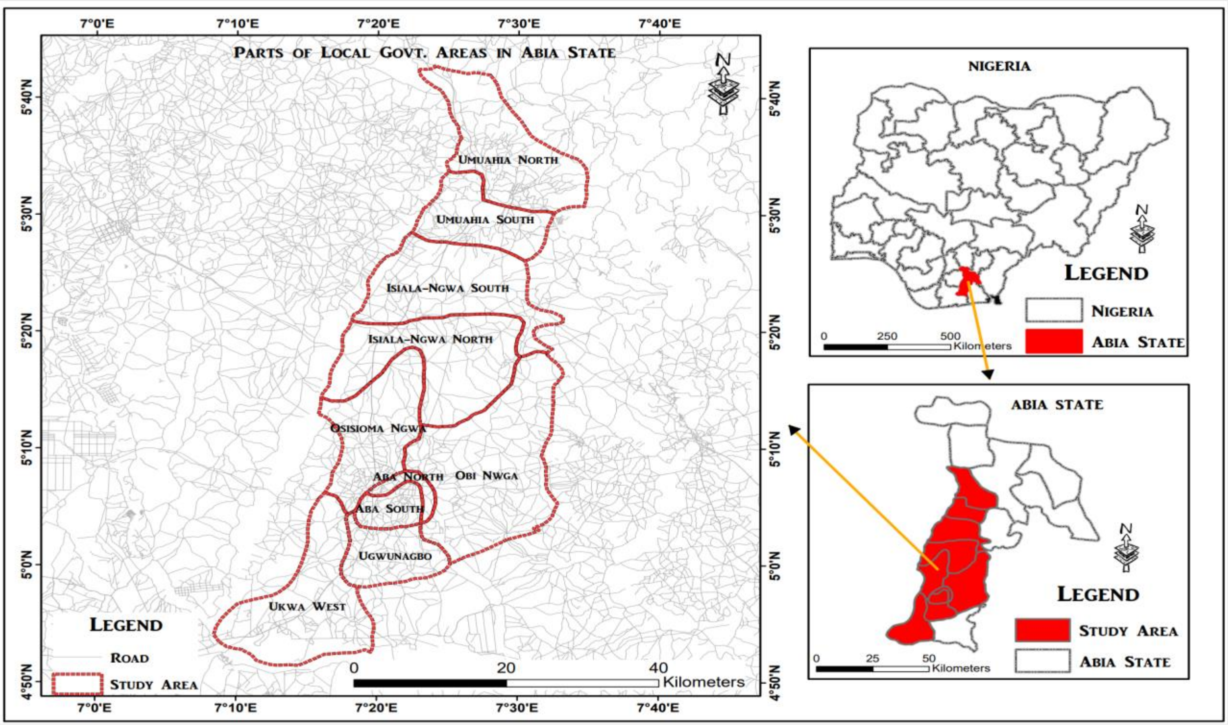
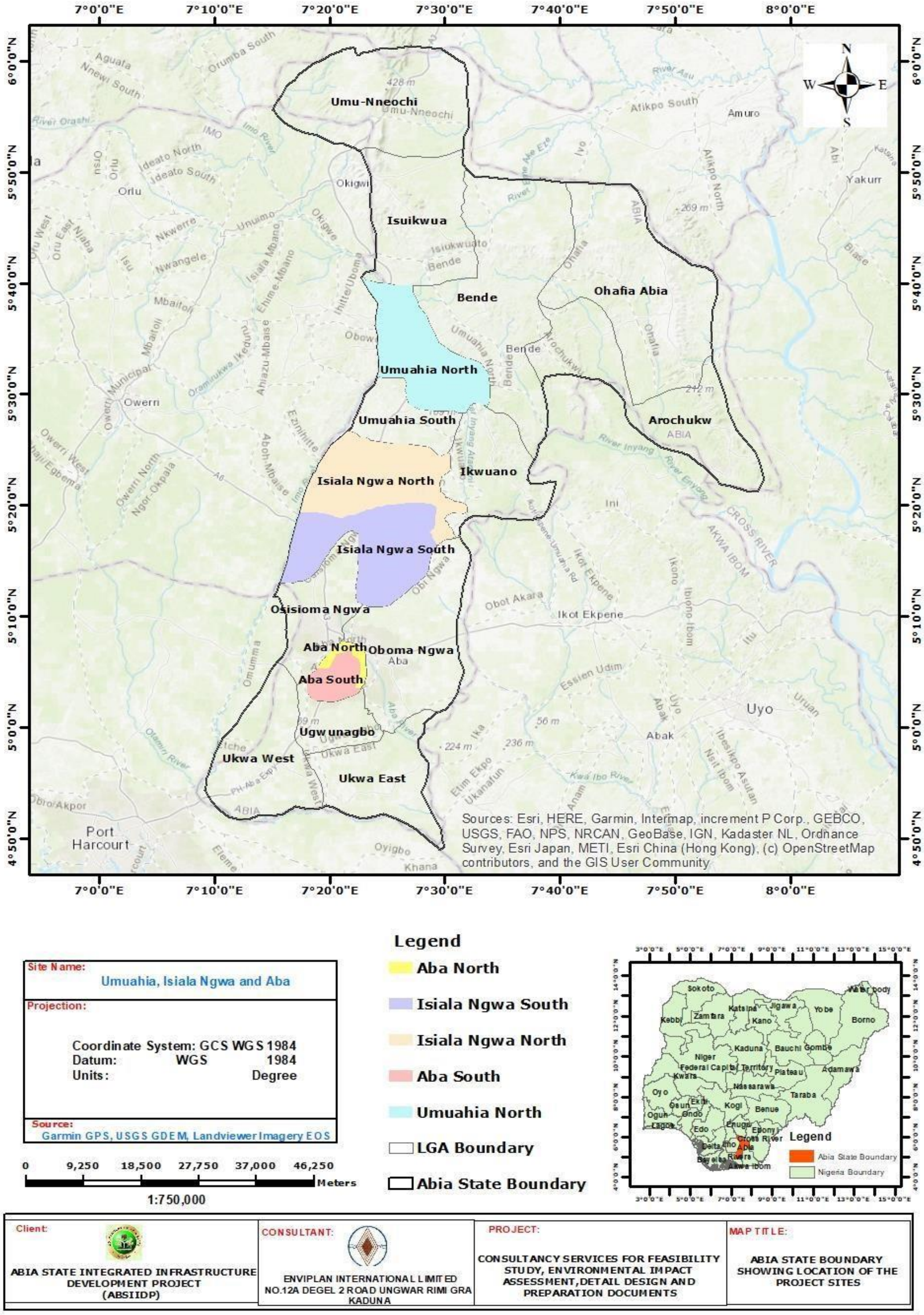
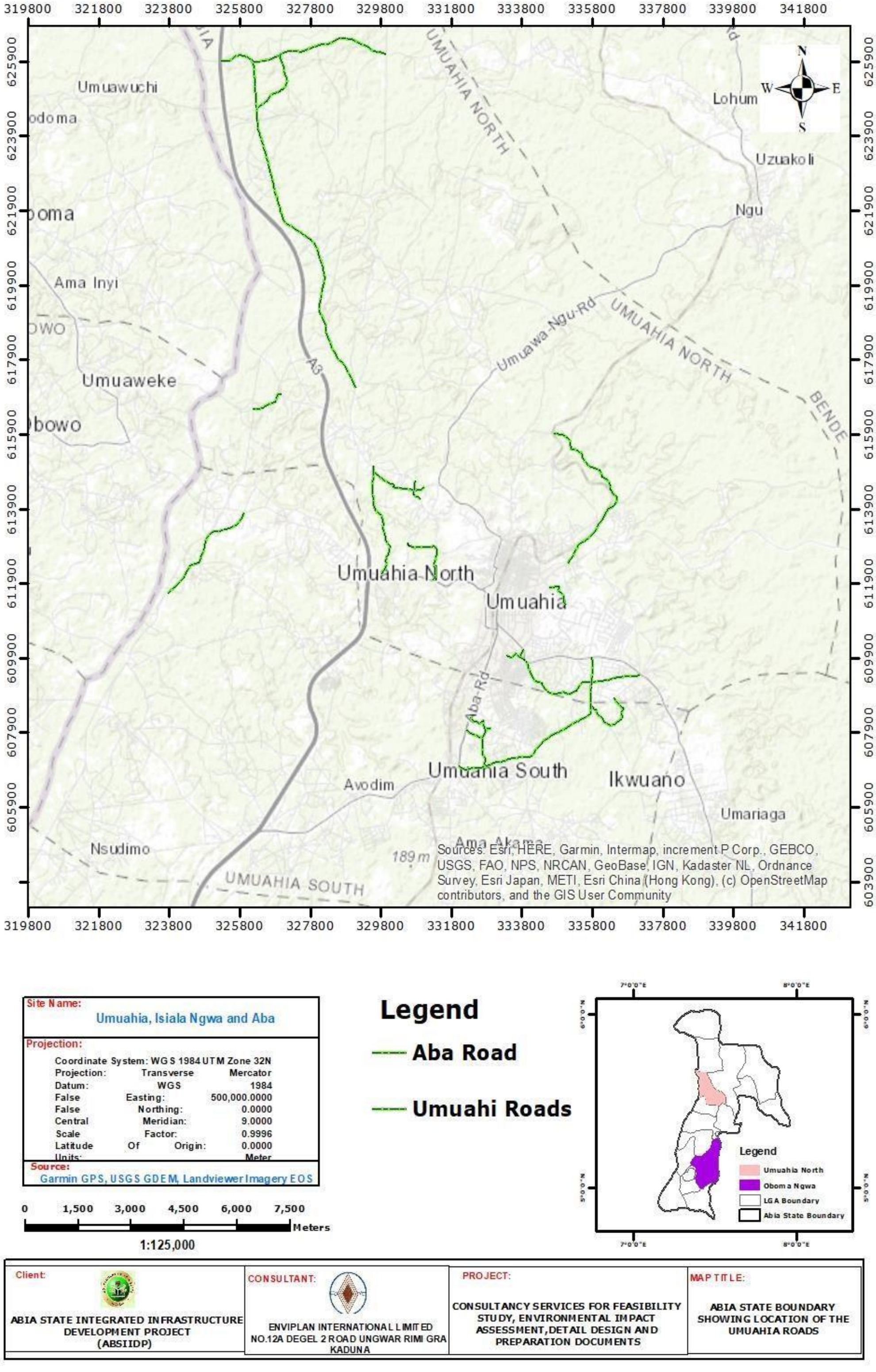


Figure 3.1: Map of Nigeria with Abia State and the LGAs for the Proposed Project



Map 3.2: Abia State Boundary Showing Location of the Project Sites



Map 3.3: Abia State Boundary Showing Location of Aba Roads

3.2. Overview Description of Project

The road transport intervention activities in Abia State will involve the rehabilitation and/or reconstruction of 31 roads in Aba segment spanning about 198.58 kilometres across the 10 Local Government Areas (LGA) of the state and as listed in Table 3.1

All the roads networks are largely interconnected making the planned project to have potential to create state-wide impact. The road upgrade activities on the selected roads will involve medium-sized civil engineering works entailing earthworks, provision of lateritic base, side drains, concrete culverts and river crossing infrastructure. The affected roads will be upgraded to flexible bituminous pavement standard surface finishing, having a carriageway width of 7.3 meters (for single lanes) and 1.5 meters wide concrete drainage with slab covers to serve as walkway. Drainages will be rehabilitated where they already exist

The roads are in dilapidation and the predominant issues challenging them include:

- Erosion and pot-hole vulnerability putting the roads in dilapidated conditions
- Flat topography leading to serious drainage challenges resulting in perennial flooding and erosion
- Narrow portions of roads
- Poor management of water-shed and waste which has negatively affected the urban road infrastructure imitation in the effective and efficient transportation of agricultural produce, and access to markets.

The identified roads for rehabilitation are presented in Table 3.1 below: Some of the project roads that exhibit these road difficulties are shown in Plate 3.1.

Table 3. 1: List of Proposed Roads for Rehabilitation in Aba

Road ID	Section of the road	Current Status	Coordinates	Length Km	Location/Local Government Area
1	Asa Road-Port Harcourt	Dilapidated Pavements	0315027- 0319479 0560457- 0565299	7.78	Aba south
2	Faulks Road	Built up area; fail portions	03176931- 0314713 0564707- 0566619	4.59	Aba south
3	Ohanku Road- Owerre Aba	Dilapidated Pavements. Built-up area	0319940- 03208115 0554086 –	6.61	Aba South

Road ID	Section of the road	Current Status	Coordinates	Length Km	Location/Local Government Area
			0563896		
4	Omuma Road	Fail portions; Intervention ongoing	0315706-0318335 0564424-0565129	2.14	Aba South
5	Ikot Ekpene Road	Dilapidated Pavements; Built-up area	0319591-0325482 0564991-0565691	6.82	Obingwa
6	Mbubo Umuogele Amachi Mgbokonta	Earth Road	0333713-0334509 0594563-0595230	12.72	Isiala Ngwa South & North
7	Umuala Nbawsi Eziala Osusu Okpuala Ngwa	Dilapidated Pavements	03225847-0330387 0594196 -0595924	12.64	Isi Ala-Ngwa North
8	Omoba-Umuaja Amaede Ndiolumbe	Earth Road	0324698-0331032	8.17	Isi Ala-Ngwa South
9	Mbawsi Layout-Ururuka	Dilapidated Pavements	0327651-0331850 0595407-0597752	1.87	Isi Ala-Ngwa North
10	Glass Factory Road	Earth Road	0320659-0321184 0566591-0570801	1.64	Obingwa & Aba North
11	Umuomiaukwu Agburike Umuomainta	Earth Road	0324294-0326793 0595941 -0599892	4.83	Isi Ala-Ngwa North
12	Uratta-Ugwuati	Earth Road	0308408-0314646 0559708-	9.58	Aba South & Ukwa west

Road ID	Section of the road	Current Status	Coordinates	Length Km	Location/Local Government Area
			0562268		
13	Crystal Park Junction-Obohia Road	Dilapidated Pavements	0317135 - 0318683 0555153- 0564042-	22.05	Aba South & Ugwunagbo
14	Immaculate Avenue-ITF Road Bridge	Earth Road	0318029- 0318662 0567384- 0568149	1.52	Aba North
15	Umuaro Nenu Road	Earth Road	0331375- 0335289 0579695- 0583459	4.76	Obingwa
16	Eziama Ntigha-Nsirimo-Ubakala	Earth Road	0319997- 0325347 0601022- 0604947	9.07	Isi ala-Ngwa North & Umuahia South
17	Mgboko-Omoba Umuezeukwu Mbwawsi Road	Earth road	0321322- 0324021 0573317- 0582722	6.85	Obingwa, Isi Ala-Ngwa South & North
18	Ibeme Ndiakata-Nlagu Onicha Ngwa	Earth road	0335196- 0336751 0561474- 0568326	2.82	Obingwa
19	Pepple Road-Akpu Road	Earth Road	0321484- 0321726 0564007- 0564991	1.20	Obingwa
20	Umuokpo-Ahiafor	Failed	0331472-	4.30	Obingwa

Road ID	Section of the road	Current Status	Coordinates	Length Km	Location/Local Government Area
	Link Road	portions; Intervention on going	0333611 0567374- 0570724-		
21	Owerra Aba-Osusu Umuelendu-Osusuaku	Dilapidated Pavements	0305248 - 0312055 0566814- 0568733	4.01	Osisioma
22	Umuojima Amapuife Eberi Omuma	Dilapidated Pavements	0314837 - 0317330 0568108- 0568645	9.98	Osisioma & Ukwa West
23	Umuimo Carol Pee. Ministry of Agric. Shopping Mall	Dilapidated Pavements	0307680- 0308376 0559701- 0563393-	1.49	Osisioma
24	Ugwuati-Umuiku	Dilapidated Pavements	0307680- 0308376 0559701- 0563393	4.01	Ukwa west
25	Isicourt-Ururuka Umuosu Umuala Umunkpeyi	Dilapidated Pavements	0331827- 0333640 0594082- 0604693	20.62	Umuahia South & Isi Ala-Ngwa South & North
26	Ama Emereole-Ekeonyeugba-UmokoromiriEketa	Dilapidated Pavements	0318731 - 0321751 0585138- 0587543	7.25	Isi Ala-Ngwa South
27	Ajiwe-Brass	Dilapidated Pavements	0317917 - 0317980 0566840 – 0567380	0.63	Aba North
28	Ahunanya-Immaculate	Earth Road	0317967 - 0318277	0.88	Aba North

Road ID	Section of the road	Current Status	Coordinates	Length Km	Location/Local Government Area
			0567809-0568014		
29	Oron Road-Elizabbeth Avenue-Sports Club	Dilapidated Pavements	0318397 - 0318869 0566201-0566706	0.70	Aba North
30	Umuala-Umuakwu-Ohuhu-Nsulu-Oloko Ikwuano	Dilapidated Pavements	0330380-0338079 0593027-0596380	13.70	Isi Ala-Ngwa North & Ikwuano
31	Itungwa-Agburukwe Road	Dilapidated Pavements	0330168-0333582 0574175-0575718	3.35	Obingwa
	Total length (Km)			**198.58**	10

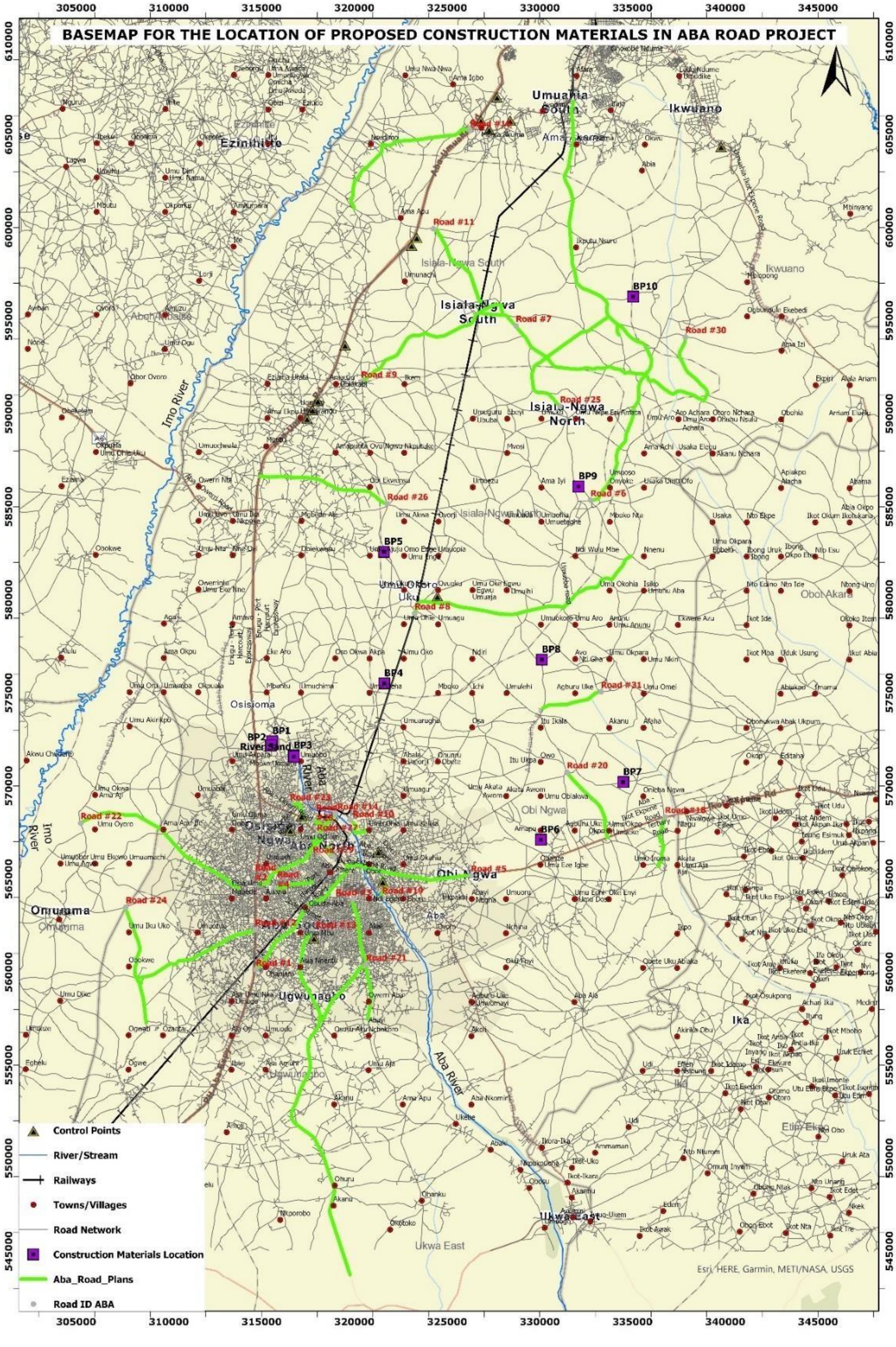
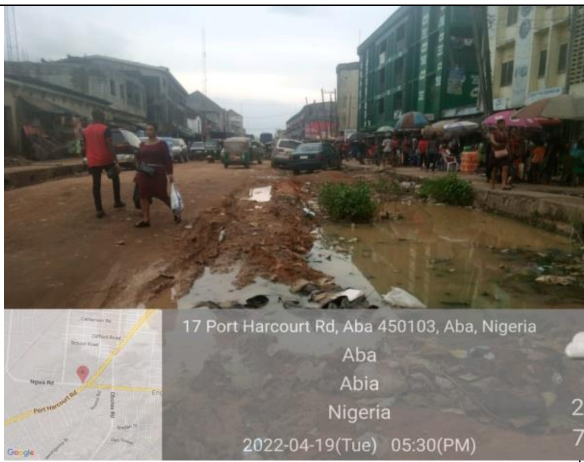


Figure 3.5 Base map for the location of proposed roads in Aba


17 Port Harcourt Rd, Aba 450103, Aba, Nigeria
Aba
Abia
Nigeria
2022-04-19(Tue) 05:30(PM)


45 Obohia Rd, Aba 450103, Aba, Nigeria
Aba
Abia
Nigeria
26°C
79°F
2022-04-19(Tue) 05:25(PM)


Shot on S11 lite
Gionee Dual Camera


Shot on S11 lite

Plate 3.1: Pictures of the current state of some of the roads in Aba

Plate 3.1b: Pictures of the current state of some of the Aba roads

3.3 Project Design

The proposed Aba roads have been designed to use the existing route alignments as much as possible to limit Environmental and Safety (E&S) footprint of the project. The route allows for a design which meets the *Draft Low Volume Roads (LVRs) Manual, 2016, Federal Ministry of Agriculture and Rural Development*, which was developed to adequately cater for the specific needs of rural roads in Nigeria, without any impediment and minimal re-alignment. Using the Draft LVR Manual approach, the project roads are expected to fulfill an access function, whereby the existing alignment is retained. Thus, the existing alignment dictates the travel speed (and hence, the horizontal and vertical alignments) depending on the terrain and existing roadside development. In cases where there are potential safety issues such as sharp crests and blind curves, appropriate countermeasures will be applied/installed on a site-specific basis.

3.4 Project Components and Ancillary facilities

The Project components would include the following:

- Road surface (paved or graded).
- Road reserve ("hard shoulder").
- Crossings (e.g. bridges, culverts).
- Drainage and erosion control structures.
- Safety and security measures (e.g. barriers and fencing).
- Other elements (e.g. signage).

The ancillary facilities will include the following:

- Lay-bys or service areas.
- Temporary construction facilities (e.g. workshops, laydown areas, working corridors outside the road reserve, workers' accommodation, and borrow pits)
- Security posts.
- Access roads within and between temporary facilities and the road being developed.
- Landscaping features, etc.

Construction activities will include:

- Establishing temporary access to work and ancillary areas, demarcating clearance zones, establishing access control.
- For road upgrading, erection of temporary diversions where needed to manage existing traffic.
- Clearance and leveling of the corridor, and major earthworks where required (e.g. cuttings, embankments).
- Location and development of borrow pits (and possibly quarries), import of materials, e.g. gravel, clay, bitumen.
- Sourcing and establishing of a water supply from surface and/or groundwater.
- Improvement of existing drainage and introduction of new road drainage, including culverts if required.

- Surfacing and sealing of the carriageway, including use of bitumen mixing plants where the road is to be sealed.
- Water crossings, e.g. construction or upgrading of bridges and culverts, including concrete batching for structures.
- Establishment or improvement of safety arrangements e.g. modification of camber, barriers, improving sight lines.
- Landscaping, as required

3.5 Engineering/Geometric Design

Geometric design is part of highway design which is the process whereby the layout ofthe road in specific terrain is designed to meet the needs of the road users, keeping in view the road function, type and volume of traffic, potential traffic hazards and safety, capital cost, maintenance costs, vehicle operating costs, environmental impacts, aesthetics as well as convenience of the road users. In particular, geometric design of a road is the design of the visible dimensions of a highway with the objective of forming or shaping the facility to suit the characteristics and behavior of drivers, vehicles and traffic.

It deals with features of location, alignment, profile, cross section, intersection and highway types with the following objectives under consideration:

1. Provide the simplest geometry attainable, consistent with the physicalconstraints,
2. Provide a design that has a reasonable and consistent margin of safety at the expected operating speeds.
3. provide a facility that is adequate and convenient to all the road users at theexpected traffic conditions,
4. Provide a facility that is Stable and Sustainable
5. Provide a facility that is in harmony with the community and preserves environmental, scenic, aesthetic, historic, and built and natural resources of thearea.
6. Provide a facility that has acceptable economic returns

The main geometric features are:

- The horizontal alignment;
- Vertical alignment; and
- Road Cross Section

Besides these main features, geometric design involves design of the road structure and safety enhancing structures and elements.

The process of geometric design usually encompasses design considerations resulting from multi-disciplinary studies which try to define the various contexts of the project road. Accordingly, geometric design has to be carried out in a context sensitive manner. Context Sensitive Design is a collaborative, interdisciplinary approach that involves all constituents to develop a transportation facility that fits its physical setting and preserves scenic, aesthetic, historic and environmental resources, while maintaining safety and mobility to all road users, and enhancing the economic, social and other needs of the society.

In terms of this concept, it is assumed that every project is unique which requires designers to address the needed roadway improvements while safely integrating the design into the unique surrounding natural and built environment.

And Geometric design standards often define parameters and limiting values considering the following three main objectives: -

- To ensure safety and comfort of drivers;
- To ensure that the road is designed economically; and
- To ensure uniformity of the alignment

Having these in mind, the consultant team of experts has carried out assessment of the project road corridor which is existing alignment and geometric design standards have been established.

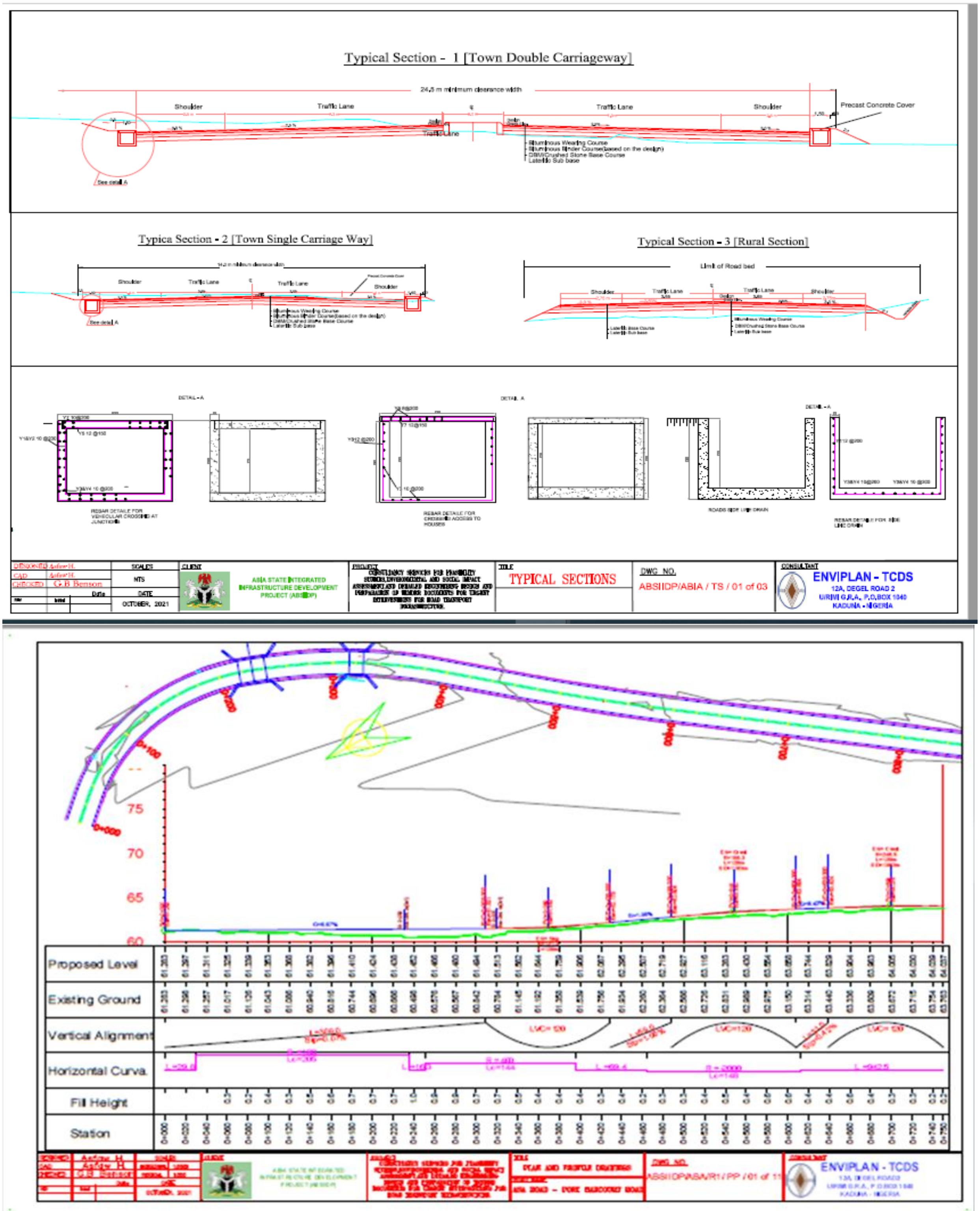


Figure 3.5: Road profile of the Aba Road project

3.6 Road Design and Structural Standards

3.6.1 Functional Classification

Road function is basically related to the most common types and purposes of travel, trip and character of service the roads provide. The character of service can broadly be understood as mobility, access and a mixture of Mobility and Access.

For mobility, high or continued speed are desirable and variable or low speeds undesirable, for land access, low speeds are desirable and high speeds undesirable.
Once the function of a road is established, then appropriate design criteria can be applied to encourage the use of the road as intended. Design features that can convey the level of functional classification to the driver include width of roadway, continuity of alignment, spacing of intersection, frequency of access points, building setbacks, alignment and grade standards, and traffic controls.

In the Nigeria context road classification is based on the function of the road it serves. In line with this the Federal Republic of Nigeria Highway Manual part 1: design, 2013, has classified the existing roads based on the function they serve. It has also set terms on which future road classification should base.

Hence the roads classify into Four (4) categories based on the character of service they provide. These are

1. Class A: National Trunk Roads
2. Class B: Primary Roads
3. Class C: Secondary Roads
4. Class D: Minor Roads

According to Nigeria Geometric Design Manual, various factors influence selection of road geometric standard also considered and further classification has been done based on design traffic volumes given in ADT terms in table 3.2 follows:

Table 3.2 Relation of ADT and Functional class of the road

Functional class	Class	ADT(Veh/d)	Minimum Design speed Km/h
Class A: National TrunkRoads	A1 Freeways in rural areas	15,000	100
	A2 Freeways in metropolitan areas	20,000	100
Class B: Primary Roads	B1 primary Rural arterials	8,000-10,000	80

	B2 primary metropolitan arterials	Design in context in which itoperates	80
Class C: Secondary Roads	C1	>4000	80
	C2	500-4,000	80
	C3	<500	60
Class D: MinorRoads			40

Since most of the roads under design is linking locally important centers to each other, to a more important Centre, or to a higher class of road (rural/market center's) and linkage between locally important traffic generators and their rural hinterland, the roads are classified as Class C.

The classified roads are shown in Table 3.3 for the Aba city.

3.6.2 Traffic Volume and Characteristics

Road standards are also selected based on the road intended capacity to accommodate traffic. Normally, for high traffic volumes a higher set of design standard (i.e, wider carriageways, gentle curves, flatter vertical gradient, full overtaking distances etc.) are anticipated while the vice versa is true for low traffic.

For all project roads traffic count and analysis was conducted at selected locations. Motorized traffic was counted for 12hours for 4days and 14hours for 3 days. In some roads traffic count take place for 12-14 hours due to security problems. Then Current ADTs were established based on data from traffic surveys.

Pursuant to the traffic count finding, ADT, along with the road functional classification, the road class has been determined for design standard and parameter selection.

3.6.3 Design Standard

It has been indicated in the Terms of Reference that the Federal Republic of Nigeria Highway Manual part 1: design, 2013 shall be used for the design and a summary of the design standard is shown in the tables below.

Table 3.3: Design Standards for Collector Roads

Item	Design controls and elements of design	Limiting values for design
Design Controls	Road Functional Classification	Collector Road
	Design Traffic volume	ADT Varies from 77 and 5,624 Veh/D
	Geometric Design standard	Class C: Secondary Roads

Item	Design controls and elements of design	Limiting values for design				
	Terrain and land use	Rural			Village	Town
	Design speed (km/hr)	100	80	60	50	50
	Stopping sight distance (m)	185	130	85	65	
	Minimum Passing sight distance (m)	670	540	410	345	
	Percent passing opportunity(%)					
Horizontal Alignment	Minimum Horizontal curveradius	437	252	123	86	
	Maximum super elevation	6%	6%	6%	4%	
Vertical Alignment	Maximum Gradient (Absolute)	6%	7%	8%	9%	
	Maximum Gradient (Desirable)	3%	4%	5%	6%	
	Minimum Gradient	0.3 %	0.3%	0.3%	0.3%	0.3%
	Limiting K-factor for crest vertical curves (stopping sight distance)	52	26	11	7	
	Limiting K-factor for sag vertical curves (stopping sightdistance)	45	30	18	13	
Cross section Elements	Type of Surfacing	Asphalt Concrete/DBST				
	Lane width/cross fall	3.65 m/2.5%				
	Shoulder surfacing/width/cross fall	(Same with carriageway in towns/Earth) /2.75m/3%				
	Parking lane width/cross fall	2.5m/2.5% (at selected place)				

Table 3.4 Design Standards for Arterial Roads

Item	Design controls and elements of design	Limiting values for design			
Design Controls	Road Functional Classification	Arterial Road			
	Design Traffic volume	ADT Varies from 8,506 and 22,200 Veh/D			
	Geometric Design standard	Class B: Primary Roads			
	Terrain and land use	Rural		Village	Town
	Design speed (km/hr)	100	80	80	60
	Stopping sight distance (m)	185	130	130	85
	Minimum Passing sight distance (m)	670	540	540	410
	Percent passing opportunity(%)				
Horizontal Alignment	Minimum Horizontal curveradius	437	252	252	123
	Maximum super elevation	6%	6%	4%	4%
Vertical Alignment	Maximum Gradient (Absolute)	6%	7%	7%	8%
	Maximum Gradient (Desirable)	3%	4%	4%	5%
	Minimum Gradient	0.3%	0.3%	0.3%	0.3%
	Limiting K-factor for crest vertical curves (stopping sight distance)	52	26	26	11
	Limiting K-factor for sag vertical curves (stopping sightdistance)	45	30	30	18
Cross section Elements	Type of Surfacing	Asphalt Concrete			
	Lane width/cross fall	3.65 m/2.5%			
	Shoulder surfacing/width/cross fall	(Same with carriageway in towns/Earth) /2.75m/3%			
	Parking lane width/cross fall	2.5m/2.5% (at selected place)			

3.6.4 Terrain Classification

The terrain of the land traversed by a road has a direct influence on the geometric design of the road. Although the type of terrain has an effect on the geometric design parameters of the design process, it is more evident in its effect on vertical alignment.As per ORN 6, A Guide to Geometric Design, ground terrain properties are categorized into the following classes:

Flat: 0-10 five-meter contours per km.

Rolling: 11-25 five-meter contours per km.

Mountainous: Above 25 five-meter contours per km.

Accordingly, as per the above classification system the project route in Aba city is45% flat, 7.0% rolling and the remaining portion which covers 48% is urban area.

3.6.5 Horizontal Alignment

Horizontal alignment as an entity consisting of a series of straight sections (tangents), circular curves, transition curves (spirals) and super-elevation. Horizontal curves are major components of the horizontal alignment which make smooth transitions betweenconsecutive tangents. They are designed to ensure that vehicles can negotiate them safely. The alignment design should be aimed at avoiding sharp changes in curvature, thereby achieving a safe uniform driving speed.

Preliminary Geometric design of the selected route has been carried out using CAD aided Design Software by using survey data. Horizontal curves have been introduced between tangents in order to create smooth transitions ranging from 25m radius to, maximum of 7000m radius.

3.6.6 Vertical Alignment

Vertical alignment is made up of vertical curvature which is governed by sight distancecriteria and gradient which is related to vehicle performance and level of service. Vertical curves are required to provide smooth transitions between consecutive gradients. The selection of rates of grade and lengths of vertical curves is based on theassumptions about characteristics of the driver, the vehicle and roadway.

The preliminary horizontal and vertical alignment designfor the project roads as per the design standard discussed above has been completed. These are shown in complete set of drawings, submitted separate documents.

3.6.7 Cross-Section Elements

Road width

Lane width has a significant influence on the safety and comfort of the traveling public.The capacity of a roadway is noticeably affected by the lane width.

Road width should be minimized so as to reduce the costs of construction andmaintenance whilst being sufficient to carry the traffic loading efficiently and safely. And the Nigerian Geometric design manual volume I recommends the minimum width of traveled way based on the traffic volume and design speeds as shown in the table below.

Table 3.5: Minimum widths of surfacing for Two Lane Highways

Minimum Widths of Surfacing in Metres for Design Volumes of:					
Design Speed Km/h	Current ADT 50 - 230	Current ADT 250 - 400	Current ADT 400 – 750 DHV 100 - 200	DHV 200 - 400	DHV 400 and over
50	6.0	6.0	6.0	6.0	7.3
60	6.0	6.0	6.7	6.7	7.3
80	6.0	6.0	6.7	7.3	7.3
100	6.0	6.7	6.7	7.3	7.3

According to the above manual, the project ADT for each segment found from traffic analysis and considering the requirement of TOR, the minimum width of the traveled way selected is 7.3 m for single carriage way and travelled way of 14.6 m, for double carriage way. In the town section, 2m of median is used for double carriage way roads. And these are adopted in the preliminary design accordingly.

Cross Slope

The selection of pavement cross slope should be a compromise between meeting the drainage requirements and providing for smooth vehicle operation. The normal cross fall of 2.5% is provided for the entire length of the project as is recommended by the Federal Republic of Nigeria Highway Manual part 1: Design, 2013.

Shoulder width

Shoulder as the portion of the roadway contiguous to the carriageway for the accommodation of stopped vehicles; traditional and intermediate non-motorized traffic, animals, and pedestrians; emergency use; the recovery of errant vehicles; andlateral support of the pavement layers.
In this preliminary design, shoulder width of 1.2m and 3.0m in the left and right of traffic respectively for divided highways. 2.5m width of shoulder is adopted in the two-lane rural section of the project.

Shoulder cross slope

As the shoulder serves as a continuation of the drainage system, a shoulder cross slopeof 3% to the right of direction of travel of traffic and shoulders to the left at the rate of 2.5% towards the median are provided in the preliminary design as per a recommendation by that the Federal Republic of Nigeria Highway Manual part 1: design,2013.

Side and Back Slopes

The slopes of embankment and cut sections depend upon the type of soil and height ofembankment or depth of cuttings. Slopes are provided in the design as per the followingtable which is extracted from the Federal Republic of Nigeria Highway Manuals.

Table 3.6 Side and Back Slope table

Material	Height of Cut Slope (m)	Side Slope (V:H)		Height of Fill Slope (m)	Back Slope
		Cut	Fill		
Earth Soil	0.0 - 1.5	1:4	1:4	0.0 – 3.0	1:3
	1.5 - 6.0	1:3	1:3	3.0 - 9.0	1:2
	> 6.0	1:2	1:2	> 9.0	2:3
Strong Rock	0.0-2.0	4:5			2:1
	>2.0	1:1			4:1
Weathered Rock	0.0-2.0	2:3			2:1
	>2.0	1:1			3:1
Decomposed Rock	0.0 - 1.0	1:3			1:3
	1.0 - 2.0	1:2			1:2
	> 2.0	2:3			2:3
Black Cotton Soil (expansive clays)	0.0 - 2.0m	1:6			-
	Over 2.0m	1:4			

Sidewalks

A 1.5 m width of sidewalk for single and double carriage way is provided in towns/village seats, respectively. The cross slope of this sidewalk is kept at 2.0%.

1. Typical Cross Section

As per the nature of the project roads, three types of cross-sections have been proposed. These are: -

1. Typical Section–1: Town Double carriageway
2. Typical Section-2: Town single carriageway
3. Typical Section-3: Normal rural typical cross section

The detail of the geometric configuration of the roadway elements is shown in the proposed typical sections represented in the Appendix – I of this report.

3.7 Pavement Structure Design

3.7.1 General

Pavements are the main structural elements of road that carries the load imposed fromwheel loads of the traffic and distributes to the underlying subgrade layer. The aim of pavement design is to select the most economical pavement thickness and quality of pavement material which will limit the stresses induced in the subgrade by the anticipated traffic loading to a safe limit and to ensure the road pavement layers themselves do not deteriorate beyond tolerable level of serviceability before the designperiod.

The basic inputs for the design of the pavement structures are the Design Subgrade Strength and the Design Traffic Class. The availability of suitable and sufficient quantity of construction materials are also vital input for an economical design of the pavement.

The pavement thickness is designed based on the Nigerian Federal Highway Manual Part 1 of 2013. This follows specified pavement structure that depends on defined traffic catalogue [Tn] and subgrade strength catalogue [Sn]. It is believed that the manual has been prepared taking into consideration past experience and practice together with the existing situation of the country. It is the current applicable standard of the country.

This section discusses about traffic class, design CBR & sub grade strength class, and pavement thickness design.

3.7.2 Pavement Design Life

As per the Terms of reference, the recommended design period is same as the economic evaluation year, which is 20 years.

Traffic and the generated traffic component are projected over the project design period, 20 years, to estimate the anticipated cumulative traffic volumes over the design period.

The design traffic will be obtained by evaluating the Cumulative Equivalent Standard Axle load (CESA) over the design life. The necessary parameters to determine the CESA are discussed below.

3.7.3 Pavement Structure Thickness

The pavement design is performed using Appendix C, Pavement Design Catalogue recommended in the Federal Republic of Nigeria, Highway Manual Part 1: Design, Volume III: Pavement and Material Design, 2013. The pavement will be designed for a combination design traffic class and Design subgrade strength Class.

The recommended pavement structure for all carriageways is presented in Tables 3.7 and 3.8 for different pavement type options.

Table 3.7 Proposed AC Pavement Thicknesses for Aba City Roads

Road ID	Road Name	Asphalt Wearing Coarse	Granular Road Base	Sub-base
		(mm)	(mm)	(mm)
1	Asa Road – Port Harcourt Road	50	250 (DBM)	250
2	Faulks Road	50	250 (DBM)	250
3	Ohanku Road – Owerre Aba	50	250 (DBM)	250
4	Omuma Road	50	250	150
5	Ikot Ekpene Road	90	250 (DBM)	100
6	Mbubo Umuogele Amachi Mgbokonta	50	250	175

7	Umuala Nbawsi Eziala Osusu Okpuala Ngwa	50	200	275
8	Omoba – Umuaja Amaede Ndiolumbe	50	200	175
9	Mbawsi Layout – Ururuka	50	175	150
10	Glass Factory Road	50	200	275
11	Umuomiaukwu Agburike Umuomainta	50	175	250
12	Uratta – Ugwuati	50	200	175
13	Crystal Park Junction - Obohia Road	50	175	200
14	Immaculate Avenue – ITF Road Bridge	50	150	100
15	Umuaro Nenu Road	50	175	125
16	Eziama Ntigha – Nsirimo – Ubakala	50	175	200
17	Mgboko –Omoba Umuezeukwu Mbawsi Road	50	175	250
Road ID	**Road Name**	**Asphalt Wearing Coarse**	**Granular Road Base**	**Sub-base**
		(mm)	(mm)	(mm)
18	Ibeme Ndiakata- Nlagu Onicha Ngwa	50	175	125
19	Pepple Road - Akpu Road	50	200(DBM)	250
20	Umuokpo- Owo Ahiafor Link Road	50	150	250
21	Owerre Aba – Osusu Umuelendu – Osusuaku	100	250	250
22	Umuojima Amapuife Eberi Omuma	50	250(DBM)	250
23	Umuimo Carol Pee. Ministry of Agric. Shopping Mall	50	150	150
24	Ugwuati – Umuiku	50	150	150
25	Isicourt- Ururuka Umuosu Umuala Umunkpeyi	50	150	225
26	Ama Emereole – Ekeonyeugba – Umokoromiri-Eketa	50	175	150
27	Ajiwe – Brass	50	175	150
28	Ahunanya – Immaculate	50	250(DBM)	150
29	Oron Road – Elizabbeth Avenue – Sports Club	125	225	175
30	Umuala - Umuakwu - Ohuhu Nsulu – Oloko Ikwuano	50	150	250
31	Itungwa – Agburukwe road	50	175	200

Table 3.8 Proposed DBST Pavement thicknesses for Aba City Roads

RoadID	Road Name	Granular Road Base	Sub-base
		(mm)	(mm)
1	Asa Road – Port Harcourt Road*		
2	Faulks Road*		
3	Ohanku Road – Owerre Aba		
4	Omuma Road	200	150
5	Ikot Ekpene Road*		
6	Mbubo Umuogele Amachi Mgbokonta		
7	Umuala Nbawsi Eziala Osusu Okpuala Ngwa	250	275
8	Omoba – Umuaja Amaede Ndiolumbe	250	200
9	Mbawsi Layout – Ururuka	250	150
10	Glass Factory Road	250	275
11	Umuomiaukwu Agburike Umuomainta	200	300
12	Uratta – Ugwuati	250	200
13	Crystal Park Junction - Obohia Road	200	200
14	Immaculate Avenue – ITF Road Bridge	150	150
15	Umuaro Nenu Road	200	150
16	Eziama Ntigha – Nsirimo – Ubakala	225	200
17	Mgboko –Omoba Umuezeukwu Mbawsi Road	225	250
18	Ibeme Ndiakata- Nlagu Onicha Ngwa	225	150
19	Pepple Road - Akpu Road		
20	Umuokpo- Owo Ahiafor Link Road	250	300
21	Owerre Aba – Osusu Umuelendu – Osusuaku	250	350
22	Umuojima Amapuife Eberi Omuma	200	150
23	Umuimo Carol Pee. Ministry of Agric. Shopping Mall	200	175
24	Ugwuati – Umuiku	200	200
25	Isicourt- Ururuka Umuosu Umuala Umunkpeyi	200	300
26	Ama Emereole – Ekeonyeugba –Umokoromiri-Eketa	200	200
27	Ajiwe – Brass	200	150
28	Ahunanya – Immaculate		
29	Oron Road – Elizabbeth Avenue – Sports Club	200	350
30	Umuala - Umuakwu - Ohuhu Nsulu – Oloko Ikwuano	250	300
31	Itungwa – Agburukwe road	200	250

3.8 Hydraulic Design

3.8.1 General

This involved evaluating the existing hydraulic structure for adequacy, economy and sustainability of the drainage system with respect to site conditions and design discharge. This include design of the waterway and selection of appropriate drainage structure. The main objective of this task was to determine the size of opening of the drainage structure from the rate of flood runoff (discharge) and the volume of runoff that will pass through the watercourse crossings (bridge andculverts).

3.8.2 Modelling Bridge Design

The following were the criteria used for the hydraulic analyses to determinethe sufficiency of the bridge. Simple spread sheets were used for the analysis.

Design Floods: Design floods were established for purposes of evaluation ofbackwater (afflux), clearance, and overtopping.

Backwater: Backwater and/or increases over existing condition of up to 0.5 m during the passage of the 100-year flood, if practicable, were allowed. Further, backwater shall not significantly increase flood damage to propertyupstream of the crossing.

Clearance: A minimum clearance conforming to the requirements of the Bridge Design manual was provided between the water surface elevation andthe low chord (soffit) of the bridge to allow for passage of debris. Clearance (free board) was according to recommendations of AASHTO Design Manual whose values are as stated in Table 3.9.

Table 3.9 Freeboard recommendation (AASHTO Design Manual)

Discharge, Q (m3/s)	Freeboard (m)
0 – 3.0	0.3
3.0 -30	0.6
30 -300	0.9
> 300.0	1.2

3.8.3 Hydraulic Design Modelling of Box Culverts

For the design of small drainage structures, the use of inlet control with a ratio of upstream head to the height of culvert of 1.2 was used, which was lower than the 1.5 recommended. This yields approximately the optimum hydraulic section, and was used for determining the height of embankment over the culvert taking the norms for freeboard into account.

However, for larger culverts, the following design limitations are required:

Allowable Headwater is the depth of water that can be impounded at the upstream end of the culvert that will be limited by one or more of the following:

Non-damaging to upstream property: No higher than the shoulder or 0.3 m below the edge of shoulder; Equal to an HW/D not greater than 1.5; Not higher than the low point in the road grade; and/or Equal to the elevation where flow diverts around the culvert.

The Headwater is the flood depth that: Does not exceed 0.5 m increase overthe existing 100-year flood in the vicinity of buildings or dwellings, and has a level of inundation that is tolerable to upstream property and roadway for the review discharge.

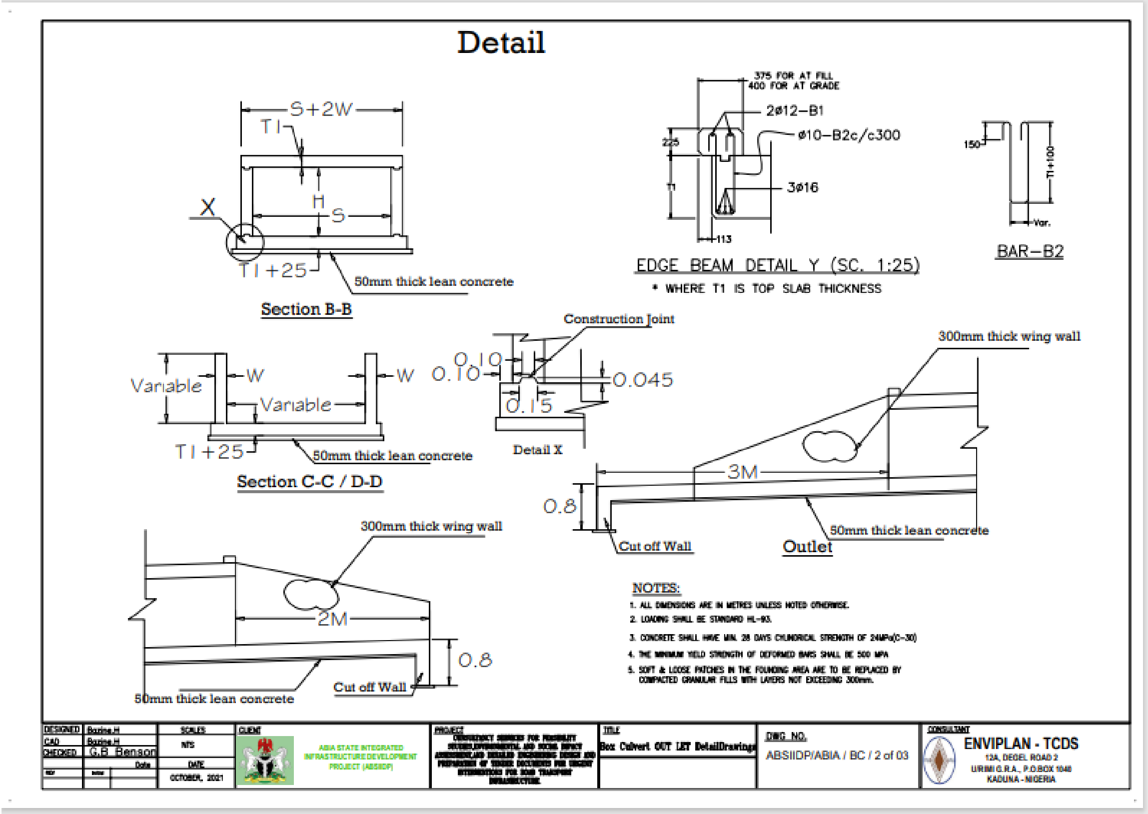


Figure 3.1 Box Culvert In Let And Out Let 02

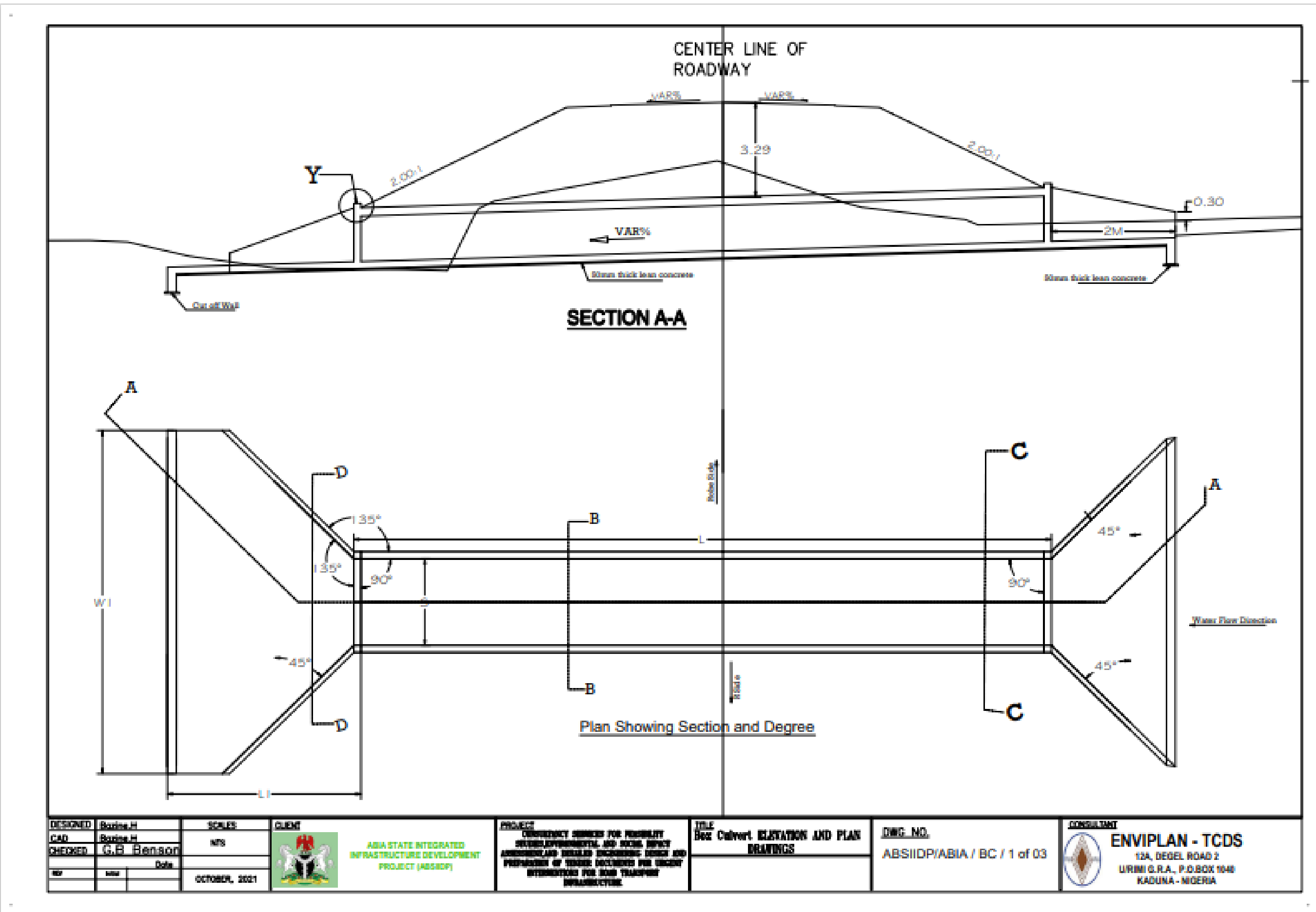


Figure 3.2 Box Culvert In Let And Out Let 01

3.9 Bridges and Structures

3.9.1 General

Cross Drainage structures are the weakest links in the chain of a roadway. Hydraulically adequate, functionally efficient, structurally sound and economically affordable structures are required for a good road.

Based on the Federal Ministry of Works, Highway Manual Part 1 Design Volume V Structural Design and Complementary sections of AASHTO LRFD Bridge Design Specification (3rd Edit, 2005), the Limit States Design Method was adopted for the design of structures. Both Ultimate Limit State (ULS) and Serviceability Limit State (SLS) requirements were checked through explicit calculations, wherever necessary and implicit provision was also made,wherever found appropriate.

3.9.2 Width of structures

The width of bridges and box culvert structures were selected to adequately fit their proposed locations on the existing two-lane carriageway, the width of which conforms to requirements of the road width standard. The walkways were raised by about 25 cm above carriage way surface and railings shall be of height not less than 900 mm above the walkway. Total width of bridge is the distance between outside face of the outer parapet railings or barriers including walkways.

3.9.3 Loading

Vehicular loading combination of HL-93, in accordance with Federal Ministry of Works design manual and other pertinent loadings have been considered for the design of bridge structures. Accordingly, the following loads and forces have been carefully considered in the design of bridges and box culverts: DeadLoad; Live Load; Impact or dynamic effect of Live Load; Wind Loads; Stream Current Forces; Earth Pressure; Longitudinal Forces and Horizontal Forces at Bearing Level.

3.9.4 Analysis and Design

Each structure has been analyzed for various load combinations and designed for the most critical case in accordance with LRFD design principles in accordance with principles laid down in the Federal Ministry of Works Designed Manual, with additional reference to AASHTO 2012 design standards and other Hand Books and relevant texts. MIDAS bridge software of 2011 EXCEL spreadsheets were used for the analysis and design of all structures, i.e. RC girder bridge, box culvert, wing walls, Abutment, foundation, pier, etc

3.9.5 Sub Structure

All foundations were designed to carry loads and forces and combinations of loads subject to permissible stresses/pressures and factors of safety with tolerable settlements as specified in relevant sections of the standards. Generally, the resultant pressure on the toe side of the base of the footing will be less than allowable bearing pressure and no tension will be allowed onthe hillside except for sound rock foundation.

In the design of earth retaining walls, the factor of safety against overturningshall be 2.0 and for sliding shall be 1.5. All walls shall be designed to carry alive load surcharge, equivalent to 0.61m height of earth fill. The fill behind the abutments, gabion boxes and wing walls shall be freely draining. Non- expansive and non-corrosive material shall be used and water shall be drainedby weep holes.

3.9.6 Loading and analysis of all structures

The following material unit weights were considered for permanent loads:

c	=	24.0 kN/m3, concrete including reinforcement,
s	=	19.3 kN/m3, back fill material
w	=	22.5 kN/m3, for future asphalt wearing surface
m	=	27.3. KN/m3, stone masonry
Steel	=	78.5. KN/m3, (7.85Tone/m3)

Table 3.10: Summary Bridge and multiple box culvert Specifications and DesignCriteria

Item Description	Specifications and Design Criteria Adopted
Design Manual	Nigerian highway Design Manual Volume V structural design AASHTO Bridge Design Specification American Association ofState Highway and Transportation Officials (AASTHO) 444 North Capitol Street, NW Suite 249Washington, DC 20001 Overseas Road Note 9 (TRL 2000)
Design Method:	Load and Resistance Factor Design (LRFD)
Live Loading:	HL-93
Other Loadings:	According to Design Manuals Provision
Concrete (Class A):	Grade C30, f'c = 24 MPa on 150mm cylinder sample
Concrete (Class C):	Grade C15, f'c = 12 MPa on 150mm cylinder sample
Reinforcement steel:	Grade 420, with minimum Tensile strength of fy = 420MPa for Φgreater than 20mm, which is equivalent to old AASHTO Grade 60 or European Ks 60 and Grade 300, with minimum Tensile strength of fy = 300MPa for Φ less than 20mm, which is equivalent to old AASHTO Grade 40 or European B500B.
Software:	Midas civil bridge /, SAP 2000 14.0.0
Unit weight ofconcrete:	24.00 KN/m³
Unit weight of Wearingsurface:	22.50 KN/m³ - (0.03m of waterproofing membrane and 0.02m of double surfaced pavement).
Exposure condition:	Warm

Typical cross section:	1.50m curb (walkway) and a carriage way width of 7.32m
Curbs:	For Both sides including railing.
Bridge railing:	Concrete Post and Railing from standard drawings
Deck drainage:	100mm GIP
Bridge bearings:	Elastomeric Bearing
Freeboard:	Minimum freeboard stated on the Nigerian drainage design manual

3.9.7 Preliminary design

The preliminary structural design drawings will have:

- Preliminary General plan and elevation drawings: provide essential plans, elevations, dimensions, views of a bridge and sections of thebridge, but the elevation of the bridge should be mentioned.
- Preliminary Super structure Reinforcement details: show the amount and accurate placement of individual bar types,
- Preliminary Abutment and wing wall detail; -consists of detail geometric and reinforcement details; bridge parapet end and bridge bearing shelf details are also included.
- Preliminary Approach slab detail; shows all detail reinforcement and all the necessary dimensions on the slab.
- Ancillary details; shows all the details for elastomeric bearing and deck drain.
- Preliminary drawings multiple span box culverts
- Standard single box culvert drawing spanning 2m,3m and 4mconsisting of different clear height.
- Double box culvert drawing spanning 2m,3m and 4m consisting of different clear height.
- Standard pipe culvert drawings with different diameter of900mm,1200mm and1500mm of Sigle, double and triple.

3.9.8 Design Hydrology and Design Return Periods

The hydrological study was undertaken in order to compute and evaluate peakdischarges for the watercourse crossing. This involved site observations, condition survey and following the drainage design procedures contained in the design manual mentioned above. Calculation of these peak discharge values enabled the determination of the hydraulic opening sizes and types ofwaterway structure required.

On the basis of hydrological/hydraulic investigation and analysis and/or other pertinent requirements such as geometric and subsurface soil properties, theopening size and the span of the drainage structures were preliminarily determined.

3.9.9 Major drainage Design

Based on the above requirements and taking the preliminary hydrologist recommendation, the opening size of the bridge has been determined. Basically, the span size determination has been made based on the hydrologic/hydraulic requirements.

Moreover, the free board of the bridge structures has been made according to the Nigerian drainage design manual. The following table shows the provided bridge and multiple box culvert openings at different locations of the Aba road segments

Table 3.11 Major drainage multiple box culvert Aba road segments

Road #	Station	Type of structure	Discharge			Recommended size			Remark
			Q25 yr. (m3/s)	Q 50 yr. (m3/s)	Q100 yr. (m3/s)	Span (m)	No of Barrel	Height (m)	
Road#8	6+810	multiple box culvert	342.55	371.34	400.35	5.00	6.00	3	Total span 30m
Road #30	7+110	multiple box culvert	523.83	567.85	612.21	5.00	8.00	3	Total span 45m
Road#31	2+500	Multiple box culvert	485.28	528.72	570.36	5.00	8.00	3	Total span 45m

Table 3.12 Bridges opening of the Aba road segments

S/No.	Road ID	Station	Type of structure	River Channel Slope (m/m)	Design Discharge		Bridge Design Opening Size		
					for 50 Yrs Return Period	for 100 Yrs Return Period	Design Span (m)	No. of spans	Design Clear Depth (m)
1	Raod#5	0+970	T-Girder	0.5%	509.05	548.81	24.00	3.00	2.6

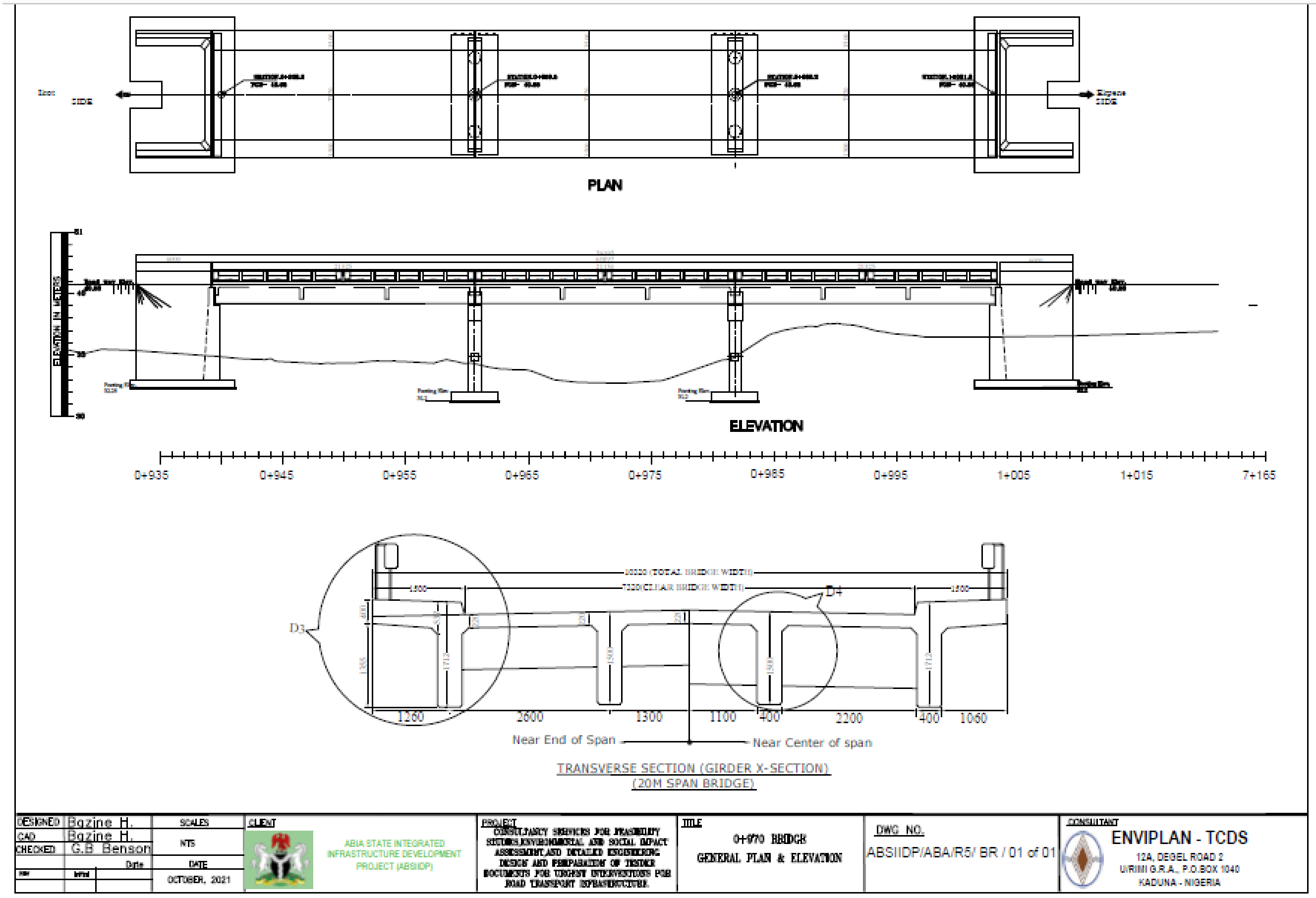


Figure 3.8: Bridge structure

3.10 Construction Method and Materials

The design consideration has assumed to make use of all available technologyand resources which include simple technique, available construction materials and labor input. In this line, the structures are mainly to be constructed using Reinforced Concrete and concrete. Accordingly, all super structural and sub-structures elements are to be of Reinforced Concrete,

- Reinforcement Steel: - The steel produce grade 60-reinforcement steel fordiameter of bar equal to and greater than 20mm, and grade 40 steel for those less than 20mm diameter. The minimum yield strength of grade 60 reinforcement steel is 420Mpa, while that of grade 40 is 300Mpa. These and other strength parameters are used in the design of thesuperstructures of the bridges. Minimum clear cover of reinforcing bars isrecommended and shown on drawings.
- Concrete: -Design parameters of C-30 concrete are used in the structural computations of superstructure of the bridges. These strength parametersare with a compressive strength of 30mpa for 150mm cube samples and 25mpa for 150mm cylindrical samples and for the plain concrete leveling at under all substructures C-15 class of concrete is used with strength parameters of a compressive strength of 15mpa for 200mm cube samples and 10mpa for 150mm cylindrical samples which

is also specified on design Drawings and technical specifications to be attained during construction stage. Resistance factors are recommended on the design manuals to account the Imperfection in production of these construction materials. Accordingly, the appropriate resistance factors for shear and bending moment of structural components were taken during the design of these components.

3.10.1 Design of Culverts (Minor Drainage Structures)

Based on the hydrology and hydraulic analysis there are 204 and 93 box culverts in number in Aba road segment, in which the size and type of each drainage structure is determined. Structuralstandard drawings have been adopted that can be appropriate with its corresponding soil type. However, structural analysis shall also be made whenlarger span (> 6.00m) is anticipated among the minor drainage structures.

3.10.2 Box Culvert

Provision of Box Culverts is recommended on weak soil with low bearing capacity and on submerged water flow (Orifice flow). Moreover, in accordance with channel geometry of the streams of the route of the project we came to introduce box culverts. The standard drawing is prepared for eachspan and depth with variable height of fill which is according to standard drawings.

3.10.3 Components of Box Culverts

- Headwalls of pipe culvert: For prefabricated or cast in place reinforced concrete Class 30 concrete headwalls& wing wall shall be provided. These retain and protect the embankment at the ends of the culvert and help to counteract the dislocation of concrete due to lateral earth fill forces at the base of embankment.
- Inlet and Outlet Structures: Depending on the natural ground condition, the position of the culvert, the longitudinal slope of the culvert, and the velocity of the outlet etc. inlet and outlet structures of types Shown on typicalinlet, outlet drawings or cascade shall be provided for each culvert.
- Erosion Protection: Scour control measures at culvert inlet and outlet shall be designed which includes, outlet channeling & concrete pitching at the inletand outlet with cut-off walls of each culvert as shown on the typical drawings.
- Culvert Skewness: In accordance with the angle of skew limits, skew culvertshall be provided for culverts with the reference of center line of the culvert and roadway profile.

The selection shall be based on:

1. Proper catchment of the flow
2. Standard requirement,
3. Past experience and appropriate engineering judgment

3.11 Project Phases

The project activities shall be carried out in phases of project life cycle i.e., mobilization or pre-construction, construction, and closure of construction phases:

3.11.1 Mobilization or Pre-construction Phase

This phase involves planning, Feasibility study & Engineering Design, Procurement of Works, securing various types of bonds & insurances, possession of site, land acquisition; land clearing, organizing the work site, construction of camp and site workshop; scheduling, initiating project resource requirement, organizing essential resources, land dispossession and property evaluation; relocation and compensation arrangements.

3.11.2 Construction Phase

This is the implementation phase, where the project plan is put into motion and the work of the project is performed practically on site. It is essential to maintain control and communicate as needed during each implementation stages. Progress should be continuously monitored and appropriate adjustments are made and recorded as variances from the original plan.

Throughout the project implementation, people carry out the tasks, and progress information is being reported through regular project team meetings. The project manager uses this information to preserve control over the direction of the project by comparing the progress reports with the project plan to measure the performance of the project activities.

The plan should be updated and available on a regular basis. Status reports should always highlight the probable end point in terms of cost, schedule, and quality of deliverables. Each project deliverable produced should be reviewed for quality and measured against the acceptance criteria. When deliverables have been produced and the Employer has agreed on the final solution, the project is said to be ready for closure.

In this phase, the project shall include all associated activities during construction work such as (a) Scarification of failed sections (b) Provision of Stone Base (c) provision of Prime Coat (d) Asphalt Overlay/construction (e) Reinstatement of Shoulders (f) Construction of concrete lined drains and earth Drains and (g) Bridge Construction and maintenance.

The detail works are as follows:

Site Clearance and Earthworks

- Site Clearance on either side of road up to limits of construction width of all bush, grass and trees including topsoil
- Vegetation Clearing viz; cutting of bush, grass, shrub and trees etc. on either side of the roadway and/or median
- Scarification of failed sections of existing asphaltic surface

Cutting of potholes to rectangular shapes
Excavation of burrow pits etc.
Culverts and Drains

- Demolition of failed pipe Culverts
- Removal of Debris
- Excavation and backfilling works for pipe, box, culverts and side drains
- Laying of cast in situ/precast RC pipes and concrete box culvert
- Concrete works

Pavement and Surfacing

- Provision, spread and compacting of base and sub base material Laying of prime Coat
- Surface dressing
- Laying of Asphaltic concrete binder

Ancillary works like installing sign posts, guide posts, KM posts, grassing of embankments

3.11.3 Closure of Construction Phase

During the final closure, the importance is on providing the final deliverables to the customer, that is:

- Movement and demolition of temporary construction facilities,
- Handing over project documentation to the business
- Restoration of borrow pits,
- Conducting tests after completion,
- Various inspections and remedial work on defective works
- Termination of the temporary workers' employment
- Clean up and waste management,
- Termination of supplier contracts
- Releasing project resources
- Communicate the closure of the project to all stakeholders.

3.11.4 Operation and Maintenance Phase

Following construction, the road will become operational. During this phase, the road and ancillary infrastructures will be monitored and maintained by the SPIU to ensure sustainability. The SPIU has sensitized all communities along the road to form road maintenance groups. Maintenance equipment will be made available to this group for light maintenance activities including cleaning and vegetation control along the shoulders and around culverts and other drainage structures culverts. Only large scale maintenance activities will be handled by the SPIU following routine monitoring.

3.11.5 Decommissioning Phase

It is highly unlikely that the road infrastructure would be abandoned and decommissioned. It will most likely be upgraded or rehabilitated. Therefore, decommissioning is not extensively considered within this ESIA. In the unlikely event that the Abia State government decides to abandon and decommission the road in the future, an abandonment, decommissioning and closure plan should be developed taking into consideration the most cost effective and practicable methods, legal requirements and industry practices at that time. This plan should be submitted to the SMEnv and other relevant regulatory agencies for approval, at least 6 months before scheduled abandonment and decommissioning.

3.12 Materials

Availability of naturally occurring construction materials such as water, fine aggregates and crushed stone aggregates were also investigated in various locations (Table 3.3). The locations presented sources of various materials such as **Quarry Stone for asphalt, cement concrete and base course.** Aggregates of these shall be purchased and stockpiled from existing quarries from popular construction market, at Amasiri Ebonyi State. The aggregates meets requirements for use in asphalt, cement concrete, base course and masonry work (Table 3.4).

Table 3.3 Location where samples were collected

SN	NORTHING	EASTING	MATERIAL USE	REMARK
1	613122.134	329379.925	BC, SB, SG	BP1
2	614489.334	328682.736	BC, SB, SG	BP2
3	610394	329065	BC, SB, SG	BP3
4	605967.916	326623.626	BC, SB, SG	BP4
5	610386.298	329198.192	BC, SB, SG	BP5
6	614920.217	327968.001	BC, SB, SG	BP6
7	624535.791	325428.52	BC, SB, SG	BP7
8	624500.136	325324.686	BC, SB, SG	BP8
9	625183.929	326290.997	BC, SB, SG	BP9
10	614875.574	331269.427	BC, SB, SG	BP10
11	622137.122	325493.649	Fine Aggregates	River sand
12	621169.895	326082.932	Fine Aggregates	River sand
13	Amasiri		Coarse aggregates, Stone base	Quarry market

Table 3.4: Summary of Testing Results on Crushed Stone

Type of Testing	Location		Remarks
	Amasiri 1	**Amasiri 2**	
Los Angeles Abrasion	29.45	30.95	
Aggregate Crushing Value	28.63	27.22	**Good Less than 45% permissible**
Aggregate Impact Val...	5.19	4.44	**Permissible 45%, Result Is Satisfact...**
Elongation Index (%)	8.46	6.77	**Satisfactory**
10 percent fine value	4.41	4.28	
Soundness Test (%)	2	5.4	Average loss in weight after 12 cycles not exceeding 12% in sodium sulphate. Result is good
Specific Gravity	2.73	2.68	No presence of organic matter (No presence of deleterious substance)
Water Absorption	1.82	1.98	
Bitumen Affinity Test	97.8	93.4	Affinity of bitumen to aggregate after 3 cycles within standard of BS: EN 12591
Soluble salt Content (mg/Kg)	8 (0.0008%)	22 (0.0022%)	Good (less than 0.4% permissible)

During earthworks, it is estimated that topsoil will be stripped from the bulk earthwork areas. In addition, it is expected there will be some material unsuitable for engineered fill, imported material and material due to relocated as part of cut to fill bulk earthworks. All stockpiles will be located within the bulk earthwork areas or just outside, but within the catchment of the erosion and sediment control devices.

Prior to earthworks activities commencing, adequate perimeter and open channel drain controls must be installed to prevent sediment from entering the permanent and intermittent streams running through the site. Principal perimeter controls for this site include the installation of two construction entrances, silt fences and diversion drains/bunds.

A temporary water supply will be made available to the areas so that vehicle wheels can be washed prior to leaving the site, if necessary. All sediment laden water from wheel washing is to be directed into runoff diversion channels and into one of the decanting earth bunds prior to discharge to the intermittent stream.

3.13 Environmental, Health and Safety Management

Sediment And Erosion

Sediment will be removed by the various sediment control measures proposed for the site, primarily silt fences, sediment retention ponds, decanting earth bunds and proprietary devices where required.

Runoff Control

Runoff volumes are likely to increase during earthworks due to a change in the ground surface from grass and vegetation to bare soil. Earthworks will be monitored on site by the supervising engineer, who will review sediment control performance. Overall, given the application of the aforementioned measures, the associated potential negative environmental effects are considered manageable. However additional mitigation measures for runoff control are able to be installed where deemed necessary.

Neighbourhood Effects- Noise and Dust

The main neighbourhood effects associated with earthworks are noise and dust.

Dust from site earthworks and associated activities is considered to be minor and will be minimised by a number of measures, including wetting and mulching, to mitigate potential negative effects on neighbours.

Appropriate dust control measures will be implemented at the site where necessary, such as the use of water carts to dampen exposed areas or mulching. Dust control measures will be implemented in accordance with health & safety requirements and conditions of consent.

Noise will be generated by construction machinery and equipment during normal working hours over the earthworks period. Construction noise shall meet the limits in and be measured and assessed in accordance with NESREA requirements. Work shall not continue on the site if compliance with the above standard is not achieved. Mitigation measures to reduce noise levels will be implemented, if required.

Landscaping and Green Cover or Vegetation

Vegetation removal shall be limited as much as practicable to within the bulk earthwork areas. Any vegetation removal outside earthwork areas shall occur prior to commencement of bulk earthworks.

Best practise, site sediment controls to prevent degradation of the natural environment shall apply. Adequate measures shall be taken to minimise the potential for silt/sediment to enter the downstream receiving environments, while the proposed maintenance regime will check that these measures are functioning properly. Hence, it is considered that the potential negative effects of earthworks on any ecosystems in the receiving environment will be avoided or mitigated by these means provided the measures are correctly constructed and maintained.

Solid Waste

The bulk of waste generation is envisaged during construction and decommissioning phases. During operation, the project is not expected to generate significant quantity of waste, other than the routine waste that running water in the drainage lines convey in the course of movement downstream and from the normal maintenance of the project site.

For the various phases, the expected waste to be generated and manner of management are outlined in Table 3.5.

Table 3.5: Anticipated Waste to be Generate and Management

S/No	Phase	Estimated Waste Quantity (tons/month)	Management
A	**Mobilisation and Construction phase**		
1	Asphalt and Concrete	2tonnes	Concrete/asphalt debris can be sized and recycled on-site as pipe bedding or project base
2	Plastic, nylon and scrap metals	1ton	Recover scrap metal for recycling off-site
3	Wood	0.5kg	Chip leftover wood for reuse
4	Debris/ Landscape Materials	5ton	recycled on-site as pipe bedding or project base
5	Paper, Garbage/Trash	0.7kg	Recover for recycling/compositing
6	Spent/used oil Caterpillar Dump Truck Crane	12litres	collect and stored temporarily in a safe place and give recycling depots.
B	**Operation**		
	Plastic, nylon and scrap metals with debris	0.7	Recover for recycling offsite

3.14 Manpower Requirements

Both skilled and unskilled personnel will be hired for construction activities and maintenance of the treated erosion gully site. Local employees will be recruited from the communities nearby and will be trained to perform specific tasks as necessary. The specific number of work force that would be involved in the construction phase of the Project is yet to be finalized. However, it is envisaged that labour force with reasonable local content will be engaged during the Project execution. For the various phases of the project, the manpower identified are outlined in Table 3.6.

Table 3.6: Manpower Requirement

Phase	Manpower Needed*	
	Senior Management	Other staff Categories
Pre and Construction	5	20
Operation phase	2	8
Decommissioning phase	1	5
Total		

***** *The specific number of work force that would be involved in the construction phase of the Project is yet to be finalized*

3.15 Project Implementation Schedule (Estimated)

Following completion of construction works over a period of three years, the project-life of the project will be about 20 years. The road project construction is expected to start by the end of year 2021 and will be accomplished at the end of 2025. The project, therefore, will be opened for traffic by mid of 2025. As the service year (design life) of the project is 20 years, the traffic demand is projected to the year 2044.

Table 3.13: The conceptual project schedule for the project

S/N	Activity	2021		2022				2023				2024			
		Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	Appointment of Consultants to prepare EIA														
2.	EIA Preparation & Certification Process														
2	Completion of preliminary engineering design and tender preparation														
3	Preparation of site														
4	Construction														
5	Commissioning														

CHAPTER FOUR
DESCRIPTION OF THE PROJECT ENVIRONMENT

4.0. Introduction

This Chapter provides the baseline characteristics of the project site locations with regard to the relevant biophysical elements as well as the socio-economic and health baseline conditions obtained through extensive literature review, field observations and sampling/surveys and analyses. The site description is on the environmental and social receptors likely to influence or be impacted by the project. The environmental components include:

- **Biological/Physical Environment** - flora and fauna, phyto and zooplankton, fisheries, sediment, endemic and endangered species, ambient air, soils, geology/hydrogeology, climate and meteorology, hydrology and groundwater.
- **Socioeconomic Environment** - land tenure, land use, community health, historical and cultural heritage, religion, demographics, income, economic livelihood, culture, education, employment, infrastructure and social services, community structure/administration, social organizations/institutions.

4.1 Study Approach and Method of Baseline Data Acquisition

In the acquisition of baseline information for a study of this nature, the Federal Ministry of Environment (1995) specified that *"the baseline study ....must be developed through a study of existing documents, and where existing data are not relevant or incomplete, it may be necessary to supplement by conducting field survey."*

Otherwise the information so gathered from the literature could be sufficent in describing the baseline of an area. Such existing data could be gotten from maps, reports, studies, research papers, etc. Thus, a review of the existing baseline information and literature material proved to be very helpful in the actualization of this study. It provided the basis for gaining deeper understanding of the project and the environmental and social conditions that exist in the proposed project area. New field data collected and analysed in conformity with Federal Ministry of Environment approved procedures and other standard and routine practices were further used to enhance the existing data and provide new data as the case may be. Quality Assurance/Quality Control was assured by ensuring that all scientific instruments were properly calibrated and samples obtained stored in accordance with specific procedures for each sample.

Field Sampling and Laboratory Analysis were carried out by staff/consultants of Tobejay Technologies Limited (Federal Ministry of Environment and DPR accredited Environmental Company) and Quality Analytical Laboratory Services Ltd (QALS) located in Benin City, Edo State. The Laboratory is a duly accredited and standard laboratory with IPAN Certificate No. 0028 (ISO 17025 Laboratory Quality Management), A multidisciplinary approach involving professionals in the relevant field, physical, chemical and biological sciences as well as social and health disciplines was engaged with a view to developing the baseline conditions of the study area.

A review of the relevant literature yielded the background environmental and socio-economic conditions of the proposed project location (study area) to be obtained. The commencement of field work was preceded by a reconnaissance visit to the site. During the visit, sampling stations were identified and marked. A review of methodologies to be employed and safety measures were also carried out before actual field work. Appendix 4.1 shows sampling coordinates, communities and sample media collected.

4.1.1 Data Coding, Manipulation and Documentation

To ensure preservation of the integrity of data collected, data coding forms for use in the field were designed in such a way that field data could be directly entered into computer data sheets.

Since their analysis may be required in legal proceedings, it is essential to establish sample authenticity. Samples must be properly sealed and labelled. All data collected were labelled and the following information provided among others:

- Identification code or sample number
- Date and time of sampling
- Description of sample
- Methods of sampling
- Particulars of any photographs taken.

Data gathering exercise was carried out from May 2, 2021 to June 28, 2021. The field exercise involved field sampling, sample collection and preservation as well as in situ observations and measurements of concerned indicators. Sample preservations were done on site prior to laboratory analysis.

With regard to socio-economics, several data collection tools were used to document available data during the study. These tools included use of checklists, photography, Geographical Positioning Systems (GPS), structured interview guide/questionnaires, Focus Group Discussion (FGD) among others. All data collected were analyzed for production of the report.
A multiple data collection approach was adopted for this survey and includes:

- The collection of qualitative and quantitative information done through the administration of structured individual interview schedules on randomly selected respondents. The questionnaires were administered to persons around the project area
- Focus Group Discussion with stakeholders
- Field observation activities included detailed pictorial account and documentation of infrastructure and facilities identified within the proposed project area.

4.1.2 Quality Assurance

The quality assurance programme encompasses all aspects of the ESIA study, including Sample collection, handling, laboratory analyses, data coding and manipulation, statistical analysis, presenting and communicating results.

4.1.3 Sample Collection and Handling

This was carried out as far as possible in accordance with the Federal Ministry of Environment guidelines on Sampling and Handling of Samples. Where logistic and safety considerations precluded strict compliance with the above guidelines and standards, other proven, scientifically acceptable methods of sample collection and handling were used.

4.1.4 Laboratory Analyses

The methods of analyses used were those specified in Federal Ministry of Environment Guidelines and Standards and other International Analytical Standards such as APHA for water quality. Trace metal analysis was done using Atomic Absorption Spectrophotometer duly calibrated using standards. Physicochemical parameters were determined using SPECTRONIC 21D+ Spectrometer and Orion ISE Meter Model 710A, duly calibrated with standards, as well as Atomic Absorption Spectrophotometer Unicam 969. Organics were analysed using Gas Chromatograph.

4.1.5 Statistical Analysis

Errors in field data include those resulting from the instrument and those introduced by the observer. With proper, sustained calibration of the instrument and the use of standardized observational procedures, equipment errors were brought to acceptable minimum. However, other errors arise from the method of sampling. Errors often arise from two-stage sampling or sub sampling, or even from the fact that the samples collected are not representative samples of the medium. There are also spatial variations of the same medium, e.g., soil and water. Thus, it is necessary to determine the true mean and the estimated variance among the number of samples taken, so as to establish a reasonable level of confidence in the results obtained. A good result is obtained when the variance is within 5% of the mean.

4.1.6 Socio-Economic studies

In line with project sustainability objectives, wide consultations were held, and communities' aspirations were also recorded. The study was conducted through an integrated participatory approach that also involved literature review. The study assessed the prevailing socio-economic, cultural and health situation under the prevailing road conditions and the impacts of the project. The socio-economic impacts assessment focused on evaluation of the impacts of the project on community social and economic health, opportunities creation and prevention of adverse outcomes on social, gender, health and 8 cultural attributes of the communities.

The socio-economic baseline survey was conducted concomitantly during the enumeration of crops, economic trees and structures from 5th – 30th April 2022 seeks to determine the socio-cultural, demographic, and quality of life of the project affected persons. The questionnaire used in obtaining socio-economic data employed a combination of "open-ended" and "closed" questionnaire format. Qualitative data were generated through informed meetings and also observation in small groups of stakeholders in the various project-affected communities with homogeneous socio-economic backgrounds and interests.

Additionally, the study discusses the perceptions, concerns, and expectations of members and residents of these communities, and establishes the project's potential impacts, positive impact enhancement, and mitigation measures.

The study was conducted in communities along the 31 roads proposed for construction in Aba South, Aba North, Osisioma, Ugwunagbo, Obingwa, Isialangwa North, Ukwa East, Umuahia South, Isialangwa South, and Ikwuano LGAs, covering 10 LGAs in Abia State.

The project is expected to impact 3781 PAPs of which 874 are female and 2253 are male while 654 of the PACs were not identified as they were absent during social survey and property enumeration in their area.

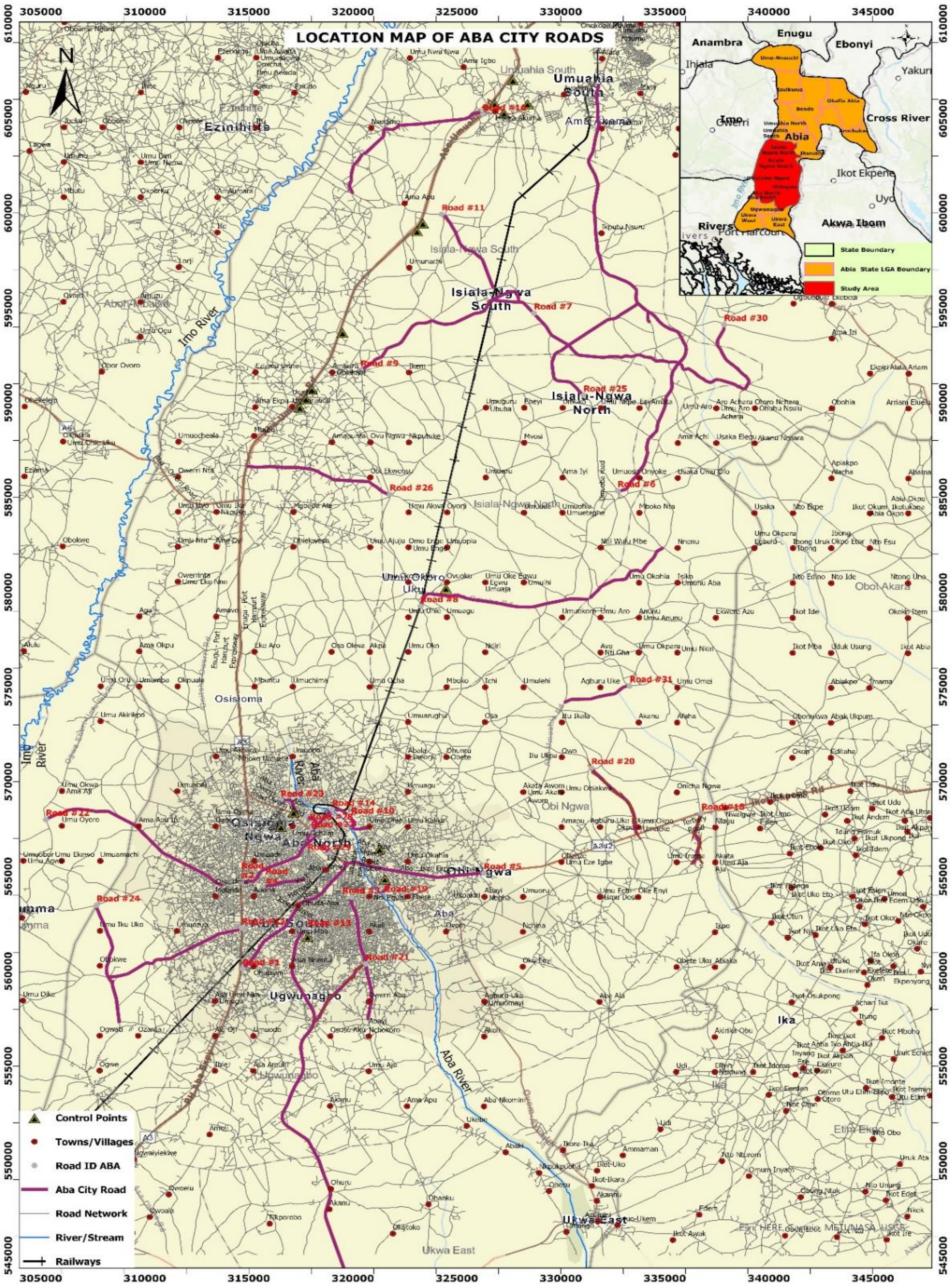


Figure 4.1: The Project Location

4.2 Physical Description of Project Areas

4.2.1 Climate and Rainfall

The climate of the project area is humid tropics (semi-hot equatorial). Rainfall is significant most months of the year, and the short dry season has little effect. The climate is characterized by the rainfall season from March to October with the highest rainfall recorded in the month of August. The wet season displays a unimodal pattern with average monthly rainfall varying from 64 mm in March to 288 mm in September with the lowest of 8.9 mm in January. The average annual rainfall for the site is 1918 mm. On average, 97 % of the annual total rainfall falls during the wet season. From available records, the average annual rainfall of 322 mm and the average annual temperature in Aba is 25.6 °C | 78.2 °F. The climate is essentially controlled by latitudinal locations, and the prevailing (seasonal) winds. There are two dominant air masses, namely:

- The dry Northeasterly Tropical Continental (cT) from across the Sahara, North of the West African region, and
- The wet Southwesterly Tropical Maritime (mT) from across the Atlantic Ocean in the South.

Separating the two air masses is an Inter Tropical Convergence Zone (ITCZ), often referred to as *Inter-tropical Discontinuity (ITD)* or *Inter-tropical Front (ITF).* The front oscillates with the apparent location of the sun towards the North and South of the equator thereby accounting for the dominant seasons of the area. Marginal alterations are also recorded due to other landform characteristics, especially the dominant ocean currents, configuration of surrounding shoreline and the generally flat topography of the region**.** The dry season is dominated by the dry, dust-laden Harmattan North East trade winds. Annual relative humidity is 75%, reaching 90% during the rainy season. The average daily wind speed in August is about 4km/h (3MPH) or 2knots.

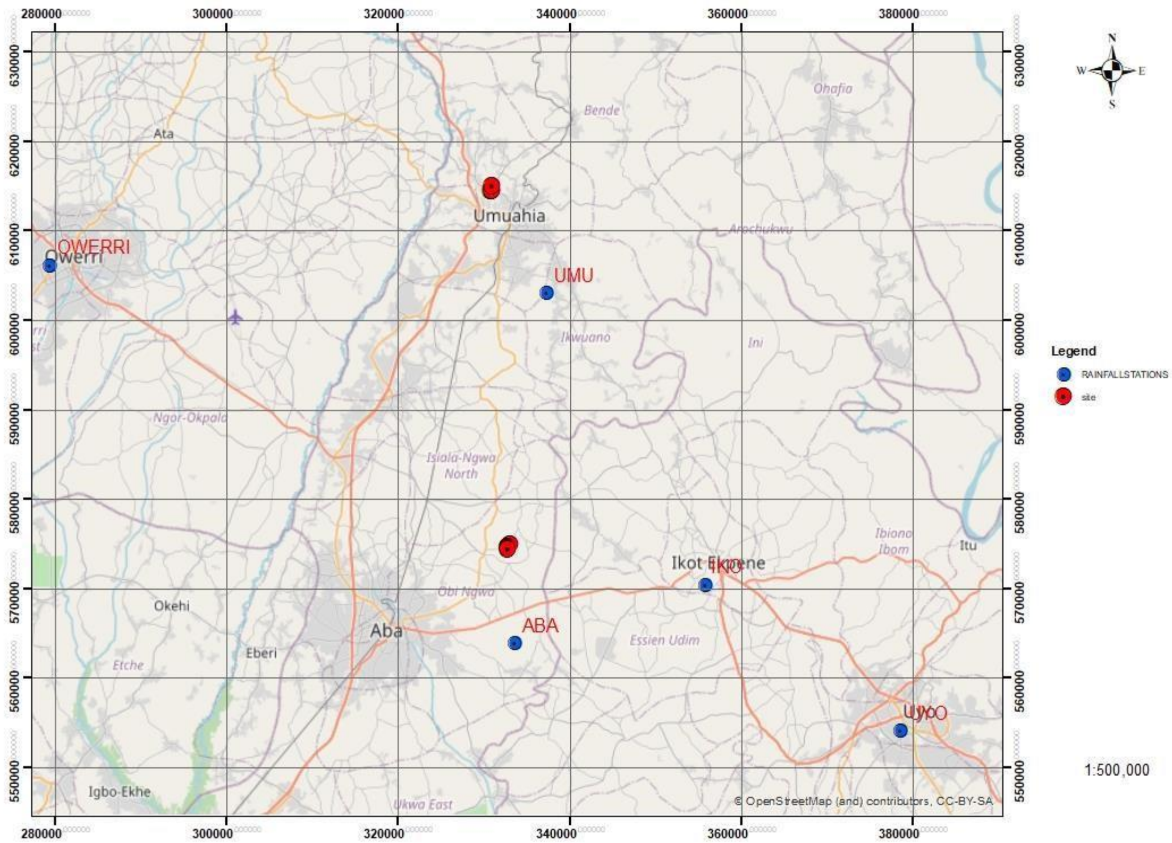
The minimum daily rainfall record is 0.0 mm whereas the maximum daily rainfall record is 201.8 mm. The statistical parameters for the daily rainfall data are summarized in Table 4.2.

Table 4. 3: Statistical summary of the rainfall data

	Name of Station	**Min**	**Mean**	**Max**	**SD**	**Annual**
		mm	mm	mm	mm	mm
1	Aba	0.0	5.0	174.4	13.0	1842

Selection of Rainfall stations

Based on their proximity to the project sites, only data from Aba rainfall station is considered for further analysis. The rainfall variation over Aba catchment is represented by data from Aba station.



Map 4.1: Closest Rainfall Stations

Monthly Rainfall

The long-term monthly rainfall data derived from the station data clearly shows the seasonality of the rainfall where the wet season is spread over eight months whereas the dry season lasts only four months (Figs 4.2). Those months of high rainfall are of interest in the gully control works since gully walls become unstable and collapse in these wet months. Moreover, the degree of erosion is extremely high in those months as per international scales.

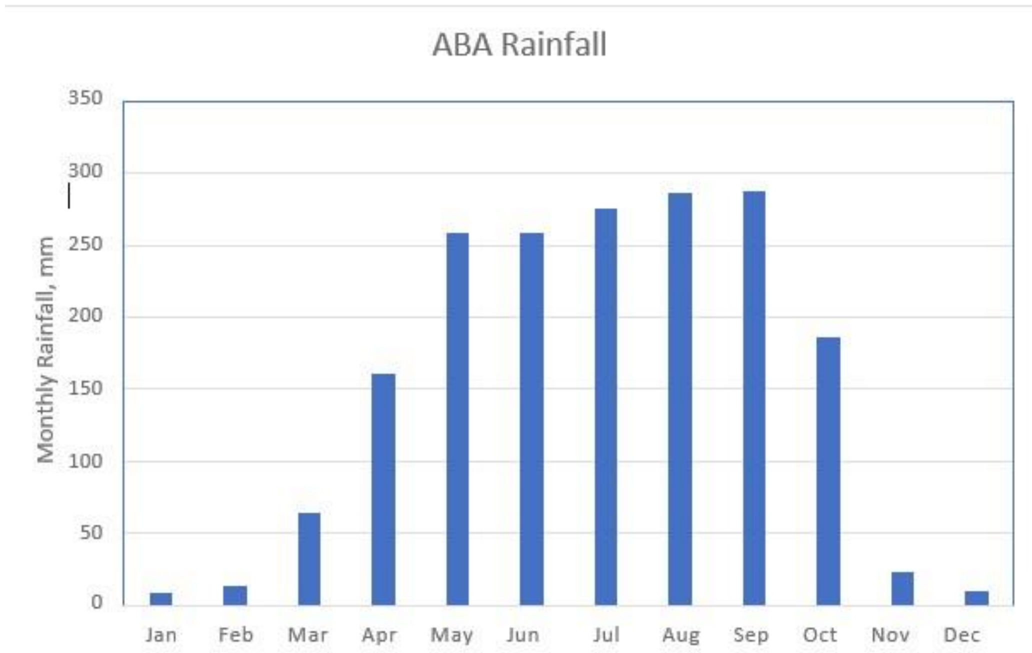


Figure 4.3: **Long Term Rainfall station at Aba Station**

Annual Rainfall

The annual rainfall based on the station data at Aba varies from a minimum of 1375 mm to 2924 mm. The highest annual rainfall was observed recently in 2011. The annual rainfall data is important in estimating the rate of gully erosion, in addition to the catchment area. As the annual rainfall increases, the rate of erosion increases proportionally. A declining trend has been observed in the annual data as the straight line runs horizontal across the data as shown in Figure 4.5.

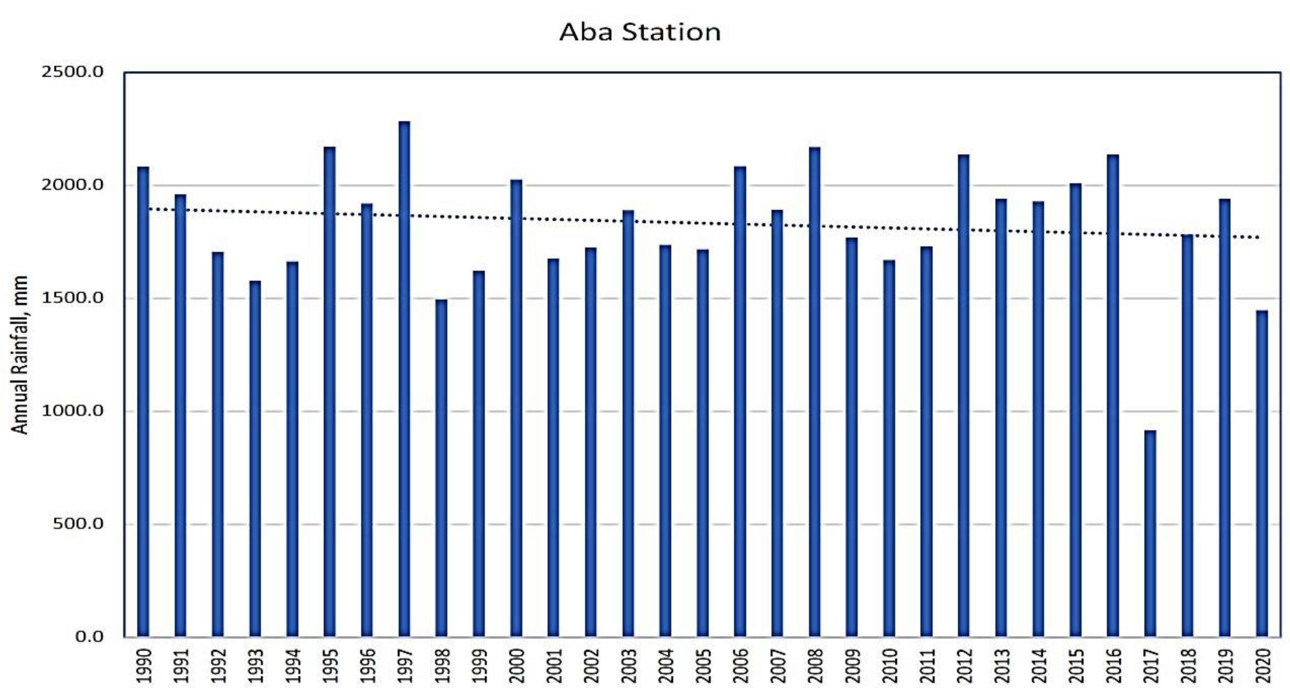


Figure 4. 4: **Annual Rainfall Station at Aba Station**

Rainfall Analysis

Rainfall data were procured for Abia state and state capitals around the Abia State i.e Aba city; Iko; Owerri (Imo State); Portharcourt, Umuahia from the Nigeria Meteorological Services Agency (NiMet). NiMet is an Agency of Federal Ministry of Transport and had maintained over the years meteorological stations at the nation' airports and aerodrome. NiMet is recognised by the World Meteorological Organization (WMO) for quality data monitoring using standard procedures and instrumentation. Data collected were for duration of thirty-one years which is considered adequate for the design of stormwater control and cross drainage structures under this project, hence satellite based rainfall data were not sought in this study.

The annual daily maximum was extracted from the daily rainfall for each of the station illustrated in Figure 4.5.

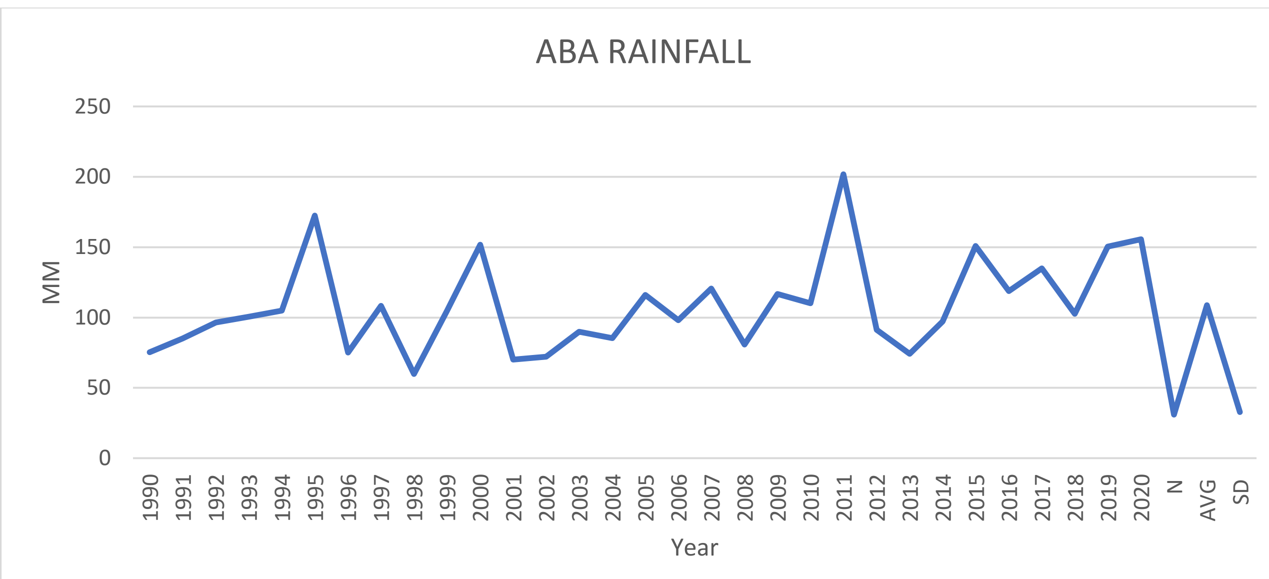


Figure 4.5: **Maximum Annual Rainfall around Abia State.**

Rainfall Frequency Analysis

A goodness-of-fit test based on the Kolomogorov-Simirnov test was conducted on the maximum daily rainfall series for the project site were used to conduct the frequency analysis. The results of the Kolomogorov-Simirnov test are presented in Table 4.5 The result of test shows p-value for all stations is more than 0.05 ($p>0.05$) and this confirms normal distribution of all the data. The data do not differ significantly from that which is normally distributed

Table 4. 4: Results of the Kolomogorov-Simirnov Test

Umu	
Count	31

Mean	108.8
Median	79.8
Std_Dev	37.7
Skewness	0.98
Kurtosis	1.201382
ThevalueoftheK-Steststatistic(D)	0.14014
Thep-value	0.40732

Computation of Intensity Duration Frequency for Rainfall

Abia State and the project sites in particular belong to rainfall zone VI of Nigeria (Pg 418 Highway Manual Part 1: Design Volume IV: Drainage Design) for which the estimates of the parameters of equation 4.5 are presented in Table 4.6.

Table 4.6: Estimates of parameters of the IDF Equation for Rainfall Zone VI of Nigeria

Zone	(1/α),β	0.2hr	0.4hr	1hr	3hr	6hr	12hr	24hr
Iva	1/α	21.42	16.24	12.65	4.69	3.04	1.57	0.89
	β	111.83	83.38	49.13	20.3	10.61	5.61	2.83

Using Equation 4.5 to Equation 4.7, based on the procedures recommended by the Nigerian Highway Manual 2013, the Rainfall-Intensity-Duration-frequency table for the project sites is presented in Table 4.7.

Table 4.7: Rainfall-Intensity-Duration-Frequency Table for Abia State based on NHM Method

Zone	**Rain Duration (hrs)**	**0.2**	**0.4**	**1**	**3**	**6**	**12**	**24**
Iva	1/α	21.42	16.24	12.65	4.69	3.04	1.57	0.89
	β	111.83	83.38	49.13	20.3	10.61	5.61	2.83
	y(Tr)	Rainfall Intensity (mm/hr)						
I2yr	0.42	120.76	90.15	54.41	22.26	11.88	6.26	3.20
I5yr	1.51	144.11	107.85	73.60	44.77	35.08	30.08	27.30
I10yr	2.25	160.07	119.95	77.62	30.86	17.46	9.15	4.83
I25yr	3.20	180.35	135.33	89.59	35.30	20.33	10.63	5.68
I50yr	3.90	195.41	146.75	98.49	38.60	22.47	11.74	6.30
I100yr	4.60	210.37	158.09	107.32	41.87	24.59	12.83	6.92

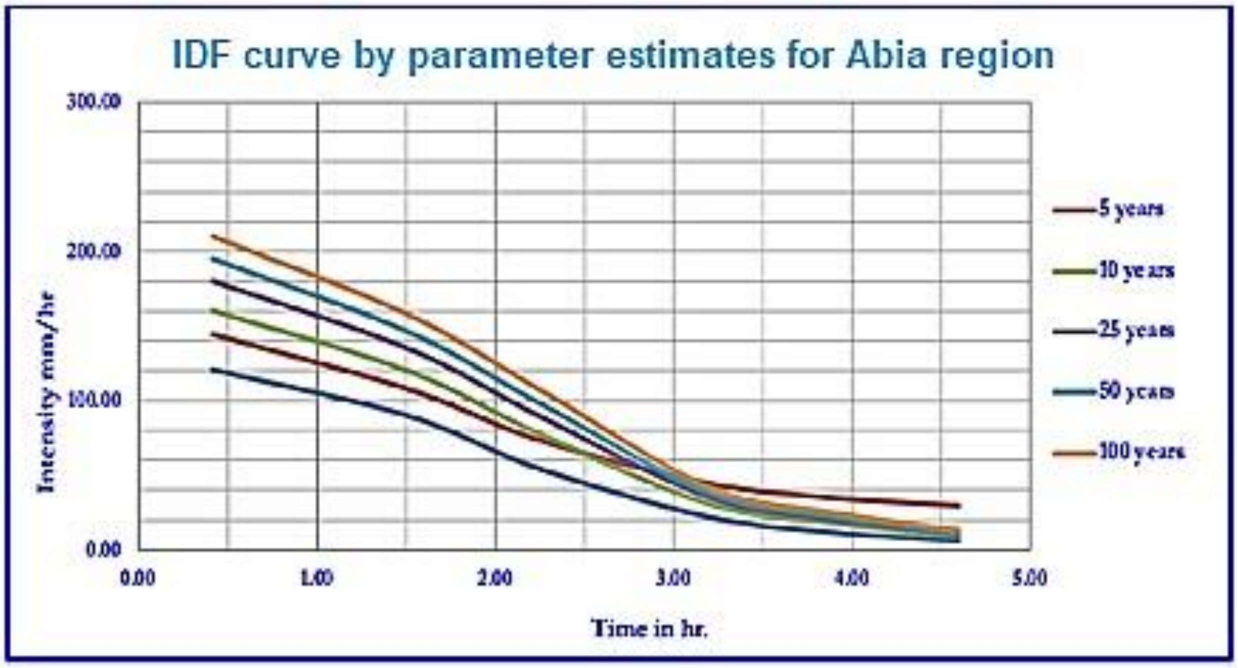


Figure 4.4: **Rainfall Intensity-Duration Frequency Curve for Abia State**

Comparing the results from the two methods of computation of the rainfall-intensity duration-frequency curve, the Highway Manual (2013) produces a single intensity value for all the entire Abia State while the computation method based on the maximum daily rainfall depth-duration-frequency for Abia project site produces higher intensity values, Uma using the recent rainfall data. The estimated rainfall intensities from the maximum daily rainfall depth-duration-frequency for road segments of Aba city project site methods was used for the computation of the peak runoff each of catchment area.

4.2.2 Meteorology, Air Quality and Noise

In general, for Nigeria, air quality in the rural areas is good, while air quality in cities is poor, with elevated concentrations of carbon monoxide, volatile hydrocarbons, and particulate matter, largely due to industrial activities.

The major source of air pollutants in the Project area observed during preliminary site visit were emissions from vehicles and dust from the adjoining untarred road. Aside vehicle emissions and dust along the untarred road, air quality conditions of the study area are within regulatory limits, except for particulate matters (PM2.5) which constitutes the main pollutant ranging from 42.2 – 60.2 (4 – 6 times above WHO exposure recommendation (Table 4.13). Detailed air quality studies carried out at target locations during the field data gathering as part of the ESIA study.

Table 4. 8: **Air pollution data of cities in Abia**

City	Air quality Index (US AQI)	Main Pollutant (PM2.5) µg/m³	Remark
Aba	153	60.2	Currently 6 times above WHO exposure recommendation
Akwete	153	60.2	Currently 6 times above WHO exposure recommendation
Bende	120	43.2	Currently 4 times above WHO exposure recommendation
Mbalano	122	44.2	Currently 4 times above WHO exposure recommendation
OkpualaNgwa	122	44.2	Currently 4 times above WHO exposure recommendation
Omoba	122	44.2	Currently 4 times above WHO exposure recommendation
Osisioma	122	44.2	Currently 4 times above WHO exposure recommendation
Umuahia	122	44.2	Currently 4 times above WHO exposure recommendation
Amaigbo	120	43.2	Currently 4 times above WHO exposure recommendation
Isiala Oboro	120	43.2	Currently 4 times above WHO exposure recommendation
Nkwoagu Isuochi	120	43.2	Currently 4 times above WHO exposure recommendation
Oke-Ikpe	120	43.2	Currently 4 times above WHO exposure recommendation
Arochukwu	117	42.2	Currently 4 times above WHO exposure recommendation
Ebem Ohafia	117	42.2	Currently 4 times above WHO exposure recommendation
Ohafia-Ifigh	117	42.2	Currently 4 times above WHO exposure recommendation

Source: IQAir 2021 (www.iqair.com)

Table 4.9: **Breakpoints for the AQI**

CATEGORY	GOOD	MODERATE	UNHEALTHY	UNHEALTHY FOR SENSITIVE GROUPS	VERY UNHEALTHY		HAZARDOUS
AQI	0-50	51-100	101-150	151-200	201-300	301-400	400-500
POLLUTANTS	BKP	BKP	BKP	BKP	BKP	BKP	BKP
CO (ppm)	0-4.4	4.5-9.4	9.5-12.4	12.5-15.4	15.5-30.4	30.5-40.4	40-50.4
NO_2 (ppm)	0-0.05	0.054-0.1	0.101-0.36	0.361-0.64	0.65-1.24	1.25-1.64	1.65-2.04
Q_3 1hr (ppm)			0.125-0.164	0.165-0.204	0.205-0.404	0.41-0.50	0.505-0.604
PM_{25}(ppm)	0-15.4	15.4-40.4	40.5-65.4	65.5-150.4	150.5-250.4	250.5-350.4	350.5-500.4
Pm_{10}(ppm)	0-54	55-154	155-254	255-354	355-424	425-504	505-604
SO_2(ppm)	0-0.03	0.035-0.14	0.145-0.224	0.225-0.304	0.305-0.604	0.605-0.804	0.805-1.004

Source: Fernando (2012). BKP = Breakpoint

In the present study, the air quality parameters were measured in six (06) locations from Aba to complement the secondary air quality monitoring data sourced from *IQAir 2021 (www.iqair.com).* The basemaps and sampling sites for Meteorology, Air Quality and Noise are shown in figures 3.8 – 3.9. State the name(s) of other relevant literature consulted.

Table 4.10: The results of *in situ* meteorological, air quality and noise level analysis.

		IKOT EKPENE ROAD, ABA		FMEnv. Limit 8-hour
PARAMETERS	**UNITS**	**AQ 1**	**AQ 2**	
LATITUDE		N05°06.982'	N05°07.975'	
LONGITUDE		E007°22.845'	E007°22.509'	
Temp.	^{0}C	35.2	34.2	35
Rel. Humidity	%	62.3	65.3	NA
Wind speed	m/s	0.88	0.87	
Wind Direction		SW	SW	
Radiation	uSv/H	0.015	0.013	6310
NO_2	µg/m3	0.004	0.004	0.1
SO_2	µg/m3	0.006	0.005	0.06
'CO	µg/m3	<0.01	<0.01	10
H_2S	µg/m3	<0.01	<0.01	NA
NH_3	µg/m3	<0.01	<0.01	NA
SPM	µg/m3	4.0	4.2	250
VOC	µg/m3	<0.01	<0.01	20
O_2	%	20.9	21	21
O_3	µg/m3	<0.01	<0.01	NA
Noise	dBA	53.7	50.9	90

Table 4.11: Descriptive statistics of Measured Parameters from the Table (4.10)

PARAMETERS	**UNITS**	**MIN**	**MAX**	**MEAN**	**SD**	**FMEnv. Limit 8-hour**
Temp.	^{0}C	34.2	37	35.8	0.97	35
Rel. Humidity	%	48.5	65.3	56.7	6.65	NA
Wind speed	m/s	0.87	2.03	1.5	0.52	NA
Wind Direction						
Radiation	uSv/H	0.011	0.025	0.0	0.00	6310
NO_2	µg/m3	0.004	0.006	0.0	0.00	0.1
SO_2	µg/m3	0.004	0.006	0.0	0.00	0.06
CO	µg/m3	<0.01	<0.01	<0.01	<0.01	10
H_2S	µg/m3	<0.01	<0.01	<0.01	<0.01	NA
NH_3	µg/m3	<0.01	<0.01	<0.01	<0.01	NA
SPM	µg/m3	3.5	4.2	3.9	0.27	250
VOC	µg/m3	0	0	#DIV/0!	#DIV/0!	20
O_2	%	20.9	21	21.0	0.05	21
O_3	µg/m3	0	0	#DIV/0!	#DIV/0!	NA
Noise	dBA	46.8	54.8	51.1	3.05	90

Air Temperature

As expected for a tropical climate, high ambient temperatures were recorded at all the sampling sites during this assessment. A temperature range of 34.2 – 37.0^{o}C with a mean of 35.8 ^{o}C was measured at the selected sites. High ambient temperature enhances the formation of photochemical oxidants like photochemical smog and tropospheric ozone. These high temperatures are indicative of Global warming.

Relative Humidity

Relative humidity expresses the degree of wetness or dryness of the atmosphere. In this study, a reasonably moderate level of humidity values was recorded at all the sampling locations with a range of 48.5 – 65.3 with a mean of 56.7%. A highly humid atmosphere readily precipitates as wet deposits of gaseous pollutants (NO_2, SO_2) that are released into it.

Wind Speed

The ability of the atmosphere to dilute and disperse the pollutants released into it, depends substantially on the prevailing wind speed. In this study, very low wind velocities were measured at all the selected sites, with a range of 0.87 – 2.03 m/sec (i.e. 3.132 – 7.308 km/hr). The implication of this observation is that proactive measures must be developed and enforced, to ensure that air pollutants are perpetually kept low in this environment otherwise, their dispersion by air current would be difficult.

Wind Direction

The wind directions were observed to be southwesterly, easterly etc. However, as expected for a wet season, the predominant wind direction was observed to be southwesterly at all the sites.

Nitrogen Dioxide

Globally, emissions of nitrogen oxides from natural sources far outweigh those generated by anthropogenic activities. Natural sources include intrusion of stratospheric nitrogen oxides, bacterial and volcanic action, and lightning. However, because natural emissions are distributed over the entire surface of the earth, the resulting background concentrations are very small. The major sources of anthropogenic emissions of nitrogen oxides into the atmosphere are the combustion processes in stationary sources, e.g., gas flares, power generation, and mobile sources, such as internal combustion engines in road transport vehicles. In most ambient situations, nitric oxide is emitted and transformed into nitrogen dioxide in the atmosphere.

Very low Nitrogen dioxide was detected at the sampling sites. Nitrogen dioxide is rife only in an environment with high traffic volume. In these Communities, traffic volume was observed to be on the very low side, which has been reflected in the low emissions of NO_2 (0.004 – 0.006 μg/m^3) in the project area.

Sulphur Dioxide (SO_2)

SO_2 was detected in relatively low levels across all concerned communities with measurement values ranging from 0.004-0.006 μg/m^3. It is imperative to state that eighty percent (80%) of all SO_2 emissions in the ambient air are due to fossil fuel combustion, especially coal combustion (UNEP 1983).

Carbon Monoxide

Carbon monoxide is an odourless, colourless gas that is highly toxic at high concentrations (> 10.0 ppm). However, in this assessment, <0.01 μg/m^3 was recorded for all locations sampled. Spatial variation in the data was found to be statistically insignificant ($P > 0.05$).

Ammonia

Ammonia is a nitrogenous compound of nitrogen and hydrogen (NH_3) with a profound choking smell. It is a "non-criteria" air pollutant that has National Tolerance Limit for Ambient Air Pollutants of 0.20 mg/m^3 (0.29 ppm). Ammonia can irritate the respiratory tract at excessive levels. In this study, Ammonia was detected at relatively low level (<0.01 μg/m^3).

Suspended Particulate Matter (SPM)

Suspended Particulate Matter constitute the sum of all solid and liquid particles suspended in air, ranging in size from 0.1 micrometre to about 30 micrometres in diameter, many of which are hazardous. This complex mixture contains for instance dust, soot and smoke. These particles constantly enter the atmosphere from many sources (see Figure 4.10).

Ambient particulate matter is responsible for harmful effects on health, even in the absence of other air pollutants. Both fine and coarse particles have been shown to affect health, in particular the respiratory system. Fine particles are more dangerous than coarse particles. Apart from the size of the particles, other specific physical, chemical, and biological characteristics that can influence harmful health effects including the presence of metals, PAHs, other organic components, or certain toxins.

Airborne Particles at excessive levels have grave environmental and health consequences - respiratory and cardiovascular diseases. The value of SPM in the sampled locations ranged from 3.5 – 4.2 μg/m^3 with a mean of 3.9 μg/m^3. Spatial variations in the data were observed to be insignificant ($P > 0.05$), the regulatory limits of 250 μg/m^3 FMEnv/NESREA was complied with.

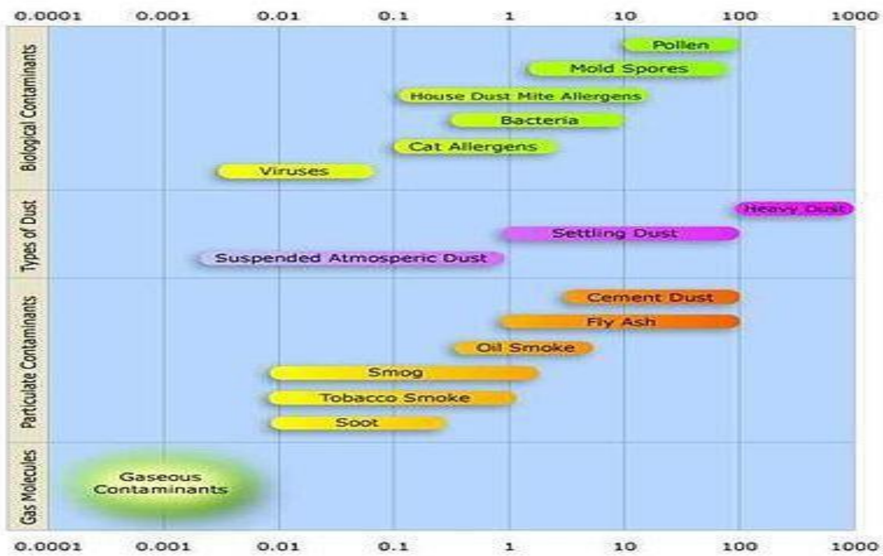


Figure 4.5: Diagram showing the size distribution in micrometres of various types of atmospheric particulate matter. It also shows the different types of particulates in the atmosphere (Source: Wikipedia)

Volatile Organic Compounds (VOCs)

Volatile Organic Compounds constitute a wide range of chemical compounds that have a high vapour pressure and low water solubility. They include hydrocarbons (alkanes, alkenes, aromatics), oxygenates (alcohols, aldehydes, ketones, ether) and halogen containing species. They are carcinogenic and formed primarily from incomplete combustion of organic materials, the use of petrochemical solvents and vaporization of petroleum products. In this study, VOCs as methane were detected at a level less than 0.01 $\mu g/m^3$.

Noise level

Noise data captured at the sampling sites with a range of 46.8 – 54.8 dB(A) and a mean of 51.1 dB(A), are typical of unperturbed natural environment. The NESREA Statutory limit of 55 dB(A) for commercial and residential areas was not breached at any of the selected sampling points. Spatial variations in the noise data were found to be statistically insignificant ($P > 0.05$) when subjected to Chi-square goodness of fit to ration1:1. It must be stated that there is no statutory noise level limit within Nigerian communities (there used to be some local by-laws by local Councils which are non-operative). The noise limits referred to above are purely occupational.

Summary of Findings

- The concentrations of all the pollution indicators were found to be very low and, in some cases, lower than the detection limits of the sampling equipment used (0.01).
- Noise levels were also found to be within the prescribed limit of 90 dB(A).

- High ambient temperatures and low relative humidity values were measured at all the sites.
- Generally, low wind velocities were measured at all the locations. The wind direction was predominantly South-westerly.

4.2.3 Topography or Terrain

The topography in the southern part of the state is low-lying while the other parts of the State have moderately high plains with elevations ranging between 20 and 200 metres above sea level. South-eastern part is about 122 m above sea level. The average elevation in the entire state is about 152 m above mean sea level.

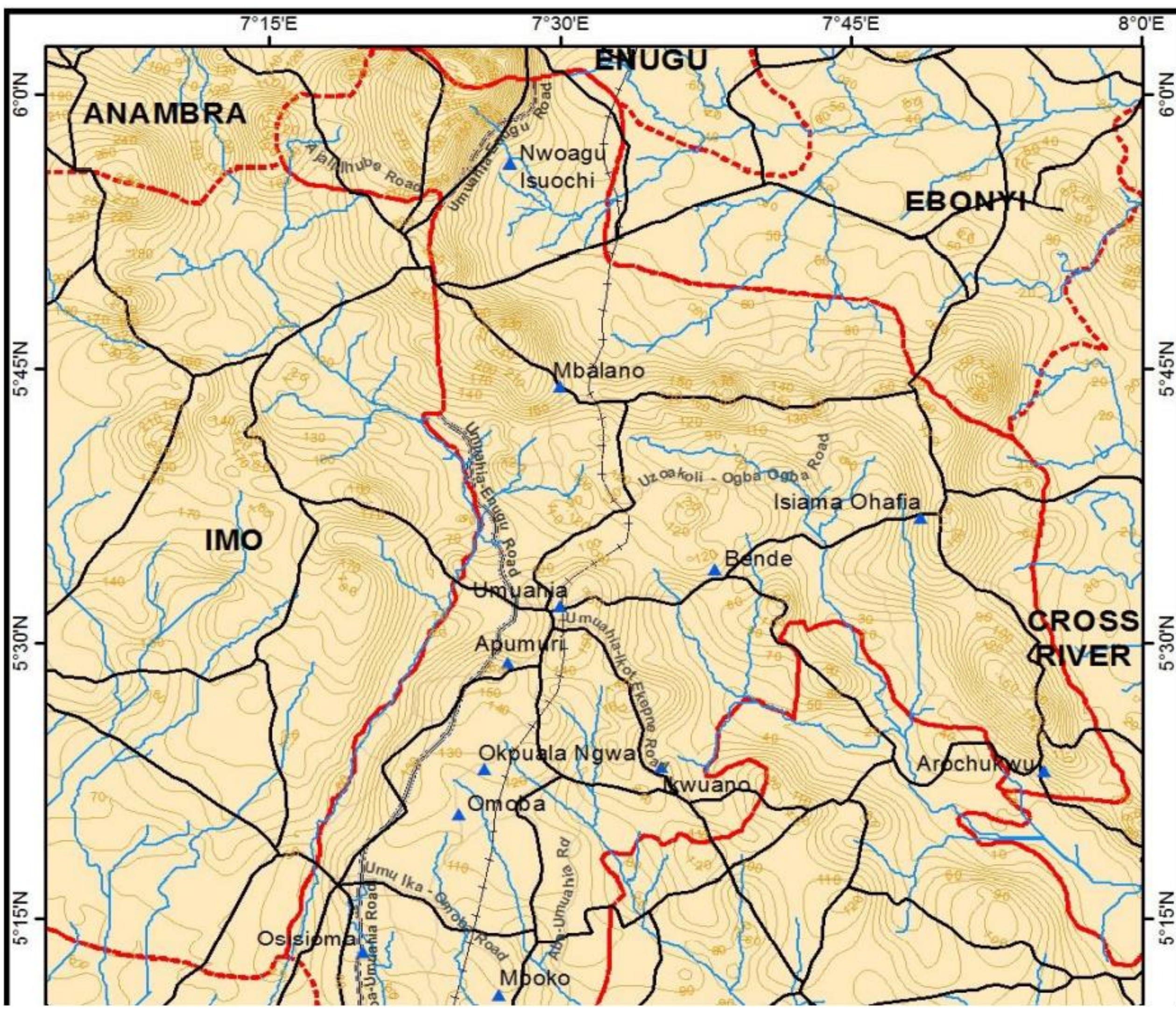


Figure 4. Topography of Abia State

4.2.4 Drainage System

Abia State is drained by five important rivers namely; Abia, Esu, Cross river, Akpoha, Igu and Aba River. Other rivers are Ogbor, Ohiya, Abi and Anya.

The drainage is however dominated by two main rivers; The Abia River on the west and the Cross-River on the east. The Bende-Ameki formation of Eocene age consists of medium-coarse grained white stones. The late Tertiary Benin formation is the most predominant and completely overlies the Bende-Ameki formation with a south west ward dip. The formation is about 200m thick. The lithology is unconsolidated finemedium-coarse-grained bedded sands occasionally pebbly with localized clay and shale.

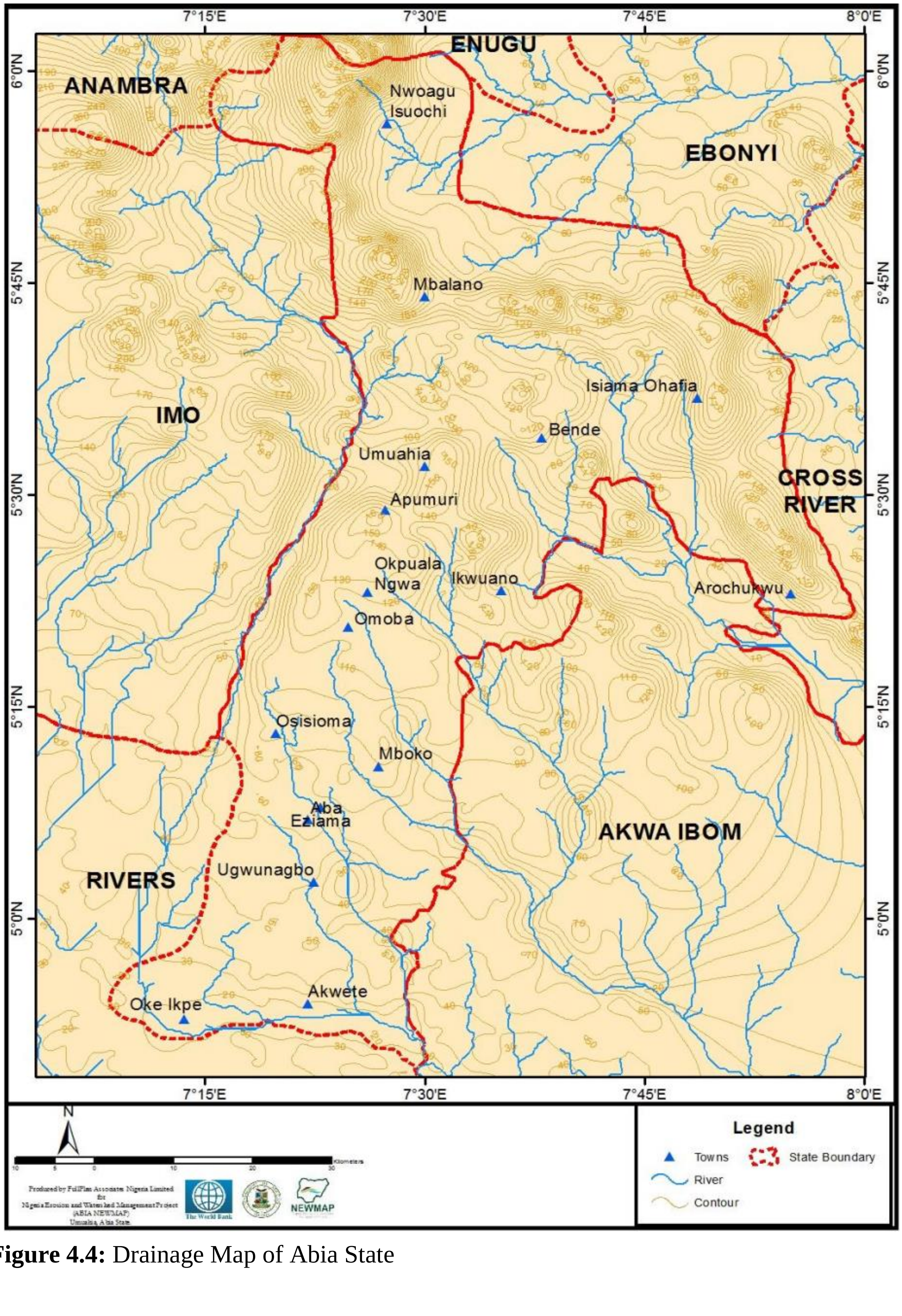


Figure 4.4: Drainage Map of Abia State

4.2.5 Geology

There are two principal geological Formations in the state namely; Bende-Ameki and the Coastal Plain Sands otherwise known as Benin Formation. The Bende-Ameki formation of Eocene to Oligocene age consists of medium-coarse grained white stones. The late Tertiary-Earl Quaternary Benin formation is the most predominant and completely overlies the Bende-Ameki formation with a South west ward dip. The formation is about 200m thick. The lithology is unconsolidated fine-medium-coarsegrained cross bedded sands occasionally pebbly with localized clay and shale.

A variety of landforms exist dominated by flat and lowlying land, generally less than 120m above sea-level. The rock system is divided into three namely, Upper Coal Measure, False-Bedded Sand Stones, and Lower Coal Measure. The Upper Coal Measure formation is the largest geological formation in this region and is comprised mainly of coarse grains, alternating sediments of grey sands, dark shale which contains sands of impure coal in place of vertical horizon (Fig 4.5).

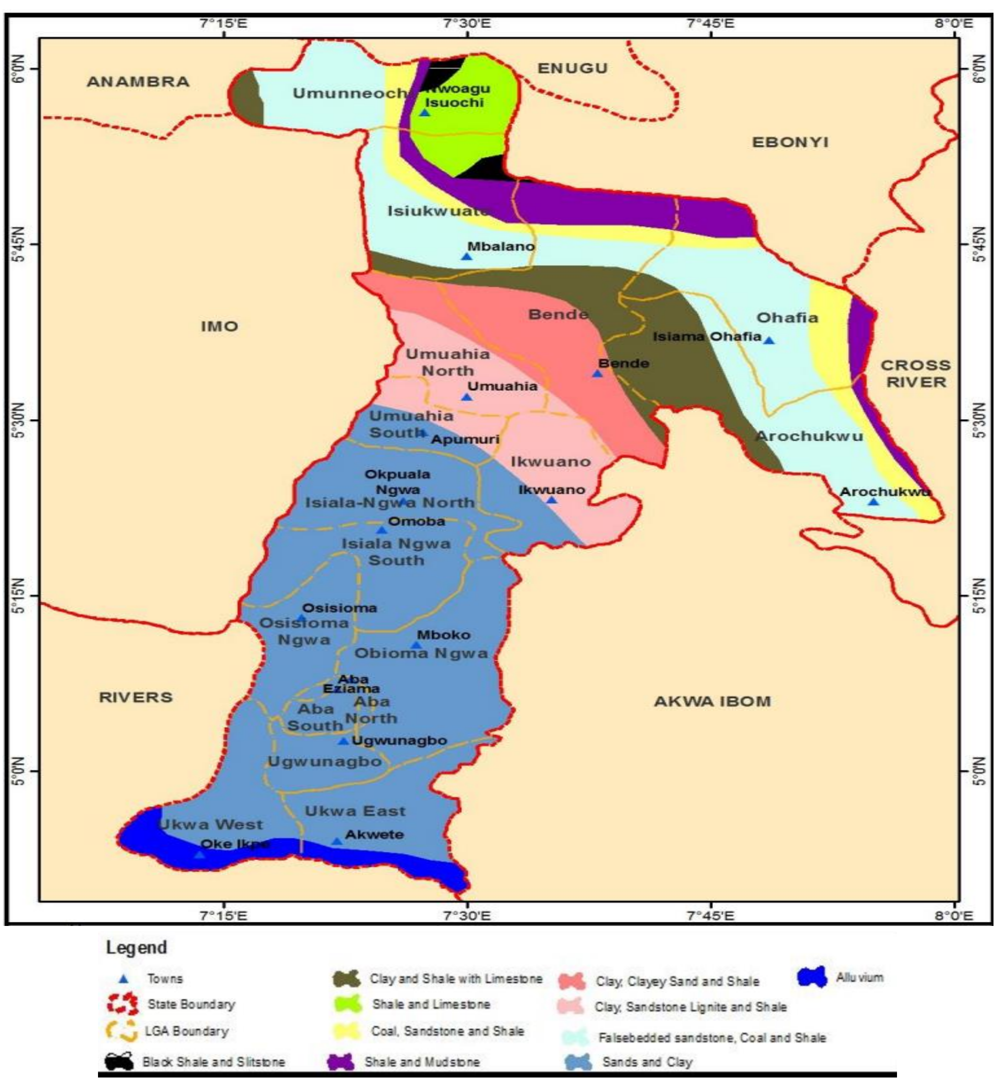


Figure 4.5. The Geology of Abia State - *Source: NEWMAP, 2017*

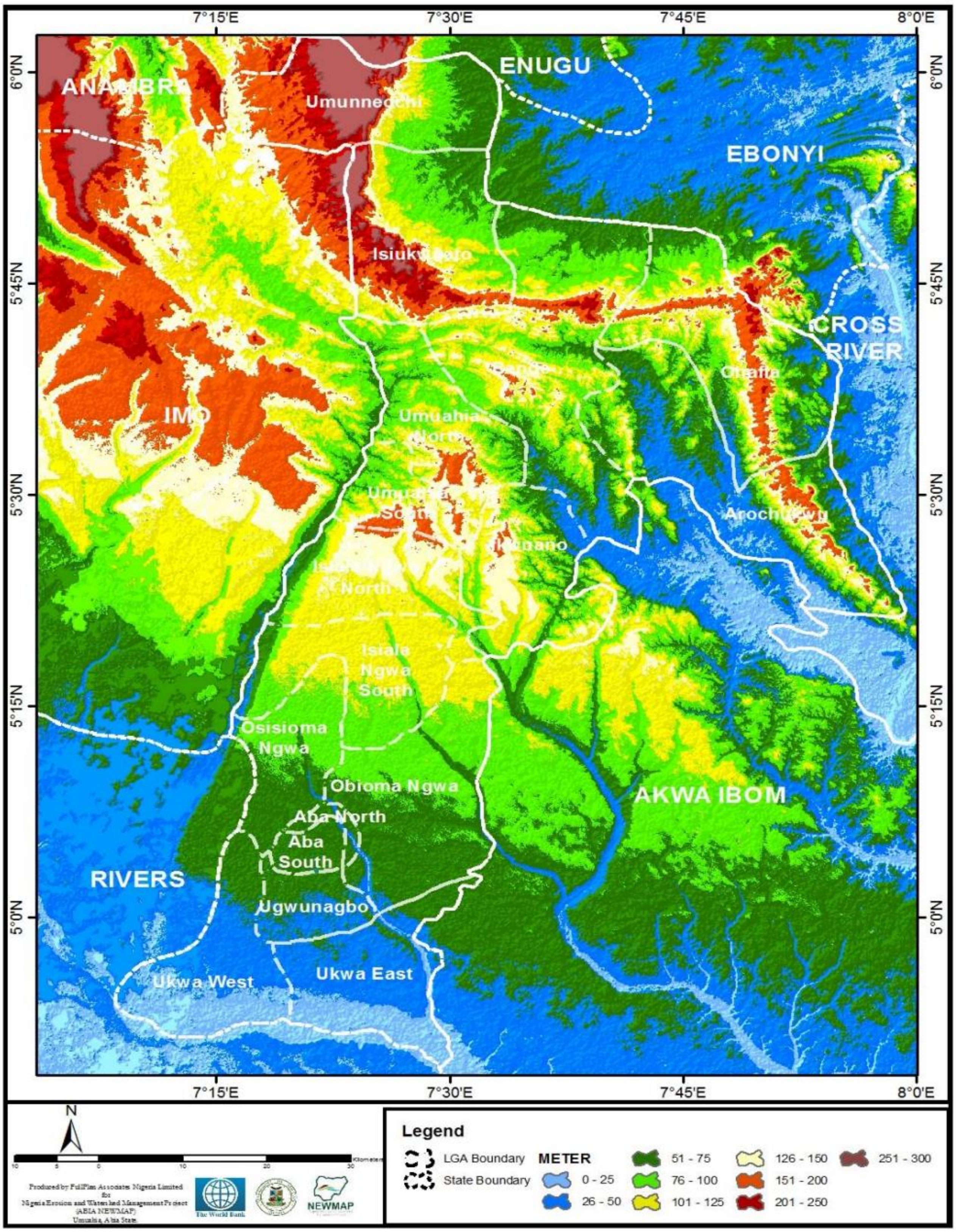


Figure 4.6: A Digital Elevation Model of Abia State

4.2.6 Groundwater and Surface Water Quality

The experimental investigation of the extent of the groundwater quality of Aba South local government area of Abia State, Nigeria has shown (judging from the physicochemical variables measured) that groundwater in the vicinity is safe for drinking and other uses (WHO 1984). Thus, the study has helped to allay people's fear that the water here is sub-standard for drinking and domestic purposes (Chukwu, 2008). Groundwater is an important natural resource which is next alternative to the surface supply sources that are prone to easy contamination.

In a related study by Amos-Uhegbu *et al.* (2012), the groundwater analyses show that physical and chemical parameters are within acceptable limits for either drinking water or general domestic use. However, all samples did not meet the pH standard of 6.5–8.5 stipulated for drinking water. This is normal for most groundwater qualities in Nigeria.

The dominant chemical ion in the groundwater of the study area is Sodium bicarbonate except at Umuika where Calcium chloride dominated. The results of surface water quality were generally acceptable as most of the parameters measured were within FMEnv acceptable values.

Table 4.15: Water Data / Log for Aba

S/N	PARAMETER	ABA/OSISIOMA		REMARKS	
1	WELL LOGS	Sound, Clay Sand & Sand Clay Resistivity ranging between 2500Nm-2300Nm			
2	STATIC LEVEL	Approx. = 60ft			
3	PUMP TEST RESULT	Approx. = 450m^3/hr			
4	WATER RESOURCE AND WATER SUPPLY DEVELOPMENT MAP (PIPELINE)	Soft Copy Available			
5	DRAINAGE AND SANITATION INFRASRUCTURE MAP	NA			
6	POWER TRANSMISSION LINES	NA		NA = Not Available	
7	**STREAM (SURFACE) & GROUND WATER QUALITY DATA**	**GROUND WATER**	**SURFACE WATER**	**GROUND WATER**	
7a	Turbidity (NTU)	0.395	38.2	1.52	
7b	Conductivity (µs/cm)	31.5	32.6	36.3	

7c	Total Dissolved Solid (TDS) [mg/L]	152	152	218	
7d	pH (Power of Hydrogen) - Acidity/Alkaline	6.69	7.14	6.81	
7e	Colilert (Bacteriological) Method (CFU100ml)	0	+8	0	+ (cell count)
7f	Nitrate (NO_3) [mg/L]	0.1	0.28	0.14	
7g	Nitrite (NO_2) [mg/L]	0.4	0.24	0.51	
7h	Aluminum (Al) [mg/L]	0.43	0.723	0.44	
7i	Manganese (Mn) [mg/L]	0.024	0.23	0.011	
7j	Fluoride (FI) [mg/L]	2.94	2.64	2.71	
7k	Iron (Fe) [mg/L]	0.31	2.40	0.38	

The water data/log for Aba determined in June 2021 and provided by Abia State Water and Sewage Corporation (AbSWSC) are presented in Table 4.17. The well logs were composed mainly of sand, clay sand and sand clay with Resistivity ranging between 230nM – 200nM and static level 98ft.

At Aba, the surface water quality had relatively high turbidity (23.4 NTU) and alkaline pH (7.85). Other parameters were within normal range for surface waters in southern Nigeria. Groundwater had <1 NTU turbidity and low conductivity and slightly acidic pH (6.69). The surface and groundwater quality results for Aba/Osisioma were not different from the situation at Aba. In general, the quality of groundwater at both locations were potable and fit for drinking.

The detailed results of analysis of groundwater samples collected from existing boreholes during the fieldwork are provide in Table 4.17 and summarized in Table 4.18.

Table 4. 16: Results of analysis of groundwater samples from different local governments during the fieldwork in Oct, 2021

PARAMETERS	OSISIOMA-UMUOBO WATER SAMPLE, OSISIOMA L.G.A	UMUEVO UMUIKEA WATER SAMPLE, ISIALA NGWA SOUTH L.G.A	ARUMUIKA II WATER SAMPLE, ISIALA NGWA SOUTH L.G.A	AMAISE WATER SAMPLE, ISIALA NGWA SOUTH L.G.A
A. PHYSICAL PARAMETER				
APPEARANCE	Clear & Colorless	Clear & Colorless	Clear & Colorless	Clear & Colorless
COLOUR	None	None	None	None
TASTE	Nil	Nil	Nil	Nil

ODOUR	Nil	Nil	Nil	Nil
TEMPERATURE (°C)	29.5	290	290	28.5
TURBIDITY (NTU)	3	3.4	4	2.8
CONDUCTIVITY (µS/L)	138	124	118	136
TDS (Mg/l)	102	142	92	112
B. CHEMICAL ANALYSIS				
PH	6.8	6.6	6.7	6.8
TOTAL HARDNESS (Mg/l)	122	132	118	126
CACO3 (Mg/l)	108	126	101	106
FE total				
Mn	ND	ND	ND	ND
Cu	ND	ND	ND	ND
K (Mg/l)	13.8	21.2	28.2	32.8
Ca (Mg/l)	138	133.6	128	86
Mg (Mg/l)	46	36	24	30
Cd	ND	ND	ND	ND
Pb	ND	ND	ND	ND
S04		30.8	26.7	42.8
H.C03 (Mg/l)	0.6	0.8	0.2	0.06
Na (Mg/l)	28	32.2	46	23
Fe	ND	ND	ND	ND
Cl2 total (Mg/l)	58.6	62.6	62.8	86
MICROBIOLOGY				
TOTAL COLIFORM	No BacteriaI growth after 48hrs of incubation	No BacteriaI growth after 48hrs of incubation	No BacteriaI growth after 48hrs of incubation	No BacteriaI growth after 48hrs of incubation
E. COLI	No BacteriaI growth after 48hrs of incubation	No BacteriaI growth after 48hrs of incubation	No BacteriaI growth after 48hrs of incubation	No BacteriaI growth after 48hrs of incubation

Table 4.17: Summary of Groundwater Quality Parameters sampled during the Field investigation, July 2021

PARAMETERS	**MIN**	**MAX**	**MEAN**	**ST.DEV**	WHO Recommendation
A. PHYSICAL PARAMETER					
APPEARANCE					Clear
TEMPERATURE (°C)	28.5	290	203	134.78	-
TURBIDITY (NTU)	2.7	4	3.183	0.48	< 5 NTU
CONDUCTIVITY (µS/L)	118	138	128.33	8.14	< 250 µS/L
TDS (Mg/l)	78	142	104	21.76	

% TRANSMITTANCE	0	0			
B. CHEMICAL ANALYSIS	0	0			
PH	6.6	6.8	6.7	0.09	(6.5-8.5)
TOTAL HARDNESS (Mg/l)	107	156	126.83	16.57	
CACO3 (Mg/l)	86	132	109.83	16.83	
K (Mg/l)	13.8	37.6	24.96667	9.46	
Ca (Mg/l)	86	142	125.9333	20.33	< 250 Mg/l
Mg (Mg/l)	24	46	32.66667	7.66	< 250 Mg/l
S04	26.7	42.8	33.43	8.37	< 250 Mg/l
H.C03 (Mg/l)	0.06	0.8	0.443	0.33	
Na (Mg/l)	23	62.5	38.28	14.30	
Cl2 total (Mg/l)	58.6	86	68.3	9.88	500 Mg/l
Dissolved O2	0	0			> 5 Mg/l
MICROBIOLOGY	0	0			
TOTAL COLIFORM	0	0			
E. COLI	0	0			

All the values of chemical parameters are within the WHO standard for drinking water. There are no traces of metallic ions and the water is not contaminated. The groundwater is therefore potable and fit for drinking. This corroborated the results of secondary data acquired during the preliminary ESIA report.

As part of total survey of water quality in the project area, surface water and sediment samples were collected from the up- and downstream of rivers in Aba at the points of bridge crossings during the fieldwork in October, 2021. The upstream stations serve as controls against future assessment. The detailed results are presented in Table 4.19, while the statistical results of minimum, maximum, mean, standard deviation, and the FMEnv regulatory standards are summarized in Table 4.20.

Results of the water quality analysis reveal that Total Suspended Solids (TSS), Turbidity, Colour and pH were all of normal range for unpolluted waters, with mean values within the regulatory standards. Among the chemical parameters, the water bodies had slightly acidic pH. Low conductivity and salinity which are typical of freshwaters. The waters were well oxygenated with dissolved oxygen (DO) values ranging from 5.6 to 7.5 mg/l which is able to support aquatic life. The low level of ammonium nitrogen and biochemical oxygen demand (BOD) is indicative of low level of biodegradation and organic pollution.

The cations were low in concentration, with Ca dominating, a typical phenomenon in tropical freshwater systems (Ogbeibu et al. 2013; 2014a,b; Ogbeibu and Eghaghe 2014; Ogbeibu and Iyorah 2015; Arazu et al. 2015; Arazu and Ogbeibu 2016; Ogbeibu and Ogiesoba 2019). The anions and nutrients were also within normal range.

The other parameters (heavy metals, organics and BTEX) were all very low and within the normal range stipulated by FMEnv. Hg and As were not detected. The low concentrations of heavy metals indicate no serious pollution from petroleum hydrocarbon and other anthropogenic activities.

Table 4. 18: Physico-chemical qualities of surface waters in Aba, October, 2021.

Parameters	Units	Methods	Aba River	Aba River
Matrix			**SW1**	**SW2**
			N05°06.982'	N05°07.975'
			E007°22.845'	E007°22.509'
Physicochemical Parameters				
pH		ASTM D129318	5.5	5.4
Temp	0C	EPA 1979, 170.1	29.3	31
TDS	mg/l	ASTM D1668	23	19
EC	uS/cm	ASTM D112595	46	38
Turbidity	NTU	APHA 2130B	1.72	1.95
TSS	mg/l	APHA 2540C	0.08	0.09

Parameters	Units	Methods	Aba River	Aba River	Eme River	Eme River	Amaogwugwu River	Amaogwugwu River
Matrix			**SW1**	**SW2**	**SW3**	**SW4**	**SW5**	**SW6**
TS	mg/l	ASTM D1868	23.08	19.09	10.95	9.96	23.86	23.87
DO	mg/l	ASTM D888-92(1996)	5.6	5.8	7.3	7.4	6.1	6.2
BOD	mg/l	APHA 507	2.6	2.2	2.5	2.6	2.53	2.74
COD	mg/l	ASTM D125295	14.56	22.81	12.54	14.14	15.51	16.22
Chloride	mg/l	API-RP45	13.8	11.4	5.3	5.4	13.1	13.2
Bicarbonate	mg/l	ASTM D106792	24.4	18.3	17.4	18.3	18.1	18.3
Carbonate	mg/l	ASTM D106792	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Sulphate	mg/l	APHA 427C	0.152	0.101	5.831	5.765	11.214	10.974
Phosphate	mg/l	ASTM D515-88	0.004	0.024	0.054	0.079	0.135	0.165

Nitrate	mg/l	ASTM D386990	1.014	2.789	1.059	1.859	2.521	2.535
Sulphide	mg/l	APHA, 1985	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Ammonium-nitrogen	mg/l	ASTM D142693	0.12	0.12	0.141	0.146	0.152	0.158
Sodium	mg/l	ASTM D279193	3.74	2.05	0.77	0.67	1.79	1.72
Potassium	mg/l	ASTM D279193	1.42	0.78	1.42	0.99	2.8	2.3
Calcium	mg/l	ASTM D1126-96B	5.77	3.85	3.12	2.57	4.77	4.49
Magnesium	mg/l	ASTM D1126-96B	2.72	3.11	2.54	3.89	5.16	5.46
Total Hardness	mg/l	ASTM D112696B	11.21	12.81	15.21	16.01	25.32	25.62
METALS								
Iron	mg/l	APHA 3111B	0.07	0.03	1.021	0.992	1.86	1.62
Lead	mg/l	APHA 3111B	0.042	0.018	0.065	0.058	0.066	0.062
Copper	mg/l	APHA 3111B	0.062	0.036	0.07	0.056	0.077	0.074
Cadmium	mg/l	APHA 3111B	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc	mg/l	APHA 3111B	0.045	0.049	0.051	0.056	0.062	0.064
Cobalt	mg/l	APHA 3111B	0.024	0.021	0.046	0.049	0.051	0.056
Nickel	mg/l	APHA 3111B	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Manganese	mg/l	APHA 3111B	0.047	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	mg/l	APHA 3111B	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	mg/l	APHA 3111B	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mercury	mg/l	APHA 3111D	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
ORGANICs								
Oil & Grease/THC	mg/l	ASTM D3941	<1.0	<1.0	0.46	0.56	0.59	0.64
PAH	mg/l	USEPA 8270	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BTEX	mg/l	USEPA 8260	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
MICRO ORGANISMS								
HUB	cfu/ml (10^3)	Vaour Phase Transfer	1.18	1.16	1.52	1.54	1.43	1.46

HUF	cfu/ml (10^3)	Vapour Phase Transfer	0.68	0.64	0.7	0.72	0.74	0.78
THB	cfu/ml (10^5)	Pour Plate	3.02	2.76	2.98	2.67	2.89	2.98
THF	cfu/ml (10^3)	Pour Plate	1.23	1.56	1.44	1.64	2.02	2.26

Table 4.19: Summary of physico-chemical qualities of surface waters in Aba, October, 2021.

Parameters	Units	Min	Max	Mean	SD	FMEnv Limit
Physicochemical Parameters						
pH		5.4	6.2	5.767	0.314	6.5-8.5
Temperature	0C	28.3	32.6	30.350	1.919	
TDS	mg/l	9	23	17.667	6.501	500
Elect Cond	uS/cm	18	48	35.667	13.352	
Turbidity	NTU	1.72	27.52	12.068	12.043	
TSS	mg/l	0.08	1.87	0.962	0.787	<10
TS	mg/l	9.96	23.87	18.468	6.462	
DO	mg/l	5.6	7.4	6.400	0.767	7.5
BOD	mg/l	2.2	2.74	2.528	0.181	0
COD	mg/l	12.54	22.81	15.963	3.582	0
Chloride	mg/l	5.3	13.8	10.367	3.967	250
Bicarbonate	mg/l	17.4	24.4	19.133	2.604	
Carbonate	mg/l	0	0			
Sulphate	mg/l	0.101	11.214	5.673	4.906	(200-400)
Phosphate	mg/l	0.004	0.165	0.077	0.063	
Nitrate	mg/l	1.014	2.789	1.963	0.781	
Sulphide	mg/l	0	0			
Ammonium-nitrogen	mg/l	0.12	0.158	0.140	0.016	<1.0
Sodium	mg/l	0.67	3.74	1.790	1.111	200
Potassium	mg/l	0.78	2.8	1.618	0.779	
Calcium	mg/l	2.57	5.77	4.095	1.162	
Magnesium	mg/l	2.54	5.46	3.813	1.252	
Total Hardness	mg/l	11.21	25.62	17.697	6.259	200
METALS		0	0			

Iron	mg/l	0.03	1.86	0.932	0.762	1
Lead	mg/l	0.018	0.066	0.052	0.019	0.05
Copper	mg/l	0.036	0.077	0.063	0.015	0.1
Cadmium	mg/l	0	0			0.01
Zinc	mg/l	0.045	0.064	0.055	0.008	5
Parameters	**Units**	**Min**	**Max**	**Mean**	**SD**	**FMEnv Limit**
Cobalt	mg/l	0.021	0.056	0.041	0.015	
Nickel	mg/l	0	0			0.05
Manganese	mg/l	0.047	0.047	0.047		(0.05-0.5)
Chromium	mg/l	0	0			0.05
Arsenic	mg/l	0	0			0.2
Mercury	mg/l	0	0			0.001
ORGANICs		0	0			
Oil & Grease/THC	mg/l	0.46	0.64	0.563	0.076	0.05
PAH	mg/l	0	0			
BTEX	mg/l	0	0			
MICRO ORGANISMS		0	0			
HUB	cfu/ml (10^3)	1.16	1.54	1.382	0.169	
HUF	cfu/ml (10^3)	0.64	0.78	0.710	0.049	
THB	cfu/ml (10^5)	2.67	3.02	2.883	0.140	
THF	cfu/ml (10^3)	1.23	2.26	1.692	0.381	

4.2.7 Soil

The project area is made up mainly of *hydromorphic soils* which consist of reddish brown gravely and pale coloured clayey soil. The soil is rich for agriculture and it supports the growth of yam, cassava, maize, rice, etc. The soil material from the gully site could be classed as silty sand derived from weathered sandstone and limestone in the area. The soil material graded from dark brown to reddish yellow with lenses of grey sandy silt of moderately void ratio. These parameters make the soil in the area very erodible.

The soil texture varies from loamy sand in the surface layer to sandy clay loam down the profile. Chemically, the soil of the project area is deficient in basic cations with aluminum saturation being greater than 83%. The soils are moderately acidic (pH 4.5 – 4.9) and low in organic carbon, total nitrogen and available phosphorus. Total nitrogen and organic carbon are medium and available phosphorus is low in this soil. The mineralogy of clay sized particles showed a dominance of kaolinite in both soils with some quantities of montmorillonite that increased down the profile.

During the present study, detailed location specific route soils survey and laboratory testings were carried out for the design of all the proposed roads in Aba. At Aba, a total of two hundred and eighteen samples **(218 Nos**) were obtained with hand auger/manual trial pitting at the selected locations, for geotechnical investigations. Evaluation of the characteristics of the soils along the proposed alignment and the general features along the formation was carried out by observation and augering/manual trial pitting to the depth of 0.0 -1.5m along the route. The static water level was observed to be deeper than the depth of all the trial pits. The materials observed along the formation were laterite, and laterite with Pebbles. This was observed between 0.0 -1.5m in the trial pits.

The existing sub grade along the proposed route is made up of clayey and silty sands. This was encountered within 1.5m trial pit depth and has AASHTO classification of A-2-4, A-2-6, A-6, A-1-b, A-2-5, A-7-6, A-2-7, A-5 and A-4 with soaked CBR of 6 - 82%. The soaked CBR values obtained for sub grade materials were used in the pavement design as indicated in the project feasibility studies.

The roads alignment is generally overlain by thick overburden layer of silty sand, stiff silty sand, dense sand, dump, clayey sand, fine silt, fine sand, lateritic clay, silty clay, clayey silt, fine silty sand, laterite. These are further underlain in some areas by hills and gentle slopes.

Soil Stratigraphy was also carried out at different locations. At the study area, the overburden comprises predominantly of fine sand and gravely laterite. These were proved within total explored depth of 8.1 m in the 2Nos test borings. The specific types of formation observed are given in Table 4.20:

Table 4. 20: Soil Stratification (Percussion Drilling)

Depth (m)	Materials Proven	
	BH1 32P0326918E 0622037N	BH2 32N326948.556E 621999.316N
0.0 – 0.6	Gravely laterite	Gravely laterite
1.5 – 2.1	Gravely laterite	Gravely laterite
3.0 – 3.6	Fine sand	Fine sand
4.5 – 5.1	Fine sand	Fine sand
6.0 – 6.6	Fine sand	Fine sand
7.5 – 8.1	Fine sand	Fine sand

The specific types of formation observed are given in Table 4.23:

Table 4.21: Stratigraphy

Depth (m)	General Lithology
0.0 – 0.6	Fine sand
1.5 – 2.1	Fine sand
3.0 – 3.6	Fine sand
4.5 – 5.1	Fine sand
6.0 – 6.6	Fine sand
7.5 – 8.1	Fine sand

4.2.8 Land Use and Tenure System

Land use

Land, which is central to the economy, social and political spheres of community, society, and the nation at large is regarded as a crucial asset. It is the most important economic resources, most particularly for developing countries with a largely rural population and most people earn their living through agriculture. It has remained the most important factor of production since the creation of man and a fundamental factor of production in the agricultural sector all over the world. It provides a basis for crop production in Nigeria as a whole and Abia State in particular.

There has been some Nigeria do not have adequate access to arable land for increased production. The evidence shows that differences in land access of smallholders are large, resulting in significant differences in production, income, and wealth. Instances where they are allowed to expand their farming practices, then they are allocated land in virgin forests, and consequently faced with the challenge of the high cost of clearing and preparing the land for cultivation.

Farming households, whose livelihood is partly or entirely dependent on agriculture and based on a traditional production system, land plays a pivotal role in shaping and directing livelihoods. In most communities the land is, therefore, the basis of agriculture production and the most important production factor for farmers. It is the most important asset, particularly in poor communities where wealth and survival are measured by control, and access to land.

Secured access to productive land is critical to thousands of poor livings in rural areas and who depend on agriculture, livestock, and forest for their livelihood. It will reduce their vulnerability to hunger and poverty; influence their capacity to invest in their productive activities and the sustainable management of their resources; enhance their prospects for better livelihood and helps them to develop more equitable relations with the rest of their society, thus contributing to peace and sustainable development. Irrespective of these, evidence shows that the land size and productivity per a given plot are decreasing whereas, the needs to satisfy household demand are increasing which could be explained with fundamental economic questions about production and population. This paradox leads to the question of how the farm households meet their demands under limited and declining trends in productivity while ensuring sustainable land-use systems.

The issue of land use and associated natural resources are some of the pressing socioeconomic problems. These issues stem from deep-rooted traditional systems of assessing land access and use combined with livelihood activities associated with other surrounding natural resources. Also, in the State, access to land emanated from the traditional open regime. Here, increasing demand for land, formalization process of rural ownership, and access occurring since decades of long-standing traditions of agricultural extensification practices. Consequently, smallholder farmers in Abia have experienced unwise population induced agricultural intensification practices, resulting in decreasing land productivity.

Agriculture is the second economic sector of Abia, representing 27% of the GDP, and employs 70% of the State workforce. With its adequate seasonal rainfall, Abia has much arable land that produces yams, maize, potatoes, rice, cashews, plantains, taro, and cassava. Oil palm is the most important cash crop. Also, three agricultural zones of the state, namely Abia North, Abia South, and Abia Central.

Tenure System

In Nigeria, land takes up importance as a commodity for daily use for many purposes. For several decades, land has continued to influence the lives of Nigerians socially, eco- nomically and politically. In the process of using the land, complex set of relationships has emerged among groups. The more complex various Nigerian communities become, and the more established arc the physical manifestations of development, the more friction and dashes arc likely over rights in land. This shows that in Nigeria, as in other developing countries generally, land constitutes a sensitive asset whose administration must be based on meaningful policy decisions to benefit most Nigerians. Land is the most important resource-input in Nigerian agriculture and so, policies affecting it affect the farming population more so than other members of the community. The concept of land tenure has been described as «a systematization of the rules which function by specifying what different classes of persons may or may not must or must not do, with reference to the occupancy, use, abuse or disposition of Land. Such rules define the privileges and obligations, the rights and duties of persons in relation to each other, with reference to land. Although the basis of land-ownership in Nigeria has long been the family from which other interests are carved out, there are essentially two categories of interests recognized in land. The first, that of superior interests which are proprietary in nature and confer the highest decision-making rights to the holder, having regard to the laws and customs prevailing in the locality. Secondly, there are inferior interests which are rights exercised by individuals, not in perpetuity as in superior interests, but for a Limited period of time.

These are rights which have been derived from, or carved out of the superior rights and are subject to the laws, customs, sanctions, rules and regulations of the community. Under the derivative rights to land, the derivator or tenant acquired rights of use from the landlord. Where the landlord and tenant contribute inputs in equal proportions (50/50), that is, the landlord provides seeds or/and fertilizers while the tenant supplies labor and working capital, it is usual for the tenant to receive one third of the produce while the landlord receives two thirds. One third of the landlord's share represents contribution from the land per se. If, however, the landlord makes no further contribution apart from the land, then products of the harvest are shared in equal proportions by both the landlord and the tenant. In Nigeria, no land exists without an owner although that ownership may be the basis for dispute. Umeh (1973) has recognized four main categories of who may exercise rights or interests in Nigerian land. These are natural and supernatural persons, corporate bodies and the State. The concept of land tenure is pervasive as the issue of rights to land for the purpose of food production has always been important to the Nigerian farmer. It has enabled the Nigerian farmer to gain access to land in order to feed himself and members of his family. The customs, sanctions and duties associated with use of land have also ensured preservation of the farmer's rights of ingress and egress. In a way, customary laws of land tenure have in the past given the farmer a feeling of reasonable permanence on the land he cultivates. The pervasive nature of land tenure is evident in the areas of the agricultural sector where it makes an impact. These include productivity levels, security of tenure, shifts in income distribution, rural capital formation and stability of employment.

4.3. Biological Description of the Project Area

4.3.1. Aquatic Ecology

This section on Aquatic Ecology is concerned with the species composition, community structure and diversity of the biotic (or living components like zooplankton, benthic invertebrates and fisheries) of the environment, their interactions amongst themselves and their relationships with the abiotic or physico-chemical components.

The term "Plankton" refers to those minute aquatic forms which are non motile or insufficiently motile to overcome the transport by currents and living suspended in the open or pelagic water. The planktonic plants are called **phytoplankton** and planktonic animals are called **zooplankton** (APHA, 1995). The plankton community, occupy the regions of high light intensities namely on the surface layer of pelagic zone.

Phytoplankton

Phytoplankton is made up of small plants, mostly microscopic in size and unicellular. They are the primary producers in the aquatic ecosystem and thus are the most important producers of organic substances and the rate at which energy is stored up by these tiny organisms determines the basic primary productivity of the ecosystem. All other living forms of higher trophic levels are directly or indirectly dependent on phytoplankton for their energy.

In this study, twenty (20) species of phytoplankton grouped into four major groups namely Bacillariophyta (represented by 2 species), Chlorohyta (represented by 12 species), Cyanophyta (represented by 4 species) and Xanthophyta (represented by 2 species) was encountered. A checklist of the phytoplankton encountered as well as their spatial distribution and abundance is presented in Table 4.24. Station 6 (SW 6) had the highest abundance of phytoplankton closely followed by station 4 (SW 4) while stations 1 and 5 (SW1 and SW 5) had the lowest abundance of phytoplankton (Figure 4.11). In terms of percentage species contribution, members of the division Chlorophyta made the highest contribution, contributing 68% of the total phytoplankton species encountered, followed by members of the division Bacillariophyta and Cyanophyta which contributed 14% each of the total phytoplankton species abundance encountered while members of the division Xanthophyta made the lowest contribution , contributing 4% of the total phytoplankton species abundance encountered in the study (Figure 4.12).

A measure of diversity using Shannon- Wiener index showed station 4 (SW 4) to have the highest diversity (H=2.65) while station 2 (SW 2) had the lowest diversity (H=2.451) (Table 4.25). A test of significant difference using one-way analysis of variance (ANOVA) showed that there was no significant difference (p>0.05)) in phytoplankton abundance across the sampled stations.

Table 4. 23: Phytoplankton species Composition, Distribution and Abundance across the sampled stations

TAXA	SW1	SW 2	SW 3	SW 4	SW 5	SW 6
Bacillariophyta						
Tabellaria flocculosa	3	4	1	0	3	2
Synedra sp.	2	4	3	3	1	2
Chlorophyta						
Closterium leiblinii	0	2	1	3	0	1
Closterium moniliforum	2	3	1	0	0	3
Fragillaria sp.	3	2	4	4	3	5
Microspora flocosa	0	0	1	3	1	0
Microspora sp.	1	0	0	1	1	0
Penium spirostriolatum	2	4	3	3	4	2
Spirogyra communis	4	1	3	3	4	6
Spirotaenia condensata	1	4	3	2	2	1
Stigeoclonium sp.	0	0	2	0	1	0
Tetrahedron hastatum	2	4	3	2	1	3
Ulothrix zonata	2	0	0	3	1	3
Volvox sp.	3	2	4	2	3	3
TAXA	**SW1**	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**SW 6**
Cyanophyta						
Lyngbya limnetica	1	0	0	2	0	1
Oscillatoria bornetia	0	0	1	0	3	2
Oscillatoria Formosa	1	2	0	3	1	0
Oscillatoria tenuis	3	1	3	2	0	3
Xanthophyta						
Rtibonema utriculosum	0	1	0	0	1	0
Gloeobotrys limneticus	1	0	2	1	1	2
TOTAL	**31**	**34**	**35**	**37**	**31**	**39**

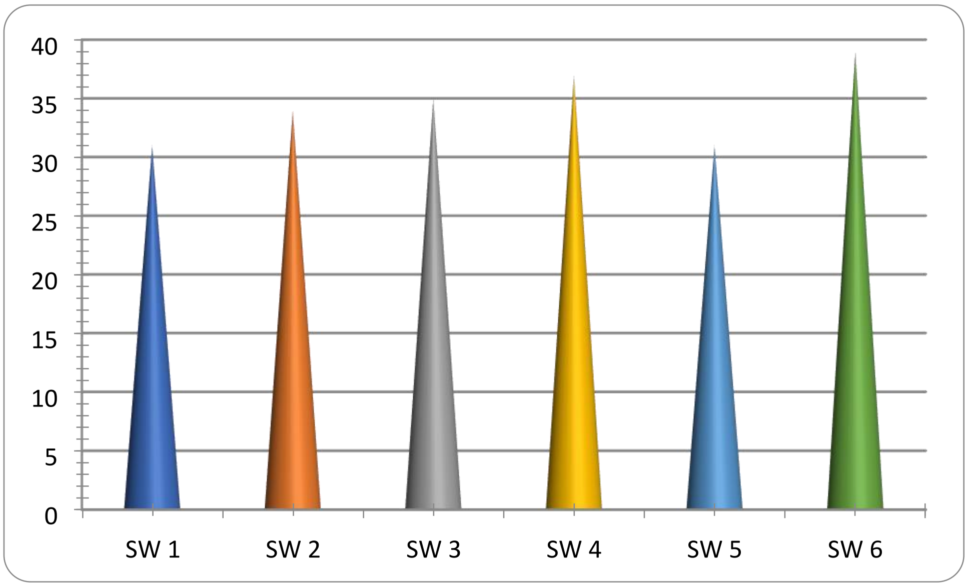


Figure 4.6: Spatial variation in the abundance of phytoplankton across the sampled stations.

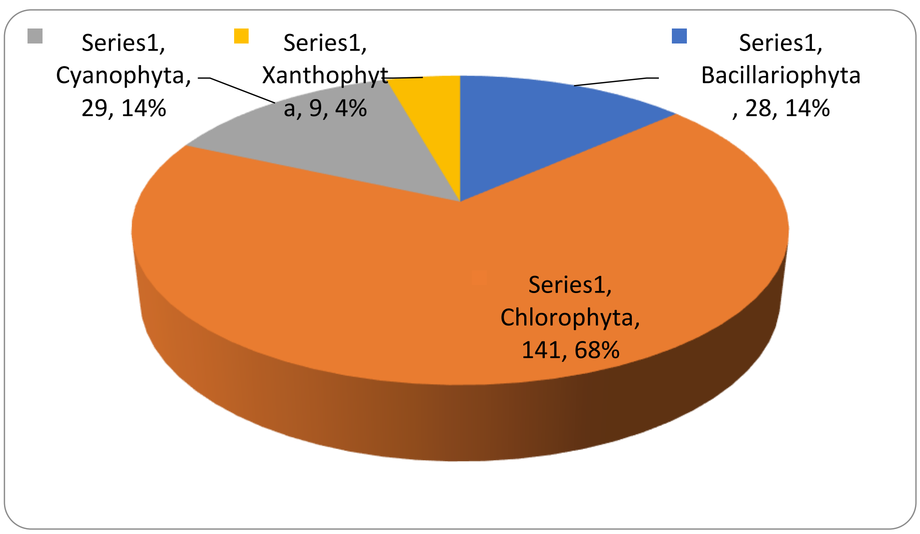


Figure 4.7: Percecentage species composition of the major groups of phytoplankton encountered

Table 4. 24: Diversity of phytoplankton across the sampled stations

Index	SW1	SW2	SW3	SW4	SW5	SW6
Taxa_S	15	13	15	15	16	15
Individuals	31	34	35	37	31	39
Dominance_D	0.08012	0.09343	0.08082	0.07378	0.08429	0.08481
Shannon_H	2.606	2.451	2.594	2.65	2.606	2.581
Menhinick	2.694	2.229	2.535	2.466	2.874	2.402
Margalef	4.077	3.403	3.938	3.877	4.368	3.821
Equitability_J	0.9624	0.9555	0.958	0.9786	0.94	0.9532

The twenty species of phytoplankton recorded in this study may not be the only phytoplankton species in the water bodies sampled as studies carried out by various authors in these water bodies revealed some others species which were not encountered during the period of this study.

Zooplankton

The animals making up the zooplankton are taxonomically and structurally diverse. Zooplankton are the central trophic link between primary producers and higher trophic levels. Most of them depend to a large extent, on various bacterioplankton and phytoplankton for food. Many of the larger forms feed on smaller zooplankton, forming secondary consumers. Some of them are detritivore feeders, browsing and feeding on the substrate attached organic matter, phytoplankton or concentrating on the freely suspended organic matter particles or those lying on the bottom sediment. Many of these organisms are also fish food organisms and are consumed by the other aquatic macrofauna.

Twenty-three (23) species of Zooplankton were encountered in the plankton samples. These consist mainly of ten copepods namely *Thermocyclops neglectus, Mesocyclops bodanicola, Tropocyclops prasinus, Eucyclops serrulatus, Mesocyclops ogunnus, Metacyclops minutus, Micricyclops varicans, Ectocyclops phaleratus, Tropodiaptomus incognitus* and *Halicyclops troglodytes*, ten **cladocerans** namely *Kurzia longirostris, Diaphanosoma excisum, Moina micrura, Echinisca rosea, Chydorus sphearicus, Alona affinis, Alona davidi, Alona eximia, Alona karua* and *Alona quadrangulari*s, and three rotifers namely *Brachionus patulus patulus, Lecane papuana* and *Platyias leloupui.* A checklist of the zooplankton encountered in this study as well as their spartial distribution and abundance is presented in **Table** 4.26. The spatial variation in zooplankton abundance across the sampled stations showed that station 2 (SW 2) had the highest zooplankton abundance followed by station 1 (SW 1) while stations 3 and 6 (SW 3 and SW 6) had the lowest zooplankton abundance **(Figure** 4.13**)**. Copepods contributed 61% of the zooplankton abundance encountered; cladocerans contributed 33% of the total zooplankton abundance while rotifers contributed 6% of the total zooplankton abundance **(Figure** 4.14**).** A measure of diversity using Shannon-Wienner index showed station 2 (SW 2) to have the highest diversity in zooplankton followed by station 4 (SW 4) while station 6 (SW 6) had the lowest diversity of zooplankton **(Table** 4.27**).** Analysis of variance using one-way analysis of variance (ANOVA) showed that there was no significant difference ($p>0.05$) in zooplankton abundance across the sampled stations.

Table 4.25: Zooplankton species Composition, Distribution and Abundance across the sampled points.

TAXA	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6
Crustacea: Copepoda						
Ectocyclops phaleratus	2	0	1	3	0	1
Eucyclops serrulatus	1	2	1	0	0	2
Halicyclops troglodytes	3	1	0	0	1	0
Mesocyclops bodanicola	2	0	2	3	1	3
Mesocyclops ogunnus	1	2	1	0	2	0
Metacyclops minutes	1	3	2	2	4	2
Micricyclops varicans	1	3	0	1	1	0
Thermocyclops neglectus	4	2	4	2	2	3
Tropodiaptomus incognitus	0	0	1	0	2	0
Tropocyclops prasinus	2	3	2	3	3	2
Crustacea: Cladocera						
Alona affinis	0	1	0	0	1	0
Alona davidi	0	2	2	1	0	2
Alona eximia	1	2	0	2	1	1
Alona karua	0	0	1	0	1	0
Alona quadrangularis	1	2	1	0	0	1
Chydorus sphearicus	1	0	0	1	0	0
Diaphanosoma excisum	0	3	1	2	3	1
Echinisca rosea	3	1	0	1	1	0
Kurzia longirostris	2	0	0	2	0	0
Moina micrura	1	1	0	1	1	0
Monogononta: Ploimida						
Brachionus patulus patulus	0	0	0	1	1	0
Platyias lelupui	0	1	0	2	0	1
Lecane papuana	0	1	0	1	0	0
TOTAL	**26**	**30**	**19**	**28**	**25**	**19**

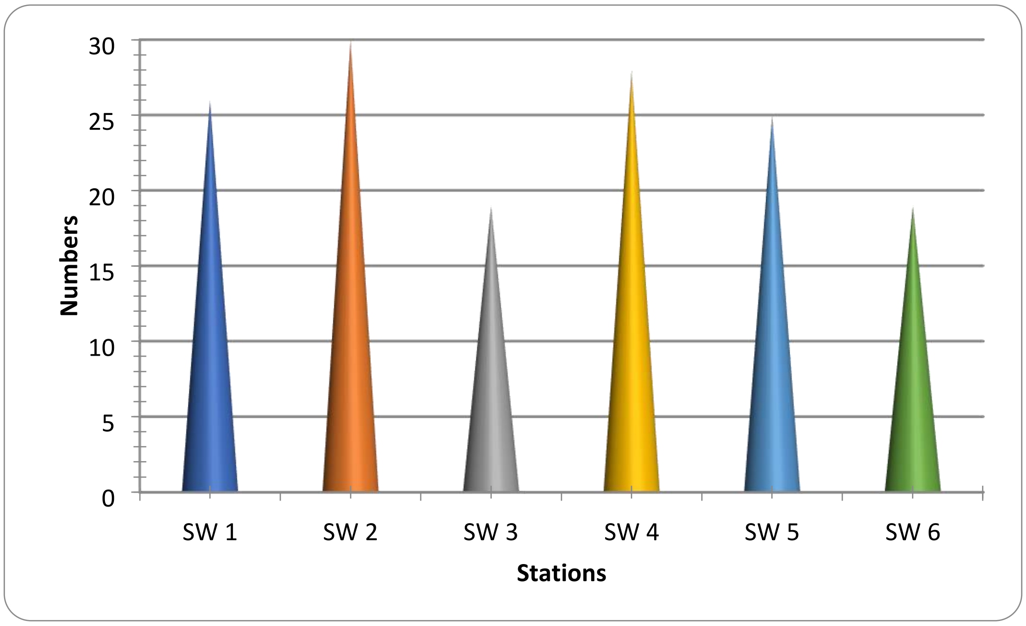


Figure 4. 8: Spatial variation in the abundance of zooplankton across the sampled stations.

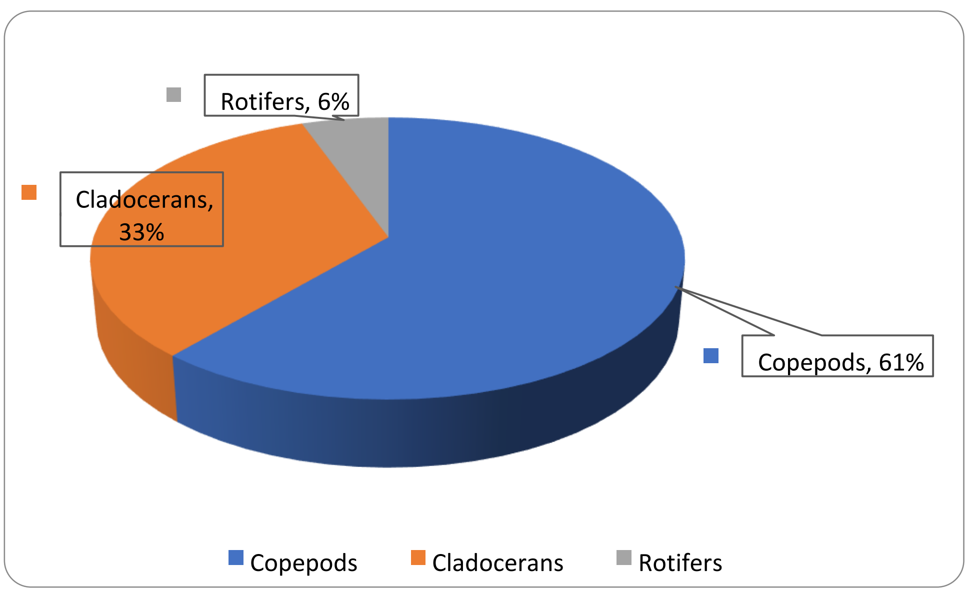


Figure 4. 9: Percentage abundance of the major groups of zooplankton encountered.

Table 4.26: Diversity of zooplankton across the sampled stations.

Index	SW1	SW2	SW3	SW4	SW5	SW6
Taxa_S	15	16	12	16	15	11
Individuals	26	30	19	28	25	19
Dominance_D	0.0858	0.07333	0.108	0.07398	0.088	0.108
Shannon_H	2.578	2.684	2.361	2.682	2.567	2.306

Menhinick	2.942	2.921	2.753	3.024	3	2.524
Margalef	4.297	4.41	3.736	4.502	4.349	3.396
Equitability_J	0.952	0.9682	0.95	0.9673	0.9479	0.9615

The twenty-three (23) species of zooplankton recorded in this study may not be the only zooplankton species in the water bodies sampled. Studies by various authors in these water bodies revealed zooplankton species which were not encountered in this study.

In this study, phytoplankton constituted 58% of the total plankton abundance while zooplankton constituted 42% of the total plankton abundance encountered in this study **(Figure** 4.12**).**

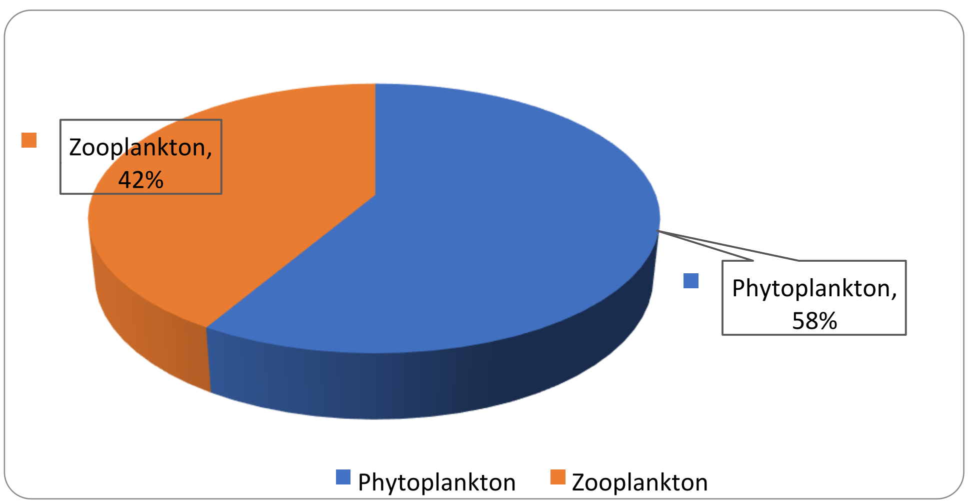


Figure 4. 10: Percentage composition of plankton encoutered in the study.

Benthic Macrofauna

Benthic macrofauna, or more simply "benthos", are animals that are larger than 0.5 millimeter (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.

Twelve species of benthic macrofauna all belonging to the class Insecta grouped into five different Orders namely Hemiptera, Diptera, Odonata, Coleoptera and Trichoptera was encontered in this study. Odonata dominated with five species, followed by Hemiptera, Diptera and Coleoptera with two species each while Trichoptera had one representative species. A checklist of the benthic macrofauna encountered in this study as well as their spatial variation and abundance is presented in **Table** 4.27**.** The spatial variation in benthic fauna abundance across the sampled stations showed that stations 2 and 5 (SW 2 and SW 5) had the highest benthic fauna abundance while station 1 (SW 1) had the lowest benthic fauna abundance **(Figure** 4.27**)**. Odonata dominated the benthic insect fauna abundance encountered in the study area, contributing 39% of the insect abundance, followed by Hemiptera with 23% while Trichoptera contributed the lowest abundance of the benthic insect fauna abundance with 4% **(Figure** 4.28**).**

A measure of diversity across the sampled stations using Shannon-Weiner index showed that station 4 (SW 4) had the highest diversity (H=2.201) in benthic fauna closely followed by station 5 (SW 5) (H=2.114) while station 1 (SW 1) had the lowest diversity (H=1.907) in benthic fauna **(Table** 4.29**).** One-way analysis of variance showed that there was no significant difference ($p>0.05$) in benthic macrofauna abundance across the sampled stations.

Table 4. 27: Spatial variation in benthic macrofauna Composition, Distribution and Abundance across the sampled points.

TAXA	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6
Odonata						
Cordulid sp.	0	2	1	0	2	1
Gomphus sp	0	2	4	1	0	0
Libellula sp	2	3	2	1	3	2
Orthetrum sp.	0	1	0	1	0	0
Sympetrum sp.	2	1	3	1	2	3
Hemiptera						
Lethocerus sp.	2	0	3	2	2	0
Notonecta sp.	2	3	2	3	4	1
Diptera						
Chironomus fractilobus	1	0	2	0	1	3
Chironomus transvalensis	0	2	0	2	2	1
Coleoptera						
Dytiscus sp.	1	4	1	2	2	3
Hydrophilus sp.	2	1	0	3	0	1
Trichoptera						
Agraylea sp.	0	0	0	1	1	2
TOTAL	**12**	**19**	**18**	**17**	**19**	**17**

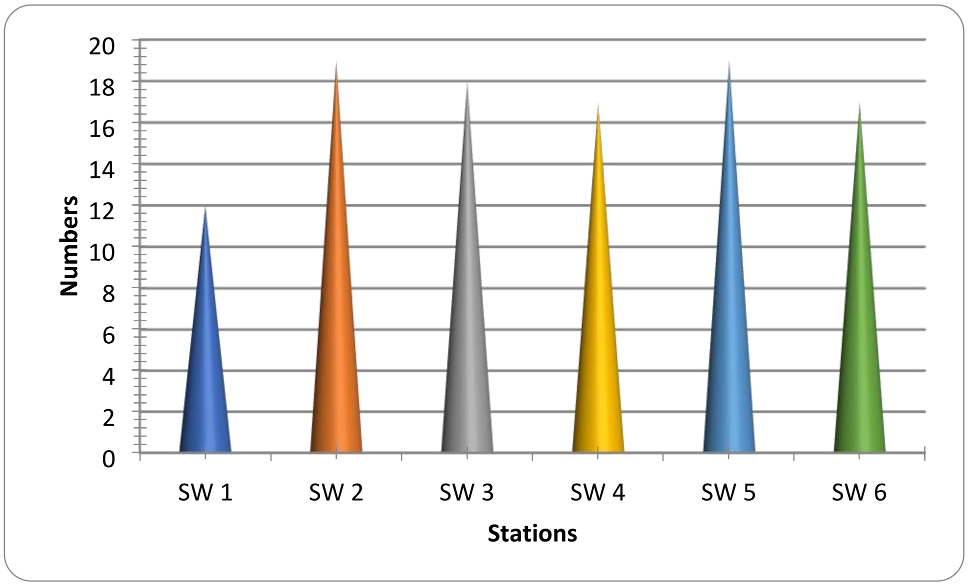


Figure 4. 11: Spatial variation in benthic macrofauna abundance across the sampled points

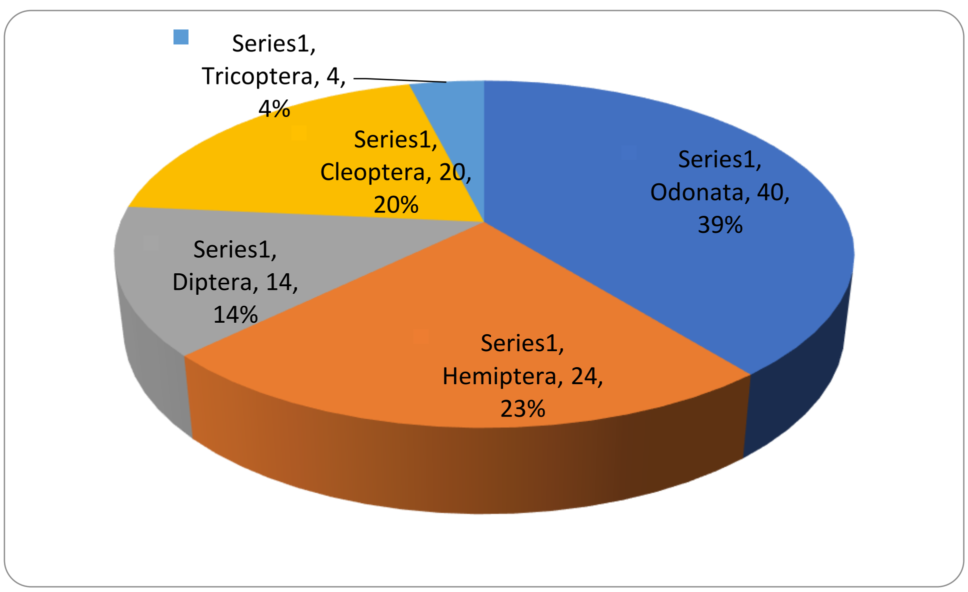


Figure 4. 12: Percentage abundance of the insect orders encountered in the study area.

Table 4. 28: Diversity in benthic macrofauna across the sampled points.

Index	SW_1	SW_2	SW_3	SW_4_	SW_5	SW_6
Taxa_S	7	9	8	10	9	9
Individuals	12	19	18	17	19	17
Dominance_D	0.1528	0.1357	0.1481	0.1211	0.1302	0.1349
Shannon_H	1.907	2.087	1.985	2.201	2.114	2.089
Menhinick	2.021	2.065	1.886	2.425	2.065	2.183
Margalef	2.415	2.717	2.422	3.177	2.717	2.824

Equitability_J	0.9802	0.9497	0.9546	0.9558	0.9623	0.9505

The twelve species of benthic fauna recorded in this study may not be the only benthic fauna in the water bodies sampled as more benthic fauna have been reported in the study area by various authors.

4.3.2. Fisheries

Fisheries studies investigated the utilization of harvestable aquatic organisms, their abundance and the population involved in fisheries activities in the study communities. It also covered the fishing gears/methods, catch composition, fish species composition. The study area is primarily a freshwater ecosystem. Fishing in Aba and Eme River, a tributary of the Imo River is carried out mainly by few artisanal fishermen from the riparian communities. The fishing techniques utilized include such basic gears as gill nets, cast net, long lines and traps.

The checklist of fish species

Table 4.29 shows the checklist, common and local names of commercially important fish species recorded during the study, based on data from direct sampling and secondary information from fisher folk. The list shows that 16 species in 9 families of fish were recovered from Aba and Eme River, a tributary of the Imo River. The number of fish species in these rivers in artisanal fisheries assessment are comparable with fish diversities in similar rivers. Adaka et al. (2015) reported 11 species in 7 families from the Imo River at Owerri-Nta, Abia State. The family Cichlidae appeared extensively in the catches, with *Tilapia zilli* dominating in abundance.

The variation in number of fish species and families in the fisher's catch across different water bodies could be attributed to fishing methods and gear selectivity, which could also be as a result of fish size and target species. The distribution of the fish species could also depend upon the biotic and abiotic factors of the ecosystem including rainfall (Moses, 1987, 2001), volume of river discharge and surface area of river basin, hydrographic heterogeneity-mean depth, water level fluctuations, morphometric features and nature of the river bottom.

Table 4. 29: Checklist of fish species in the study area

Family	Scientific Name	Common Name	Local name
Alestidae	*Alestes macrophthalmus*	Tiger fish	Sako
Cichlidae	*Hemichromis fasciatus*	Tilapia	Atabala
	Lates niloticus	Tilapia	Atabala

	Oreochromis niloticus	Tilapia	Atabala
	Sarotherodon melanotheron		
	Tilapia guineensis	Tilapia	Atabala
	Tilapia zilli	Tilapia	Atabala
Claridae	*Clarias gariepinus*	Catfish	Atuma
	Heterobrancus bidorsalis	Catfish	Echim (Asu isii)
Claroteidae	*Chrysichthys nigrodigitatus*	Silver Catfish	Okpor
Channidae	*Parachanna obscura*	Snakehead	Snakehead
Hepsetidae	*Hepsetus odoe*	Tiger fish	Sako
Mormyridae	*Mormyrus rume*	Trunk fish	Obor
Polypteridae	*Erpethoichthys calabaricus*	Rope fish	Iroro
Schilbeidae	*Schilbe mystus*	Butterfly fish	Adele
	Schilbe intermedius	Butterfly fish	Adele

Adaka *et al*. (2015) noted that a number of fishermen were found using small mesh size gillnets of one finger (1 inch) to crop the juveniles of highly valued fish species. Therefore, fishing pressure, both in terms of the number of fishermen and the kinds of fishing gear in use, has a depurative effect on the abundance and sizes of commercially exploited species, such as; *Chrysichthys nigrodigitatus, Hepsetus odoe*, *Parachanna obscura*, and the cichlids.

4.3.3. Wildlife

Flora

Generally, Aba falls into the Tropical Rainforest belt of Nigeria, with pockets of freshwater Swamp Forests. The vegetation of the project area is made up of tall trees forming a canopy, shrubs and tall grasses. The common species that comprise the indigenous vegetation of the project area are shown in Tables 4.30 – 4.32. The pockets of freshwater swamp forests harbour valuable economic tree species such as mahogany, Iroko, Rubber, oil and Rafia palm, and Bamboo which are also found along the proposed routes. The original vegetation of tropical rain forest has been reduced to Guinea Savannah Mosaic due to deforestation and other anthropogenic activities.

Table 4.30: Floristic Composition along Aba Road site

S/No	Scientific Name	Family	Common Name	Growth Form	Economic importance
1	*Manihot esculenta*	Euphorbiaceae	Cassava	Shrub	Food
2	*Musa paradisiacal*	Musaceae	Plantain	Tree	Food
3	*Musa sapientum*	Musaceae	Banana	Tree	Food
4	*Colocasia esculenta*	Araceae	Coco yam	Herb	Food
5	*Dioscoreasp*	Dioscoreaceae	Yam	Climber	Food
6	*Pennisetum purpureum*	Poaceae	Elephant grass	Herb	
7	*Mangifera indica*	Anacardiaceae	Mango	Tree	Food
8	*Panicum maximum*	Poaceae	Guinea grass	Herb	
9	*Commelina spp.*	Commelinaceae	Dy flower	Creeper	
10	*Mimosa pudica*	Fabaceae	Sensitive plant	Herb	
11	*Tridax procumbens*	Asteraceae	Goat weed	Herb	
12	*Helianthus annuus*	Asteraceae	Sunflower	Herb	
13	*Calapogonium mucunoides*.	Fabaceae	Calapo	Creeper	
14	Chromoleana odorata	Asteraceae	Siam weed	Herb	Medicine
15	*Elaeis guineensis*	Arecaceae	Oil palm	Tree	Food
16	*Bambusa vulgaris*	Poaceae	Bamboo	Tree	Industrial
17	*Laportea aestuans*	Malvaceae	Tropical netleweed	Herb	
18	*Sida acuta*	Malvaceae	Broom weed	Herb	
19	*Dryopteris filix-mas*	Dryopteridaceae	Male fern	Herb	

Table 4.31: Floristic Composition along Asa Road – PH Road site

S/No	Scientific Name	Family	Common Name	Growth Form	Economic importance
1	*Manihot esculenta*	Euphorbiaceae	Cassava	Shrub	Food
2	*Musa paradisiacal*	Musaceae	Plantain	Tree	Food
3	*Musa sapientum*	Musaceae	Banana	Tree	Food
4	*Colocasia esculenta*	Araceae	Coco yam	Herb	Food
5	*Dioscoreasp*	Dioscoreaceae	Yam	Climber	Food
6	*Pennisetum purpureum*	Poaceae	Elephant grass	Herb	
7	*Eupatorium*	Asteraceae	Siam weed	Shrub	Medicine

	odoratum				
8	*Cocos nucifera*	Arecaceae	Coco nut	Tree	Food
9	*Panicum maximum*	Poaceae	Guinea grass	Herb	
10	*Commelina spp..*	Commelinaceae	Dy flower	Creeper	
11	*Mimosa pudica*	Fabaceae	Sensitive plant	Herb	
12	*Tridax procumbens*	Asteraceae	Goat weed	Herb	
13	*Helianthus annuus*	Asteraceae	Sunflower	Herb	
14	*Calapogonium mucunoides.*	Fabaceae	Calapo	Creeper	
15	Chromoleana odorata	Asteraceae	Siam weed	Herb	Medicine
16	*Elaeis guineensis*	Arecaceae	Oil palm	Tree	Food
17	*Bambusa vulgaris*	Poaceae	Bamboo	Tree	Industrial
18	*Laportea aestuans*	Malvaceae	Tropical netleweed	Herb	
19	*Sida acuta*	Malvaceae	Broom weed	Herb	
20	*Dryopteris filix-mas*	Dryopteridaceae	Male fern	Herb	
21	*Carica papaya*	Caricaceae	Pawpaw	Tree	Food

Table 4. 32: Flora features within the Proposed Roads for Rehabilitation in Aba

Road ID	Section of the road	Length Km	Significant Features	Plates
1	Asa Road-Port Harcourt	7.78	Four lane carriageways with dilapidated bituminous surface through densely populated settlements. Only grasses, and few economic trees.	
2	Faulks Road	4.59	Bituminous road with pot holes and flooding in almost all the sections.	
3	Ohanku Road-Owerre Aba	6.61	Bituminous road with pot holes and flooding in almost all the sections	
4	Omuma Road	2.14	Existing dilapidated bituminous surface from the beginning to the end; densely populated area with only grasses and few economic trees	

5	Ikot Ekpene Road	6.82	Highly populated area; limited vegetation coverage	
6	Mbubo Umuogele Amachi Mbokonta	12.72	Degraded fallow lands with secondary vegetation	
7	Umuala Nbawsi Eziala Osusu Okpuala Ngwa	12.64	Degraded fallow lands with secondary vegetation, oil palms, etc	
8	Omoba-Umuaja Amaede Ndiolumbe	8.17		
9	Mbawsi Layout-Ururuka	1.87	Degraded fallow lands with secondary vegetation, oil palms, etc	
10	Glass Factory Road	1.64	Road with dilapidated bituminous surface, through densely populated settlements. Secondary forests and economic trees along sections of the road	
11	Umuomiaukwu Agburike Umuomainta	4.83	Earth road with secondary vegetation dominated by oil palms	
12	Uratta-Ugwuati	9.58	Earth road with secondary vegetation dominated by oil palms	
13	Crystal Park Junction-Obohia Road	22.05	Road with dilapidated bituminous surface, through densely populated settlements. Secondary forests and economic trees along	

			sections of the road	
14	Immaculate Avenue-ITF Road Bridge	1.52		
15	Umuaro Nenu Road	4.76	Earth road with secondary vegetation dominated by oil palms in populated settlements	
16	Eziama Ntigha-Nsirimo-Ubakala	9.07	Earth road with secondary vegetation dominated by oil palms, elephant grasses, plantain, etc in populated settlements	
17	Mgboko-Omoba Umuezeukwu Mbwawsi Road	6.85		
18	Ibeme Ndiakata-Nlagu Onicha Ngwa	2.82		
19	Pepple Road-Akpu Road	1.20	Earth road with secondary vegetation dominated by oil palms, elephant grasses, plantain, etc in populated settlements	
20	Umuokpo-Ahiafor Link Road	4.30		
21	Owerra Aba-Osusu UmuelenduOsusuaku	4.01	Road with dilapidated bituminous surface, through densely populated settlements. Secondary forests and economic trees along sections of the road	

22	Umuojima Amapuife Eberi Omuma	9.98	Earth road with secondary vegetation dominated by oil palms, elephant grasses, plantain, etc in populated settlements	
23	Umuimo Carol Pee. Ministry of Agric. Shopping Mall	1.49	Road with dilapidated bituminous surface, through densely populated settlements. Degraded land and economic trees along sections of the road	
24	Ugwuati-Umuiku	4.01	Earth road with secondary vegetation dominated by oil palms, elephant grasses, plantain, etc in populated settlements	
25	Isicourt-Ururuka Umuosu Umuala Umunkpeyi	20.62	Road with dilapidated bituminous surface, through densely populated settlements. Degraded land with economic trees, oil palm plantations, etc along sections of the road	
26	Ama Emereole-EkeonyeugbaUmokoromiri-Eketa	7.25	Earth road with secondary vegetation dominated by oil palms, elephant grasses, plantain, etc in rural settlements	
27	Ajiwe-Brass	0.63	Road with dilapidated bituminous surface, in densely populated settlements. Fallow land and economic trees, oil palm plantations, etc	
28	Ahunanya-Immaculate	0.88	Earth road with, through densely populated settlements. Degraded land with economic trees along sections of the road	

29	Oron Road-Elizabbeth Avenue-Sports Club	0.70	Earth road with, through densely populated settlements. Degraded land with economic trees along sections of the road	
30	Umuala-Umuakwu-Ohuhu-NsuluOloko Ikwuano	13.70	Earth road with, through densely populated settlements. Degraded land with oil palm plantations along sections of the road	
31	Itungwa-Agburukwe Road	3.35	Earth road with, through densely populated settlements. Degraded land with oil palm plantations along sections of the road	
	Total length (Km)	**198.58**		

Fauna

The characteristic fauna of the project area (as recorded through direct sighting of wildlife, observation of burrows, faecal pellets/droppings, hairs, foot prints/tracts, devoured cassava and yam tubers and oil palm fruits as well as trampled/disturbed vegetation and oral interview) are presented in Table 4.33.

The result as presented indicate the presence of 58 species representing 15 mammals, 20 birds, 5 reptiles, 3 amphibians, 3 molluscs, 9 arthropods and 3 worms/annelids. The endangered species according to the endangered species Decree 11 of 1985 include 2 mammal {*Atherurus africanus* (African brush-tailed porcupine), *Epixerus ebii* (Western Palm squirrel)} and 2 birds {*Milvus migrans* (Black kite) and *Necrosyrtes monachus* (Hooded vulture)}.

Among the mammals, the great cane rat or cutting grass *(Thryonomys swinderianus*) and the giant rat (*Cricetomys emini*) were of the highest abundance and were the most frequently trapped "bush meat" in the area. Other small mammals of the families Muridae *(*rats and mice) and Soricidae (Squirrels) were well represented. The squirrels are dominated mainly by two arboreal species, viz: the sun squirrel and the giant forest squirrel which are fond of oil palm trees and Raphia palm leaves, respectively. Few primate species like the mona monkeys are still known to be resident in the forests.

Among the Aves (birds), the cattle egrets, sun-birds and the African swifts were the most abundant. The cattle egrets (Little egret) (*Egretta egretta),* sun-birds were fond of the farmland fallow lands while the latter were often sighted on palm trees and near buildings. The weaver birds were abundant particularly in farms where they feed on grains. Among the diurnal birds of prey were the black kite, which occur in very low numbers.

Data obtained from interview indicate that there are many species of snakes including the pythons and cobras, and some of these are poisonous. The snakes take refuge in low bushes around farmlands and fallow lands.

Of the amphibian fauna within the area, the common toads, and (*Bufo* sp) was most abundant and its primary habitat was the humid forest and farmland s where they found a lot of insects to feed on.

Among the invertebrates were dominated by the arthropods represented by the ants, grasshoppers, locust, dragon flies, butterflies, and crickets. Soil fauna were dominated by the segmented worms (Annelida) represented by the oligochaetes. The abundance of termites, crickets and earthworms in the study area is clearly visible by the numbers of tiny burrows and pore spaces present near river and water logged areas. Termite mounds are also most occurring although they are easily preyed on by hermit crabs, where soil textures are very soft. The cricket mounds can easily be mistaken for fresh agricultural grounds.

 African brush-tailed porcupine (*Atherurus africanus*)	 Western Palm squirrel (*Epixerus ebii*)

 Black kite (*Milvus migrans*)	 Hooded Vulture (*Necrosyrtes monachus)*

Plate 4. 1: Some Endangered Species of Wildlife

Table 4. 33: Checklist of wildlife and other invertebrate fauna common in the study area

PHYLUM/CLASS	ORDER/FAMILY	SCIENTIFIC NAME	COMMON NAME	Relative abundance	Conservation Status (IUCN)
PHYLUM CHORDATA: MAMMALIA	**Order Primata (Primates)**				
	Family Cercopithecidae				
		Cercopithecus mona	(Mona Monkey)	++	
	Order Canivora				
	Family Viverridae	*Herpestes ichneumon*	(Egyptian Mongoose)	+	
	Order Artiodactyla				
	Family Suidae (Pigs)	*Potamochoerus porcus*	(Bush Pig or Red River Hog)	++	
	Family Bovidae	*Cephalophus monticola*	(Blue or Maxwell's Duiker)	++	
	Order Rodentia				
	Family Sciuridae (Squirrels)	*Paraxerus poensis*	(Small Green Squirrel)	++	
		Anomalurus peli	(Pel's Flying Squirrel)	++	
		Expixerus ebii	Western Palm Squirrel	++	Endangered
		Xerus sp	Ground Squirrel		
	Family Hystricidae	*Atherurus africanus*	(African brush tailed Porcupine)	++	Endangered
	Family Muridae	*Cricetomys emimi*	Giant Rat	+++	
		Rattus rattus	Black Rat	+++	
		Mastomys natalensis	Multi-mammate Mouse		
	Family Soricidae (Shrews)	*Crocidura flavescen*	African Giant Shrew		
	Family Thryonomidae	*Thryonomys swinderianus*	Greater cane rat (cutting grass)	+++	
	Order Hyracoidea	*Procavia capensis*	(Cape Rock Hyrax)	++	
AVES	Family Ardeidae	*Butorides striatus*	(Green backed Heron)	+	
		Egretta egretta	(Little egret)	+++	
	Family Accipitridae	*Haliaetus vocifer*	(West African River Eagle)	++	
	Family Alcedinidae	*Ceys picta*	(Pigmy Kingfisher)	++	
	Family Aegypiidae	*Necrosyrtes monachus*	Hooded Vulture	+	Endangered
		Gypohierax angiogenesis	Palm-nut Vulture	+	

	Family Bucerotidae	*Bycanistes subcylindricus*	(Black and White Casqued Hornbill)	++	
		Tockus fasciatus	(Black and White Tailed Hornbill)	++	
	Family Charadriidae	*Pluvialis squatarola*	(Grey plover)	+	
	Family Cuculidae	*Centropus leucogaster*	(Black throated Coucal)	++	
		Centropus sensgaliensis	Senegal coucal	+++	
		Pycnonotus harbatus	Graden bulbuls	+++	
	Family Laridae	*Sterna hirundo*	(Common Tern)	++	
	Family Falconidae	*Milvus migrans*	Black Kite	++	
	Family Micropopidae	*Cypsiurus parvus*	African Palm Swift	++	

PHYLUM/CLASS	ORDER/FAMILY	SCIENTIFIC NAME	COMMON NAME	Relative abundance	Conservation Status (IUCN)
		Apus affinis	Little Swift	++	
	Family Ploceidae	*Plesiositagra cucullatus*	Village Weaver	+++	
		Cinnamopteryx costaneofuscus	Chestnut and Black Weaver	++	
		Hyphanturgus brachpterus	Speckled Weaver	+++	
		Vidua macroura	Pin-tailed Whydah	+	
	Family Strigidae	*Ptilopsis leucotus*	White-faced Owl	+	
REPTILIA	Order Squamata				
	Family Agamidae	*Agama agama*	Common Agama lizard	+++	
	Family Boidae	*Python sebae*	(African rock python)	+	
		Python regius	(Royal python)	+	
	Family Viperidae	*Bitis gabonica*	(Gabon viper)	++	
	Family Elapidae	*Naja melanopleura*	(Black cobra)	++	
AMPHIBIA	ANURA	*Bufo regularis*	Toad	+++	
		Hyperolius fusciventralis	Tree frog	+	
		Rana sp.	(Common frog)	++	
PHYLUM ARTHROPODA					
CLASS INSECTA	**Order Coleoptera**	Carabid spp	Ground beetles	+++	
		Auchmeromyia luteola	Blue beetles	+++	
		Anthophorid spp	Bumble bees	++	
	Order Dictyoptera	*Blatella* sp.	Cockroaches	+++	

	Order Diptera	*Musca domestica domestica*	Houseflies	+++	
	Order Hymenoptera	*Formica* spp.	Black ants	+++	
		Sima spp.	Medium sized ants	+++	
	Order Lepidoptera		Butterflies	+++	
	Order Odonata		Dragonflies	++	
	Order Orthoptera	Zonocerus variegatus	Variegated grasshopper	+++	
		Gryllus sp.	Crickets	++	
Gastropoda		*Archachatina marginata suturalis*	Giant African land snail	++	
		Limicolaria aurora	Garden snail	++	
		Lymnea sp.	Water snail	++	
Annelida / Flatnorms					
	Oligochaeta	*Eudriliuseuginiae*		+	
	.	*Hyperiodrilus africanus*	Oligochaetes	++	
		Lumbricus spp	Earth worm	+++	

Note: +++ Abundant, ++ Common, + Rare

Conservation Concern

Human population pressure is high in this part of the country and designating large swathes of land for conservation has not been an important public policy thrust. No protected area is specifically marked down for wildlife and there are no Game Reserves.

Table 4. 34: Protected Area System of Abia State

No.	Name	Management Unit	Vegetation type	Area (ha)
1	Obeaku	1	High forest/swamp forest forest	1,700
2	Mbeagu	1	Lowland rainforest, freshwater swamp forest	112
3	Obieze-isu	2		2,720
4	Ohambele	1		118

Source: Beak Consultants 1998. Forest Resources main Report (Draft) Vol. II page 5-9.

4.4. Social economic Baseline of Aba

Owing to the objectives and achievable goals of the road construction projects, it is important to establish the socio-economic baseline and/or characteristics of the people in the host communities. The socio-economic baseline is the description of the characteristics of the people as they were at the project time. Basically, it includes information about demographic data, life style, occupations, economic, health and educational statuses as well as their perceptions of impacts.

Overview of Study Area

Aba is a major urban settlement and commercial centre in a region that is surrounded by small villages and towns. Aba is well known for its craftsmen and also the most populous city in the South Eastern Nigeria. As of 2016, Aba had an estimated population of 2,534,265. The state's slogan is "God's own State". Aba North and Aba south make up the popular commercial city: Aba which is known for business, creativity and industrialization.

Aba is the commercial city of the state. Aba is situated on a plain with Aba River Valley on its eastern side as the only prominent physical feature. Aba is one of the railway stations on the eastern railway. It has the largest concentration of people in the state. It is the largest commercial centre in the state with the famous Ariaria Market sited west of the town, close to the Port-Harcourt-Enugu Expressway. Besides, there is the Ngwa Market, the Cemetery Market and virtually every street in Aba has its share of the business activities for which the town is known. There is a good number of both public and private industrial establishments as well as financial institutions.

As a result of the primate role enjoyed by Aba in the hierarchy of settlements in the state, enormous environmental problems have become manifest. These include refuse heaps, traffic congestion, overcrowding of residential areas, dearth of infrastructures and the pollution of water bodies.

The study was conducted in communities along the 31 roads proposed for construction in Aba South, Aba North, Osisioma, Ugwunagbo, Obingwa, Isialangwa North, Ukwa East, Umuahia South, Isialangwa South, and Ikwuano LGAs, Abia State.

The project is expected to impact 3781 PAPs of which 874 are female and 2253 are male while 654 of the PACs were not identified as they were absent during social survey and property enumeration in their area.

Data from the educational attainment of the PAPs shows that more than 60% of the identified PAPs have formal education and this will make PAPs' training and technology transfer quite easy. Data obtained showed there are more PAPs (293) with higher education within the Omoba – Umuaja Amaede Ndiolumbe Road.
Data from the social census indicates that there are more PAPs within the ages of 45-54 (897), followed by the PAPs within 55-64 age bracket (824) and no PAP is underage (<15 years).

Demography of the Study area
National Census of Nigeria carried out in 1991 puts the population of Abia State at 1,976,805 consisting of 920,268 males and 956,434 females. In 2006, total population was 2,845,380 consisting of 1,430,298 males and 1,415,082 females (Figure 4.34). Projected to 2017, the population would be 3,766,150 consisting of 1,875,503 males and 1,890,647 females (Table 5.15). In almost all local government areas of Abia State, the population of females is more than that of males except in Aba area (Aba North and Aba South LGAs) where the population of males is more than that of females

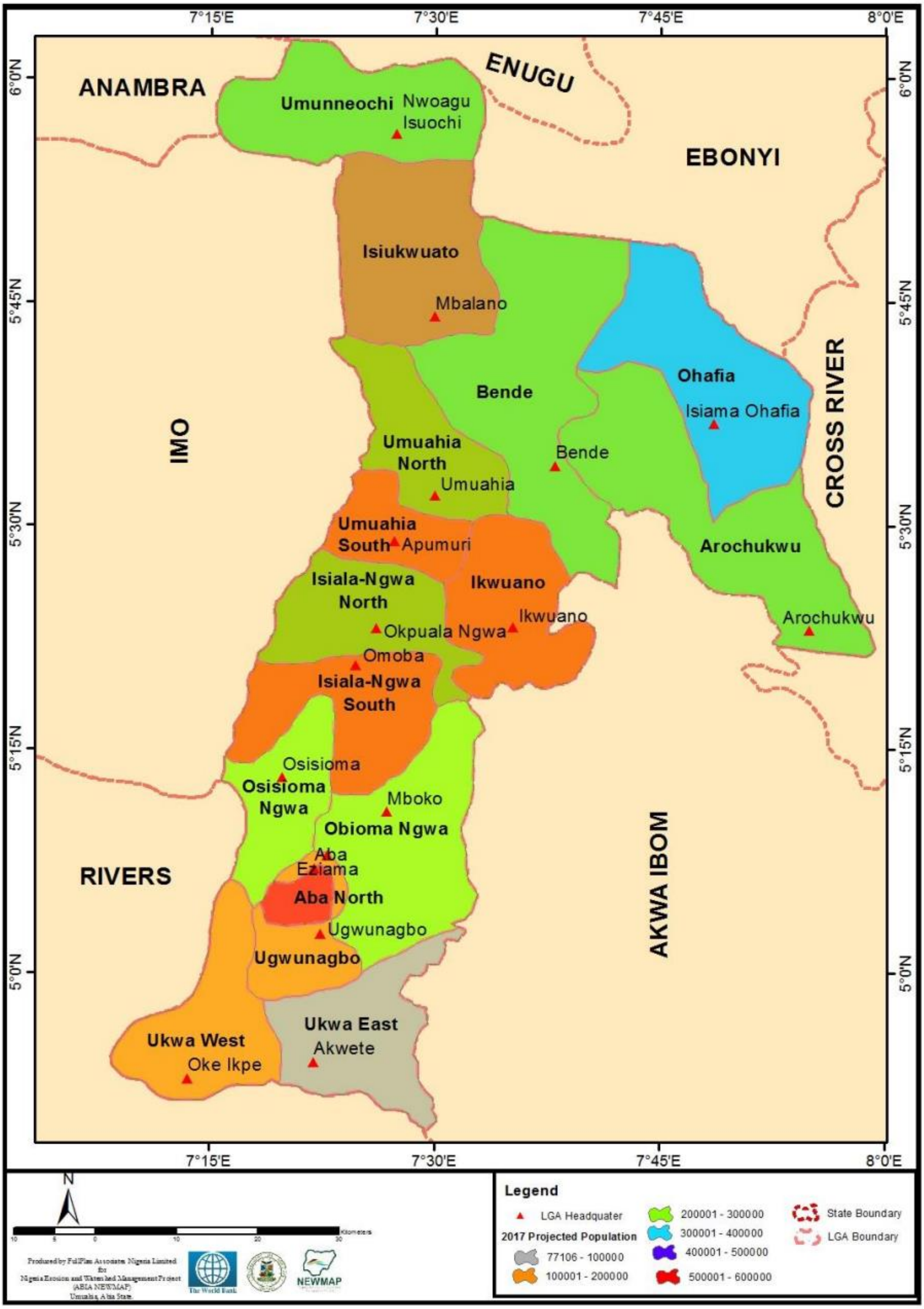


Figure 4.34: LGAs in Abia State with Populations Distributions

Agriculture

The vegetation and climate of Aba support most tropical crops. The city has fertile soil which grows mostly root crops and tree crops. Cash tree crops include oil palm, raffia palm, rubber, citrus fruits and kola nuts. Cash crops grown include rice, cassava, yam, cocoyam and maize. Pig and Fish farming is another cash spinning agro-business in the State while goats, chicken and snails are reared within households.

	
Household at Agburike with Many economic trees	Household at Amakama Community showing economic trees
	
Mini farmland at Umunna Nsulu	Mini farmland close to the Imo River at Ugbor Community

Plate 4.2: Economic trees and farmlands in the Study area

Mineral Resources

Abia State is blessed with natural resources which include crude oil found in oil fields at Imo River, Obuzo, Owaza, Ngboko, Nkali, Odogwa, Obeakpu and Isimir; lime stone in Ewe-Arochukwu LGA and southwestern part of Isuikwato LGA; natural gas; kaolin, lead, zinc, laterite, bentonite clay, tar sand, phosphate and recently (about five months before this baseline study), gold and uranium were discovered at Amafor community in addition to other mineral resources located in the State.

Industry

The area has a number of industries which include: the Nigeria Breweries Plc, Aba; Golden Guinea Breweries Plc; Aba textile Mills Plc, Aba; International Glass Industries Plc (IGI), Aba; Ogwe Golden Chicken Farms Limited, Ogwe; Aba Palm Limited, Ohambele; Unilever Plc, PZ Plc Aba; International Equitable Association Limited, Aba; Guinness Nigeria Plc, Osisioma, etc. Many other

small and medium scale industrial set ups in the state also contribute to the vibrant commercial nature of the State.
Aba is surrounded by oil wells which separate it from the city of Port Harcourt. A 30 kilometres (19 mi) pipeline powers Aba with gas from the Imo River natural gas repository. Its major economic contributions are Textiles and Palm Oil along with pharmaceuticals, plastics, cement, and cosmetics. This trade makes the Ariaria International Market the second largest market in Nigeria after the Onitsha Main Market. There is also a Heineken brewery, a glass company and distillery within the city. Finally, it is famous for its handicrafts.

Infrastructure
Infrastructural facilities and services in Aba in terms of availability and sustainability can be said to be fair but not to good enough for economic advancement.

Roads within the urban centers are fair, such as in Aba main. The main arterial routes are tarred and maintained. But within the high density built – up areas, the roads are characterized by potholes and lack of side drains, and standard setbacks. Traffic congestion characterizes the arterial routes within the big cities where tricycles (Keke NAPEP), and other street users hold sway. Interstate and intercity roads are fair, but not good enough. For instance, the waterside overhead bridge and axis are normally jam packed in the evenings owing to traffic, this could be resolved when other road networks are accessible.

Potable water supply is basically from boreholes dug in private and public owned buildings within the cities, especially in Aba. But within the suburbs and rural areas, potable water supply and its infrastructure is poor for various communities along the project roads. About 90% of the state population rely on boreholes, hand dug wells, rain water and streams. Most of the potable water is sourced from boreholes. There are over 2000 boreholes in Aba municipality alone.

Health facilities are 85% adequate in Abia State. This is evident because almost all host communities have an accessible primary healthcare centre within its catchment. Power supply in Abia State is vested in the Enugu Electrical Distribution Company. Generally, electricity supply in the State is unreliable and epileptic. This has encouraged the use of personal/private generators or use of the trending solar panels by households and organizations. However, host communities surveyed all had transformers sited in different locations of the communities. That implies that if the Electrical Company provides power, they would have access to electricity supply. Apart from Ofeme community where they have issues with staff the electrical distribution company, so they have not had light for over a year as indicated by their youth president.

		
Transformer at Ofeme Community	Transformer at Amaogwugwu Community	Transformer at Agburike Community

Plate 4.63 Rural Electrification in Aba **communities**

Settlement and Land Use in Abia State is essentially for agriculture as an agrarian State. But it is relatively urbanized compared with some states in Nigeria. The settlement pattern is nucleated (clustered) having a Town Square with large trees around where cultural activities and meetings are held in the rural communities along the project roads. Land use in the cities and towns are mixed; Residential, commercial, Industrial, Civic and Agriculture in the outskirts. They acquisition of land is majorly through inheritance and outright purchase. It also available to the citizens of these communities, as socio-cultural beliefs do not permit female citizens the rights-to-own landed properties.

Types of buildings in Aba are made up of sophisticated to simple buildings of concrete work and aluminum and or corrugated roofing sheets. The suburbs and rural areas generally house concrete buildings with corrugated zinc sheets, and very few mud houses with corrugated zinc sheets. In very rare cases, the building roofs are made of rafia or palm fronts, thatched roofs on huts. However, it shows civilization has also robbed-off on the options of buildings/houses in the host communities.

	
An apartment in the catchment Area	An apartment in Agburike community

Plate 4.4 Types of residential buildings in some rural communities in Aba **axis**

4.4.1. Socio-economic Characteristics of the Project Affected Persons (Respondents)

Gender

From the baseline studies, 98% of host communities visited had high population of women and children compared to men which indicates that the present conditions of the roads in host communities would have more impact on these categories of population. The remaining 2% of host communities surveyed had equal population of gender. However, the socio-cultural beliefs of communities place more importance on the male personality to the female. During the baseline data collection, the female would refuse most times to answer questions from interviewers claiming that their husband, sons and/or elder statesman would be in a better position to provide the team with the correct information. This was the situation in most rural and semi-urban communities.

Although, there was a better participation of women in the urban communities yet the number of men that participated in the giving information were more to the women. This signifies that the belief within the Igbo ethnic group on male child being important is still very much in existence.

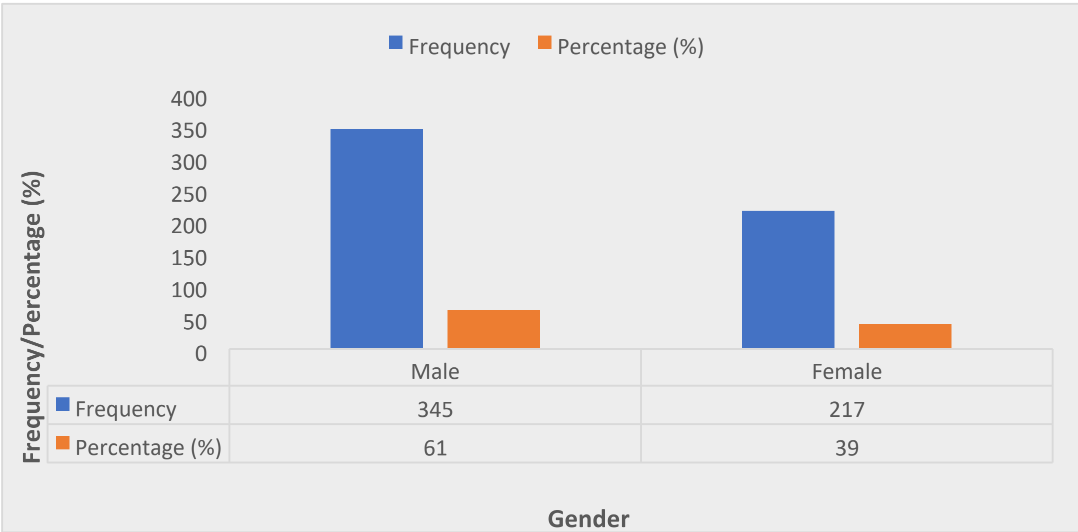


Figure 4.17: Participation of respondents based on gender *Source: Fieldwork, 2021*

Age

The categories of age group in the urban catchment of host communities varies from that of semi-urban and rural catchments. Owing to the business/work locations within urban communities, 60% of the population were within 20- 56 years of age. The categories of these age groups make up the work force for development and economic advancement with the host communities. Obviously, the re-installation and construction of these road networks would aid their economic activities within the state, hence, reduction of poverty.

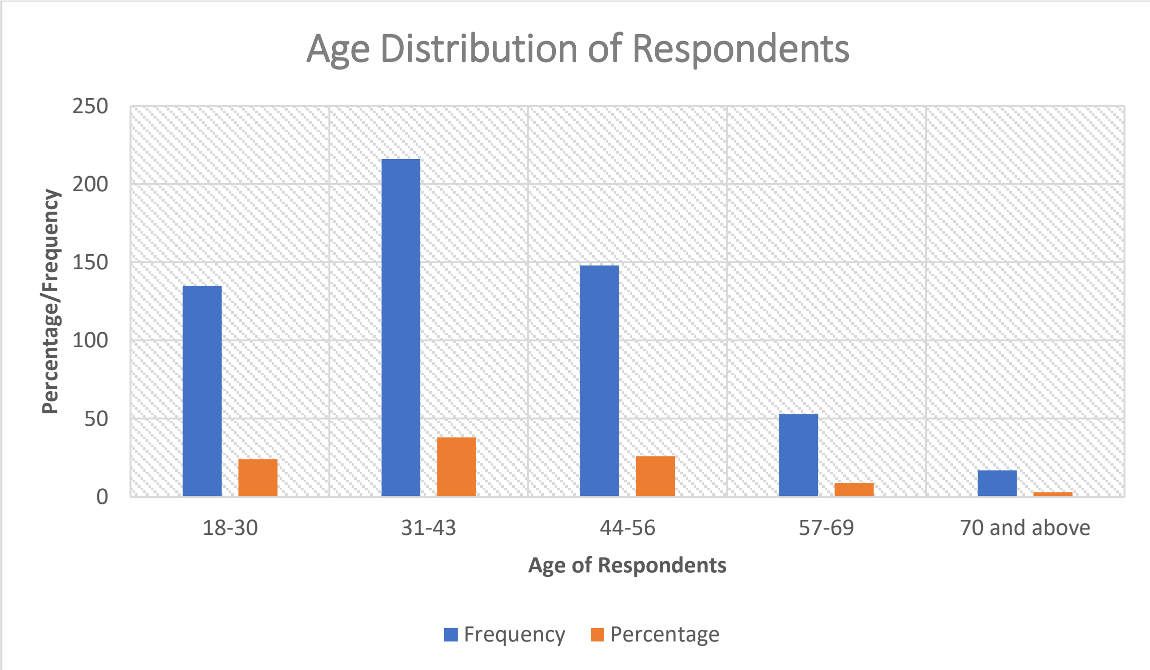
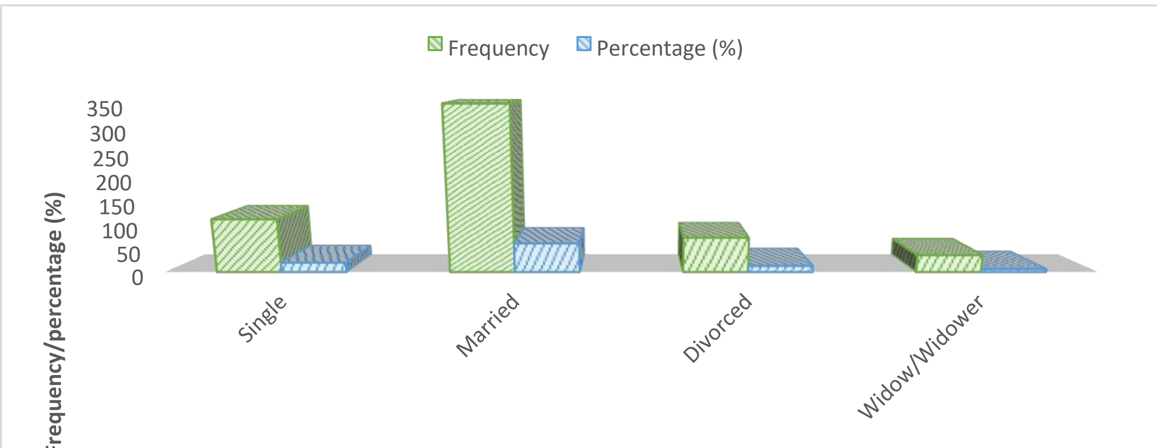


Figure 4.18: Participation of respondents based on Age *Source: Fieldwork, 2021*

The table above captures age distributions of respondents surveyed from the baseline studies.

Marital Status

Over 61% of the respondents from the baseline studies are married, making them responsibility to family members such as spouse, children, dependents, etc. 20% of the respondents are single which signifies their ability to wanting to be responsible and comfortable; while divorced and widowed respondents recorded 13% and 6% respectively. In other words, whichever marital status one may belong to, accessibility to good road networks help to boast one's economic attainment.



	Single	Married	Divorced	Widow/Widower
Frequency	112	348	73	36
Percentage (%)	20	61	13	6

Figure 4.19: Marital status of respondents for the baseline studies *Source: Fieldwork, 2021*

Observations on marital status notes that polygamy was on a very low scale, one could be re-married owing to the death or divorce of a spouse. It became rare to notice men having more than one wife within the host communities surveyed. This could be tied to indoctrination into Christianity or the harsh economic situation of the state and country at large.

Religious affiliations

Religion: The people of Aba are predominantly affiliated to Christianity (60%); another 20% of the respondents practice both Christians and Traditional religious worshippers. The remaining 20% comprises strictly traditional religious worshippers, Muslims and freethinkers.

Ethnic Group of Respondents

Despite the fact that this study was conducted in the southeastern state of Nigeria, the data collected shows the presence of other ethnic groups residing within the study areas. 80% of the surveyed respondents are Ibos; not literally from Abia State but from other eastern states. This connotes similarity in socio-cultural beliefs and perceptions. However, the remaining 20% recorded respondents from Calabar, Ikwerre, Hausaland and others. These indications imply that migrants from other ethnic groups also perceive the host communities as a place to improve their economic status. It is also unlikely that the homogeneity of the host communities will subsist for very long.

Highest Education Attainment of Respondents

The highest education attainment of respondents was significant to their catchment within the host communities for road constructions. A cross-tabulation analysis shows that most rural communities surveyed, 78% of the respondents had no formal education compared to the urban and semi-urban host communities, recording 22% of respondents with no formal education attainments. This implies that the more education attainment one has, it would increase rural-urban migration (movement from rural areas to the urban centres). It is simply the movement to greener pasture for better economic advancement.

However, the Figure 4.20 represents the distribution of respondents' education attainment surveyed during the baseline studies.

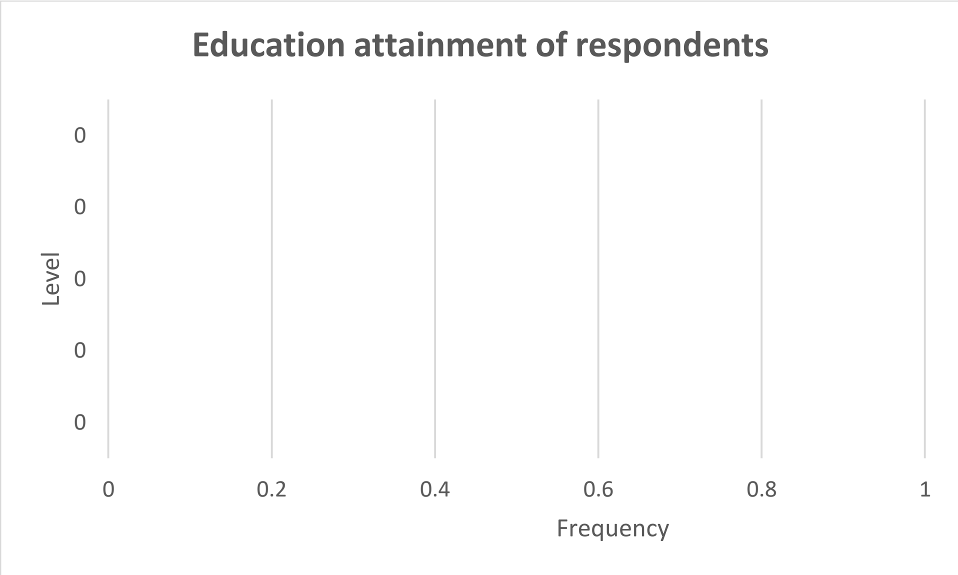


Figure 4. 20: Education attainment of respondents
Source: Fieldwork, 2021

Abia state has a fair distribution of all categories of education attainment amongst surveyed respondents. This could be explained through the existence of tertiary institutions, one of which is the Abia State University, Technical Secondary Schools, Primary Schools, to mention but a few.

During the baseline studies, most of the visited schools were already in a dilapidating and/or in a deploring state. The condition of the schools might also contribute drastically to students' participation and/or academic performance. A staff in one of the schools visited stated that the road construction is a very welcomed development, but the present road construction has destroyed the school fence; making the premises and students unsecured. Another head teacher concern in another school stated that the road construction has channeled water from the road into the school. This has contributed to a flooded learning environment which reduces students' attendance in school.

Condition of learning facility at Umunna Nsulu Autonomous Community

Condition of learning facilities in Ogbor Community

Deplorable toilet facility for both staff and students

Traces of flooding owing to premises Road construction

Condition of learning facility in in school Amaogwugwu

Plate 4.5 Some Public Facilities in the Communities

Most of the schools within the semi-urban and rural areas lack teachers. It becomes obvious that teachers might be skeptical in teaching within these catchment/host communities since the structures are dilapidated and roads inaccessible.

Livelihood Options of Respondents

The average Ibo man is business oriented. Fifty percent (50%) of surveyed respondents are into businesses which include buying and selling of various goods and services such as building materials, clothing & textiles, food, home accessories, etc. 23% are also civil servants who are gainfully employed in the different MDAs across the state. 20% are farmers who are experts in areas such as poultry, piggery, fish ponds, different areas of crop farming, etc. while the remaining 7% accounts for artisans.

A cross tabulation shows that those in the civil service are also in one way or the other part of the business men/women distribution. This is owing to the fact that a good percentage of them also own business outlets in form of farms, rendering services, contractors and/or supplies of various materials, etc.

It was also observed that there are jobs determined by gender. For example, cutting down palm fruits from the tree is majorly a man's role while the haulage is a woman's duty. Hunting is mainly a man's role while planting of vegetables is a woman's task. Therefore, livelihood options sometimes depend on socio-cultural perceptions/belief. The feminist theory definitely do not have a place in certain cultural practices within the Ibo ethnic group.

Income category

Severally, the responses on respondents' income are not reliable, it is synonymous to a man asking an African woman her age. The expression on the faces of respondents when interviewers ask about their monthly or yearly income always follow with a question "why do you ask"? Some believe that if accuracy is shared, their tax might increase or they might not benefit from any possible goodies from the government purse. However, responses were still collated. Majority of the respondents (57%) claim they earn below N30,000 monthly which is the country's minimum wage, 28% claim they earn below N100,000 monthly while the remaining 15% earn above N100,000 monthly.

Healthcare facilities

Almost every host community (85%) surveyed had primary health care centre, the remaining 15% who did not have primary health care centre in their community claims they used the ones in the neighbouring community which was a maximum of 30-45mins drive. This is an indication that gap of accessing health facilities has been closed.

However, there are lapses, the once with newly constructed buildings most times do not have enough staff or facilities like beds, drip stands, etc. Then the old dilapidated ones have their facilities due for renewal.

Primary health centre at Amakama community

Primary health centre at Amachi Nsulu

Primary health centre at Ofeme community

Primary health centre at Amaogwugwu community

Plate 4.6 Health centres in Aba **roads axis**

Health is indeed wealth. These primary healthcare centres are located within catchment where the roads are inaccessible which has defeated the essence of having them. Medical staff and practitioners might find it boring being at work under such bad conditions of roads.

Waste disposal strategies

The method of disposing waste has a lot to do with the health of a community. 95% of waste witnessed across host communities were indiscriminately disposed. This could lead to an epidemic illness such as diarrhea, cholera, and other communicable diseases. It also shows that there are no proper waste management within host communities. In most of the host communities, no campaign have been made on how to properly dispose waste.

Indiscriminate waste disposal centre at Umuosa Umunna Nsulu community

Indiscriminate waste disposal Close to a primary healthcare close to the market and residents at Amachi Nsulu community

Indiscriminate waste disposal Amaogwugwu community

Indiscriminate waste disposal even within school premises at along road paths at Amakama community

Plates 4.7 Evidence in the pattern of indiscriminate waste disposal across host communities in Aba**.**

Means of Transport and Ownership Status of Respondents

The predominate means of transportation in host communities in Abia state is tricycle and commercial buses which records 60% mode of mobility. 30% of the means of transportation are private owned cars and the remaining 10% could account for other means such as motor-cycles and bicycles. This indicates that commercial transport operators are the most reliable and cost effective means of movement. However, there seems to a predominance private owned cars in Aba because it a civil servant orientated catchment

Obviously, the road construction projects would be beneficial not to households alone but would stimulate increased economic activities in Aba.

Water supply

Most of the surveyed respondents (80%) across affected host communities claim that dug borehole is their source of water supply. Where there are no boreholes, residents walk 10-15mins from their house in search of houses that would permit them to fetch from their taps. Some philanthropists living amongst these communities, sometimes extends their hands of assistance by installing tap heads outside their premises so that those in search of water can have access to water without accessing their compounds. The story is not different in the rural host communities, 100% of the respondents have storage cans of different sizes to store water either from borehole or rain water. However, there are few rural communities that have access to community boreholes installed either by their Community Development Committee or by a notable politician within their fold.

	
Community source of water supply Agburike Community.	Community solar source of Water at Supply Mbaraogbom Umuakwu Nsulu Community provided by Anambra Development Authority

Plates 4.8 Cross section of source of water supply in selected host communities, Aba

Project Affected Persons (PAPs)

The project affected persons are defined as those living within 10 metres from the road construction whose properties have been partly or wholly damaged. In this project, 1655 persons will be affected in Aba segment of the project.

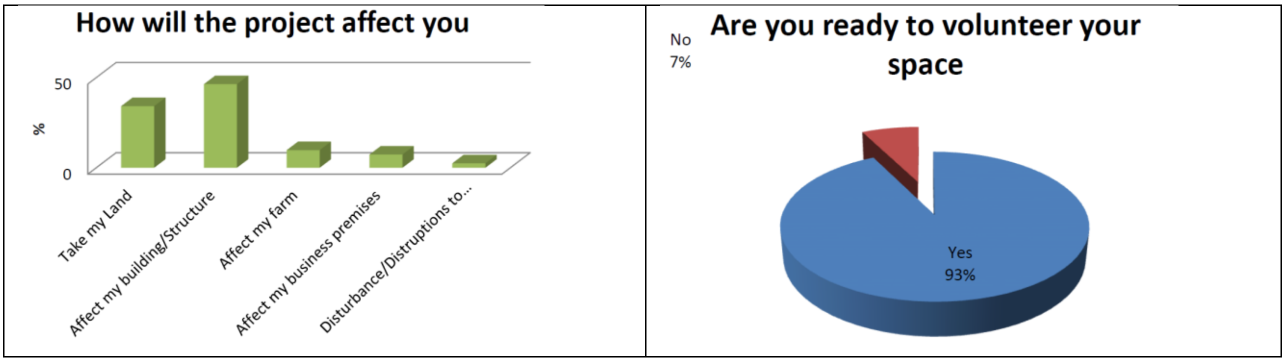
Desirability of the Project by Respondents

100% of the respondents are happy with the proposed project and earnestly desired it realization.

Project Impact on Asset Understanding and Willingness to Support

Many (46%) of the respondents believe that the project will affect their buildings or structures, while 34% are certain that it will take their land. 10% of the respondents along this corridor believe the project will affect their farm, and 7% are of the opinion that it will affect their business premises and 3% think it will cause disturbancers and disruptions to their businesses as indicated in Fig 4.21.

Majority (93%) agreed and are ready to evacuate their site or shift backward for the civil work, while few (7%) of the respondents were not agreeable to the option of giving up their site except adequate mitigation measure is ensured (Fig. 4.22).

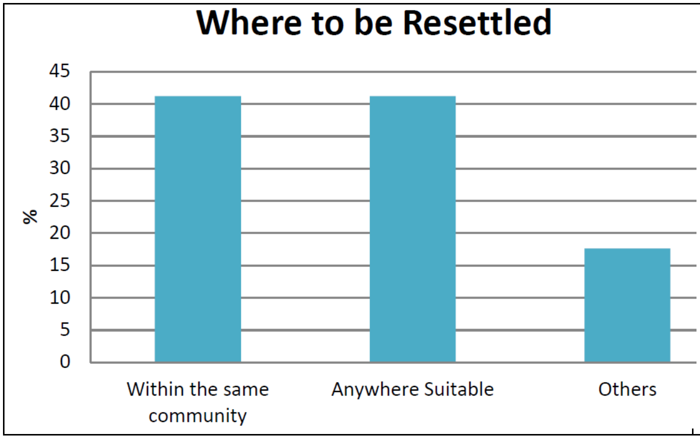


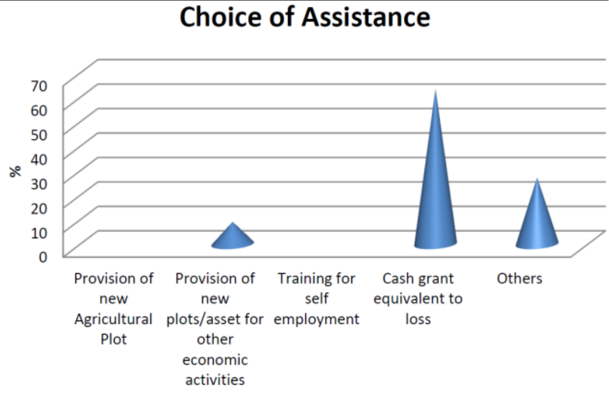
Source: Field Survey, **Figure 4.21 Effect of Project and willingness to accommodate project**

Preferred Forms of Mitigation Measures

In the event of displacement, the respondents that preferred to be resettled within the same community were 41%, another 41% of the respondents preferred to be resettled in any other community as long as it was suitable, and 18% were not particular whether they were resettled in the same community or a different community as long as they were resettled. (Fig.4.22).

When asked the preferred choice of compensation, majority (64%) of the respondents want to be compensated with cash grant equivalent to loss while (9%) want to be provided with kind for kind. The remaining 27% are interested in other forms of compensation such as new structures, occupying same location after construction (Fig. 4.23).





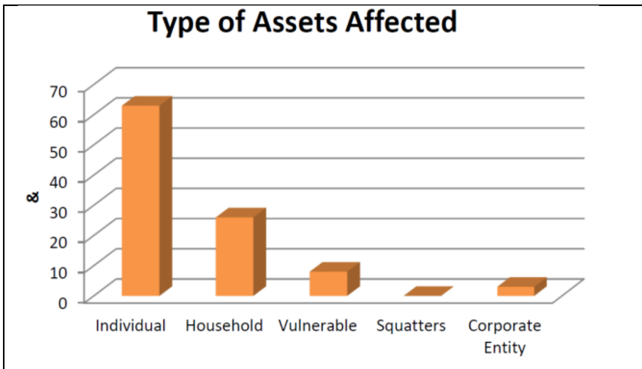
Source: Field Survey, Oct., 2021

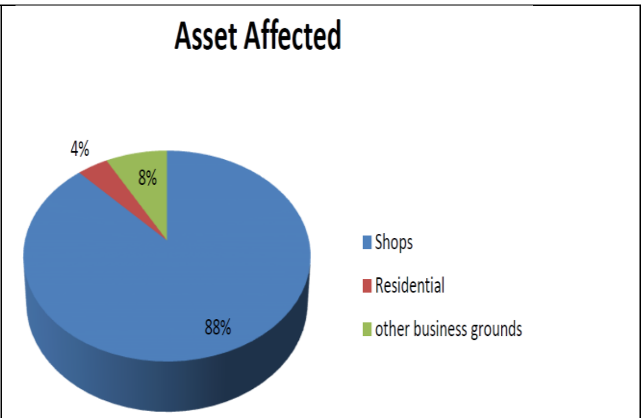
Fig. 4.22 Preferred Forms of Mitigation Measures

Type of Affected Persons and Asset

Sixty percent (60%) of the respondents mentioned affected entity will be individuals, 20% mentioned households, vulnerable persons make up 10% of the respondents, 7% of the respondents are corporate entities.

Majority of the affected asset 88% are trading structures/shops, 4% of the affected structure are residential, and other 8% are business grounds





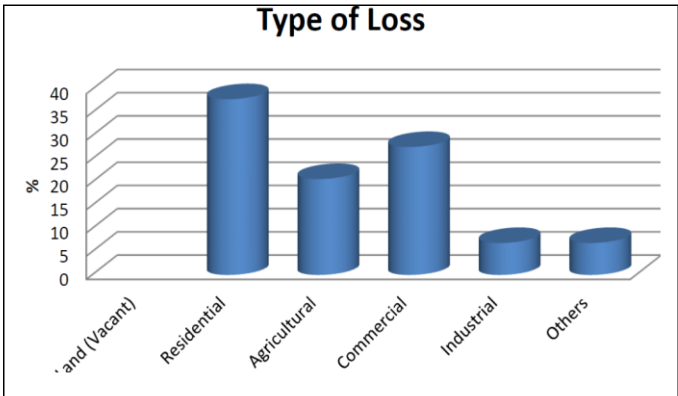
Source: Field Survey, Feb., 2018

Fig. 4.23 Type of Affected Persons and Asset

Type of Business/Income Loss

The major type of loss suffered along this corridor will be residential as Fig.4.21 shows that 27% of the respondents, will be affected in this way, 34% of the loss will be commercial, while agricultural loss will be 23%. Industrial and other losses will be 6% each.

The respondents indicate that the category of loss of the project affected persons would be more of rent for commercial purpose, customers and income placed at 25% respectively



Source: Field Survey, June., 2021

Figure 4.24 Type of Business/Income Loss

4.5 Traffic Studies and Traffic Forecast

A thorough understanding of past, present and future traffic movement on the proposedproject road is needed for its successful planning and design. The volume and loading pattern of the existing and anticipated future traffic on any proposed road project are the most important factors in determining its feasibility, setting design standards and estimating construction and maintenance costs. Thus, an accurate estimate of currentand predicted traffic must be done before any planning and design work is undertaken.The current traffic survey locations were identified by the consultant team while visiting the site an early stage of the project, and selected a vital traffic station.

In this case, a traffic survey on motorized traffic have been conducted for the project road, following the standard techniques outlined in the study of Economic Feasibility and Concept Engineering Design of the road project, and provide in the Nigerian Highway Manual's standard manual.

Objectives of Traffic Count

Traffic Counts belong to the Supply-Side group of transport surveys that describe the nature of the transport system, its scale and productivity, its bottlenecks and the scopefor its development. Traffic counts were conducted in the current project with the overarching objectives of:

Recording the level of use of a road (by vehicle volume)

1. Classifying the vehicles by type. Classification is particularly used to highlightthe number of heavy goods vehicles (HGVs) and may be used in association with axle-load surveys to indicate both the design requirements and the amount of damage being inflicted on the road pavement.

The traffic count data obtained will be particularly useful for the following:

2. Establishing the use of the road network by vehicles of different categories.
3. Establishing the feasibility and economic implications of the roadimprovement scheme.
4. Ascertaining appropriate/optimal timings for maintenance interventions and rehabilitation needs of the various roads.

Methodology for Traffic Count

The Manual Classified Traffic Count method, involves counting all the vehicles passing a selected location on a road for a pre-determined period of time, was employed to collect traffic data along the respective prioritized project roads.

Location of Traffic Count Stations

In general, the traffic counted should be representative of the average traffic flow on a particular section of road. As such, care was taken not to locate the count stations where traffic is abnormally high on a section of road, i.e., near a village square, market or near to a school. The following criteria served the Consultant as useful guidelines fortraffic count site selection:

Using judgement and local knowledge, the chosen location should be where the traffic flow is typical of the average flow on the road under question.
The following locations should be avoided:

- Built up areas (as a general rule, stations should not be located closer than 3km to major towns), Market places, Road junctions, Bus stops/lorry stops
- The count station should be located where enumerators can take shelter in case of inclement weather and still observe the traffic. A lighted location would be of advantage for counts conducted after daylight.
- Enumerators should have good vision of traffic approaching from both directions.
- Avoid locating the station on bends or at placeswhere trees/buildings obscure vision.

Vehicle Classification

The following seven vehicle classifications were adopted for the traffic count exercise:

- Motorcycles/ Tricycles
- Passenger Cars
- Mini Buses
- Large Buses/ Coaches
- Light Trucks/ Delivery Vans/Pickups
- Medium Trucks
- Heavy Trucks

Fig.9 shows the description of the various vehicle types.

Timing of Traffic Counts

According to the Terms of Reference, the manual traffic count is to be carried out for 7 (seven) consecutive days out of which 4 (four) days will be 12 (twelve) hours and 3 (three) days for 24 (twenty-four) hours. As at the time of visit to the state in May 19thby our team of expert, there was an imposed curfew (8pm to 6am) due to security challenges in the state. It was only possible to conduct traffic count from 6am to a maximum time of 8pm (i.e.,12hours for 4days and 14hours for 3days). The manual traffic counts were conducted along each of the project roads of interest, over a consecutive 7-day period. It is noteworthy to mention that for low volume roads, the variability in traffic flow from day to day can be very high, and short counting periods (less than 7 days) can introduce high errors in traffic estimates.

Variability from seasonality (with the possibility of impassability in the rainy season), may be important. However, adjustment factors for seasonal variation are usually difficult to estimate with any degree of accuracy, because typically, as is the case in Abia State, relevant data are not available such as the average daily traffic count for wet and dry seasons, over a number of years.

In order to limit the effect of high errors in traffic estimates due to seasonal variations, short duration of traffic counts (less than 7 days) was avoided. In addition, the HDM-4 model employed for economic evaluation, takes cognizance of the duration of dry and wet seasons in defining levels of service and projecting traffic estimates.

Traffic Data Collection

Vehicles were recorded onto a standard form, the Traffic count format/Tally Sheet (Fig.10) in hourly time segments in order that variations in traffic flow over the day canbe identified. Data was also recorded in both directions of travel. Fig.11 shows the Traffic Count Summary Sheet which aggregates the traffic volumes for each day for theduration of the 7-day count.

Baseline Traffic

Traffic analysis along the proposed road has been considered relying on traffic count data collected through establishing a number of stations along the route. Vehicles are classified as motorcycles, passenger cars, minibuses, large buses, light trucks, mediumtrucks, and heavy trucks. The detail data on traffic count along the proposed road is presented in Tables 5 and 6 below.

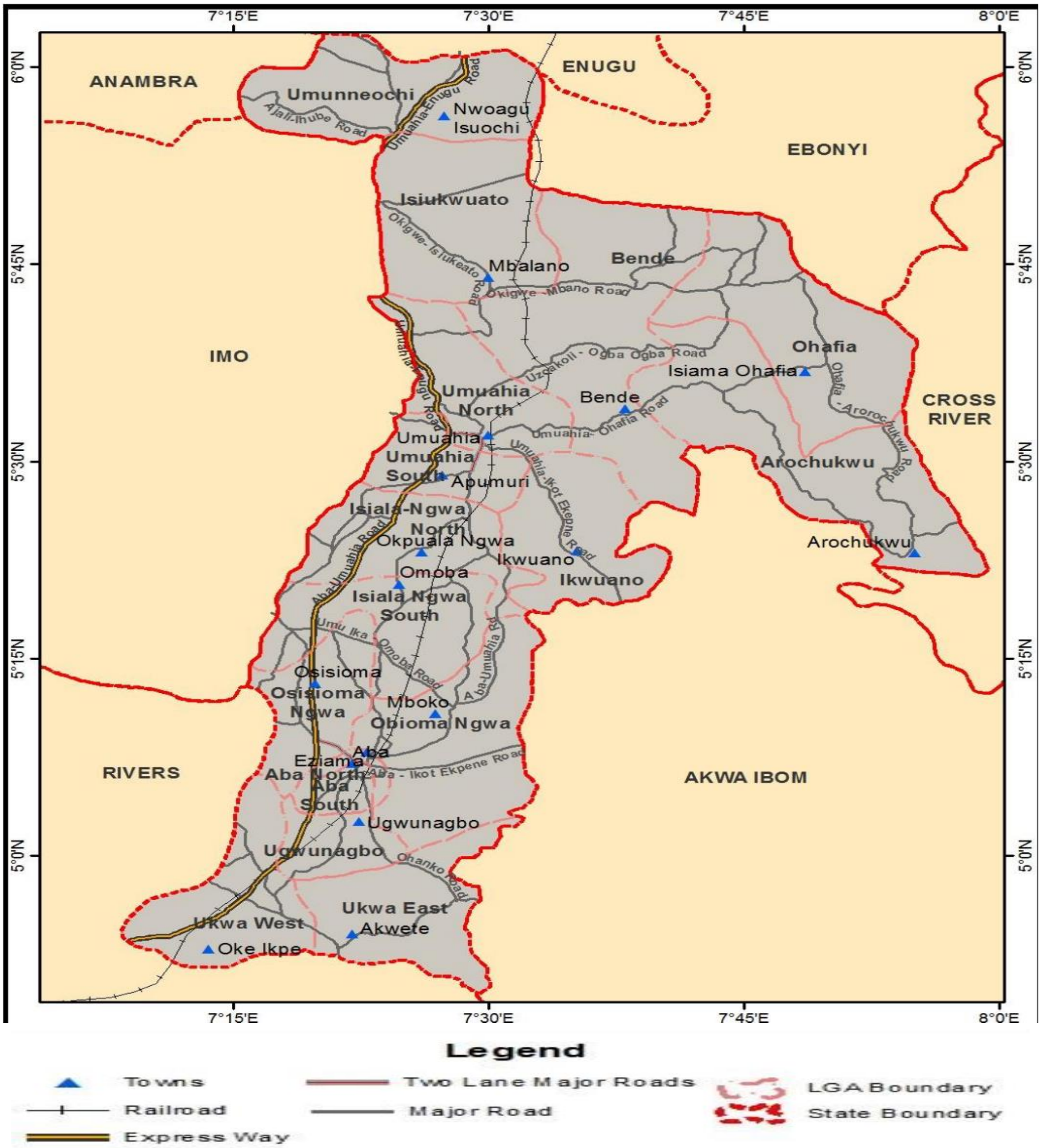


Figure 4.8: Transport Network of Abia State – *Source: NEWMAP, 2017*

Table 4.28: Traffic Study for Aba City Road Sections

ROAD Id.	Road section name	ROAD SECTION LENGTH (Km	Vehicle Type and Composition								
			Motor cycles/Tricycles	Passenger cars	Mini Buses	Large Buses/coaches	Light Trucks/Delivery Vans/Pick-ups	Medium Truck	Heavy Trucks	Total	Total Less motor cycles
1	Asa Road-Port Harcourt	7.8	21565	21549	19671	11341	3505	3592	3042	84,265	62,700
2	Faulks Road	4.6	6978	7263	8109	4150	3912	4000	3207	37,619	30,641
3	Ohanku Road-Owerre Aba	6.6	6805	0	0	0	0	0	0	6,805	0
4	Omuma Road	2.1	1366	0	0	0	0	0	0	1,366	0
5	Ikot Ekpene Road	6.8	8883	11234	10412	8792	8285	8266	10242	66,114	57,231
6	Mbubo Umuogele Amachi Mbokonta	12.7	6136	2150	895	728	788	758	461	11,916	5,780
7	Umuala Nbawsi Eziala Osusu Okpuala Ngwa	12.6	8094	1490	121	667	205	135	270	10,982	2,888
8	Omoba-Umuaja Amaede Ndiolumbe	8.2	3866	1790	1421	957	758	572	0	9,364	5,498
9	Mbawsi Layout-Ururuka	1.9	969	725	0	0	0	0	0	1,694	725
10	Glass Factory Road	1.6	22539	12447	1251	926	958	742	221	39,084	16,545
11	Umuomiaukwu Agburike Umuomainta	4.8	2706	1605	639	266	0	565	0	5,781	3,075
12	Uratta-Ugwuati	9.6	4778	2717	1042	261	889	263	350	10,300	5,522
13	Crystal Park Junction-Obohia Road	22.1	7317	1641	1127	391	406	71	63	11,016	3,699
14	Immaculate Avenue-ITF Road Bridge	1.5	0	0	0	0	0	0	0	0	0
15	Umuaro Nenu Road	4.8	2567	1577	1594	75	160	238	3	6,214	3,647
16	Eziama Ntigha-Nsirimo-Ubakala	9.1	1927	2291	185	127	149	88	105	4,872	2,945
17	Mgboko-Omoba Umuezeukwu Mbwawsi Road	6.9	7105	1257	565	30	720	475	0	10,152	3,047
18	Ibeme Ndiakata-Nlagu Onicha Ngwa	2.8	1612	290	0	0	0	0	0	1,902	290
19	Pepple Road-Akpu Road	1.2	2679	0	0	0	0	0	0	2,679	0
20	Umuokpo-Ahiafor Link Road	4.3	2127	507	649	531	401	540	283	5,038	2,911
21	Owerra Aba-Osusu Umuelendu-Osusuaku	4.0	2686	0	0	0	0	220	0	2,906	220
22	Umuojima Amapuife Eberi Omuma	10.0	2971	2305	1423	1193	789	289	355	9,325	6,354
23	Umuimo Carol Pee. Ministry of Agric.Shopping Mall	1.5	5782	2795	1457	359	756	157	46	11,352	5,570
24	Ugwuati-Umuiku	4.0	536	351	73	16	175	8	1	1,160	624
25	Isicourt-Ururuka Umuosu Umuala Umunkpeyi	20.6	0	0	0	0	0	0	0	0	0
26	Ama Emereole-Ekeonyeugba-Umokoromiri-Eketa	7.3	817	478	69	60	192	10	16	1,642	825
27	Ajiwe-Brass	0.6	2734	753	49	123	49	1	0	3,709	975
28	Ahunanya-Immaculate	0.9	3935	2419	2108	1289	928	520	107	11,306	7,371

29	**Oron Road-Elizabbeth Avenue-Sports Club**	0.7	1122	2281	26	2	2	1	0	3,434	2,312
30	**Umuala-Umuakwu-Ohuhu-Nsulu-Oloko Ikwuano**	13.7	2619	0	0	0	0	0	0	2,619	0
31	**Itungwa-Agburukwe Road**	3.3	3712	698	190	259	44	59	31	4,993	1,281

Traffic Data Results and Analysis

The main output from the traffic count is a measure of average traffic flow, recorded as the total traffic passing in both directions over a 24-hour period (the Average Daily Traffic or ADT); and which for practical purposes is appropriately represented by the 16-hour count in the current project. Tables 7 and 9 present the estimated traffic volume for representative roads from each of the two project cities (19 segments in Umuahia City and 31 segments in Aba city). The results show total traffic volumes for all vehicles, traffic volumes without motorcycles, and the proportion of motorcycles in the traffic stream, which is very significant.

Appendix F contains summary results from the traffic count exercise indicating the traffic volumes measured for each day, and for each vehicle category. The count stations and direction of travel are also shown in the Appendix E.

Average Daily Traffic (ADT)

To compute the average daily traffic for each section of the project road, many factors were taken into consideration. Of greatest importance is the adjustment factor to convert various categories of vehicles into their equivalent passenger car units. Taking into consideration the number of lanes and the average gradients of the road sections, the following passenger car unit (PCU) factors have been adopted:

- Cars and taxies 1.0
- Light commercial vehicle (LCV) 1.0
- Medium goods vehicles (MGV) 2.0
- Heavy goods vehicles (HGV) 3.0.

The Average Daily Traffic (ADT) for the seven-day count for each of the road is shown in Appendix F of this report.

Table 4.36: Measured Traffic Flow Aba City (Average Daily Traffic)

CITY LOCATION	ROAD ID.	ROAD NAME	AVERAGE DAILY TRAFFIC, ADT		% MOTORCYCLES
			TOTAL	TOTAL (LESS MOTORCYCLES)	
ABA	1	Asa Road – Port Harcourt Road	12,038	8,957	25.59%
	2	Faulks Road	5,374	4,377	18.55%
	3	Ohanku Road – Owerre Aba	972	0	100.00%
	4	Omuma Road	195	0	100.00%
	5	Ikot Ekpene Road	9,445	8,176	13.44%
	6	Mbubo Umuogele Amachi Mgbokonta	1,701	824	51.54%
	7	Umuala Nbawsi Eziala Osusu Okpuala Ngwa	1,569	413	73.70%
	8	Omoba – Umuaja Amaede Ndiolumbe	1,338	785	41.29%
	9	Mbawsi Layout – Ururuka	242	104	57.20%
	10	Glass Factory Road	5,583	2,364	57.67%
	11	Umuomiaukwu Agburike Umuomainta	839	452	46.08%
	12	Uratta – Ugwuati	1,471	789	46.39%

13	Crystal Park Junction - Obohia Road	1,574	528	66.42%
14	Immaculate Avenue – ITF Road Bridge	ROAD IS CLOSED		
15	Umuaro Nenu Road	887	521	41.30%
16	Eziama Ntigha – Nsirimo – Ubakala	696	421	39.55%
17	Mgboko –Omoba Umuezeukwu Mbawsi Road	1,450	435	69.99%
18	Ibeme Ndiakata- Nlagu Onicha Ngwa	272	41	84.75%
19	Pepple Road - Akpu Road	383	0	100.00%
20	Umuokpo- Owo Ahiafor Link Road	720	416	42.22%
21	Owerre Aba – Osusu Umuelendu – Osusuaku	415	31	92.43%
22	Umuojima Amapuife Eberi Omuma	1,332	908	31.86%
23	Umuimo Carol Pee. Ministry of Agric. Shopping	1,622	796	50.93%
24	Ugwuati – Umuiku	166	89	46.21%
25	Isicourt- Ururuka Umuosu Umuala Umunkpeyi	2,729	1,381	49.41%
26	Ama Emereole – Ekeonyeugba –Umokoromiri-E	235	118	49.76%
27	Ajiwe - Brass	530	139	73.71%
28	Ahunanya - Immaculate	1,615	1,053	34.80%
29	Oron Road – Elizabbeth Avenue – Sports Club	491	330	32.67%
30	Umuala - Umuakwu - Ohuhu Nsulu – Oloko Ikw	374	0	100.00%
31	Itungwa – Agburukwe road	713	183	74.34%

Source: Consultant

Table 4.37: (Average Daily Traffic (ADT) * Adjustment Factor) ABA ZONE

CITY LOCATION	ROAD ID.	ROAD NAME	AVERAGE DAILY TRAFFIC (ADT)*Adjustment factor		% MOTORCYCLES
			TOTAL	TOTAL (LESS MOTORCYCLES)	
ABA CITY	1	Asa Road – Port Harcourt Road	13,420	10,339	22.96%
	2	Faulks Road	6,862	5,865	14.53%
	3	Ohanku Road – Owerre Aba	972	0	100.00%
	4	Omuma Road	195	0	100.00%
	5	Ikot Ekpene Road	13,552	12,283	9.36%
	6	Mbubo Umuogele Amachi Mgbokonta	1,941	1,064	45.16%
	7	Umuala Nbawsi Eziala Osusu Okpuala Ngwa	1,665	509	69.43%
	8	Omoba – Umuaja Amaede Ndiolumbe	1,419	867	38.91%
	9	Mbawsi Layout – Ururuka	242	104	57.20%
	10	Glass Factory Road	5,753	2,533	55.97%
	11	Umuomiaukwu Agburike Umuomainta	933	546	41.45%
	12	Uratta – Ugwuati	1,609	926	42.42%
	13	Crystal Park Junction - Obohia Road	1,602	557	65.25%
	14	Immaculate Avenue – ITF Road Bridge	ROAD IS CLOSED		
	15	Umuaro Nenu Road	922	556	39.74%
	16	Eziama Ntigha – Nsirimo – Ubakala	739	463	37.27%
	17	Mgboko –Omoba Umuezeukwu Mbawsi Road	1,518	503	66.86%
	18	Ibeme Ndiakata- Nlagu Onicha Ngwa	272	41	84.75%
	19	Pepple Road - Akpu Road	383	0	100.00%
	20	Umuokpo- Owo Ahiafor Link Road	878	574	34.62%
	21	Owerre Aba – Osusu Umuelendu – Osusuaku	447	63	85.92%
	22	Umuojima Amapuife Eberi Omuma	1,475	1,050	28.78%
	23	Umuimo Carol Pee. Ministry of Agric. Shopping Mall	1,657	831	49.84%
	24	Ugwuati – Umuiku	167	91	45.81%
	25	Isicourt- Ururuka Umuosu Umuala Umunkpeyi	2,809	1,461	48.00%
	26	Ama Emereole – Ekeonyeugba –Umokoromiri-Eketa	241	124	48.52%
	27	Ajiwe - Brass	530	139	73.69%
	28	Ahunanya - Immaculate	1,720	1,158	32.68%
	29	Oron Road – Elizabbeth Avenue – Sports Club	491	330	32.66%
	30	Umuala - Umuakwu - Ohuhu Nsulu – Oloko Ikwuano	374	0	100.00%
	31	Itungwa – Agburukwe road	731	200	72.59%

Source: Consultant

Historic Traffic Factor (Seasonal Conversion Factor)

Nevertheless, the TOR recommends adopting the five to ten years of historic traffic data, the consultant couldn't able to find any historic traffic count of the project area. Thus, led the consultant to use the ADT for the design purpose. Perhaps the National Highway Manual[3], believes the AADT is the most reliable indicator for overall use of the road, yet it recommends using the ADT for the design class and volume derived based on ADT. Thus, the consultant uses to develop the future of the traffic on ADT.

Origin and Destination Report

In summary of the survey carried out on all the project routes, shows that some percentage of traffic will divert into the project road after improvement. This is as a result of the existing condition of the road (i.e., bad nature or traffic congestion). The summary of respondent reply from questionnaires shows that some traffic uses the various project roads frequently while others would not use the road because it is off their regular route. Others agreed to use the project roads when they are improved on as indicated in the data summary table.

Also, other traffic might be diverted to the various project roads after construction even when their route destination is longer because of the improved pavement.

Volume of Diverted Traffic

According to the OD survey result the consultant adopted from 11% -42% traffic has a potential for diversion found at OD station. The detail explanation about the OD survey, detail and summarized tables of respondents reply from the questionnaire, and OD matrix are discussed for each road and attached in the Appendix F of this report.

The following summarized table gives the volume of traffic that can divert to the project road.

Table 4.38: Potential Diverted Traffic in Aba Town

TOWN	ROAD I. D	DIVERTED TRAFFIC	TOTAL RESPONDENT	TOTAL DIVERTED TRAFFIC VOLUME
ABA TOWN	ROAD 1	13%	171	22
	ROAD 2	11%	169	19
	ROAD 3	26%	171	44
	ROAD 4			
	ROAD 5	16%	165	26
	ROAD 6	26%	160	42
	ROAD 7	11%	157	17
	ROAD 8	29%	164	48
	ROAD 9	11%	157	17
	ROAD 10	17%	103	18

	ROAD 11	16%	93	15
	ROAD 12	18%	79	14
	ROAD 13	26%	171	44
	ROAD 14	17%	81	14
	ROAD 15	29%	164	48
	ROAD 16	30%	74	22
	ROAD 17	29%	164	48
	ROAD 18	17%	96	16
	ROAD 19			
	ROAD 20	16%	104	17
	ROAD 21	21%	171	36
	ROAD 22	16%	140	22
	ROAD 23	8%	90	7
	ROAD 24	16%	135	22
	ROAD 25	26%	160	42
	ROAD 26	19%	75	14
	ROAD 27	13%	64	8
	ROAD 28	17%	81	14
	ROAD 29	18%	73	13
	ROAD 30			
	ROAD 31	19%	68	13

Source: Consultant

Normal Generated Traffic

Once the project road is realized, it is assumed that the traffic to be generated is triggered by decrease in transport cost subsequent to the improvement in the condition of the road. The improvement which involves improvement in geometric and pavement feature of the road, are expected to result in increased demand for transportation, and hence more vehicles will be induced to the project road.

The existing road along the project route is in very poor condition. Considering the current situation, the construction of the project road is expected to stimulate generation of trips in vehicular transport which will enhance access to markets and various service centers in the vicinity of the project.

The recommended approach to forecasting generated traffic is to use demand relationships which show how traffic increases as the cost of a journey decreases. Studies carried out in similar countries give an average for the price elasticity of demand for transport of about -1.0. This means that a one per cent decrease in transport costs leads to a one per cent increase in traffic. This is extra traffic over and above the increase in normal traffic.

However, Handy and Boarnet (2014) performed a critical evaluation of various induced travel studies and found that short-run elasticity effect of road development generally ranges from 0.3 to 0.6. (Generated Traffic and Induced Travel Implication for Transport Planning, 2015).

The estimation of generated traffic is based on estimating the shape of the demand function, which is expressed as an elasticity of demand. It shows the responsiveness of demand to a change in cost, which in turn is a response of change in the travel time. In the case of generated traffic, the demand for transport is related to expected reductions in journey costs and travel time. For this analysis, savings in travel time is used to determine the percent of generated traffic based on travel time with and without the project using the formula: seasonal factor

Generated Traffic Factor = β [(Cijp / Cijb) – 1]

Where:

β is the elasticity;

Cijp is the with-project travel cost;

Cijb is the base case, without project travel cost;

Table 4.39: Travel time to estimate Generated Traffic Factor for ABA City

oadID	**Section of the road**	**Without Project**			**With Project**		
		.ength (km)	**Speed (km/hr.)**	**vel Time(min)**	**.ength (km)**	**Speed (km/hr.)**	**Travel Time (min)**
1	Asa Road-Port Harcourt	7.78	30	15.4	7.7	60	7.7
2	Faulks Road	4.59	20	13.9	4.6	60	4.6
3	Ohanku Road-Owerre Aba	6.61	10	39.0	6.5	60	6.5
4	Omuma Road	2.14	20	6.2	2.1	60	2.1
5	Ikot Ekpene Road	6.82	20	19.5	6.5	60	6.5
6	Mbubo Umuogele Amachi Mbokonta	12.72	10	71.9	12.0	60	12.0
7	Umuala Nbawsi Eziala Osusu Okpuala Ngwa	12.64	10	75.8	12.6	60	12.6
8	Omoba-Umuaja Amaede Ndiolumbe	8.17	10	47.9	8.0	60	8.0
9	Mbawsi Layout-Ururuka	1.87	20	5.6	1.9	60	1.9
10	Glass Factory Road	1.64	20	10.5	3.5	60	3.5
11	Umuomiaukwu Agburike Umuomainta	4.83	10	8.5	1.4	60	1.4
12	Uratta-Ugwuati	9.58	20	29.0	9.7	60	9.7
13	Crystal Park Junction-Obohia Road	22.05	20	30.0	10.0	60	10.0
14	Immaculate Avenue-ITF Road Bridge	1.52	10	7.2	1.2	60	1.2
15	Umuaro Nenu Road	4.76	10	31.5	5.3	60	5.3
16	Eziama Ntigha-Nsirimo-Ubakala	9.07	15	36.2	9.1	60	9.1

17	Mgboko-Omoba Umuezeukwu Mbwawsi Road	6.85	20	20.4	6.8	60	6.8
18	Ibeme Ndiakata-Nlagu Onicha Ngwa	2.82	20	8.6	2.9	60	2.9
19	Pepple Road-Akpu Road	1.20	10	8	1.3	60	1.3
20	Umuokpo-Ahiafor Link Road	4.30	10	25.2	4.2	60	4.2
21	Owerra Aba-Osusu Umuelendu-Osusuaku	4.01	20	11.4	3.8	60	3.8
22	Umuojima Amapuife Eberi Omuma	9.98	30	26.4	13.2	60	13.2
23	Umuimo Carol Pee. Ministry of Agric. Shopping Mall	1.49	10	8.4	1.4	60	1.4
24	Ugwuati-Umuiku	4.01	30	8.1	4.1	60	4.1
25	Isicourt-Ururuka Umuosu Umuala Umunkpeyi	20.62	10	124.4	20.7	60	20.7
26	Ama Emereole-Ekeonyeugba-Umokoromiri-Eketa	7.25	10	43.5	7.2	60	7.2
27	Ajiwe-Brass	0.63	20	1.9	0.6	60	0.6
28	Ahunanya-Immaculate	0.88	30	1.8	0.9	60	0.9
29	Oron Road-Elizabbeth Avenue-Sports Club	0.70	10	4.1	0.7	60	0.7
30	Umuala-Umuakwu-Ohuhu-Nsulu-Oloko Ikwuano	13.70	10	81.4	13.6	60	13.6
31	Itungwa-Agburukwe Road	3.35	10	20.1	3.4	60	3.4

Source: Consultant

Table 4.40: Estimate of Generated Traffic Factors from the travel time (ABA CITY)

Road Section	Parameter	With Project (Upgrading of existing Road to Paved Road)		
		Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
Asa Road-Port Harcourt	Cijp (time in minutes)	7.7	7.7	7.7
	Cijb (time in minutes)	15.4	15.4	15.4
	Generated Traffic Factor (GTF)	0.15	0.23	0.30
Faulks Road	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	4.6	4.6	4.6
	Cijb (time in minutes)	13.9	13.9	13.9
	Generated Traffic Factor (GTF)	0.20	0.30	0.40
Ohanku Road-Owerre Aba	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6

	Cijp (time in minutes)	6.5	6.5	6.5
	Cijb (time in minutes)	39.0	39.0	39.0
	Generated Traffic Factor (GTF)	0.25	0.38	0.50
Omuma Road	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	2.1	2.1	2.1
	Cijb (time in minutes)	6.2	6.2	6.2
	β (elasticity)	-0.3	-0.45	-0.6
	Generated Traffic Factor (GTF)	0.2	0.3	0.40
Ikot Ekpene Road	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	6.5	6.5	6.5
	Cijb (time in minutes)	19.5	19.5	19.5
	Generated Traffic Factor (GTF)	0.20	0.30	0.40
Mbubo Umuogele Amachi Mbokonta	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	12.0	12.0	12.0
	Cijb (time in minutes)	71.9	71.9	71.9
	Generated Traffic Factor (GTF)	0.25	0.38	0.50
Umuala Nbawsi Eziala Osusu Okpuala Ngwa	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	12.6	12.6	12.6
	Cijb (time in minutes)	75.8	75.8	75.8
	Generated Traffic Factor (GTF)	0.25	0.38	0.50
Omoba-Umuaja Amaede Ndiolumbe	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	8.0	8.0	8.0
	Cijb (time in minutes)	47.9	47.9	47.9
	Generated Traffic Factor (GTF)	0.25	0.38	0.50
Mbawsi Layout-Ururuka	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	1.9	1.9	1.9
	Cijb (time in minutes)	5.6	5.6	5.6
	Generated Traffic Factor (GTF)	0.20	0.30	0.40
Glass Factory Road	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	3.5	3.5	3.5

	Cijb (time in minutes)	10.5	10.5	10.5
	Generated Traffic Factor (GTF)	0.20	0.30	0.40
Umuomiaukwu Agburike Umuomainta	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	1.4	1.4	1.4
	Cijb (time in minutes)	8.5	8.5	8.5
	Generated Traffic Factor (GTF)	0.25	0.38	0.50
Uratta-Ugwuati	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	9.7	9.7	9.7
	Cijb (time in minutes)	29.0	29.0	29.0
	β (elasticity)	-0.3	-0.45	-0.6
	Generated Traffic Factor (GTF)	0.20	0.30	0.40
Crystal Park Junction-Obohia Road	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	10.0	10.0	10.0
	Cijb (time in minutes)	30.0	30.0	30.0
	Generated Traffic Factor (GTF)	0.20	0.30	0.40
Immaculate Avenue-ITF Road Bridge	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	1.2	1.2	1.2
	Cijb (time in minutes)	7.2	7.2	7.2
	Generated Traffic Factor (GTF)	0.25	0.38	0.50
Umuaro Nenu Road	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	5.3	5.3	5.3
	Cijb (time in minutes)	31.5	31.5	31.5
	Generated Traffic Factor (GTF)	0.25	0.38	0.50
Eziama Ntigha-Nsirimo-Ubakala	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	9.1	9.1	9.1
	Cijb (time in minutes)	36.2	36.2	36.2
	Generated Traffic Factor (GTF)	0.23	0.34	0.45
Mgboko-Omoba Umuezeukwu Mbwawsi Road	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	6.8	6.8	6.8
	Cijb (time in minutes)	20.4	20.4	20.4

	Generated Traffic Factor (GTF)	0.20	0.30	0.40
Ibeme Ndiakata-Nlagu Onicha Ngwa	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	2.9	2.9	2.9
	Cijb (time in minutes)	8.6	8.6	8.6
	Generated Traffic Factor (GTF)	0.20	0.30	0.40
Pepple Road-Akpu Road	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	1.3	1.3	1.3
	Cijb (time in minutes)	7.5	7.5	7.5
	Generated Traffic Factor (GTF)	0.25	0.38	0.50
Umuokpo-Ahiafor Link Road	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	4.2	4.2	4.2
	Cijb (time in minutes)	25.2	25.2	25.2
	β (elasticity)	-0.3	-0.45	-0.6
	Generated Traffic Factor (GTF)	0.25	0.38	0.50
Owerra Aba-Osusu Umuelendu-Osusuaku	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	3.8	3.8	3.8
	Cijb (time in minutes)	11.4	11.4	11.4
	Generated Traffic Factor (GTF)	0.20	0.30	0.40
Umuojima Amapuife Eberi Omuma	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	13.2	13.2	13.2
	Cijb (time in minutes)	26.4	26.4	26.4
	Generated Traffic Factor (GTF)	0.15	0.23	0.30
Umuimo Carol Pee. Ministry of Agric. Shopping Mall	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	1.4	1.4	1.4
	Cijb (time in minutes)	8.4	8.4	8.4
	Generated Traffic Factor (GTF)	0.25	0.38	0.50
Ugwuati-Umuiku	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	4.1	4.1	4.1
	Cijb (time in minutes)	8.1	8.1	8.1
	Generated Traffic	0.15	0.23	0.30

	Factor (GTF)			
Isicourt-Ururuka Umuosu Umuala Umunkpeyi	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	20.7	20.7	20.7
	Cijb (time in minutes)	124.4	124.4	124.4
	Generated Traffic Factor (GTF)	0.25	0.38	0.50
Ama Emereole-Ekeonyeugba-Umokoromiri-Eketa	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	7.2	7.2	7.2
	Cijb (time in minutes)	43.5	43.5	43.5
	Generated Traffic Factor (GTF)	0.25	0.38	0.50
Ajiwe-Brass	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	0.6	0.6	0.6
	Cijb (time in minutes)	1.9	1.9	1.9
	Generated Traffic Factor (GTF)	0.20	0.30	0.40
Ahunanya-Immaculate	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	0.9	0.9	0.9
	Cijb (time in minutes)	1.8	1.8	1.8
	β (elasticity)	-0.3	-0.45	-0.6
	Generated Traffic Factor (GTF)	0.15	0.23	0.30
Oron Road-Elizabbeth Avenue-Sports Club	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	0.7	0.7	0.7
	Cijb (time in minutes)	4.1	4.1	4.1
	Generated Traffic Factor (GTF)	0.25	0.38	0.50
Umuala-Umuakwu- Ohuhu-Nsulu-Oloko Ikwuano	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	13.6	13.6	13.6
	Cijb (time in minutes)	81.4	81.4	81.4
	Generated Traffic Factor (GTF)	0.25	0.38	0.50
Itungwa-Agburukwe Road	Parameter	Low	Medium	High
	β (elasticity)	-0.3	-0.45	-0.6
	Cijp (time in minutes)	3.4	3.4	3.4
	Cijb (time in minutes)	20.1	20.1	20.1
	Generated Traffic Factor (GTF)	0.25	0.38	0.50

Average		0.22	0.33	0.44

Source: Consultant

The above tables' show that the generated traffic factor for Aba city in the low scenario, medium scenario, and high scenario. Traffic generation also depends on the economic activity in the area, and the level of development, and the status of the living condition of the people in the area. If the economic activity is low, and the development and living condition of the people in the area is in low level, the demand for transportation will be less. Considering the current development level of the project area, it is envisaged that the level of traffic generation falls in the medium to the high scenario. Hence, it is assumed that a medium scenario of normaltraffic volume will generate within one to two years of the opening of the project.The detail is explained in below tables.

Table 4.41: Generated Traffic Aba City

Road No.	GTF	Passenger cars	Mini Buses	Large Buses	Light Trucks	Medium Truck	Heavy Trucks	TOTAL	Road No.
2021	1		3078	2810	1620	501	1026	1304	10339
2025		0.23	708	646	373	115	236	300	2378
2021	2		148	1158	593	559	1143	1374	4976
2025		0.30	34	266	136	129	263	316	1144
2021	3		75	176	133	138	300	476	1298
2025		0.38	17	41	31	32	69	109	299
2021	4		0	0	0	0	0	0	0
2025		0.30	0	0	0	0	0	0	0
2021	5		1605	1487	1256	1184	2362	4389	12283
2025		0.30	369	342	289	272	543	1010	2825
2021	6		307	128	104	113	217	198	1066
2025		0.38	71	29	24	26	50	45	245
2021	7		213	17	95	29	39	116	509
2025		0.38	49	4	22	7	9	27	117
2021	8		256	203	137	108	163	0	867
2025		0.38	59	47	31	25	38	0	199
2021	9		104	0	0	0	0	0	104
2025		0.30	24	0	0	0	0	0	24
2021	10		1778	179	132	137	106	95	2427
2025		0.30	409	41	30	31	24	22	558
2021	11		229	91	38	0	161	0	520
2025		0.38	53	21	9	0	37	0	120
2021	12		388	149	37	127	75	150	926
2025		0.30	89	34	9	29	17	35	213
2021	13		234	161	56	58	20	27	557
2025		0.30	54	37	13	13	5	6	128
2021	14		0	0	0	0	0	0	0
2025		0.38	0	0	0	0	0	0	0
2021	15		225	228	11	23	68	1	556

2025		0.38	52	52	2	5	16	0	128
2021	16		327	26	18	21	25	45	463
2025		0.34	75	6	4	5	6	10	107
2021	17		180	81	4	103	136	0	503
2025		0.30	41	19	1	24	31	0	116
2021	18		41	0	0	0	0	0	41
Road No.	GTF	Passenger cars	Mini Buses	Large Buses	Light Trucks	Medium Truck	Heavy Trucks	TOTAL	Road No.
2025		0.30	10	0	0	0	0	0	10
2021	19		0	0	0	0	0	0	0
2025		0.38	0	0	0	0	0	0	0
2021	20		72	93	76	57	154	121	574
2025		0.38	17	21	17	13	35	28	132
2021	21		0	0	0	0	63	0	63
2025		0.30	0	0	0	0	14	0	14
2021	22		329	203	170	113	83	152	1050
2025		0.23	76	47	39	26	19	35	242
2021	23		399	208	51	108	45	20	831
2025		0.38	92	48	12	25	10	5	191
2021	24		50	10	112	25	2	0	200
2025		0.23	12	2	26	6	1	0	46
2021	25		1009	122	104	86	83	58	1461
2025		0.38	232	28	24	20	19	13	336
2021	26		68	10	9	27	3	7	124
2025		0.38	16	2	2	6	1	2	28
2021	27		108	7	18	7	0	0	139
2025		0.30	25	2	4	2	0	0	32
2021	28		346	301	184	133	149	46	1158
2025		0.23	79	69	42	30	34	11	266
2021	29		326	4	0	0	0	0	330
2025		0.38	75	1	0	0	0	0	76
2021	30		0	0	0	0	0	0	0
2025		0.38	0	0	0	0	0	0	0
2021	31		100	27	37	6	17	13	200
2025		0.38	23	6	9	1	4	3	46
Road No.	GTF	Passenger cars	Mini Buses	Large Buses	Light Trucks	Medium Truck	Heavy Trucks	TOTAL	Road No.
2021	1		3078	2810	1620	501	1026	1304	10339
2025		0.23	708	646	373	115	236	300	2378
2021	2		148	1158	593	559	1143	1374	4976
2025		0.30	34	266	136	129	263	316	1144

2021	3		75	176	133	138	300	476	1298
2025		0.38	17	41	31	32	69	109	299
2021	4		0	0	0	0	0	0	0
2025		0.30	0	0	0	0	0	0	0
2021	5		1605	1487	1256	1184	2362	4389	12283
2025		0.30	369	342	289	272	543	1010	2825
2021	6		307	128	104	113	217	198	1066
2025		0.38	71	29	24	26	50	45	245
2021	7		213	17	95	29	39	116	509
2025		0.38	49	4	22	7	9	27	117
2021	8		256	203	137	108	163	0	867
2025		0.38	59	47	31	25	38	0	199
2021	9		104	0	0	0	0	0	104
2025		0.30	24	0	0	0	0	0	24
2021	10		1778	179	132	137	106	95	2427
2025		0.30	409	41	30	31	24	22	558
2021	11		229	91	38	0	161	0	520
2025		0.38	53	21	9	0	37	0	120
2021	12		388	149	37	127	75	150	926
2025		0.30	89	34	9	29	17	35	213
2021	13		234	161	56	58	20	27	557
2025		0.30	54	37	13	13	5	6	128
2021	14		0	0	0	0	0	0	0
2025		0.38	0	0	0	0	0	0	0
2021	15		225	228	11	23	68	1	556
2025		0.38	52	52	2	5	16	0	128
2021	16		327	26	18	21	25	45	463
2025		0.34	75	6	4	5	6	10	107
2021	17		180	81	4	103	136	0	503
2025		0.30	41	19	1	24	31	0	116
2021	18		41	0	0	0	0	0	41
2025		0.30	10	0	0	0	0	0	10
2021	19		0	0	0	0	0	0	0
2025		0.38	0	0	0	0	0	0	0
2021	20		72	93	76	57	154	121	574
2025		0.38	17	21	17	13	35	28	132
2021	21		0	0	0	0	63	0	63
2025		0.30	0	0	0	0	14	0	14
2021	22		329	203	170	113	83	152	1050
2025		0.23	76	47	39	26	19	35	242
2021	23		399	208	51	108	45	20	831

2025		0.38	92	48	12	25	10	5	191
2021	24		50	10	112	25	2	0	200
2025		0.23	12	2	26	6	1	0	46
2021	25		1009	122	104	86	83	58	1461
2025		0.38	232	28	24	20	19	13	336
2021	26		68	10	9	27	3	7	124
2025		0.38	16	2	2	6	1	2	28
2021	27		108	7	18	7	0	0	139
2025		0.30	25	2	4	2	0	0	32
2021	28		346	301	184	133	149	46	1158
2025		0.23	79	69	42	30	34	11	266
2021	29		326	4	0	0	0	0	330
2025		0.38	75	1	0	0	0	0	76
2021	30		0	0	0	0	0	0	0
2025		0.38	0	0	0	0	0	0	0
2021	31		100	27	37	6	17	13	200
2025		0.38	23	6	9	1	4	3	46

Source: Consultant

Traffic Growth and Forecast

A general traffic forecasting approach is considered to be reasonable as compared to a road-specific projection, for a road with a strategic rather than specific function such as the project road. In general, transport demand (and hence traffic) is a derived demand driven by growth in population, economy and personal income. Forecasts of these factors are therefore required to make accurate traffic forecasts.

Traffic growth can also be related to the growth in fuel consumption and vehicle fleet; trends are therefore developed for these parameters.

A general traffic forecasting approach is considered to be practical compared to a road-specific projection, for a road with a strategic rather than specific function such as the project road. In general, transport demand (and hence traffic) is a derived demand driven by growth in population, the economy and personal incomes. Forecasts of these factors are, therefore, required to make accurate traffic forecasts. Traffic growth can also be related to the growth in fuel consumption and vehicle fleet; therefore, trends are also developed for these parameters.

Moreover, estimates of income elasticity, relating to traffic growth directly to forecast changes in national income, are often applied in making forecasts; this approach will also be adopted for this specific project.

4.5 Public Consultations

4.5.1 Introduction

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 ESIA safeguard instrument. This is because *i*t is recognised 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 PMU and the public. With this it was possible to build understanding and improved in decision-making by actively involving relevant stakeholders, especially the project affected persons and organizations with a stake and reducing the likelihood for conflicts.

4.5.2 The Objectives of Consultations

The objectives of the engagement are as outlined below"

- Canvass the inputs, views and concerns; and take account of the information and views of the public in the project design and in decision making.
- Obtain local and traditional knowledge that may be useful for decision-making;
- Facilitate consideration of alternatives, mitigation measures and trade-offs and ensure that important impacts are not overlooked and benefits maximized;
- Reduce conflict through the early identification of contentious issues;
- Provide an opportunity for the public to influence the designs and implementation in a positive manner;
- Improve transparency and accountability in decision-making; and Increase public confidence in the project.

4.5.3 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.

4.5.3.1 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 include the following:

i. Government

- Representatives from FMENV
- Abia State Government is the principal stakeholder and the tier of government incharge of the consultancy services as the administrator of all urban land
- All affected/host Local Government Council is the first tier of government with direct jurisdiction over the road constructions although it has taken no action allegedly because the scope is beyond its capacity.

ii. Traditional/Community leaders

- Palace/titled chiefs
- Community leaders
- Women leaders
- Youth leaders

iii. PAPs

The project affected persons are defined as those living within 10 metres from the road construction whose properties have been partly or wholly damaged.

In Table 4.15, a summary of the consultations made are summarised. **Plate 4.31 provides some images of stakeholders at the Public Meeting**

Table 4.15: Schedule of Public Meetings Held

S/N	Communities Met	Date	Issues Discussed
1.	Aba	11/02/2021	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.
2.	Aba	11/02/2021	Overview of the project and the ESIA 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.
3.	Aba	12/02/2021	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.
4.	Aba	12/02/2021	Livelihoods, income levels and expenditure patterns, employment situations in households. Perceptions, concerns and expectations of women about the proposed project. The H.R.H of the community replies that the community is not aware of the project and other project in the LGA they are not consulted for the input in the project.

Officials of FMEnv addressing stakeholders

Kolanut breaking by one of the stakeholders from host community

Plate 9.1: Some of the Stakeholders at the Public Meeting

4.5.3.2 Summary of Outcome of Public Consultations

The meetings were properly documented with main issues of concern, contributions, queries and opinions summarized n Appendix 9.1. Suffice it to say that opinions and responses/how the issues are addressed or would be addressed by the project are shown in Table 4.32

Table 4.32: **Summary of Outcome of Public Consultations**	
Stakeholders	*Response/How Project Address the Issues*
Expectations of the People about proposed Project: • We look forward to seeing this project becoming a reality. • We thank the governor for keeping his promises. • Job creation for persons especially the unemployed youths in communities at the execution phase of the project.	• *Your remarks are well noted and shall be communicated to the appropriate quarters* • *Adequate supervision by all responsible stakeholders will ensure quality road*

Table 4.32: **Summary of Outcome of Public Consultations**	
Stakeholders	*Response/How Project Address the Issues*
• Alleviation of the transportation challenges in the State especially the rural dwellers • Increase in economic activities in the communities after project execution. • Let the project be executed with quality and speed. • The project if realized will really help us in bringing our agricultural products to markets and sell them for more profits. • Please, we are willing to give any support required of us to facilitate the actualization of this project. • We shall give maximum cooperation to the construction company especially in terms of security.	
The Expressed Fears of the People Despite the high expectations of the net benefits of the project to the communities, some fears were expressed. These include among others; • Given that the project will result in job creation, priority should be given to the affected community members • With influx of persons into the communities, there might be a corresponding increase in vices such as drug abuse and alcoholism, violence, sexual vices (which will cause the rapid spread of sexually transmitted diseases (STDs) such as HIV/AIDS, Syphilis, etc.) and criminal activities among the younger folks. • There will be increase in cost of living as a result of increase in demand for food and essential services due increase in the population of the communities as a result of the establishment of the proposed project • Let the project be executed with quality and speed. • Will the youth be incorporated in the project by the contractors? • Will the youth be incorporated in the project by the contractors? • Will PAPs be resettled be the commencement	• To ensure best practice in terms of management of environmental and social issue that would emanate from the project that is why this ESIA is being carried out with responsibility outlined for all relevant stakeholders • Priority shall be given to the affected community members in terms of employment in project execution • Awareness creation shall be created with regard to HIV/AIDS and other social ills with proper decorum in project implementation • All affected assets and persons shall be recorded and on the basis of this adequate mitigation measures shall be devised

Table 4.32: **Summary of Outcome of Public Consultations**	
Stakeholders	*Response/How Project Address the Issues*
of the project or after? • If street light, water line and other infrastructure destroyed during road construction, will they be replaced after? • We do not envisage any hazard. When will the project start?	in managing all the challenges
Requests of the Communities • The youths should be considered first during employment at all stages of the establishment of the project. • Provide infrastructural facilities that are inadequate. • Where ever, the economic wellbeing of members of the communities will be adversely affected, adequate compensation should be paid to guard against conflicts.	• Qualified community mem (skill and unskilled shall given priority \ • The road is one of the pro the Government is embar on. Other • infrastructural facilities follow

4.5.4 Communities along the proposed road project and identified benefits to locals

The interactions with the host communities revealed possible benefits to them in rehabilitation of the **proposed roads as captured in Table 9.3**

Table 9.3: Benefits of the Roads to the Communities when Rehabilitated

S/N	**Aba Roads**	**Community(ies)**	**LGAs**	**Road justification/Objectives eg traffic decongestion, movement of food crops**
1	Asa Road – Port Harcourt Road	Ogbor Onicha Nlagu	Aba South	Traffic Decongestion, major link road towards A3 expressway out of Aba town.
2	Faulks Road	Umule	Aba North - Osisioma	Traffic decongestion. Major route to and from Ariria international market in Aba.
3	Ohanku Road – Owerre Aba	Owerre-aba Abayi nchokoro Umuaja Ohunku	Aba South - Ugwunagbo	Traffic decongestion and ease of movement between high populated towns in Aba.
4	Omuma Road		Aba North	Traffic decongestion.
5	Ikot Ekpene Road		Aba South - Obingwa	Traffic decongestion an ease of movement out from Aba town.
6	Mbubo Umuogele	Mbubo Umuogele	Isialangwa North	Ease of movement of agricultural produce and linkage between

S/N	**Aba Roads**	**Community(ies)**	**LGAs**	**Road justification/Objectives eg traffic decongestion, movement of food crops**
	Amachi Mgbokonta	Amachi Mgbokonta		highly populated towns.
7	Umuala Nbawsi Eziala Osusu Okpuala Ngwa	Umuala Nbawsi Eziala Osusu Okpuala Ngwa	Isialangwa North	Ease of movement of agricultural produce and linkage between highly populated towns.
8	Omoba – Umuaja Amaede Ndiolumbe	Omoba Umuaja Amaede Ndiolumbe	Isialangwa South	Ease of movement of agricultural produce and linkage between highly populated towns.
9	Mbawsi Layout – Ururuka	Nbawsi	Isialangwa North	Ease of movement of agricultural produce and linkage between highly populated towns.
10	Glass Factory Road	Okpulumobo Umungasi	Aba North	Ease of movement through industrial zones in Aba town.
11	Umuomiaukwu Agburike Umuomainta	Umuomiaukwu Agburike Umuomainta	Isialangwa North	Ease of movement of agricultural produce and linkage between highly populated towns.
12	Uratta – Ugwuati	Uratta Ugwuati	Osisioma – Ukwa East	Ease of movement of agricultural produce and linkage between highly populated towns.
13	Crystal Park Junction - Obohia Road	Obohia Ohambele	Aba South – Ukwa East	Ease of movement of agricultural produce and linkage between highly populated towns.
14	Immaculate Avenue – ITF Rod Bridge	Umungasi	Aba North	
15	Umuaro Nenu Road	Umuaro Nenu	Obingwa	Ease of movement of agricultural produce and linkage between populated towns.
16	Eziama Ntigha – Nsirimo – Ubakala	Eziama Ntigha Nsirimo Ubakala	Umuahia South – Isialangwa North	Ease of movement of agricultural produce and linkage between populated towns.
17	Mgboko – Omoba Umuezeukwu Mbawsi Road	Mgboko Omoba Umuezeukwu Mbawsi	Obingwa – Isialangwa South – Isialangwa North	Ease of movement of agricultural produce and linkage between highly populated towns.
18	Ibeme Ndiakata- Nlagu Onicha Ngwa	Ibeme Ndiakata Nlagu Onicha Ngwa	Obingwa	Ease of movement of agricultural produce.
19	Pepple Road - Akpu Road		Aba South – Aba North	Ease of movement of agricultural produce.
20	Umuokpo- Owo Ahiafor Link Road	Umuokpo Owo Ahiafor	Obingwa	Ease of movement of agricultural produce and linkage between highly populated towns.
21	Owerre Aba –	Owerre Aba	Aba South -	Ease of movement of agricultural

S/N	**Aba Roads**	**Community(ies)**	**LGAs**	**Road justification/Objectives eg traffic decongestion, movement of food crops**
	Osusu Umuelendu – Osusuaku	Osusu Umuelendu Osusuaku	Ugwunagbo	produce and linkage between highly populated towns.
22	Umuojima Amapuife Eberi Omuma	Umuojima Amapuife Eberi Omuma	Osisioma	Ease of movement of agricultural produce and linkage between highly populated towns.
23	Umuimo Carol Pee. Ministry of Agric. Shopping Mall	Umuimo	Aba North - Osisioma	Traffic decongestion.
24	Ugwuati – Umuiku	Ugwuati Umuiku	Ukwa East	Ease of movement of agricultural produce.
25	Isicourt-Ururuka Umuosu Umuala Umunkpeyi	Isicourt Ururuka Umuosu Umuala Umunkpeyi	Umuahia South – Isialangwa North – Isialangwa South	Ease of movement of agricultural produce and linkage between highly populated towns.
26	Ama Emereole – Ekeonyeugba –Umokoromiri-Eketa	Ekeonyeugba Umokoromiri Eketa	Isialangwa South	Ease of movement of agricultural produce and linkage between highly populated towns.
27	Ajiwe – Brass		Aba North	Traffic decongestion.
28	Ahunanya – Immaculate	Umungasi	Aba North	Traffic decongestion.
29	Oron Road – Elizabbeth Avenue – Sports Club	Umungasi	Aba North	Traffic decongestion.
30	Umuala - Umuakwu - Ohuhu Nsulu – Oloko Ikwuano	Umuala Umuakwu Ohuhu Nsulu Oloko Ikwuano	Isialangwa North - Ikwuano	Ease of movement of agricultural produce and linkage between highly populated towns.
31	Itungwa – Agburukwe road	Itungwa Agburukwe	Obingwa	Poor drainage system along road which lead to the formation of GES 2. Ease of movement of agricultural produce.

4.5.5 Communication and Stakeholder Engagement Plan

For continual communication and engagement of the public, especially the host communications, this Plan has been developed. Here the Communication Plan refers to specific guidelines and protocols consistent with the principles of participation that will govern the project and which will be reflected in the Communication Plans.

They are:

- establishment of feasible participation mechanisms ,

- establishment of participation mechanisms prepared with the basic objectives of transparency, responsibility of delivery of public service and an anticorruption approach;
- promotion of arenas of dialogue based on realistic and objective data avoiding the creation of expectations that cannot be met;
- positive discrimination for the most vulnerable groups, such as women, young persons, children, older persons and indigenous communities.

A key element of sustaining stakeholders' support in any project execution is to consult and communicate with the stakeholders effectively and to engage them as early as possible with the project which has been done in the course of preparation of this safeguard instruments. Like any other business function, stakeholder engagement shall be managed and driven by a well-defined strategy as provided in Table 9.4.

All reasonable efforts must be made to disclose/display this ESIA and other relevant safeguard documents to the public at strategic points within the project's area of influence so as to allow all stakeholders read and understand how they stand to be affected and support required by the project. The disclosure shall be in accordance with the requirements of the Federal Ministry of Environment and the AfDB

An effective two-way communication of HSE issues shall be maintained to include awareness programme to motivate staff and contractors and the general public to support the project in terms of adherence to HSE rules. Appropriate communication methods shall be employed to effectively promote HSE and create awareness such as use of news media, community meetings, openly display of plans and performance targets, HSE performance board, etc.

Table 4.34: Summary of the of Stakeholder Engagement Plan

Activity	**Stakeholders / Community**	**Frequency / Timeline**
Pre-Construction / Prior to Project Commencement		
Project email, postal address and contact details	All stakeholders	Once-off establishment
Briefings	State Government , Local Government, Bank	As required, subject to the approvalsprocess
Site tours	Regulators, Site Committee, community, Bank, etc	As required
Personal meetings	Targeted stakeholders	As required
Community Sessions	Residents of affected areas/ Community and interest groups	As required, subject to approvals route and feedback from the community
Develop and disseminate Feedback and Complaints	All stakeholders	As required, subject to any updates on the Project

Table 4.34: Summary of the of Stakeholder Engagement Plan

Activity	Stakeholders / Community	Frequency / Timeline
Mechanism and communications procedures		
Briefings, Site Tours and Community Sessions - for development of the Rehabilitation and Closure Plan	Government authorities, Local communities, • Additional relevant stakeholders	Prior to Work Plan approval
Disclosure of Safeguard Reports	Area of project influence	As required by Federal Ministry of Environment
Review of EIA Report		As required by Federal Ministry of Environment
Construction and operations		
Ongoing community liaison	Local community	Ongoing
Project updates	All stakeholders	Monthly
Responding to issues and inquiries as per Feedback and Complaints Mechanism	All stakeholders	Ongoing / as required
Annual reporting	All stakeholders	Annually

* Budget to be determined based on profile of stakeholders, duration, location and size

CHAPTER FIVE
ASSOCIATED AND POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS

5.1 Introduction

This Chapter contains a summary of the impacts that are likely to result from the proposed intervention work because of the interaction between the project components and the environmental elements. The method employed for impact identification and evaluation is also given in this Chapter.

5.2 Impact Assessment

5.2.1 Impact Identification and Evaluation

The Impact Identification and Evaluation process flow adopted for the project are depicted in Figure 5.1. The identification and management of impacts associated with the project activities were based on a risk assessment method which involves: Identification of project activities that may interact with the site environment, development of implementing controls to reduce the risk of impacts and development of Monitoring the effectiveness of the controls.

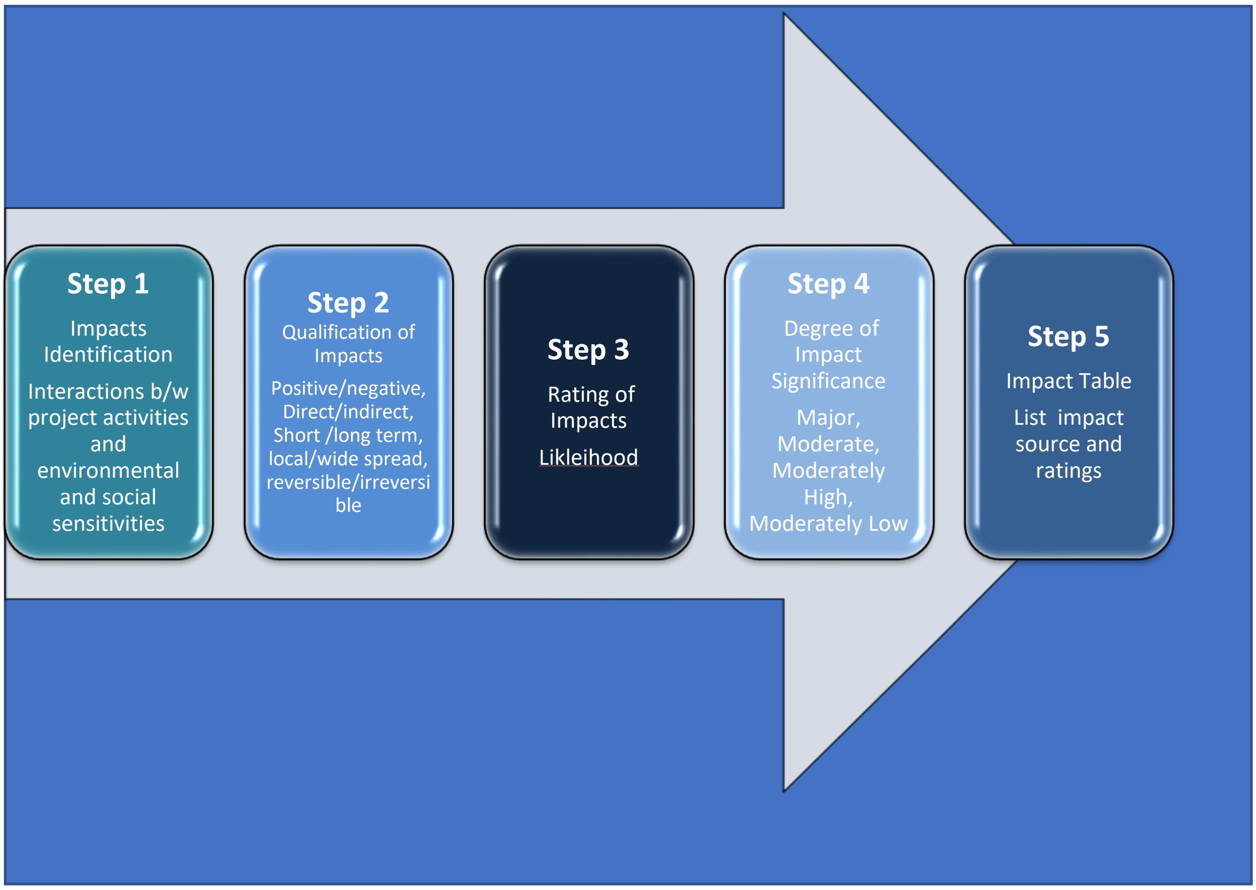


Figure 5.1: Impact Identification and Evaluation Process Flow

5.3 Environmental Components and Impact Indicators

In Table 5.1, some main components of the environment and potential impact indicators were identified. The components are those that the project activities are most likely to impact upon, while the indicators are the easily observable parameters that will indicate change/deviation, which could be used to monitor the various environmental components during the various phases of the project.

Table 5.1: Environmental Components and Impact Indicators

S/No	Environmental Components	Potential Impact Indicators
1.	Climate	Relative humidity, rainfall, temperature,wind speed and direction
2.	Air Quality	Particulate matters, , CO,CO2, H2S,NOX, NO2, SOX,
3.	Noise & Vibration	On-site & Off-site disturbance, noise related health problems, communication interference.
4	Flora and Fauna	Changes in original types and deviation from normal characteristics
5.	Water Quality	Solids,pH, nitrate, chloride, turbidity, salinity, chemical toxicity, and microbiological characteristics.
6	Ecological setting	Erosion, flooding, etc.
7.	Socio-economics	Traffic, population, security, income, settlement pattern, and infrastructure change. Access to communication facilities, aesthetic value, Level of income and financial flows, Opportunities for contracting and procurement, Opportunities for local and national employment, Access to transport, Respect for human rights, Promoting equal opportunities
8.	Health and Safety	Accidents, Exposure to nuisance (dust, noise etc.), Level of disease vectors, Exposure to STIs/HIV/AIDS, Mortality rate, Morbidity rate, Physical activity, Hygiene, Exposure to commercial sex workers, Access to primary health care, Access to secondary health care, Access to traditional medicine, Access to emergency services

5.4 Impact Identification and Evaluation

The identification and evaluation of impacts associated with the proposed road construction project activities were based on a risk assessment process. This involved the identification of project activities that may interact with the project environment, controls to reduce risk of impacts and monitoring the effectiveness of controls.

The key project activities of the proposed development were identified. The pathways (or events) that may cause impacts to the environment were determined, and their associated potential impacts listed. The risk of the impacts occurring was analysed by determining the consequence severity of the impacts and the likelihood of the consequences occurring. The severity of the consequences was determined using a Consequence Severity Table and the likelihood of an impact resulting from a pathway was determined with a Likelihood Ranking Table and then the level of risk was determined using a Risk Matrix (Table 5.3).

To prevent or minimize the impacts, controls were placed on the pathways in this order of priority:

- Elimination of the activity,
- Substitution with a lower risk activity,
- Engineering solutions to reduce the impact of the event,
- Implementation of administrative procedures to control the activity and
- Clean up or remediation measures to mitigate impacts after an event

Table 5.2: Consequence Severity, Likelihood Ranking & Risk Matrix Tables

Consequence Severity Table		
Level		Consequence (Hazard Effect)
1	Insignificant	No detectable impact to the existing environment, Minor Injury (e.g. bruising, abrasion)
2	Minor	Short term of localised impact, Injury requiring Medical attention or first aid
3	Moderate	Prolonged but recoverable impact on the environment and commercial industries, 3 Day Injury/Temporary Disability
4	Major	Prolonged impact to the environment which may not be recoverable and threatens an ecological community, the conservation of species, Major Injury/Long Term Absence
5	Catastrophic	Non-recoverable change to existing environment leading to loss of endangered Species or creation of human health risk, Fatality/Permanent Disability
Likelihood Ranking Table		
Level		Likelihood (Probability)
5	Almost certain	The incident is expected to occur most of the time (i.e. every time), Will invariably happen - could occur repeatedly
4	Likely	The incident will probably occur in most circumstances (i.e. regularly, weekly), Highly probable - could occur several times
3	Moderate	The incident should occur at some time (i.e. quarterly), Possible: Feasible - could occur sometime
2	Unlikely	The incident could occur at some time during the life of the project, Possible: Might Happen - unlikely though conceivable .
1	Rare	The incident may occur only in exceptional circumstances and may never happen, Remote Possibility/Negligible

Table 5.3: RISK ASSESSMENT MATRIX TABLE

Likelihood		Severity				
		Minor Injury/Not detectable	First Aid Injury/Short term	3 day Injury Temporary Disability/Prolonged but recoverable impact	Major Injury/Long Term Absence/ Prolong Impact	Fatality/ Catastrophic
Probability	Remote Possibility/Rare	1	2	3	4	5
	Might Happen/Unlikely	2	4	6	8	10
	Feasible/Moderate	3	6	9	12	15
	Highly Probable/Likely	4	8	12	16	20
	Invariably Happen/Almost certain	5	10	15	20	25

Scale

+	0	Low	Moderate	High

Decisions and nature of Actions

Rating		Definition
11-25	H	Unacceptable risk - immediate action required, Risk reduction required - high priority, High impact - Senior management involvement and planning needed
6-10	M	Medium risk - action required so far as is reasonably practical, Moderate Impact - Management responsibility must be specified.
1-5	L	Low risk - no further action required, Low impact - Managed by routine procedures
0	0	No Impact-neutral
+	+	Positive Impact

To ensure a comprehensive evaluation, a variety of measures to identify and weigh likely impacts were considered. These include:

- Overlaying project components on maps of existing conditions to identify potential impact areas and issues;
- Experience from similar projects;
- Published and unpublished documents that provided guidance on performing impact analysis, and the EIA provisions of Nigerian's Environmental laws and regulations.
- The sensitivity / vulnerability of the ecosystem component;

- Knowledge of the possible interactions between the proposed project and the environment;
- Envisaged sustainability of the project environment;
- The economic value of the proposed project;
- Projected duration of the impact of each project activity on various environmental components.
- Knowledge of the proposed project activities, equipment types, layout of the project facilities;
- Peculiar observations and results of baseline studies of the study area;

5.4.1 Project Benefits

The project is envisaged to have a range of positive environmental and social impacts. Some of these are a function of the objectives of the project, while others are a function of the way in which the project is designed to meet its objectives. The major benefits will occur in the form of improved erosion management and gully reclamation which will provide for:

- Reduced loss of infrastructure, mainly the roads and other assets
- Reduced loss of agricultural land and productivity from soil loss caused by surface erosion.
- Reduced risks of floods (due to reduced siltation)
- Progressively restored vegetative cover, improved environmental conditions and more humid local microclimates. This results in increased vegetation cover for wildlife and carbon sequestration.
- Environmental improvements due to land stabilization measures which preserve the landscape and biodiversity.

5.4.2 Negative Impacts

The proposed project activities unfortunately are also likely to exert adverse impacts on the social and physical environment within which it is executed. Based on the design of the project, these impacts can be divided into two, namely: short-term construction-related impacts and long-term unavoidable impacts due to use the use and maintenance of the reclaimed areas highlighted below:

Short-term construction-related impacts typical of construction activities of six months duration such as:

- Increased level of noise and dust nuisance during the preparation of site, and trucking materials to sites.
- Generation, temporary storage and disposal of waste from the labor camp. These may cause dust emissions, erosion, littering, damage to soil.
- Contamination of soil and groundwater by stored fuel, lubricants, paints; and refueling of vehicles.
- Traffic disruption
- Increase in public and occupational health and safety issues within the vicinity of the site and possible increase in communicable diseases such as COVID 19
- Use of resources, runoff of flood, increase in social vices, etc.

Long-term unavoidable impacts due to the operation which are likely to come out in the form of:

- Direct impacts: emissions and pollution due to traffic and transport of goods, for instance
- Indirect impacts: changes in economic structure, trade and transportation systems, Impact on the people's lifestyle, social values, and the "rebound effect,"

The construction activities are one-time activities and not permanent ones, about six months. Although the proposed construction activity does not envisage any large-scale construction activities, impacts associated with the activities are rated to be moderate on severity and "minor" on duration.

All these impacts can sufficiently be mitigated based on the measures designed correspondingly. Nevertheless, unless good construction management practices are followed, construction activities can cause serious environmental pollution, ecological degradation and health and safety concerns to both workers and the public.

With regard to occupational Health and Safety, some workers will be recruited for construction activities and workers' camp will be constructed. These will include non-skilled workers, operators and drivers as well as surveyors and construction supervisors. Since the works will be relatively small scale and expected to be completed within six months, large numbers of workers are not expected. However, safety and health impacts will be also expected.

A more project specific potential negative impacts and the level of impacts that could emanate from the project are summarized in Table 5.3 with some specific fields of impacts briefly described below:

Table 6.3: Potential Environmental and Social Impacts of the Proposed Project

Project Phase	Project Activity	Description of Impact	Impact Qualification							Overall Rating
			Beneficial	Neutral	Negative	Short term < 3 months	Long term > 3 months	Reversible	Irreversible	
Mobilization/ Preconstruction	Construction of camps for personnel Construction of yard for equipment and offices	**Biophysical** Site clearance for camps and yard for equipment Impact on air, soil and water **Socio-Economic** Socioeconomic impact based on new influx of people	+			S		R		**L**
	Movement of goods, workers, Equipment, etc	**Biophysical**								
		Increase in noise nuisance			-	S		R		**L**
		Reduction in air quality			-	S		R		**L**
		Socio-Economic								
		Increased pressure on existing infrastructures e.g. housing			-	S		R		**L**
		Employment	+							**L**
		Health And Safety								
		Increase in road traffic volume and risk of accidents/injury			-	S		R		**L**
		Increase in respiratory diseases			-	S		R		**L**
		Movement of heavy equipment to worksite may pose danger to public			-	S		R		**L**
Construction	Re-establishment of RoW Removal of vegetation/ Land use along the road alignment Opening of trail Stockpiling of construction materials & material Use Slope Stability/ Earthworks (cut and fill equalization)	**Biophysical**								
		Air Pollution: Construction-related dust generation, Batching plants and asphalt plant operations, Material dump sites, Vehicular emissions and haulage of materials			-		L	R		**H**
		Solid Waste: Generation of debris from demolitions, spoils and domestic refuse			-		L	R		**H**
		Water resources & Pollution: The hydrological regime of streams along the road corridor will be affected during the construction work and water quality will be altered.			-		L	R		**H**
		Wetlands: Siltation and oil pollution may affect the wetlands.			-	S		R		**L**
		Fauna: Animals and birds will be disturbed by the clearing activities and their homes/nesting sites may be destroyed. Noise and dust pollution will occur during construction activities.			-	S		R		**L**
		Wildlife; construction workers poaching and trading wildlife			-	S			I	**L**
		Vegetation/Flora: Clearing of vegetation will be necessary for the road realignment. Natural vegetation is not regarded as having			-	S		R		**H**

Project Phase	Project Activity	Description of Impact	Impact Qualification: Beneficial	Neutral	Negative	Short term < 3 months	Long term > 3 months	Reversible	Irreversible	Overall Rating
	Quarries and borrow pits Fuel consumption Spoil and construction waste disposal Work/ Labour camp operation -	any special conservation significance. However, clearing activities could encourage soil erosion.								
		Material Source: third party site								**M**
		Hazardous Materials: Contamination of the immediate surroundings due to handling and Storage			-	S		R		**M**
		Soil Degradation & Landscape Damage: Creation of Excavation sites and triggering erosion. However, materials are sourced from third party quarries. Damage to abutting land use to construction line			-		L	R		**M**
		Noise: increases during construction and ground vibration due to construction operations			-	S		R		**H**
		Hydrology/ Flooding/Drainage: Alteration of the hydrology of the area because due to the flat nature of the terrain, the road level will need to be raised in many areas. Hence, runoff will be channeled through culverts. This will be a temporary problem occurring during the construction works.			-	S		R		**H**
		Socio-Economics								
		Land use pattern along the road alignment: Alignment likely to displace persons and assets			-	S			I	**H**
		Aesthetics/Visual intrusion: During construction visual intrusion will be affected due to road works and traffic and likely to increase landscape scars along the road alignment. In addition, if the construction spoils are disposed of improperly, the ground vegetation would be destroyed which will be visible from a distance			-	S		R		**M**
		Cultural, historical or traditional sites: There are sites of cultural, historic or traditional value that would be affected by the road works.i.e. the grave yards		0	-		L		I	**L**
		Agricultural activities: During construction, little or no change is expected with regard to agricultural activities.			-		L		I	**H**
		Settlements/ Induced settlements: During construction, a pool effect is likely to occur for would be petty traders to the roadside	+		-		L		I	**M**
		Employment opportunities: The project will provide temporary employment for many of the local people for example as casual	+				L		I	**H**

Project Phase	Project Activity	Description of Impact	Impact Qualification							Overall Rating
			Beneficial	Neutral	Negative	Short term < 3 months	Long term > 3 months	Reversible	Irreversible	
		laborers during construction works and allow for the trade of food and basic supplies to workers.								
		Gender/Vulnerable: Impacts on the vulnerable groups **(**1,151 PAPs)			-		L		I	**H**
		Cultural Resources			-		L		I	**L**
		Conflict due to Local people excluded from project activities & Promises made to local people during feasibility and planning phases								**M**
		Traffic: Disruptions and Diversion Impacts, Road Closure and Detours			-	S		R		**M**
		Service infrastructures: community-level service infrastructures disruption or dismantled								**H**
		Workmen/Contractor camp: Presence of the camp is likely to lead to an increase in water usage putting a strain on the local communities. Solid waste disposal and sanitation problems will be an issue.	+			S			I	**M**
		Health and Safety								
		Road safety: During construction, there will be some danger to pedestrians and cyclists along the existing road		-		S		R		**M**
		COVID 19/HIV/AIDS and STIs: impact likely due to presence of more workers from other communities			-	S		R		**M**
		Public health interference: Exposure to accidents, dust, noise, etc		-		S		R		**M**
		Occupational health and Safety Workers exposed to accidents, dust, etc		-		S		R		**H**
		Workers and Camp: Provision of potable and sanitation facilities and lay down areas; minimum wage; sexual harassment and forced and child Labour by sub-contractors		-		S		R		**M**
		Biophysical								
		Revegetation								**L**
		Environmental Justice	+				L		I	**H**
		Increase in noise nuisance			-		L		I	**L**

Project Phase	Project Activity	Description of Impact	Impact Qualification							Overall Rating
			Beneficial	Neutral	Negative	Short term < 3 months	Long term > 3 months	Reversible	Irreversible	
Operation	Vehicular movement, passenger patronage and maintenance	Reduction in air quality			-		L		I	**L**
		Climate Change due to GHG Emission			-		L	R		**L**
		Soil Degradation and Soil/Groundwater contamination			-		L	R		**L**
		Flooding			-			R		**L**
		SOCIO-ECONOMICS								
		Improved and reliable journey times on corridor by public	+				L		I	**H**
		Poverty alleviation and welfare improvement of people	+				L		I	**H**
		Job Creation and Business opportunities/Economic enhancement	+				L		I	**H**
		Pressure on existing infrastructure			-	S		R		**L**
		Stress on existing security structures			-	S		R		**L**
		Transport affordability with constant and easily understandable fares with reduction in freight haulage and transportation time**,** improved tourism opportunities,	+				L	R		**H**
		Agricultural activities: the improved road would encourage agricultural activity between communities.	+				L		I	**H**
		Growth of Businesses and Market Centres as economic activities will increase along the corridors due to enhanced transportation which will attract ventures- businesses, market centres and other essential services	+/-				L		I	**H**
		Traffic Congestion - Road Closure and Detours			-		L	R		**M**
		Social Benefits -Through social responsibility arrangements, the project may intervene on social facilities including schools, health centres and water supplies along the road,	+				L		I	**H**
		Waste generation and impact on disposal facility			-		L	R		**L**
		Visual Aesthetics	+				L	R		**L**
		Encroachment due to unmanaged settlement, construction along the RoW.	-				L	R		**M**
										L
		HEALTH AND SAFETY								
		Enhanced Public Safety and security on corridor	+				L	R		**H**
		Injury/fatalities in workforce/communities			-		L	R		**H**
		Road Accidents			-		L	R		**H**

Project Phase	Project Activity	Description of Impact	Impact Qualification							Overall Rating
			Beneficial	Neutral	Negative	Short term < 3 months	Long term > 3 months	Reversible	Irreversible	
		Increase in road traffic volume, accidents/injury			-		L	R		**H**
		Fire and other Emergencies -			-		L	R		**L**
		PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY								
		Road safety: High-speed driving, Deteriorated road surface, Road Sections with multiple tracks/off-road driving could increase accidents		-		S		R		H
		Public health interference: Dust generation		-		S		R		L
		Occupational health and Safety Exposures – workers		-		S		R		L
Decommissioning	Demolition and Removal of camps, cabins, equipment etc	**Biophysical**								
		Revegetation	+	-		S		R		M
		Increase in noise nuisance		-		S		R		L
		Reduction in air quality		-		S		R		L
		Climate Change due to GHG Emission		-		S		R		L
		Soil Degradation and Soil/Groundwater contamination		-		S		R		L
		Erosion/Flooding		-		S		R		L
		SOCIO-ECONOMICS		-		S		R		L
		Traffic disruption		-		S		R		L
		Public health interference: Dust generation		-		S		R		L
		Occupational health and Safety Exposures – workers		-		S		R		L

5.5. Summary of Significant Impacts

5.5.1. Significant Positive Impacts

The proposed current road project is expected to have high positive socio-economic impacts especially on the affected persons and communities in Abia State.

***Improvement in rural road network**:* There will be great improvement in rural road network in the state, connecting rural to semi-urban communities thereby stimulating both local and regional economic activities. The road network will also improve accessibility to rural communities, markets, farms and agro-processing centers in the State.

Increase in agricultural output and economic empowerment**:** As the majority of the population in the affected LGAs are farmers, the provision of good road network in the area will lead to increase in agricultural output as the road will ultimately facilitate easy access to farm inputs, extension services, primary and secondary (urban) markets. Improvement in agricultural productivity will translate to economic empowerment, poverty reduction and socio-cultural wellbeing of the benefiting communities.

Provision of employment opportunities: Another contribution of the proposed road rehabilitation project to the overall socio-economic wellbeing of the benefiting region is the provision of employment opportunities. A large number of locals are expected to be engaged directly, especially as semi-skilled (e.g. masons, carpenters, electrical technicians, welders, etc.) and unskilled labour (e.g. for site clearance, loading and offloading of materials, security services e.t.c). There will also be indirect opportunities for local contractors, businesses and food sellers amongst others. This will be a significant impact since the rate of unemployment is generally high in Nigeria and in project communities. Other benefits include:

- visual aesthetics;
- enhanced safety on the road;
- transport fare affordability;
- reliability due to improved journey times; and
- environmental benefits due to reduction of journey times, *reduced vehicular emissions which contributes to global warming*

5.5.2. Significant Negative Impacts

Inevitably, the project will have some adverse impacts on the biophysical and social environment which are expected to be typically more pronounced during the construction phase of the project. These adverse impacts will be largely localized in spatial extent and short term and can be avoided or managed through the application of appropriate mitigation measures, sound engineering design, good construction practices, effective maintenance and adequate supervision and enforcement during project implementation.

Impacts of Land Acquisition

Envisaged impacts of land acquisition for the road rehabilitation project will be largely economic displacement. This will be particularly so as the existing road in some locations may not have the required width to accommodate the new road. Consequently, there will be acquisition of land from farmers in the rural communities along the road. The impact of land acquisition as it relates to economic displacement is adjudged to be of medium significance as land acquisition from individual farmers will be minimal or insignificant if minimal road alignments (15 m or less) on either side of the rural roads will be used which will comprise of mainly grass and bushes as well as few economic trees and perennial crops that will be affected. However, a separate instrument (RAP) will be prepared to address the issues of land acquisition and economic displacement that may result from this project.

Grievance and Conflicts

There is usually payment of compensation on farmlands to be acquired and this has the tendency to generate grievances and conflicts in the project area arising from discontentment over resettlement, non-compensation payment and/or inadequate implementation of compensation. This impact is considered to be of medium significance in view of the insignificant amount of land that may be taken from individual farmers as well as the development and implementation of RAP to compensate affected farmers.

Displacement/ Destruction of Cultural and Sacred Sites

Although no such sites were found along the project roads/corridors, should any come up later due to road re-alignment, the project coordinating unit will consult the community leaders and affected parties on acceptable and sustainable mitigation measures including relocation and compensation.

Loss of Employment

After the construction phase, those employed directly or indirectly because of the road project may lose their jobs. The loss of employment and economic livelihood is considered to be of medium significance in view of the temporary or short-term nature of such employment in the first instance and the expectation of workers to eventually be disengaged after project implementation.

Threat to community culture, safety and security

The influx of more people from other regions may lead to increased vices such as increased crime rate, illicit drug use and peddling, gender-based violence, sexual exploitation and abuse, introduction of communicable diseases, etc. This impact is considered to be of High significance in view of large number of construction workers as well as business opportunists that will arrive in the rural communities especially during the construction phase of the project. It is however instructive to note that no major cultural heritage will be impacted or diluted by the project based on the outcome of consultations held in the project area.

Pressure on Existing Infrastructures in Host Communities

Arrival of construction workers during construction and associated influx of camp followers or business opportunists in the project area may put pressure on existing healthcare and sanitary facilities in the host communities. This impact is however considered to be of medium significance because the worker's camp would be equipped with a clinic to cater for the needs of the employed workers. Temporary toilets and bathrooms will also be erected to meet the sanitary needs of construction workers. Some of the business opportunists are likely to be residents of nearby communities and as such only little pressure is expected to be put on existing facilities.

Security Challenges

Security challenges may arise in the project area due to the storage of equipment and materials on site prior to construction. Storage of these materials may attract thieves and hoodlums to the area with increased risks of threats to lives and properties. Presence of migrant workers may also lead to kidnapping, robbery and other vices. In view of this, the potential security risk is considered to be of High significance.

Impact on Community Health and Safety

The project will inevitably lead to an increase in the emission of gaseous pollutants and dust to the atmosphere within the vicinity of the road corridor. The major sources of air pollution during the project will include construction activities and movement of vehicles. Exposure to gaseous pollutants may lead to respiratory and eye related problems. In addition, exposure to construction noise can however adversely affect people's quality of life especially those living and working along the road corridor. To a large extent, such exposure may cause annoyance, irritability, anxiety, loss of sleep, stress and even high blood pressure.

Impact on Occupational Health and Safety (OHS)

Occupational health and safety issues will likely be of concern particularly during preconstruction, construction phase of the proposed project. Activities such as mobilization of equipment and materials, site clearing and demolition, as well as construction activities involving use of heavy-duty vehicles and equipment, road construction, drainage and bridge construction, civil works and road furniture installation may increase construction workers exposure to occupational health and safety hazards. These short-term construction-related impacts include impacts on air quality, noise and vibration, drainage, flooding and solid wastes management and social impacts likely on land use, traffic congestion and health and safety. Consequently, there may be potential risks to workers' health and safety with increased predisposition to accidents, injuries and possibly death.

Although the outcome of these health and safety hazards can potentially be fatal to workers, these impacts are however considered to be of varied **(minor - major) significance** due to the duration of project activities and extent of workers' exposure. A robust site-specific Occupational Health and Safety Plan (OHSP) will however be developed and implemented by the contractors. Enforcement of this Plan will ensure the protection of workers health and safety and the prevention of serious accidents and injuries.

Risk of Sexually Transmitted Diseases

There is the potential for increased Sexually Transmitted Diseases (STDs), particularly during preconstruction and construction phases of the project, due to increased concentration of people such as construction workers, migrant settlers and camp followers with diverse cultural and social backgrounds. Inevitable interactions among these migrant population and inhabitants of host communities may cause to increased prevalence of STDs especially HIV/AIDS.

Labor Influx

During project implementation, the arrival of construction workers and associated influx of camp followers or business opportunists in the project area may result in some labor influx-related risks such as workers' sexual relations with minors and resulting pregnancies, presence of sex workers in the project communities, the spread of HIV/AIDS, sexual harassment of female employees, child labor and abuse, increased drop-out rates from school, poor community participation, poor labor practice, and lack of road safety.

Gender Based Violence

Gender Based Violence (GBV) risks in the project areas might include Intimate Partner Violence (IPV), public harassment including verbal insults, physical abuse, rape, harmful widowhood practices and women and child trafficking.

GBV Risk Management Mechanisms

The development and implementation of specific GBV risk prevention and mitigation strategies, tailored to local contexts, will be critical.

HIV/AIDS Issues

During the construction phase, construction companies' workers coming from different places with different social backgrounds and lifestyles are inevitably going to interact and establish relationships with community members. With the poor socio-economic conditions in the rural areas and low awareness about communicable diseases coupled with attitudes of some people, the stakeholders expressed concern that STD, HIV and AIDS are likely going to spread in the communities, particularly among vulnerable groups.

Decommissioning Phase

The **Decommissioning Phase** of the project may have the following negative impacts:

- Physical disturbance arising from equipment removal
- Soil erosion resulting from improper reinstatement of excavated soil
- Air quality degradation and noise generation in the course of excavation to remove entrenched equipment and the breaking down of buildings/structures
- Hazards/risks and accidents
- Waste management problems
- Social misfit/miscreants taking over the site
- Break up old road surface and soil, etc.

5.5.3 Detailed Description of Some Specific Impacts

Some specific impacts of concern as they relate to the various phases of the project are discussed briefly:

5.5.3.1 Biophysical Impacts

Construction phase

Air Quality

Air-borne particulate would result from soil disturbances during construction activities. All diesel-powered facilities such as power generators would emit SO_2, CO_2, NO_X and other gases. These combustion gases can cause air pollution problems for immediate areas and health related hazards. Degradation of air quality can also occur due to emission from vehicular traffic and the generation of fugitive dusts.

During this phase, there will be temporary emissions of pollutants into the atmosphere due to site activities.

- Dust produced by the movement of soils during site excavation and grading
- Emission from internal combustion engines of vehicles and other construction related equipment.

These emissions are short-termed and localized to the immediate site area; though the occurrence is likely, the overall impact risk level is rated low.

Impacts on Climate

Changes in climatic parameters are usually determined only after a long period of study spanning at least five to ten years. Hence it was not possible to determine the immediate effects of the project on the climate of the area during this phase.

Noise Impacts

During construction, a major source of noise will be construction equipment and vehicular movements as well as other associated activities. Noise levels arising from these activities though expected to exceed ambient levels at times will be transient and localized, and are not expected to adversely affect the nearest residential location. Consequently, noise impacts arising from local construction activities are expected to be temporary and acceptable within the project area but insignificant some 200 metres away. Thus, overall risk level is predicted as low.

Impact on Geology

Only minimal geological impacts are expected in the construction phase of the project, as there will be no major topographic or geologic alteration due to the construction of the facility since there will be only few road realignments here and there. Soil erosion, which is another potential impact to geology of the area, is not anticipated to be a major issue at the project corridor as from history it has never been prone to erosion. However adequate erosion control measures will be put in place. Impact consequence from construction activities is rated low, while the likelihood of its occurrences is remote and thus, the overall risk is of a low priority.

Soil Impact

The potential impacts related to soil resources could manifest mostly as soil erosion, land degradation and fugitive dust released to the atmosphere, changes in drainage patterns and contamination from discharges, leakage of petroleum products and hazardous chemicals used at construction sites. Management procedures that will be put in place shall make these impacts unlikely.

Considering the manner in which the impact could manifest, tending to spread beyond the immediate spot of activity, it is rated negatively low, with a high likelihood of occurrence. Nevertheless, the consequence is expected to be local due to the temporary nature of the construction and overall impact risk is High.

Impacts on Water Resources

Seasonal variation of the groundwater should be anticipated in the area.

Groundwater flow in the area is not expected to be disturbed as a consequence of the construction of the road as only the topmost layer of earth materials would be involved during the construction. The only possibility of impact on the groundwater is expected to occur in the remote case of percolation of construction materials and wastes if not properly stored. This possibility is remote considering the management plan that will be put in place.

Impact consequence from construction activities is rated a minor, while the likelihood of its occurrences is remote and thus, the overall risk is low i.e. of a low priority.

The surface water of the rivers may be temporarily impacted by construction activities especially bridge construction. Impact consequence from construction activities on surface water quality is rated low.

Operation phase

Air Quality

The new road *will contribute to air emission from more vehicles plying the road, but this impact is rated low due to the wide expanse of land available.*

Climate Change

The transport sector is one of the main contributors of greenhouse gases (GHGs) which are most likely to interfere with the climate system. According to a report released by the Intergovernmental Panel on Climate Change (IPCC), road transport is responsible for 74% of total transport CO_2 emissions. There appears to be a direct correlation between the economic and population growths and transport-related emissions as increases in gross domestic product per capita bring along an increased demand for vehicle use and ownership. And if the trajectory of transport demand remains at a steady growing pace due to economic growth, then the alarming issue of increased emission needs to be addressed.

Noise Impacts

The effects of excessive noise and vibration include human welfare and physiological disruption, hearing impairment and communication problems. These may cause elevated stress levels and associated behavioural and health problems. Vibrations can damage road side structures, particularly makeshift or lightly constructed buildings. It is unlikely that Noise levels that shall be generated by the operation of vehicles would exacerbate the prevailing levels. It may be concluded, therefore, that impacts to the public is low because it is envisaged to be insignificant in terms of severity.

Impact on Geology

The study area lies in a geologically (both tectonic and seismic) stable region with no recorded cases of or tremors. Furthermore, no major or minor faults are known to traverse the area.

Therefore, the possibility of any geo-hazards occurring in the area is remote and overall impact risk is low.

Soil Impact

Potential impacts to soil during the operation phase could occur through the improper use, storage and handling of wastes. The comprehensive environmental management procedures prepared for the project will ensure that any potential impact(s) are adequately mitigated against. Thus, impact level is rated medium with a remote likelihood of occurrence and no detectable severity.

Impacts on Water Resources

Public conveniences would be provided along the road. Thus the impact is rated low since likelihood of solid and liquid waste accumulation will be low

5.5.3.2 Socio-Economic Impacts

The potential social impacts during the operation phase will be mostly beneficial. The beneficial impacts include:

- improved land use,
- attraction of small businesses
- Visual aesthetics
- Employment generation and poverty alleviation
- Increased income

Construction phase

Traffic Disruptions and Diversion Impacts

There will be conveyance of materials with heavy trucks and this could disturb vehicular and pedestrian traffic. Thus, during construction, any disruption on the road would mean traffic build up. The situation can be aggravated without carefully planned detours and road closures. The effect of traffic disruptions includes increased travel time, congestion, social stress and agitations. From the foregoing, it can therefore be concluded that impact of traffic would be of high priority/unacceptable, since the likelihood of occurrence is almost certain with major negative consequence.

Operation phase

Traffic Disruptions and Diversion Impacts

During operation, the good road surface would mean more vehicles on the corridor, however, the overall impact is rated low.

Impact on roadside business and other social activity/Land take

Permanent occupancy of the open space of a publicly owned right-of-way quite commonly invites encroachment of local community activities onto the roadside. These activities include small businesses such as vehicle repair shops, production of bricks, Okada riders, etc within the right of way. Compulsory land acquisition and demolishing of structures such as buildings, business premises, shops, etc, can result in displacement of communities, loss of business, properties and incomes, social stress, social and psychological disruption for the affected individuals and families. The project is not envisaged to take significant land from any of these groups. Nevertheless, a thorough study in the form of social survey as part of a resettlement action plan would reveal the level of impact of the project on those on the right of way.

5.5.3.3 Health and Safety Impact

Some of the perceived health and safety impacts due to the proposed project are elaborated upon briefly below:

Injuries

Injuries due to accidents from construction and maintenance constitute one of the most important risks in the transport sector. In the course of operation, moving machinery, unguarded parts of equipment and a disregard for health and safety measures, they may occur. Injuries from road traffic accidents are a common phenomenon, which may also occur when parts of roads are being plied while road construction is still underway.

Other sources of injuries that have the potential of harming both workers and road users, including pedestrians are noise, vibration and heat, and also lubricants some of which contain solvents with potential to cause skin irritation and allergies.

Noise Impact on Health

The effects of excessive noise and vibration include human welfare and physiological disruption, hearing impairment and communication problems. These may cause elevated stress levels and associated behavioural and health problems. They can also cause auditory fatigue, sleep disorders, and even contribute to learning problems in children. Vibrations can damage road side structures, particularly makeshift or lightly constructed buildings.

Health Damage from Air Pollution

Vehicular emissions and constructional equipment powered by gasoline or diesel adversely affects health of people engaged directly or indirectly in transport sector activities. The resultant effects are acute respiratory disorders like bronchitis, pneumonia, lung and heart diseases, the type of ailment depending on the size of particulates as well as the materials adsorbed on them. Other pollutants like SO_2, NO_2 and CO emanating from vehicular emissions also contribute to respiratory ill health. Asthmatics are particularly sensitive to irritant substances like SO_2 which may bring on attacks. Long term exposure is associated with chronic lung diseases such as lung cancer and silicosis. Apart from respiratory effects, dust may result in irritation of mucous membranes or allergic reactions that may be particularly harmful to the eyes and skin.

Table 5. 7: Health Risk Assessment

Stressor/ Exposure	**Impact on health**	**Population at risk**	**Probability of occurrence**	**Impact Rating**	**Environment/biological indicator (monitoring)**
Gaseous or air emissions	-climatic change (injuries, deaths)	-world-wide	-low	Low	-geoclimatic data and weather phenomena
	-carboxyhemo globinemia (cHB)	-public	Very rare	Low	-level of blood cHB
	-irritation of respiratory tract	-vicinity	-rare	Low	-atmospheric NO_2 level
	-respiratory problems (asthma, bronchitis, etc.)	-vicinity	-rare	Low	-epidemiology of respiratory ailments
	-respiratory irritations	-vicinity	-very rare	Low	-epidemiology of respiratory ailments
Noise Nuisance	-sleep disturbance, stress	-vicinity	-rare	Low	-noise levels L (8 hrs), 45 dB, nighttime
	-quality of life	-vicinity	-rare	Low	-perception studies "focus groups"
	-environmental allergy	-vicinity	-rare	Low	-perception studies, assessment of odors.
Road Accidents	-traumas, injuries, deaths	-workers, vicinity and community	-occasional	Low	-morbidity and mortality reports, fire department reports
Fire	Damage to humans and vehicle/equipment	Workers, passengers	Rare	Low	Storage of chemicals, and other flammable substrates.
Bridge Collapse	Accidents	Pedestrian and possibly other passersby	Rare	Low	

Indirect impacts or other exposure	Individual and collective stress, conflicts, economic losses	Community	Occasional	Low	General health of community members, "focus group", property assessment

5.6. Impact on Persons and Assets

A total of 3781 Project Affected Persons (PAPs) were identified with different types of losses as shown in Table 5.8. No significant destruction is being expected to be made; owing to the fact that all roads for construction and rehabilitation are already in existence in different forms. The list of household/farmlands with economic crops is represented in the RAP report. Most of the economic crops are within open or fenced household compounds and/or farmlands, and the affected persons are more interested in the successful completion of the road project than compensation for crops

5.7. Impact on Vulnerable Group

The various groups considered vulnerable due to their inability to cope with and participate in decision making with regard to resettlement in the course of work were identified along the corridor as impacted. These included widows, physically challenged, single mothers and the elderly (Table 5.9).

These vulnerable PAPs will need assistance and protection that will help them overcome difficulties in the process. They cannot successfully relocate without adequate support and assistance. However, as earlier stated, since the proposed road construction/rehabilitation is not on fresh roads rather on existing roads. Minimal or no negative impact/destruction would be made on existing structure and properties.

To provide a safety net until they become self-sufficient and resilient to economic stresses as they were pre-project or even better, psychological preparedness of the entire resettlement process shall be ensured. Also, priority shall be given to this group in all mitigation measures related to them. Furthermore, stress transfer to this group shall be avoided where mitigation measures includes physical preparation of relocation site.

Table 5.8: Vulnerable Group

S/No	Vulnerable PAPs	Total frequency and percentage of affected vulnerable PAPs in project areas	Remarks

1	The elderly	217(16%)	It is envisaged that the aged especially the female within the ages 60 years who might be impacted based on their physically weakness. But the project is also envisaging that there would be a minimal impact on this category of PAPs.
2	Single mothers & female heads of household	70(5%)	Faced with multiple tasks of being breadwinners; mothers; providers of shelter; and providers of security for those under their responsibility. Shelter relocation and livelihood improvement will be huge tasks for single mothers. The same is true for female heads of households, probably more so because some of them will also have to deal with irresponsible husbands.
3	Widows/widowers	19(1%)	Have lost their breadwinners and are suddenly faced with the reality that they have to provide for themselves, the children and other dependants. Resettlement will be an additional responsibility, which will need outside support. The need becomes bigger where the widow is elderly.
4	Physically challenged	8 (0.58%)	The physically challenged such lame, blind, etc are also vulnerable because they cannot attend to their resettlement responsibilities without support from family members or relatives.
		314 (23%)	

5.8. Cultural Property (Archaeological and cultural sites)

No cultural property or site of archaeological interest has been identified to be affected. The destruction of graveyards and other sites of cultural significance are potentially significant due to the cultural importance of these sites and the rituals associated therewith. The impact of the disturbance or destruction of such sites is therefore an offence to cultural practices. No graveyards of interest have been identified to be affected in the course of the field work

5.9 Irreversible Changes

No long-term losses of significant resources are anticipated with this project. The project itself will neither consume nor engender significant land alterations due to the realignment, environmental and socio-cultural resources changes. The project will not generate nor lead to other significant demands on natural resources of the immediate or surrounding area nor disturb archaeological sites.

5.10 Cumulative/Secondary Impacts

Cumulative impacts in this report refer to changes to the environment (biophysical and social) that could result are caused by the proposed project activity in combination with other past, present and future human activities. The concept of cumulative effects here holds that while impacts could be small individually, the overall impact of all environmental and social changes affecting the receptors taken together could 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 reasonable foreseeable future activities associated with this and/or other projects result in a larger and more significant impacts.

Although the envisaged cumulative /secondary impacts arising from the proposed rehabilitation of the road corridor is considered minimal, the followings, however, should not be overlooked:

1. Growth-inducing potential: Each new action can induce further actions to occur. The effects of these "spin-off" actions may add to the existing impact generated by the various activities along the corridor. In deed the corridors will have a pull-effect in some of the nodal communities.

5.11 Environmental justice

The road will be patronized by persons of all social strata, irrespective of the income. Moreover, especially for the poor, this is considered to be a well-targeted intervention to meet their basic transport needs to increase their well-being. Therefore, any adverse effects of this project would not be predominately borne by the low-income population.

Furthermore, disproportionately high and adverse human health or environmental effects on minority and low-income populations are not anticipated on this project since the road corridor cuts across different towns and villages that vary widely in income levels. No particular towns or villages would be affected by the physical environmental impacts differently than another.

5.12 Climate Change Impact

World Bank (2018) notes that considering a variety of climate change scenarios, most projections indicate that Africa's climate will be very different from what it is today; however, there is no consensus as to the nature, intensity, and geographic distribution of those changes. However, quantifying the broader impact of climate-related traffic disruptions shows that when climate events shut down or reduce the capacity of a road, the consequences on supply chains, economic output, and access to services will vary widely based on local factors such as the volume of traffic on a particular road or the existence of alternative routes.

On high-traffic roads, even relatively mild changes in climate could severely affect people and the economy—making the case for adaptation particularly strong.

While the roads are particularly vulnerable to climate stressors such as higher temperatures, increased precipitation, or flooding, when rehabilitated well with quality materials, good and proper drains, well greened and increased maintenance and more frequent rehabilitation is not likely to contribute or degrade due to climate change.

CHAPTER SIX
MITIGATION/ENHANCEMENT MEASURES

6.0 Impacts Mitigation/Enhancement Measures

Based on the impacts identified appropriate corresponding mitigation measures have been identified to prevent, minimise, mitigate or compensate for adverse environmental and/or social impacts. In addition, enhancement measures have been developed in order to improve project environmental and social performance. The roles and responsibilities to implement these measures are clearly defined alongside the budget for the measures estimated. Also the cost for environmental and social capacity building and gender mainstreaming have been included. The residual impacts has also been summarised in this subsection.

6.1 Mitigation Measures Hierarchy

The measures proposed are specific, measurable, achievable and relevant to the proposed and time based (SMART). The measures also considered the environmental laws in Nigeria, and internationally and the principles of sustainable development and best available technology. The principle of mitigation hierarchy outlined below was also considered:

- **Avoid at Source; Reduce at Source:** Avoiding or reducing at source is essentially 'designing' the project so that a feature causing impact is designed out or altered (e.g. reduced working width). This can also be termed minimization.
- **Abate on Site:** This involves adding something to the basic design to abate the impact- pollution controls fall within this category.
- **Abate at Receptor:** If an impact cannot be abated on-site then measures can be implemented off-site. An example of this would be to instruct authorities in affected schools to increase the level of supervision of their students and pupils during the period of civil works.
- **Repair or Remedy:** Some impacts involve unavoidable damage to a resource, e.g. agricultural land during construction. Repair essentially involves restoration and reinstatement type measures.

6.2 Projects Impacts Mitigation Measures

In Table 6.1 a summary of the potential impacts associated with the project, together with corresponding mitigation measures.

Table 6.1: Mitigation Measures for Potential Impacts		
S/No	Activities Envisaged/Impacts	Mitigations (Planning and Design (P&D), Construction (C), or Operation and Maintenance (O&M))
General Planning and designing existing roads		
1	Project Preparation (Planning & Design)	• Incorporation of environmental concerns in project preparation to avoid impacts in construction and operation stages • Avoidance of roads through sensitive areas as reserved forests/sanctuaries/wetlands etc • Compliance with legal requirements. • Chose or develop design standards for each facet of construction and related activities—road bed, road surface, drainage, erosion control, re-vegetation, stream crossing, sensitive areas, steep slopes, material extraction, transport and storage, construction camps, decommissioning (P&D) • Provide plans to identify, protect, and use sensitive habitats (P&D) • Take into account problems in soil and slope stability and local weather and natural phenomena—flooding, heavy rain, drought (P&D)
		• Develop an erosion control plan for all projects (P&D)
2	Route planning	• Take into account problems in soil and slope stability and local weather and natural phenomena—flooding, heavy rain, mudslides, drought (P&D) • Avoid gradients greater than 10 percent and long straight downhill stretches (P&D) (C) • Identify sites for temporary and permanent storage of excavated material and construction materials. Where excavated material will not be reused decide how it will be disposed of or shaped (P&D) (C) • Avoid environmentally sensitive areas, such as wetlands, and sites near protected areas or relatively under graded forests. Explore possible compromise alternatives—a narrow, improved trail across protected area lands that provides access to foot, bicycle, or motorcycle traffic while constructing main access roads around these areas (P&D) (C) • Avoid constructing roads through forest areas, if possible. If clearing is unavoidable, protect or restore forests elsewhere in the drainage basin as close as possible to those lost (P&D) • Minimize aesthetic and scenic impacts by avoiding roads that cut long straight paths across valleys and plains. Instead, hide roads beneath forest cover to minimize adverse aesthetic effects, and provide meanders where feasible (P&D) • • If sensitive areas cannot be avoided, involve ecologists and engineers in designing road, construction camp, quarries, and other areas (P&D) (C)
3	Construction contracts	• Select or develop guidelines and procedures to be applied to each facet of road construction or

		rehabilitation and incorporate them into contracts with construction companies—site clearing, bed and surface construction, drainage, fuel and material usage, quarry site management, construction camp and work site operating procedures, including worker safety • Include incentives for adhering to guidelines and penalties for violating them
4	Maintenance agreements	• Finalize maintenance agreements with local communities before beginning construction. All parties must clearly understand and be committed to terms of the agreement, such as who will do what work, when, how frequently, for what compensation, and within what limits
5	Sloped areas and raised roads	• Stabilize slopes by planting vegetation. Work with agronomists to identify native species with the best erosion control properties, root strength, site adaptability, and other socially useful properties. Set up nurseries in project areas to supply necessary plants. Do not use non-native plants. Use soil stabilizing chemicals or geo-textiles (fabrics) where feasible and appropriate (P&D) (C) • Minimize use of vertical road cuts even though they are easier to construct and require less space than flatter slopes. The majority of road cuts should have no more than a 0.75:1 or 1:1 slope to promote plant growth. Vertical cuts are acceptable in rocky landscapes and in well-cemented soils (P&D) (C) • Install drainage ditches or berms on uphill slopes to divert water away from roads and into streams (P&D) (C) • Install drainage turnouts at more frequent intervals and check dams to reduce ditch erosion (P&D) (C) • If possible, use higher grade gravel that is much less prone to erosion (P&D) (C) • If very steep sections cannot be avoided, provide soil stabilizers or surface with asphalt or concrete (P&D) (C)
Planning and designing existing- Existing Roads (Reconstruction/Repair/Realignment)		
1	Road surface is below grade of surrounding	• Raise road surface with stable fill material. Grade with in-slope, out-slope, or cambered shape. Install sufficient cross-drains ditches, and settling ponds (P&D) (C) (O&M) road
2	Road is steeply sloped and eroding	• Consider realigning the road section so that it conforms to preferred design parameters described above. Decommission original road sections after realignment (P&D) (C) (O&M)
3	Deteriorated road surface	• Determine cause of deterioration. If heavily used, find a means of reducing traffic or upgrade road to more durable surface— gravel, asphalt, or concrete (P&D) (C) (O&M)
4	High-speed driving	• Realign road sections to meander; curving roads deter speeding (P&D) • Add speed bumps in villages or populated areas (C)

5	Road Sections with multiple tracks/off-road driving	• Generally caused by either muddy/flooded roadway or highly deteriorated roadway. Maintain or upgrade road so section no longer floods or becomes muddy (P&D) (O&M) • Raise the road bed or define the roadway with rocks. Realign the road to a better area. Avoid very flat terrain (P&D) (O&M)
6	Road section must be realigned	• Remove surface and loosen soil of previous track to accelerate regeneration of vegetation. Block access with rocks, branches, roadblocks, and signs. Narrow tracks usually re-vegetate naturally with no noticeable scars. Wider roads may require planting and reseeding (C) (O&M)
•	**Construction**	
1	Site Preparation	• Relocation of utilities, common property resources and cultural properties • Avoidance of affect on roadside vegetation
2	Construction Camps	• Avoidance of sensitive areas for location of construction camps • Infrastructure arrangements for workers and construction Equipment
3	Borrow Areas	• Avoidance of agriculture lands as borrow areas • Redevelopment of borrow areas
4	Compacting	• Water the road immediately before compacting to strengthen the road surface, otherwise traffic will soon beat back the road surface to pre-bladed condition (P&D) (C) • When possible, delay compacting until the beginning of the wet season or when water becomes more available (P&D) (C
5	Blasting	• Minimize blasting (P&D) (C) • Take safety precautions to protect being injured by flying or falling rock
6	Topsoil Salvage, Storage & Replacement	• Topsoil removal from areas temporarily/permanently used for construction • Reuse of topsoil at areas to be revegetated and in agriculture lands
7	Quarry Management	• Redevelopment of quarries in case new quarries are setup for the Project
8	Water for Construction	• Extraction of water in water scarce areas with consent of community • Scheduling construction activities as per water availability
9	Slope Stability and Erosion Control	• Slope stability along hill roads • Protection of land on hill side from stability loss due to cutting • Protection of lands on valley side from debris due to construction • Adequacy of drainage for erosion control • Geological/geomorphological studies conducted to investigate and recommend best available options. • Civil engineering structures and bio-engineering measures used.

		• Measures taken to avoid undercutting of slope toes. • Quarrying prohibited in river beds, where flood discharge is significant.
10	Road surface Help or be adverse to road user Comfort	• Stabilize the road surface with gravel, murram, and other rocky surfacing material • Elevate road surface (measure from base of wheel tracks) above side channel water) (P&D) (C) • Clearly define the type of road surface shape and drainage method—in-sloped, out-sloped, or cambered/crown roadway— be used for each section of roadway (P&D) (C)
11	Waste Management	• Slope stability along hill roads • Protection of land on hill side from stability loss due to cutting • Protection of lands on valley side from debris due to construction • Adequacy of drainage for erosion control
12	Water Bodies/ Perennial and Intermittent rivers and streams	• Avoidance from cutting due to alignment • Protection of embankment slopes in case of alignment on embankments
13	Wetlands	• Avoid routing through these areas (see "Route planning" above for additional guidance) (P&D) • Minimize cuts and fills and compensate for impact by protecting other wetlands (P&D) (C) • Take special precautions to prevent dumping of debris, oil, fuel, sand cement, and similar harmful materials (C) • Use elevated porous fills (rock-fills) or multiple pipes to maintain natural groundwater and near-surface flow • patterns (C)
14	Drainage	• Conduct of hydrological investigations during project preparation • Provision of longitudinal and cross drainage as per requirements • Proper location of drainage outfall • Install drainage structures during rather than after construction. Most erosion associated with roads occurs in the first year after construction. Delaying installation of drainage features greatly increases the extent of erosion and damage during the first year (P&D) (C) • Clearly define the type of road surface shape and drainage method—in-sloped, out-sloped, or crown roadway— to be used for each section of roadway. Use outside ditches control surface water when necessary, but keep in mind that they concentrate water flow and require the road to be at least a meter wider. Install structures, such as berms or ditches, to divert water off the road before it directly

		reaches live stream channels (P&D) (C) • Install diversion structures, such as cross drains, drivable, rolling dips, or water bars, to move water off the road frequently and minimize concentration of water (P&D) (C) • Install drainage crossings to pass water from uphill to downhill. If using culvert pipes, at least roughly design them using the Rational Formula or back-calculate using Manning's Formula and high-water mark before or during construction to determine the anticipated flow, and select the correct size of pipe. Where flows are difficult to determine, use structures—such as fords, rolling dips, and overflow dips—that can accommodate any flow volume and are not susceptible to plugging (P&D) (C) • Stabilize outlet ditches (inside and outside) with small stone riprap or vegetative barriers placed on contour to dissipate energy and to prevent the creation or enlargement of gullies (P&D) (C) • Extend runout drains far enough to allow water to dissipate evenly into the ground (P&D) (C) • Visually spot check for drainage problems, such as accumulation of water on road surfaces, immediately after first heavy rains and at the end of the rainy season. Institute appropriate corrective measures (C)
15	Construction Plants & Equipment Management	• Maintenance of machinery and equipment to avoid pollution • Minimize use of heavy machinery (P&D) (C) • Set protocols for vehicle maintenance, such as requiring that repairs and fueling occur elsewhere or over impervious surface such as plastic sheeting. Prevent dumping of hazardous materials, and capture leaks or spills with drop cloths or wood shavings. Burn waste oil that is not reusable or readily recyclable and does not contain heavy metals and are flammable. Prohibit use of waste oil as cooking fuel (P&D) (C) • Investigate and use less toxic alternative products (P&D) (C) • Prevent fuel tank leaks by a) monitoring and cross-checking fuel level deliveries and use, b) checking pipes and joints for leaks c) tightening generator fuel lines, d) preventing over-filling of main storage and vehicle tanks
16	Spoil disposal	• Minimize spoil by balancing cut and fill wherever possible • Safe tipping areas identified and enforced. • Spoil traps constructed. • Land owner compensated.
17	Hazardous materials	• Checks to ensure that storage is good and that there are no losses or leaks. • Checks to ensure that protective clothing and safety measures are used.
18	Tree Plantation	• Avoidance of impact on trees

		• For every single felled tree , two trees of local species will be planted by the project authorities • Encourage growing of trees on roadside
19	Natural Habitats	• Identification of natural habitats • Management measures for roads passing through natural habitats (EMP) • Structure of management plan
20	Dust	• Speed controlled using speed bumps. If water is available, the road surface can be sprayed on a frequent schedule. • Permanent speed bumps installed in villages and bazaars to reduce traffic speeds in inhabited areas. • • Bitumen surface constructed in bazaars, with speed controls. • Dense vegetation planted on roadside.
21	Noise	• Work schedule to minimize disturbance. • Alight public when loud noise will be generated
22	Worker's Health & Safety	• Provision of Personal • Protective Equipment to workers • Provision of basic necessities to workers
23	Public Health and Safety at Construction Site	• Public safety while travel along construction sites • Public safety during operation of the road • Traffic safety measures installed, such as warning signs, delineators and barriers. • Awareness of road safety raised among affected communities. • Road safety audits carried out and recommendations implemented. • Contractor develop an acceptable construction site Environment, Health and Safety Plan. • Reducing construction site risks to the workers and the public – safety rules for work operations shall be instituted by the Contractor, including, but not limited to; location of plant equipment away from sensitive locations (hospitals, schools, etc.), equipment operation procedures, safety barriers, warning signs, first aid and medical kits and procedures, and safety training for the workers. • Reducing health risks from compound living conditions and interaction with the community – employee rules and information campaigns shall be instituted by the Contractor on health practices and communicable diseases. The Contractor shall also ensure that prevention and treatment facilities are made available to his employees. • Covid 19HIV/AIDS awareness and treatment – in collaboration with the National HIV/AIDS Coordination Agency

24	Cultural Properties/ Graveyards and Sacred Areas	• Avoidance of impacts due to project • Protection of boundaries from impacts due to construction • Relocation in case impacts are unavoidable • Avoid disturbance through: (i) adjustments to alignments; and/or (ii) drainage and other design measures to avoid excessive runoff or erosion onto the graveyard or burial
25	Land use and resettlement issues	• Manage in line with the RAP prepared for the project
26	Local people excluded from project activities	• Designs incorporate methods within the skills of local people. • Contractors encouraged using local labor wherever possible.
27	Promises made to local people during feasibility and planning phases	• Checks to ensure that the promises are fulfilled; if they prove to be not possible, reasonable alternatives must be negotiated
28	Road Closure and Detours	• Contractor install and maintain warning signs • Avoid collision with construction vehicles between work sites and gravel pits. • Speed restrictions. • Road closures, where unavoidable, plan in close collaboration with the Community.
30	Chance Finds of Cultural Resources	• Specify procedures for archaeological "chance finds" during the course of construction activities in contract document
Operation and Maintenance		
1	Road maintenance	• Monitor and maintain drainage structures and ditches including culverts. Clean out culverts and side channels and runouts when they begin to fill with sediment and lose their effectiveness (O&M) • Fill mud holes and potholes with good quality gravel; remove downed trees and limbs obscuring roadways (O&M) • Use water from settling basins and retention ponds for road maintenance (O&M • Ensure a combined approach, with a private contractor performing mechanized maintenance and subcontracting labor-intensive maintenance to the communities. • Ensure Maintenance contracts that is performance-based with penalties in case of non-compliance with the agreed standards (e.g. flouting safety rules, number of potholes per km of roads). • Conduct gender study to assess the challenges and opportunities for the mainstreaming of gender concerns in the use of, access to and maintenance of roads
Decommissioning		

1	Decommissioning	• Break up old road surface and soil. Remove and dispose of surfacing material if necessary and loosen soil of previous track to accelerate regeneration of vegetation • Reshape eroded or culled surfaces with out-sloping, or add cross drains or water bars so water will no longer follow the course of the roadway Re-vegetate as needed. Narrow tracks will usually re-vegetate naturally with no noticeable scars or impact on the environment, but wider roads may require active planting and reseeding (O&M) • Block access with rocks, branches, roadblocks, and signs

ABSIIDP/SPIU will be responsible for the implementation

6.3 Enhancement Measures for Positive Impacts and Reduction/Avoidance of Negative Impacts

A Mechanism for enhancement of positive impacts and reduction/avoidance of negative impacts has been developed in relation to the Project Concept and design, Construction and Operation, Control of Earthworks and Erosion and Sediment Control Plan, Control of Water Quality, Waste Management , Neighbourhood Effects Management. These are described briefly below:

6.3.1 Project Concept

In planning the project, greatest care must be exercised to ensure the nature topography be maintained as far as possible. Development schedule must be clearly defined, and timing of construction carried out in manner that the project starts and keeps within the schedule of completion.

Adopt the innovative concept of design with nature to minimize the impact of the project on the environment, making it more environmentally acceptable and enhancing project visually. Some of the concepts that are impeded in the concept that must be promoted in the final stage include:

- Making use of natural topography where possible.
- Exploiting natural features to blend with the environment
- Minimizing the footprints of any landtake
- The use of low-emission materials and sustainable landscaping
- Ensure all waste not avoided are recovered for recycling
- Use alternative energy technologies such as photovoltaics for lighting
- Optimizing utmost savings in carbon and emissions reduction through effective green designs and practices.

As part of the design ensure the following **Ancillary facilities to be installed:**

1. **Conventional Road signs and markings -** Design and erect in accordance with Nigeria road design guidelines and best international practice.
2. **Foot paths -** design of the road includes construction of footpaths at all the highly settled trading centers on either side of the road
3. **Trucks lay bys and bus bays-** to absolve the pull-effects of the project as it stimulates further economic development with the create more bus stops where rural access road are likely to bring pedestrian traffic to the road and ensure the exact locations are indicated in the detailed engineering plan.
4. **landscaping and grassing-** grass using suitable perennial vegetation to prevent erosion and restore aesthetics in areas where cutting will be made, and steep surfaces created
5. **Safety Barriers**- install safety barriers where the height of fills exceeds 3.6m and at the major structures along the project route.
6. **Road Safety provisioning**
    1. **Street lighting** - Design and erect appropriate street lighting
    2. **Pedestrian crossing**- install in areas with schools, health facilities and utilities such as churches along the roads

3. **Animal crossing-** this is not a frequent occurrence- however, where these are noticed in the course of work, create then designated livestock and signage installed for wildlife crossings

6.3.2 Construction and Control of Earthworks

During construction, earthwork is the most critical stage and the problems of soil erosion and wash off loosen soil materials which will need to be addressed. So plan the earthworks and implement control measures at the earliest stage and schedule to avoid rainy season and detailed earthworks plan should be endorsed by professional engineer.

6.3.3 Neighbourhood Effects Management

The main neighbourhood effects associated with earthworks are noise and dust. Dust from site earthworks and associated activities is major during dry season and minor during rainy. These and will be minimised by several measures, including wetting and mulching, to mitigate potential negative effects on neighbours.

Water spraying facilities should be used during construction and wheels of vehicles or machinery used for transportation of construction materials shall be cleaned before leaving the construction site so as not to litter the roads with mud and soil.

Noise from the construction site shall be generated by different activities during construction such as: earth moving vehicles and vehicle movements. Vibration from piling operation not only can cause annoyance but can also cause structural failure risk to nearby buildings.
Noise control can be done by either engineering means, separation of source and receptors or through limiting the hours of operation of the noise source. Engineering methods could be the installation of quiet machines, insulating the machines or providing screens and noise barriers. Generally, noise in the boundary of the construction site shall be controlled so as not to exceed 55 dB(A) at night and 65 dB(A) during the day.

It should be noted that there are no sensitive areas such as hospital, schools, residential and places of worship within the vicinity of the proposed site.

6.3.4 Mainstreaming Women, Youth and PWDs Issues

Women, youth and PWDs are at times marginalized in most activities but constitute a very important segment of society. Women are key to ensuring the sensibility and sustainability of the overall project management. Plan to increase sustainable programmes targeted at youths and women as special groups, greater empowerment opportunities.

Nigeria made several commitments to ensuring that gender issues are not only a part of the national discourse but also that they are integrated into policies and development programs. These commitments are contained in frameworks such as the National gender Policy and the United Nations' SDGs.

To this end and as part of project preparation, a gender study and consultations with communities should be conducted to assess the challenges and opportunities for the mainstreaming of gender concerns in the use of, access to and maintenance of roads.

As part of project preparation the challenges and opportunities for the mainstreaming of gender concerns in the use of, access to and maintenance of roads is relevant. Attention should be given to:

- **Women's transport needs**: aims to assess women's transport needs and identify ways to address such needs, including during road selection.
- **Women's voice in community consultation**: aims to identify mechanisms to ensure women's preferences are reflected in community consultations, whether for consultations on social safeguards or road selection.
- **Women's participation in community-based maintenance**: aims to identify context-specific entry points and mechanisms (e.g. quotas) for women's participation in the maintenance of rehabilitated roads.
- **Project impact on women's livelihoods**: recommend indicators or give indications on sex-disaggregation of existing indicators to reflect the project direct and indirect impact on women's livelihoods

6.3.5 Waste Management Plan

During the construction, it is inevitable that discharges of materials to the environment will occur. If these are not controlled, they may act as a source of environmental disturbance or nuisance. The construction activities could yield a variety of waste in the form of construction materials, scrap metal, municipal wastes, etc.

For effective management, contractor should develop a waste management plan approved by SPIU to used during construction to ensure that all the waste must be properly identified, minimized, segregated, properly stored, reused, tracked, monitored and audited.

All the wastes that cannot be re-used will be safely managed and disposed of in a manner that meets regulatory requirements. Suffice it to say that solid waste management steps can take the form of:

- Reusable materials sorted and prepared for recycling as much as possible;
- Small waste streams of residues and specific hazardous waste dealt with in a sustainable way with good practices

6.3.6 Social Integration and Participation

In a human-dominated world, ecosystem services are not generated by ecosystems alone, but by social–ecological systems. In line with their suggestion, it is also recommended that adaptive governance for ecosystem management which employs a social–ecological systems approach be adopted.

Adaptive governance refers to flexible and learning-based collaborations and decision-making processes involving both state and non-state actors, often at multiple levels, with the aim to adaptively negotiate and coordinate management of social–ecological systems and ecosystem services across landscapes. The collaboration should involve:

- building knowledge and understanding of the ecosystem dynamics and services,
- feeding such knowledge into adaptive management practices, and
- dealing with external perturbations, uncertainty, and surprise.
- Adaptive governance expands the measures available and provides the coordination and the context for choosing between tools, monitoring their effect, and adjusting them as the social–ecological system evolves.

6.3.7 Communication, Information and Monitoring

It is important that good relations be maintained with potentially affected local community throughout the duration of project.

Community members should be informed of the intended scope and duration of the project and associated activities well in advance and this has been started and reinforced in the course of this ESIA preparation. They should be kept informed of any changes to scheduling throughout the duration of the different aspect of the phases of the project.

All site contractors, including sub-contractors shall be made familiar with this plan prior to the commencement of any site works.

Communication mechanisms that enable engagement with communities at all times during the project cycle will have to be developed. These will enable detection and resolution of emergent issues that may impinge negatively on the project implementation. The issues may be economic, political, cultural transgression, perceived or real concerns by the community.

6.3.8 Grievance Redress Mechanism

This is designed to address situations of conflicts or disagreements about some of the project activities during construction and operation in the following order:

- All complains will go to the contractor directly at the first instance.
- Where issues are not addressed, complaints shall be scaled to the project manager.
- Where it is perceived that no satisfactory attention was given then the complainant shall have access to the project owner
- If, it is considered that issues or issues are not satisfactorily addressed by the Site Manager, or the complainant shall be free to approach SPIU Management.
- Informing the relevant government authorities is considered the next step if SPIU Management is seen not to have resolved the arising issues satisfactorily
- The last but undesirable is reaching the court by settlement of any issues that are not addressed at the previous levels
- This grievance redress process shall be provided to any person who has complaints or grievances during the phases of the project

Any environmental or social incidents shall be documented (Appendix 8). The report shall be transmitted to the relevant authority by the SPIU, where necessary/applicable. The reporting shall be with a view to taking appropriate mitigation measures. All complaints received should be investigated and a response (even if pending further investigation) is to be given to the complainant within 5 days.

The following information must be provided:

- Time, date and nature of the incident/report;
- Type of communication (e.g. telephone, personal meeting);
- Name, house location and contact telephone number of person making the complaint. If this person wishes to remain anonymous then "not identified" is to be recorded;
- Details of response and investigation undertaken as a result of the incident/complaint;
- Name of person undertaking investigation of the incident/complaint;
- Corrective action taken as a result of the incident/complaint.

The report shall be rendered for both internal (in-house) uses all phases of the project for internal and external (public) consumption through the regulators.

6.3.9 Environmental Code of Conduct, Social Integration and Participation

An Environmental and social Code of Conduct for road Infrastructure development for contractors is shown in Appendix 6.1. These procedures, if followed, would yield benefits for longer period in terms of financial and environmental sustainability.

Furthermore, all activities as a matter of principle will promote the avoidance of any activity/subproject that

- Overlooks the rights and special provisions of vulnerable groups in the communities • Causes any conflict among community or groups
- Restricts the participation of women and/or marginalized any group.

It is considered necessary to include in contract clauses the idea of holding Contractors financially and in some cases criminally liable for adverse impact that result from failure to implement contracted required mitigated measures.

6.3.10 Climate Risk Management

The contextual site physical factors of the geographical location shows that hydrology, soil, slopes, etc and artificial factors such as land use, urban development, etc are of relevance. The climate factors likely to affect the road infrastructure is extreme weather event relating to rain, majorly. This is an intrinsic risk source for soil erosions. This could also be enhanced through artificial changes (e.g. soil waterproofing due to urban development or deforestation).

To reduce climate-related risks there is need to mitigate vulnerabilities and minimise consequences with adaption measures (Figure 6.1). For the road adaptation measures are considered more vital and so the following have been suggested:

- Alter maintenance regimes to target vulnerable sections
- Retrofit existing stormwater infrastructure (e.g. culvert crossings, bridges) to accommodate increasing flow patterns)
- Harden or stabilize slopes subject to increased run off from extreme weather events
- Elevate mechanical and electrical equipment in operations or maintenance facilities (e.g.

traffic signals)

- Use waterproof materials
- Utilize permeable pavements for heavy traffic areas, the use of permeable pavement shoulder can be beneficial, especially in highly urbanized areas as provides an alternative for areas that cannot integrate bioretention areas or temporary water storage and serves as a durable and ecological solution to minimize the risk of flooding

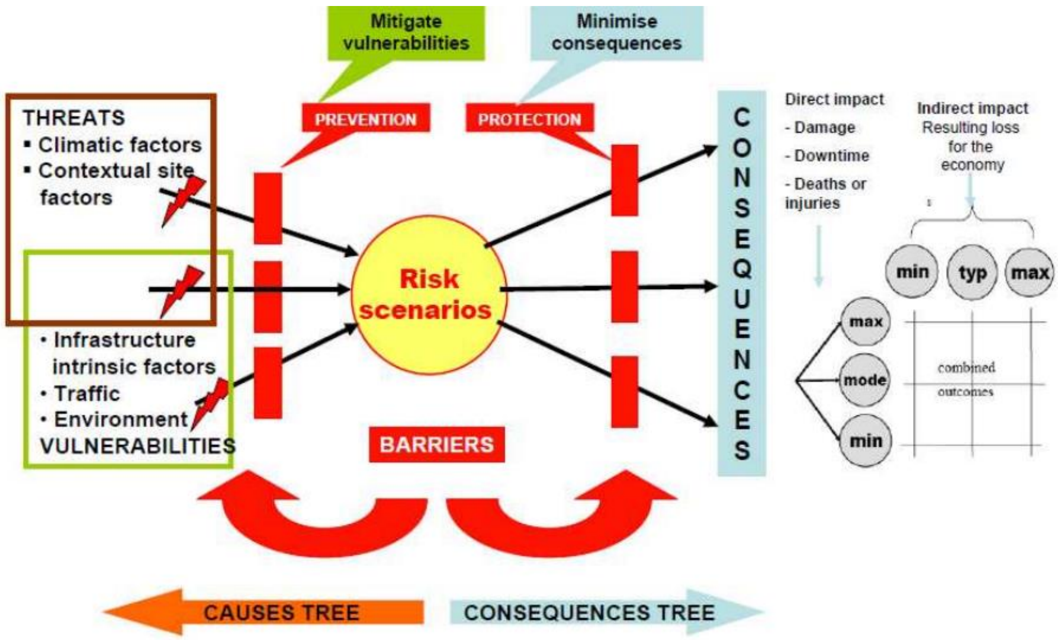


Figure 6.5: Ways to mitigate vulnerabilities and minimise consequences of Climate Risk

6.3.11 Integrating into project design and tender documents

The mitigation measures developed should be integrated into the project design and tender documents. Using this approach, the mitigation measures will automatically become part of the project construction and operation phase. By including mitigation measures in the contract or in specific items in the Bill of Quantities, monitoring and supervision, mitigation measure implementation could be covered under the normal engineering supervision provisions of the contract. A summary of key environmental and social aspects and their mitigation measures and implementation that could be embedded are summarised in Table 6.5. Examples of clauses that should be incorporated into contracts with construction companies include:

1. Construction contracts should:
    - Select or develop guidelines and procedures to be applied to each facet of road construction or rehabilitation—site clearing, bed and surface construction, drainage, fuel and material usage, quarry site management, construction camp and work site operating procedures, including worker safety
    - Include incentives for adhering to guidelines and penalties for violating them

2. Maintenance agreements should ensure:
   - Finalization of maintenance agreements with local communities before beginning construction.
   - A combined approach, with a private contractor performing mechanized maintenance and subcontracting labor-intensive maintenance to the communities.
   - Maintenance contracts that is performance-based with penalties in case of non-compliance with the agreed standards (e.g. flouting safety rules, number of potholes per km of roads).All parties must clearly understand and be committed to terms of the agreement, such as who will do what work, when, how frequently, for what compensation, and within what limits

Table 6.5: **Mitigation Implementation**

No	**Mitigation Activity**	**Implementation Responsibility Party**			
		Project Design	**Contract**	**Bill of Quantity**	**Monitoring***
	Pre-and Construction Phase				
1	Slope stability	Specify bio-engineering and relevant techniques.	Contractor shall comply with clauses pertaining to mitigation in the contract.	Identify stabilization area. Provide list of vegetation to be planted.	Adequacy, quality of vegetation. Survival rate of plants.
2	Spoil disposal	Identify mass balance techniques. Safe tipping areas identified and enforced. Design spoils traps.	Do	Quantify disposal and extraction volume.	Presence of scouring, erosion, damage to property, water supply disruption. Complaints from local people
3	Water management	Design safe discharge drainage and techniques (check dam) to natural water course.	Do	Physical works for safe discharge drainage listed.	Evidence of fresh surface erosion, presence of gullies, increase in water turbidity, loss of agriculture forest land. Slope condition. Public complaints.
4	Land use	Explore use of marginal land. Check impacts are limited to compensated trees and products.	Do	-	Quantify actual land use pattern for construction and other activities. Public complaints.
5	Plants and wildlife	Consider construction affecting forests and productive plots.	Do	-	Check habitats re-created on marginal roadside land.

No	**Mitigation Activity**	**Implementation Responsibility Party**			
		Project Design	**Contract**	**Bill of Quantity**	**Monitoring***
6	Quarries and borrow pits	Design bunds to screen noise and dust. Design re-grading slopes. Use bio-engineering techniques for rehabilitation.	Do	Quantify restoration costs and present technical specifications.	Check for water ponding, formation of gullies, water turbidity. Check unauthorized quarrying activities.
7	Stone crushing and asphalt plants	-	Do	Amount to be included in contractor's own expense.	Dust control equipment being utilized. Public complaints.
8	Hazardous materials	Specify storage facilities for explosives and toxic materials.	Do	Amount to be included in contractor's own expense through rate for supplying materials.	Checks to ensure that storage is good and that there are no losses or leaks. Checks to ensure that protective clothing and safety measures are used.
9	Camp operation	Identify camping grounds.	Do	Amount to be included in contractor's own expense through work camp item expense.	Toilets construction and effective waste disposal. Check disruption in water supply. Replantation, rehabilitation of site.

No	**Mitigation Activity**	**Implementation Responsibility Party**			
		Project Design	**Contract**	**Bill of Quantity**	**Monitoring***
10	Dust and noise	Indicate use of safe pollution level equipment.	Do	Specify buffer area requirements. Amount to be included in contractor's own expense through work camp item	Air pollution control equipment. Dust deposition on crops and vegetation. Survival rate of plants. Public complaints.
11	Social issues	Incorporate socially acceptable design specifications.	Do	-	Check issues pertaining to social concern.
	Operational Phase				
1	Road maintenance	Arrangement with the various communities on the corridor and private contractor	Penalties in case of non-compliance with the agreed standards (e.g. number of potholes per km of roads).	Specify manner of maintenance and specific roles	Harmonious relationship with well maintained road

CHAPTER SEVEN
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

7.1. Introduction

In order to ensure that mitigation measures and environmental and social management objectives are integrated into the project planning and design based on identified impacts, this Chapter on the Environmental and Social Management Plan (ESMP) has been developed. It provides specific description of the impacts identified, mitigation measures as well as the institutional arrangements, i.e. who is responsible for carrying out the mitigating and monitoring measures (for operation, supervision, enforcement, monitoring of implementation, remedial action, financing, reporting and staff training).

The ESMP has been developed to meet international and national standards on E&S performance. It details the mitigation measures the SPIU and their contractors will be committed to implement throughout project implementation including timing for actions, monitoring and responsibilities. The ESMP is implemented throughout the project life-cycle.

This ESMP has been developed to identify the environmental and social management and mitigation actions required to implement the road project in accordance with the AfDB/World Bank's Performance Standards and the requirements of applicable Nigerian legislation and environmental policies. It summarizes the potential impacts associated with the proposed project and sets out the management measures required at all phases of project development. The ESMP is to be utilized by the State Project Implementation Unit (SPIU) and the contractors commissioned by the Client for the project and will form the basis of the site-specific management plan that will be prepared by the contractors as part of their construction methodology.

The approach to carry out the Environmental and Social Management Plan shall include assessing adherence with national regulations and management of implementation site. In terms of communications, the team responsible for ESMP monitoring (team in SPIU) will cause to be forwarded to FMEnv and the Bank's Environmental experts monthly and quarterly regular Reports depending on which aspect being monitored and level of sensitive demanded.

The major indicators to be measured will include:

- The state of biological conditions
- The state of physical environment
- The state of key social concerns eg as it relates to project beneficiaries
- All operational and environmental problems encountered
- Suggested options to address the problems
- The status of social performance line with measures adopted

The method of implementation of the ESMP monitoring programme shall be carried at two layers based on the intensity and specificity expected.
Layer 1: Monitoring (Control) mission from the AfDB which will be looking at the validity of claims and conclusions and effectiveness of mitigation measures among other things. This layer of monitoring will be done along with FME in Abuja with the support of NESREA.
Layer 2: Monitoring of site activities which will be done regularly by the Monitoring Team (SPIU) guided by the stipulations of the national and district level environmental standards as contained the relevant laws of Nigeria.

The Layer 1 mission will carry out the following roles: (i) to review the contractor's detailed worksite ESMP and its specific procedures; (ii) to appraise the adverse effects determined; (iii) monitoring if the proposed measures to mitigate the negative impacts were actually carried out in the implementation phase (iv) to determine how effective the mitigation measures are in addressing the adverse effect; (iv) to ascertain the extent of reach and sustainability of the achievements recorded from the mitigation measures applied; (v); monitoring the recommended measures; (vii) proposing remedies in the event of occurrence of major impacts; and (viii) conducting environmental compliance and assessment at the end of the project.

It is suggested that the Layer 1 monitoring (Control) mission be undertaken every six months. In their missions they will target measuring project performance using the above environmental monitoring indicators which will reflect the Nigeria's goals of Environmental Monitoring and that of AfDB.

7.2. Environmental and Social Mitigation and Monitoring Plan

As part of the ESMP, a project specific E&S management and monitoring plan has been designed. This plan establishes E&S action plans with well-defined desired outcomes and actions to address all potential impacts identified for the road rehabilitation project under the ABSIID. The plan also includes elements such as parameters to be measured, methods of measurement, location of measurement, performance indicators (targets or acceptance criteria) that can be tracked over defined time periods, and with estimates of the resources and responsibilities for monitoring. The plan is presented in Table 7.1.

7.3. Institutional Arrangement

State Project Implementing Unit of the ABSIIDB is the principal Executing Agency for the project and through a designated Focal Environmental and Social safeguard Officer will be responsible for the overall monitoring and management of the project during both construction and operation, including ensuring the implementation of the mitigation and enhancement measures and adherence to Nigeria's environmental regulations and the Bank's Operational Safeguards.
The successful implementation of the monitoring program will depend on the commitment and capacity of the SPIU, E&S safeguards unit, consultants and other third parties/institutions to implement the program effectively. The roles and responsibilities of those that will be involved in the implementation and monitoring of this ESMP are highlighted in Table 7.1 while the institutional arrangement is shown in Figure 7.1.

Table 7.1: Roles and Responsibilities of Institutions

S/No	Category	Roles & Responsibilities
1.	SPIU	• Implementing authority • Ensure all environmental and social commitments are implemented during the life cycle of the project • Ensure adequate implementation and compliance of the ESMP by all parties • Appoint Environmental and Social Safeguard officer who have the responsibility to ensure compliance with the ESMP and other safeguard documents and provides training schedule on environmental and social matters.
2.	State Ministry of Works and ABSIIDP	• Co-ordinate all policies, programmes, and actions relating to the project • Ensure that the project is carried out in a sustainable manner.
3.	Federal Ministry of Environment (FMEnv)	• Provides lead role on review of draft ESIA report (in liaison with Abia State Ministry of Environment), receiving comments from stakeholders, public hearing of the project proposals and social liability investigations, monitoring and evaluation process and criteria.
4.	Abia State Ministry of Environment	• Review of draft ESIA report (in liaison with Federal Ministry of Environment) • Receiving comments from the public on ESIA report following disclosure • Site assessment and monitoring of ESIA implementation. • Environmental monitoring and compliance overseer at the State level
5.	Other MDAs	• Come in as and when relevant areas or resources under their jurisdiction or management are likely to be affected by or implicated projects such as utility. • Participate in the processes and in project decision-making that helps prevent or minimize impacts and to mitigate them. • Provide consent or approval for an aspect of the project as may be required of.
6.	AfDB	• Assess implementation • Provide implementation support and guidance that ensures sustainability • Recommend additional measures for strengthening the ESMP implementation
7.	Contractor	• Implementation of mitigation measures outlined in the ESMP • Develop a Construction Environmental Management Plan (CEMP) with sub management plans before construction works starts e.g., Oil spill and control management plan, health and safety management plan, risk management and emergency response plan, waste management plan, erosion control management plan • Be responsible for ensuring that all site staff, including sub-contractors and sub-contracted activities comply with the projects ESMP.

		• Appoint HSE Officer primarily responsible for daily inspection and monitoring of this ESMP and CEMP implementation. • Receive complaints and redress as the first level of redress • Ensure that there are sufficient resources (time, money and people) to manage the environmental issues of the works.
8.	Site Engineers/Supervisors	• Provide oversight function during construction to ensure adherence to good practice and the ESMP
9.	Trade Association/CDAs/CSOs	• Assisting in their respective ways to ensure effective response actions, • Ensure members participation by mobilizing, sensitizing community members;
10.	Direct and Other Stakeholder/Groups	• Ensure social values are not interfered with. • Identify issues that could derail the project • Could complain about project execution manner. • Support project impacts and mitigation measures, Awareness campaigns
11.	Local Community	• Support project implementation by ensuring safety and security of construction workers and materials • Assist and liaise with other stakeholders to ensure works are carried out without hinderance • Participate in practical awareness campaign for the proposed projects, amongst the various relevant grass roots interest groups • Support in monitoring project execution within their domains to ensure compliance with this ESMP and other relevant requirements • Recommend youths from the community that could support the contractor in security matters
12.	Local Government	• Support in monitoring project execution within their domains to ensure compliance with this ESMP and other relevant requirements • Engaged and encouraged to carry out a comprehensive and practical awareness campaign for the project, amongst the various relevant grass roots interest groups.

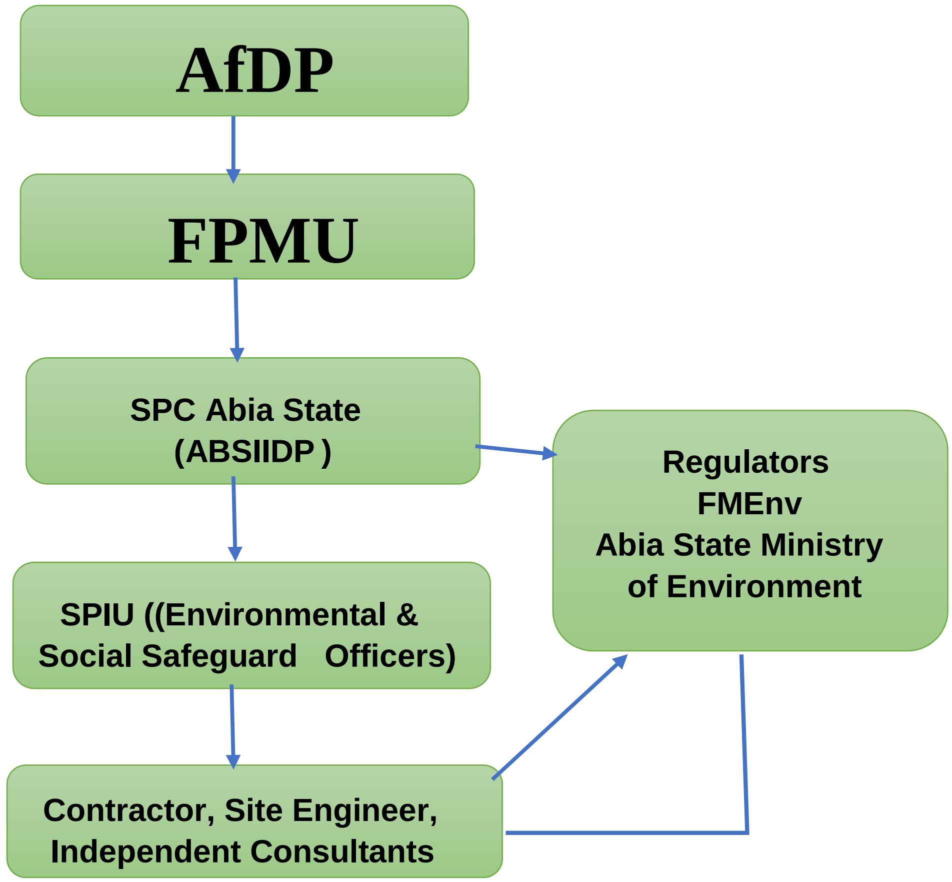


Figure 7.1: Institutional Arrangement for ESMP Implementation

7.4 Institutional Capacity Building & Training Plan

The objective of the Institutional Capacity Building & Training Plan is to empower all relevant key stakeholders to take personal responsibility regarding safeguard issues. It is also to enhance the respective roles and collaboration of the relevant stakeholders.

The programme shall include a combination of awareness creation, face to face learning, initial, periodic refresher, and annual training activities conducted by qualified persons. This shall be on a continual basis with appropriate training for the various aspects of the project activities. As the case may be, periodic competence gap analysis shall be carried out.

Based on the interaction with the relevant stakeholders, assessment, and determination of the characteristics of all the relevant stakeholders with key roles in the project as well as the assessment of the institutional capacities of the different parties involved in the EMP implementation; areas of awareness creation and training/capacity building/strengthening have been identified, some areas have been identified for capacity building for effective implementation of the EMP (Table 8.2).

Table 8.2: Training Modules on Environment and Social Management

Programme	Description	Participants	Form Of Training	Duration/ Location	Training Conducting Agency	Cost (#)
Sensitization Workshop	Introduction to Environmental and Social Management	Engineers and Environmental/Safeguard Unit, Procurements & other relevant groups	Workshop	½ Working Day	Environmental & Social Specialists of Design Consultant/External Agency engaged for capacity building	250,000
Module I	Introduction to Environment: Basic Concept of Environment, Environmental Regulations and Statutory requirements as per Government	Engineer/MoW	Lecture	¼ Working Day	Environmental & Social Specialists of Design Consultant/External Agency engaged for capacity building	150,000
-Module II	Environmental Considerations in projects Management: Environmental components affected by project, Environmental Management Good Practices, Stakeholder and Community project Participation	Engineers/ MoW (Technical unit), Community leaders//NGOs	Workshop	1 Working Day	Environmental & Social Specialists of Design Consultant/External Agency engaged for capacity building	300,000
Module III	ESMP and its integration into Designs: Methodology of Assessment of Pollution Monitoring, Methodology for site selection of waste disposal areas, e.t.c.	PMU Engineer, Contractors/MOW,	Lecture and Field Visit	½ Working Day	Environmental & Social Specialists of Design Consultant/External Agency engaged for capacity building	200,000
Module IV	Improved Coordination with other MDAs:	Officials of MoE and other line MDAs	Workshop	1day	Environmental & Social Specialists of Design	300,000

Table 8.2: Training Modules on Environment and Social Management						
Programme	Description	Participants	Form Of Training	Duration/ Location	Training Conducting Agency	Cost (#)
	Overview of PMU Projects, Environmental & Social Impacts, Statutory Permissions – Procedural Requirements, Co-operation & Coordination with other Departments				Consultant/External Agency engaged for capacity building	
Module VI	Civil works for Road Construction in environmental management practices: Roles and Responsibilities of officials/contractors /consultants towards protection of environment and Implementation Arrangements Monitoring mechanisms	Officials of MoW, and other line MDAs	Workshop	½ day	Environmental & Social Specialists of Design Consultant/External Agency engaged for capacity building	200,000
Module VII	Monitoring and reporting system Community Participatory Monitoring and Evaluation	Engineers, MoW, & relevant MDAs, Community leaders	Workshop	½ day	Environmental & Social /External Agency engaged for capacity building	100,000.00
Module VIII	Alternative income generation program -income generating activities with [adequate] commercial potential in the agricultural and non-farm sectors.	Community liaison and support professional, site committee members, local government staff, etc	hands-on	To be determined	Environmental & Social /External Agency engaged for capacity building	Seen as part of the normal operation cost
Total						**1,600,000.00**

7.5 Waste Management Plan

During the various phases of the project (construction, operation and maintenance), it is inevitable that discharges of materials described here as waste to the environment will occur. If these are not controlled, they may act as a source of environmental and social disturbance or nuisance. The rehabilitation/construction activities could yield a variety of waste in the form of construction materials, scrap metal, municipal wastes, etc.

For effective management, the waste management plan during construction and operation phases will ensure that all the waste must be properly identified, minimized, segregated, properly stored, reused, tracked, monitored and audited.] Wastes generated during the proposed project shall be handled, stored, treated, recycled, and disposed based on the nature of each waste stream. The project-specific waste management guidelines shall take into consideration the nature of each waste stream to be generated during the lifetime of the proposed project.

All the wastes that cannot be re-used will be safely managed and disposed of in a manner that meets regulatory requirements. This implies that the waste should be properly handled since the consequences are detrimental. Poor waste handling could lead to the following:

Environmental consequences

- Unsightliness
- Air pollution, especially when waste is burnt
- Blockage of water runoff channels
- Increased amount of waste
- Waste management disposal problem

Economic consequences

- Loss / waste of resources that can be recycled for re-use
- Opportunities for recycling industries and employment lost
- Ozone depletion has led to unpredictable weather conditions. Prolonged droughts and floods demand the use of resources which should be deployed for growth and development in other sectors

Social consequences

- Substantial public spending on health care
- Improperly managed waste affects people's health.
- Growth of informal waste disposal centres in the neighbourhood

Responsible waste management is accomplished through hierarchical application of the practices of source reduction, reuse and recycling as well as incineration and landfill. This shall be the guiding principle of waste management in the proposed project. All wastes, which cannot be reused, will be managed and disposed off as the least option in accordance with regulatory standards. The integration of this efficient and effective waste management plan would help to reduce or minimize risk and environmental disturbance.

7.5.1 Waste Generation

The bulk of waste generation is envisaged during construction and demolition (rehabilitation) phase. During operation, the project is not expected to generate significant quantity of waste, other than the routine waste generated by passengers who ply the route and from the normal maintenance of the road. For a start, the expected waste types that shall be generated include: Asphalt and concrete, landscape debris, Scrap metal, wood and pallets, Garbage/trash and Cardboard/papers. (Table 7.3)

Table 7.3: Estimated Waste Generation – Rehabilitation phase

S/No		**Estimated Waste Quantity (tons/day)**	**Handling**
1	Asphalt and Concrete	30	Concrete/asphalt debris can be sized and recycled on-site as pipe bedding or road base
2	Scrap metals	20	Scrap metal can be recycled off-site
3	Wood	20	Wood debris can be chipped
4	Debris/ Landscape Materials	40	recycled on-site as pipe bedding or road base
5	Garbage/Trash	10	Landfill
6	Spent/used oil Caterpillar Dump Truck Crane	 7.87 1.68 1.25	Used oil and hydraulic fluid generated on the construction sites will be collected and stored temporarily in a safe place before they are sent to a recycling depot.
7	Paper	0.5	Give others to second hand users and dispose others in landfill
8	Plastic	<1	Send to recycling plants
9	Metal scrap	0.8	Give to second hand users
10	Drums and containers Chemical Wastes	1	All vessels (drums, containers, etc.) containing hazardous chemicals shall be bunded in order to contain spillage.

7.5.2 Waste Handling

Waste handling and disposal procedures shall be well defined at source and a waste inventory register kept. The general information required, as minimum, for adequate definition of wastes include:

- Waste stream identification
- Proper waste categorization
- Waste segregation
- Appropriate handling and disposal practice; and
- Recommended Management practices.

Waste management issues shall be part of the agenda for HSE meetings and shall be included in routine HSE Inspections. The findings from such inspections shall be included in the Environmental Audit Tracking System.

a. Waste Minimization Guidelines

The four principles of waste minimization process; reduce, recycle, reuse and recovery shall be adopted as applicable, to ensure reduction to the possible extent, of the volume or relative toxicity of liquid or solid wastes.

b. Waste Segregation Guidelines

All wastes to be generated from the project shall be segregated at source, into clearly designated bins at strategic locations. Construction debris would be separated on-site into material-specific containers to facilitate reuse and recycling and to increase the efficiency of waste reclamation and/or would be collected by a contracted waste hauler and separated at the points of generation. Source separation of materials at the construction site is essential to

1. Ensure appropriate waste diversion rate,
2. Minimize costs associated with transportation and disposal, and
3. Facilitate compliance with the relevant regulations.

c. Waste Disposal Guidelines

All debris, spoilt materials, rubbish and other waste, shall be cleared from the site during construction and disposed of accordingly at Government designated sites for such wastes.
Some of the procedures for the treatment and/or disposal of waste envisaged are summarized in the Table 7.4.

Table 7.4: Some Waste Disposal Options

Chemical wastes	**Stored in separate container and labelled with their contents**	**Unused and surplus chemicals shall be returned to the supplier whenever possible.**
Hazardous substances: - **Waste oil** - **Solvents**	Stored in separate designated containers/ drums and in area designed to control and contain	Residuals of hazardous waste. Waste oil shall be taken for recycling whenever possible or given to second

- Hydrocarbon based detergents	spills and leaks. Containers shall be labelled with their contents.	users.
Medical Waste	Stored in separate container and labelled with the contents.	Incinerated
Consumption waste	Closed container for storage	Garbage and trash shall be stored and moved away to appropriate disposal site frequently to avoid smell.
Scrap metals and batteries	Designated container (basket) for storage and transportation.	Reuse/disposal. Specialized disposal for hazardous metal contaminants (e.g. pb, Hg).
Paper	Stored in container or sacks	Destroy confidential ones and give others to second hand users
Plastic	Stored in designated area.	Give to second hand users or send to recycling plants
Wood scrap	Stored in designated ar\ea	Give to second hand users
Drums and containers	Stored in designated storage areas.	If delivered to the disposal site, they shall be cleaned properly first.

All wastes in transit shall be tracked by waste consignment note. The waste consignment note records shall be kept and would include as a minimum with the information in Table 8.5:

Table 8.5: Waste Consignment Record Template

• Location	
• Date of dispatch	
• Description of Waste	
• Summary of Waste quantity/container type	
• Designated disposal site and method	
• Consignee/driver name and means of transportation	
• Confirmation of actual disposal (time and date)	

Waste and/or Recyclable Materials		Reuse and Recycling		Disposal
Possible Materials Generated	estimated volume (m3) or Area (m2) or weight (t)	On-site (How will materials be reused and/or recycled on-site?)	Off-site (Specify the contractor and recycling facility)	contractor and/or landfill site

How will materials be stored on-site for reuse and recycling? e.g. in skip bins.				
How will site operations be managed to ensure minimal waste creation and maximum reuse and recycling? e.g. staff training, feedback from waste management service provider, on-going checks by site supervisors, separate area set aside for sorted wastes, clear signage for waste areas etc.				
How will this plan be evaluated, and who is responsible for the evaluation? e.g. feedback from staff collected by the site supervisor				

d. Corporate Social Responsibility

As a responsible government, in addition to the road infrastructure, other relevant amenities that meet the needs of the host communities on the road corridor shall be provided within the means of the government. The government shall also encourage other well-meaning organization to support the government activity as respect, for instance, community HIV/AIDS programmes, educational support, the provision of infrastructural facilities in disadvantaged areas, etc.

7.6 Gender Management Plan

Gender mainstreaming is intended to uplift the social and economic status of both men and women. On gender sensitization, efforts shall be put in place to ensure that both men and women take part in project preparation and implementation. Women are key to ensuring the sensibility and sustainability of the overall project management. The empowerment of women groups is essential for public good, to ensure for every opportunity. Distribution of jobs during construction shall be guided by the national policy of at least 30% to be women employed. In addition, the contractors shall be obliged to develop a code of conduct to ensure no abuse takes place during the work and ensure appropriate messages and procedures are followed.

Of importance is gender sensitization during implementation of the mitigation measures related to displacement to ensure rightful owners of properties are compensated and that for family assets, both wife and husband are availed with full information and payment procedures.

7.7 Environmental Hazard Management (EHM)

EHM describes the security measures and propose a preliminary contingency plan for the construction and operation phases of the project (possible contingency situations, major actions to properly react to accidents, responsibilities and means of communications). This project is not expected to cause major technological accidents whose consequences may exceed the project site. Hence there was no need to include an analysis of the technological accident risk which will include detailed identification of hazard and potential consequences, estimation of the consequences' magnitude and frequency, and risk estimation and evaluation.

Suffice it to say that some simple steps to managing the potential environmental hazards in road construction/rehabilitation and management such as noise, dust and vibrations have been provided.

7.7.1 The Hazard Effect Management Process

Hazard and Effect Management Process (HEMP) as a risk management process, which ensures that Hazards/Risks to the workforce, types of equipment, properties, and environments are properly controlled shall be integrated into the processes. In cases of failure in controls, it helps manage the impacts of incidents as well.

The Hazards and Effects Management Process (HEMP) shall identify and assess HSE hazards, implement control and recovery measures, and maintain a documented demonstration that major HSE risks shall be reduced to a level that is As Low As Reasonably Practicable (ALARP).

The principles of 'identity', 'assess', 'control', and 'recover' are the basis of HEMP, with the individual stages summarised in the following steps:

- Identify Hazards and Potential Effects
- Evaluate Risks
- Record Hazards and Effects
- Compare with Objectives and Performance Criteria
- Establish Risk Reduction Measures.

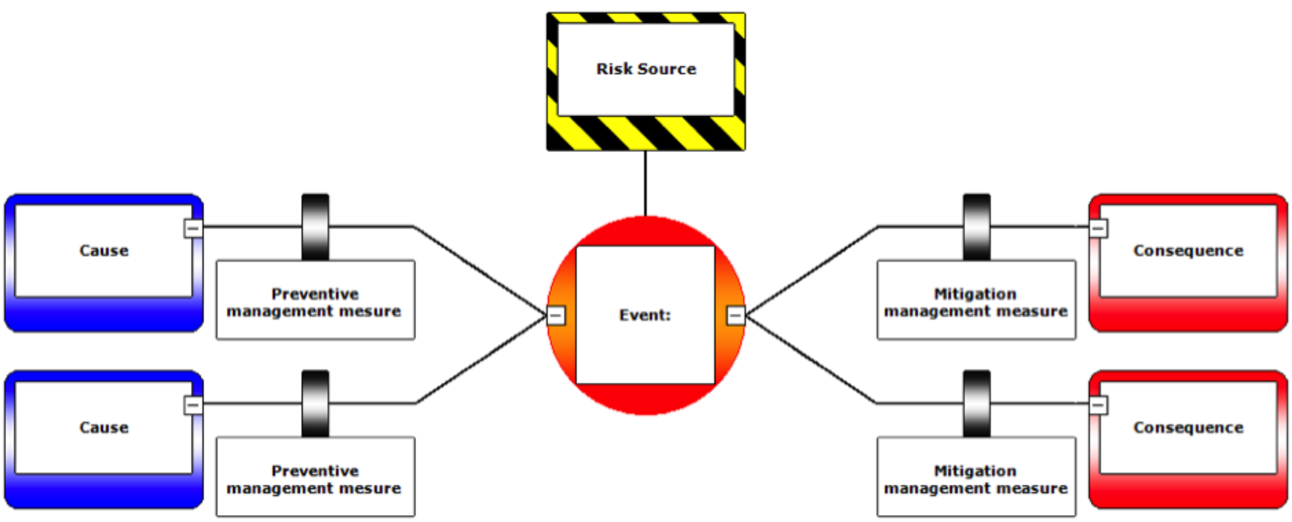


Figure 7.1: The Bow-tie HEMP Flow Chart

7.7.3 Environmental Hazards Management (EHM) for Proposed Project

EHM involves formulation of strategies for preventing, minimizing, or controlling these hazards. Environmental hazards are the natural or human induced accidents, risks or harms caused to the environment, which could subject living things to a material risk of death, injury or impairment of health. In order to enhance compliance with mitigation measures and environmental and social management objectives in the implementation of the Aba road rehabilitation project, this Chapter on the Environmental Hazard Management (EHM) to further strengthen EMMP. The EHM provides specific description of the Hazards identified, mitigation measures as well as roles and responsibilities This is to minimize the risk associated with rehabilitation, operations and decommissioning phases.

The EHM is to be utilized by the ABSIIDP /State Project Implementation Unit (SPIU) and the contractors commissioned by the Client for the project and will complement the site-specific Environmental management and Monitoring plan. The details the mitigation measures the SPIU and their contractors will be committed to implement throughout project implementation including timing for actions, monitoring and responsibilities. The EHM outlines the procedure for hazard identification, risk assessment & determining controls for various stages of the project's development.

Principles to Manage Hazards

Environmental Hazards can be managed by following some simple steps. The most important being the identification. This is followed by further detailed analysis of the situation.

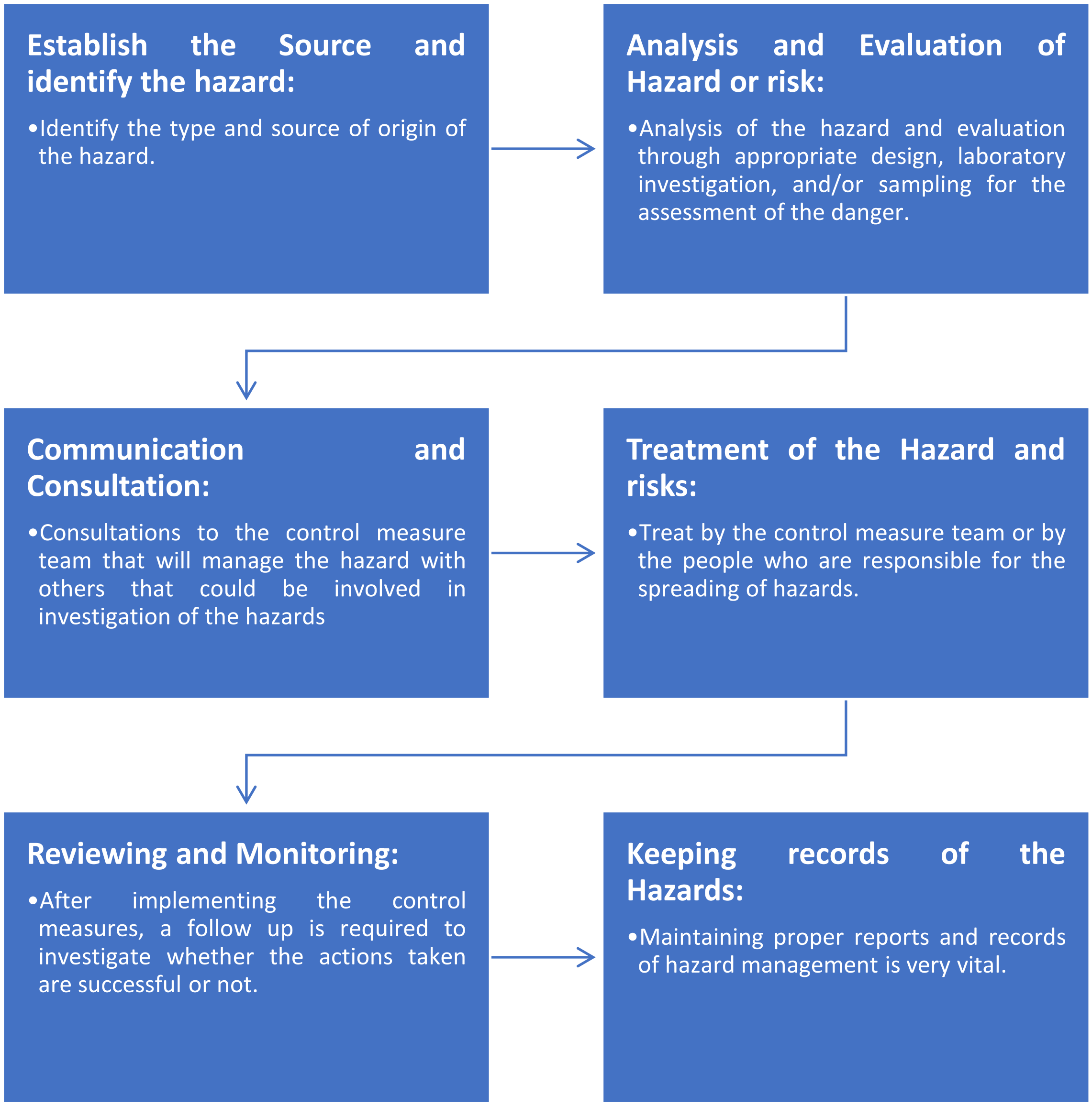


Figure 7.2: Principles to Manage Hazards

7.7.4 Environmental Hazard Management Procedure

In the execution of the proposed Road projects across the various phases (construction, operation and maintenance), it is likely that there will be exposure to activities/ materials considered to be hazardous to personnel and the environment will occur. The company or contractor should have its own documented Hazards Management Program (HMP) that outlines a framework for human and environmental safety for all its operational units and ensuring compliance with regulations.
In the drawing strategy for Environmental hazard Management the following general practices will followed:

1. Developing Hazard material Inventory that contains list of hazardous material used by employees or in store with their manufacturer's name. Hazardous material in store should be categorized according to their compatibility group (acids, bases, compressed materials, aerosols, inorganic peroxides and heavy metals etc)
2. Develop a database for personnel and the type of hazardous operations that encounter in their different work units
3. Develop a waste management plan and ensure adherence. The waste management plan should indicate the following; waste handling method, guidelines for waste minimization and segregation and waste disposal guidelines. Method of waste disposal should be attached to their containers, if possible with codes.
4. Hazardous equipment inventory which should have the list of such equipment and approved personnel to manage them
5. Identify required safety trainings for applicable employees based on the exposure to hazard and the regularity of such training
6. Regular review of job operations according to work units and indicate the necessity for PPE
7. Other necessary procedures include:
    - To keep record of past accidents and near misses, and products and services
    - To categorizes the hazards which have been identified and perform an assessment on the scale of the risks presented by the various hazards
    - Integrate measures to reduce the risks rated as priority and eliminate the hazard or hazardous situation. Some of the specific activities that reduce the risk include:
        - Placing Signs
        - Warning
        - Administrative controls
        - Substitution of hazardous activities

7.7.5 Use of PPE

As part of the EHM, the ABSIIDP shall ensure that the Contractor(s) will establish and implement procedures.
Throughout the project's life cycle, the project team and its Contractors shall demonstrate that all actual or potentially significant hazards and potential impacts of the project activities have been identified, the associated risks evaluated and understood, and that controls and recovery measures to effectively manage these risks and impacts are in place on site.

In addition, the under listed hazardous operations shall have written procedures. The employees including concerned contractors and sub-contractors shall be familiar with the content of the procedures as it relates to individual jobs before mobilization.

- Handling of emergency
- Notification of authorities
- Safety and environment
- Repair methods and procedures
- Emergency repair material

The site safety officer will be responsible for the implementation of the EHM plan and training.

Table 7.1: Environmental Hazard Management Matrix

Project Phase	Hazard Type	Risk level	Mitigation Approach	Role
Pre-Construction				
	Erosion Hazard from land clearing and Borrow pits	H	Using conservative clearing method, location camps in places not fragile or prone to erosion,	Contractor
	Loss of Biodiversity	M	Using conservative clearing method	Contractor
	Sharp scrap metals and batteries	H	Designate containers (basket) for storage and transportation. Reuse should be promoted	Contractor
	Fire accidents from welding and gasoline		Create appropriate warning signs and emergency exit routes Place fire extinguishers Provide First Aid tools	Contractor
Construction	Pollution oil leaks/ grease from equipment and heavy machines Hydrocarbon based Detergents Spilled Gasoline/diesel and other fuel products Chemical waste	H	Training personnel on use of petrol chemicals Change old parts Provide First Aid tools Placing of warning sign	Contractor
	Erosion Hazard from land clearing		Using conservative clearing method	Contractor
	Exposure to radioactivity and release of chemicals		Provide radiation counter to workers for monitoring individual radiation levels. Provide and enforce the use of protective aprons. Ensure that the activity is carried	Contractor

			out in accordance with standard procedures.	
	Noise pollution from heavy machine	H	Placing of warning signs and administrative control Use of PPE	Contractor
	Air pollution from dust through earth movement	H		Contractor
	Solid waste from empty containers, construction and demolition activities, and food vendor	H	Stored in designated storage areas. containers/ drums and in area designed to control and contain spills and leaks. Containers shall be labelled with their contents	Contractor
	Water pollution from siltation Water pollution from contaminants from machines and vehicles	M	Locating Site camps away from water sources Minimize leaks Reduced earth movement and creation of drainages	Contractor
	Loss of Biodiversity		Using conservative clearing method	Contractor
Operation and Maintenance Phase	Air pollution from increased traffic	H	Ensure the vehicles are road worthy Use of less polluting fuels	ABSIIDP
	Solid waste from increased traffic and passenger movement	M	Provide waste bins for vehicles	ABSIIDP
	Loss of biodiversity	L	Reduce land clearing during maintenance Plant more trees	ABSIIDP

Risk Level : H= High, M = Medium, and L = Low

7.8 Environmental Monitoring and Auditing Plan

Environmental and Social Monitoring Plan provides specific means to ensure that the activities of the project during construction and operation comply with the applicable environmental and social standards and practices. This calls for a systematic observation and measurement of selected environmental variables.

In order to effectively and efficiently implement this EMP, a system for monitoring and auditing has been built into the overall management plan. Monitoring and auditing assist in the examination of management, employee knowledge, programme responsibilities, records and effectiveness.

Specifically, this shall help to:

- Improve environmental and social management practices;
- Check the efficiency and quality of the environmental management processes;
- Establish the scientific reliability and credibility of the EMP for the project and
- Provide the opportunity to report the results on safeguards and impacts and proposed mitigation measures implementation

The Environmental and social monitoring activities shall be based on direct or indirect indicators of emissions, and resource use applicable to the road project. Monitoring frequency shall be sufficient to provide representative data for the parameter being monitored. Monitoring shall be conducted by trained individuals who can carry out the monitoring and record-keeping effectively using properly calibrated and 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. As part of monitoring programme, visual inspections and quality monitoring for light attenuation shall be conducted daily, for instance, during construction.

Inspections oversight should rest with the PMU supported by the Ministry of Works with local knowledge, policies and procedures.

However, the Safeguard Officer of the PMU shall ensure routine inspections are carried out especially during the rehabilitation control and may be the contractor's project manager, site supervisor or principal contractor representative etc. All inspection details should be formally documented, filed and made available for inspection as required by PMU and relevant authorities.

7.8.1 Objectives of the Monitoring Plan

Specifically, the monitoring programme for this proposed project shall be instituted in order:

- To ensure that normal standard set by regulatory bodies for air, noise, etc. are not exceeded.
- To monitor changes in existing physical, chemical and biological characteristics of the environment.
- Early warning of environmental damage is thus provided so that action may be taken if possible, to reduce the seriousness of the unwanted impact.

- To determine whether any detected changes in environmental components are caused by the project or by other forces;
- To determine the effectiveness of the mitigation measures as well as to check that mitigation measures are correctly implemented;
- To highlight areas of concern undetected by this EIA and provide a basis for recommending additional mitigation measures.

7.8.2 Parameters to Monitor

Based on the available baseline data, the under listed environmental variables are recommended for either continuous or periodic monitoring. Samples should be taken at the stations established for this study and analyzed.

Table 7.6a: Environmental and Social Monitoring Plan

S/No	Activity/ Issue	Mitigation Measure Implementation	Monitoring Activity	Frequency	Monitoring Responsibility	Budget *
Environmental and Social Monitoring Plan Construction Phase (Pre- Construction)						
1	Erection of contractor construction camp	• Contractor to identify suitable camp site in consultation with SPIU/ relevant MDAs • Contractor obtain approval for camp site from members of the public/Local government	• Retain a record of discussions • Retain a record of approval	• After each discussion • Once	**FMEnv SMEnv SPIU/ Contractor**	**0.1m**
2	Materials testing	• SPIU to include requirement for independent materials testing in contracting documents • SPIU to ensure that Contractor complies with requirements	• Retain copy of contracting documents with the requirement • Check record of materials testing	• Once • When materials are delivered	**FMEnv SMEnv SPIU Site Engineers**	
3	Operation of Contractor construction camp	• Inclusion of requirement for regular watering of camp site and construction sites in contracting documents • Contractor to implement approved Contractor work plan • submit monthly reports on Contractor implementation of approved work plan and mitigation measures • Establish and maintain public complaints register • Include the following requirements for worker facilities in contracting documents - Covered rubbish bins for scraps - Adequately stocked first aid medical kits - Trained person to provide first aid assistance if required • Include requirement in contracting documents for Contractor to provide facilities for disposal of solid and liquid wastes • Contractor to undertake regular disposal of solid and liquid wastes undertake frequent regular monitoring to ensure compliance with requirements	• Retain copy of contracting documents with the requirement • Maintain record of implementation activities • Daily monitoring • Ensure all complaints are recorded in the register • Maintain a record of working hours • Maintain a record of discussions with local members of the public in relation to requests for extension of working hours • Maintain a record of any agreements for extension of working hour • Retain copies of contracting documents	• Once • Daily during dry weather condition • Daily • Monthly • As required • Once • As required • As	**FMEnv SMEnv SPIU Contractor SPIU Site Supervisor**	

S/No	Activity/ Issue	Mitigation Measure Implementation	Monitoring Activity	Frequency	Monitoring Responsibility	Budget *
			with requirement • Retain copies of waste disposal dockets • Maintain a photographic record of disposal activities • Maintain documentary record of monitoring activities	required • Daily and weekly		
4	Heavy machinery operation	• Ensure contracting documents include specifications relating to type, weight and operation of heavy machinery	• Retain copy of contracting documents on project files • Include reference in acceptance advice • Maintain record of inspections and public complaints	• Once • Once • Weekly	**SPIU/Contractor**	
5	Excavation generally	• Include requirement in contracting document for Contractor to remove and dispose of surplus material at approved sites • Include the following requirements for Contractors in the contracting documents: - Provide temporary services acceptable standard where required - Undertake permanent repair works for disrupted services within specified times - Provide warning and safety signs in local language at excavation sites - Provide PPE for site workers	• Maintain photographic and documentary record of Contractor material disposal activities • Retain copy of approved list on project files • Retain copy of contracting documents on project files • Retain copy of contracting documents on project files • Maintain duplicate copies record of Contractor performance • Maintain photographic and documentary record of Contractor performance	• Daily • Once	**FMEnv** **SMEnv** **SPIU** **SPIU/Contractor**	

S/No	Activity/ Issue	Mitigation Measure Implementation	Monitoring Activity	Frequency	Monitoring Responsibility	Budget *
6		• Ensure that requirements relating to spill management and debris are included in contracting documents • Ensure that Contractor addresses spill management and debris removal as criteria for acceptable Contractor work plan • Ensure that Contractor to promptly attend to any spills	• Retain copy of contracting documents on project files • Maintain photographic and documentary record of Contractor performance	• Once • Daily	**FMEnv SMEnv SPIU/Contractor**	
7	Social issues	• Continual undertake public consultation • Conclude all resettlement issues that may arise • SPIU to include requirement for continual stakeholder consultations and public enlightenment in contracting documents	• Retain copies of minutes of discussions	• After each discussion	**FMEnv SMEnv SPIU/Contractor**	
8	Health and Safety Issues	b) SPIU to include requirement for contract document need for contractor to mount in advance of the construction work awareness campaign relevant to health and safety and adequate project signs to warn pedestrians and motorists of construction activities, diversions, etc. provided at appropriate points.	• Retain copy of contracting documents on project files • Maintain photographic and documentary record of Contractor performance	• Once	**FMEnv SMEnv SPIU/Contractor**	
9	Traffic Safety and Traffic Management	f) SPIU to include requirement for contract document need for contractor g) to ensure public safety, and meet traffic safety requirements for the operation of work to avoid accidents. h) be responsible for the safety along the related to the site, i) provide and maintain necessary barricades, suitable and sufficient flashlights, flagmen, danger signals, and signs. j) Submit weekly activities schedule and the locations of his work along the	• Retain copy of contracting documents on project files • Maintain photographic and documentary record of Contractor performance • Records of accident plan •	• Once	**FMEnv SMEnv SPIU/Contractor**	

***No budget as these are part of the overall contractual arrangement between SPIU and Contractors**

Table 7.6b: Summary of Environmental and Social Monitoring Plan during Construction and Operation

Component	Parameters	Method & Where	Frequency	Responsible*	Cost (N)
Material sites	No of people living at/near the sites have been information No of sites excavated	Evidence of meeting/records filed visual assessment of site During and a	Before excavation during construction and after abandonment		
Air quality	Dust	Visual Observation at location of activities	Every day during construction		
	PM, SO_2, CO, NO_X , CO_2	Ambient air monitoring using standard method of sampling and analysis at established sampled locations for the baseline data	Monthly during construction and any other item incident relating to pollution are noticed (where visual observations indicate unpleasant scenario)		
Noise	Level (dB-A)	Disturbance/pinch	Everyday during construction		
	Level	Sensor measurement at established sampled locations for the baseline data	annually		
Erosion	Top soil movement/ground cutting Control and retention of disturbed soil at earthwork	Visual assessment	Routinely during construction and when erosive forces are observed		
Water Quality	Turbidity	Standard method of sampling and analyses at established sampled locations for the baseline data	Where it is established that construction caused impact		
			Annually		
Soil Quality	pH, Conductivity, Heavy Metals, TOC, Total Hydrocarbons, Cations	Sampling and analyses at designated locations	• monthly during construction; • Quarterly during the first 3 years of operation; •Biannually Subsequently		
Vegetal Cover	Lawn/vegetation growing well & maintained	Visual assessment, No of tree removed/planted	Routinely and growth		
General Waste	Reduction,	Visual Assessment, General	Routinely, Daily		

Component	**Parameters**	**Method & Where**	**Frequency**	**Responsible***	**Cost (N)**
Management	Segregation protocols, proper handling, storage, treatment, and transportation Contractor to develop waste management plans and provide appropriate facilities during operation	Aesthetics, hazard free environment along the			
Training	Responsible HSE behaviour and culture	General HSE Awareness and specific training for workers and investors	Routinely and as need arises		
Socio-economics including displacement	Project benefit opinions, Lifestyle, no of livelihoods opportunities created, income, gender characteristics, no of women participating in watershed management programs, etc	Questionnaires, direct observations and interviews.	Once in two years		
Land use changes	Emerging land use trends along the project during construction and operation	Absence of encroachment No of fines, changing social and economic development	Six monthly		
Climate Change	GHG Emission	Inventory	Once in three years		
Circular Economy and Waste Management	Amount of waste avoided/recovered and reused No of eco-chains or by-product exchanges created to encourage utilization of by-products among industries	Across the facility zones	During construction and operational life monitored quarterly during construction and annually during operation		
Health & Safety	Incidents	Hazard assessment	Before Start of work and routinely		
Environmental	Assessment of Mitigation,	Presence of Audit Report	Once in two years		

Component	Parameters	Method & Where	Frequency	Responsible*	Cost (N)
& Social Audit	monitoring & Other management measures				
Total					4,500,000.00

**SPIU has the primary responsibility* ^ *for a typical road*

7.9 Implementation Schedule

- The provisional time schedule for preparing contract documents, awarding of tenders and start of construction has to be taken into consideration in the implementation schedule for the ESMP.
- The contractor is expected to prepare and submit a plan of action covering the means by which the construction related environmental and social mitigation measures recommended in the ESMP will be implemented once a notice to proceed is received.
  The contractor shall strictly follow the Action plan, mitigation action required at the pre-construction phase which would have been implemented

The key elements of the implementation schedule plans which are shown in Table 7.10 are as listed below:

- Preparation and submission of the Action plan;
- Nominating Environmental Management Representative;
- Finalizing site and layout plans for construction camps/temporary yards incorporating environmental requirements;
- Preparation and submission of construction schedule;
- Implementation of mitigation and enhancement measures;
- Environmental auditing (Ministry of Works and Transport , Consultant /FMEnv);
- Monitoring and reporting on EMP implementation (Ministry of Works and Transport, FMEnv & consultant).

Table 8.7: ESMP Implementation Schedule

S/N	Activity Description	Responsible	Pre-Construction	Construction	Post Construction (Operation)
11.	Disclosure of Environmental Assessment Report	ABSIID			
12.	Allocating Budget for EMP	ABSIID			
13.	Appointing Support Staff for EMP	ABSIID			
14.	Review and Approval of Contractor's EMP and Safety Plan	ABSIID			
15.	Finalizing site and layout plan of construction plan	ABSIID			
16.	Implementation of Mitigation Measures	ABSIID, Environmental Consultant &FMEnv			
17.	Supervising EMP Implementation	ABSIID & Environmental consultant			

18.	Environmental Auditing	ABSIID, Environmental Consultant &FMEnv										
19.	Monitoring & Reporting on EMP Implementation	ABSIID, Environmental Consultant &FMEnv										
20.	Environmental Training	ABSIID, & Environmental Consultant										

7.10 Reporting

7.10.1 Reporting Procedures

The reporting procedures presented in Table 7.11 have been developed in order to ensure that the SPIU is able to receive feedback from the implementation of the ESMP on an ongoing basis and to take rapid corrective actions if there are issues of non-conformance.

Table 7.8: Reporting Procedures

Phase	Responsibility	Deliverables	Frequency	Accountability
Preconstruction	Safeguard Unit	Report of monitoring activities including any specific events	Once	SPIU, also SME & FMEnv on request
Construction	Safeguard Unit	Two (2) monitoring Reports. First to be prepared mid-way into the civil works and the other upon completion of all construction activities.	Twice	SPIU, also SME & FMEnv on request
	Safeguard Unit	Additional Reports according to specific conditions e.g. Accidents, serious environmental/social impacts	Once	SPIU, also SME & FMEnv on request
Completion of Construction and demobilization of contractor from site	Safeguard Unit	Final Monitoring Repor	Once	SPIU. Report to be archived and made Lender, SME & FMEnv on request

7.10.2 Record Keeping and Control

It is mandatory that the contractor keeps records of ongoing mitigation activities. These records may include site monitoring plan, HSE Policy, Site Specific HSE Plan, Waste Management Plan, Traffic Control Plan, Emergency response and preparedness procedures, site instructions, training records, complaints records, incident report, Inspection, maintenance and equipment calibration records. These documents are to be made available to the Safeguard Unit as the need arises.

In the same vein, the Safeguard Unit is to keep records to provide evidence of monitoring activities and effectiveness of the monitoring plan. The site monitoring Plan identified problems/corrective actions and monitoring Reports highlighted in subsection 8.6.1 are to be kept by the Safeguard unit and be made available to relevant regulators upon request. In addition, all significant communications with FMEnv, Abia SME and other relevant authorities should be documented and kept. These documents are required to track performance in order to achieve and demonstrate compliance with the monitoring plan and applicable regulatory requirements.

7.11 Cost Estimates for ESMP Implementation

The total cost of mitigation by the Contractor will be included in the contract as part of the implementation cost by the Contractor. The breakdown of cost is presented in Table 7.9.

Table 7.9: Indicative Budget for Implementation of Measures

Item	Responsibility	Cost Estimate in Nigerian Naira (N)	Cost Estimate in US Dollars (US$) *
Mitigation	Contractor	11,900,000	
	SPIU	8,750,000	
Monitoring	SPIU, MDAs	4,250,000	
Capacity Building	SPIU,	2,800,000	
Cost for GRM	SPIU	2,850,000	
Sub- Total		27,750,000	
	10% of Sub- Total	2,775,000	
Total		**30,525,000**	**61,050.00**

*1 US$ =N500. Cost estimates are for ESMP implementation for each road except for Capacity Building cost which covers ESMP implementation for the entire project.

7.12 ESIA Disclosure

After the ESIA review and clearance by the Bank, the information in Table 8.10 describes the process of disclosure.

Table 8.10: Disclosure procedure

S/N	Action	Remarks
1	Disclosure on National newspapers	This will be done based on direction by the Federal Ministry of Environment/Country system
2	Disclosure at the Abia State Ministry of Environment	This will be done based on direction by the Federal Ministry of Environment/Country system
3	Disclosure at the ABSIIDP office	This will be done based on direction by the Federal Ministry of Environment/Country system
4	Disclosure at respective LGA office & the host communities	The purpose will be to inform stakeholders about the project activities; environmental and social impacts anticipated and proposed environmental and social mitigation measures based on country system
5	Disclosure at AfDB website	The ESIA will be disclosed according to the AfDB Disclosure Policy

CHAPTER EIGHT
CONCLUSION

8.1. Conclusion

The Environmental and Social Impact Assessment of the road project revealed that the project will have significant economic benefits for the local, state and national economy. There will be both positive and negative impacts due to the construction activities and normal operations of the road in case of all suggested alignments. The proposed road rehabilitation project will have significantly beneficial impacts on the rural adjoining communities and respective LGAs and the State at large as it will undoubtedly improve accessibility to communities, markets, farms and agro-processing centres in the project areas. Other benefits include improvement in rural road network, accessibility to rural communities, markets, farms and agro-processing centers in the State, increase in agricultural output as the road will ultimately facilitate easy access for farm inputs, extension services, primary and secondary (urban) markets. Improvement in agricultural productivity will translate to economic empowerment, poverty reduction and sociocultural wellbeing of the benefiting communities. Another contribution of the proposed road rehabilitation project to the overall socio-economic wellbeing of the benefiting region is the provision of employment opportunities, income generating sources, skills acquisition, settlement development and other multiplier effects.

Inevitably, the project will have some adverse impacts on the biophysical and social environment during execution and operation and is assigned Category 1 according AfDB Operational Safety guidelines. Construction related activities will have impact on the natural drainages, generation of excess materials, noise and air pollution, impact on surface water quality, biodiversity and protected areas, temporary restriction of movement and hindered accessibility, resettlement and land acquisition needs. Impacts during operation will include noise, traffic accidents, vehicular emissions and waste generation. Expected negative impacts can be managed by implementation of mitigation measures and monitoring of their efficiency.

The road transport intervention activities on 31 Rural Roads in Aba, Abia State is environmentally and socially feasible for implementation provided the recommended mitigation and monitoring measures are implemented, and the proposed implementation arrangements are upheld by all with relevant roles and responsibilities. The ESIA of the proposed project shows that the project can be achieved and operated with minimal negative impacts on the surrounding environment and humans by strict adherence and implementation of the recommended mitigation measures. The ESIA has also developed an Environmental and Social Management Plan (ESMP), which incorporates various mitigation measures that will eliminate or reduce the potential impacts of the proposed project on the environment. Mitigation measures were subsequently developed for adverse impacts based on industry best practices, available technology and HSE considerations.

The ESMP shall be implemented and maintained throughout the duration of the project with the adverse impacts mitigated to as low as reasonably practicable levels. Impact mitigation monitoring shall also be carried out with the involvement of regulators to check compliance with the ESMP.

The benefits of improved access roads in rural areas far outweigh the short-term and often reversible impacts. Thus, the proposed project can be executed within the ambit of sustainable development and this will therefore form the basis for the actual project implementation.

8.2. Recommendations

The following recommendations will enhance the overall sustainability of the proposed road transport intervention project on 31 Rural Roads in Aba, Abia State:

- As much as possible, options of avoidance should be promoted rather than seeking compensation and resettlement. Nonetheless, in situations where compensations are inevitable, the requirements of the RAP should be implemented in full;
- Priority should be given to local workers during project implementation in order to limit the number of migrant workers. This will reduce threats to community culture, health, safety and security as well as stimulate local socioeconomic activities, improve livelihood and reduce poverty in the affected communities;
- Community-based Grievance Redress Mechanism should be developed and implemented to promptly and effectively resolve grievances from affected groups or persons;
- The Safeguard Unit of SPIU should coordinate active monitoring to ensure the contractor(s) adhere strictly to the requirements of the ESMP especially in the application of mitigation measures during project design and implementation; and
- The implementation of the road transport intervention activities on 31 Rural Roads in Aba, Abia State should involve a well-established community relation to create a sense of ownership of the project by the communities and make the project more sustainable.
- It is important that strengthening the capacity of key implementing institutions is adhered to as recommended in the ESMP. The capacity development will provide an enabling environment to address environmental and social issues by the project.
- Gender, occupational and environmental health issues need to be emphasized on by the various stakeholders in the project during the implementation and operational phases

Bibliography

African Development Bank's *Integrated Safeguards System 2013 adopted in 2014* African Development Bank's *Environmental and Social Procedures (ESAP)*

Environmental and Social Impact Assessment (ESIA) for the Road Rehabilitation Subproject in Aba, Abia State, June 2021 prepared under Abia State Integrated Infrastructure Development Project and State Project Management Implementation Unit by Enviplan International Limited, Kaduna, Nigeria with Quality Assurance by Multiple Development Services (MDS) Team led by Dr. Eugene Itua

American Public Health Association (APHA), 1995. *Standard Methods for Analysis of Water and Wastewater*, *18th edition*. Port City Press, Baltimore, MD.

Amos-Uhegbu *et al.* (2012). Amos-Uhegbu, C. (2008). Lithostratigraphy and depositional environment of Agbogugu/Ihie section of Owelli sandstone, Anambra Basin, Southern Nigeria. Unpublished MSc. thesis, Department of Geology, University of Port-Harcourt, Nigeria.

Arazu, V. N., Ogbeibu, A. E. & Okeke, P. A. (2015). Pre-Dredging Physico-chemical Status of the River Niger at Onitsha Stretch, Anambra State, Nigeria. *Environment and Ecology Research* 3(1): 15 - 23 http://www.hrpub.org DOI: 10.13189/eer.2015.030103

Chukwu, G.U. (2008). Water quality assessment of Boreholes in Umuahia South Local Government Area of Abia State, Nigeria. Pacific J. Sci. Technol., 9(2), 592 – 598.

Cranston, P.S., Oliver, D. R., & Saether, O.A. (1983) The larvae of Orthocladinae (Diptera: Chironomidae) of the Holartic region – keys and diagnoses. *Entomologica Scandinavica Suppl.* 19, 149 – 291.

Defaye, D. (1988) Contribution a la connaissance des Crustaces Copepodes d'Ethiopie. *Hydrobiologia* 164, 103–147.

Environmental Impact Assessment for Umugini Pipeline Project. (2012).

Fagade, S.O. (1971). The food and feeding habits of Tilapia species in the Lagos lagoon. *J. Fish Biol.* 3, 151-156.

Fagade, S.O. and Olaniyan, C.I.O.(1973). The food and feeding inter-relationship of fishes in the Lagos lagoon. *J. Fish Biol.* 5 (2), 205-215.

Fittkau, E.J. & Roback, S.S. (1983) The larvae of Tanypodinae (Diptera: Chironomidae) of the Holartic region – keys and diagnoses. *Entomologica Scandinavica Suppl.19, 33 – 110.*

Fl¨ossner, D. (2000). *Daphnia hyalina* Leydig 1860. In: *Die Haplopoda und Cladocera (Ohne Bosminidae) Mitteleuropas*, Leiden: Backhuys Publishers.

Gillies, M.T.1980. An introduction to the study of Cloeon Leach (Beatidae, Ephemeroptera) in West Africa. *Bulletin De. L' Institut Français Afrique Noire 42 Ser. A*. 1: 135-156.

Hammer, Ø., Harper, D.A.T. and Ryan, P.D.(2001). PAST: Paleontological statistics software package for education and data analysis. Paleontologia Electronica 4(1): 9pp

Hammond C.O. (1983). *The Dragonflies of Great Britain and Ireland* (2nd ed). Harley books, England.205pp.

Imoobe T. O. T. & Ohiozebau, E (2009). Pollution Status of a Tropical Forest River Using Aquatic Insects as Indicators. *African Journal of Ecology*, 48, 232–238.

Imoobe, T.O.T. (2006). Composition, Distribution and Abundance of Aquatic Insect of Ologe Lagoon in Lagos, Nigeria. *Nigerian Journal of Entomology* 23: 22 – 25.

Imoobe, T.O.T. (2008). Variation in benthic macroinvertebrate assemblages in Ologe Lagoon, Nigeria. *African Journal of Aquatic Science, 33(1)*: 45-50.

Korinek, V., 1999. *A Guide to Limnetic Species of Cladocera of African Inland Waters* (*Crustacea*, *Branchiopoda*). Occasional Publication No. 1, The International Association of Theoretical and Applied Limnology, BTL, Geneva.

Macan TT (1959) Aguide to freshwater invertebrate animals. Longmans publishers 120pp

Mellanby H. (1963). *Animal Life in Freshwater:* A guide to freshwater invertebrates. Chapman and Hall Ltd, London 308pp.

Moses, B.S., 1987. The influence of flood regime on fish catch and fish communities of the Cross River floodplain ecosystem, Nigeria. *Environ. Biol. Fishes*, 18: 51-65.

Moses, B.S., 2001. The influence of hydroregime on catch, abundance and recruitment of the of Southeastern Nigeria's inshore waters. Environ. Biol. Fishes, 61: 99-109.

Ogbeibu A.E and Egborge A.B.M. (1995). Hydrobiological studies of water bodies in the Okomu Forest Reserve (Sanctuary) in Southern Nigeria. 1: Distribution and diversity of the invertebrate fauna. Tropical Freshwater Biology 4: 1–27.

Ogbeibu A.E and Victor R. (1989). The effect of road and bridge construction on the bank root macrobenthic invertebrates. Environmental Pollution 56: 58–100.

Ogbeibu A.E. & Eghaghe, E.A. (2014). The impact of Bitumen on the Physico - Chemical Quality of the Benin River, in Koko Delta State, *Trop. Freshwat. Biol., 23*: 115 – 129

Ogbeibu A.E. and Ogiesoba-Eguakun C.U. (2019). Evaluation of water quality parameters of the Okhuaihe River, Edo State, Nigeria. *Trop. Freshwat. Biol.* 28(3): 91-111

Ogbeibu A.E., Omoigberale, M.O., Ezenwa I. M. and Oboh I.P. (2013). Application of some biometric indices in the assessment of the water quality of the Benin River, Niger Delta, Nigeria. *Trop. Freshwat. Biol., 22:* 49 – 64

Ogbeibu, A. E., Arazu, V.N., Nzei N. & Igho R. (2010). Impact of dredging on the water quality and macrobenthic invertebrate fauna of the Ikpoba River in southern Nigeria. *Tropical Freshwater Biology* 19(1): 59-78

Ogbeibu, A.E., Chukwurah, N.A. & Oboh, I.P. (2012). Effects of an open waste dump-site on its surrounding groundwater in Ekurede-Urhobo, Warri, Delta State, Nigeria. Tropical Freshwater Biology, 21 (2), 81 – 98

Ogbeibu, A.E. & Ibadin, H. & Omoigberale, M.O., Oboh, I.P. (2014). The water quality and the distribution of zooplankton in a relatively pristine river in Emu, southern Nigeria. *Journal of Aquatic Sciences* 29 (1A): 27-38

Ogbeibu, A.E. &. Iyorah, I.E. (2015). Determination of the water and sediment quality of the Ellah River, Edo State, Nigeria *Trop. Freshwat. Biol., 24*: 9-21

Ogbeibu, A.E. 1991. *Hydrobiological characteristics of water bodies in the Okomu Forest Reserve (Sanctuary) Benin City*. PhD thesis, University of Benin, Benin City Nigeria. 205pp.

Ogbeibu, A.E., Oriabure, P., Oboh, I.P. & Edogun, I.S. (2014). The effects of brewery effluent discharge on the water quality and sediment of the Ikpoba River, Benin City, Nigeria. *Journal of Aquatic Sciences 29 (1A):* 39- 56

Omoigberale, M.O., Ogbeibu, A.E. & Olotu, N.O. (2009). Assessment of Groundwater Quality of Benin City, Edo State. Nigeria. *Trop. Freshwat. Biol.* **18**(2): 15-35

Petr, T. 1972. Benthic fauna of a tropical man-made Lake (Volta Lake, Ghana, 1965-1968). *Archiv für Hydrobiologie* 70: 484-533.

Smirnov, N. N. (1996). Cladocera: The Chydorinae and Sayciinae (Chydoridae) of the World: 1-197. (Guides to the Identification of the Microinvertebrates of the Continental Waters of the World, SPB Academic Publishing, Amsterdam).

Van de Velde, I. (1984). Revision of the African species of the genus Mesocyclops, Sars 1914(Copepoda, Cyclopoida). Hydrobiologia 109 ; 3-66.

Victor R. and Ogbeibu A.E. (1991). Macrobenthic communities in the erosional biotope of an urban stream in Nigeria. Tropical Zoology 4: 1–12.

Ward, H.B. & Whipple, G.C. (1959) *Freshwater Biology*. Second Edition, Edited by W.T. Edmonson. John Wiley & Sons, New York. 124.

WHO 1984. World Health Organisation (WHO). (1984). Guidelines for drinking water quality. Vol 1 Recommendations Geneva. Switzerland.

Zapala, A. G., Chiba, A. And Vera, A. (1996). Cells and tissues of the immune system of fish. In: the Immune system: Organism, Pathogen and Environment. Fish Immunology Series (Iwama G, Nakanshi T. Editions) New York Academic Press: 1-55pp.

Federal Ministry of Environment (2011): Resettlement Policy Framework (RPF) for The Nigeria Erosion and Watershed Management Project covering Abia, Anambra, Cross River, Edo, Ebonyi, Enugu, and Imo States prepared by *Eugene O. Itua*

FPMU (2008?)Environmental & Social Management Framework (ESMF) For Rural Access And Mobility Project, covering Enugu and Osun State - Draft Final Report (Updated Edition) Prepared By Earth Guard,

LAMATA (2009): Environmental and Social Management Framework (ESMF) Towards The Preparation For LUTP II, Prepared By Multiple Development Services, June.

Ministry Of Local Development, Nepal, (2004): Environmental and Social Management Framework for Rural Access Improvement Project

The World Bank (2012): Project Appraisal Document On A Second Rural Access And Mobility Project (RAMP 2) to Federal Republic Of Nigeria Report No: 65586-NG

USAID (2009): Environmental Guidelines for Small-Scale Activities in Africa

World Bank (2010): Environmental And Social Management Framework (ESMF) Environmental And Social Management Framework For State Expenditure Effectiveness For Opportunities And Results (SEEFOR) In Niger Delta States (Bayelsa, Delta, Edo & Rivers) Nigeria Prepared By Eugene Itua

Https://Www.Cgidd.Com/

https://www.roadex.org/e-learning/lessons/environmental-considerations-for-low-volume-roads/environmental-issues-related-to-road-management/

AASHTO LRFD Bridge Design Specification (3rd Edit, 2005), the Limit States Design Method

APPENDICES

Appendix 3.1: the Proposed Roads Description

Length and Classification of the ABA Roads

SN	ROAD NO	LENGTH, KM	Classification
1.1	Asa Road – Port Harcourt Road	7.78	Urban
1.2	Faulks Road	4.59	Urban
1.3	Ohanku Road – Owerre Aba	6.61	Urban
1.4	Omuma Road	2.14	Urban
1.5	Ikot Ekpene Road	6.82	Urban
1.6	Mbubo Umuogele Amachi Mgbokonta	12.68	Rural
1.7	Umuala Nbawsi Eziala Osusu Okpuala Ngwa	12.64	Rural
1.8	Omoba – Umuaja Amaede Ndiolumbe	8.17	Rural
1.9	Mbawsi Layout – Ururuka	1.87	Urban
1.10	Glass Factory Road	2.07	Urban
1.11	Umuomiaukwu Agburike Umuomainta	4.83	Urban
1.12	Uratta – Ugwuati	9.58	Urban and peri-urban
1.13	Crystal Park Junction - Obohia Road	22.05	Urban, and Rural
1.14	Immaculate Avenue – ITF Rod Bridge	2.52	Urban
1.15	Umuaro Nenu Road	4.76	Rural
1.16	Eziama Ntigha – Nsirimo – Ubakala	9.07	Rural
1.17	Mgboko –Omoba Umuezeukwu Mbawsi Road	23.17	Rural
1.18	Ibeme Ndiakata- Nlagu Onicha Ngwa	2.82	Rural
1.19	Pepple Road - Akpu Road	1.20	Urban
1.20	Umuokpo- Owo Ahiafor Link Road	4.30	Peri-urban
1.21	Owerre Aba – Osusu Umuelendu – Osusuaku	4.01	Urban
1.22	Umuojima Amapuife Eberi Omuma	9.98	Peri-urban
1.23	Umuimo Carol Pee. Ministry of Agric. Shopping Mall	1.49	Urban
1.24	Ugwuati – Umuiku	4.01	Rural
1.25	Isicourt- Ururuka Umuosu Umuala Umunkpeyi	20.62	Rural
1.26	Ama Emereole – Ekeonyeugba –Umokoromiri-Eketa	7.25	Peri-urban
1.27	Ajiwe – Brass	0.63	Urban
1.28	Ahunanya – Immaculate	0.88	Urban
1.29	Oron Road – Elizabbeth Avenue – Sports Club	0.70	Urban
1.30	Umuala - Umuakwu - Ohuhu Nsulu – Oloko Ikwuano	13.70	Rural
1.31	Itungwa – Agburukwe road	3.35	Rural
	Total Length	216.29	

Source: Abia State Government

Summary of Route Features (Asa Road – Port Harcourt Road)

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks

TP1	0319479 0565299	0 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth road
TP2	0318863 0564580	0 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth road
TP3	0318158 0563861	0 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth road
TP4	0317469 0563565	0 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth road
TP5	0316924 0562655	0 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road
TP6	0316255 0561960	0 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road
TP7	0315553 0561301	0 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road
TP8	0315027 0560457	0 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road

Summary of Route Features (Faulks Road)

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks
TP1	03176931 0566619	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Built up area
TP2	0317023 0565912	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Built up area
TP3	0316156 0565563	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Built up area

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks
TP4	0315410 0564973	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Built up area
TP5	0314713 0564707	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Built up area

Summary of Route Features (Ohanku Road – Owerre Aba)

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks
TP1	0319940 0563896	0.00 – 1.5 Reddish Brown silty clay	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated pavement, Built up area
TP2	0320163 0563001	0.00 – 1.5 Reddish Brown silty clay	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated pavement, Built up area
TP3	0320271 0562068	0.00 – 1.5 Reddish Brown silty clay	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated pavement, Built up area
TP4	0320415 0561132	0.00 – 1.5 Reddish Brown silty clay	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated pavement, Built up area
TP5	0320671 0560059	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated pavement, Built up area
TP6	0320884 0558996	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated pavement, Built up area

Summary of Route Features (Omuma Road)

S/No	Coordinates	Soil Profile (meter depth)	Water Table (m)	Topography	Remarks
TP1	0318335 0565129	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Intervention ongoing
TP2	0317702.35 564819.897	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Intervention ongoing
TP3	316838.455 564720.038	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Intervention ongoing
TP4	0315706 0564424	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Intervention ongoing

Summary of Route Features (Ikot Ekpene Road)

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks
TP1	0319591 0565691	0.00 – 1.5 Brownish laterite	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated pavements, built up area
TP2	0320534 0565600	0.00 – 1.5 Brownish laterite	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated pavements, built up area
TP3	0321516 0565378	0.00 – 1.5 Brownish laterite	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated pavements, built up area
TP4	0322466 0565219	0.00 – 1.5 Brownish laterite	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated pavements, built up area

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks
TP5	0323465 0565045	0.00 – 1.5 Brownish laterite	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated pavements, built up area
TP6	0324471 0564991	0.00 – 1.5 Brownish laterite	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated pavements, built up area
TP7	0325482 0565104	0.00 – 1.5 rownish laterite	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements, Built Up Area

Summary of Route Features (Mbubo Umuogele Amachi Mgbokonta Road)

S/No	Coordinates	Soil Profile (meter depth)	Water Table (m)	Topography	Remarks
TP1	0333713 0595230	0.00 – 1.5 Reddish Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth road
TP2	0334509 0594563	0.00 – 1.5 Reddish Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth road
TP3	0335162 0593937	0.00 – 1.5 Reddish Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth road
TP4	0335860 0593265	0.00 – 1.5 Reddish Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth road
TP5	0335915 0592382	0.00 – 1.5 Reddish Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road
TP6	0335366 0591591	0.00 – 1.5 Reddish Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road
TP7	0335294 0590667	0.00 – 1.5 Reddish Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road

S/No	Coordinates	Soil Profile (meter depth)	Water Table (m)	Topography	Remarks
TP8	0334975 0589709	0.00 – 1.5 Reddish Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road
TP9	0334638 0588755	0.00 – 1.5 Reddish Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road
TP10	0334183 0587980	0.00 – 1.5 Reddish Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road
TP11	0334069 0587010	0.00 – 1.5 Reddish Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road
TP12	0333147 0585443	0.00 – 1.5 Reddish Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road

Summary of Route Features (Umuala Nbawsi Eziala Osusu Okpuala Ngwa Road)

S/No	Coordinates	Soil Profile (meter depth)	Water Table (m)	Topography	Remarks
TP1	0330387 0593054	0.00 – 1.5 Reddish Brown clayey sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP2	0329545 0593575	0.00 – 1.5 Reddish Brown clayey sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP3	0328976 0594391	0.00 – 1.5 Reddish Brown clayey sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP4	0328371 0595087	0.00 – 1.5 Reddish Brown clayey sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP5	0327360 0595345	0.00 – 1.5 Reddish Brown clayey sand	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements

S/No	Coordinates	Soil Profile (meter depth)	Water Table (m)	Topography	Remarks
TP6	0326405 0595441	0.00 – 1.5 Reddish Brown clayey sand	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements
TP7	03225847 0595924	0.00 – 1.5 Reddish Brown clayey sand	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements
TP8	0325086 0595374	0.00 – 1.5 Reddish Brown clayey sand	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements
TP9	0324235 0594730	0.00 – 1.5 Reddish Brown clayey sand	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements
TP10	0323356 0594196	0.00 – 1.5 Reddish Brown clayey sand	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements

Summary of Route Features (Omoba – Umuaja Amaede Ndiolumbe Road)

S/No	Coordinates	Soil Profile (meter depth)	Water Table (m)	Topography	Remarks
TP1	0331032 0581976	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP2	0330071 0581813	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP3	0329131 0581858	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP4	0328166 058199	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP5	0327313 0581722	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively Levelled terrain	Earth Road

TP6	0326547 0581232	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively Levelled terrain	Earth Road
TP7	0325585 0580833	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively Levelled terrain	Earth Road
TP8	0324698 0580530	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively Levelled terrain	Earth Road
TP7	0325585 0580833	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively Levelled terrain	Earth Road
TP8	0324698 0580530	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively Levelled terrain	Earth Road

Summary of Route Features (Mbawsi Layout – Ururuka Road)

S/No	Coordinates	Soil Profile (meter depth)	Water Table (m)	Topography	Remarks
TP1	0326739 0595407	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP2	0327651 0595847	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP3	0328616 0595966	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP4	0329477 0596241	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP5	0330464 0596485	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements
TP6	0331316 0596926	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements

TP7	0331850 0597752	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements

Summary of Route Features (Glass Factory Road)

S/No	Coordinates	Soil Profile (meter depth)	Water Table (m)	Topography	Remarks
TP1	0320739 0566591	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP2	0321184 0567493	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP3	0320678 0568034		Deeper than depth of trial pit	Relatively levelled terrain	Earth Road

Summary of Route Features (Umuomiaukwu Agburike Umuomainta Road)

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks
TP1	0324294 0599892	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP2	0324873 0599104	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP3	0325243 0598271	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP4	0326066 0597698	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP5	0326457 0596866	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth Road
TP6	0326793 0595941	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth Road

Summary of Route Features (Uratta – Ugwuati Road)

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks
TP1	0314646 0562268	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP2	0313663 0561993	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP3	0312826 0561561	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP4	0311964 0561092	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP5	0311048 0560658	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively Levelled terrain	Earth Road
TP6	0310208 0560433	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively Levelled terrain	Earth Road
TP7	0309251 0559912	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP8	0308408 0559708	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road

Summary of Route Features (Crystal Park Junction - Obohia Road)

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks
TP1	0317749 0562226	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	DILAPIDATED PAVEMENTS

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks
TP2	0318316 0563084	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	DILAPIDATED PAVEMENTS
TP3	0318683 0564042	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	DILAPIDATED PAVEMENTS
TP4	317312.251 561628.551	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	DILAPIDATED PAVEMENTS
TP5	317167.191 560740.986	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	DILAPIDATED PAVEMENTS
TP6	317135.409 559763.709	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	DILAPIDATED PAVEMENTS
TP7	317421.543 559135.656	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	DILAPIDATED PAVEMENTS
TP8	317800.531 558482.548	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	DILAPIDATED PAVEMENTS
TP9	318139.612 557377.482	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	DILAPIDATED PAVEMENTS
TP10	317594.781 556376.229	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	DILAPIDATED PAVEMENTS
TP11	317608.659 555153.612	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	DILAPIDATED PAVEMENTS

Summary of Route Features (Immaculate Avenue – ITF Road Bridge)

S/No	Coordinates	Soil Profile (meter depth)	Water Table (m)	Topography	Remarks
TP1	318269.225 567692.177	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP2	318542.598 567979.955	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP3	0318029 0567384	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP4	0318662 0568149	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road

Summary of Route Features (Umuaro Nenu Road)

S/No	Coordinates	Soil Profile (meter depth)	Water Table (m)	Topography	Remarks
TP1	0331375 0579695	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP2	0332133 0580376	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP3	0333038 0580671	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP4	0333745 0581124	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP5	0334392 0581727	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively Levelled terrain	Earth Road

Summary of Route Features (Eziama Ntigha- Nsirimo-Ubakala Proposed Road)

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks
TP1	0319997 0601022	0.00 – 1.5 Reddish Brown clayey sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP2	0319928 0601978	0.00 – 1.5 Reddish Brown clayey sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP3	0320011 0602870	0.00 – 1.5 Reddish Brown clayey sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP4	0320296 0603845	0.00 – 1.5 Reddish Brown clayey sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP5	0321363 0604359	0.00 – 1.5 Reddish Brown clayey sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth Road
TP6	0322403 0604629	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth Road
TP7	0325347 0604947	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth Road

Summary of Route Features (Mgboko –Omoba Umuezeukwu Mbawsi Road)

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks
TP1	0321322 0573317	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth road
TP2	0321637 0574267	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth road
TP3	0321923 0575159	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth road
TP4	0322238 0576102	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Earth road
TP5	0322541 0577021	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road
TP6	0322846 0577937	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road
TP7	0323159 0578895	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road
TP8	0323447 0579840	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road
TP9	0323613 0580780	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road
TP10	0323822 0581776	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road

Summary of Route Features (Ibeme Ndiakata- Nlagu Onicha Ngwa Road)

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks
TP1	0336751 0568326	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively levelled terrain	Earth road
TP2	0336458 0567359	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively levelled terrain	Earth road
TP3	0336611 0566490	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively levelled terrain	Earth road
TP4	0336426 0565625	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively levelled terrain	Earth road
TP5	0336549 0564754	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road
TP6	0336374 0564077	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road
TP7	0336016 0563233	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road
TP8	0335605 0562314	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road
TP9	0335196 0561474	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively Levelled terrain	Earth road

Summary of Route Features (Pepple Road - Akpu Road)

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks
TP1	0321500 0564007	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively levelled terrain	Earth road
TP2	0321726 0564441	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively levelled terrain	Earth road
TP3	0321484 0564991	0.00 – 1.5 Reddish brown laterite	Deeper than depth of trial pit	Relatively levelled terrain	Earth road

Table 80: Summary of Route Features (Umuokpo- Owo Ahiafor Link Road)

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography
TP1	0331472 0570724	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain
TP2	0332162 0569947	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain
TP3	0332896 0569245	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain
TP4	0333456 0568405	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain
TP5	0333611 0567374	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain

Summary of Route Features (Umuojima Amapuife Eberi Omuma Road)

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography
TP1	0312055 0568733	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively levelled terrain
TP2	0311252 0568212	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively levelled terrain
TP3	0310665 0567562	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively levelled terrain
TP4	0310354 0566814	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively levelled terrain
TP5	0309673 0567574	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively Levelled terrain
TP6	0308873 0568079	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively Levelled terrain
TP7	0307910 0568438	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively Levelled terrain
TP8	0306773 0568566	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively Levelled terrain
TP9	0305622 0568201	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively Levelled terrain
TP10	0305248 0568007	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively Levelled terrain

Summary of Route Features (Umuimo Carol Pee. Ministry of Agric. Shopping Mall)

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks
TP1	0317330 0568108	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP2	0317028 0569039	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP3	0316536 0569029	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP4	0314837 0570471	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP5	0315729 0570130	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements
TP6	0316487 0569849	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements
TP7	0316492 0568872	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements
TP8	0316380 0568645	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements

Table 83:Summary of Route Features (Ugwuati – Umuiku Road)

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks
TP1	0308235 0559701	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP2	0308280 0560667	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP3	0308376 0561558	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP4	0308023 0562527	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP5	0307680 0563393	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements

Summary of Route Features (Isicourt- Ururuka Umuosu Umuala Umunkpeyi)

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks
TP1	0331818 0606780	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP2	0331827 0604693	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP3	0331639 0603835	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP4	0331383 06020917	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP5	0331639 0602012	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements
TP6	0331707 0600992	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements
TP7	0331601 0600056	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements
TP8	0331664 0599075	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements
TP10	0331965 0597186	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements
TP11	0332686 0596586	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements
TP12	0333496 0596109	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements
TP13	0333640 0595182	0.00 – 1.5 Brownish silty clay	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements

Summary of Route Features (Ama Emereole – Ekeonyeugba –Umokoromiri-Eketa Road)

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks
TP1	0321751 0585138	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP2	0320924 0585706	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP3	0320380 0586403	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP4	0319778 0587140	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements

Summary of Route Features (Ajiwe – Brass Road)

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks
TP1	0317917 0566840	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP2	0317939 0567278	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP3	0317980 0567380	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements

Summary of Route Features (Ahunanya – Immaculate Road)

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks
TP1	0317967 0568014	0.00 – 1.5 Reddish Brown laterite	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road
TP2	0318277 0567809	0.00 – 1.5 Reddish Brown laterite	Deeper than depth of trial pit	Relatively levelled terrain	Earth Road

Summary of Route Features (Oron Road – Elizabbeth Avenue – Sports Club Road)

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks
TP1	0318869 0566201	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP2	0318568 0566519	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP3	0318397 0566706	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements

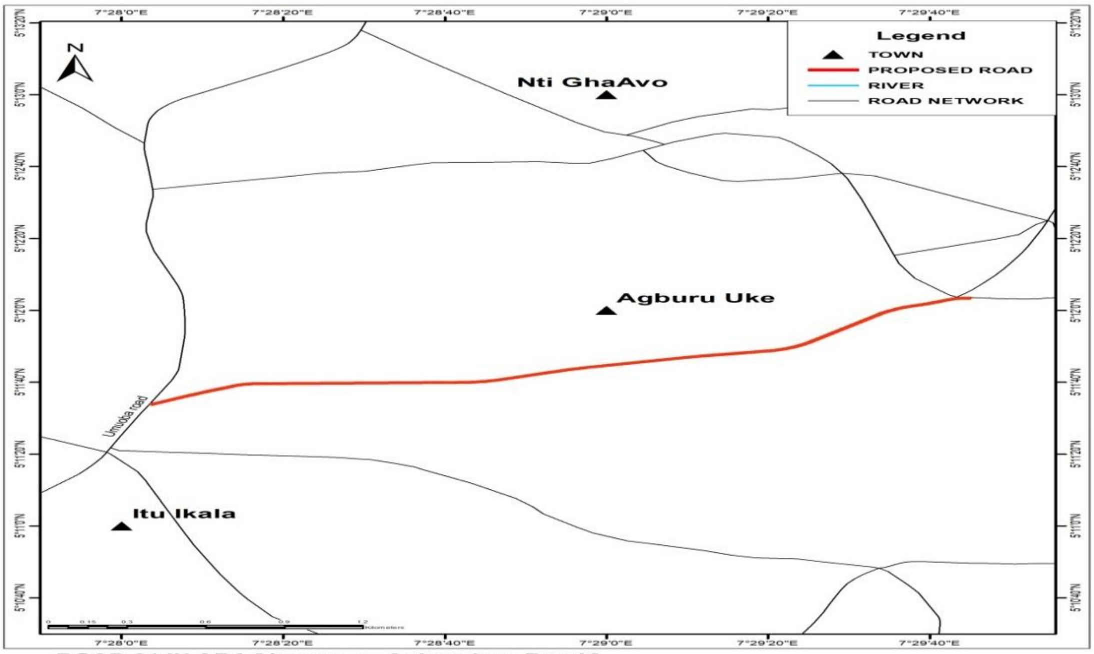
Summary of Route Features (Umuala - Umuakwu - Ohuhu Nsulu – Oloko Ikwuano Road)

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks
TP1	0330380 0593027	0.00 – 1.5 Reddish Brown clayey sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP2	0331175 0592464	0.00 – 1.5 Reddish Brown clayey sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP3	0332080 0592376	0.00 – 1.5 Reddish Brown clayey sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP4	0333089 0592450	0.00 – 1.5 Reddish Brown clayey sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP5	0333975 0592438	0.00 – 1.5 Reddish Brown clayey sand	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements
TP6	0334921 0592207	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements
TP7	0335822 0591932	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements
TP8	0336525 0591487	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements
TP9	0337339 0591133	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively Levelled terrain	Dilapidated Pavements

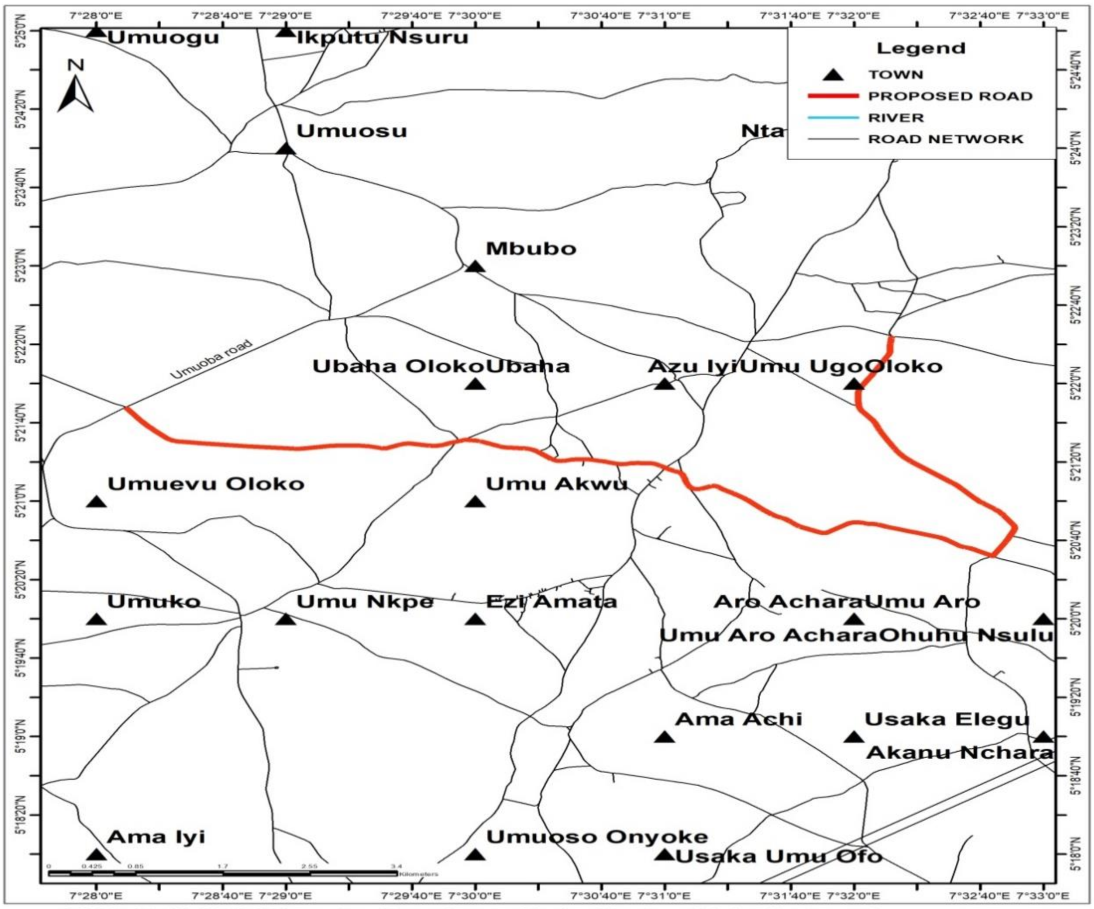
Summary of Route Features (Itungwa – Agburukwe Road)

S/No	Coordinates	Soil Profile (metre depth)	Water Table (m)	Topography	Remarks
TP1	0330168 0574175	0.00 – 1.5 Reddish Brown clayey sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP2	0331131 0574353	0.00 – 1.5 Reddish Brown clayey sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements
TP3	0332013 0574523	0.00 – 1.5 Brownish silty sand	Deeper than depth of trial pit	Relatively levelled terrain	Dilapidated Pavements

Constraints Maps



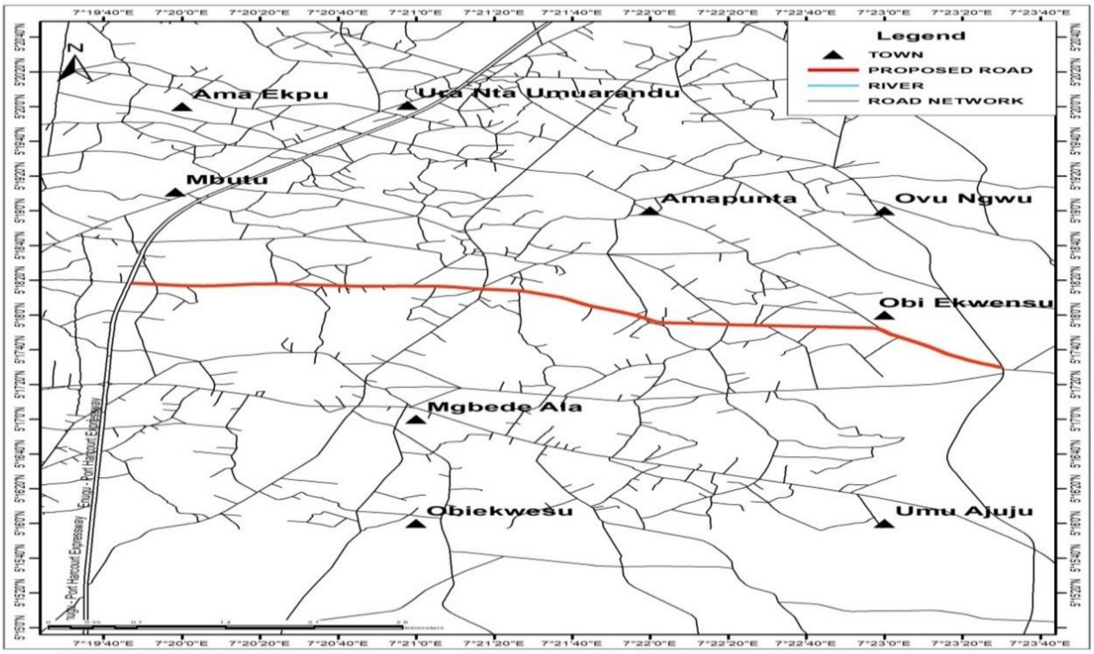
ROAD 31 IN ABA [Itungwa – Agburukwe Road]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP



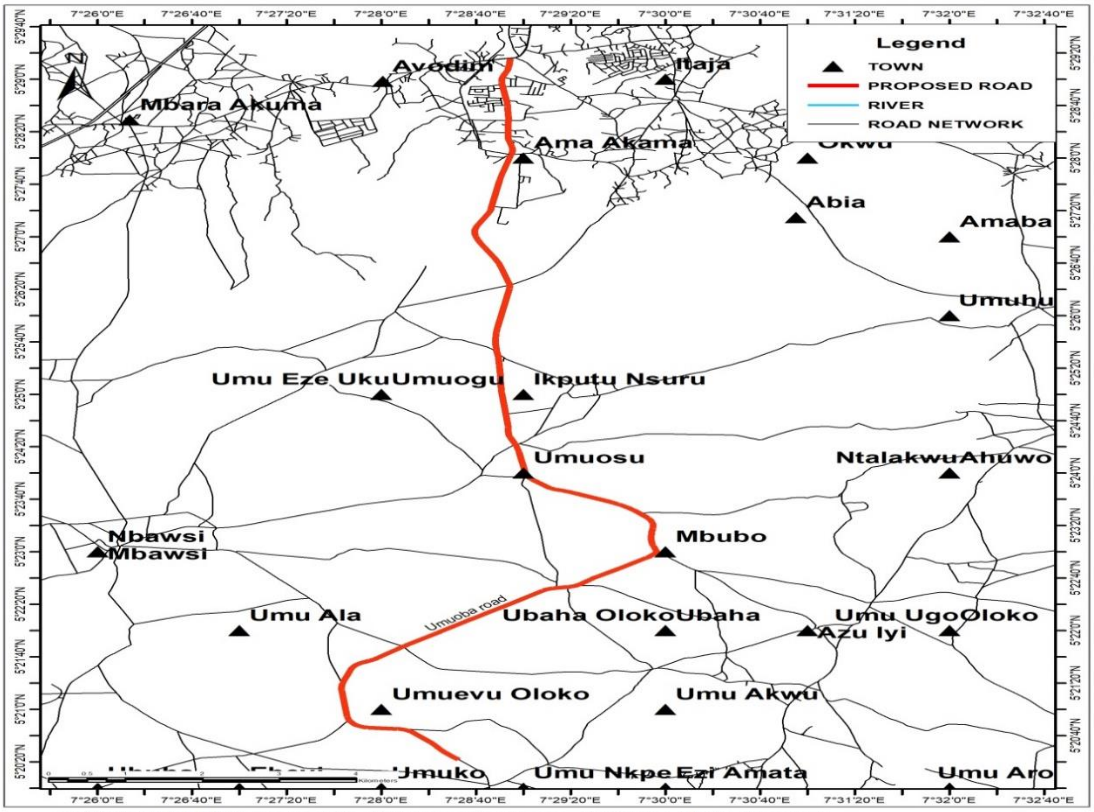
ROAD 30 IN ABA [Umuala - Umuakwu - Ohuhu Nsulu – Oloko Ikwuano]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP

ROAD 29 IN ABA [Oron Road – Elizabbeth Avenue – Sports Club]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP

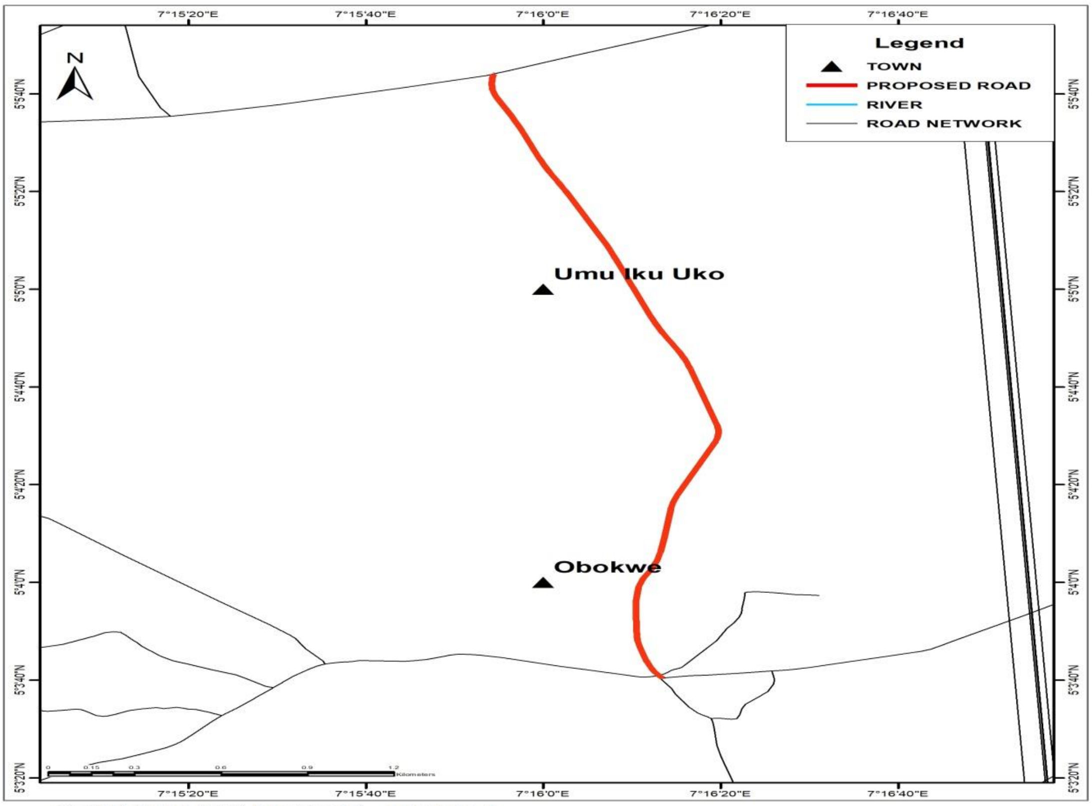
ROAD 28 IN ABA [Ahunanya - Immaculate]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP



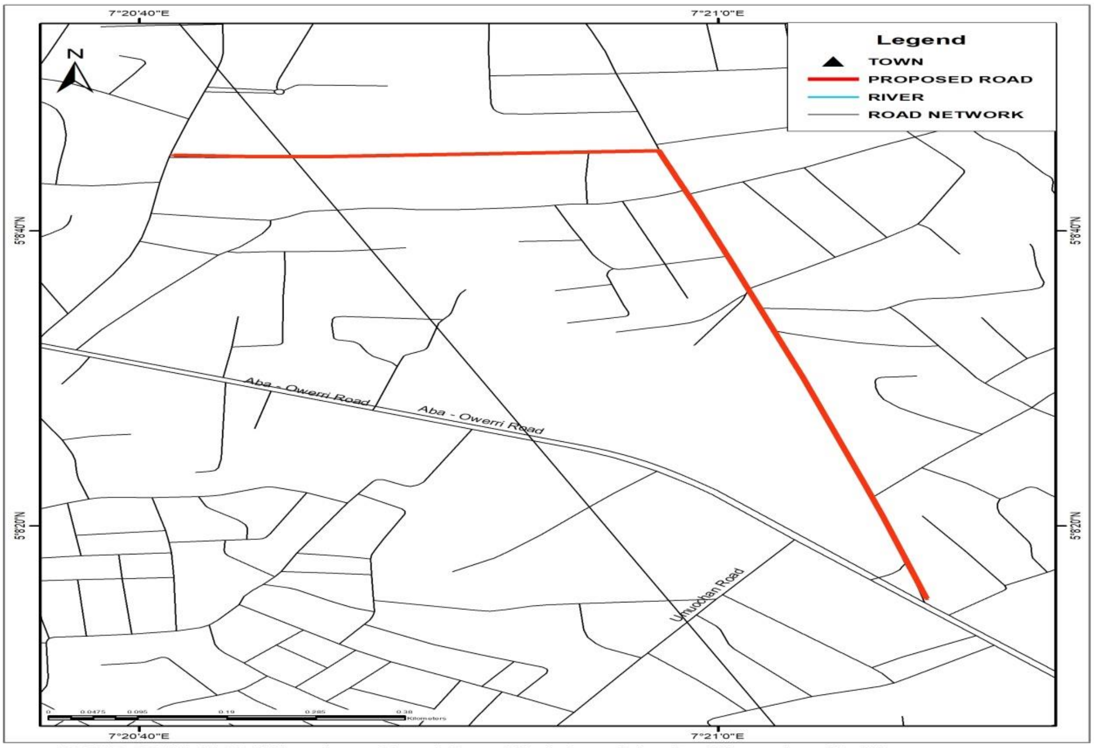
ROAD 26 IN ABA [Ama Emereole – Ekeonyeugba –Umokoromiri-Eketa]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP



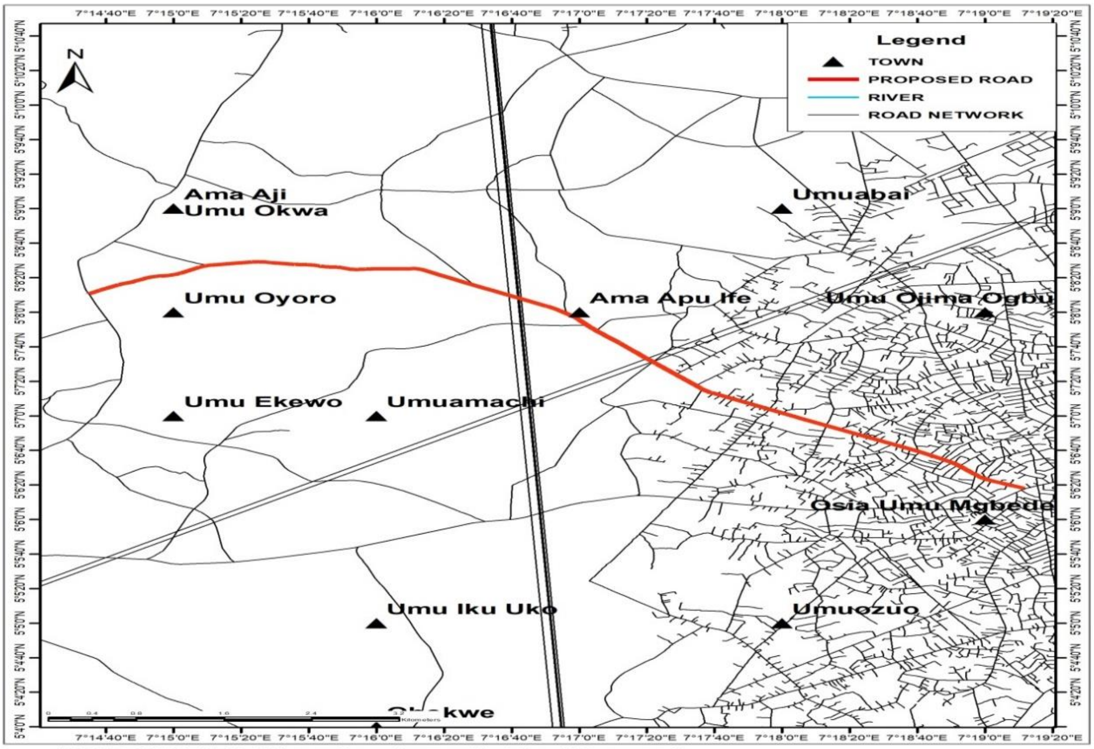
ROAD 25 IN ABA [Isicourt- Ururuka Umuosu Umuala Umunkpeyi]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP



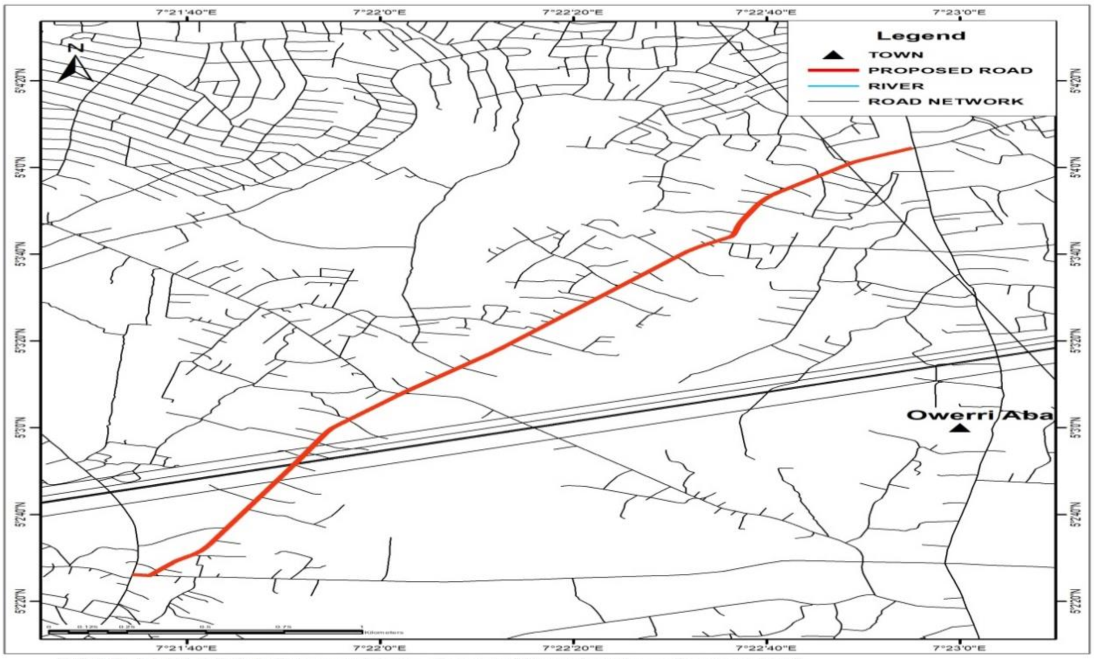
ROAD 24 IN ABA [Ugwuati – Umuiku]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP



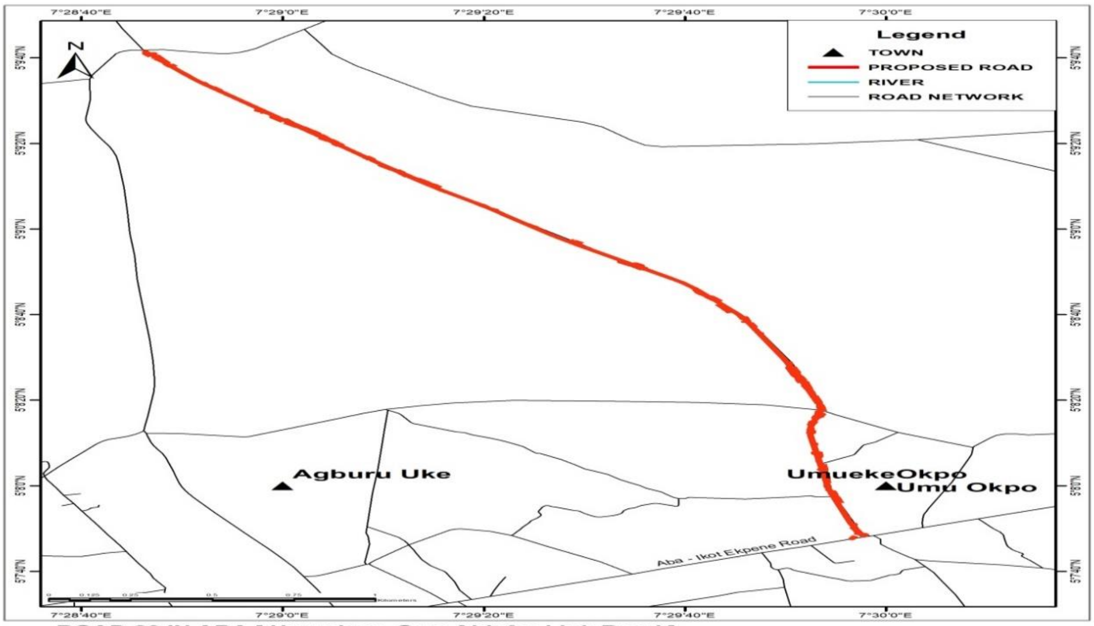
ROAD 23 IN ABA [Umuimo Carol Pee. Ministry of Agric. Shopping Mall]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP



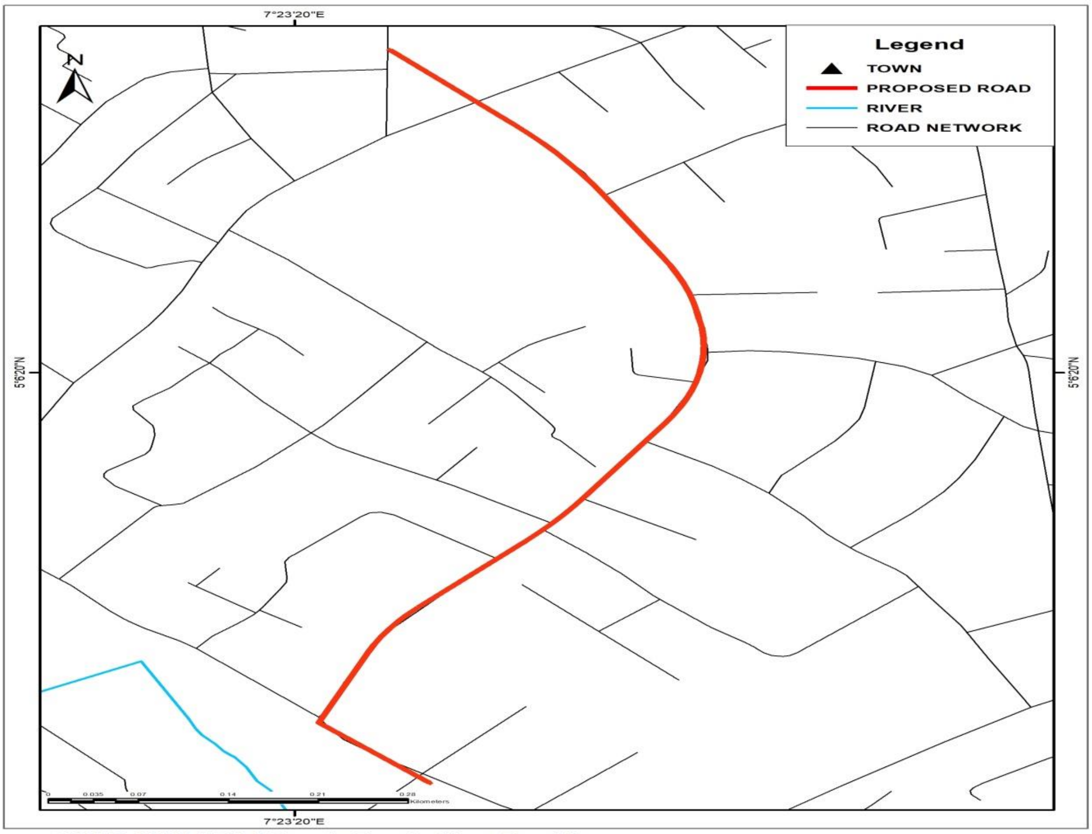
ROAD 22 IN ABA [Umuojima Amapuife Eberi Omuma]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP



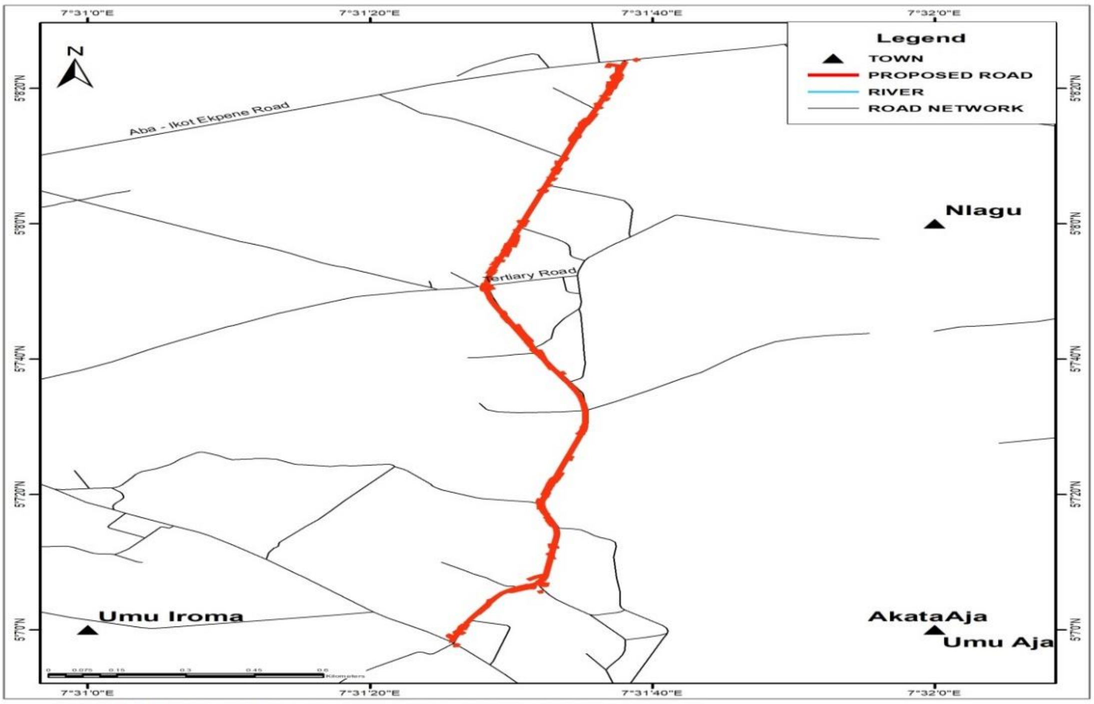
ROAD 21 IN ABA [Owerre Aba – Osusu Umuelendu – Osusuaku]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP



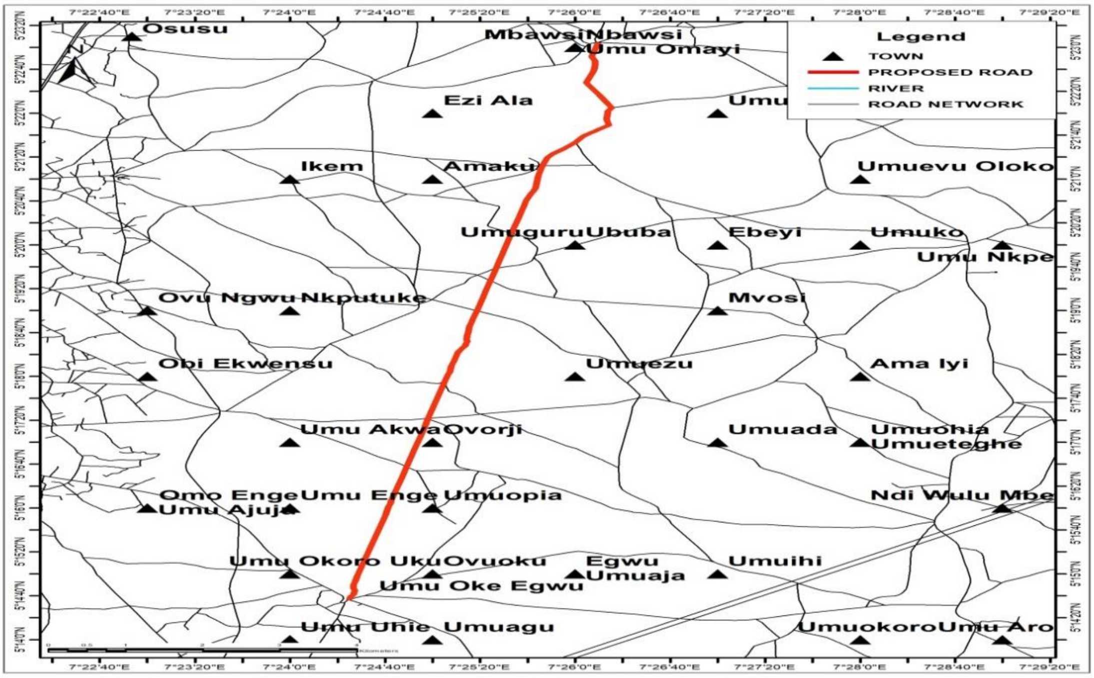
ROAD 20 IN ABA [Umuokpo- Owo Ahiafor Link Road]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP



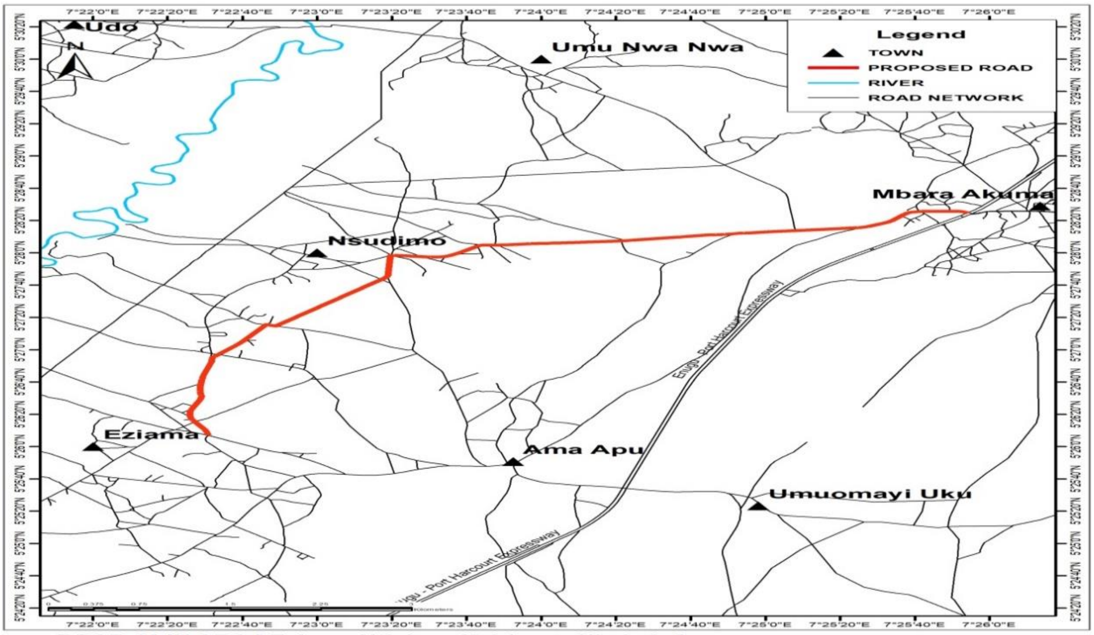
ROAD 19 IN ABA [Pepple Road - Akpu Road]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP



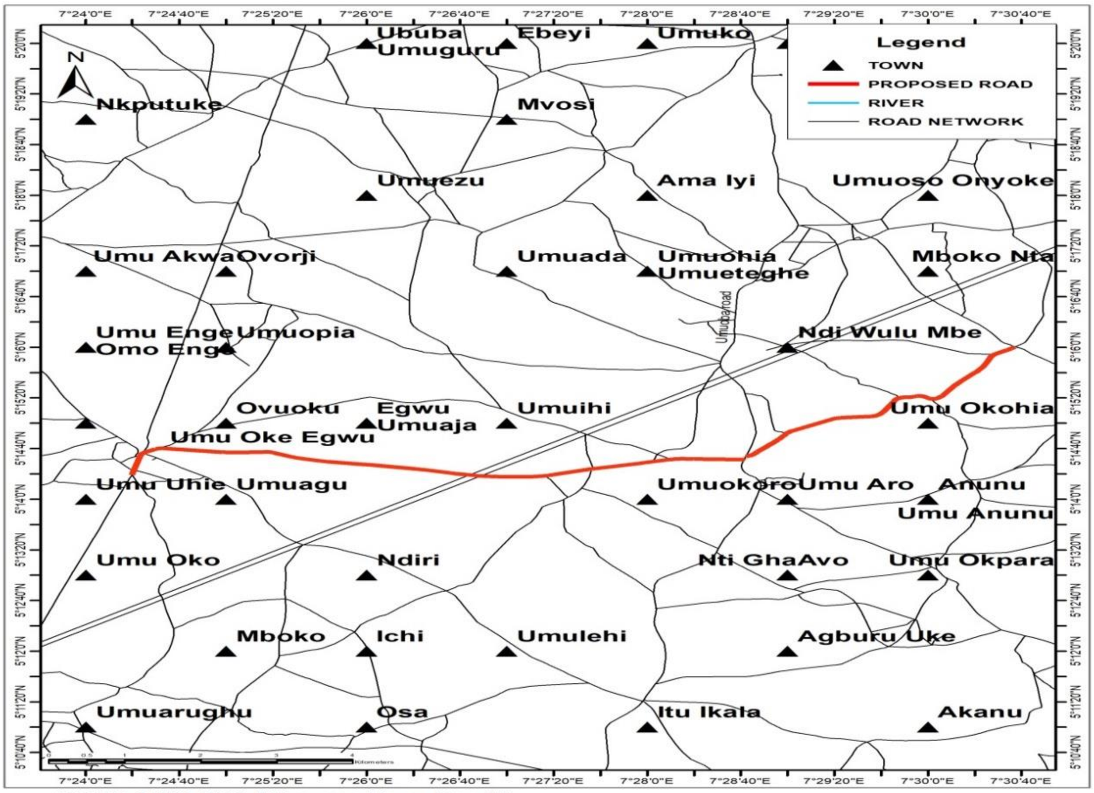
ROAD 18 IN ABA [Ibeme Ndiakata- Nlagu Onicha Ngwa]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP



ROAD 17 IN ABA [Mgboko –Omoba Umuezeukwu Mbawsi Road]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP

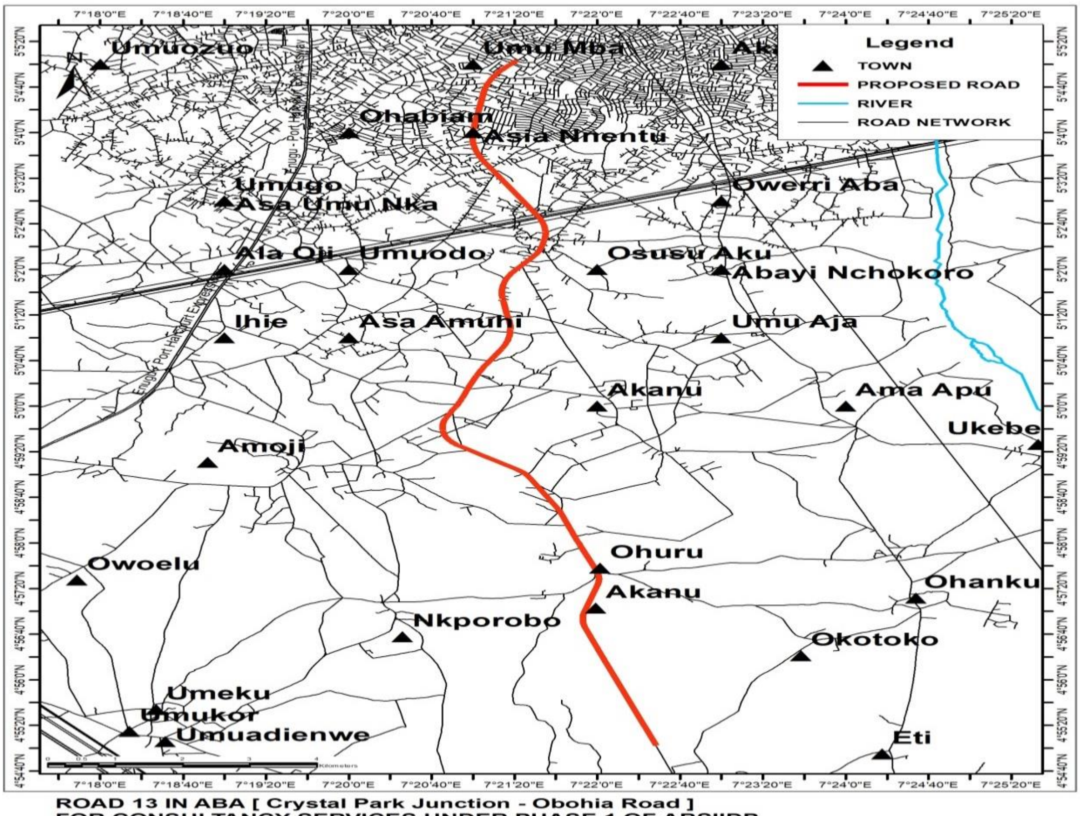


ROAD 16 IN ABA [Eziama Ntigha – Nsirimo – Ubakala]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP

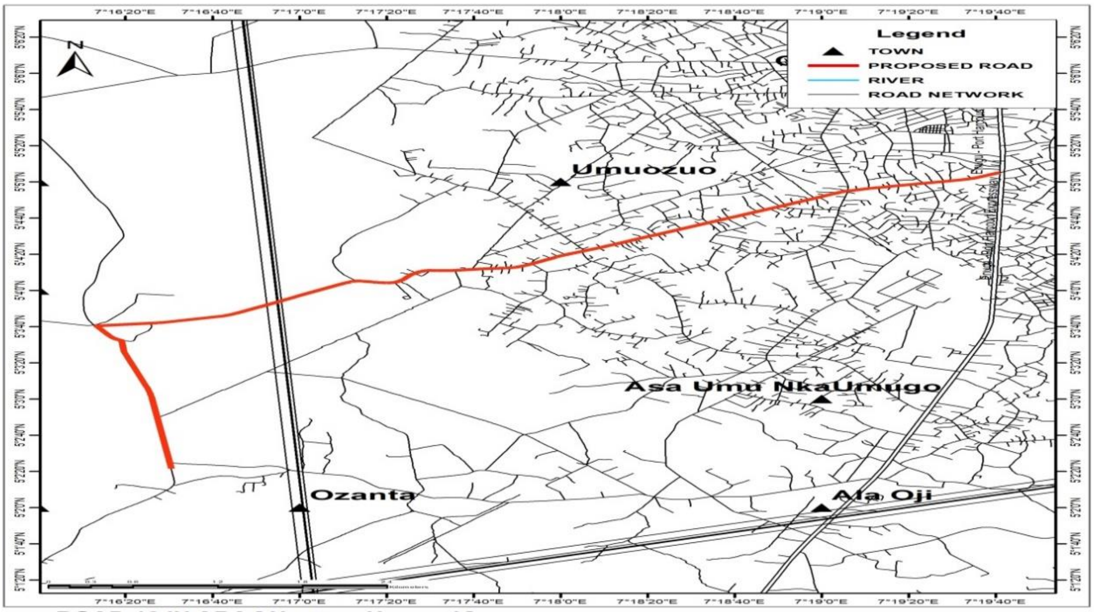


ROAD 15 IN ABA [Umuaro Nenu Road]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP

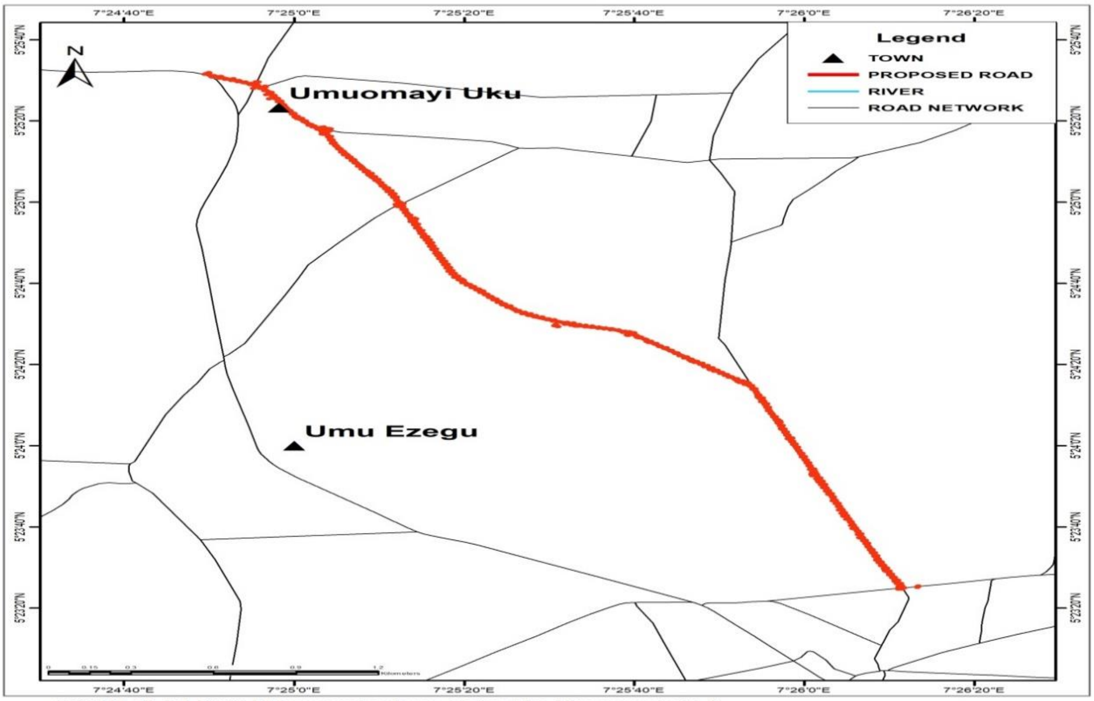
ROAD 14 IN ABA [Immaculate Avenue – ITF Rod Bridge]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP



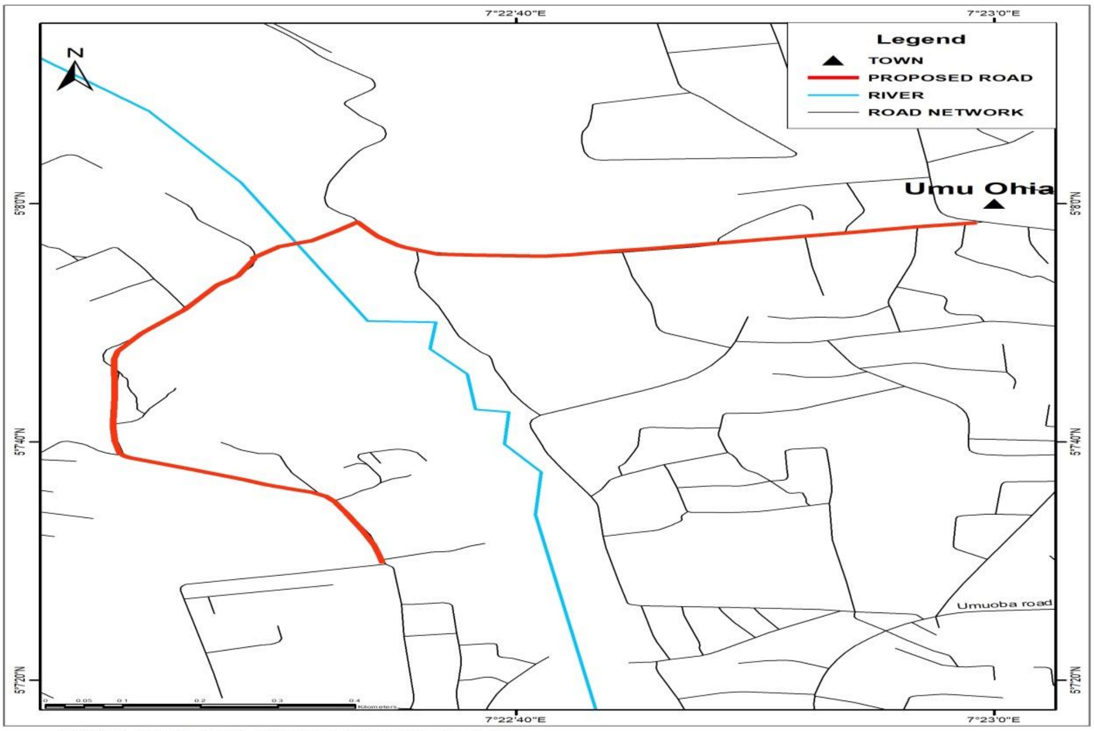
ROAD 13 IN ABA [Crystal Park Junction - Obohia Road]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP



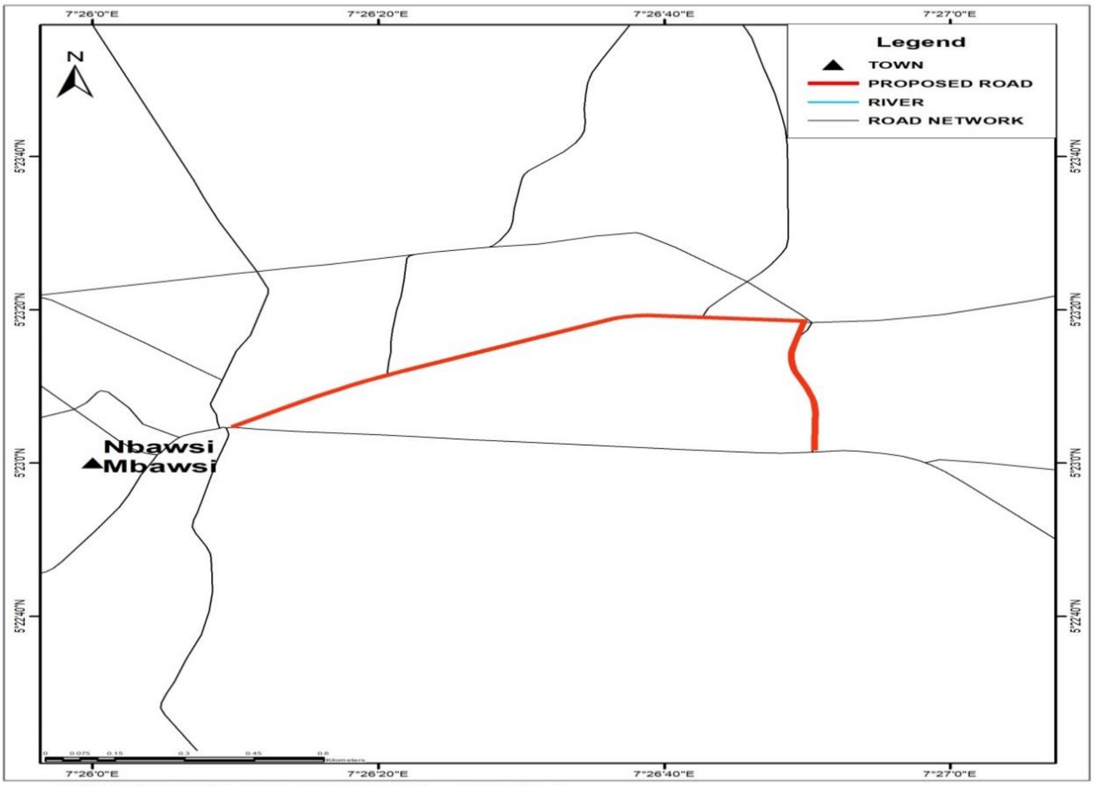
ROAD 12 IN ABA [Uratta – Ugwuati]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP



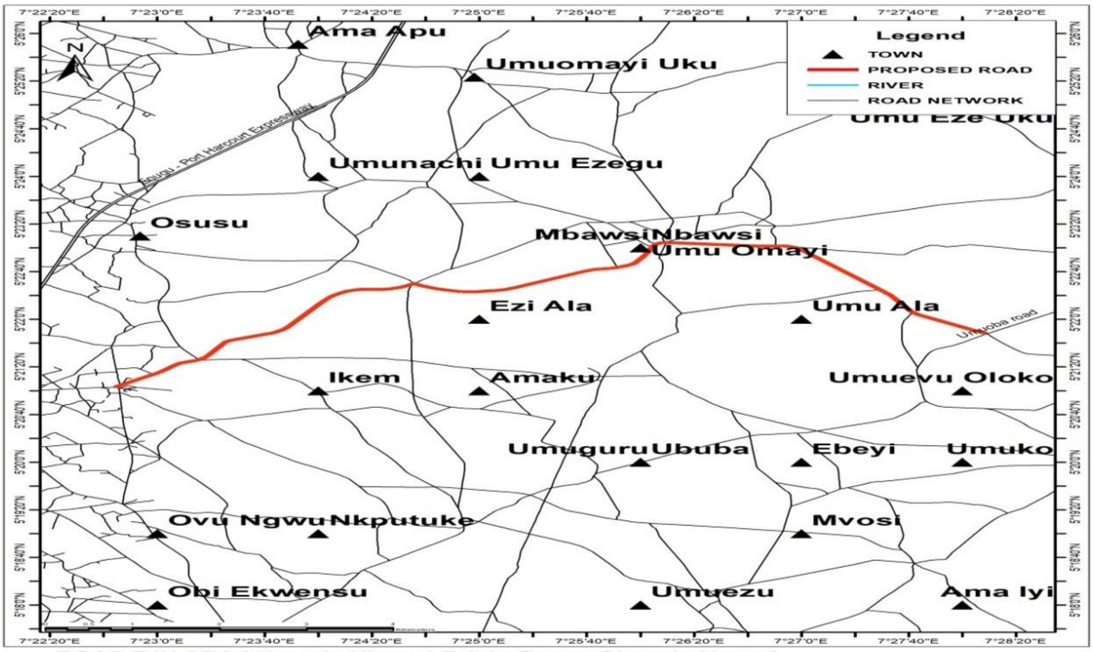
ROAD 11 IN ABA [Umuomiaukwu Agburike Umuomainta]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP



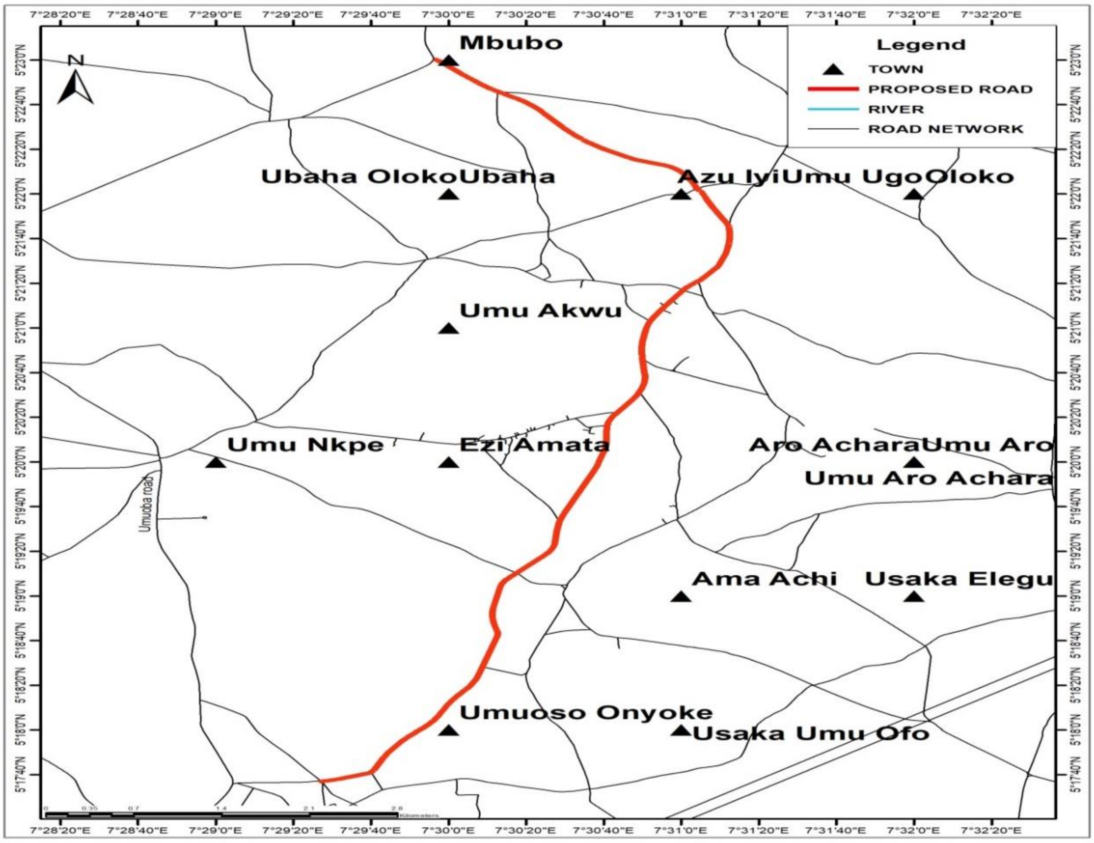
ROAD 10 IN ABA [Glass Factory Road]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP



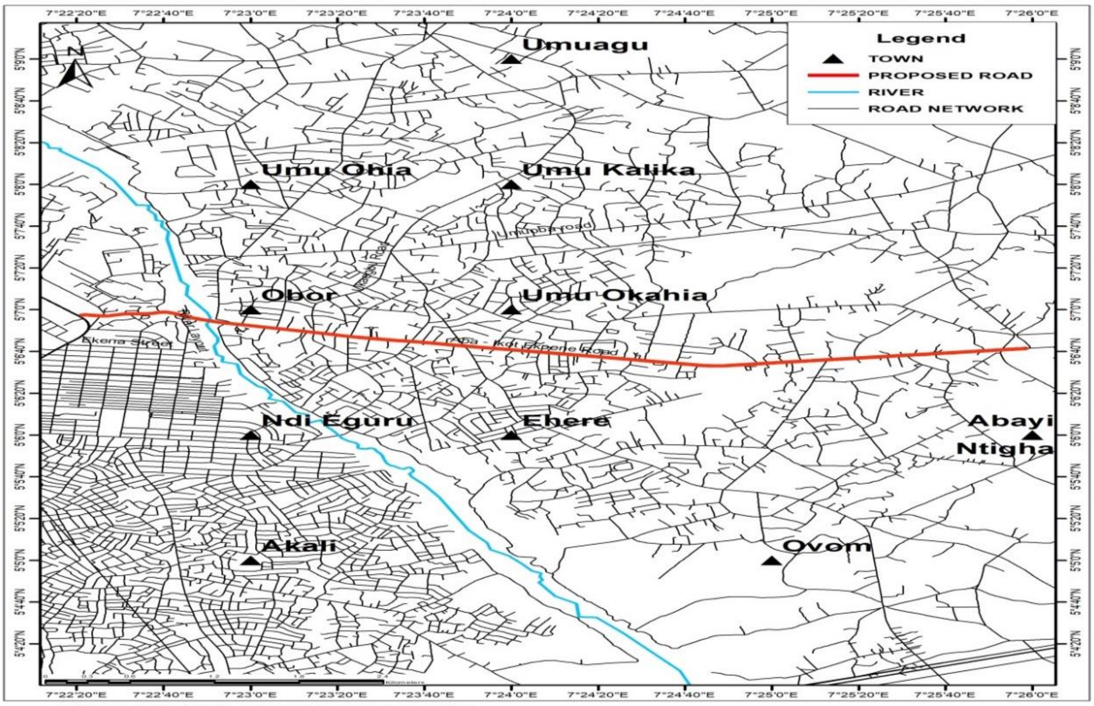
ROAD 9 IN ABA [Mbawsi Layout – Ururuka]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP



ROAD 7 IN ABA [Umuala Nbawsi Eziala Osusu Okpuala Ngwa]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP

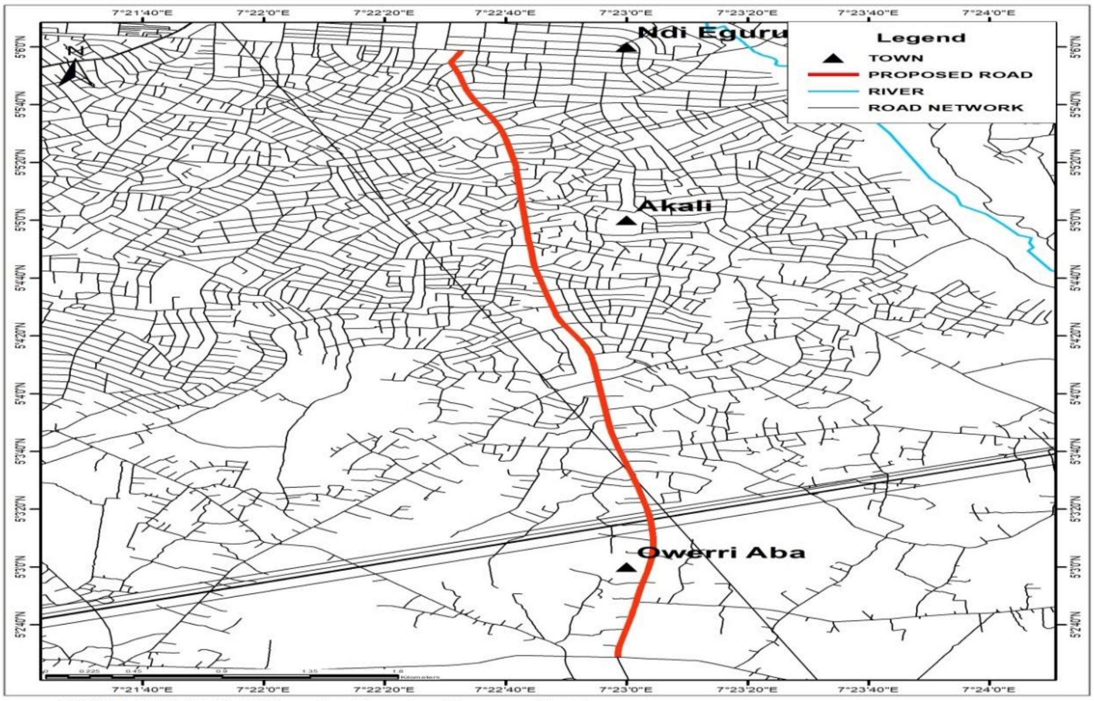


ROAD 6 IN ABA [Mbubo Umuogele Amachi Mgbokonta]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP

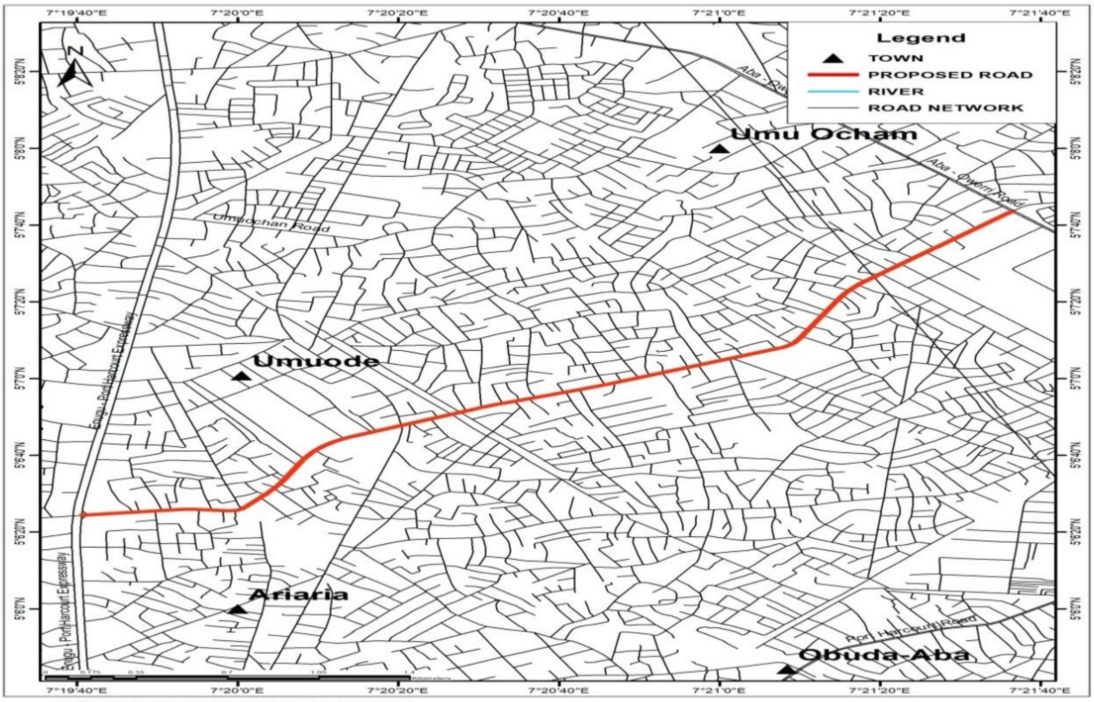


ROAD 5 IN ABA [Ikot Ekpene Road]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP

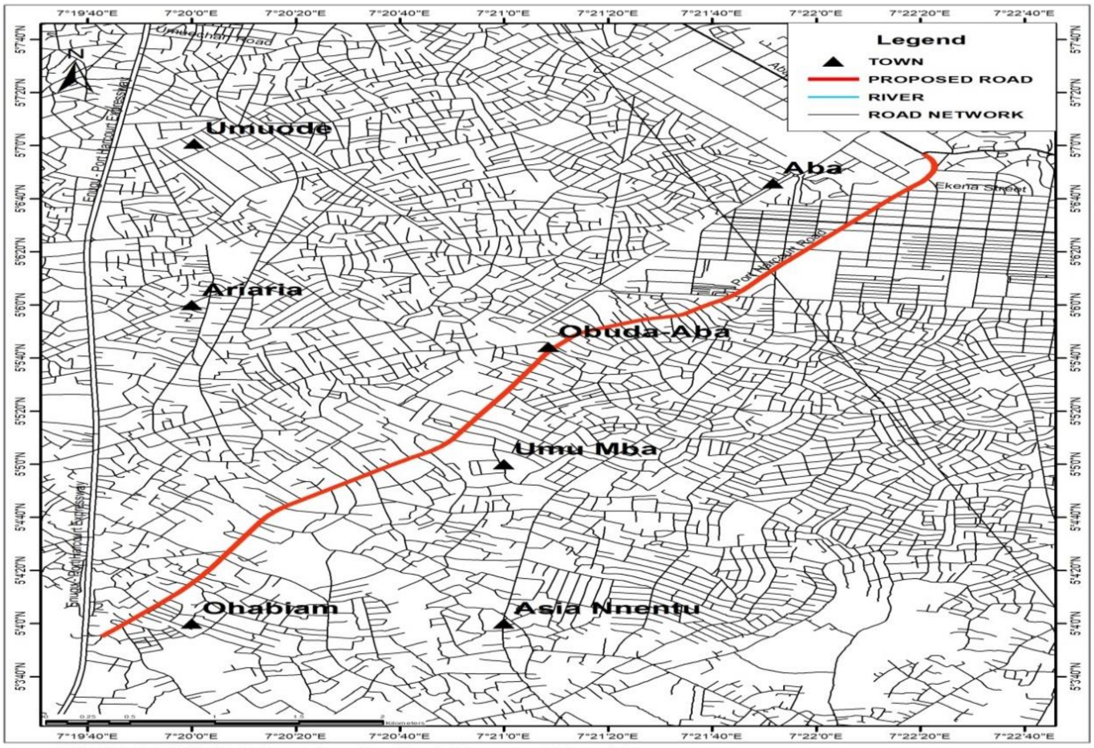
ROAD 4 IN ABA [Omuma Road]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP



ROAD 3 IN ABA [Ohanku Road – Owerre Aba]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP



ROAD 2 IN ABA [Faulks Road]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP



ROAD 1 IN ABA [Asa Road – Port Harcourt Road]
FOR CONSULTANCY SERVICES UNDER PHASE 1 OF ABSIIDP

Appendix 4: 4: Air Quality Status in Project Area											
Station Code	Description	Coordinates	SPM(ug/m3)		NOx	H2S	SOx	CO	VOC	Noise(dB)	
		Lat. (N) /Long. (E)	2.5	10	ppm					Low	High
1	Aba Road-Port Harcourt	0315027-0319479 0560457-0565299	10.2	19.6	0.001	0.000	0.000	0.000	0.12	59.8	76.2
2	Faulks Road	03176931-0314713 0564707-0566619	15.2	32.3	0.001	0.000	0.001	0.000	0.13	66.9	72.0
3	Ohanku Road-Owerre Aba	0319940-03208115 0554086 - 0563896	14.5	31.6	0.001	0.001	0.000	0.000	0.15	57.8	72.1
4	Omuma Road	0315706-0318335 0564424-0565129	15.6	35.1	0.000	0.001	0.000	0.000	0.17	56.9	71.0
5	Ikot Ekpene Road	0319591-0325482 0564991-0565691	15.6	42.1	0.002	0.000	0.000	0.000	0.72	69.0	77.4
6	Mbubo Umuogele Amachi Mgbokonta	0333713-0334509 0594563-	42.5	65.8	0.001	0.000	0.000	0.000	0.13	60.1	64.3

Appendix 4: 4: Air Quality Status in Project Area												
Station Code	Description	Coordinates	SPM(ug/m3)		NOx	H2S	SOx	CO	VOC	Noise(dB)	
		Lat. (N) /Long. (E)	2.5	10	ppm					Low	High
		0595230									
7	Umuala Nbawsi Eziala Osusu Okpuala Ngwa	03225847-0330387 0594196 - 0595924	15.3	35.4	0.001	0.001	0.001	0.000	0.15	66.4	73.5
8	Omoba-Umuaja Amaede Ndiolumbe	0324698-0331032	50.4	64.0	0.001	0.000	0.000	0.000	0.12	59.8	76.2
9	Mbawsi Layout-Ururuka	0327651-0331850 0595407-0597752	15.4	25.5	0.001	0.000	0.001	0.000	0.13	66.9	72.0
10	Glass Factory Road	0320659-0321184 0566591-0570801	44.1	65.2	0.001	0.001	0.000	0.000	0.15	57.8	72.1
11	Umuomiaukwu Agburike Umuomainta	0324294-0326793 0595941 - 0599892	60.4	70.1	0.000	0.001	0.000	0.000	0.17	56.9	71.0
12	Uratta-Ugwuati	0308408-0314646	48.0	54.5	0.002	0.000	0.000	0.000	0.72	69.0	77.4

Appendix 4: 4: Air Quality Status in Project Area											
Station Code	Description	Coordinates	SPM(ug/m3)		NOx	H2S	SOx	CO	VOC	Noise(dB)	
		Lat. (N) /Long. (E)	2.5	10	ppm					Low	High
		0559708-0562268									
13	Crystal Park Junction-Obohia Road	0317135 - 0318683 0555153-0564042-	20.1	35.0	0.001	0.000	0.000	0.000	0.13	60.1	64.3
14	Immaculate Avenue-ITF Road Bridge	0318029-0318662 0567384-0568149	38.7	49.5	0.001	0.000	0.000	0.000	0.12	59.8	76.2
15	Umuaro Nenu Road	0331375-0335289 0579695-0583459	38.4	54.5	0.001	0.000	0.001	0.000	0.13	66.9	72.0
16	Eziama Ntigha-Nsirimo-Ubakala	0319997-0325347 0601022-0604947	44.0	55.0	0.001	0.001	0.000	0.000	0.15	57.8	72.1
17	Mgboko-Omoba	0321322-	38.6	44.0	0.000	0.001	0.000	0.000	0.17	56.9	71.0

Appendix 4: 4: Air Quality Status in Project Area												
Station Code	Description	Coordinates	SPM(ug/m3)		NOx	H2S	SOx	CO	VOC	Noise(dB)	
		Lat. (N) /Long. (E)	2.5	10	ppm					Low	High
	Umuezeukwu Mbwawsi Road	0324021 0573317- 0582722									
18	Ibeme Ndiakata-Nlagu Onicha Ngwa	0335196- 0336751 0561474- 0568326	40.1	48.0	0.002	0.000	0.000	0.000	0.72	69.0	77.4
19	Pepple Road-Akpu Road	0321484- 0321726 0564007- 0564991	35.2	45.1	0.001	0.000	0.000	0.000	0.13	60.1	64.3
20	Umuokpo-Ahiafor Link Road	0331472- 0333611 0567374- 0570724-	10.2	19.6	0.001	0.000	0.000	0.000	0.12	59.8	76.2
21	Owerra Aba-Osusu Umuelendu-Osusuaku	0305248 - 0312055 0566814- 0568733	15.2	32.3	0.001	0.000	0.001	0.000	0.13	66.9	72.0
22	Umuojima Amapuife Eberi Omuma	0314837 - 0317330 0568108-	14.5	31.6	0.001	0.001	0.000	0.000	0.15	57.8	72.1

Appendix 4: 4: Air Quality Status in Project Area											
Station Code	Description	Coordinates	SPM(ug/m3)		NOx	H2S	SOx	CO	VOC	Noise(dB)	
		Lat. (N) /Long. (E)	2.5	10	ppm					Low	High
		0568645									
23	Umuimo Carol Pee. Ministry of Agric. Shopping Mall	0307680-0308376 0559701-0563393-	15.6	35.1	0.000	0.001	0.000	0.000	0.17	56.9	71.0
24	Ugwuati-Umuiku	0307680-0308376 0559701-0563393	15.6	42.1	0.002	0.000	0.000	0.000	0.72	69.0	77.4
25	Isicourt-Ururuka Umuosu Umuala Umunkpeyi	0331827-0333640 0594082-0604693	12.5	25.8	0.001	0.000	0.000	0.000	0.13	60.1	64.3
26	Ama Emereole-Ekeonyeugba-UmokoromiriEketa	0318731 - 0321751 0585138-0587543	10.2	19.6	0.001	0.000	0.000	0.000	0.12	59.8	76.2
27	Ajiwe-Brass	0317917 - 0317980 0566840 – 0567380	15.2	32.3	0.001	0.000	0.001	0.000	0.13	66.9	72.0
28	Ahunanya-Immaculate	0317967 - 0318277	40.1	58.0	0.001	0.001	0.000	0.000	0.15	57.8	72.1

Appendix 4: 4: Air Quality Status in Project Area												
Station Code	Description	Coordinates	SPM(ug/m3)		NOx	H2S	SOx	CO	VOC	Noise(dB)	
		Lat. (N) /Long. (E)	2.5	10	ppm					Low	High
		0567809-0568014									
29	Oron Road-Elizabbeth Avenue-Sports Club	0318397 - 0318869 0566201-0566706	15.4	28.1	0.000	0.001	0.000	0.000	0.17	56.9	71.0
30	Umuala-Umuakwu-Ohuhu-Nsulu-Oloko Ikwuano	0330380-0338079 0593027-0596380	12.5	30.2	0.002	0.000	0.000	0.000	0.72	69.0	77.4
31	Itungwa-Agburukwe Road	0330168-0333582 0574175-0575718	17.0	35.6	0.001	0.000	0.000	0.000	0.13	60.1	64.3
Min			10.2	19.6	0.000	0.000	0.000	0.000	0.12	56.9	64.3
Max			15.8	42.1	0.002	0.001	0.001	0.000	0.72	69.0	77.4
Mean			14.6	33.1	0.001	0.000429	0.000286	0.000	0.22	62.4	72.3
FMEnv			NS	NS	0.04-0.06	0.008	0.1	10	1.9	90	

Appendix 4.4a Air Quality Benchmarks

Nigerian Ambient Air Quality Standards**

Pollutants	Time of Average	Limit
Particulates	Daily average of hourly values Hourly value	250□g/m3 600*□g/m3
SOx as SO2	Daily average of hourly values Hourly value	0.01ppm (26□g/m3) 0.1ppm (260□g/m3)
NOx as NO2	Daily average of hourly values (range)	0.04 – 0.06ppm (75-113□g/m3)
Carbon Monoxide	Daily average of hourly values 8 - hourly range	10ppm (11.4mg/m3) 20ppm (22.8mg/m3)
Petrochemical Oxidants	Hourly value	0.66ppm
Non-Methane Hydrocarbon	Daily average of 3-hourly values	160□g/m3

*Note: Concentration not to be exceeded for more than once a year

**Guidelines and Standards for Environmental Pollution Control in Nigeria Federal Environmental Protection Agency, 1991.

: WHO Air Quality Guidelines

Pollutants	Time- Weighted Averagea	Averaging time
SO2	500 300 100 - 150b 40 - 60b	10min 1h 24h 1yr
CO	30 10	1h 8h
NO2	400 150	1h 24h
O3	150 – 200 100 – 120	1h 8h
Black smoke	100 – 150 40 - 60b	24hr 1yr
Total suspended particulates	150 - 230b 60 - 90b	24hr 1yr
Thoracic particles (PM10)	70b	24hr
Pb	0.5 – 1	1yr

All concentrations in µgm-3 except CO in mgm-3

Guideline values for combined exposure to SO2 and suspended particulate matter (they may not apply to situations where only one of the components is present)

a to protect health b to protect public welfare

The above Table deals with Air Quality only.

US National Ambient Air Quality Standards (NAAQS)

Pollutants	Average Time	Primary Standard
SO2	3h 24h Annual average	- 365□gm-3 (0.14ppm) 80□gm-3

NO2	Annual average	100□gm-3 (0.05ppm)
NO	1h 8h	40mgm-3 (35ppm) 10mgm-3 (9ppm)
O3	1h	235□gm-3 (0.12ppm)
Black smoke	100-150 40-60b	24hr 1yr
PM10 (d□10□m)	24h Annual average	150□gm-3 50□gm-3
Pb	3months	1.5gm-3

Appendix 6.1: General Environmental Management Conditions For Construction Contracts
Project Concept Development schedule must be clearly defined and timing of construction spread evenly and according to phases. The innovative concept of design with nature, will not only minimize the impact of the project on the environment thus making it environmentally acceptable but will also enhance the project visually. Some of the concepts that are impeded in the concept that must be promoted in the final stage include: Making use of natural topography where possible; Exploiting natural features to merit and Balancing cut and fill. Designing The design needs to incorporate the findings of this ESMP or any other studies conducted such as hydrological, geo-technical or soil erosion risk areas. Mitigating measures proposed to minimize environmental impact need to be incorporated into the project design. Design of silt ponds and retention ponds for example should be able to cope with the surface run-off during construction and the most adverse weather conditions. Construction and Operation During construction, earthwork is the most critical stage and the problems of soil erosion need to be urgently addressed. Soil erosion created a host of other associated problems including siltation, deterioration of water quality and flooding of areas downstream offsite. Control of Earthworks Earthworks contribute the highest impact if not carried out with proper environmental control.. There is a need to plan the earthworks and implement control measures at the earliest stage. Appropriate sediment control measures must be put in place before earthworks commence. Earthworks shall be scheduled to avoid rainy season and detailed earthworks plan shall be prepared and endorsed by a professional engineer. Environmental Code of Conduct- Integrating into project design and tender documents The mitigation measures and the general Environmental code of Conduct developed herewith shall be integrated into the project design and tender documents. Using this approach, the mitigation measures and code of conduct will automatically become part of the project implementation. By including mitigation measures in the contract or in specific items in the Bill of Quantities, monitoring and supervision, mitigation measure implementation shall be covered under the normal engineering supervision provisions of the contract. This is considered necessary in order to hold Contractors financially and in some cases criminally liable for adverse impact that result from failure to implement contracted required mitigated measures and code of conduct. The levels at which these shall be incorporated are outlined below: Project Design The mitigation measures should be integrated in the design of the project itself. Such a step will enhance the mitigation measures in terms of specific mitigation design, cost estimation of the mitigation measure, and specific implementation criteria. The mitigation measure integration in the design phase will also help in strengthening the benefits and sustainability of the project. Project Contract The project contractor should be bound by the parameters identified in the environmental and social assessment pertaining to specific mitigation measures in the contract. The final

acceptance of the completed works should not occur until the environmental clauses have been satisfactorily implemented.

Bill of Quantities

The tender instruction to bidders should explicitly mention the site-specific mitigation measures to be performed, the materials to be used, labor camp arrangements, and waste disposal areas, as well other site specific environmental requirements. Such a definition would clearly exhibit the cost requirement to undertake mitigation measures, which otherwise might be lost as the bidders in an attempt to be more competitive may not include the price realistic enough to fund mitigation measures and other protection measures.

Supervision and Monitoring

The purpose of supervision is to make sure that specific mitigation parameters identified in the environmental and social assessment and as bound by the contract is satisfactorily implemented. Likewise, monitoring is necessary such that the mitigation measures are actually put into practice.

Social Integration and Participation

As a matter of principles, Social inclusions or community participation in the site project execution shall be managed, in particular through the inclusion of clauses that involve the following measures:

Community participation - Participation in decision- making built into the planning and implementation of the intervention works to allow local people a voice in matters concerning them.

Integration with host populations & promotion of social inclusion - Use existing local groups such as the site committees rather than form new ones –

Social Inclusion & Avoidance of elite Capture/ Vulnerable groups- Include special efforts (affirmative action) to fully integrate socially marginalized people into the society

Gender issues- The empowerment of women is essential for public good, so ensure opportunities to involve at least 50% women

Implementation Arrangements- Include and ensure community participation and oversight of the intervention work

Accountability in the use of public funds - Ensure participatory planning, budgeting and monitoring and public information dissemination on fund use

Implementation schedule - Affected persons and site committee members/CDOs/CDAs should be abreast of the schedule

Project Monitoring - Ensure local communities play a role in the monitoring framework.

Erosion and Sediment Control Plan

Contractor should develop an Erosion and Sediment Control Plan with the objectives to:

Minimize disturbance to areas where erosion may occur, including steep slopes and exposed land

Stage construction to minimize the area worked on at any one time, to minimize the extent and duration of temporary stockpiles and to ensure revegetation can occur in a staged manner, so as to reduce the risk of silt/sediment running off the site and entering the downstream receiving environment

Ensure exposed areas are stabilized as soon as practicable by sowing or mulching to prevent erosion

Install perimeter controls such as diversion drains, silt fences and a construction entrance to prevent sediment leaving the site

Install temporary decanting earth bunds for silt/sediment removal from runoff.

Install temporary sediment removal ponds for silt/sediment removal from runoff provide guidance in case of unforeseen events including poor weather ensure all control measures are inspected and repaired after storm events

Ensure that the site is rehabilitated prior to the removal of sediment control measures

Mitigate dust emissions from the site during earthworks so as not to adversely affect any nearby properties

Minimize potential environmental effects.

Control of Water Quality

Other than sediment that can cause deterioration of water quality, the discharge of untreated sewage and sullage especially form workers' quarters can be another source of pollutants. Temporary sanitary facilities that comply with the requirements of Sewerage Services should be provided in the workers quarters.

Waste Management Plan

Dispose overburden or earth spoils in designated spoil tips. Open burning of waste, construction materials such as formworks and bio-mass removed is strictly prohibited. These materials should be chipped and carted away to appropriate location or used as fuel.

Create awareness amongst community members not to dump waste

5.5.6 Control of Air and Noise Pollution

As the need arises, water spraying facility shall be provided during earthworks and wheels of vehicles or machinery used for transportation of construction materials shall be cleaned before leaving the construction site so as not to litter the roads with mud and soil.

Generally, noise in the boundary of the site shall be controlled with the use of manual machines that are equally effective as much as possible and noise level shall not exceed 55 dB(A) during the day as much as possible.

5.7 Example Format: EHS Incident Notification

EHS Incident Notification

Provide within 24 hrs to the Supervising Engineer

Originators Reference No:...

Date of Incident:... Time:........................

Location of incident:...

Name of Person(s) involved:...

Employing Company:..

Type of Incident:...

Description of Incident:

Where, when, what, how, who, operation in progress at the time (only factual)

Immediate Action:

Immediate remedial action and actions taken to prevent reoccurrence or escalation

Signature (Name, Title, Date):...

Contractor Representative

Contract: Period of reporting:

EHS management actions/measures:

Summarize EHS management actions/measures taken during period of reporting, including planning and management activities (e.g. risk and impact assessments), EHS training, specific design and work measures taken, etc.

Appendix 6.1: General Environmental Management Conditions For Construction Contracts

EHS incidents:

Report on any problems encountered in relation to EHS aspects, including its consequences (delays, costs) and corrective measures taken. Include relevant incident reports.

EHS compliance:

Report on compliance with Contract EHS conditions, including any cases of non-compliance.

Changes:

Report on any changes of assumptions, conditions, measures, designs and actual works in relation to EHS aspects.

Concerns and observations:

Report on any observations, concerns raised and/or decisions taken with regard to EHS management during site meetings and visits.

Signature (Name, Title Date):

Contractor Representative

Nigerian Ambient Air Quality Standards**

Pollutants	**Time of Average**	**Limit**
Particulates	Daily average of hourly values Hourly value	250μg/m^3 600*μg/m^3
SO_x as SO_2	Daily average of hourly values Hourly value	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

**Note: Concentration not to be exceeded for more than once a year*

*****Guidelines and Standards for Environmental Pollution Control in Nigeria Federal Environmental Protection Agency, 1991.***

: WHO Air Quality Guidelines

Pollutants	**Time- Weighted Average**[a]	***Averaging time***
SO_2	500 300 100 - 150[b] 40 - 60[b]	10min 1h 24h 1yr
CO	30 10	1h 8h
NO_2	400 150	1h 24h

O_3	150 – 200 100 – 120	1h 8h
Black smoke	100 – 150 40 - 60[b]	24hr 1yr
Total suspended particulates	150 - 230[b] 60 - 90[b]	24hr 1yr
Thoracic particles (PM_{10})	70[b]	24hr
Pb	0.5 – 1	1yr

- *All concentrations in µgm^{-3} except CO in mgm^{-3}*
- *Guideline values for combined exposure to SO_2 and suspended particulate matter (they may not apply to situations where only one of the components is present)*

a to protect health b to protect public welfare

The above Table deals with Air Quality only.

US National Ambient Air Quality Standards (NAAQS)

Pollutants	**Average Time**	**Primary Standard**
SO_2	3h 24h Annual average	- 365□gm^{-3} (0.14ppm) 80□gm^{-3}
NO_2	Annual average	100□gm^{-3} (0.05ppm)
NO	1h 8h	40mgm^{-3} (35ppm) 10mgm^{-3} (9ppm)
O_3	1h	235□gm^{-3} (0.12ppm)
Black smoke	100-150 40-60[b]	24hr 1yr
PM10 (d□10□m)	24h Annual average	150□gm^{-3} 50□gm^{-3}
Pb	3months	1.5gm^{-3}

Appendix 6.1 Environmental and Social Code of Conduct for Contractors

SN	Enviro	Potential Impact	Codes of Conduct
		Pre-construction/Construction Phase	
1	Land Use		• Plan road alignment to minimize loss of resources. • Avoid width of road of more than 4.5 m in hilly area. • Demarcate RoW to avoid encroachment.
2	Material Use	Excess extraction of local resources, such as wood, sand, soil, boulders, etc.	• Extract materials only on need basis. • Avoid sensitive areas, such as steep slopes and water-ways.
3	Slope Stability	Extraction of forest products and cutting of trees in the steep slopes increases soil erosion/landslide due to loss of soil binding materials. Wrong alignment can trigger	• Extract carefully and secure the top soil within 25 cm from the surface. • Limit down grading of the road to 50. • If down grading exceeds 70, construction of side drainage is necessary. • Keep optimum balance in extraction and filling of soil works. • geo-hazardous assessment and
4	Wildlife	Wildlife habitats at forests, shrub land along road alignment are affected from the road construction activities.	• Avoid as much as possible areas with high biodiversity. • Efficient movement of machinery and other traffic. • Control poaching activities and regulate movement of labor force and their dependents into the forest area.
5	Drainage	Higher flow rate of surface water and water logging induce land	• It is strongly recommended that the cross drainage outlets must be channeled to the confirmed natural drains.
6	Protection of Vegetation	Protected areas and highly forested areas. Degradation of forest areas. Degradation of agricultural land.	• Use minimum and efficient use of wood products for construction. • Initiate plantation at damaged and damage prone areas. • Increase liability of local forest user groups. Avoid protected areas or densely forested areas
7	Disposal of Construction Wastes	Dumping of wastes along the road or elsewhere.	• Selected spoil dumping sites should be used. After disposal, the area should be leveled and compacted. • It is recommended to conserve the soil by planting indigenous plants including grasses. Wastes could also be used as leveling materials along the
8	Disposal	Unmanaged sanitary	• Proper sanitation area needs to be

9	Impacts on amenities along RoW	Road crossings at water supply, irrigation lines may be disturbed/damaged.	• Avoid as much as possible the crossing over such amenities.
10	Pollution	Dust generation from construction activities, construction vehicular movement increases air pollution.	• Possibly construction period should be during August to December when soil moisture content is most. • Consider construction of road at 50 m from settlement.
1. Operation Phase			
1	Encroachm	Unmanaged settlement,	• Establish RoW properly and enforce its
2	Interruption of Water Flow	Concentrated flow left unattended might have severe impact at the downhill alignment of	• Cross drain structures, namely pipe culverts, slab culverts, box culverts, need to be maintained. Outlet of these structures would be carrying the concentrated run off flow of the respective catchment, which
3	Pollution/V	Dust generation from	Enforce speed limit of vehicles.

Appendix 3: Environmental Hazard Management - Suggested Code of Conduct and Clauses for Contractors

General

1. As part of Environmental Hazard Management, the Contractor shall be made to comply with the principles for good practices through the implementation of all measures necessary to avoid undesirable adverse environmental and social impacts, wherever possible as well as restore work sites to acceptable standards, and abide by any environmental performance requirements by law or specified in this ESIA report. In general, these measures shall include but not be limited to:

a. Minimize the effect of dust on the surrounding environment resulting from earth mixing sites, asphalt mixing sites, dispersing coal ashes, vibrating equipment, temporary access infrastructure such as roads, etc. to ensure safety, health and the protection of workers and communities living in the vicinity dust producing activities.
b. Ensure that noise levels emanating from machinery, vehicles and noisy construction activities (e.g., excavation, blasting) are kept at a minimum for the safety, health and protection of workers within the vicinity of high noise levels and nearby communities.
c. Ensure that existing water flow regimes in rivers, streams and other natural or irrigation channels is maintained and/or re-established where they are disrupted due to works being carried out.
d. Prevent bitumen, oils, lubricants and waste water used or produced during the execution of works from entering into rivers, streams, irrigation channels and other natural water bodies/reservoirs, and also ensure that stagnant water in uncovered burrow pits is treated in the best way to avoid creating possible breeding grounds for mosquitoes.
e. Prevent and minimize the impacts of quarrying, earth burrowing, piling and building of temporary construction camps and access infrastructure such as roads on the biophysical environment including protected areas and arable lands; local communities and their settlements. As much as possible, restore/rehabilitate all sites to acceptable standards.
f. Upon discovery of ancient heritage, relics or anything that might or believed to be of archaeological or historical importance during the execution of works, immediately report such findings to the SE so that the appropriate authorities may be expeditiously contacted for fulfilment of the measures aimed at protecting such historical or archaeological resources.
g. Discourage construction workers from engaging in the exploitation of natural resources such as hunting, fishing, collection of forest products or any other activity that might have a negative impact on the social and economic welfare of the local communities.
h. Implement soil erosion control measures in order to avoid surface run off and prevents siltation, etc.
i. Ensure that garbage, sanitation and drinking water facilities are provided in construction workers camps.
j. Ensure that as much as possible, local materials are used to avoid importation of foreign material and long-distance transportation.
k. Ensure public safety, and meet traffic safety requirements for the operation of work to avoid accidents.

2. The Contractor shall indicate the period within which he/she shall maintain status on site after completion of civil works to ensure that significant adverse impacts arising from such works have been appropriately addressed.

3. The Contractor shall adhere to the proposed activity implementation schedule and the monitoring plan / strategy to ensure effective feedback of monitoring information to project management so that impact management can be implemented properly, and if necessary, adapt to changing and unforeseen conditions.

4. Besides the regular inspection of the sites by the relevant government authority and other supervising agencies for adherence to the contract conditions and specifications, the contractor will appoint an Inspector to oversee the compliance with these environmental conditions and any proposed mitigation measures. State environmental authorities may carry out similar inspection duties. In all cases, the Contractor shall comply with directives from such inspectors to implement measures required to ensure the adequacy rehabilitation measures carried out on the bio-physical environment and compensation for socio-economic disruption resulting from implementation of any works.

Worksite/Campsite Waste Management

Appendix 3: Environmental Hazard Management - Suggested Code of Conduct and Clauses for Contractors

a) All vessels (drums, containers, bags, etc.) containing oil/fuel/surfacing materials and other hazardous chemicals shall be bunded in order to contain spillage. All waste containers, litter and any other waste generated during the construction shall be collected and disposed off at designated disposal sites in line with applicable government waste management regulations.

b) All drainage and effluent from storage areas, workshops and camp sites shall be captured and treated before being discharged into the drainage system in line with applicable government water pollution control regulations.

c) Used oil from maintenance shall be collected and disposed off appropriately at designated sites or be re-used or sold for re-use locally.

d) Entry of runoff to the site shall be restricted by constructing diversion channels or holding structures such as banks, drains, dams, etc. to reduce the potential of soil erosion and water pollution.

e) Construction waste shall not be left in stockpiles along the infrastructure such as road, but removed and reused or disposed of on a daily basis.

f) If disposal sites for clean spoil are necessary, they shall be located in areas, approved by the SE, of low land use value and where they will not result in material being easily washed into drainage channels. Whenever possible, spoil materials should be placed in low-lying areas and should be compacted and planted with species indigenous to the locality.

Material Excavation and Deposit

a) The Contractor shall obtain appropriate licenses/permits from relevant authorities to operate quarries or burrow areas.

b) The location of quarries and burrow areas shall be subject to approval by relevant local and national authorities, including traditional authorities if the land on which the quarry or burrow areas falls within traditional land.

New extraction sites:

a) Shall not be located in the vicinity of settlement areas, cultural sites, wetlands or any other valued ecosystem component, or on high or steep ground or in areas of high scenic value, and shall not be located less than 1km from such areas.

b) Shall not be located adjacent to stream channels wherever possible to avoid siltation of river channels. Where they are located near water sources, burrow pits and perimeter drains shall surround quarry sites.

c) Shall not be located in archaeological areas. Excavations in the vicinity of such areas shall proceed with great care and shall be done in the presence of government authorities having a mandate for their protection.

d) Shall not be located in forest reserves. However, where there are no alternatives, permission shall be obtained from the appropriate authorities and an environmental impact study shall be conducted.

e) Shall be easily rehabilitated. Areas with minimal vegetation cover such as flat and bare ground, or areas covered with grass only or covered with shrubs less than 1.5m in height, are preferred.

f) Shall have clearly demarcated and marked boundaries to minimize vegetation clearing.

g) Vegetation clearing shall be restricted to the area required for safe operation of construction work. Vegetation clearing shall not be done more than two months in advance of operations.

h) Stockpile areas shall be located in areas where trees can act as buffers to prevent dust pollution. Perimeter drains shall be built around stockpile areas. Sediment and other pollutant traps shall be located at drainage exits from workings.

i) The Contractor shall deposit any excess material in accordance with the principles of the general conditions, and any applicable EMP, in areas approved by local authorities and/or the SE.

j) Areas for depositing hazardous materials such as contaminated liquid and solid materials shall be approved by the SE and appropriate local and/or national authorities before the commencement of work. Use of existing, approved sites shall be preferred over the establishment of new sites.

Rehabilitation and Soil Erosion Prevention

Appendix 3: Environmental Hazard Management - Suggested Code of Conduct and Clauses for Contractors
a) To the extent practicable, the Contractor shall rehabilitate the site progressively so that the rate of rehabilitation is similar to the rate of construction. b) Always remove and retain topsoil for subsequent rehabilitation. Soils shall not be stripped when they are wet as this can lead to soil compaction and loss of structure. c) Topsoil shall not be stored in large heaps. Low mounds of no more than 1 to 2m high are recommended. d) Re-vegetate stockpiles to protect the soil from erosion, discourage weeds and maintain an active population of beneficial soil microbes. e) Locate stockpiles where they will not be disturbed by future construction activities. f) To the extent practicable, reinstate natural drainage patterns where they have been altered or impaired. g) Remove toxic materials and dispose of them in designated sites. Backfill excavated areas with soils or overburden that is free of foreign material that could pollute groundwater and soil. h) Identify potentially toxic overburden and screen with suitable material to prevent mobilization of toxins. i) Ensure reshaped land is formed so as to be inherently stable, adequately drained and suitable for the desired long-term land use, and allow natural regeneration of vegetation. j) Minimize the long-term visual impact by creating landforms that are compatible with the adjacent landscape. k) Minimize erosion by wind and water both during and after the process of reinstatement. l) Compacted surfaces shall be deep ripped to relieve compaction unless subsurface conditions dictate otherwise. m) Revegetate with plant species that will control erosion, provide vegetative diversity and, through succession, contribute to a resilient ecosystem. The choice of plant species for rehabilitation shall be done in consultation with local research institutions, forest department and the local people.
Water Resources Management
a) The Contractor shall at all costs avoid conflicting with the water demands of local communities. b) Abstraction of both surface and underground water shall only be done with the consultation of the local community and after obtaining a permit from the relevant Water Authority. c) Abstraction of water from wetlands shall be avoided. Where necessary, authority must be obtained from relevant authorities. d) Temporary damming of streams and rivers shall be done in such a way as to avoid disrupting water supplies to communities downstream, and to maintains the ecological balance of the river system. e) No construction water containing spoils or site effluent, especially cement and oil, shall be allowed to flow into natural water drainage courses. f) Wash water from washing out of equipment shall not be discharged into water courses or infrastructure such as road drains. g) Site spoils and temporary stockpiles shall be located away from the drainage system, and surface run off shall be directed away from stockpiles to prevent erosion.
Traffic Management
a) Location of access infrastructure such as roads/detours shall be done in consultation with the local community especially in important or sensitive environments. Access infrastructure such as roads shall not traverse wetland areas. b) Upon the completion of civil works, all access infrastructures such as roads shall be ripped and rehabilitated. c) Access infrastructure such as roads shall be sprinkled with water at least five times a day in settled areas, and three times in unsettled areas, to suppress dust emissions.
Blasting
a) Blasting activities shall not take place less than 2km from settlement areas, cultural sites, or wetlands without the permission of the SE. b) Blasting activities shall be done during working hours, and local communities shall be consulted on the proposed blasting times. c) Noise levels reaching the communities from blasting activities shall not exceed 90 decibels.
Disposal of Unusable Elements
a) Unusable materials and construction elements such as electro-mechanical equipment, pipes, accessories and demolished structures will be disposed of in a manner approved by the SE. The Contractor must agree with the SE which elements are to be surrendered to the Client's premises, which will be recycled or reused, and which will be disposed of at approved landfill sites. b) As much as possible, abandoned pipelines shall remain in place. Where for any reason no alternative alignment for the new pipeline is possible, the old pipes shall be safely removed and stored at a safe place to be agreed upon with the SE and the local authorities concerned. c) AC-pipes as well as broken parts thereof must be treated as hazardous material and disposed of as specified above.

Appendix 3: Environmental Hazard Management - Suggested Code of Conduct and Clauses for Contractors	
d)	Unsuitable and demolished elements shall be dismantled to a size fitting on ordinary trucks for transport.
	Health and Safety
a)	In advance of the construction work, the Contractor shall mount an awareness and hygiene campaign. Workers and local residents shall be sensitized on health risks particularly of AIDS.
b)	Adequate infrastructure such as road signs to warn pedestrians and motorists of construction activities, diversions, etc. shall be provided at appropriate points.
c)	Construction vehicles shall not exceed maximum speed limit of 40km per hour.
	Repair of Private Property
a)	Should the Contractor, deliberately or accidentally, damage private property, he shall repair the property to the owner's satisfaction and at his own cost. For each repair, the Contractor shall obtain from the owner a certificate that the damage has been made good satisfactorily in order to indemnify the Client from subsequent claims.
b)	In cases where compensation for inconveniences, damage of crops etc. are claimed by the owner, the Client has to be informed by the Contractor through the SE. This compensation is in general settled under the responsibility of the Client before signing the Contract. In unforeseeable cases, the respective administrative entities of the Client will take care of compensation.
	Contractor's Environment, Health and Safety Management Plan (EHS-MP)
a)	Within 6 weeks of signing the Contract, the Contractor shall prepare an EHS-MP to ensure the adequate management of the health, safety, environmental and social aspects of the works, including implementation of the requirements of these general conditions and any specific requirements of an EMP for the works. The Contractor's EHS-MP will serve two main purposes:
b)	For the Contractor, for internal purposes, to ensure that all measures are put in place for adequate EHS management, and as an operational manual for his staff.
c)	For the Client, supported where necessary by a SE, to ensure that the Contractor is fully prepared for the adequate management of the EHS aspects of the project, and as a basis for the monitoring of the Contractor's EHS performance.
d)	The Contractor's EHS-MP shall provide at least:
•	a description of procedures and methods for complying with these general environmental management conditions, and any specific conditions specified in an EMP;
•	a description of specific mitigation measures that will be implemented in order to minimize adverse impacts;
•	a description of all planned monitoring activities (e.g. sediment discharges from burrow areas) and the reporting thereof; and the internal organizational, management and reporting mechanisms put in place for such.
•	The Contractor's EHS-MP will be reviewed and approved by the Client before start of the works. This review should demonstrate that the Contractor's EHS-MP has covered all of the identified impacts, and has defined appropriate measures to counteract any potential impacts.
	EHS Reporting
a)	The Contractor shall prepare bi-weekly progress reports to the SE in compliance with these general conditions, the project EMP if any, and his own EHS-MP. An example format for a Contractor EHS report is portrayed in Annex 6. It is expected that the Contractor's reports will include information on:
b)	EHS management actions/measures taken, including approvals sought from local or national authorities;
c)	Problems encountered in relation to EHS aspects (incidents, including delays, cost consequences, etc. as a result thereof);
d)	Lack of compliance with contract requirements on the part of the Contractor;
e)	Changes of assumptions, conditions, measures, designs and actual works in relation to EHS aspects; and
f)	Observations, concerns raised and/or decisions taken with regard to EHS management during site meetings.
g)	It is advisable that reporting of significant EHS incidents be done "as soon as practicable". Such incident reporting should be done individually. Also, it is advisable that the Contractor keep his own records on health, safety and welfare of persons, and damage to property. It is advisable that the include such records, as well as copies of incident reports, as Annexes to the bi-weekly reports. A sample format for an incident notification is shown below. Details of EHS performance will be

Appendix 3: Environmental Hazard Management - Suggested Code of Conduct and Clauses for Contractors	
	reported to the Client through the SE's reports to the Client.
	Training of Contractor's Personnel
a)	The Contractor shall provide sufficient training to his own personnel to ensure that they are all aware of the relevant aspects of these general conditions, any project EMP, and his own EHS-MP, and are able to fulfil their expected roles and functions. Specific training should be provided to those employees that have particular responsibilities associated with the implementation of the EHS-MP. General topics should be:
b)	EHS in general (working procedures);
c)	emergency procedures; and
d)	social and cultural aspects (awareness raising on social issues).
	Cost of Compliance
a)	It is expected that compliance with these conditions is already part of standard good workmanship and state of art as generally required under this Contract. The item "Compliance with Environmental Management
b)	Conditions" in the Bill of Quantities covers this cost. No other payments will be made to the Contractor for compliance with any request to avoid and/or mitigate an avoidable EHS impact.
Example Format: EHS Report	
a)	Contract:
b)	Period of reporting:
c)	EHS Management Actions/Measures:
d)	Summarize EHS management actions/measures taken during period of reporting, including planning and management activities (e.g. risk and impact assessments), EHS training, specific design and work measures taken, etc.
e)	EHS incidents:
f)	Report on any problems encountered in relation to EHS aspects, including its consequences (delays, costs) and corrective measures taken. Include relevant incident reports.
g)	EHS compliance:
h)	Report on compliance with Contract EHS conditions, including any cases of non-compliance.
i)	Changes:
j)	Report on any changes of assumptions, conditions, measures, designs and actual works in relation to EHS aspects.
k)	Concerns and observations:
l)	Report on any observations, concerns raised and/or decisions taken with regard to EHS management during site meetings and visits.
m)	Signature (Name, Title Date):
n)	Contractor Representative
EHS Incident Notification	

Appendix 3: Environmental Hazard Management - Suggested Code of Conduct and Clauses for Contractors
a) Provide within 24 hrs to the Supervising Engineer b) Originators Reference No: .... c) Date of Incident: .... d) Time: .... e) Location of incident: .... f) Name of Person(s) involved: .... g) Employing Company: .... h) Type of Incident: .... i) Description of Incident: j) Where, when, what, how, who, operation in progress at the time (only factual) k) Immediate Action: l) Immediate remedial action and actions taken to prevent reoccurrence or escalation m) Signature (Name, Title, Date): .... n) Contractor Representative