ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

Draft Report

OF THE PROPOSED

LAGOS – CALABAR COASTAL HIGHWAY

SECTION 2 KM 47.5KM - 104KM, LAGOS STATE

SUBMITTED TO

THE FEDERAL MINISTRY OF ENVIRONMENT

Abuja, Nigeria

BY

Federal Ministry of Works

Mabushi, Abuja

August, 2024

Report Preparation Summary

Project Title:	Environmental and Social Impact Assessment of the proposed Lagos – Calabar Coastal Highway **– Section 2**
Client:	Nigeria Federal Ministry of Works, on behalf of the Federal Government
Representative Department of Cleint	The Honourable Minister, Federal Ministry of Works, Mabushi, Abuja
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This Report Title	**Environmental and Social Impact Assessment (ESIA)**
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List of Acronyms & Abbreviations

%	Percent
AAA	Atomic absorption spectrometry
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)
BAT	Best Available Technology
BKP	Break point
BOD	Biochemical Oxygen Demand
Cd	Cadmium
CESMP	Construction ESMP
CIT	Companies income Tax
Cr	Chromium
CSD	Context Sensitive Design
cT	Tropical Continental
dB(A)	Decibels (A-weighted)
DBST 3.8	Double Bituminous Surface Treatment
DO	Dissolved Oxygen
DP	Development Partners
E&S	Environment and Safety
EA	Environmental Assessment (Audit)
EAG	Environmental Assessment Guidelines
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
EU	European Union
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
FGN	Federal Government of Nigeria
FMW	Federal Ministry of Works
FMEnv	Federal Ministry of Environment
FPMU	Federal Project Management Unit
FRN	Federal Republic of Nigeria
FRSC	Federal Roads Safety Commission
GBV	Gender Based Violence
GC	Gas Chromatography
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
IUCN	International Union for Conservation of Nature
JHA	Job Hazard Analysis
K	Pottasium
KII	Key Informant Interviews
km	Kilometer
LASEPA	Lagos State Environmental Protection Agency
LASBCA	Lagos State Building Control Agency
LASMIRA	Lagos State Infrastructure Maintenance and Regulatory Agency
LASWA	Lagos State Waterways Authority Law
LASPPA	Lagos State Physical Planning Permit Authority
LAWMA	Lagos State Waste Management Agency
LFTZ	Lekki Free Trade Zone
LFN	Laws of the Federation of Nigeria
LGA	Local Government Authority
LRFD	Load and Resistance Factor Design

LT-EDS	Long-Term Low Emissions Development
StrategyLTI	Lost Time Injuries
LTV	Long Term Vision
LVR	Low Volume Road
m	meter
M/s	Messrs
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
Na	Sodium
NAAQS	National Ambient Air Quality Standards
NDC	Nationally Determined Contributions
NEP	National Environmental Policy
NESREA	National Environmental Standards and Regulations Enforcement Agency
NEPZA	Nigerian Export Processing Zone Authority
NIMET	Nigerian Meteorological Services Agency
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
PPP	Public-Private Partnership
PPM	Parts per Million
QA	Quality Assurance
QC	Quality Control
QALS	Quality Analytical Laboratory Services
RAM	Risk Assessment Matrix
RAP	Resettlement Action Plan
ROI	Return on Investment
RoW	Right of Way
SDG	Sustainable Development Goal
SEP	Stakeholder Engagement Plan
SEPA	State Environmental Protection Agencies
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
Tn	Traffic Catalogue
Tr	Return Period
TSDF	Treatment, Storage and Disposal
FacilityTSS	Total Suspended Solids
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
WMO	World Meteorological Organization
WMP	Waste Management Plan

Executive Summary

Introduction

Nigeria is Africa’s most populous nation, home to an estimated 229 million people with a rapid growth rate projected to reach 400 million by 2050. Despite abundant natural resources and burgeoning commercial activities, the country faces significant challenges in maximizing its potential. A critical bottleneck hindering development is the underdeveloped inland transportation infrastructure. This hampers the exploitation of natural resources, leading to substantial waste, and negatively impacts the agricultural sector, a key economic driver. Post-harvest losses due to inadequate transportation networks remain a significant challenge.

With over 1,200 cities and towns, including 19 with populations exceeding one million, Nigeria presents a complex urban landscape. Lagos, Africa's largest city with over 27 million inhabitants, is the economic and commercial hub. However, the rapid urbanization has outpaced infrastructure development, leading to challenges in housing, transportation, and public services.

Nigeria's transportation infrastructure is composed of roads, railways, ports, airports, and inland waterways. Although recent investments, such as the modernized Abuja-Kaduna railway, have shown progress, the sector faces significant hurdles. Challenges include inadequate maintenance, severe congestion, and overall inefficiency. To meet the burgeoning demands of its growing population and economy, Nigeria necessitates substantial investments and strategic planning in its transportation system.

The federal road network, spanning approximately 36,000 kilometers, is the backbone of transportation. However, inadequate maintenance, coupled with increasing traffic volumes, has led to deteriorating road conditions.

Recognizing these challenges, the government has initiated the proposed Lagos-Calabar Coastal Highway designed to improve connectivity and facilitate economic growth. A visual representation that highlights the Nigerian coastal states (Ogun, Ondo, Delta, Bayelsa, Rivers, and Akwa Ibom states) traversed by the proposed Lagos-Calabar Coastal Highway

The Lagos-Calabar Coastal Highway is an ambitious 700-kilometer project that will stretch from Victoria Island in Lagos to Calabar in Cross River State. This transformative project promises improved transportation, economic growth, and enhanced connectivity for Nigeria. This highway aims to connect the western and southeastern regions of Nigeria, enhancing cross-country connectivity and trade relations.
The highway will traverse through several states, including Lagos, Ogun, Ondo, Delta, Bayelsa, Rivers, and Akwa Ibom, before reaching its final destination in Calabar. It’s designed to link major urban centers, industrial hubs, and seaports along the southern coast.

The Lagos-Calabar Coastal Highway will serve as a vital link, connecting Lagos to the coastal regions of Ogun, Ondo, Edo, Delta, Bayelsa, Rivers, Akwa Ibom, and Cross River States. Additionally, it will intersect with several north-south vertical routes:

- A1: Lagos to Sokoto
- A2: Warri to Kaduna, Zaria, Kano, and Daura
- A3: Port Harcourt to Makurdi, Bauchi, and the Kano/Maiduguri Road
- A4: Calabar to lkom, Ogoja, Jalingo, Numan, and Maiduguri

The Lagos-Calabar Coastal Highway project requires an Environmental and Social Impact Assessment (ESIA) due to the potential environmental and social impacts associated with its construction to comply with both international standards and Nigerian regulations. The ESIA is a crucial tool for identifying, assessing, and mitigating the potential negative impacts of the Lagos-Calabar Coastal Highway project while maximizing its benefits. Alongside the ESIA is the preparation of a Resettlement Action Plan (RAP) for the Highway. A Resettlement Action Plan (RAP) is essential for a highway due to the potential for involuntary resettlement.

Objectives of the Study

The ESIA aims to ensure that the project is developed and implemented sustainably, protecting the environment and benefiting the local community. The primary goal of the Environmental and Social Impact Assessment (ESIA) for the Lagos-Calabar Coastal Highway is to **identify, assess, and mitigate potential negative impacts** on the environment and society.

Specific Objectives include:

- Understand the existing environmental and social conditions.
- Determine the project's potential impacts on both the natural and human environment.
- Evaluate the potential risks associated with the project.
- Develop strategies to avoid, minimize, or compensate for negative impacts.
- Create an Environmental and Social Management Plan (ESMP) to implement mitigation measures.
- Document findings and recommendations in a comprehensive ESIA report.

Scope of the ESIA

The Lagos-Calabar Coastal Highway project is a significant infrastructure development spanning over 700 kilometers and divided into nine sections. Section 2 spans from 47.8km to 104km, eleko roundabout to the boundary between Lagos and Ogun State. Notably, Section 2 includes development activities related to transportation, coastal resort facilities, hotels, and recreational facilities in national parks and marine parks

The project's impact assessment has a phased approach to demonstrate a commitment to environmental and social considerations. This ESIA report specifically focuses on Section 2, providing a foundation for subsequent sections. The ESIA evaluates the environmental and social impact of a plan, policy, program, or project before deciding to proceed with the proposed action. It covers various aspects, including physical, biological, and socio-economic elements. The ESIA will describe project activities and identify potential impacts on air, water, soil, vegetation, wildlife, land use, and affected individuals and assets.

Project Entities

The Lagos-Calabar Coastal Highway project is structured under an Engineering, Procurement, Construction, and Financing (EPC+F) model with the following key entities: Federal Ministry of Works (FMW): Project Proponent responsible for overall project management and development with responsibilities for the construction, rehabilitation, planning, design, and monitoring of federal highways. Hitech Construction Africa Ltd is the EPC+F Contractor responsible for project execution and Natural Eco Capital Limited takes the role for preparation of Environmental and Social Impact Assessment (ESIA) and Resettlement Action Plan (RAP).

Thus, the project is a Public-Private Partnership (PPP) between the government and the private sector. The EPC+F model ensures efficient project delivery and risk allocation. Environmental and social considerations are integrated into the project through the involvement of a dedicated consultant.

Project Justification and Alternatives

The Lagos-Calabar Coastal Highway is promising for Nigeria's development, economic growth, and improved connectivity. The specific benefits and opportunities associated with the Lagos-Calabar Coastal Highway include Enhanced National Integration, Economic Opportunities and Trade, Community Connectivity and Relationships, Infrastructure Corridor, Improved Travel Efficiency, Enhanced Connectivity, Unlocking Development Potential, Scenic Views and Beach Proximity, Relieving Congestion, Multi-Modal Transit Artery, Integration with Existing Routes and Rail Lines and Transportation Flexibility:

The Lagos-Calabar Coastal Highway Project represents a transformative opportunity for Nigeria, combining economic development with environmental considerations. It's a step toward a more connected, prosperous, and sustainable future. While the project primarily focuses on transportation, its positive impact on the environment can contribute to a greener economy:

- Reduced Emissions: Efficient transportation reduces carbon emissions, benefiting air quality and sustainability.
- Promoting Sustainable Practices: The project can incorporate eco-friendly materials and energy-efficient designs.
- Enhanced Livelihoods: Job creation and economic growth can lead to better living standards and increased environmental awareness.

The Lagos-Calabar Coastal Highway is a transformative project with far-reaching implications for Nigeria's economic growth and regional connectivity.

Integrating rail systems and enhancing transportation options promises to create a seamless and sustainable network for passengers and cargo.

The coastal region around Lagos, Nigeria, has experienced significant changes over the years due to natural processes and human development. Let's delve into the details:
A study assessed the evolution of the Lagos coast over 20 years (2001 to 2020). Researchers relied on archived Google Earth imagery to estimate and visualize the magnitude of erosion and accretion along the Lagos coastline. The study used the Analyzing Moving Boundaries Using R (AMBUR) software package, an R programming language add-in. The key findings included:

- Cumulative mean rate of shoreline change: +0.93 meters/year (indicating overall accretion).
- Mean erosion rate: -1.94 meters/year.
- Mean accretion rate: +4.84 meters/year.
- Victoria Island, a prominent area, experienced the highest shoreline change rate (+6.24 meters/year) due to land reclamation.
- However, eastward of Victoria Island, there was unabated erosional activity, resulting in disappearing beaches and urban structures.

The impact has been coastal erosion affecting various communities along the shoreline. The coastline is experiencing annual retreats of 1-2 meters due to coastal erosion as captured by various media such as:

1. Lagos Coast Erosion Section of Coastline in Marwa, Lekki, Faces Threat
   https://www.youtube.com/watch?v=CVpIQwKJdS4
   https://youtu.be/CVpIQwKJdS4
   Channels Television
2. Lagos Coastal Erosion
   https://www.youtube.com/watch?v=62uHzyoSz84
   https://www.youtube.com/watch?v=lGDfPAgM4K8
   Channels Television
3. WASHED AWAY: THE LAGOS EROSION CRISIS
   https://www.youtube.com/watch?v=lGDfPAgM4K8
   Arise News
4. Erosion in Lagos chases communities away: More than 180 kilometres submerged in a decade.
   https://www.youtube.com/watch?v=zDKLYep8A98
   Al Jazeera English

This erosion risks infrastructure, including buildings, railroads, bridges, and roads, and threatens populations near the coastline. Managing coastal erosion in Lagos requires a holistic approach that balances development with environmental preservation. The proposed project would ensure careful planning to address accretion and erosion challenges.

To ensure that the activities necessary for the project ultimately lead to intended or observed impacts the Lagos-Calabar Coastal Highway project, Theory of Change model that bring the strategic planning (inputs and activities) and the effects (outputs, outcomes and impacts) was adopted.

Strategic Planning **Effects**

Inputs:	Activities:	Outputs:	Outcomes:	Impacts:
Funding: Financial resources allocated for construction, maintenance, and operation.	**Design and Planning**: Detailed engineering plans, environmental impact assessments, and alignment studies.	**Physical Infrastructure**: Completed highway with multiple lanes, bridges, and train tracks.	**Economic Growth**: Increased trade, investment, and industrial development due to improved connectivity.	**Regional Development**: Boosted economic activity, tourism, and urbanization.
Land Acquisition: Land along the coastal route for road construction.	**Construction**: Building the highway, including earthworks, bridges, tunnels, and drainage systems.	**Improved Connectivity**: Enhanced transportation links between coastal states.	**Job Creation**: Employment opportunities during construction and maintenance.	**Social Well-Being**: Better access to healthcare, education, and services.
Skilled Labor: Engineers, construction workers, and project managers.	**Maintenance**: Regular upkeep, repairs, and safety measures.	**Reduced Travel Time**: Shorter distances between cities along the route.	**Environmental Impact**: Reduced congestion and pollution as traffic flows more efficiently.	**National Progress**: A landmark infrastructure project contributing to Nigeria's growth and global recognition.
Materials: Cement, steel, etc., required for building the highway.				

ES Figure 1: Lagos-Calabar Coastal Highway Project Theory of Change Model

The Chosen Engineering Option: Rigid Pavement

Cement and asphalt are commonly used materials for paving surfaces but have different climate impacts. It is well known that darker surfaces get hotter in sunlight than lighter ones. Climate scientists use a metric called 'albedo' to help describe this phenomenon. T**he** proposed project is based on using Cement for the rigid pavement, which is considered superior to asphalt**.** This choice ensures a durable road and contributes to a more sustainable environment, keeping you well-informed and engaged in the project's positive climate impact.

- **Value of the Project**

Economic analysts predict that completing the first phase could increase Lagos State's economy by **50%**, thanks to connections with the Lekki Deep Seaport and the Lekki economic corridor, where the Dangote Refinery and Petrochemical Complex are located[1]. The proposed project is estimated at N1,067,887,381,148.61 (VAT inclusive) in terms of monetary cost. The project is estimated at N4.33bn per kilometre using reinforced concrete technology for a carriage width of 59.7 meters, to include ten lanes, shoulders and rail with additional designs of service ducts, street lights, drainages and shore protection. The 10-lane coastal road is designed to connect Lagos to Cross River, passing through Ogun, Ondo, Delta, Bayelsa, Rivers, and Akwa Ibom states before culminating in Calabar, the Cross River State capital.

The estimated costs and benefits for Section 2 of the Lagos-Calabar Coastal Road:

Section 2 spans approximately 57 kilometres, so the total estimated cost for this phase would be around N189.88 billion. The Potential Benefits:

- Improved Connectivity: The road will link major urban centres, industrial hubs, and seaports along the southern coast, enhancing regional integration.
- Economic Growth: Reduced travel times and improved transportation infrastructure stimulate economic activity and attract investments.
- Employment Opportunities: Construction and subsequent maintenance create jobs.
- Market Access: Businesses of all sizes benefit from better access to markets.
- Inclusive Development: Bridging rural-urban gaps fosters inclusive growth and reduces income disparities.

While the costs are substantial, the long-term benefits of the Lagos-Calabar Coastal Road are expected to impact the region's economic development and living standards.

The Lagos-Calabar Coastal Highway is an investment with net positive benefits, promoting sustainable development and improved livelihoods. Also, the **value of the Lagos-Calabar Coastal Highway project** and its critical contributions could be stated in the following ways:

Project Description

The road starts from Lagos, near the Lekki Deep Seaport, and runs through several states: Lagos, Ogun, Ondo, Delta, Bayelsa, Rivers, Akwa Ibom and ends in Cross River State—the Lagos-Calabar. The project will be implemented in stages, allowing for incremental opening of completed segments for public use. Thus, the project will start with Section 2, which is the focus of this report.

The Section 2 alignment begins at **Eleko (47 km)** and terminates at **Ode-Omi (104 km**) for the Section 2 from Lagos to Ogun state, Nigeria.
This is initial phase spans 55.6 kilometres. It commences from **Eleko** and extends to **Ode-Omi**, a bustling commercial hub in Lagos, serves as the starting point. The highway then winds its way through the coastal landscape, connecting various regions. The journey culminates at **Ode-Omi**, which borders and connects with Ogun state.

A. *The Key Details of the Project Information*

S/No	Aspect*	Details
1.	Project Length	• Approximately 700 kilometres
2.	Rail Integration	• Rail lines within median strips of highways
3.	Number of Sections of the Road	• 9
4.	Start and End of Section 1	• The first phase of the highway covers a 56 kilometres section starting from Eleko in Lagos.
5.	Economic Impact of the Coastal Road	• Boosting trade, industry, and livelihoods
6.	National Importance	• Enhancing Nigeria’s coastal connectivity

S/No	Aspect*	Details
7.	Construction and Features:	• It features five lanes on each side of the dual carriageway, with a train track running through the middle.
8.	Alignment Considerations:	• Eko Atlantic's Ahmadu Bello Road: The alignment starts here, running parallel to the coastline • Cross-State Connection: Extends across Ogun, Ondo, Delta, Bayelsa, Rivers, and Akwa Ibom States, terminating in Calabar, Cross River State. • Trans West African Highway Connection: Links with the Lagos-Benin-Enugu-Abakiliki-Ikom-Cameroon-Mombasa route.
9.	Ecological Considerations:	• Deflection to Avoid Sensitive Areas: The alignment avoids ecologically sensitive zones, such as mangrove swamps and turtle nesting areas.
10.	Existing Infrastructure/Utilities Considerations	• Avoidance of infrastructures/utilities like Telecommunication corridor (marine cables) that are existing along the proposed corridor. • Oil Pipelines: Existing pipelines influence the alignment in certain segments.

Summary of Activities in Project Phases

Construction Phase:

- Establish temporary access to work areas and create clearance zones while controlling access.
- Construct temporary diversions for roads that need upgrading to manage existing traffic.
- Clear and level the corridor and perform major earthworks (cuttings, embankments).
- Locate and develop borrow pits and quarries to import materials (gravel, clay, bitumen).
- Source and establish a water supply from surface and groundwater.
- Improve existing drainage and introduce new road drainage (including culverts if necessary).
- Surface and seal the carriageway (using bitumen mixing plants where applicable).
- Build water crossings such as bridges and culverts, including concrete batching for structures.
- Establish or improve safety arrangements (modify camber, barriers, sight lines).
- Perform landscaping as needed.

Operation Phase:

- The road becomes operational, serving transportation needs.
- Regular maintenance, monitoring, and safety checks are essential.

Demobilization Phase:

- Decommission temporary facilities (workshops, laydown areas, etc.).
- Restore any disturbed areas to their natural state.
- Evaluate the project's success and lessons learned.

Construction Method and Materials (new placement)

1. **Design Considerations**:

The project aims to utilize all available technology and resources.
Key factors include simple techniques, readily available construction materials, and efficient labour input.

2. **Structural Materials**:
   - **Reinforced Concrete (RC)**:

All superstructural and substructural elements will be constructed using reinforced concrete.

   - **Reinforcement Steel**:

Grade 60 reinforcement steel for bars with a diameter equal to or greater than 20mm.
Grade 40 steel for bars with a diameter of less than 20mm.
Minimum yield strength: 420MPa for grade 60 and 300MPa for grade 40.
The minimum clear cover for reinforcing bars will be as recommended and shown on the drawings.

3. **Concrete**:
   - **Superstructure**:

Design parameters for C-30 concrete will be used in structural computations.
Compressive strength: 30MPa for 150mm cube samples and 25MPa for 150mm cylindrical samples.

   - **Substructure (Plain Concrete Leveling)**:

C-15 class of concrete will be used.
Compressive strength: 15MPa for 200mm cube samples and 10MPa for 150mm cylindrical samples.
These parameters are specified in design drawings and technical specifications for attainment during the construction stage.

4. **Resistance Factors**:

Resistance factors are recommended to account for imperfections in production.
Appropriate factors for structural components' shear and bending moment were considered during the design phase.

Raw Materials and Hazardous Materials

These include fine-grained soil, which is used for roadbed preparation and stabilization. Gravel: Essential for road base layers and drainage. Blocks: Used in structures like retaining walls and bridges. Laterite: A locally available material used for road construction.
These raw materials form the **building blocks** of the road. The sand for filling shall be **sourced from the Atlantic Ocean/sea**. Proper sourcing and utilization of these materials contribute to efficient and sustainable construction.

Estimated Quantities Of Materials

ITEM	Unit	Quantity	NOTES
Cut	m3	4,002,058	
Fill	m3	Up to 17 million	
CRCP Service Lanes (Phase 1)	m3	290,400	2 lanes for each direction for main road (Shoulders are not paved)
Base &Subbase (Phase 1)	m3	441,600	icluding shoulders
CRCP Main Carriageways (Phase 2)	m3	390,000	3 lanes for each direction for main road + 2 lanes for service road (Shoulders are not paved)
Base &Subbase (Phase 2)	m3	656,640	including shoulders
Number of Streetlight	Number	2,377	
Interchanges	Number	4	

Energy: The project will make use of the national grid as power supply; however, due to the situation of the grid power supply in Lagos, having backup diesel generators for the Ancillary Sites is crucial to ensure uninterrupted operations, especially during construction activities where consistent power supply is essential. The generators' capacity is 800 KVa, 100KVa at the Laydown Area and 200 KVa at the construction site.

Workforce: The contractor will require both a skilled and unskilled workforce. Priority will be given to employing unskilled staff in local communities near the yard sites. The project aims to employ **1000 people** for direct labour, and indirect labour involves **400 people**, including subcontractors, suppliers, and transporters. The project will have **50 expatriate personnel** who bring specialized knowledge and experience.

- Environmental releases of emissions, discharges, and wastes, such as dust, greenhouse gas (GHG) emissions, and noise, would occur during construction. Other include wastewater and solid waste management.

Managing GHG emissions during construction and ensuring sustainable practices for long-term operation are critical for minimizing environmental impact. The standard seven greenhouse gases usually considered include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3). The construction will lead to the following GHG emissions:
Sustainable practices during construction and operation shall consider Using eco-friendly materials, minimizing emissions during construction, and encouraging the use of public transport to reduce individual vehicle emissions. And Regular monitoring of emissions and adherence to environmental regulations.

Estimated GHG Emission During Construction from Equipment

Units	capacity	Number	Emission Factor (kg CO2e/hr/unit)	Maximum Days of Operation	Estimated Emissions (tons CO2e)	Remarks
Crane	24.5/ hour	4	3129.92	351	3306.3	
Excavator	24.5	8	6279.84	351	6612.7	
Dredgers	625 / h	6	2306.88	351		
Pneumatic Road Roller	12L/hr	6	2306.88	351	2204.2	
Grader	16L/h	6	3075.84	351	3238.9	
Soil compactor	12/L	6	2306.88	351	2429.1	
Wheeled loader	12L/hr	6	2306.88	351	2429.1	
Other						
Power Generators	18L/hr	4	1409.76	351	1484.5	
Dumper	15L/hr	4	2204.2	351	2024.3	
Wirtgen						
Water/diesel tankers	35L/62mile	8 (Diesel 6, water -2)	13008	351	37651	
Others, add, please and specify						
Total	10955412				t85897.3COe	

- *Water/Wastewater*

Effective wastewater treatment and responsible construction practices shall be ensured to safeguard both surface water and underground water quality during the project. The wastewater management and potential risks associated with construction activities: **Wastewater Treatment in Construction**, **Surface Water Contamination Risks** and **Diesel Spills and Pollutants**. Proper handling, containment, and monitoring are essential to minimize environmental damage.

Estimated Solid Waste Generation and **Contractor's Waste Management Plan**:

Waste Description	**Waste Quantity**
Steel Pile Excavation Spoils –	Will not be used on this project
Concrete Pile Excavation Spoils –	N/A
Rear Barrette Excavation Spoils	N/A
Steel Reinforcement Waste –	230 cubic meter
Concrete Waste –	195000 cubic meters
Workforce Sewage Generation	28,320
Workforce Waste Generation – Average 0.15 kg/person per day	87.3kg

A **Waste Management Plan** outlining waste handling, segregation, recycling, and disposal procedures has been developed to ensure proper waste management compliance with environmental regulations and minimize negative impacts.

- *Dredging for Reclamation*

Dredging from the sea plays a crucial role in the proposed project. Responsible management that balances economic progress through dredging with environmental conservation shall be adopted. The strategies include **beneficial** reuse, which involves upcycling dredged sediments for beach restoration and other purposes**; monitoring and** planning, which involves regularly monitoring water quality, ecological impacts, and **eco-friendly technologies**; and integrating sustainable practices and technologies.

- *Environmental, health, and safety management (EHS)*

The construction phase would adopt the following to manage the following issues:

1. Sediment and Erosion:
2. Runoff Control:
3. Neighbourhood Effects: Noise and Dust:
4. Landscaping and Green Cover:
5. Solid Waste:

The proposed project is expected to be completed in 36 months,

ENVIRONMENTAL AND SOCIAL BASELINE

To identify the presence of sensitivities or sensitive receptors in this area, an investigation was conducted within a 50-meter buffer along both sides of the route. The Area of Influence (AOI) primarily encompasses industrial and commercial zones, including residential areas, commercial/industrial areas, hospitals, roads, churches, schools and farmlands. The baseline study involved primary monitoring and surveys, as well as the collection of relevant secondary data from various sources.

Study Area: The alignment begins at **Eleko (47 km)** and terminates at Ode-Omi (104 km) for the Section 2 from Lagos to Ogun state, Nigeria.
This Section 2 spans 56 kilometres. It commences from **Eleko** and extends to **Ode-Omi**, a bustling commercial hub in Lagos, serves as the starting point. The highway then winds its way through the coastal landscape, connecting various regions. The journey culminates at **Ode-Omi**, which borders and connects with Ogun state.

Physical Environment

Climatic Condition of the Study Region: The project area in South-Western Nigeria experiences a tropical climate with longer wet seasons from April to October and shorter dry seasons from November to March, including the Harmattan wind from December to early February. Rainfall, expected for 274 out of 547 construction days, poses a risk of delays, reduced soil stability, and landslides. Temperature extremes below 29°C and above 33°C can impact construction, particularly for bitumen, asphalt, and concrete work. High humidity, averaging 80%, especially from June to September, affects material performance and worker health. Prevailing winds in Lagos State average 6.5 knots, with a peak of 8.2 knots.
In terms of Climate Risk Assessment while the project location is generally vulnerable to the impacts of climate change, the estimated total CO2 emissions (**Green House Gas Emission**) per hour from diesel-powered trucks and the coastal road due to truck movements are approximately 107,200 kg of CO2.

a. **Soil Sampling**

Systematic sampling design (systematic line transect) was employed to collect soil by establishing plots across the sampled area. Soil samples were collected from each of the stations with the aid of a Dutch Hand Auger, Hand gloves, a spool and hammer at depths of 0-15cm and 15-30cm, representing top and bottom samples. These are the soil depths at which most (>80%) of the plants feeder roots and soil micro-organisms are concentrated.

At each sampling station, three (3) samples were taken for each depth and composited to give one representative sample. All sampled points were geo-referenced in the field using the Garman Geographic Positioning System (GPS) Equipment. Furthermore, field investigations on soil morphological properties as it affects slope, drainage/flooding, presence of soil structure impediments, texture mottling, were conducted. The physical appearances of contaminants such as hydrocarbons were also examined, alongside the land use practices. All soil samples connected were analyzed in the laboratory using standard methods. The following sub-samples were taken for each depth, namely:

Samples for physico-chemical parameters which were put into polythene bags; Samples for hydrocarbon analysis which were put into glass bottles; Samples for microbiological analysis collected with McCartney bottles and stored in ice-packed coolers

***b.* Water Quality Sampling**

Surface and groundwater samples were collected along the coastal road project in Lagos for physico chemical analysis**.** Key sampling locations along rivers, streams, estuaries, and other water bodies that could be impacted by the coastal road project were identified. These locations represent various environmental conditions and potential sources of pollution, such as urban runoff, industrial discharge, and agricultural activities.

Water samples were collected using clean, sterile containers to prevent contamination. Samples were collected at a consistent depth and location within the water body, following standard protocols to ensure accuracy and reproducibility. They were then subjected to analysis for a range of physical, chemical, and biological parameters, including pH, dissolved oxygen, turbidity, nutrients (nitrogen and phosphorus), heavy metals, pesticides, and fecal coliform bacteria. These parameters provided insights into water quality, pollution levels, and ecological health

***c.* Groundwater Sampling**

Ground water samples for this study were collected from 11 study locations within the study area. Table 1 below shows some of the locations where the groundwater samples were collected, their geographic coordinates and depth. The groundwater samples were collected in high density polyethylene bottles prewashed with 1 N hydrochloric acid followed by distilled water and then rinsed two to three times with the sampled water. The collected water samples were taken to Bato Chemical Laboratories Ltd for comprehensive analyses. The samples were filtered using 0.45 µg cellulose membrane before the analyses. The analytical procedures employed were as documented by the American Public Health Association (APHA, 2017).

d. Air Quality Sampling

Assessment of the sampling locations was done taking into cognizance the predominant wind direction and other requisite criteria as stipulated by the World Bank to have good representative sampling points for the locations. These criteria include:

Predominant Wind Direction; Unobstructed flow of air to equipment probe or inlet from 3 out of the 4 cardinal points (270 degrees) of the location including the predominant wind direction; Distance from trees (minimum of 10meters); Distance from nearby tall buildings – > twice the difference in elevation (of the building and inlet of the equipment); Distance from roadways to equipment probe or inlet 2-10 and 10-100 meters (depends on average daily traffic in vehicles per day with 2-10 for micro-scale site, except for a designated traffic site, and 10-100 for middle and neighbourhood scale site with upper limit for ~40,000 – 70,000 vehicles per day).

In addition, a control sampling point is located at Folu Community in Ibeju Lekki LGA of the State. The location represents an area with baseline conditions unaffected by the proposed project but similar in environmental characteristics to the proposed project sites. Aeroqual Series 500 with the respective sensor heads was used to collect the air quality data.

e. **Shoreline Dynamic Mapping - Shoreline Dynamics in the Last 45 Years (1979-2024)**

Historic shoreline dynamics across the project area were calculated using the DSAS tool on ArcGIS. Spatial dataset used include satellite imageries acquired in different years and covering a time span of 45 years (1986). The images were sourced from the USGS Landsat online data archive (*www.glovis.org, www.earthexplorer.org*) and were carefully selected based on the conditions that little or no cloud coverage was present and the tide period was the same, e.g. low tide and small tidal range. Table 4.3 shows the characteristics of each of the dataset.

Sediment Quality: Sediment samples were obtained alongside the surface water sample. Results of sediment studies showed that the physicochemical parameters analysed in the sediment sample except Cadmium and Chromium were within ISQG threshold values. The high Cadmium and Chromium content recorded in the sediment samples compared to the water samples could be attributed to industrial and artisanal waste streams. The presence of factories in the area and the various industrial activities further corroborate the assertion.

Erosion and Accretion Pattern

The Lagos coast is characterized by west-east trending barrier islands, fortified by Badagry Creek, the study of the shoreline changes is crucial for understanding coastal erosion and accretion. The construction of breakwaters between 1908 and 1912 at the entrance to Lagos Harbour disrupted the natural flow of the longshore drift, leading to accelerated erosion in the Victoria Island area and accretion on the western side. Despite interventions like the Eko Atlantic City project and coastal defences, recent satellite imagery and shoreline change analysis show that these measures have only shifted erosive actions to areas downstream of the coastal defences. Furthermore, the Lagos shoreline undergoes continuous changes due to natural processes and human development. Google Earth images (2001 and 2020) showed an average shoreline change rate of +0.93 m/year, erosion rate of -1.94 m/year, and accretion rate of +4.84 m/year. Victoria Island experienced the highest shoreline change rate, with an average of +6.24 m/year due to accretion activities. Land reclamation activities contributed to the high accretion rate. However, significant erosion is observed eastward of Victoria Island. Effective land use and cover management plans are needed, especially for Victoria Island.

Biological Environment

The biological surveys conducted in the project area focused on biodiversity and hydrobiology.

The soil macro-fauna identified in the study area include various arthropods (*Myricarid striata*, *Dorylus fimbriatus, Glomens marginata*), Annelids (Earthworms) and Nematodes (*Acanthamoeba polyphaga, Acrobeloides sp, Porcellia scraber*). These organisms are primary consumers; decomposers, mixers and utilizers of energy stored in plants and plant residues, and contribute to the recycling of nutrients. Others are secondary consumers such as centipedes and spiders. These animals consume smaller sized animals and they, also may serve as food for organisms occupying higher levels of the food chain.

Data were collected along the road alignment (Phase 1). Within each sampling plot, the plants were identified to species level and the occurrences of each species were recorded in each plot. The occurrence of each species was described in semi-quantitative terms in accordance with the method used by Edwin-Wosu and Edu (2013). Species with a wide frequency of distribution with many stands within a plot and across majority of plots are described as *very abundant* (++++). Some species with similarly wide frequency of distribution, but with few stands are said to be *less frequent* *or abundant* (+++), while species of limited geographical distribution and with a few stands are termed *scarce* (++) and *very scarce* (+) species.

Hydrobiology: The hydrobiology assessment included desktop studies, stakeholder consultations, field sample collection, and laboratory analyses, revealing diverse aquatic communities. The project area water bodies support a variety of aquatic resources, thirty-five (35) fish species were inventoried in the area. On the other hand, twenty (20) phytoplankton species, sixteen (16) species each for zooplankton and macrobenthos respectively were inventoried in the project area.

Socioeconomic Environment

Government Area with its corridors in thirty-one (31) communities from Eleko to Ode Omi. Based on the findings of the socioeconomic studies, the communities located at the corridors of the proposed road are urban, semi urban settlements and rural communities that are either moderately or sparsely populated and fall under Ibeju Lekki LGA and administratively under the Lekki LCDA, the Lekki LCDA is administratively under Ibeju Lekki LGA. More than half of these communities are fishing communities; the main settlers are believed to be migrants from Epe and Ile Ife. Other tribes have also migrated and are resident in the communities till date like the Ilajes, Ijaws, Calabars, Ghanaians, Togolese etc. The project affected communities are listed in the table below.

The project affected communities include Okunraye, Alasia, Itoke, Idotun, Alagbon Segun, Oke Iyanta, Ilekuru, Idasho, Ilede, Imobido, Tiye, Akodo, Orofun, ELeko, Iberekodo, Orimedun, Magbon Ilado, Magbon Oga, Museyo, Ogogoro, Igbo Olomi, Idata, Ilagbo, Kajola, Siriwon, Ebute Lekki, Ise, Igbohun, Abakeji, Mafogunde, and Ode- Omi.

Socioeconomic survey

The age distribution of respondents along the project corridor indicates a predominantly young and active population, with 38.46% aged 31-40 years and 25.64% aged 18-30 years. The majority of respondents (69.23%) are male. Most are married (78%) with 3-4 or 5-6 children, and household sizes average 6 to 10 people. The Yoruba ethnic group is predominant, making up 53.2% to 61.5% of respondents across different communities, followed by the Ibo. Religious practices are mainly Christian (66%), with Muslims comprising 28%. Educational attainment is high, with 43.59% having tertiary education. Access to potable water relies mainly on private wells and boreholes, while energy sources include gas, kerosene, firewood, and electricity, varying across communities. The presence of educational institutions and challenges like limited potable water access and reliance on traditional fuels underscore the socio-economic diversity and infrastructural needs within the project area.

Household waste is mainly managed through open dumping (50%) and incineration (25%), leading to potential environmental and health issues. Sewage disposal practices include water closets, pit latrines, and open defecation, with two-thirds using water closets, correlating with housing, social status, and education. About 75% use pit latrines or open defecation, contributing to E. coli presence in the soil. Common household facilities include power generators, televisions, and radios, indicating reliance on these for electricity and information. Ilasan Iroko Awe and Sangotedo have the highest number of generators, showing unreliable power supply, while Oniru has the most televisions and radios, indicating a strong desire for connectivity. Economic activities are diverse, with fishing and aquaculture prevalent, especially in Sangotedo and Lakowe, though challenges such as lack of capital and poor infrastructure hinder development. Communication primarily occurs through mobile networks from providers like MTN, GLO, AIRTEL, and 9MOBILE, with news accessed via radio, television, and digital devices.

Transportation and infrastructure patterns show disparities in commute distances, spending, infrastructure effectiveness, and public transport satisfaction. Communities like Eko Atlantic and Oniru have high short-distance commutes, greater transport spending, and higher car usage, reflecting better service access and income levels. In contrast, areas like Badore and Akinlade, which spend minimally on transport and rely heavily on public options, face infrastructure challenges, leading to longer travel times and lower satisfaction. Infrastructure effectiveness is higher in Eko Atlantic and Oniru but decreases in more remote areas, where residents report inadequacies. Public transport satisfaction varies, with higher satisfaction in developed areas and dissatisfaction in less-served communities, highlighting the need for improvements.

Health facilities include fifteen Primary Health Centres (PHCs) and one hospital, such as Awoyaya Public Health Centre and Ibeju Lekki General Hospital. A shortage of facilities raises health concerns, with prevalent diseases like malaria, typhoid, and respiratory infections. This has led to the use of herbal treatments and traditional healers, with malaria affecting 42.1% of the population. Poor hygiene, such as indiscriminate refuse disposal, exacerbates disease spread. Traditional medical practices are common, with 82% seeking these remedies due to insufficient facilities. Sexual health issues, including HIV/AIDS and STIs, are prevalent, though data is lacking. Condom use is low, with less than 30% of males and 35% of females having used them, and only 12% of males and 7% of females using them consistently. Despite an 80% immunization rate for children under five, which exceeds the national target, deficiencies remain. Land ownership is mainly by the community or families, with the state able to acquire land for public use. Vulnerable groups, including children, women, non-indigenes, the elderly, and the physically challenged, form significant population segments. Cultural heritage sites are absent, and gender disparities are evident, with men dominating land ownership, credit access, and decision-making. Male circumcision is nearly universal, but rare among females, reflecting gender imbalances in the project area.

Traffic: The survey results highlighted consistent vehicle flow throughout the day, with noticeable peak traffic during 9-10 am and 1-2 pm, likely corresponding to work commutes and lunch breaks. Off-peak periods were identified early in the morning (6-7 am) and late in the afternoon (5-6 pm), where traffic volumes were relatively lower. This variation in traffic flow suggests that the proposed road must be designed to handle fluctuations in traffic, ensuring capacity during peak hours while maintaining efficiency during off-peak periods. The traffic survey revealed that cars and SUVs dominate the road, indicating a reliance on personal vehicles, while lorries represent ongoing commercial activities. Traffic direction varies by time of day, with outgoing traffic peaking in the morning and incoming traffic peaking at midday.

Stakeholder Engagement
A comprehensive stakeholder consultation process was conducted for a road project, involving five planned rounds, with the first three rounds completed. The consultations aimed to engage stakeholders, discuss environmental and social impacts, address concerns, and gather data to inform the project's planning and implementation.

Key Outcomes:

- **Environmental and Scoial Impact Assessment (ESIA) Scope:** Agreement on the ESIA scope, identification of key environmental issues, and a plan for further stakeholder engagement.
- **Fair Compensation and Transparency:** Commitment to fair compensation, transparent communication, and careful enumeration, compensation, and property realignment.
- **Data Collection Framework:** Establishment of a comprehensive data collection framework to ensure all environmental and cultural factors are considered.
- **Mitigation Strategies:** Agreements on mitigation strategies to protect water resources, minimize impact on farmlands, and implement noise-reduction measures.
- **Cultural Heritage Preservation:** Emphasis on preserving cultural heritage, including sacred sites, shrines, and traditional festivals.
- **Infrastructure Needs:** Identification of urgent infrastructure needs in host communities, including access to clean water, healthcare, well-maintained roads, and job opportunities.

Stakeholder Concerns:

- **Environmental Pollution:** Concerns about environmental pollution, displacement of animals, and impact on fishing livelihoods.
- **Displacement and Compensation:** Concerns about discrepancies in compensation, property realignment, and fate of properties on the right-hand side of the corridor.
- **Community Health and Well-being:** Concerns about emissions, noise, and vibrations affecting community members, especially around Eleko.

Summary of Potential Impacts

The Lagos-Calabar Coastal Highway holds immense promise; responsible planning, environmental assessment, and mitigation strategies are essential to balance development with preserving natural ecosystems. However, the project also has its negative impacts. Both negative and positive effects are summarised below:

Significant Positive Impacts
The Lagos-Calabar Coastal Highway spans approximately 650 to 700 kilometers. The project is expected to take eight years to complete. This extensive highway will herald a new era of efficient travel and trade along Nigeria's coastal corridor. The project's estimated cost is $2 billion (approximately N4 billion per kilometre), with a tentative cost based on other projects within the same budget. The government aims to recoup its investment by tolling the highway 15 years after completion.

The Lagos-Calabar Coastal Highway project holds immense promise for Nigeria's economic landscape, and carefully considering these factors will be essential for its successful implementation.

The proposal holds high positive socio-economic impacts. The highway connects major financial hubs, potentially boosting trade and commerce. However, this must be balanced with environmental considerations. Proper planning can ensure that the highway minimizes environmental impact while enhancing connectivity.

1. Distance Compression:

The coastal road will remarkably compress the distance between Lagos and Ondo State.
For instance, the direct distance from Ibeju-Lekki in Lagos to Araromi in Ondo State is approximately 50 kilometres along the coast. This translates to about an hour's journey, significantly reducing travel time compared to existing routes.

2. **Economic Impact**:

The completion of the first phase of the project alone could increase the size of Lagos State's economy by 50%. The connection to the Lekki Deep Seaport and the Lekki economic corridor, where the Dangote Refinery and Petrochemical Complex is situated alongside other multinational industries, will drive economic growth. Upon completion, the highway is expected to significantly improve Nigeria's Logistics Performance Index (LPI) for trade and transport infrastructure. It could contribute at least 0.5 to 1.0 points to the LPI.

3. Transformational Potential:

The coastal highway will usher in a new era of ambitious road infrastructural development projects in Nigeria. Similar to the iconic Third Mainland Bridge, which spans over 11 kilometres across the lagoon, the Lagos-Calabar Coastal Road aims to be monumental. When completed, it will enter the world record books alongside iconic coastal routes like the Wild Atlantic Highway in Ireland and the Pacific Coastal Highway in the United States.

4. Integration and Connectivity:

The highway will have two spurs linking up with Northern Nigeria, further integrating the north and south in terms of movement of people, goods, and services. It promises to enhance regional connectivity and foster economic exchange.

5. Blue Economy:

The coastal highway connects major economic hubs, including the Lekki Deep Seaport. It facilitates efficient movement of goods, boosting trade and economic growth. Proper waste management along the highway is essential to prevent pollution of coastal waters.

6. Ecotourism:

The scenic coastal route can promote ecotourism. Sustainable development, preservation of natural habitats, and wildlife conservation are vital. Interpretive centres, eco-friendly rest stops, and guided tours can enhance the ecotourism experience.

7. Provision of employment opportunities:

The highway will contribute to the overall socio-economic wellbeing of the benefiting communities through the provision of employment opportunities (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.

8. National Impact:

- **Improved Transport Conditions:** The Highway enhances connectivity, allowing smoother movement of goods, services, and people.
- **Sustained Access**: By maintaining the proposed infrastructure, Nigeria ensures long-term accessibility for its citizens.
- **Economic Growth**: The Highway contributes to Nigeria's economy on a global scale. Efficient transportation fosters trade, investment, and economic expansion.
- **GDP Contribution:** The coastal Highway facilitates the transit of goods to states along its route, bolstering GDP.
- **Strategic Importance**: As a major corridor, it supports regional integration and development.

9. Host Communities:

- **Increased Travel Efficiency and Productivity:** Reduced travel time and smoother journeys benefit commuters, businesses, and tourists.
- **Environmental Improvement:** Proper road construction minimises environmental impact. Sustainable practices enhance the quality of the surroundings. Integrated coastal managed to deal with coastal erosion and ensure biodiversity enhancement
- **Enhanced Quality of Life and Social Standards:** Access to better infrastructure positively affects residents' well-being. Improved roads lead to safer, more comfortable travel.
- **Economic Activity Spread:** The Highway connects villages and towns, promoting economic growth. Local businesses thrive due to increased accessibility.
- **Safety and Security Enhancement:** Addressing poor safety records ensures safer travel for all. Reduced accidents and incidents benefit both travellers and communities.
- **Stress Reduction:** Smooth roads alleviate stress for commuters and long-distance travellers.
- **Comfortable Rides:** Adequate facilities, including sidewalks, enhance the overall travel experience.
- **Environmental Aesthetics and Carbon Reduction:** Proper maintenance and greenery along the corridor reduce the carbon footprint. Aesthetically pleasing surroundings contribute to a better quality of life.

Significant Negative Impacts

Unfortunately, the proposed development is also likely to negatively impact the social and physical environment within which it is executed. This is because, for instance, the construction phase is often a rapid and disorderly process when a strong emphasis on completing the project is paramount, not protecting the environment.

Construction activities occur only once but can have lasting effects due to site preparation, earthworks, waste generation, traffic and safety, which are localized and reversible. During construction, the impacts are rated as significant. However, they are considered minor in duration since construction activities are temporary. Proper construction management practices are crucial to minimize negative impacts. Adherence to safety protocols and environmental safeguards is essential. Proactive measures, responsible construction practices, and continuous monitoring will help mitigate any adverse effects during the construction phase.

Based on the design of the project, these impacts can be divided into two, namely:

a. Short-term construction-related impacts typical of building construction activities such as:

1. **Community Engagement and Land Acquisition:**
- Community Resistance: Some communities may resist land acquisition for the highway, leading to delays and disputes.
- Compensation: Ensuring fair compensation for affected landowners and communities is critical for maintaining goodwill.
- Relocation Challenges: Resettling communities while minimizing disruption requires thoughtful planning and sensitivity.

2. **Geological and Environmental Factors:**
- Habitat Destruction: The construction of the coastal highway could lead to habitat destruction, disrupting ecosystems along the route.
- Vulnerability to Erosion and Flooding: Altering the coastal landscape may increase vulnerability to erosion and flooding. The coastal region’s susceptibility to erosion poses a risk to soil stability and overall highway integrity.
- Swamps, Mangroves, and Wetlands: These natural features complicate foundation work and roadbed construction along the route.
- Ecological Impact: Striking a balance between development and environmental conservation is crucial. Efforts to minimize harm to local ecosystems and wildlife habitats are essential.

3. **Infrastructure and Logistics:**
- Materials Supply: Transporting construction materials long distances can be costly and time-consuming.
- Access Roads: Developing access roads to remote construction sites is challenging.
- Bridge Construction: Building durable bridges across rivers and estuaries demands specialized engineering expertise.

4. **Security and Safety:**
- Security Threats: The highway passes through regions with security challenges (e.g., militancy, banditry). Ensuring safety for workers and equipment is paramount.
- Traffic Management: Coordinating traffic during construction, especially in densely populated areas, requires careful planning.

5. **Funding and Budget Constraints:**
- Cost Overruns: Unexpected expenses can strain the project budget. Vigilant cost management is essential.
- Government Funding: Consistent funding throughout the eight-year construction period is critical for project continuity.

6. **Technical Engineering Challenges:**
- Soft Soil Stabilization: Techniques like soil compaction, geotextiles, and deep foundations are necessary for stability.

- Drainage Design: Proper drainage prevents waterlogging and erosion.
- Bridge Durability: Constructing bridges that withstand environmental forces and heavy traffic is a significant task.

7. Noise and Dust Nuisance:

- The preparation of the site and material transportation can lead to increased noise and dust levels.

8. Waste Generation and Disposal:

- Proper waste management from the site and camp is essential to prevent environmental harm.

9. Soil Contamination:

- Stored fuel, lubricants, and paints can contaminate the soil.

10. Health and Safety Issues:

- Occupational Health: Workers involved in construction (including non-skilled workers, operators, drivers, surveyors, and supervisors) face health risks.
- Workers' Camp: Proper facilities and safety measures must be in place at the workers' camp.
- Public Safety: Ensuring the public's safety near construction zones is critical.

11. Resource Utilization:

- Efficient use of resources is necessary.

12. Potential Social Issues:

- Increased social vices and other community-related challenges may arise.

Environmental and Social Management and Monitoring Plan

ES Table 1 outlines the proposed project's Environmental and Social Management and Monitoring Plan.

ES Table 1: Environmental and Social Management and Monitoring Plan – Pre-Construction Phase.

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**PRE-CONSTRUCTION PHASE**										
	Site Clearing and Mobilization										
Environmental Impacts											
1.	Increase in amounts of fugitive dust, exhaust fumes and GHGs from movement of heavy-duty vehicles and equipment into work area.	Sprinkling of water via spraying devices to limit dusts.	Contractor	4000	Fugitive dust	Visual Observation	Minimal dust on project site & surroundings	Project site & surroundings	Daily	Supervision Consultant/ FMEnv FMW	1000
		Ensure that vehicles are serviced; undergo vehicle emission testing (VET) and vehicle exhaust screening (VES) as laid down in the NESREA guidelines.	Contractor	1000	Greenhouse gases Vehicle emission	In-situ Air Quality. Measurement Vehicle emission testing (VET) and vehicle exhaust screening (VES Report	FMEnv air pollutants permissible limit	On-site and surroundings	Monthly	Supervision Consultant/ FMEnv FMW	
2	Loss of top soil and soil compaction due to movement of vehicles to site and stacking of heavy-duty equipment	Limit zone of vehicle and equipment weight impacts (designate an area for parking and stacking equipment)	Contractor	500	Visible demarcation of vehicles and equipment limit zone	Visual observation Soil Compaction test	Visual observation Soil Compaction test	Project camp site and equipment packing zone.	Monthly	Supervision Consultant/ FMEnv FMW	500

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**PRE-CONSTRUCTION PHASE**										
	Leakages from stacked equipment and subsequent intrusion of oil and chemical substances into soil.	Ensure fastening of loose parts (bolts, nuts); Install impermeable surface at the limit zone to contain potential leakages	Contractor	1000	Installation of impermeable platform at limit zone.	Project camp site and equipment packing zone.	Soil quality test	Project camp site and equipment packing zone	Monthly	Supervision Consultant/ FMEnv FMW	
3	Increase in noise level above permissible noise level, (90dB) during equipment movement	Equipment should be transported early hours (6-7.00am) when it will cause least disturbance Retrofit machines with sound proof	Contractor	-	Number and frequency of complaints in project area	In-situ measurement of noise level	Noise level test (Not to exceed 90dB(A) for 8 hours working period	Project site	As required	Supervision Consultant/ FMEnv FMW	500
4	Displacement of soil fauna and damage to flora.	Limit vegetation clearing to minimum area required to create access path	Contractor	-	Radius of cleared path	Visual Observation	Evidence of re-vegetation	Non-Access pathway in Project site	One-off	Supervision Consultant/ FMEnv FMW	
5	Occupational accidents and injuries from the use of machineries and equipment	• Provision of PPE to workers; • Worker Education • Incident/accident reporting; • Provision of First Aid onsite • Ensure that staging areas for contractor equipment are adequately	Contractor	2000	Contractors Compliance.	Routine inspection	Use of PPEs by Workers Training Records	Construction site	Daily	FMEnv FMW LSMEnv LASEPA	FMEnv – 500 LASEPA – 500 LSMEnv – 500

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**PRE-CONSTRUCTION PHASE**										
		delineated and cordoned off with reflective tapes and barriers • Workers should get a daily induction/toolbox before going on the site and a refresher of what happened on site a day before • appropriate security measures in place to prevent harassment or kidnapping of workers									
6	Accidents involving vehicles or pedestrians during vehicle and equipment movement to the site.	Training of drivers on safe driving practices Install safety signage	Contractor	500	Accident Report	Site Inspection Consultations	Training Report Accident/ Incident Report	Routes to the Project site	Every 2 weeks	Supervision Consultant/ FMEnv FMW	500
Social Impacts											
7	Nuisance to nearby Hospital and School Blocks	Retrofit with suitable cost effective vehicle sound proofing materials/ technologies.	Contractor	-	Number and frequency of complaints in project area	In-situ measurement of noise level	Noise level test (Not to exceed 90dB(A) for 8 hours	Routes to project site	Weekly	Supervision Consultant/ FMEnv FMW	500

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**PRE-CONSTRUCTION PHASE**										
							working period				
8	Labour Influx which could lead to Increase in sexual activities leading to possible spread of STDs/STIs in the project host communities	Awareness campaign against sexual diseases, and distribution of male and female condoms.	Contractor	200	Level of Awareness and Education No of new STI Cases.	Rapid health survey	Level of awareness and knowledge of preventive measures. % of reported STI/ STD cases among workforce	Nearby communities Health care facilities	Twice during Construction	FMEnv FMW	100
9	Potential risk of Sexual Exploitation and Abuse (SEA)/ Gender Based Violence (GBV) Influx of workers (non-locals) to project location	All contractor's workers to sign Code of Conduct (CoC) (see Annex for sample CoC) and be sensitized on zero tolerance for sexual integration with host community . CLOs to sensitize the community on appropriate conduct with contractors Appoint NGO at the state level to manage social risks associated	PIU GBV Specialist Contractor Management	400	Stakeholders concerns on risk of GBV	Consultations GBV Incident Report	Signed CoCs with the PIU Conduct of sensitization campaigns	Host communities	Twice during Construction	FMEnv FMW Supervision Consultant	3000

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**PRE-CONSTRUCTION PHASE**										
		with GBV/SEA in the project area Provide Referral Centres for survivors of GBV/SEA.									
10	Child labour and school drop out	• Ensure that children and minors are not employed directly or indirectly on the project. • Communication on hiring criteria, minimum age, and applicable laws should be ensured.	Contractor Supervision Consultant	500	Visual observation	Routine inspection	No. of cases observed & recorded	Project site	Daily	FMEnv FMW Project Engineer	300
Sub Total				**10,100=**							**7,300=**

ES Table 2: Environmental and Social Management and Monitoring Plan - Construction Phase.

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**CONSTRUCTION PHASE**										
	Construction activities and installation works										
Environmental Impacts											

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**CONSTRUCTION PHASE**										
1	Fugitive dust	Sprinkling of water during activities	Contractor	See A1	Fugitive dust	Visual Observation	Minimal dust	On-site	Daily	LSMEnv LASEPA	500
	Release of exhaust fumes, hazardous gases (NOx, CO, SOx, SPM,), Oxides from machinery GHG Emissions	Fuel switching- Fuel switching from high- to low-carbon content fuels (where available) can be a relatively cost effective means to mitigate GHG emissions during this phase. Energy efficiency- Machines e.g. generator plants could be turned off when not in use, in order to reduce carbon emissions.	Contractor	See A1	Gaseous pollutants: SO_2, NO_2, CO_2, CO,VOCs, H_2S, PM	In-situ Air Quality Measurement Vehicle emission testing (VET) and vehicle exhaust screening (VES Report	FMEnv air pollutants permissible limit	Project area	Every two months	FMEnv FMW Supervision Consultant	
2	Pollution of the environment from open defecation by contractors' workers	Contractor to provide mobile toilets for workers or rehabilitate existed toilet facilities at the Project Site. Sensitize workers against open defecation	Contractor	500	Evidence of feacal waste within the project site & surroundings	Site inspection	Absence of faecal-waste on-site & surroundings	Camp site and working zone	Weekly	Supervision Consultant FMEnv FMW	500

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**CONSTRUCTION PHASE**										
3	Surface soil compaction from Movement of heavy vehicles/Stationary vehicles and equipment	Creation of limit zone Minimize compaction during stockpiling by working in the dry state Rip compacted areas to reduce runoff and re-vegetate where necessary	Contractor	200	Visible demarcation of vehicles and equipment limit zone	Visual observation Soil Compaction test	Visual observation Soil Compaction test	Project camp site and equipment packing zone	Monthly	Supervision Consultant FMEnv FMW Project Engineer	200
4	Pollution of soil and groundwater contamination by oil spills, lubricants and other chemicals	All oil and lubricants should be sited on an impervious base and should have drip pans The storage area should be far from boreholes, all containers should be clearly labelled	Contractor	1000	Soil quality parameters (especially hydrocarbon contaminants) Compliance with fuel storage procedures	In situ/ Laboratory Analysis Visual Observation	FMEnv Soil pollutants permissible limit	Project area	Twice during construction	FMEnv LSMEnv LASEPA FMEnv FMW	300
5	Presence of construction waste on-site which can pollute the environment leading to community and public health issues.	Implement site-specific waste management plan in Annex Liaise with State Waste Management Authority and affected LG Environmental Unit for effective waste management and safe handling/disposal of waste.	Contractor	200	Presence of construction waste on-site & surroundings	Site inspection	Compliance with the site waste management plan Good house keeping	Project site & surroundings	Weekly	LAWMA FMEnv FMW Project Engineer	200

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**CONSTRUCTION PHASE**										
6	Air quality deterioration	Suppress dust emission by sprinkling water	Contractor	500	Fugitive dust	Visual Observation	Emission of noxious gases	Location of work on project site	Daily	Supervision Consultant FMEnv FMW	200
7	Increase in noise level above permissible noise level, (90dB) during construction activities and OHS issues	Adequate maintenance of equipment and machineries to reduce noise Retrofit machines with sound proof Implement OHS Plan in Annex	Contractor	-	Number and frequency of complaints in project site & surroundings	In-situ measurement of noise level	Noise level test (Not to exceed 90dB(A) for 8 hours working period	Location of work on project site	Weekly	Supervision Consultant FMEnv FMW	200
8	Risk of occupational accidents (OHS), Injuries and diseases	Implement project OHS Plan in Annex Provide and enforce usage of appropriate PPE. Demarcate/cordon off construction areas and , lit up adequately at night, Fence out danger zones and keep out of reach. Restricted access to be placed at construction site using caution signs and manned personnel Use caution tapes.	Contractor	See A5	HSE Plan Developed Compliance with HSE Plan	Consultations Accident Report	increase/decrease in Lost Time Injuries	Project area	Monthly	FMEnv FMW	200

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**CONSTRUCTION PHASE**										
		Develop and implement visitors' management protocol Ensure that staging areas for contractor equipment are adequately delineated and cordoned off with reflective tapes and barriers Workers should get a daily induction/toolbox before going on the site and a refresher of what happened on site a day before Appropriate security measures in place to prevent harassment or kidnapping of workers									
Social Impacts											
9	Grievances and negative perception by job seekers, Community Members and CBOs	Conduct consultation at every phase of the project	Contractor PIU	2,000	No of complaints by affected persons	Consultations Review grievance log	Minimal number of reported cases	Host Communities	Every 2 months	Grievance Committees FMEnv FMW	300

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**CONSTRUCTION PHASE**										
10	Increase in sexual activities leading to possible spread of STDs/STIs from influx of workers (non locals) to project location	Awareness on sexual diseases, and distribution of male and female condoms.	Contractor	See A 8	Level of Awareness and Education No of new STI cases	Rapid health survey	Level of awareness and knowledge of preventive measures. % of reported STI/ STD cases among workforce.	Host Community	Twice during Construction	FMEnv FMW Supervision Consultant	See A 8
11	Potential risk of Sexual Exploitation and Abuse (SEA)/ Gender Based Violence (GBV) Influx of workers (non locals) to project location	All contractors workers to sign Code of Conduct (CoC) see Annex for sample CoC) and be sensitized on zero tolerance for sexual integration with job seekers, CDA and CBOs to sensitize the community on appropriate conduct with contractors	PIU GBV Specialist	See A 9	Stakeholders concerns on risk of GBV	Consultations GBV Incident Report	Signed CoCs with the FMWR Conduct of sensitization campaigns	Project community	Twice during Construction	FMEnv FMW Supervision Consultant	See A 9
12	Conflicts between contractor and host community members over labour intake	Good work enforcement program Grievance Redress Mechanism Regular consultations	Contractor Grievance Redress Committee (GRC)	500	No of complaints received	Consultation Review Grievance redress Log	No of cases handled by the GRC	Project area of influence	Continuous	Grievance Redress Committee	500

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**CONSTRUCTION PHASE**										
13	Increase demand on existing Hospital sanitation infrastructure due to influx of temporary workers	Provide basic amenities (water, sanitation etc to workers)	Contractor	3000	No of amenities in worker's camp & project site	Visual observation	Availability of all essential amenities in workers' camp & project site	Workers camp & project site	Monthly	FMEnv FMW Supervision Consultant	300
14	Child labour and school drop out	•Ensure that children and minors are not employed directly or indirectly on the project. •Communication on hiring criteria, minimum age, and applicable laws should be ensured.	Contractor	See A 10	Visual observation	Routine inspection	No. of cases observed & recorded	Project site	Daily	FMEnv FMW Supervision Consultant	A 10
Sub Total				**7,900=**							**3,400=**

ES Table 2: Environmental and Social Management and Monitoring Plan –Operation Phase

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
C	**OPERATION PHASE**										
	Demobilization of equipment and construction materials from site.										
Environmental Impacts											
1	Potential oil contamination of soil and water	Cart away all spoils through the relevant authorities Clean out impact areas	Contractor	2000	Oil Spillages, Littered construction waste and spoilt equipment/parts	Site inspection	Good house keeping	Workers Camp site	Quarterly for one year	FMEnv FMW Project Engineer Supervision Consultant	300
2	Increase in vehicular movements will lead to increase in air pollution from exhaust fumes	In collaboration with the State Government, implement regular sensitization via mass media on the allowable vehicular emission limit and the need for regular vehicle maintenance and the effect of excessive	Contractor FRSC; VIO	1000	Gaseous Pollutants such as SO_2, NO_2, CO_2, CO, VOCs, H_2S, TSP, PM 10 and PM 2.5	In-situ measurement of air quality	General compliance	Project site	Quarterly	LSMENV LASEPA FMEnv FMW	300

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
C	**OPERATION PHASE**										
		emissions into the atmosphere Routine inspection of motorists' compliance									
3	The drainages may become conveyors for surface debris and improperly disposed wastes during a heavy rain, leading to drainage blockage and disruption of free flow. This may result in stagnated water, and water contaminatio	Routine maintenance of drainages Proper waste management system in the communities	Contractor FMW	1500	Flow rate of water through the drainage systems Adequate waste treatment in the communities	Visual observation	Implementation of proffered mitigation	Project site and community	Quarterly	LSMENV FMEnv FMW Project Engineer	500

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
C	**OPERATION PHASE**										
	n downstream.										
4	Possibility of culvert collapse, flooding, or erosion from post construction which may result from poor designs, non-compliance to designs, sub-standard materials, poor maintenance	To follow proper design and best available practices to rural road construction Strict adherence to terms of reference and specifications of engineering design for bridge and road construction Adequate and regular maintenance	Contractor Project Engineer FMW	300	Structural and performance integrity of hydraulic features		Efficient Durability of roads and hydraulic structures	Project Sites	Quarterly	FMEnv FMW LSMENV LASEPA	200
D	**Demobilization of equipment and construction materials from Site**										
Social Impacts											
1	The project area & host communities	Vigilance & surveillance to sustain and	NPF Lagos State Command;	1,500	Incidence of security breach	Routine interview	Absence of security threat	Communities along	Quarterly for 2 years	Lagos State Police Force	300

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
C	**OPERATION PHASE**										
	will become more accessible and thus there will be improvement in security, business & commerce etc	enhance business and commerce	Community executives and Traditional Leaders					project path			
2	Accidents involving vehicles or pedestrians are likely to occur as a result of increased vehicle density, operation and increased speed, as community roads	Adequate road signs for motorists and pedestrians Routine maintenance of roads. Routine inspection of motor-able roads and road users. Training of road users on interpretation of road signs	FRSC	1,000	Road accidents/animal crushing	Routine interview	No complaints from the community	Communities	Quarterly	Road Marshals	300
3	Discrimination against gender and	Continues sensitization and awareness program and	project monitoring committee	500	Reports and awareness	Number of cases indicated	General compliance	communities	Quarterly	NGO Women Affairs	200

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
C	**OPERATION PHASE**										
	vulnerable group Gender Based violence Grievance and conflicts amongst members	ensure that community level programs allow for gender inclusiveness Reporting GBV, SEA VAC cases properly and timely Implement requirements of GRM that addresses such issues								GBV/SEA Referral Units	
Sub Total				**7,800=**							**2,100=**
TOTAL A+B+C				**25,800.00**							**12,800**

NB: FMEnv – Federal Ministry of Environment; LSMEnv – Lagos State Ministry of Environment, LASEPA – Lagos State Environmental Protection Authority; LAWMA – Lagos State Waste Management Authority; EHS Team – Environmental , Health & Safety Team (Contractor), GRM – Grievance Redress Mechanism; VAC – Violence Against Children

Relevant Management Plans

Relevant additional management plans are necessary to ensure full implementation of the ESMP. These plans outline specific activities for each environmental and social aspect of the project, aligning with both international and local regulations.

Below an overview of these management plans is provided. These plans are crucial for ensuring the project's sustainability and addressing potential environmental, social, and economic impacts. By implementing these management plans, the Lagos-Calabar Highway Section 2 project can be executed in a responsible manner, minimizing negative impacts and promoting positive outcomes.

S/No	Management Plan	Description	Mitigation Measures
1.	Resettlement Action Plan (RAP)	Addresses the social impacts of the project on affected communities.	• Provides compensation, relocation assistance, and livelihood restoration programs.
2.	Livelihood Restoration Plan (LRP)	Restores livelihoods of affected communities.	• Develops sustainable livelihood options and provides training and support alongside the RAP
3.	Biodiversity Management Plan	Conserves, restores, and enhances biodiversity.	• Develops a Biodiversity Action Plan to identify threats and protection measures.
4.	Heritage/Cultural Management Plan	Manages affected cultural heritage throughout the project's lifecycle.	• Incorporates design features to avoid or mitigate negative effects on cultural heritage.
5.	Shoreline and Coastal Erosion Management Plan	Supports localized responses to shoreline erosion.	• Uses barriers and vegetation to prevent erosion.
6.	Gender Management Plan	Mainstreams gender dimensions throughout the project.	• Tackles gender stereotypes, promotes paternity leave, and empowers women and girls.
7.	Dust Management Plan	Controls dust emissions to protect air quality.	• Uses automatic dust suppression systems like misting cannons.
8.	Environmental Construction Method Statement	Describes environmentally friendly construction methods.	• Grades fine materials from haul roads and keeps them compacted.
9.	Emergency Management Plan	Outlines procedures for responding to emergencies.	• Includes structural and non-structural mitigation measures.
10.	Human Resources Management Plan	Manages human resources to ensure a safe and healthy work environment.	• Focuses on recruitment, training, and welfare.
11.	Waste Management Plan	Manages construction and hazardous waste.	• Prioritizes prevention, minimization, recycling, and reuse.
12.	Wastewater Management Plan	Manages wastewater generated during construction.	• Employs physical, biological, chemical, and sludge water treatment.

S/No	Management Plan	Description	Mitigation Measures
13.	Construction Contaminated Land Management Plan	Manages contaminated land during construction.	• Uses remediation methods like soil removal and replacement.
14.	Soil and Water Management Plan	Protects soil and water resources.	• Implements agronomic measures like mulching and crop management.
15.	Occupational Health and Safety Management Plan	Ensures worker health and safety.	• Communicates health and safety policies, deals with hazards promptly, and equips employees with necessary tools.
16.	Community Health and Safety Management Plan	Addresses health and safety concerns of local communities.	• Considers health outcomes and determinants, and mitigates risks from construction activities.
17.	Contractor and Supplier Management Plan	Manages contractors and suppliers.	• Employs strategies like supply chain mapping, weighted ranking, and diversification.
18.	Stakeholder Engagement Plan	Engages with stakeholders.	• Defines stakeholders, analyzes their interests, and plans effective communication and engagement.
19.	Security Management Plan	Addresses security risks, particularly during construction.	• Implements measures to ensure security throughout construction and operation.

Physical Climate Risk Management and InfraTech (Infrastructure Technology)

The Lagos-Calabar Coastal Road faces significant climate risks due to its coastal location. These risks include increased rainfall, flooding, coastal erosion, extreme weather events, and temperature extremes. A detailed analysis of the physical climate risks and impacts on the Lagos-Calabar Coastal Road, as well as a summary of the impact assessment has been created as a stanadlone but aligned with this ESIA report. The key strategies identified based on the risk assessment are outlined below:

Climate Risk	Impact	Adaptation Strategies
1. Flooding and Sea Level Rise	Increased flooding, road submersion, traffic disruption, structural damage	Elevate road sections, improve drainage systems, construct sea walls, use resilient materials, relocate vulnerable sections.
2. Increased Rainfall	Overwhelmed drainage systems, water accumulation, road damage	Improve drainage systems, use resilient materials, implement stormwater management systems.
3. Coastal Erosion	Undermined road foundations, collapses,	Construct sea walls and barriers, plant vegetation, relocate vulnerable sections.

		increased maintenance costs	
4.	Habitat Destruction	Increased vulnerability to erosion and flooding	Plant vegetation, implement coastal protection measures.
5.	Vulnerability of Coastal Communities	Disruption of local economies and livelihoods	Relocate vulnerable communities, provide economic support.
6.	Morphological Change in Terrain and Landforms	Increased vulnerability to erosion and flooding	Implement coastal protection measures, use resilient materials.
7.	Extreme Weather Events	Overwhelmed drainage systems, water accumulation, road damage	Improve drainage systems, use resilient materials, implement emergency response plans.
8.	Temperature Extremes	Increased vulnerability to stress	Use resilient materials, implement cooling systems, conduct regular maintenance.

Involving Local Communities and Monitoring

Below is monitoring programs as part of dealing with the challenges of climate risk through Communities involvement and Monitoring for the Lagos-Calabar Coastal Road:

Monitoring Program	Description	Activities
9. Nigerian Meteorological Agency (NIMET)	Continuous monitoring of weather patterns and early warning systems.	Weather monitoring (rainfall, temperature, wind speed). Early warning systems for extreme weather events.
10. Federal Ministry of Works and Housing	Regular inspections and erosion monitoring.	Infrastructure inspections. Monitoring coastal erosion rates. Implementing erosion mitigation measures.
11. Academic Institutions and Research Organizations	Ongoing research on climate impacts and collaborative projects.	Climate impact studies. Collaborative projects with universities, government agencies, and international organizations.
12. Community-Based Monitoring	Local community involvement in monitoring and	Local involvement in monitoring. Training and education programs for local communities.

	reporting climate impacts.	
13. International Partnerships	Participation in global climate monitoring networks.	Access to advanced monitoring tools and data through networks like WMO and IPCC.

Leveraging InfraTech (Infrastructure Technology) Towards Climate-Resilience

The Lagos-Calabar Coastal Highway Project Provides a compelling case study for the application of InfraTech solutions to deal with vulnerability to climate change impacts, including coastal erosion, flooding, saltwater intrusion, etc. The project shall leverage various infratech solutions as outlined below:

Key Area	InfraTech Solutions
1. Coastal Protection	• Nature-Based Solutions: Mangrove forests, seagrass meadows, • Innovative Materials: Geotextiles, composite materials for seawalls and breakwaters • Early Warning Systems: Real-time monitoring
2. Flood Management	• Sustainable Drainage Systems: Rain gardens, bioswales, permeable pavements • Flood Modeling: Advanced modeling techniques • Early Warning Systems: Flood alerts for timely evacuation and response
3. Climate-Proofing Transportation	• Elevated Roadways: Construct elevated roadways in flood-prone areas • Resilient Materials: Use weather-resistant materials • Adaptive Design: Flexible and adaptable infrastructure design
4. Energy Infrastructure Resilience	• Renewable Energy Integration: Solar, wind energy • Microgrids: Ensure energy supply during disruptions • Smart Grid Technologies: Optimize energy distribution and improve resilience
5. Urban Planning and Development	• Climate-Sensitive Urban Planning: Integrate climate change considerations • Green Infrastructure: Parks, green roofs, urban forests
6. Climate Information Services	• Data Collection and Analysis: Monitor climate change impacts • Early Warning Systems: Alerts for extreme weather events • Climate Modeling: Predict future climate scenarios

Decommissioning and Restoration Plan

Decommissioning covers the project cessation of operations and the removal of inventory to obtain a state of passive safety. Though this phase is unlikely for a Project like the Lagos-Calabar Highway Road, the restoration programme at the end of the Lagos-Calabar Coastal Highway project's economic life is crucial for environmental sustainability. The statutory regulations emphasize the importance of rehabilitating areas to be relinquished after a project, a responsibility we all share in ensuring a sustainable future. In this context, the biological objective of rehabilitation programs establishes an ecologically functional system that supports satisfactory flora growth, such as the following:

- When a project concludes, the site must be restored to its original or improved state.
- Rehabilitation ensures that disturbed ecosystems recover and regain functionality.
- Our goal is to create an ecosystem that functions naturally and supports life, underscoring the importance of your role in achieving this goal.
- This involves restoring soil health, water cycles, and nutrient cycling.
- Flora (plants) play a crucial role in ecosystem stability.

Conclusion and Recommendations

The Lagos-Calabar Coastal Highway Project Section 2 Environmental and Social Impact Assessment (ESIA) has been prepared *with a strong commitment to comply with the Environmental Impact Assessment (EIA) Act CAP E12, LFN 2004.* The report results from a rigorous scoping of the proposed alignment, areas of influence, and the existing baseline environmental and social impact based on previous studies. The report presents compelling and inspiring findings demonstrating the importance of responsible and sustainable development practices.

The ultimate objective of the ESIA process was to ensure that the Project has no major residual impacts on the environment, be it in the long term or over a vast area. Consequently, after implementing the delineated mitigation measures, the residual impacts of the Project were significantly reduced to mostly short-term, localized, and reversible. Alongside this, we provided recommendations to optimize the beneficial effects of the Project and sustain them for the long term.

An Environmental and Social Management Plan (ESMP) was developed to ensure that the Project meets its operational requirements and delivers its stated business objective in an environmentally responsible manner. The ESMP outlines the mitigation/enhancement measures to action points and recommends performance indicators monitoring and audit programmes. This helps maintain all impact indicators for the various environmental components within statutory limits throughout the Project's life.

Overall, the Lagos-Calabar Coastal Highway, beyond being just a road, is a testament to collaboration, foresight, and commitment. The Lagos-Calabar Coastal Highway project (Section 1) stands on solid ground, supported by multiple pillars of assurance as outlined below:

- Social and Cultural Acceptance:
    - The project aligns with societal norms and cultural values.
    - Communities find it appropriate and acceptable.
- Technical Soundness:
    - Rigorous engineering design ensures technical feasibility.
    - The highway's construction and operation are sustainable.
- Environmental Considerations:
    - Environmental impact assessments have been thorough.
    - Mitigation measures are in place to minimize harm.
- Economic Viability:
    - Leveraging private sector resources and funding.
    - The project's financial sustainability is assured.
- Government Commitment:
    - Key ministries (Federal Ministry of Works, Federal Ministry of Environment, and Federal Ministry of Finance) champion the project.
    - Regulatory frameworks and flexible financing instruments are actively implemented.

In conclusion, the ESIA highlights the importance of balancing economic development with environmental and social sustainability. By implementing the proposed mitigation measures and engaging with stakeholders, the project can achieve its objectives while protecting the environment and enhancing the well-being of local communities.

Acknowledgement

The Federal Ministry of Works sincerely appreciates the representatives of the Federal Ministry of Environment (FMEnv), Lagos State Ministry of Works, Lagos State Ministry of Environment and Water Resources, Hitech Construction Company Limited (Contractor), Ibeju Lekki Local Government Area of Lagos State as well as the host communities and other stakeholders for the unflinching supports they gave throughout the assessment study.

CHAPTER ONE
INTRODUCTION

1.0 Project Background

Nigeria is Africa’s most populous nation in the World, home to an estimated 229 million people with a rapid growth rate projected to reach 400 million by 2050. Figure 1.1 shows the Map of Nigeria in the World.

Figure 1.1: Nigeria in the World

Despite abundant natural resources and burgeoning commercial activities, the country faces significant challenges in maximizing its potential. A critical bottleneck hindering development is the underdeveloped inland transportation infrastructure. This hampers the exploitation of natural resources, leading to substantial waste, and negatively impacts the agricultural sector, a key economic driver. Post-harvest losses due to inadequate transportation networks remain a significant challenge.

With over 1,200 cities and towns, including 19 with populations exceeding one million, Nigeria presents a complex urban landscape. Lagos, Africa's largest city with over 27 million inhabitants, is the economic and commercial hub. However, the rapid urbanization has outpaced infrastructure development, leading to challenges in housing, transportation, and public services.

Nigeria's transportation infrastructure is composed of roads, railways, ports, airports, and inland waterways. Although recent investments, such as the modernized Abuja-Kaduna railway, have shown progress, the sector faces significant hurdles. Challenges include inadequate maintenance, severe congestion, and overall inefficiency. To meet the burgeoning demands of its growing population and economy, Nigeria necessitates substantial investments and strategic planning in its transportation system.

The federal road network, spanning approximately 36,000 kilometres, is the backbone of transportation. However, inadequate maintenance, coupled with increasing traffic volumes, has led to deteriorating road conditions.

Recognizing these challenges, the government has initiated the proposed Lagos-Calabar Coastal Highway designed to improve connectivity and facilitate economic growth. A visual representation that highlights the Nigerian coastal states (Ogun, Ondo, Delta, Bayelsa, Rivers, and Akwa Ibom states) traversed by the proposed Lagos-Calabar Coastal Highway is given in Figure 1.2.

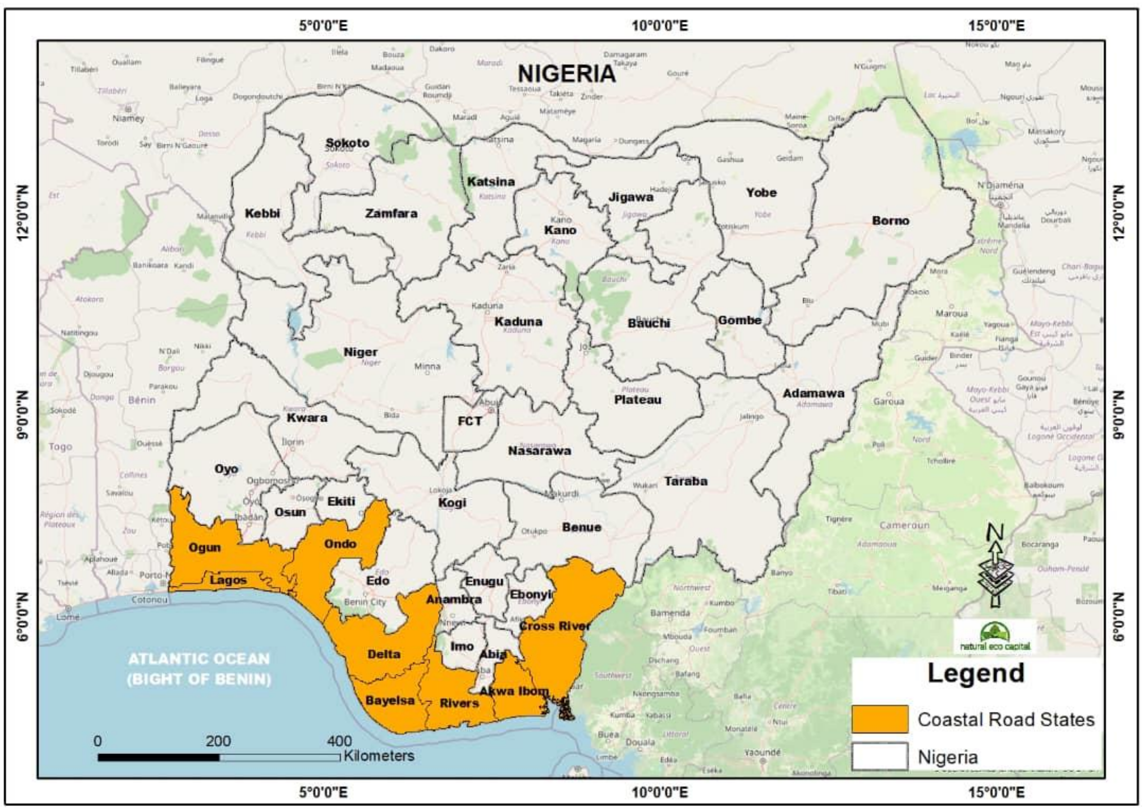

Figure 1.2: Nigerian Coastal States Traversed by the Proposed Lagos-Calabar Coastal Highway

1.1 The Proposed Lagos-Calabar Highway

The Lagos-Calabar Coastal Highway is an ambitious 700-kilometers project that will stretch from Victoria Island in Lagos to Calabar in Cross River State. This transformative project promises improved transportation, economic growth, and enhanced connectivity for Nigeria. This highway aims to connect the western and southeastern regions of Nigeria, enhancing cross-country connectivity and trade relations.

Some key details include:

1. **Route and States Covered:**
    - The highway will traverse through several states, including Lagos, Ogun, Ondo, Delta, Bayelsa, Rivers, and Akwa Ibom, before reaching its final destination in Calabar.
    - It's designed to link major urban centres, industrial hubs, and seaports along the southern coast.
2. **Alignment Considerations:**
    - To avoid ecologically sensitive areas, the alignment takes a significant detour between the River Dodo and the River St. Nicholas. This deflection bypasses mangrove swamps and turtle nesting/breeding grounds.
    - Additionally, it avoids built-up areas like Brass Town and existing facilities such as the AGIP Terminal and the Brass LNG Plant.
    - As it approaches the New Calabar River, the alignment courageously hugs the coastline, passing through barrier island forests. Interestingly, the presence of oil pipelines in this segment eliminates the need for further ecological precautions.
3. **Interconnected Routes:**
    - The Lagos-Calabar Coastal Highway will serve as a vital link, connecting Lagos to the coastal regions of Ogun, Ondo, Edo, Delta, Bayelsa, Rivers, Akwa Ibom, and Cross River States.
    - Additionally, it will intersect with several north-south vertical routes:
        - A1: Lagos to Sokoto
        - A2: Warri to Kaduna, Zaria, Kano, and Daura
        - A3: Port Harcourt to Makurdi, Bauchi, and the Kano/Maiduguri Road
        - A4: Calabar to lkom, Ogoja, Jalingo, Numan, and Maiduguri

Figure 1.3 shows the proposed Lagos - Calabar Coastal Highway and Connection with Nigeria's North-South Vertical Routes**.**

Figure 1.3: Proposed Lagos - Calabar Coastal Highway and Connection with Nigeria's North-South Vertical Routes

1.2 The Proposed Project Objectives

The Lagos-Calabar Coastal Highway is a strategic investment designed to drive economic growth, improve transportation infrastructure, and enhance the overall quality of life for Nigerians. The Highway is a massive infrastructure project aimed at transforming transportation and economic development along Nigeria's coastline.

The key objectives are outlined below:

- **Enhanced Connectivity:** Improve transportation links between major coastal cities and towns, integrating with existing federal roads.
- **Economic Growth:** Boost trade, tourism, and overall economic development in the region.
- **Reduced Travel Time:** Significantly shorten travel distances between coastal cities, leading to increased efficiency and productivity.
- **Infrastructure Development:** Utilize concrete technology to stimulate local industries and create employment opportunities.

The expected impact includes:

- **Economic Expansion:** The project is expected to increase Lagos State's economy by 50% in the first phase alone due to its connection to the Lekki Deep Seaport and other industrial zones.
- **Regional Integration:** Foster collaboration and development among coastal states.
-

1.3 Project Facilitation Entities

The Lagos-Calabar Coastal Highway project is structured under an Engineering, Procurement, Construction, and Financing (EPC+F) model with the following key entities:

1. Federal Ministry of Works (FMW)

- **Role:** Project Proponent responsible for overall project management and development.
- **Responsibilities:** Construction, rehabilitation, planning, design, and monitoring of federal highways.

2. Hi-tech Construction Africa Limited

- **Role:** EPC+F Contractor responsible for project execution.
- **Responsibilities:** Engineering, procurement, construction, and financing of the highway.
- **Expertise:** Specializes in coastal erosion solutions and marine engineering.

3. Natural Eco Capital Limited

- **Role:** Environmental and Social Consultant.
- **Responsibilities:** Preparation of Environmental and Social Impact Assessment (ESIA) and Resettlement Action Plan (RAP).
- **Expertise:** Sustainability consulting, with a focus on environmental impact assessment and sustainable development.

Thus, the project is a Public-Private Partnership (PPP) between the government and the private sector. The EPC+F model ensures efficient project delivery and risk allocation. Environmental and social considerations are integrated into the project through the involvement of a dedicated consultant.

1.4 The Need for the Environmental and Social Impact Assessment (ESIA)

The Lagos-Calabar Coastal Highway project requires an Environmental and Social Impact Assessment (ESIA) due to the potential environmental and social impacts associated with its construction. The following are the key reasons:

- The project involves significant civil engineering work, including road construction, drainage systems, and potentially bridges and culverts.
- Nigerian law mandates ESIA for road projects, and the project must adhere to federal and state environmental regulations.

- The ESIA will identify potential environmental impacts and propose mitigation measures to protect ecosystems and natural resources.
- The assessment will evaluate the project's social implications, including impacts on local communities, livelihoods, and cultural heritage.
- By conducting an ESIA, the project aims to ensure that it is environmentally and socially responsible, promoting sustainable development.

In essence, the ESIA is a crucial tool for identifying, assessing, and mitigating the potential negative impacts of the Lagos-Calabar Coastal Highway project while maximizing its benefits.

Alongside the ESIA is the preparation of a Resettlement Action Plan (RAP) for the Highway.
A Resettlement Action Plan (RAP) is essential for a highway due to the potential for involuntary resettlement. The following are the key reasons:

- Construction of the highway requires acquiring land, which may displace people, businesses, or communities.
- Building the highway may necessitate removing or relocating existing infrastructure, such as homes, shops, or public facilities.
- People dependent on land for agriculture, fishing, or other livelihoods may be affected by the project.
- Resettlement can lead to social disruptions, loss of community cohesion, and psychological distress.

Thus, by preparing a RAP, the project ensures that people affected by the highway construction are treated fairly and justly, and that their livelihoods and well-being are protected. The RAP addresses these challenges by outlining:

- How affected people will be identified and classified.
- The process for determining compensation for lost assets.
- Plans for resettlement, including housing, infrastructure, and livelihood restoration.
- Measures to minimize disruptions and support affected communities.

1.5 Objectives of the ESIA

The ESIA aims to ensure that the project is developed and implemented in a sustainable manner that protects the environment and benefits the local community. The primary goal of the Environmental and Social Impact Assessment (ESIA) for the Lagos-Calabar Coastal Highway is to identify, assess, and mitigate potential negative impacts on the environment and society.

Specific Objectives include:

- **Baseline assessment:** Understand the existing environmental and social conditions.

- **Impact identification:** Determine the potential impacts of the project on both the natural and human environment.
- **Risk assessment:** Evaluate the potential risks associated with the project.
- **Mitigation planning:** Develop strategies to avoid, minimize, or compensate for negative impacts.
- **Environmental management:** Create an Environmental and Social Management Plan (ESMP) to implement mitigation measures.
- **Reporting:** Document findings and recommendations in a comprehensive ESIA report.

1.6 Scope of the ESIA

The Lagos-Calabar Coastal Highway project is a significant infrastructure development spanning over 700 kilometres and divided into nine sections.

Figure 1.4: The Proposed Coastal Highway showing the proposed Alignment

The section 2 continues from Section 1 (0-47.5km), which spans from 47 km to 103 km and is in Lagos (Figures 1.5 and 1.6).

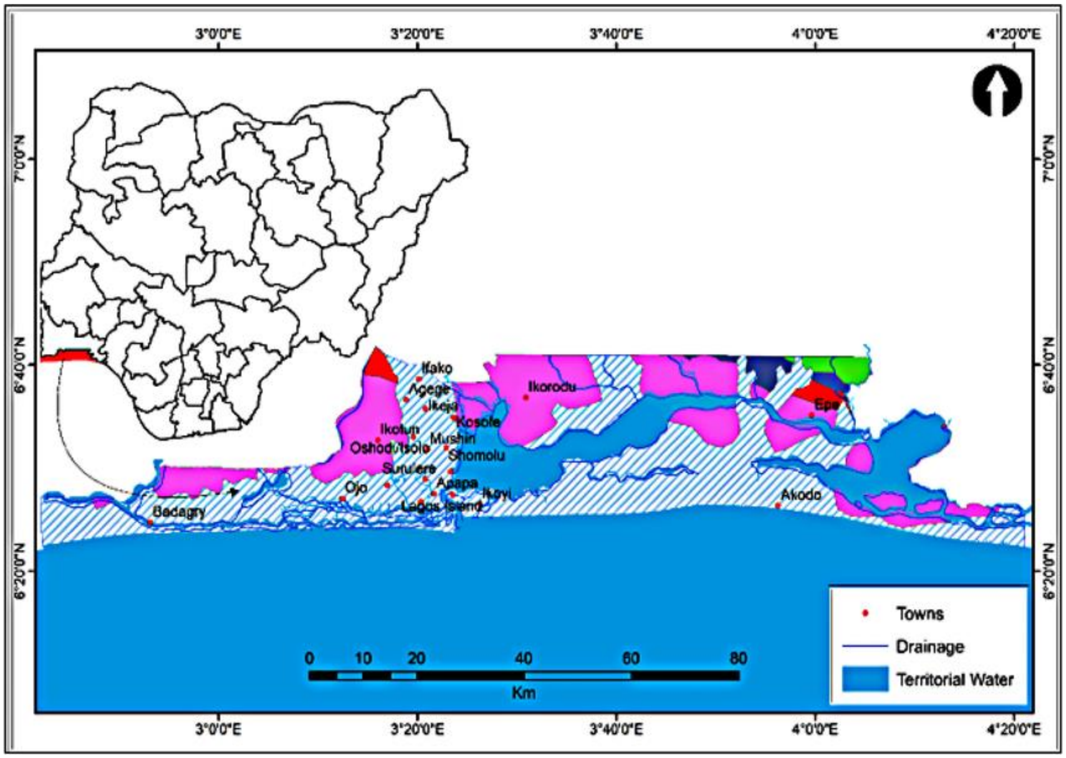

Figure 1.5: State of Coastal Highway Project Kick-off – Lagos State in Nigeria

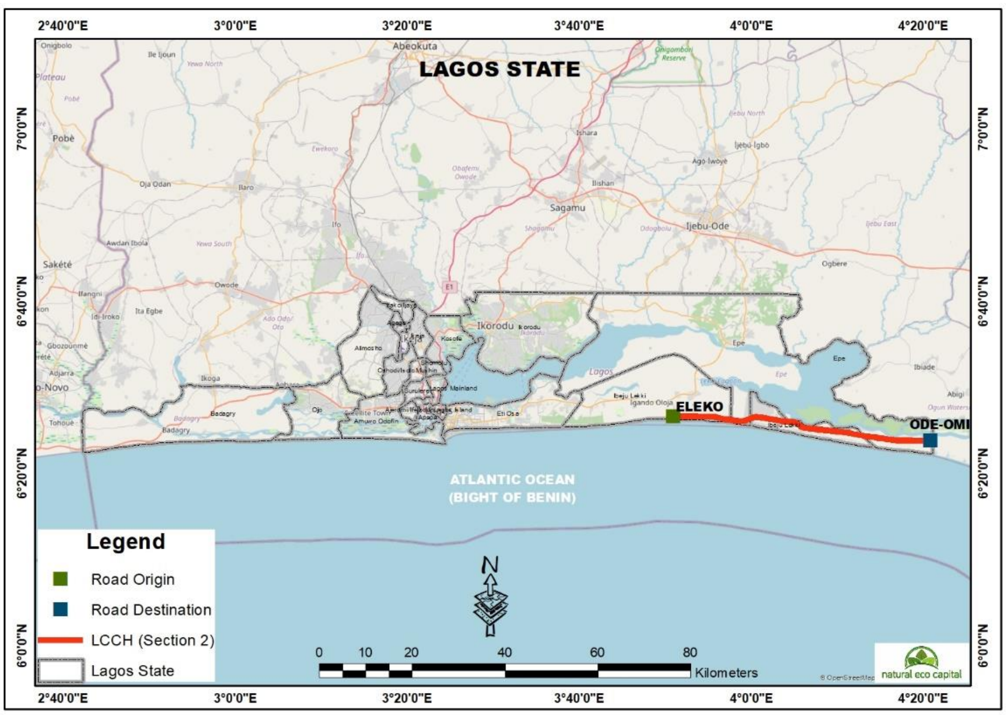

Figure 1.6: Length of the Proposed Section 2 of the Lagos-Calabar Coastal Highway

The project's impact assessment has a phased approach to demonstrate a commitment to environmental and social considerations. This ESIA report specifically focuses on Section 2, providing a foundation for subsequent sections. The ESIA evaluates the environmental and social impact of a plan, policy, program, or project before deciding to proceed with the proposed action. It covers various aspects, including physical, biological, and socio-economic elements. The ESIA will describe project activities and identify potential impacts on air, water, soil, vegetation, wildlife, land use, and affected individuals and assets.

1.7 Approach and Methodology for the ESIA

1. **Strategic Approach**:

The ESIA process adheres to relevant local, national, and international policies, regulations, and standards. The key guiding parameters include:

- Considering policy, legal, and administrative frameworks.
- Focusing on main issues.
- Involving appropriate professionals and groups.
- Consulting the public.
- Linking information to decision-making.
- Presenting clear options for mitigating adverse environmental and social impacts.
- Providing helpful information to road agencies, donor agencies, planners, engineers, and decision-makers.

2. **ESIA Methodology**:

- The methodology ensures sustainable development, considering environmental and societal needs.
- It identifies potential risks and impacts associated with the project.
- A framework for mitigation measures is developed.
- Critical steps outlined in Figure 1.3 guide the preparation of the ESIA Report.

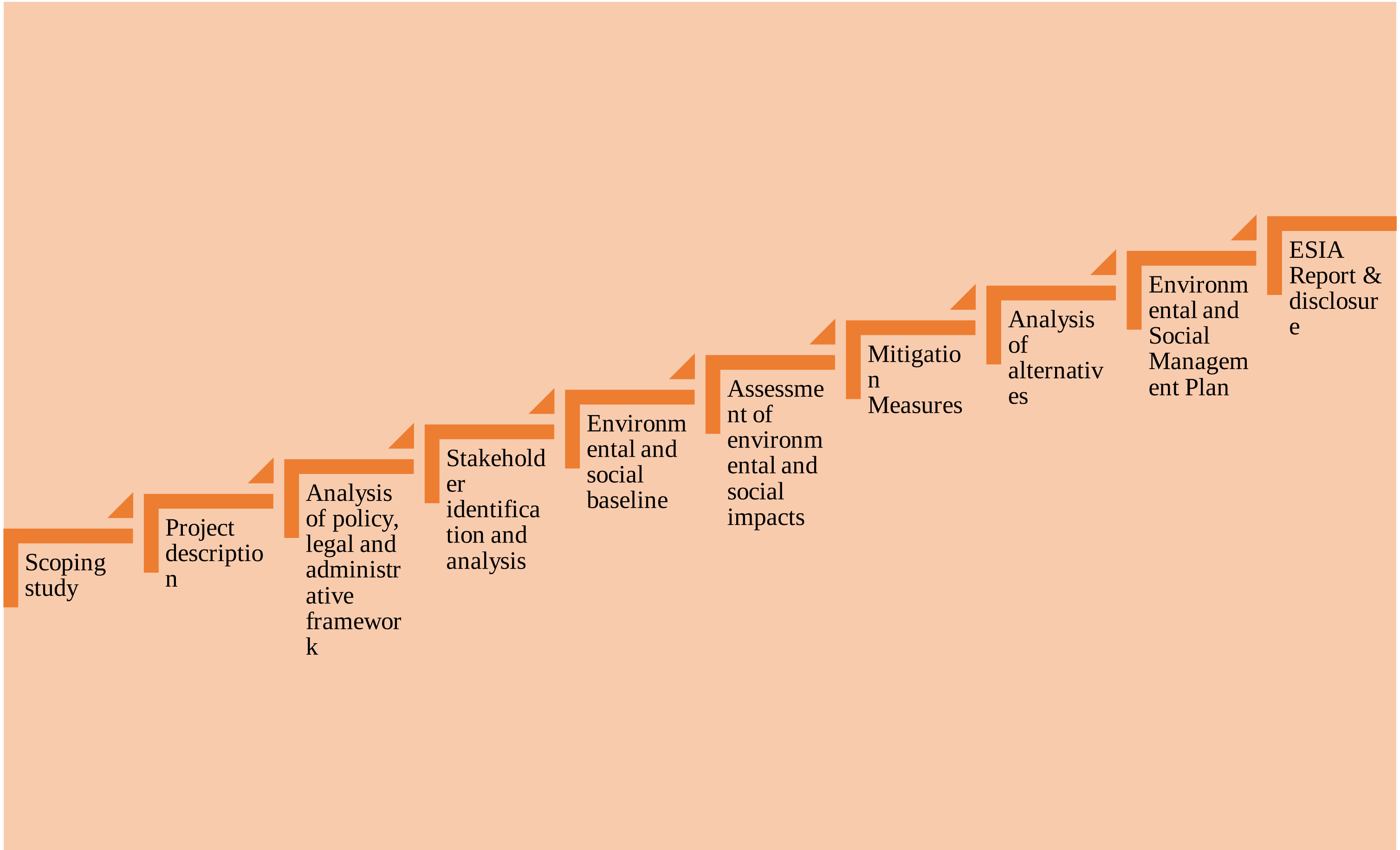

Figure 1.7: Key Elements of the ESIA Process

1.8 Environment-Related Federal Institutions

1. National Council on Environment

This is the apex policy-making organ on the 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 broaden national development.

The Council meets regularly to

- Consider and receive States' reports on environmental management.
- Consider national environmental priorities and action plans as it affects Federal and State governments; and

- Exchange ideas and information where necessary with the Federal Government on environmental issues.

2. Federal Ministry of Environment (FMEnv)

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.

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.

Regulatory instruments are enforced through the activities of the following agencies:

1. **Forestry Research Institute of Nigeria (FRIN)**:
   - FRIN focuses on forestry research, conservation, and sustainable forest management.
   - It contributes to environmental protection through research and policy recommendations.
2. **National Biosafety Management Agency (NBMA)**:
   - NBMA regulates modern biotechnology and genetically modified organisms (GMOs) to ensure their safe use and minimize environmental risks.
3. **National Environmental Standards and Regulations Enforcement Agency (NESREA) with** Gazette No. 92, Vol. 94 of 31st July 2007.
   - NESREA is responsible for enforcing environmental standards and regulations.
   - It monitors compliance with environmental laws and promotes sustainable practices.
4. **National Oil Spill Detection and Response Agency (NOSDRA)** established under Act of 2006:
   - NOSDRA addresses oil spill incidents, especially in the oil-producing regions.
   - It ensures timely response, containment, and clean-up of oil spills to protect the environment.
5. **National Park Service of Nigeria**
   - Responsible for preserving, enhancing, protecting and managing vegetation and wild animals in the national parks of Nigeria.
6. **Environmental Assessment Department**
   - Under the Ministry 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:
   - Implementation of the provisions of the Environmental Impact Assessment (EIA) Act of 1992 on development projects.

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

1.8.1 Environment-Related State Institutions

State Ministry of Environment/Environmental Protection Agency

Each State of the Federation has an Environment Ministry and/or Environmental Protection Agency (EPA) that is charged with the responsibility of providing a decent, orderly, conducive and habitable environment.

In the State, *inter alia*, the Ministry of the Environment carries out the following:

- Liaison with the Federal Ministry of Environment to achieve healthy or better management of the environment.
- Co-operate with FMEnv and other National Directorates/Agencies in the performance of environmental functions including environmental education/awareness to the citizenry.
- Monitoring waste management standards,
- Responsibility for general environmental matters in the States, and
- Monitoring the implementation of ESIA studies and other environmental studies for all development projects in the State.

Lagos State has a number of Ministries, Departments and Agencies (MDAs) relevant to the Project. These institutions collaborate to safeguard the environment, promote sustainable practices, and enhance the quality of life for Nigerians. The main thrust of these agencies is to **protect and improve the environment**. They assist public and private organizations, industries, businesses, and non-governmental organizations in achieving compliance by providing environment-friendly solutions to varied environmental challenges.

Lagos State Ministry of Environment and Water Resources

The **Lagos State Ministry of Environment and Water Resources** in Nigeria have the following:

- Vision and Mission:
  - Vision: “A flood-free, hygienic, and beautiful Lagos.”
  - Mission: "To foster a clean, healthy, sustainable environment for the well-being of citizens through the application of best practices in environmental management."
- Mandate and Structure:

- The ministry's primary mandate is to secure **a clean, healthier,** and **sustainable environment** conducive for **tourism, economic growth**, and the well-being of its citizens.

It oversees several **agencies:**

i. Lagos State Environmental Protection Agency (LASEPA): Responsible for environmental protection and regulation and monitors and enforces environmental standards within Lagos State, and with regard to Vehicular Emission Standards, Setting, monitoring, and enforcing standards and guidelines on vehicular emissions.
ii. Lagos State Waste Management Authority (LAWMA): Manages waste disposal through collection, disposal, and recycling in Lagos.
iii. Lagos State Parks and Garden Agency (LASPARK): LASPARK oversees parks, green spaces, and urban forestry.
iv. Lagos Water Corporation (LWC): Deals with water supply.
v. Lagos State Water Regulatory Commission (LSWRC): Regulates water resources.
vi. Lagos State Environmental Sanitation Corps (LAGESC): LAGESC plays a critical role in enforcing environmental sanitation laws in Lagos State. Surveillance and Reporting**:** Monitoring and maintaining surveillance along highways, streets, and public amenities. Reporting Breaches: Regularly reporting any violations of environmental laws to appropriate enforcement authorities.

These institutions collaborate to safeguard environmental quality, promote sustainable practices, and enhance the well-being of Lagos residents.

- Office of Environmental Services & Water Resources:
  - This office handles various aspects, including administration, environmental health, legal services, enforcement, advocacy, environmental management, planning, finance, and more.
- Office of Drainage Services & Water Resources:
  - Responsibilities include administration, finance, drainage construction/dredging, drainage maintenance, enforcement, water resources, project planning, and more.
- Climate Change:
  - Climate change refers to long-term shifts in temperatures and weather patterns.
  - Human activities, such as burning fossil fuels, drive climate change.
  - Greater Lagos aims to address climate challenges and promote sustainable practices.
- Waste Disposal Management:
  - The ministry focuses on effective waste management to keep Lagos clean and healthy.

- **Ministry of Physical Planning and The Directorate of Lands and Surveys**

The Directorate deals with land issues, plans, development controls and establishes residential, commercial and industrial layouts. They also execute in the state, the Nigerian Urban and Regional Planning laws.

1.8.2 Environment-Related Local Government Institutions

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 Local Government, where the proposed project is located.

The local government institutions work diligently with the State Government to safeguard environmental quality, promote sustainable practices, and enhance the well-being of Lagos residents.

1.8.3 Administrative and Legal Framework

In carrying out EIA studies, local and international environmental laws, guidelines and regulations are handy guides and references. In Nigeria, the Federal Ministry of Environment (FMEnv) is the nation's regulatory authority for the environment. Act No. 58 of 1988 established the Federal Environmental Protection Agency (FEPA) -now defunct- as the chief regulatory body for environmental protection in Nigeria. The FMEnv, created in June 1999, now oversees the functions of defunct FEPA. The Act establishing the Ministry places on it the responsibility of ensuring that all development and industry activity, operations and emissions are within the limits prescribed in the National Guidelines and Standards, and comply with relevant regulations for environmental pollution management in Nigeria as may be released by the Ministry.

In general, the Nigerian laws, regulations, and policies applicable to this project are described as follows:

1.8.4 National Legislations/Regulations/Policies

A. Federal Ministry of Environment (FMEnv)

❖ **National Policy on Environment**

Environmental management in Nigeria is based on the National Policy on the Environment (1989), as revised in 1999 and 2016. The goal of this policy is to achieve sustainable development, in particular to:

- Secure for all Nigerians a quality of environment which is adequate for their health and wellbeing;

- Conserve and use the environment and natural resources for the benefit of present and future generations;
- Restore, maintain and enhance the ecosystems and ecological processes essential for the functioning of the biosphere to preserve biological diversity and the principle of optimum sustainable yield in the use of these natural resources and ecosystems;
- Raise public awareness and promote understanding of essential linkages between environment and development and to encourage individual and community participation in environmental improvement efforts; and
- Co-operate in good faith, with other countries, international organizations/agencies to achieve optimal use of trans-boundary natural resources and effective prevention or a statement of trans-boundary environmental pollution.

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

The EIA Act No 86 of 1992 stipulates that the public or private sector of the economy shall not embark on or undertake or authorize projects or activities without prior consideration, at an early stage of their environmental effects. The Act makes EIA mandatory for any major development project, prescribes the procedure for conducting and reporting EIAs. The Act also clearly stipulates among other things the objectives of an EIA, list of project activities for which an EIA is mandatory; minimum content of an EIA, regulatory authority of FMEnv; offences and penalties.

❖ **National Environmental Impact Assessment Procedural Guidelines, 1995.**

In response to the promulgation of the EIA Act of 1992, the FMEnv developed a National EIA Procedure in 1995. The procedure provides steps to be followed from the stage of project conception to commissioning in order to ensure that the project is implemented with maximum consideration for the environment. Figure 4 presents the EIA Process Flowchart showing the onset of EIA Registration with the Federal Ministry of Environment to Audit stage when a project becomes operational.

❖ **S.I.9 National Environmental Protection (Pollution Abatement in Industries Generating Wastes) Regulations 1991**

The National Environmental Protection (Pollution Abatement in Industries Generating Wastes) Regulations, S.1.9 of 1991 (No. 42, Vol. 78, August, 1991) impose restrictions on the release of toxic substances and stipulate requirements for pollution monitoring units, machinery for combating pollution and contingency plan by industries; submission of lists and details of chemicals used by industries to FMEnv; requirement of permit by industries for the storage and transportation of harmful or toxic waste; the generator’s liability; strategies for waste reduction; permissible limits of discharge into public drains; protection of workers and safety requirements; environmental audit (or EIA for new industries) and penalty for contravention.

❖ **Harmful Waste (Special Criminal Provisions etc.) Act CAP HI LFN 2004.**

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

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

This Act is essentially penal legislation. The offences are committed doing any of the act or omission stated in section 12 of the act. The jurisdiction of the Act is far reaching as it sought to remove any immunity conferred by the diplomatic immunities and privileges Act on any person for the purpose of criminal prosecution.

❖ **S.1.15 National Environment Protection (Management of Solid and Hazardous Wastes) Regulations 1991.**

The National Environment Protection (Management of Hazardous and Solid Wastes) Regulations, S.1.15 of 1991 (No. 102, Vol. 78, August, 1991) define the requirements for groundwater protection, surface impoundment, land treatment, waste piles, landfills, and incinerators. The Regulations describe the hazardous substances tracking programme with a comprehensive list of acutely hazardous chemical products and dangerous waste constituent. The requirements and procedure for inspection, enforcement and penalty are also described.

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.

◊

❖ **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, which 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 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).

- **Nigeria Long-Term Low Emission Development Strategy (LT-LEDS)**

Nigeria**'s Long-Term Low Emission Development Strategy (LT-LEDS) is** a comprehensive plan that outlines the country's vision for achieving low-carbon, climate-resilient, and sustainable development. It represents a transformative pathway toward sustainable development, resilience, and a low-carbon future.

The key features of Nigeria's LT-LEDS:

1. Global Commitments:
    - Nigeria submitted its Long-Term Vision 2050 during COP26 in Glasgow, demonstrating its commitment to the Paris Agreement. *FINAL NIGERIA LT VISION_2050_Nov2021.pdf (unfccc.int))*.
    - The LT-LEDS aligns with global efforts to address climate change and achieve net-zero emissions.
2. Implementation Pathway:
    - The LT-LEDS translates this vision into quantified emission reduction targets.
    - It explores technological options and cost implications.
    - The LT-LEDS integrates gender considerations throughout its implementation.
3. Existing Policies and Commitments:
    - Nigeria's existing policies, such as the Climate Change Act, National Climate Change Policy, and Economic Sustainability Plan, contribute to LT-LEDS goals.
    - The LT-LEDS builds upon these efforts to accelerate decarbonization.
4. Stakeholder Engagement:
    - The LT-LEDS involves stakeholders, including government agencies, communities, and civil society.
    - Regular consultations ensure transparency and inclusivity.

- **Nationally Determined Contributions**
  The Development of the Nationally Determined Contribution (NDC) by the Government embodies the country's effort to reduce National Emissions and adapt to the impacts of Climate change. If the laws mentioned and discused above are critically followed and implemented, Nigeria would reduce Greenhouse Gas by 20% unconditionally and 45% with international support. At the same time, the economy will grow at an average annual rate of 5% by 2030. This represents an important milestone in tackling the challenges of climate change in the country

- **Abandonment Guidelines 1995**
  The guidelines help to ensure the environment is returned to, as much as reasonably practicable, its original/baseline conditions.

B. National Environmental Standards and Regulations Enforcement Agency (NESREA), Act 2007.

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.

- 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.
- Section 8 (1)(K) empowers the Agency to make and review regulations on air and water quality, effluent limitations, control of harmful substances and other forms of environmental pollution and sanitation.

- Section 27 prohibits, without lawful authority, the discharge of hazardous substances into the environment.

The Act also enables the Agency also:

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

NESREA has, over the past years, provided at least 24 regulations gazette as supplementary in its Act. Some of these include:

- National Environmental (**Surface and Groundwater Quality Control)** Regulations, S. I. No. 22 of 2011
- National Environmental (**Sanitation and Wastes Control)** Regulations, S. I. No. 28 of 2009
- National Environmental **(Ozone Layer Protection)** Regulations, S. I. No. 32 of 2009
- National Environnemental **(Noise Standards and Control)** Régulations, S. I. No. 35 of 2009.
- National Environmental (Electrical and Electronic Equipment) Regulations, 2011 (S.I 23)
- National Environmental (Soil Erosion and Flood Control) Regulations, 2010 (S.I.12)
- National Environmental (Surface and Groundwater Quality Control) Regulations, 2010 (S.I.22)
- National Environmental (Ozone Layer Protection) Regulations, 2009 (S.I.32)

C. Criminal Code Act Cap C38 LFN, 2004

The Criminal Code contains provisions for the prevention of public health hazards and for environmental protection. Sections 245-248 deal with offences ranging from water fouling to the use of noxious substances.

The Nigerian Criminal Code makes it an offence punishable with up to 6-month imprisonment for any person who:

- Violates the atmosphere in any place so as to make it noxious to the health of persons in general dwelling or carry on business in the neighbourhood, or passing along a public way or
- Does any act which is, and which he knows or has reason to believe to be likely to spread the infection of any disease dangerous to life, whether humans or animals.

D. 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.

E. 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.

F. Forestry Act CAP 51 LFN 1994

This Act provides for the preservation of forests and the setting up of forest reserves. It is an offence, punishable with up to 6 month imprisonment, to cut down trees over 2ft in height or to set fire to the forest except under special circumstances.

G. Endangered Species Act 11, 1985

In pursuance of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, (CITES), the Federal Government of Nigeria enacted Endangered Species (Control of International Trade and Traffic) Act 11, 1985. The Law makes, among others, provisions for the conservation, management and protection of some of the country's endangered species. Section 1 absolutely prohibits the hunting or capture or trading in threatened animal species. The list of endangered species includes reptiles, birds (Aves) and mammals (insectivores, primates, rodents, carnivores).

H. Wild Animals Preservation Act CAP132 LFN 1990

The act was designed to protect the rare and more valuable kinds of game by giving complete protection to certain species. The use of traps and weapons was limited, and the slaughter of female game prohibited. The act sets out in the attached schedule those animals, which are protected, the hunting, killing or capturing of which require special permission from the Administrative Officer or magistrate.

I. National Resource Conservation Action Plan, 1992

The plan was established to set out objectives for living resources conservation through:

- Maintaining genetic diversity in order to ensure permanence in the supply of materials to satisfy basic human needs and thus improve the well-being of society.
- Promoting the scientific value of natural ecosystems, the study of which is required to enhance conservation itself, to improve the management of man-made systems, and to provide clues to technical innovations in agriculture, medicine and industry.
- Regulating environmental balance in such factors as carbon dioxide and radiation levels and the bio- geo chemical cycles.
- Maintaining ecological services through the protection of catchment's areas in order to enhance water resources and check soil erosion and flooding, protection of grazing lands against desert encroachment and the stabilization of coastal zones and.
- Enhancing the amenities values of natural resources, including aesthetic, heritage, religious, sentimental, ethical and recreational values on which tourism may be built.

J. FRSC Act CAP 141 (LFN), 2007.

In February 1988, the Federal Government created the Federal Road Safety Commission through Decree No. 45 of the 1988 as amended by Decree 35 of 1992 referred to in the statute books as the FRSC Act cap 141 Laws of the Federation of Nigeria (LFN) Passed by the National Assembly as Federal Road Safety Commission (establishment) Act 2007.

K. Water Resources Act, CAP W2, LFN 2004

This is an Act to promote the optimum planning, development and use of Nigeria's water resources and other matters connected therewith. It describes the right to the use and control of all surface water and ground water and any watercourse affecting more than one states together with the bed and banks thereof.

L. National Guidelines on Environmental Management System 1999

Recognizing the value of EMS to EIA, this document sets out objectives and provides a guide on the general scope and content of an EMS.

M. Road sector-related policies and laws **in Nigeria**

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.

N. Health and Safety National Instruments

Integrating Health and Safety standards into ESIA ensures that projects prioritize worker safety, prevent harm, and contribute to sustainable development.

The relevant instruments include National Policy on Occupational Safety and Health, revised 2020, which has the chief goal to facilitate improvement of occupational health and safety performance of all workers in all sectors of economic activity, the National Health Policy 2016 which, *inter alia*, 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 **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)**.

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

i. **Factories Act Cap 126 Lfn 1990**
the act makes provision for health and safety of persons employed in places statutorily defined as factories and for which a certificate of registration is required by law. it requires that workers should be adequately protected from occupational health and safety hazards.

ii. **Workmen Compensation Act, 1987**
this is an act to provide compensation for injuries and death suffered by workmen in the course of their employment. (1) an employer shall pay compensation to any of his employees who suffer injury from any accident arising out of and in the course of his employment. (2) an employer shall pay compensation to the person or persons entitled to the estate of any of his employees who dies as a result of an accident arising out of and in the course of his employment.

iii. **Public Health Law Cap 103 Lfn 1990**
public health law examines the authority of the government at various jurisdictional levels to improve the health of the general population within societal limits and norms. the state is empowered to protect and improve the environment and safeguard the water, air and land, forest and wildlife of nigeria. the law prohibits the public or private sector of the economy not to undertake or embark on or authorize projects or activities without prior consideration of the effect on the environment.

iv. **National Policy on Occupational Safety and Health, 2016**
The policy is aimed at ensuring that all workers are safe at their workplaces across the country. This policy was derived from provisions of the Nigerian constitution and the International Labour Organization’s (ILO) convention.

v. The Fire Service Act CAP F29, LFN 2004

An Act to make provision for the organisation, discipline, powers and duties of the Federal Fire Service, and for matters incidental thereto or connected therewith.

vi. The National Emergency Management Agency (NEMA)

The National Emergency Management Agency of Nigeria was established via Act 12 as amended by Act 50 of 1999, to manage disasters in Nigeria. Therefore, from its inception, NEMA has been tackling disaster-related issues through the establishment of concrete structures and measures. Such measures as the education of the public in order to raise their level of awareness and reduce the effects of disasters in the Country.

It coordinates resources towards efficient and effective disaster prevention, preparedness, mitigation and response in Nigeria. It acts in the following areas: Coordination, Disaster Risk Reduction (DRR), search and rescue, policy and strategy, Geographic Information System, Advocacy, education, administration, finance and logistics, relief and rehabilitation, planning, research and forecasting.

The NEMA Act mandated all States to establish State Emergency Management Agencies and Local Governments to establish Local Emergency Management Committees. NEMA promotes the decentralization of DRR activities at all levels. There is a national multi-sectoral platform for disaster risk reduction and a National Action Plan for DRR. NEMA has the authority to mobilise and coordinate actions by other agencies such as the Fire Service, the Police, the Nigeria Security and Civil Defence Corps, the Federal Road Safety Commission, the Federal Ministry of Health and the Red Cross.

vii. **Federal Road Safety Commission (Establishment) Act 2007**

The Federal Government of Nigeria established the Federal Road Safety Commission (FRSC) via a federal law (Federal Road Safety Commission [Establishment] Act 2007) and among others tasks it to handle traffic management and prevent accidents on the highways. The Federal Road Safety Commission (Establishment) Act 2007 binds the FRSC and its staff, so that they cannot act beyond their powers.

1.8.5 Nigerian National Social Protection Policies and Laws

In the consideration of social legislation, the acts and/or 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). These laws and policies collectively contribute to enhancing social well-being, reducing poverty, and promoting a life of dignity for Nigerians. the social protection laws in Nigeria that aim to enhance the well-being of citizens and provide a safety net for vulnerable populations.

a. Specific Areas of Legislation and Policies:

- Gender Equality: Legislation and policies promoting gender equality.
- Disability: Measures addressing disability rights.
- Ethnicity and Religion: Relevant legislation.
- Migration and Displacement: Policies related to migration.
- Children and Young People: Laws impacting children and youth.
- Sexual Minorities: Legislation affecting sexual minorities.
- HIV: Policies concerning HIV

b. Principles of Social Security:
The basic principles include:
  - Maximum welfare, freedom, and happiness for every citizen.
  - Provision of adequate shelter, food, national minimum living wage, old age care, and support for the disabled.
  - Ensuring opportunities for adequate livelihood and suitable employment.
  - Providing public assistance in deserving cases or during conditions of need.

c. Social Security and Health:
  i. Social Work Profession:
    - The primary legislation governing social work in Nigeria is the **Social Work Profession (Registration and Regulation) Act.**
    - This act establishes the **Council for Social Work Education and Practice** (CSWEP), setting standards for social work education and professional practice.

  ii. National Social Protection Policy:
    - The **Nigeria National Social Protection Policy** aims to promote **social justice, equity,** and **inclusive productive growth**.

d. National Social Protection Policy:
  - The **National Social Protection Policy** serves as an umbrella framework in Nigeria. It incorporates related social agenda paradigms with the intention to reduce poverty and ensure a life of dignity for all citizens.
  - This multi-sectoral and multi-disciplinary approach contributes to poverty reduction and aligns with government policy priorities for sustainable development.
  - The Ministry of Finance, Budget, and National Planning led the revision of this policy, involving active participation from stakeholders in both public and private sectors at federal and subnational levels. It reflects national consensus and consultation.
  - Key objectives include reducing inequality, providing social incentives, and fostering human-centered development through health, education, and good governance[1].

e. Laws Regulating Social Security:

i. Pension Reform Act (PRA) of 2014:

- Regulates retirement benefits for individuals who worked in formal employment (public service, private sector, etc.).
- Ensures timely provision of retirement benefits, disability benefits, and survivors' benefits to dependents of deceased employees.

ii. National Health Insurance Scheme (NHIS) Act of 1999:

- Establishes a contributory health insurance scheme.
- Employers with a minimum of ten employees contribute to provide insured persons and their dependents with good-quality and cost-effective health services.

f. **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. While Nigeria has ratified all eight core International Labour Organization Conventions and enacted laws to enforce the provisions, there are indications of restrictions on the trade union rights of workers in Nigeria, discrimination, child labour and forced labour.

g. **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 the 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.

h. 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 focuses on:

- Contribution towards women's empowerment and the eradication of unequal gender power relations in the workplace and economy, in trade unions and in broader society.
- Encouragement of the participation, support and co-operation of men in taking shared responsibility for the elimination of sexism and redefining of oppressive gender roles.
- Increase the participation of women in leadership and decision-making.

- Ensure that through 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.

Table 1.1 shows the general overview and the specific relevance of each law and regulation to the coastal road project would require a more detailed analysis.

Table 1.1: National laws and regulation and their relevance to the coastal Highway Project

S/No	Subject Area	Relevant Laws and Regulations	Key elements	Relevance to coastal road
1	Environment	• National Policy on the Environment • EIA Act • National Environmental Impact Assessment Procedural Guidelines • National Environmental Protection (Pollution Abatement in Industries Generating Wastes) Regulations • Harmful Waste Act • National Environment Protection (Management of Solid and Hazardous Wastes) Regulations • Nigeria Climate Act • Nigeria's Long-Term Low Emission Development Strategy (LT-LEDS) • Nigeria's Nationally Determined Contributions (NDCs) • Abandonment Guidelines • National Environmental Standards and Regulations Enforcement Agency (NESREA) Act	• Air, water, soil, biodiversity, climate change, waste management, land use, natural resources.	• Potential impacts on coastal ecosystems, wetlands, and marine life. • Air and noise pollution from construction and vehicle emissions. • Water pollution from construction runoff and potential impacts on water bodies. • Soil erosion and disturbance during construction. • Climate change implications, including greenhouse gas emissions and vulnerability to climate hazards. • Waste management during construction and operation. • Land use changes and impacts on local communities. • Potential impacts on natural resources, such as fisheries and forestry.

Table 1.1: National laws and regulation and their relevance to the coastal Highway Project

S/No	Subject Area	Relevant Laws and Regulations	Key elements	Relevance to coastal road
		• National Environmental (Surface and Groundwater Quality Control) Regulations • National Environmental (Sanitation and Wastes Control) Regulations • National Environmental (Ozone Layer Protection) Regulations • National Environmental (Noise Standards and Control) Regulations • National Environmental (Electrical and Electronic Equipment) Regulations • National Environmental (Soil Erosion and Flood Control) Regulations • Forestry Act • Endangered Species Act • Wild Animals Preservation Act • National Resource Conservation Action Plan • Water Resources Act		

Table 1.1: National laws and regulation and their relevance to the coastal Highway Project

S/No	Subject Area	Relevant Laws and Regulations	Key elements	Relevance to coastal road
		• National Guidelines on Environmental Management System		
2	Social	• Land Use Act • Nigerian Urban and Regional Planning Act • Violence Against Persons (Prohibition) Act • National Gender Policy • National Policy on Child Labour	• Communities, livelihoods, land rights, cultural heritage, social impacts, resettlement.	• Potential impacts on local communities, including displacement and disruption of livelihoods. • Land acquisition and compensation issues. • Impacts on cultural heritage and historical sites. • Social cohesion and potential conflicts. • Resettlement planning and implementation.
3	Health and Safety	• Factories Act • Workmen Compensation Act • Public Health Law • National Policy on Occupational Safety and Health • The Fire Service Act • National Emergency Management Agency (NEMA) Act	• Worker health and safety, public health, emergency response.	• Occupational health and safety for construction workers. • Public health risks associated with air and water pollution, waste management, and vector-borne diseases. • Emergency response plans for accidents and disasters.

Table 1.1: National laws and regulation and their relevance to the coastal Highway Project

S/No	Subject Area	Relevant Laws and Regulations	Key elements	Relevance to coastal road
		• Federal Road Safety Commission (Establishment) Act		
4	Transport - Sector	• FRSC Act • Road sector-related policies and laws	• Road infrastructure, traffic management, mobility, accessibility.	• Improvement of road connectivity and accessibility. • Traffic management and safety measures. • Reduction of travel time and transportation costs. • Potential impacts on public transportation and alternative modes of transport.
5	Rail System	• Nigerian Railway Corporation (NRC) Act: Establishes the NRC as the primary operator of railway services. • National Transport Commission (NTC) Act: Regulates the transport sector, including railways. • Land Use Act: Governs land acquisition for railway projects. • Environmental Impact Assessment (EIA) Act: Mandates	• Infrastructure: Railway lines, stations, depots, signaling systems, rolling stock. • Operations: Freight and passenger services, maintenance, safety, efficiency. • Integration: Connectivity with other transport modes (road, air, maritime). • Economic Impact: Job creation, trade facilitation, regional development.	• Intermodal Transportation: Integration of rail and road transport for efficient goods movement and passenger travel. • Reduced Road Congestion: Shifting freight and passenger traffic from roads to rail can alleviate congestion on coastal roads. • Economic Development: Improved rail connectivity can boost economic activities along the coast.

Table 1.1: National laws and regulation and their relevance to the coastal Highway Project				
S/No	**Subject Area**	**Relevant Laws and Regulations**	**Key elements**	**Relevance to coastal road**
		environmental assessment for railway projects. • Other relevant laws and regulations: Safety standards, labor laws, procurement regulations.	• Environmental Impact: Reduced carbon emissions, land use efficiency.	• Environmental Benefits: Rail transportation generally has lower carbon emissions compared to road transport.

Lagos State Agencies and Legislations

The Table 1.2 serves as a valuable resource for understanding the legal and regulatory framework for coastal road projects in Lagos State.
The table can be further detailed by including specific sections or clauses of the mentioned laws relevant to coastal road projects.

- **Agency:** The table can expand on the roles and responsibilities of each agency to clarify their involvement in coastal road projects.
- **Collaboration:** The table can highlight potential collaborations between agencies for effective coastal road management.
- **Data Collection:** Information on specific data requirements, monitoring, and reporting for each agency can be added.
- **Permitting and Licensing:** The table can include information on necessary permits and licenses for coastal road projects.

Table 1.2: Legal and regulatory framework for coastal road projects in Lagos State

Subject Area	Relevant Laws and Regulations	Key Elements	Relevance to Coastal Road
Environment	Lagos State Environmental Protection Law, Lagos State Environmental Sanitation Law, Lagos State Environmental Pollution Control Law	Environmental impact assessment, waste management, pollution control, monitoring	Essential for assessing environmental impact, waste disposal, and pollution prevention during construction and operation
Waste Management	Lagos State Waste Management Authority (LAWMA)	Waste collection, disposal, recycling	Crucial for managing construction waste and potential marine debris
Parks and Gardens	Lagos State Parks and Garden Agency (LASPARK)	Green spaces, aesthetics	Important for coastal erosion prevention, public spaces, and visual impact
Water Management	Lagos State Water Corporation (LWC), Lagos State Water Regulatory Commission (LSWRC)	Water supply, quality, regulation	Essential for water supply to construction sites, water quality monitoring, and potential impacts on marine life

Urban Planning	Lagos State Urban and Regional Planning and Development Law	Physical planning, urban development, building control	Crucial for coastal zone management, land use planning, and infrastructure development
Emergency Management	Lagos State Emergency Management Agency (LASEMA)	Disaster management, response, prevention	Essential for handling potential emergencies like flooding, erosion, or accidents
Fire and Rescue	Lagos State Fire and Rescue Service	Fire prevention, response, rescue	Important for safety during construction and operation, especially considering potential hazards near water
Safety	Lagos State Safety Commission	Safety regulations, enforcement	Crucial for worker safety, public safety, and infrastructure safety

i. International Instruments for Social Protection

Table 1.3: International Instruments for Social Protection	
No.	**Applicable provisions**
1. International Bill of Human Rights	• This comprises of the Universal Declaration of Human Rights, the International Covenant on Economic, Social and Cultural Rights and the International Covenant on Civil and Political Rights and its two Optional Protocols. • Universal Declaration of Human Rights, 1948. This is a common standard for all peoples and all nations and meant to be respected and upheld by every individual, every organ of society and by member States. It comprises of 30 Articles including the right to: life, to dignity, to expression, movement and from discrimination, to access judicial justice on fair terms, to privacy, to asylum and nationality, to marriage and family life, to conscience, thought and religious freedom, to association and peaceful assembly, participation in political, social and cultural activities of the society, to social security, to gainful and decent employment on equitable terms and remuneration, to a standard of living adequate for the health and well-being of himself and of his family, to work leave, rest and leisure, to education and human development, to property, to recognition as a person; and freedom from:

Table 1.3: International Instruments for Social Protection	
No.	**Applicable provisions**
	slavery and servitude; from torture and cruel, inhuman or degrading treatment or punishment. • Duties are owed to the community to ensure the realization of these freedoms and States shall refrain from ay activities aimed at their destruction. • Article 25 of the International Covenant on Civil and Political Rights provides for the right of citizens to take part in political affairs, and Article 19 guarantees the right to freedom of expression, including the right to seek information.
2. United Nations Guiding Principles on Business and Human Rights (UNGPs)	• The UNGPs is a framework for actions by States and companies as regards business-related human rights impacts. They are non-binding on either States or companies, however, it is incumbent on them to **prevent**, **address** and **remedy** human rights abuses. • The General principles are the following: - States' have obligations to respect, protect and fulfil • human rights and fundamental freedoms; - business enterprises have a social responsibility to comply • with all applicable laws and to respect human rights; and - there should be appropriate and effective remedies when human rights are breached.
3. Equator Principles (EP) 4	• The Equator Principles serve as a common environmental and social risks framework for Equator Principles Financial Institutions (EPFIs) in evaluating projects and ensuring that they are socially responsible and reflect sound environmental practices to qualify for financing. The ten (10) principles are aligned with the United Nations Sustainable Development Goals (SDGs). • Assessments of potential adverse Human Rights impacts and climate change risks are required for Category A and higher risk Category B projects. Projects that are under Category A and B are required to develop and/or maintain an Environmental and Social Management Plan (ESMS) to address issued raised in the Assessment process and incorporate actions required to comply with the applicable standards. Effective Stakeholder Engagement, as an ongoing process with Affected Communities, Workers and, where relevant, Other Stakeholders will be required for Category A and B projects.
4. International Labour Organization	• The International Labour Organization (ILO) has maintained and developed a system of international labour standards since year 1919. The standards are aimed at promoting decent and productive work, in conditions of freedom, equity, security,

Table 1.3: International Instruments for Social Protection	
No.	**Applicable provisions**
(ILO) Core Labour Standards	and dignity. Governments, employers' and workers' organizations, international institutions, multinational enterprises and nongovernmental organizations are expected to incorporate the standards in their policies, operational objectives and processes.
5. Convention on the Rights of the Child (CRC) 6. International Programme on the Elimination of Child Labour (IPEC)	• The Convention was adopted by the UN General Assembly on 20 November 1989 and entered into force in September 1990. It incorporates in 41 articles the full range of human rights - civil, political, economic, social and cultural rights - of children under the age of eighteen years. The Convention has been ratified by Nigeria and by Lagos State. • Since 1992, the ILO has led a global effort to raise awareness of the child labour problem, to encourage member States to put in place appropriate legal and policy frameworks, and to ensure that appropriate attention is paid to the elimination of all forms, especially, the worst forms, of child labour.
7. Convention on the elimination of All Forms of Discrimination Against Women (CEDAW) 8. UN Global Compact, Women's Empowerment Principles	• The Convention on the Elimination of All Forms of Discrimination against Women (CEDAW) was adopted in 1979 by the UN General Assembly. It defines what constitutes discrimination against women and sets up an agenda for national action to end such discrimination. Countries that have ratified or acceded to the Convention are legally bound to put its provisions into practice. States parties agree to take all appropriate measures, including legislation and temporary special measures, so that women can enjoy all their human rights and fundamental freedom. The Convention has been ratified by Nigeria. • These Principles are to be adopted by business leaders to empower women in the workplace, marketplace and community and to promote gender equality and women's empowerment.
9. UN Global Compact - Labour Principles	• Principle 3. Businesses should uphold the freedom of association and the effective recognition of the right to collective bargaining. • Principle 4. Businesses should uphold the elimination of forced or compulsory labour. • Principle 5. Businesses should uphold the effective abolition of child labour. • Principle 6. Businesses should uphold the elimination of discrimination in respect of employment and occupation.

Table 1.3: International Instruments for Social Protection	
No.	**Applicable provisions**
10. International Finance Corporation (IFC) Performance Standards (PS) Performance Standard 2 – Labour and Working Conditions	• Protection of the fundamental rights of workers as the workforce is a valuable asset, and a sound worker-management relationship is a key ingredient in the sustainability of a company. • This PS is applicable during the environmental and social risks and impacts identification process, where the implementations are necessary to meet the expectations in the Company's Environmental and Social Management System (ESMS). It applies to the Company's direct workers, contracted workers and also supply chain workers. • Requirements under this PS are (i) working conditions and management of worker relationship, (ii) protection of the workforce, (iii) occupational health and safety, (iv) workers engaged by the third parties, and (v) supply chain.
12. International Finance Corporation (IFC) Performance Standards (PS) Performance Standard 8 – Cultural Heritage	• PS8 acknowledges the importance of cultural heritage for current and future generations. This is horizontal with the Convention Concerning the Protection of the World Cultural and Natural Heritage which target to ensure that the Company protect cultural heritage in the course of their project activities. • Besides that, the requirements outlined in this PS are based on standards set by the Convention on Biological Diversity which apply to cultural heritage regardless of whether or not it has been legally protected or previously disturbed. • The requirements in this PS focused on: - protection of cultural heritage in project design and execution; and - project's use of cultural heritage.
13. World Bank Group (WBG) Environmental Health and Safety (EHS) Guidelines	• The Environmental, Health and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). • The General EHS Guidelines are tailored into four (4) main sections/topics (i) Environmental, (ii) Occupational Safety and Health, (iii) Community Health and Safety, and (iv) Construction and Decommissioning. It shall be used together with the relevant Industry Sector EHS Guidelines. • Applicable topic for human rights under the World Bank EHS Guidelines is the Community Health and Safety. This section of the Guidelines is addressing some aspects of projects activities

k. Ministry of Marine and Blue Economy

In August 2023, President Bola Ahmed Tinubu announced the creation of new ministerial portfolios in Nigeria, including the Ministry of Marine and Blue Economy. This move reflects Nigeria's interest in harnessing economic opportunities from its oceans and aquatic ecosystems. However, despite this laudable step, Nigeria lacks a comprehensive policy or harmonized laws for the implementation of the blue economy.

While Nigeria has made strides in recognizing the blue economy's potential, existing legal frameworks need improvement. Nigeria's blue economy holds immense promise, but regulatory enhancements are crucial to fully realize it's potential.

l. Hospitality and Tourism - Nigerian Tourism Development Corporation

Nigerian Tourism Development Corporation Act (NTDC Act): At the core of Nigeria's travel and tourism legal framework establish the Nigerian Tourism Development Corporation (NTDC) Act. This legislation establishes the NTDC, which plays a pivotal role in promoting and regulating tourism in the country. The NTDC oversees the registration and licensing processes for tourism establishments, including hotels, travel agencies, tour operators, and tourist guides.

Compliance with these requirements ensures that establishments meet certain standards and adhere to safety protocols. The NTDC Act sets guidelines for hospitality establishment standards, ensuring that hotels, guesthouses, and other accommodation facilities maintain quality and safety for guests. Ensuring tourism safety and security is crucial. The NTDC collaborates with relevant agencies to enhance safety measures, protect tourists, and prevent incidents that could harm visitors or tarnish Nigeria's image as a tourist destination. While Nigeria's tourism sector has immense potential, continued investment and effective implementation of existing laws are essential for sustainable growth.

m. Policies and Development of Railways in Nigeria

Nigeria's railway laws aim to facilitate efficient rail transport, promote safety, and regulate railway operations. The legal framework related to railways in Nigeria.

The **Nigerian Railway Corporation (NRC) Act** provides for the establishment of the Nigerian Railway Corporation. Its purpose is to transfer the railway undertaking from the Government of the Federation to the Corporation and regulate its functions. The key provisions include the establishment and constitution of the NRC, duties and powers of the Corporation, financial provisions, staff regulations, and working of the railway system. The NRC Act outlines the duties and powers of the Corporation, including the appointment of a general manager, furnishing information, fixing rates and fares, providing additional facilities for traffic, and executing necessary works. It also addresses land acquisition, construction, and maintenance for railway purposes.

The Fifth Alteration Act empowers the National Assembly to legislate on inter-state railway tracks, infrastructure, and the establishment of a national railway agency. States can make laws for state railway carriers within their boundaries. Generally, no person can construct or operate a railway for public carriage of passengers or goods within Nigeria without the consent of the Corporation. However, the Act allows for seeking the Corporation's consent in specific cases.

1.8.6 Lagos State Agency and Legislations

1. **Lagos State Ministry of the Environment**

This is the state government Ministry responsible for the management of the environment in Lagos State with regard to relevant policies and actual implementation through **Law Cap L23, Laws of Lagos State of Nigeria (2003**). The Ministry has agencies who work together to create a conducive environment for tourism, economic growth, and the well-being of Lagos residents. The environmental agencies and bodies under the Lagos State Ministry of the Environment and Water Resources are outlined below:

- Lagos State Environmental Protection Agency (LASEPA):

LASEPA is responsible for environmental protection and regulation in Lagos State. It focuses on monitoring, enforcement, and advocacy to ensure a cleaner and healthier environment. Citizens can report environmental issues easily through LASEPA.

  - **Lagos State Environmental Sanitation Law, CAP 44, (1984).** This is a law of Lagos State focused on environmental sanitation and protection. It punishes in varying degrees acts like street obstruction, failure to clean sidewalks, cover, refuse bins or disposal wastes property.
  - **Lagos State Environmental Pollution Control Law, CAP 46 LLS (1989**). Section 12 of this law of Lagos State makes it an offence to cause or permit a discharge of raw untreated human waste into any public drain, water course or into any land or water.

- Lagos State Waste Management Authority (LAWMA):

LAWMA manages waste collection, disposal, and recycling across Lagos State. Its goal is to maintain a sustainable waste management system and promote recycling and reuse.

In December 1991, the Lagos State Waste Management Authority (LAWMA) was christened under Edict No. 55 (amended 2007), which made the agency to be responsible for the collection and disposal of municipal and industrial waste. LAWMA is government's cutting-edge response to the need to create a clean and green Lagos State.

- Lagos State Parks and Garden Agency (LASPARK):

LASPARK oversees the development and maintenance of parks, gardens, and green spaces in Lagos. It contributes to enhancing the city's aesthetics and providing recreational areas for residents.

- Lagos Water Corporation (LWC):

LWC is responsible for water supply and distribution in Lagos State. It ensures access to clean and safe water for residents.

- Lagos State Water Regulatory Commission (LSWRC):

LSWRC regulates water-related activities, including licensing, quality control, and pricing. It aims to improve water governance and sustainability.

2. Lagos State Urban and Regional Planning and Development Law, 2010.

In 2010, the Lagos State Government enacted a law to provide for the administration of physical Planning, urban development, urban regeneration and Building control in Lagos state and for connected Purposes. The law designates The Ministry of Physical Planning and Urban Development as the custodian of all Physical Planning, Urban Development, Urban Regeneration and Building Control policies of the State.

3. Lagos State Emergency Management Agency

The Lagos State Emergency Management Agency (LASEMA) was established vide LASEMA Law 16 of 2008 for emergency and disaster management in the State in pursuance to decree 12 of 1999 as amended by Act No. 50 of 1999 which established the National Emergency Management Agency (NEMA).

The Agency is responsible for the overall co-ordination of emergency management in Lagos State, working closely with all its Stakeholders.

- Be the umbrella body to co-ordinate the activities of relevant agencies in prevention and management of disasters in the State.
- For the development of loss prevention programmes and procures necessary technology to mitigate identified emergency situation.
- Prompt and adequate response as well as sustained interventions in any form of emergency or disaster in the State.
- Co-ordinates activities of stakeholders and NGOs who jointly carry out strategies for emergency/disaster management in the State.
- Provides relief materials/financial assistance to victims of various disasters in the State.
- Respond promptly to any emergency at hand, which includes but is not limited to the following;
- Firefighting (co-ordinate with fire services).
- Flood Control
- Collapsed Building
- Evacuation
- Search and Rescue Operations

- Environmental Pollution
- Crowd control/cordon off affected areas.
- Public enlightenment on safety issues.
- Perform general life saving activities including provision of relief materials.
- Clear and remove objects that constitute the carcass or remains of incidents.

4. The Lagos State Fire and Rescue Service

Lagos State Government in readiness towards protecting the lives and property of the people on its creation in 1967 established a state-owned fire station by an Edict of Lagos State Law Cap 42 of 1972. The State Fire and Rescue Service operates from 19 (nineteen) functional Fire Stations across the State and three others at various stages of completion

The Service has the VISION To save lives and properties and to guarantee prompt response to Fire Calls, Rescue Operations and other Related Emergencies while ensuring pro-activeness through Fire Preventive Measures and Training. Its MISSION is the Provision of highly professional, motivated Staff, state of the art Fire Equipment, modern Communication Gadgets and Public Enlightenment Program towards mitigation of Fire and other related Emergencies in Lagos Stat

5. **Lagos State Safety Commission**

The Lagos State Safety Commission is responsible for the coordination of all Government matters relating to the safety of lives and property of Lagosians. The Commission is vested with powers to formulate policies, provide advisory and be the regulatory body on safety related issues. The Lagos State Safety Commission has the Vision to proactively make safety a lifestyle in Lagos State and Mission, To develop policies and strategies that will build a sustainable safety culture through a regulated and coordinated safety system.

1.8.7 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 bye-laws.

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

- Coordinating the activities of Local Government Council;
- Maintenance of Law and Order in collaboration with Law Enforcement Agencies;
- Collection of taxes and fees;
- Establishment and maintenance of cemeteries, burial grounds and homes for the destitute or infirm
- Establishment, maintenance and regulation of markets, motor parks and public conveniences;
- Construction and maintenance of roads, streets, drains and other public highways, parks, and open spaces;

- Naming of roads and streets and numbering of houses;
- Provision and maintenance of public transportation and refuse disposal;

1.8.8 Multilateral Environmental Agreements

A number of the Conventions, Protocols and Treaties that promote the maintenance of a viable environment and achieving sustainable development have been endorsed by Nigeria and 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. Alongside, are Voluntary International Standards such as Equator Principles and ISO26000, Guidance on Social Responsibility are Applicable.

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 and NETZERO Trajectory

The Paris Climate Agreement represents 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 20% below business-as-usual by 2030.

A. **Net Zero Trajectory and ISO Standards for Climate Change**

Net Zero occurs when human-caused greenhouse gas emissions (GHGs) are balanced by emission removals. The U.N. Intergovernmental Panel on Climate Change (IPCC) emphasizes that reaching Net Zero is crucial for limiting global temperature increase to 1.5°C above preindustrial levels. The clock is ticking, and decisive action is imperative.

Companies, governments, and individuals worldwide recognize the urgency. The goal is to achieve Net Zero emissions by no later than 2050.

Nigeria has set its target for 2060. Nigeria's commitment to its Long-Term Low-Emission Development Strategy (LT-LEDS) with the submission of this LT-LEDS to UNFCCC Secretariat who has uploaded it to is website since April 25, 2024. By aligning with global efforts and communicating its net-zero goals, Nigeria contributes significantly to the fight against climate change (Box 1.3).

Net-Zero Emissions Commitment:

- At COP27, Nigeria made a significant pledge: to achieve net-zero emissions by no later than 2060.
- This commitment aligns with global efforts to limit temperature rise and combat climate change.

Vision Statement for Nigeria's LT-LEDS:

- The LT-LEDS aims to provide a clear pathway toward achieving net-zero emissions.
- It considers various elements, including emission reductions, carbon offsetting, transparency, stakeholder engagement, and equity.

Existing Policies and Efforts:

- Nigeria has several existing policies and initiatives contributing to decarbonization:
- Climate Change Act, 2021
- Agenda 2050 and National Development Plan (2021-2025)
- National Climate Change Policy (2021-2030)
- National Climate Change Programme for Nigeria (2021-2030)
- The Nigerian Economic Sustainability Plan
- The Nigeria 2050 Calculator (NECAL 2050)
- National Action Plan on Gender and Climate Change (NAPGCC)

Box 1.1: Nigeria's Commitment to a Sustainable and Climate-resilient Future

b. Transport Sector -outcome of COP28, **in Dubai, UAE, December, 2023**

The transport sector plays a crucial role in achieving global climate goals. The transport sector is responsible for 21% of global CO_2 emissions and has the highest reliance on fossil fuels over any other industry. In order to meet climate targets, emissions from transportation must fall by over 3% per year until 2030.

At COP28 discussions also focused on how to decarbonise the transport sector.

In other words, COP28 underscored the urgency of transitioning away from fossil fuels, highlighted the importance of adaptation and resilience, and set directions for future climate commitments1. The key points related to transportation"

1 https://www.wri.org/insights/cop28-outcomes-next-steps

1. Fossil Fuels & Clean Energy:
    - The COP28 outcome emphasized the need to transition away from fossil fuels. This decision marked the first time the term “fossil fuels” appeared in a COP’s formal outcome since UN climate negotiations began 30 years ago.
    - The commitment to move away from fossil fuels is a significant step toward addressing climate change’s main driver
2. Decarbonizing the Transport Sector:
    - Global leaders discussed strategies to decarbonize the transport sector during COP28. Emissions from transportation must decrease by over 3% per year until 2030 to meet climate targets2.
3. National Climate Plans (NDCs):
    - The COP28 outcome called for the next round of Nationally Determined Contributions (NDCs) to enhance current actions to reduce emissions. NDCs should also include plans and priorities for adaptation, just transition efforts, and loss and damage.
4. Other Climate Actions:
    - While progress was made, there were concerns. Adaptation targets lacked detail, and finance for clean energy transition remained unclear.

Outside formal negotiations, there were commitments to reduce methane emissions, create sustainable food systems, and protect forests.

- **c. ISO’s Role in Climate Action**

In the race against climate change, ISO standards pave the way toward a sustainable, net-zero future. ISO (International Organization for Standardization) plays a pivotal role in shaping climate action. At COP27 in Sharm-El Sheikh, Egypt (November 2022), ISO launched guiding principles for achieving net zero. These principles provide a roadmap for businesses and organizations on their journey toward net-zero GHG emissions.

ISO standards accelerate climate action across sectors. Members advocate for policies that promote International Standards. Sharing success stories demonstrates ISO’s leadership at national and international levels. Expertise in ISO standards supports ambitious policy development.

The Net Zero Guidelines offer:

- Common definitions
- High-level principles
- Actionable guidance

2 https://www.icis.com/explore/resources/news/2023/12/06/10951339/cop28-decarbonising-the-transport-sector/

- Transparent reporting on emissions, reductions, and removals

The Net Zero Guidelines provide clarity amidst the confusion surrounding various "Net Zero" approaches. They complement ISO's existing environmental standards (such as ISO 14000) and serve as a reference for organizations setting net-zero goals. These guidelines foster consistency and alignment across diverse efforts and initiatives.

Relevant ISO Standards:

ISO has developed several standards related to climate change:

- ISO 14090:2019: Adaptation to climate change
- ISO 14064-1:2018: Greenhouse gases
- ISO 14068-1:2023: Climate change management

▪ The Key Elements of Net Zero Strategies:

1. Emission Reductions:
   - Address emissions at the source:
     - Improve energy efficiency
     - Transition to renewable energy
     - Innovate processes to reduce waste
2. Carbon Offsetting:
     - For unavoidable emissions, invest in carbon credits from projects that remove or reduce GHGs.
3. Transparency and Accountability:
   - Regular monitoring and reporting ensure transparency and track progress toward net-zero goals.
4. Stakeholder Engagement:
     - Involve employees, customers, investors, and communities in net-zero strategies.
     - Foster a culture of sustainability and collective action.
5. Equity and Justice:
     - Align with the UN Sustainable Development Goals.
     - Ensure equitable sharing of costs and opportunities, safeguarding vulnerable communities.

ISO 14097 and Climate Neutrality:

- ISO 14097 is a framework standard that focuses on climate neutrality.
- It provides guidelines for assessing, quantifying, and reporting the net GHG emissions associated with products, services, or organizations.
- The goal: Achieve climate neutrality by balancing emissions with removals or offsets.

d. Lagos State Government developed a Lagos Climate Action Plan

Due to the impact of climate, Lagos State Government developed a Lagos Climate Action Plan (CAP). The CAP is a 5-year plan for Lagos that aligns with the Paris Agreement and aims towards carbon neutrality by 2050 A cleaner, greener, healthier, stable, and more prosperous Lagos in a changing climate" Lagos Climate Action Plan The plan is organized around four sectors: (1) waste, (2) transportation, (3) energy, and (4) climate adaptation and resilience. The CAP contains not only a broad, stakeholder-led vision but also four sets of visions each organized around the sectors. Each sector contains sets of projects organized around actions and goals.

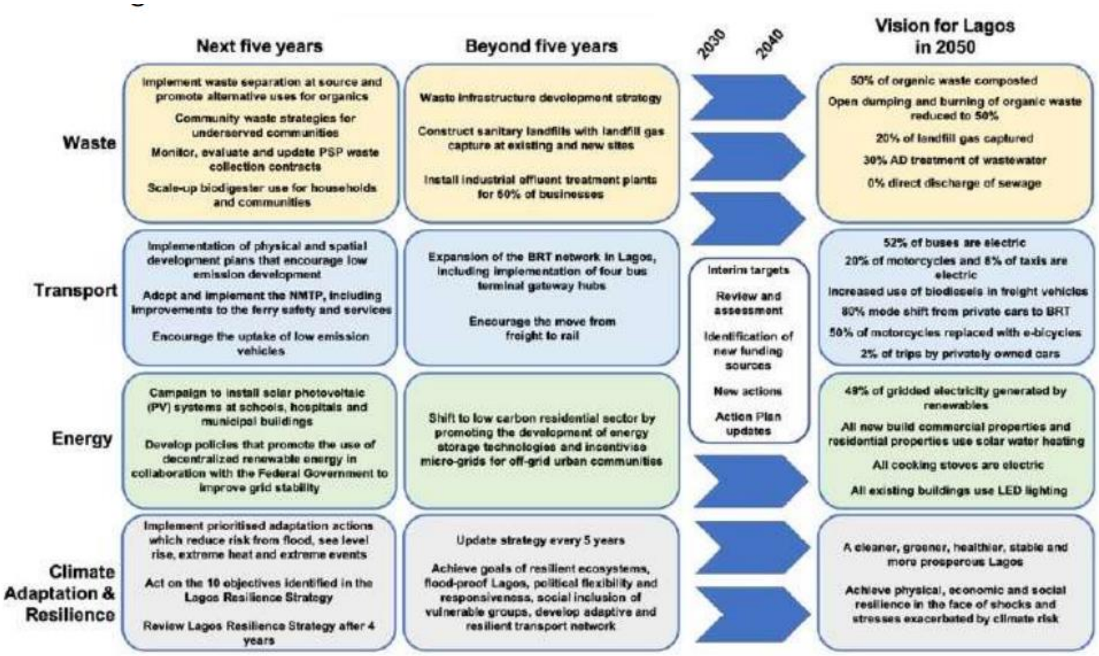

Figure 1.8: Lagos Climate Action Plan (CAP)

. Lagos-Calabar Coastal Highway and Climate Consideration

ISO standards provide the compass for a sustainable, net-zero journey, ensuring responsible infrastructure development and contributing to global climate efforts. While the highway primarily focuses on physical infrastructure, it intersects with environmental aspects. ISO 14097 principles can guide:

- Carbon Footprint Assessment: Evaluating emissions from construction, materials, and on-going maintenance.
- Mitigation Strategies: Implementing sustainable practices and optimizing logistics.
- Offset Mechanisms: Balancing emissions through reforestation or renewable energy projects.

- Reporting and Transparency: Transparently reporting efforts toward emissions reduction.

(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.

(vii) Equator Principles (EPs)

The **Equator Principles (EPs)** serve as a benchmark within the financial industry for assessing and managing environmental and social risks associated with projects. Financial institutions adopt these principles to make responsible risk decisions when financing various projects. The EPs establish a minimum standard for due diligence, emphasizing both environmental and social sustainability. They have global applicability across all industry sectors and cover a wide range of financial products.

The primary purpose of the Equator Principles is to provide a common baseline and framework for financial institutions. By adhering to these principles, institutions can effectively identify, assess, and manage environmental and social risks during project financing. Large infrastructure and industrial projects often carry significant impacts on people and the environment. However, when these risks are systematically identified, evaluated, and properly managed, sustainable outcomes can be achieved. This approach leads to improved financial, environmental, and social results. The commitment ensures that projects financed or advised on by EPFIs are developed in a socially responsible manner, incorporating sound environmental management practices. The ten Equator Principles are outlined in the Figure 1.6.

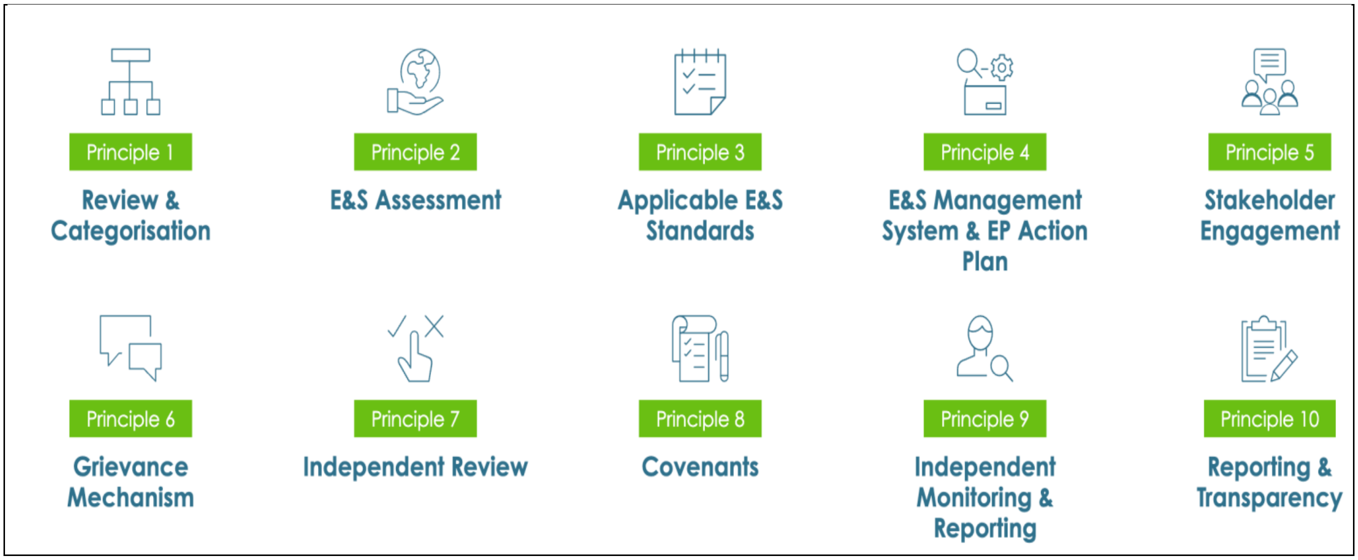

Figure 1.9: The Ten Equator Principles

1.8.9 Health and Safety International Instruments

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

The **Environmental, Health, and Safety (EHS) Guidelines** developed by the **World Bank Group** serve as technical reference documents. These guidelines provide both general and industry-specific examples of Good **International Industry Practice (GIIP**). World Bank's EHS Guidelines.

The key features of the EHS Guidelines:

- Purpose and Scope:
    - The EHS Guidelines cover a wide range of sectors and industries.
    - They offer practical guidance on managing environmental, health, and safety risks.
- Industry-Specific Examples:
    - The guidelines include specific examples relevant to various industries.
    - These examples align with international best practices.
- Integration with World Bank Policies:
    - The EHS Guidelines are referenced in the **World Bank's Environmental and Social Framework**.
    - They also relate to the **International Finance Corporation's (IFC)** Performance Standards.
- Implementation:

  - When World Bank Group members are involved in a project, the EHS Guidelines are applied as required by their respective policies and standards.
  - They ensure that projects adhere to environmental and social best practices.

ii. International Labour Standards on Occupational Safety and Health

The International Labour Organization (ILO) has adopted more than 40 standards specifically dealing with OSH. ILO's page on Occupational Safety and Health. These standards provide essential tools for governments, employers, and workers to establish sound prevention, reporting, and inspection practices for safety and health at work.

Key ILO instruments related to OSH include:

- Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187): This Convention aims to establish coherent national policies on OSH through dialogue between government, workers' and employers' organizations.
- Occupational Safety and Health Convention, 1981 (No. 155): This Convention provides for the adoption of a coherent national OSH policy and action to promote OSH and improve working conditions.
- Occupational Health Services Convention, 1985 (No. 161) Working Environment (Air Pollution, Noise and Vibration) Convention, 1977 (No. 148)
- Integration with ESIA:
  - ESIA processes consider the potential environmental and social impacts of projects.
  - OSH is a critical aspect of ESIA, especially for projects involving construction, industrial activities, or hazardous materials.
  - ESIA assesses the impact of a project on workers' health and safety, as well as the surrounding environment.
- Role of ESIA in OSH:
  - ESIA identifies OSH risks associated with project activities.
  - It proposes mitigation measures to prevent accidents, occupational diseases, and adverse environmental impacts.
  - Monitoring during project implementation ensures on-going compliance with OSH standards.
- Stakeholder Engagement:
  - ESIA involves stakeholders, including workers, communities, and relevant authorities.
  - OSH concerns are addressed through consultations, public hearings, and feedback mechanisms.
- Reporting and Auditing:
  - ESIA reports include OSH-related information.
  - Audits assess OSH performance during project execution.
  - Compliance with ILO standards is a key consideration.

1.8.10 Development Partners (DP) Safeguards System

Safeguards are powerful tools that help analysts to identify risk, 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.

When it comes to environmental and social outcomes, adhering to international best practices is crucial. Some of the prominent standards and guidelines set by reputable institutions:

1. African Development Bank (AfDB):
    - The African Development Bank Group recently updated its Integrated Safeguards System (ISS) approved on April 12, 2023.
    - The updated ISS reinforces the AfDB's commitment to responsible development while addressing environmental and social risks in its projects
    - The revised ISS clarifies the bank's roles, responsibilities, and accountability to borrowers and clients.
    - The ISS builds upon existing safeguard policies, including those related to environmental protection, involuntary resettlement, gender, and civil society engagement.
    - it integrates environmental and social considerations into its project design, implementation, and monitoring processes.
    - The AfDB promotes sustainable development, poverty reduction, and inclusive growth across Africa.
    - By adhering to these standards, the AfDB ensures sustainable development while managing environmental and social risks in its projects
2. World Bank Environmental and Social Framework (ESF).
    - The World Bank has developed a comprehensive framework known as the Environmental and Social Framework (ESF).
    - It serves as a comprehensive guide for managing environmental and social risks associated with projects financed by the World Bank.
    - The ESF enables the World Bank and borrowers to better manage environmental and social risks, leading to improved development outcomes while ensuring sustainability and transparency.
    - This framework includes **Environmental and Social Standards (ESS)** that guide projects supported by the World Bank through Investment Project Financing (IPF).
    - **Environmental and Social Standards (ESS)** which are ten (10) standards set out requirements for borrowers (project proponents) and the World Bank.
    - ESS guide project design, implementation, and monitoring

The 10 ESS which promote responsible project management, benefiting both development outcomes and environmental/social sustainability include:

- **ESS1: Assessment and Management of Environmental and Social Risks and Impacts**:
  - Borrowers assess, manage, and monitor risks throughout project stages.
  - Aims for environmental and social outcomes consistent with the ESSs.
- **ESS2: Labor and Working Conditions**:
  - Promotes fair treatment of workers and safe working conditions.
  - Enhances development benefits by treating workers fairly.
- **ESS3: Resource Efficiency and Pollution Prevention and Management**:
  - Addresses pollution (air, water, land) and resource consumption.
  - Ensures sustainable resource management throughout the project life cycle.
- **ESS4: Community Health and Safety**:
  - Focuses on health, safety, and security risks for affected communities.
  - Special attention to vulnerable groups.
- **ESS5: Land Acquisition, Restrictions on Land Use, and Involuntary Resettlement**:
  - Aims to avoid involuntary resettlement.
  - If unavoidable, minimizes impacts and supports affected persons.
- **ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources**:
  - Protects biodiversity and core ecological functions.
  - Considers livelihoods of affected parties, including Indigenous Peoples.
- **ESS7: Indigenous Peoples**:
  - Recognizes Indigenous Peoples' rights and cultural heritage.
  - Ensures their participation and benefits.
- **ESS8: Cultural Heritage**:
  - Safeguards cultural heritage sites and artifacts.
  - Balances development with preservation.
- **ESS9: Financial Intermediaries**:
  - Applies when the World Bank provides funds to financial intermediaries (e.g., banks).
  - Ensures environmental and social risk management in their lending practices.
- **ESS10: Stakeholder Engagement and Information Disclosure**:
  - Requires meaningful consultation and information sharing.
  - Establishes accessible grievance mechanisms.

Thus, for the proposed project, an effective institutional framework must be set up to achieve the needed coordination among policymakers, planners, highway authorities, environmental agencies, consultants and specialists, and other related public and private organizations and the general public.

IFC Performance Standard

Below is a highlight of how each IFC Performance Standard is relevant to the specific challenges and requirements of the Lagos-Calabar Highway Section 2 project.

IFC Performance Standard	Title	Relevance to Lagos-Calabar Highway Section 2
PS1	Assessment and Management of Environmental and Social Risks and Impacts	Essential for identifying, assessing, and managing the environmental and social risks associated with the highway project.
PS2	Labor and Working Conditions	Ensures fair treatment, non-discrimination, and safe working conditions for all workers involved in the construction and operation of the highway.
PS3	Resource Efficiency and Pollution Prevention	Aims to minimize pollution and promote sustainable use of resources during the construction and operation phases.
PS4	Community Health, Safety, and Security	Addresses the health, safety, and security risks to local communities, particularly during the construction phase.
PS5	Land Acquisition and Involuntary Resettlement	Critical for managing the significant physical and economic resettlement impacts, ensuring fair compensation and livelihood restoration.

IFC Performance Standard	**Title**	**Relevance to Lagos-Calabar Highway Section 2**
PS6	Biodiversity Conservation and Sustainable Management of Living Natural Resources	Focuses on protecting and conserving biodiversity, which is crucial given the project's intersection with areas of biodiversity significance.
PS7	Indigenous Peoples	Ensures respect for the rights, dignity, and culture of any indigenous peoples potentially affected by the project.
PS8	Cultural Heritage	Protects cultural heritage from adverse impacts of the highway project and promotes its preservation.

1.8.11 Declaration by Project Proponent

FMW and Hitech shall abide by all applicable international conventions, protocols, and agreements; national, state, and local government laws/regulations and guidelines governing effective environmental management and good practices in handling this proposed Project.

Specifically, as the contractor, Hitech Construction Africa Limited has established an Environmental and Social Management System (ESMS) in line with the IFC Performance Standards, the World Bank EHS guidelines and regulations, the Equator Principles IV as well as national regulations. This system details all the responsibilities of the E&S Team, monitoring, reporting, and auditing procedures to ensure compliance with the regulatory framework. As part of this ESMS, Hitech develops project specific management plans tailored to the impacts and needs of the project.

Hitech Management Plans, Protocols and Procedures as per the ESMS considered relevant to the proposed project are outlined below:

- **Blasting Management Plan:** This plan details procedures for safe and controlled blasting activities, ensuring compliance with environmental and safety regulations to minimize impacts on surrounding areas.
- **Community Health and Safety Management Plan:** This plan addresses health and safety concerns of local communities near the project site, focusing on mitigating risks from construction activities and promoting community well-being.

- **Dust Management Plan:** This plan identifies sources of dust, outlines measures to control emissions, and includes monitoring strategies to protect air quality and public health.
- **Environmental Construction Method Statement:** This statement describes environmentally friendly construction methods and practices to minimize environmental impacts during project implementation.
- **Emergency Management Plan:** This plan outlines procedures for responding to emergencies, including natural disasters and accidents, to minimize harm to people, property, and the environment.
- **Human Resources Management Plan:** This plan outlines strategies for managing human resources, including recruitment, training, and welfare, to ensure a safe and healthy work environment.
- **Management of Waste Procedure:** This procedure outlines the proper management of construction and hazardous waste, including storage, handling, transportation, and disposal, to minimize environmental impacts.
- **Occupational Health and Safety Management Plan:** This plan outlines measures to ensure the health and safety of workers, including training, protective equipment, and monitoring, in accordance with international standards.
- **COVID-19 Management Procedure:** This procedure outlines measures to prevent and control the spread of COVID-19 among workers and the community, including hygiene practices, tests and awareness campaigns.
- **Construction Environmental & Social Management Plan:** This plan integrates environmental and social considerations into construction activities, including biodiversity conservation, stakeholder engagement, and cultural heritage protection.
- **Traffic Management Plan:** This plan addresses traffic safety and congestion issues related to construction activities, including measures to minimize disruptions and ensure the safety of workers and the public.
- **Site Rehabilitation and Restoration Management Plan:** This plan outlines strategies for rehabilitating and restoring the project site after construction activities, including revegetation and erosion control measures.
- **Wastewater Management Plan:** This plan outlines procedures for managing wastewater generated during construction activities, including treatment and disposal methods to protect water quality.
- **Construction Contaminated Land Management Plan:** This plan outlines procedures for managing contaminated land during construction activities, including remediation measures to protect human health and the environment.
- **Soil and Water Management Plan:** This plan outlines measures to protect soil and water resources during construction activities, including erosion and sediment control measures.
- **Contractor and Supplier Management Protocol:** This protocol outlines procedures for selecting, contracting, and managing contractors and suppliers to ensure compliance with environmental, social, and health and safety requirements.

- **Stakeholder Engagement Plan:** This plan outlines strategies for engaging with stakeholders, including local communities, to address their concerns and ensure their participation in decision-making processes.
- **Community Health and Safety Management Plan:** This plan addresses the health and safety of local communities near the project site, including measures to mitigate risks from construction activities and ensure community well-being.
- **Occupational Health and Safety Management Plan:** This plan outlines measures to ensure the health and safety of workers, including training, protective equipment, and monitoring, in accordance with international standards.
- **Chance Find Procedure:** This procedure outlines steps to follow in case of unexpected archaeological or cultural discoveries during construction activities, including notifying relevant authorities and taking protective measures.
- **Livelihood Restoration Plan:** This plan outlines measures to restore or improve the livelihoods of affected communities, including training, alternative income opportunities, and support for vulnerable groups.
- **Workers Grievance Mechanism:** This mechanism provides a channel for workers to raise grievances related to their working conditions, including health, safety, and welfare, and ensures their concerns are addressed promptly and fairly.

Hitech Policies:

- **Environmental Policy:** This policy outlines the organization's commitment to environmental protection and sustainable practices, including compliance with applicable laws and regulations.
- **Social Policy:** This policy outlines the organization's commitment to social responsibility, including respect for human rights, community engagement, and stakeholder consultation.
- **Health and Safety Policy:** This policy outlines the organization's commitment to providing a safe and healthy work environment, including compliance with health and safety regulations and the promotion of a safety culture.
- **Gender-Based Violence (GBV) and Sexual Harassment Policy:** This policy outlines the organization's commitment to preventing and addressing gender-based violence and sexual harassment in the workplace, including reporting mechanisms and support services for victims.
- **Smoke-Free Policy:** This policy prohibits smoking in project areas to protect workers and the environment from the harmful effects of tobacco smoke.
- **Drugs and Alcohol Policy:** This policy prohibits the use of drugs and alcohol in project areas to ensure the health and safety of workers and prevent accidents and incidents related to substance abuse.

Hitech will elaborate project specific policies, protocols and procedures from the ESIA findings to be used during the entire project duration and in line with the regulatory framework described in this chapter.

1.9 Structure of the Report

The ESIA is structured to conform with the EIA Report Writing Format as presented in the Procedural Guidelines Annex C as presented below.

- Preliminary Pages (Cover Page, Title Page, Table of Contents, List Tables, List of Figures, List of Maps, List of Plates, List of Acronyms and Abbreviations, List of ESIA Preparers, Declaration, Acknowledgement and Executive Summary)
- Chapter 1 - Introduction
- Chapter 2 - Project Justification
- Chapter 3 - Project and Process Description
- Chapter 4 - Description of the Environment
- Chapter 5 - Associated and Potential Impacts
- Chapter 6 - Mitigation Measures
- Chapter 7 - Environmental and Social Management Plan
- Chapter 8 - Decommissioning and Restoration Plan
- Chapter 9 - Recommendations and Conclusions
- References
- Appendices

CHAPTER TWO
PROJECT JUSTIFICATION AND ALTERNATIVES

2.0 Introduction

The coastal areas of Nigeria and indeed Lagos need more attention to realize their full economic, social, and environmental potential. The proposed Lagos-Calabar Coastal Highway project reflects Nigeria's vision for progress, self-reliance, and prosperity. This chapter justifies the project and explains why the proposed route was chosen over alternatives, focusing on Section 2 of the Lagos-Calabar Highway.

2.1 Nigeria Transportation Infrastructure development

1. Contribution of the transport sector to real GDP

Recent data on Nigeria's transport sector and its contribution to the country's GDP show the situation of the transport sector in Nigeria as revealed in Box 2.1. The ***Overall Sector Growth shows that*** the transportation sector increased by 51.66 percent in real terms during the second quarter of 2022. Quarter-on-quarter growth was 66.19 per cent. The sector's contribution to real GDP in Q2 2022 totalled 1.84 percent, an improvement from the preceding year's 1.26 percent and higher than the first quarter of 2022 was 1.10 per cent.

However, it's essential to note that this growth rate represents a decline from the exceptional 92.38 percent growth rate observed in Q2 2021 and an improvement from the negative growth (-24.63 percent) in Q1 20221. Despite the challenges faced by Nigeria's transport sector, the road transport subsector's robust growth underscores its critical role in the country's economic development.

- ***Transport Sector Contribution to Nominal GDP:***
    - In the second quarter of 2022, transport activities contributed 2.79 percent to nominal GDP. This was greater than the 1.60 percent contribution in the first quarter of 2022 and higher than the 2.09 per cent reported in 20211.
    - The road transport sector emerged as the best-performing sub-sector during this period, experiencing remarkable growth with a 56.38 percent increase.
- ***Other transport modes had varying performance:***
    - ***Air Transport***: Recorded 22.45 percent growth in Q2 2022.
    - ***Rail Sector:*** Suffered a 37.90 percent decline during the same quarter.
    - ***Water Transport***: Experienced a decrease of 3.02 percent in Q2 2022.

Box 2.1: Transportation Sector Performance in Nigeria

2. Key elements of the transportation infrastructure

Table 2.1 depicts the key elements of Nigeria's transportation infrastructure, and **Figure 4.93** shows the networks. The Lagos-Kano transport corridor, the main channel for domestic, regional, and international trade in Nigeria, is also the central axis of cattle and leather trade. It spans approximately 990km and links the country's two most populous cities (Kano and Lagos), passing through Kaduna, Ilorin, and Ibadan. In comparison to the African region, Table 4.47 shows Nigeria's transport infrastructure's position

Table 2.1: key elements of Nigeria's transportation infrastructure

Modes	Infrastructure	Mode of Transportation	Services
Air	Airport infrastructure Aerodromes Air Navigation Infrastructure	Airplanes Helicopters	Airline and air freight services Airport services Training
Land (Road)	Roads Bridges Terminals	Motorized Vehicles Non-motorized vehicles	Passenger services Road Haulage Informal services Training
Land (Rail)	Railways Rail Stations Signaling Infrastructure	Trains	Passenger services Freight services (Urban) Mass Rapid Transit Training
Land (Pipelines)	Pipelines	Line Pipes	Pipeline services
Water	Waterways (Inland and Sea) Port Infrastructure Navigation Infrastructure	Ferries Ocean-going vessels	Stevedoring services Shipping/Barge services Training

Source: Federal Ministry of Transportation.

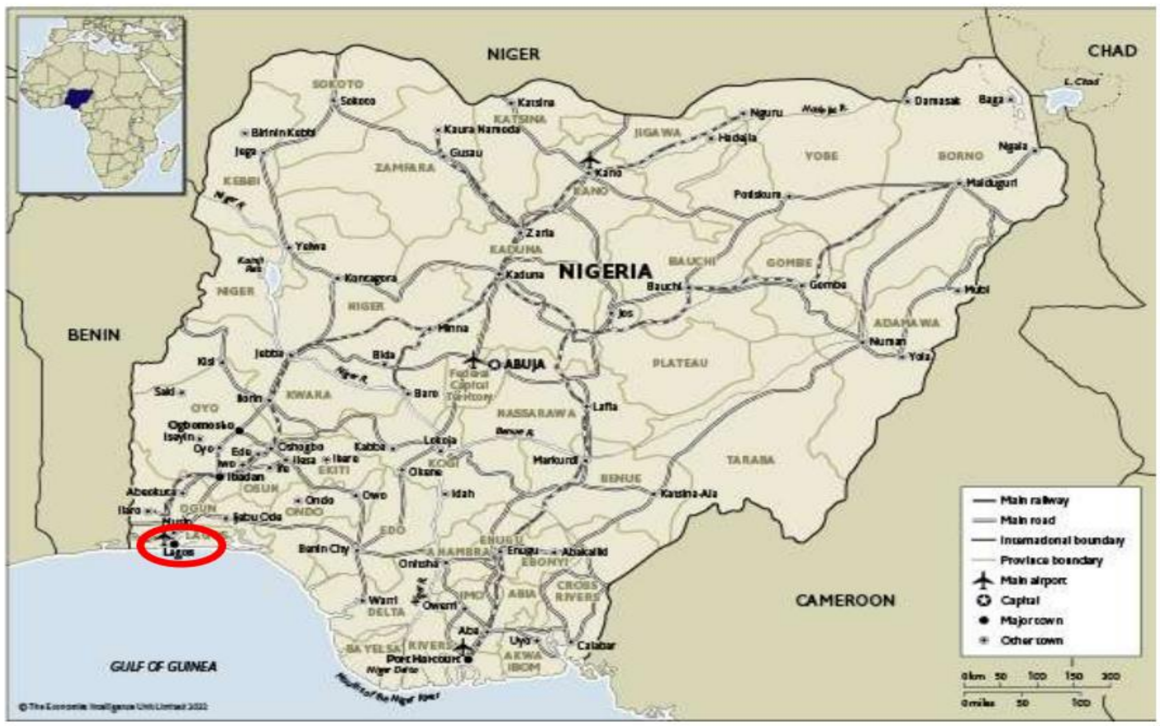

Figure 2.1: Transport Arteries in Nigeria

Table 2.2: Nigeria's Transport Infrastructure in Africa's

	Nigeria			Africa		
	total	per 1 mio inhabitants	per km²	total	per 1 mio inhabitants	per km²
Roadways	195,000 km	892.28 km	211.09 m	2,997,800 km	2,101.59 km	98.01 m
Railroads	3,800 km	17.38 km	4.11 m	88,600 km	62.10 km	2.90 m
Waterways	8,600 km	39.35 km	9.31 m	68,400 km	47.95 km	2.24 m
Commercial harbors	791	3.62	0.001	7,949	5.57	0.000
Airports	22	0.10	0.024	414	0.29	0.000

worldData.info

3. **Classification of Road Infrastructure in Nigeria:**

- **Trunk A Roads:**

These roads transcend regional boundaries and are of national significance.
They are financed, constructed, and maintained by the Federal Government of Nigeria.
Trunk A roads connect different states and facilitate inter-state transportation.

- **Trunk B Highways:**

Trunk B highways primarily connect major cities within a state.
They fall under the supervision and ownership of the respective state governments.
These highways serve as vital links for intra-state travel and commerce.

- **Trunk C Roads:**

Trunk C roads operate at the local level and are within the purview of local governments.
They connect communities, neighbourhoods, and rural areas.
Local governments are responsible for their maintenance and development.

4. **Construction Materials:**

Most roads in Nigeria are constructed using either concrete (cement) or asphalt (bitumen).
Concrete roads offer durability and strength, while asphalt roads provide flexibility and smoother surfaces.

5. **Road Transportation**:

Nigeria's roads and highways serve as the lifelines of the country's transport system. Nigeria's road infrastructure is a multi-tiered system that spans national, state, and local levels. Each category plays a distinct role in ensuring efficient transportation and connectivity across the country. According to the national integrated infrastructure master plan, they handle a staggering 90% of passenger and freight traffic. With a total road length of approximately 195,000 kilometres, Nigeria's road network is crucial in connecting communities and driving economic activities.

Despite its extensive road network, Nigeria faces spatial inefficiencies. The country's land mass of 923,768 square kilometres and population density (around 237 inhabitants per km²) must be considered. Nigeria ranks 210th globally in terms of road length per inhabitant, with an average of 0.89 meters of road per person.
Nigeria's road infrastructure falls short of expectations. Approximately 63% of the roads are untarred, and many are in disrepair. Commuters describe them as death traps, deplorable, or dilapidated.

Nigeria's road infrastructure faces challenges, but strategic investments, effective management, and community involvement can pave the way for a better-connected and more prosperous nation. Stakeholders emphasize the urgent need for action:

- Massive Investment: The government should attract private investment to expand and upgrade the road network.

- Effective Management: Efficient management practices are essential to maintain and improve existing roads.
- Local Inputs: Involving local communities and stakeholders can lead to better road planning and execution.
- Rural Connectivity: Linking rural areas is crucial for overall development and accessibility.

In recognition of these, the current Nigerian government has been actively investing in road infrastructure across the country. Some notable road projects include:

1. **Over 800 Roads and Bridges**: The Federal Government is currently executing **over 800 contracts** for roads and bridges, covering more than **13,000 kilometers** of the **35,000-plus kilometers** of federal highways and bridges nationwide. These projects aim to enhance connectivity, boost economic growth, and create employment opportunities.
2. **2024 Budget Allocation**: In the **2024 budget**, the government has earmarked **N837 billion** for the construction of **2,254 roads and bridges** across Nigeria. Notable projects include the rehabilitation of the **Kabba-Ayere-Isua-Ipele road** in Kogi and Ondo states and the construction of the **Ikot Ekpene border Aba-Owerri dual road**.

The Lagos state government, who over the years have embarked on a number of road and rail projects, has further added the 4th Mainland Bridge (4MB) project. This is a significant infrastructure endeavour aimed at enhancing connectivity and promoting economic growth. The 4MB will cover a distance of approximately 37 kilometers. It will be constructed under a Design, Build, Finance, Operate, Maintain, and Transfer (DBFOMT) concession. The project is part of Lagos State's Public-Private Partnership (PPP) program, emphasizing collaboration between the government and private investors. The 4th Mainland Bridge represents a crucial step toward improving infrastructure, fostering economic development, and ensuring efficient transportation in Lagos State.

With regard to Nigeria's Railway System, in recent time there have been significant progress in railway system, including the Abuja-Kaduna Railway (Africa's first modernized railway based on Chinese technical standards) and ongoing projects like the Kano-Maradi and Kano-Kaduna standard-gauge railway lines. In fact, the railway sector has attracted more significant attention and investment as represented by the following:

- Lagos-Calabar Railway (West-East Coastal Rail Line): The Lagos-Calabar Railway is a major rail infrastructure project under development in Nigeria. It aims to link Lagos (the largest and capital city in the southwest) to Calabar (a port city in the southeast near the border with Cameroon). The railway line will pass through several states, including Lagos, Ogun, Oyo, Osun, Ondo, Edo, Delta, Bayelsa, Rivers, Akwa Ibom, and Cross River. The project involves: Construction of 1,402 kilometers of railway line. Establishment of 22 railway stations, along with ancillary facilities, administrative spaces, and level crossings. Installation of safety systems, electrical systems, lighting systems, and signaling systems. Laying of tracks and electricity lines.

- Lagos Light Rail (Lagos Rail Mass Transit): The Lagos Light Rail is a 35-kilometer urban rail system currently under construction in Lagos. Once completed, it will enhance intra-city transportation within Lagos.

These projects reflect Nigeria's commitment to improving transportation infrastructure and fostering economic growth. These infrastructure developments play a crucial role in Nigeria's economic growth, job creation, and sustainable future.

2.2 The Need for Proposed Project

The Lagos-Calabar Coastal Highway Project is a significant initiative spanning approximately 650-700 kilometers along the southern coastline. The coastal highway aims to address these issues and improve connectivity. The Lagos-Calabar Coastal Highway represents a significant step toward improving transportation infrastructure in Nigeria and specifically, fostering economic development along Nigeria's southern coast. This ambitious project aims to connect Lagos (in the southwest) to Calabar (in the southeast) along the southern coast of Nigeria.

Figure 2.2: Entire Length of the Proposed Coastal Highway

The Lagos-Calabar Coastal Highway represents a pivotal step toward improving transportation infrastructure and fostering economic development along Nigeria's southern coast. It's exciting to see such transformative projects shaping the nation's future. This ambitious infrastructure initiative holds immense significance for Nigeria's economic growth and regional connectivity such as the following:

1. Economic Boost for Lagos State:
    - The highway's Section 2, spanning from Eleko (47 km) to Ode-Omi (104 km), has the potential to transform Lagos State's economy.
    - By connecting to the Lekki Deep Seaport, the project will facilitate efficient movement of goods, enhancing trade and industrial activities in the Lekki economic corridor.
2. Alignment with Lagos State Master Plans:
    - The Lagos-Calabar Coastal Highway's alignment with Lagos State Master Plans underscores its strategic importance.
    - Sustainable urban development, improved transportation infrastructure, and economic growth are central themes in these plans.
3. Reduced Travel Time:
    - The coastal road will significantly shorten the distance between Lagos and Ondo state.
    - For example, the route from Ibeju-Lekki to Araromi in Ondo state will be approximately 50 kilometers along the coast, resulting in faster travel times.
4. Enhanced Regional Connectivity:
    - By linking coastal states such as Ogun, Ondo, Delta, Bayelsa, Rivers, Akwa Ibom, and Cross River, the highway will promote the seamless movement of goods, people, and services across Nigeria's southern region.

2.3 Strategic Goals and Objectives of the Project

Strategically, by linking multiple states, the highway aims to enhance economic integration and trade. It will facilitate access to tourist destinations, industrial zones, and economic hubs. The highway stands to alleviate traffic congestion in Lagos and surrounding areas. It contributes to better connectivity between states in Southern Nigeria.

The main objectives of the proposed project are to:

- Increase travel efficiency and productivity.
- Improve the quality of the environment.
- Improve the quality of life and social standards.
- Increase and spread economic activity throughout the corridor and states connected.
- Remove poor safety and security records on the road that affect travellers journeying in the coastal areas.

- Remove undue stress for travellers.
- Afford comfortable ride for those who take the routes.
- 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.

2.4 Benefits of the Project

The Lagos-Calabar Coastal Highway holds immense potential for national integration, economic growth, and improved security. It is a pathway to national integration, economic prosperity, and improved livelihoods.

The construction of the coastal highway connecting Lagos and Calabar will engender a genuine feeling of national integration in the people of the country in general and South-West, South-East and South-South and Niger Delta Coastal Area in particular and enhance the wider security of the region. The New Highway will strengthen the economic opportunities among the coastline on all ports existing and planned.

The New Highway will:

- Establish connections between key ports (existing and planned), fostering trade and economic activity in the region. This connectivity has the potential to draw in additional shipping traffic, foreign investments, and trade collaborations, ultimately resulting in heightened revenue of the coastal communities, job opportunities, and overall economic advancement.
- Connect communities together and strengthen the relationship between economic centers, export processing zones, tourism destinations, and markets, across both central and northern Nigeria.
- Concentrate regional traffic onto a few routes that can also justify viable rail transport.
- Enhance the prospects of natural resource exploitation in the Niger Delta - oil and gas, salt, sand, timber, etc.
- Operate as an infrastructure corridor for gas pipeline, power transmission lines, etc.

Some additional specific benefits and opportunities it brings are listed in Table 2.3

Table 2.3: Specific Benefits and Opportunities

S/No	Benefits	Opportunities
1	Enhanced National Integration:	• The Highway physically connects regions across Nigeria, fostering a sense of unity and shared development. • It strengthens ties between the South-West, South-East, South-South, and Niger Delta coastal areas.
2	Economic Opportunities and Trade:	• Port Connectivity: The Highway establishes connections between key ports (existing and planned). • This connectivity can attract additional shipping traffic, foreign investments, and trade collaborations. • Resulting economic growth leads to heightened revenue and job opportunities. • Upon completion, the highway is expected to significantly improve Nigeria's Logistics Performance Index (LPI) for trade and transport infrastructure. It could contribute at least 0.5 to 1.0 points to the LPI.
3	Community Connectivity and Relationships:	• The Highway links communities, economic centers, export processing zones, and tourism destinations. • It strengthens relationships across central and northern Nigeria.
4	Infrastructure Corridor:	• Beyond transportation, the Highway operates as an infrastructure corridor. • It facilitates the transmission of gas pipelines, power lines, and other utilities.
5	Improved Travel Efficiency:	• Shorter routes link via Lagos to the coastal areas of Ogun, Ondo, Edo, Delta, Bayelsa, Rivers, Akwa Ibom, and Cross River States. • Faster and uninterruptable highway access and decreased journey delays leading to driver and passenger time savings. • Better pavement maintenance reduces vehicle operating costs. • Enhanced safety standards decrease accident costs.
6	Enhanced Connectivity:	• The Highway establishes new links between Eko Atlantic and the Lekki trade zone, as well as other

Table 2.3: Specific Benefits and Opportunities		
S/No	**Benefits**	**Opportunities**
		economic zones along the coastal highway. • It passes through five planned city centers along the Atlantic Ocean waterfront, including touristic resorts and support facilities.
7	Unlocking Development Potential:	• Development sites south of the Lekki Peninsula can now be fully utilized. • These areas hold promise for both commercial and residential ventures.
8	Scenic Views and Beach Proximity:	• Residential developments near the beaches can offer attractive tour views overlooking the Atlantic Ocean. • The combination of coastal beauty and accessibility enhances the prospects for real estate.
9	Relieving Congestion:	• The Highway serves as a relief valve for the congested Lekki Expressway. • Improved traffic flow benefits commuters and businesses alike.
10	Multi-Modal Transit Artery:	• The Highway provides a high-quality multi-modal transit artery. • It accommodates public transport and ensures attractive spaces for walking and cycling.
11	Infrastructure Corridor:	• Beyond transportation, the highway functions as an essential infrastructure corridor. • It can facilitate the transmission of gas pipelines, power lines, water pipes, and fiber optics.
	Integration with Existing Routes:	• The Lagos-Calabar Coastal Highway will integrate significant routes such as the Badagry Expressway, the Fourth Mainland Bridge, and the Lekki Deep Seaport Road. • This integration will facilitate seamless movement across various regions in North Nigeria. •

Table 2.3: Specific Benefits and Opportunities

S/No	Benefits	Opportunities
	Rail Lines and Transportation Flexibility:	• The project envisions incorporating rail lines within the median strips of main roads, enhancing transportation flexibility

- ## 2.5 The Coastal Highway and Theory of Change

The Lagos-Calabar Coastal Highway holds immense potential for economic growth, regional integration, and improved accessibility. By following a well-structured Theory of Change, it is possible to maximize its positive impact on communities and businesses along the southern coast. A **Theory of Change** (ToC) outlines how the activities within an intervention contribute to a chain of results, ultimately leading to intended or observed impacts. In the context of the Lagos-Calabar Coastal Highway project, the ToC reflect its unique features and objectives as depicted in Figure 2.3 with strategic planning (inputs and activities) and the effects (outputs, outcomes and impacts)

Strategic Planning		Effects		
Inputs:	**Activities:**	**Outputs:**	**Outcomes:**	**Impacts:**
Funding: Financial resources allocated for construction, maintenance, and operation.	**Design and Planning**: Detailed engineering plans, environmental impact assessments, and alignment studies.	**Physical Infrastructure**: Completed highway with multiple lanes, bridges, and train tracks.	**Economic Growth**: Increased trade, investment, and industrial development due to improved connectivity.	**Regional Development**: Boosted economic activity, tourism, and urbanization.
Land Acquisition: Land along the coastal route for road construction.	**Construction**: Building the highway, including earthworks, bridges, tunnels, and drainage systems.	**Improved Connectivity**: Enhanced transportation links between coastal states.	**Job Creation**: Employment opportunities during construction and maintenance.	**Social Well-Being**: Better access to healthcare, education, and services.
Skilled Labor: Engineers, construction workers, and project managers.	**Maintenance**: Regular upkeep, repairs, and safety measures.	**Reduced Travel Time**: Shorter distances between cities along the route.	**Environmental Impact**: Reduced congestion and pollution as traffic flows more efficiently.	**National Progress**: A landmark infrastructure project contributing to Nigeria's growth and global recognition.
Materials: Cement, steel, etc., required for building the highway.				

Figure 2.3: The Project's Theory of Change-

As part of maximizing the positive impact on communities and businesses the trajectory of the e green economy has also been taken into consideration (Box 2.2)

The Lagos-Calabar Coastal Highway Project represents a transformative opportunity for Nigeria, combining economic development with environmental considerations. It's a step toward a more connected, prosperous, and sustainable future. While the project primarily focuses on transportation, its positive impact on the environment can contribute to a greener economy:

- Reduced Emissions: Efficient transportation reduces carbon emissions, benefiting air quality and overall sustainability.
- Promotion of Sustainable Practices: The project can incorporate eco-friendly materials and energy-efficient designs.
- Enhanced Livelihoods: Job creation and economic growth can lead to better living standards and increased environmental awareness.

Natural Capital:

- The coastal road traverses diverse ecosystems, including mangroves, wetlands, and forests. Proper planning and management can enhance natural capital by preserving biodiversity, carbon sequestration, and ecosystem services.

Blue Economy:

- The road connects coastal communities, fishing ports, and maritime activities. It can stimulate the blue economy by improving transportation for fisheries, aquaculture, and marine tourism.

Net Zero:

- While not directly tied to the road, achieving net-zero emissions requires sustainable infrastructure. The road's design, materials, and energy sources impact its carbon footprint.

Green Economy:

- The road's construction and maintenance can align with green economy principles, promoting sustainable practices, job creation, and resource efficiency.

Circular Economy:

- Circular design for road materials, waste management, and recycling can minimize environmental impact.

Climate Change:

- The road's resilience to climate-related events (e.g., sea-level rise, storms) is crucial. Mitigation efforts should consider adaptation strategies.

Sustainable Development Goals (SDGs):

- The road intersects with various SDGs, including Goal 9 (Infrastructure), Goal 11 (Sustainable Cities), and Goal 13 (Climate Action).

Box 2.2: Green Economy Considerations for the Project

2.6 Coastal Road Alignment with National Strategies

Lagos-Calabar Coastal Highway represents a significant milestone in Nigeria's infrastructure development.

The National Economic Recovery and Growth Plan (ERGP) prioritizes infrastructure development as a catalyst for economic diversification. The highway project aligns with ERGP's goals by improving transportation links and fostering economic activities.

2.7 Lagos State's Development journey and the Coastal Road

Lagos State's development journey involves a mix of visionary plans, targeted policies, and a commitment to resilience. As the city continues to evolve, balancing growth with sustainability remains a critical challenge.
Box 2.3 shows the development priorities and policies shaping Lagos State.

Some related milestone project in the State is outlined below:
a. Lagos State has adopted masterplans and Model City Plans
The Lagos-Calabar Coastal Highway aligns with the broader vision outlined in the Lagos Master Plan. The plan emphasizes sustainable urban development, transportation infrastructure, and economic growth. The highway's construction is a step toward realizing this vision.

Its alignment with some Master Plans underscores its importance in shaping the State's future. The Lagos-Calabar Coastal Highway aligns with the broader vision outlined in the Lagos Master Plan. The plan emphasizes sustainable urban development, transportation infrastructure, and economic growth. The highway's construction is a step toward realizing this vision.

Lagos State has adopted masterplans and Model City Plans that cover the entire state. These plans provide guidance on growth and development.
Specifically, for the Lekki sub-region, the Lekki Comprehensive Masterplan serves as the spatial planning framework. It outlines the road infrastructure to be developed from 2013 to 2032. The Lekki Peninsula holds great potential for sustainable urban development, and strategic planning ensures that infrastructure aligns with long-term goals. The Proposed Coastal Road is already integrated into the Strategic Masterplan, indicating its importance in the overall development vision (Figure 2.4).

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1. **Lagos State Development Plan (LSDP):**
- The LSDP outlines the vision and mission for Lagos, spanning from 2012 to 2052. It builds upon the THEMES agenda, which focuses on six key areas: Traffic Management and Transport, Health and Environment, Education and Technology, Making Lagos a 21st-century economy, Entertainment and Tourism, and Security and Governance.
- The LSDP aims to eradicate poverty, promote economic growth, and drive infrastructural renewal and development. It envisions Lagos as Africa's model megacity and a global economic and financial hub that is safe, secure, functional, and productive.

2. **Lagos Resilience Strategy (2020):**
- The Resilience Strategy takes an integrated approach to address shocks and stresses experienced by the city. It focuses on building resilience across various sectors, including infrastructure, governance, and social services.
- By enhancing resilience, Lagos can better withstand challenges such as rapid urbanization, climate change, and socioeconomic disparities.

3. **Climate Action Plan:**
- Lagos committed to the C40 Cities Climate Leadership Group's Deadline 2020. This plan emphasizes climate action, sustainability, and reducing the city's carbon footprint.
- Initiatives include promoting renewable energy, improving waste management, and enhancing green spaces. These efforts align with global climate goals.

4. **Sector-Specific Policies:**
- While visionary and strategic policies like the LSDP and Resilience Strategy provide overarching direction, Lagos also has sector-specific policies.
- Examples include the Integrated Resource Plan (focused on electricity) and the Strategic Transportation Master Plan. These policies address specific challenges within their domains.

5. **Spatial Integration and Investment Coordination:**
- To achieve sustainable development, Lagos must spatially integrate and coordinate investment actions. This involves aligning infrastructure development, land use planning, and economic growth.
- By strategically linking investments, Lagos can create a more efficient, interconnected urban fabric that benefits residents and businesses alike.

Box 2.3: Development Priorities and Policies Shaping Lagos State

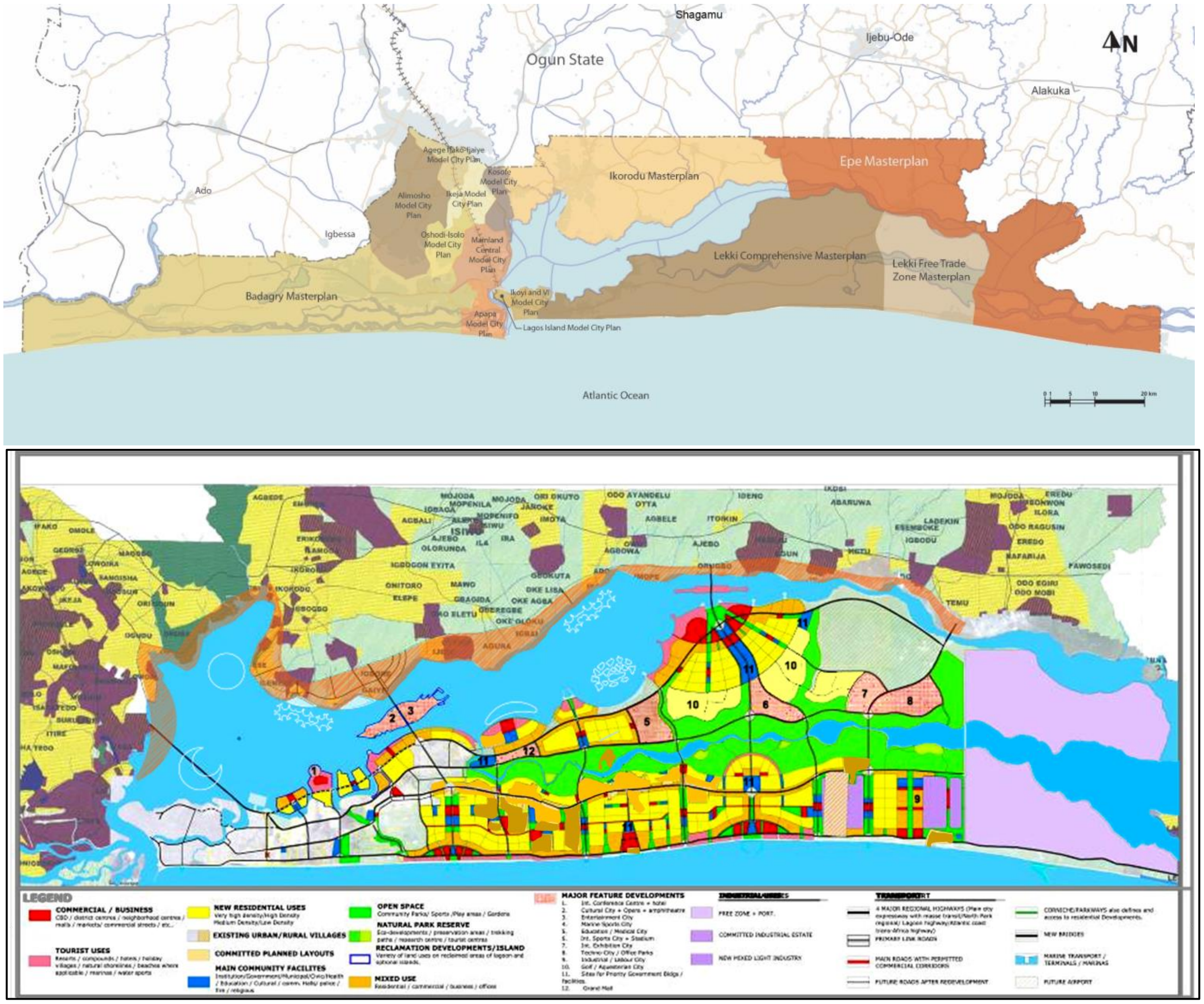


Figure 2.4: Lekki Masterplan and Proposed Coastal Road in Lagos

b. Eko Atlantic Masterplan and Lagos Coastal Road

The Lagos Coastal Road plays a pivotal role in unlocking Eko Atlantic's potential. It connects this dynamic district to the rest of Lagos, fostering economic prosperity and creating a thriving urban environment.

Eko Atlantic is a visionary development project located in Lagos, Nigeria. It is a new district constructed on land reclaimed from the Atlantic Ocean by DEME Group[1]. The project aims to create a vibrant ecosystem within Lagos—a city within a city—where dreams come to life. As

Lagos's population approaches 30 million by 2030, the demand for space is escalating, and Eko Atlantic provides a solution.

The coastal road integrates with Eko Atlantic's master plan. It provides access to residential areas, commercial zones, and recreational spaces. As the city develops, the road network ensures efficient transportation for residents, workers, and visitors.

The **Lagos Coastal Road** is a critical infrastructure project that connects various parts of Lagos along the coastline. Eko Atlantic leverages the coastal road through the following:

- **Accessibility and Connectivity**:

Eko Atlantic is strategically positioned along Lagos' Bar Beach. The coastal road ensures seamless connectivity between Eko Atlantic and other parts of the city.
Residents, commuters, and businesses benefit from improved access, reducing travel time and enhancing mobility.

- **Economic Impact**:

Eko Atlantic serves as a hub for trade, commerce, and business. The coastal road facilitates the movement of goods, services, and people.
It connects Eko Atlantic to the broader Lagos economy, contributing to job creation and economic growth.

- **Environmental Considerations**:

The Eko Atlantic Shoreline Protection and Reclamation Project reclaimed approximately 1000 hectares of land within Lagos. It addresses shoreline erosion problems at Victoria Island. The coastal road aligns with sustainable development principles, balancing urban growth with environmental conservation.

Figure 2.5: Eko Atlantic Development and the Coastal Road

- c. 4th Mainland Bridge Project

The Fourth Mainland Bridge is an ambitious infrastructure project initiated by the Lagos State Government in Nigeria. The Fourth Mainland Bridge aims to connect Lagos Island to other parts of the state, including Langbasa (Lekki) and Baiyeku (Ikorodu), spanning the Lagos Lagoon to Itamaga in Ikorodu.

It is designed as a 38 km long bridge with a 2 × 4 lane carriageway cross-sectional road. The project includes provisions for a Bus Rapid Transit (BRT) Lane and future road expansion.

Once completed, the Fourth Mainland Bridge will become the second longest bridge in Africa.

Notable features include three toll plazas, nine interchanges, a 4.5 km Lagoon Bridge, and an eco-friendly environment. The project aims to enhance transportation infrastructure, ease traffic congestion, and improve connectivity between Lagos mainland and the island.

In December 2022, the Messrs CCECC - CRCCIG Consortium was announced as the preferred bidder for the bridge construction. The Lagos State Government expects the project to be completed within four years from the announcement date.

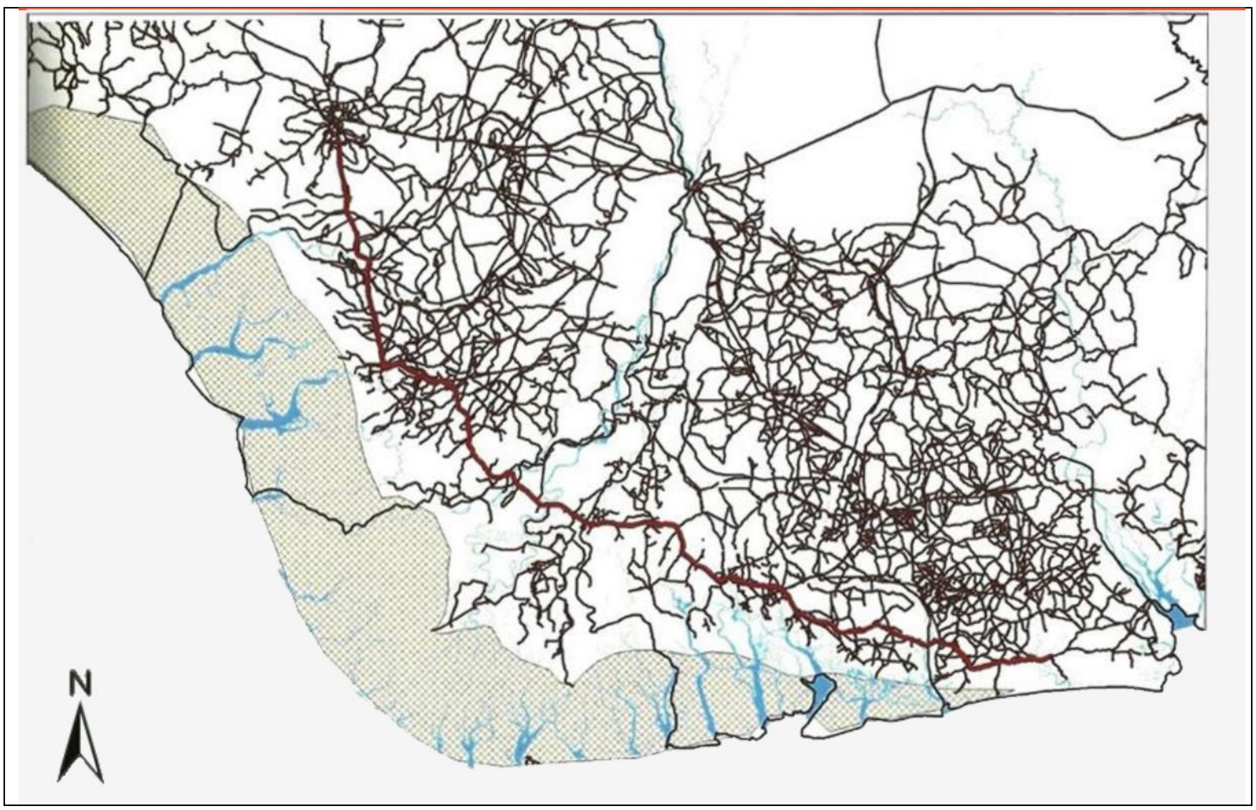
The Fourth Mainland Bridge holds great promise for Lagos State, offering improved connectivity, reduced traffic congestion, and enhanced economic opportunities. The intersection with the Coastal Road will further make this a significant milestone in Nigeria's infrastructure landscape.

2.8 Positive Impacts on Existing Situation

2.8.1 Positive Impacts on Local Communities

The project's positive impacts extend to local communities within its area of influence, contributing to their well-being and development through:

1. Offering job opportunities to locals, including women and youths, with a strategy aligned with community representatives and women's associations.
2. Enhancing locals' skills through training and capacity-building programs, empowering them for future opportunities.
3. Conducting toolbox talks and technical trainings to enhance local technical capacities and develop workers' expertise.
4. Prioritizing health and safety measures, conducting awareness campaigns, and providing training for workers and communities.
5. Actively engaging with local communities to foster a sense of ownership and collaboration for long-term sustainability.
6. Create and enhance Communities accessibility by good road.



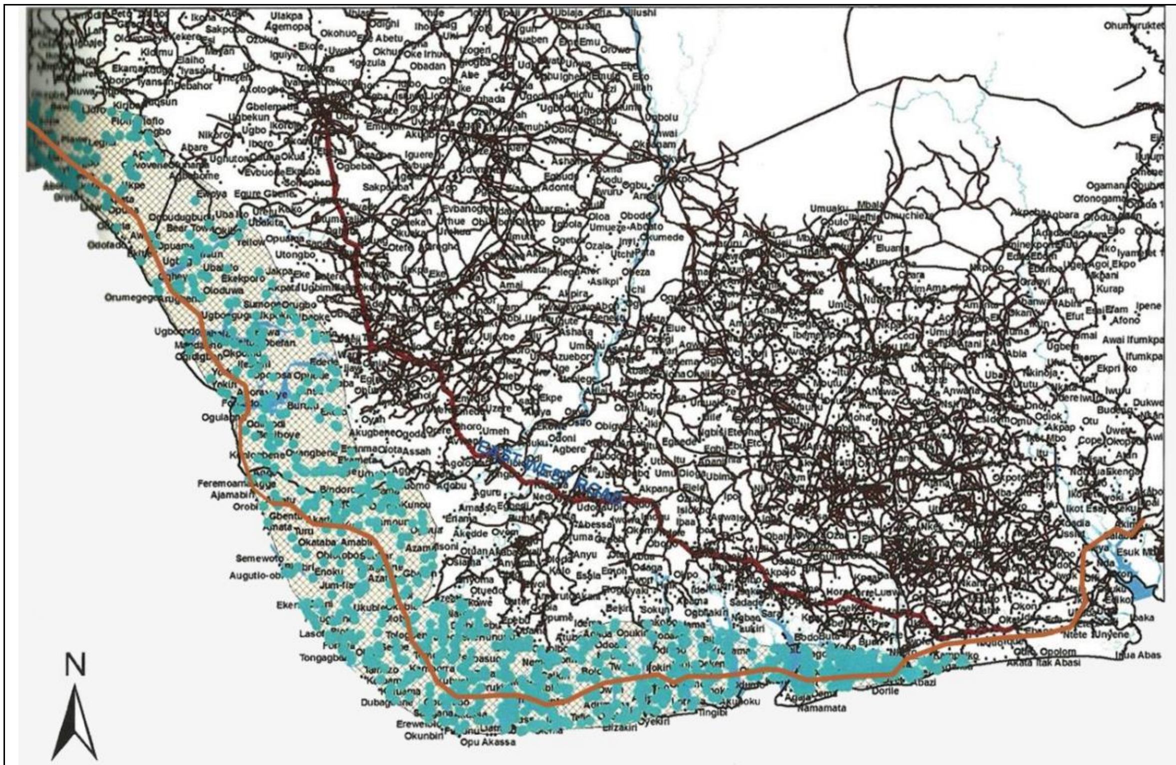


Figure 2.6: Communities Inaccessible by Road and the Proposed Project

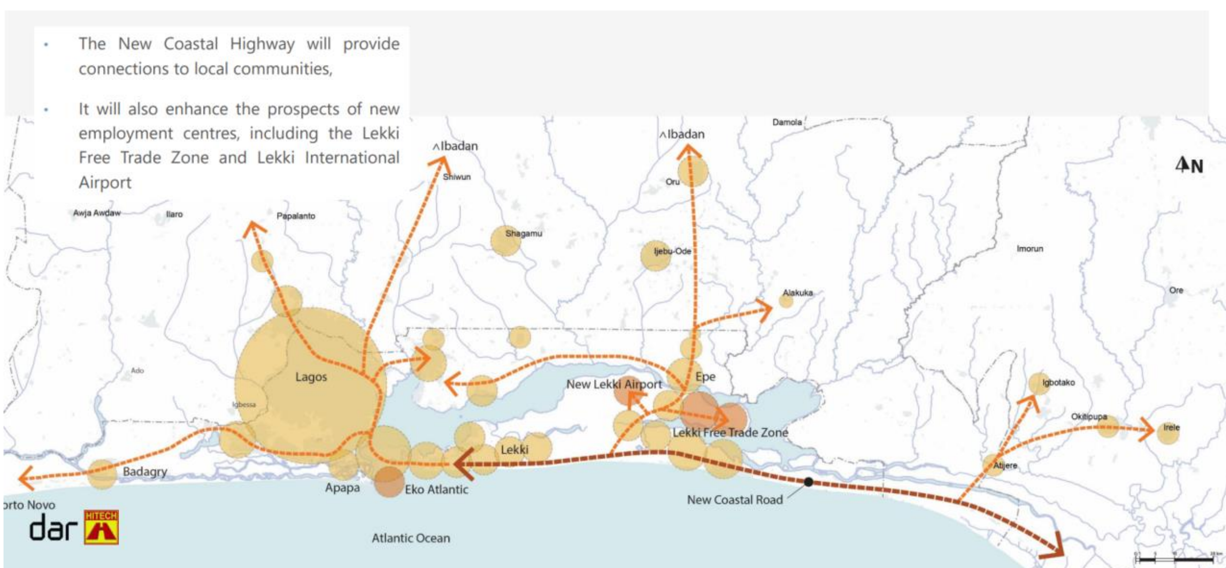


Figure 2.7: Local Opportunities

2.8.2 Positive Impact on Coastal Erosion and Shoreline Change

The coastal region around Lagos, Nigeria, has experienced significant changes over the years due to natural processes and human development. Let's delve into the details:

A study[1] assessed the evolution of the Lagos coast over a 20-year period (2001 to 2020). Researchers relied on archived Google Earth imagery to estimate and visualize the magnitude of erosion and accretion along the Lagos coastline. The study used the Analyzing Moving Boundaries Using R (AMBUR) software package, an R programming language add-in. The key findings included:

- Cumulative mean rate of shoreline change: +0.93 meters/year (indicating overall accretion).
- Mean erosion rate: -1.94 meters/year.
- Mean accretion rate: +4.84 meters/year.
- Victoria Island, a prominent area, experienced the highest shoreline change rate (+6.24 meters/year) due to land reclamation activities.
- However, eastward of Victoria Island, there was unabated erosional activity, resulting in disappearing beaches and urban structures.

The impact has been coastal erosion affecting various communities along the shoreline.

The coastline is experiencing annual retreats of 1-2 meters due to coastal erosion[3]. This erosion poses risks to infrastructure, including buildings, railroads, bridges, and roads, and threatens populations living close to the coastline (Table 2.2). Managing coastal erosion in Lagos requires a holistic approach that balances development with environmental preservation. The proposed project would support in ensuring careful planning to address both accretion and erosion challenges.

5. Lagos Coast Erosion Section of Coastline in Marwa, Lekki, Faces Threat **https://www.youtube.com/watch?v=CVpIQwKJdS4** **https://youtu.be/CVpIQwKJdS4** **Channels Television**
6. Lagos Coastal Erosion **https://www.youtube.com/watch?v=62uHzyoSz84** **https://www.youtube.com/watch?v=lGDfPAgM4K8** **Channels Television**
7. WASHED AWAY: THE LAGOS EROSION CRISIS **https://www.youtube.com/watch?v=lGDfPAgM4K8** **Arise News**
8. Erosion in Lagos chases communities away: More than 180 kilometers submerged in a decade. **https://www.youtube.com/watch?v=zDKLYep8A98**

Al Jazeera English
Box 2.4: Coastal Erosion Along Lagos shoreline and Media Concerns

2.9 Value of the Project

Economic analysts predict that completing the first phase could increase Lagos State's economy by **50%**, thanks to connections with the Lekki Deep Seaport and the Lekki economic corridor, where the Dangote Refinery and Petrochemical Complex are located[1].In terms of monetary cost, the proposed project is estimated at N1,067,887,381,148.61 (VAT inclusive. The project is estimated at N4.33bn per kilometre using reinforced concrete technology for a carriage width of 59.7 metres, to include 10 lanes, shoulders and rail with additional designs of service ducts, streetlights, drainages and shore protection. The 10-lane coastal road is designed to connect Lagos to Cross River, passing through Ogun, Ondo, Delta, Bayelsa, Rivers, and Akwa Ibom states before culminating in Calabar, the Cross-River State capital.

The estimated costs and benefits for Section 2 of the Lagos-Calabar Coastal Road:
Section 2 spans approximately 55.6 kilometers, so the total estimated cost for this phase would be around N189.88 billion. The Potential Benefits:

- Improved Connectivity: The road will link major urban centers, industrial hubs, and seaports along the southern coast, enhancing regional integration.
- Economic Growth: Reduced travel times and improved transportation infrastructure stimulate economic activity and attract investments.
- Employment Opportunities: Construction and subsequent maintenance create jobs.
- Market Access: Businesses of all sizes benefit from better access to markets.
- Inclusive Development: Bridging rural-urban gaps fosters inclusive growth and reduces income disparities.

While the costs are substantial, the long-term benefits of the Lagos-Calabar Coastal Road are expected to significantly impact economic development and living standards in the region.

The Lagos-Calabar Coastal Highway is an investment with net positive benefits, promoting sustainable development and improved livelihoods. Also, the **value of the Lagos-Calabar Coastal Highway project** and its critical contributions could be stated in the following ways:

Table 2.4: Value Consideration for the Lagos-Calabar Coastal Highway project

S/No	Value	Consideration
1.	Cost	• The project cost encompasses several aspects: • Engineering: Basic and detailed planning and design.

Table 2.4: Value Consideration for the Lagos-Calabar Coastal Highway project

S/No	Value	Consideration
		• Civil and Mechanical Works: Construction and maintenance. • Operational Costs: Ongoing expenses for management and upkeep.
2.	Critical contributions	• The highway's critical value lies in its contributions: • Increased Economic Activities: The corridor fosters trade, commerce, and industrial growth. • Employment Generation: Infrastructure development creates jobs. • Ease of Movement: Efficient transportation benefits commuters and businesses.
3.	Long-Term Benefits:	• The Project's evaluation considers: • Economic Returns: Enhanced trade, investment, and revenue. • Environmental and Socioeconomic Benefits: Positive impacts on communities and health.
4.	Economic Growth and Trade:	• Trade Routes: The highway will serve as a vital trade route connecting major cities, industrial zones, and ports. • Investment Opportunities: The corridor can attract investments in agriculture, manufacturing, logistics, and tourism. • Job Creation: the infrastructure development is expected to generate employment opportunities, benefiting local communities.
5.	Tourism and Hospitality:	• Tourist Attractions: The highway passes through scenic coastal areas, national parks, and cultural heritage sites. • Hospitality Industry: Hotels, restaurants, and recreational facilities can thrive along the route.
6.	Urbanization and Real Estate Development:	• Urban Expansion: The corridor can spur urban growth, leading to new residential and commercial developments. • Property Value: Well-planned infrastructure enhances property values and attracts real estate investments.
7.	Industrial Zones and Special Economic Zones (SEZs):	• Industrial Clusters: The highway can link existing and new industrial clusters. • SEZs: Designated SEZs can attract foreign direct investment, boost exports, and create jobs.

Table 2.4: Value Consideration for the Lagos-Calabar Coastal Highway project

S/No	Value	Consideration
8.	Transport and Logistics Efficiency:	• • Port Connectivity: Efficient road networks enhance seaport connectivity (e.g., Lekki Deep Seaport). • Reduced Transit Time: Improved highways minimize transit time for goods and passengers.
9.	Social Services and Livelihood Enhancement:	• Healthcare and Education: Corridor development can lead to better healthcare facilities and educational institutions. • Livelihood Diversification: Communities can engage in tourism-related activities, handicrafts, and services.
10	Environmental Sustainability:	• Green Infrastructure: Incorporating green belts, wildlife corridors, and sustainable drainage systems helps preserve natural ecosystems and enhances the environment. • Biodiversity Conservation: Protecting natural habitats and promoting eco-tourism contribute to biodiversity preservation.
11	Community Participation and Inclusivity:	• • Stakeholder Engagement: Involving local communities, indigenous groups, and civil society in planning and decision-making ensures their voices are heard. • Social Inclusion: Ensuring that project benefits reach marginalized groups fosters social equity.
12	Coastal Morphological Change:	• Addressing morphological changes: Lagos shoreline experiences morphological changes due to both natural processes and human development. • Over a 20-year period: Cumulative mean rate of change: +0.93 m/year, Erosion rate: -1.94 m/year and Accretion rate: +4.84 m/year and Victoria Island, with the highest shoreline change, had a mean accretion rate of 81.99 m/year. • Appropriate land use and management plan: ensuring appropriate land use and management plan to create lasting positive impacts on the environment, communities, and coastal resilience.

2.9.1 Envisaged Sustainability

The sustainability of the proposed Lagos-Calabar Coastal Highway project runs across four key areas: Economic Sustainability, Technical Sustainability, Social Sustainability, and Environmental Sustainability. Integrating these considerations serves as a model for sustainable development, benefiting present and future generations as described below and depicted in Figure 2.5.

Figure 2.8: Highway Added Values of the Proposed Project

2.9.2 Economic Sustainability:

The proposed Highway stand to demonstrate a commitment to financial sustainability, benefiting both the government and residents. This highway project is not just about roads; it is a strategic investment with long-term benefits for Nigeria's economy and local communities as briefly described below:

1. **Long-Term Economic Benefits**:

The Lagos-Calabar Coastal Highway aims to enhance trade, investment, and revenue. By seamlessly connecting major cities and ports along the coast, the highway serves as a catalyst for economic expansion, bolstering trade and tourism activities throughout the region.

2. **Job Creation**:

The Lagos-Calabar Coastal Highway is designed to create sustainable employment opportunities which is expected to contribute to economic stability. During the construction phase, the project will create jobs for both skilled and unskilled labor, benefiting local communities.

3. **Revenue Generation**:

The Lagos-Calabar Coastal Highway is proposed to provide efficient transportation infrastructure which can attract additional shipping traffic and foreign investments.
The highway's economic sustainability relies on several key revenue streams such as the following:

- Revenues from Road Users: Toll collection from road users contributes to ongoing maintenance and operational costs, ensuring the highway's functionality.
- Parking and Service Station Facilities: Providing parking, and travel break areas and service stations generates additional income while catering to travelers' needs.
- Utilities and Telecommunications Ducting: Leasing space for utility ducts (such as fiber optics and power lines) generates revenue and benefits both the highway and adjacent communities.
- Advertising Hoardings: Leasing advertising spaces along the highway generates advertising revenue.
- Leasing Land for Hotels and Retail Centers: The highway corridor can attract hotel chains and retail developments, generating long-term revenue.
- Job Creation and Socioeconomic Obligations: The project creates jobs during construction and operation, fulfilling the government's financial and socioeconomic obligations to host communities.

4. **Funding**

The proposed project is designed to support its sustainability through financing mechanisms that will allow the private sector to support the project ends. The highway is conceived as an Engineering, Procurement and Construction plus Financing project. The funding model entails part-funding by the Federal Government between 15 to 30 per cent. the private sector counterpart will provide the balance and toll the road when completed for a minimum period of 15 years, to ensure full recovery of all debts and equity applied for the delivery of the project. Under this model, the investor provides all designs, part of the financing and construction while the Federal Government provides the counterpart funding.
The Federal Ministry of Works received such a bid, worked on it and sent it to Bureau of Public Procurement (BPP).

2.9.3 Technical Sustainability:

The proposed coastal highway is designed to demonstrate a holistic commitment to technical sustainability, to benefit Nigeria's infrastructure growth and its people. This highway project goes beyond mere construction; it embodies a commitment to long-lasting benefits for both the project itself and the local community.

The Federal Ministry of Work and the Contractor 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 necessarily source for necessary technical expertise to ensure the sustainability of the project. The Ministry shall employ Best Available Technology in the implementation of the project and adhere strictly to all relevant engineering codes and standards. Specifically, the following shall be adopted to ensure the technical sustainability:

1. **Quality Infrastructure**:

Ensuring the highway's durability and resilience is paramount to the project. High-quality construction materials, engineering standards, and rigorous testing would contribute to its longevity.

2. **Maintenance and Upkeep**:

Regular maintenance is embedded in the overall [project management and this is essential to prevent deterioration. By promptly addressing wear and tear, the highway will remain safe and efficient for years to come.

3. **Adaptability**:

Designing with future needs in mind ensures the highway would remain relevant. The flexibility of the technical design would allow for adjustments as traffic patterns, technology, and urban development evolve.

4. **Best Available Techniques (BAT)**:

The project will adopt BAT for design, construction, and operation. BAT ensures the most effective and efficient methods are employed, minimizing environmental impact, and maximizing performance.

5. **Local Content Utilization**:

The project will generously utilize local content supports regional industries and creates jobs. This will foster economic growth within the communities directly impacted by the highway.

6. **Skills Transfer and Capacity Building**:

Adequate collaboration between expatriate engineers and local engineers to ensure knowledge exchange shall be the key in implementation. Local engineers gain valuable experience, enhancing their capabilities and contributing to sustainable development.

2.9.4 Social Sustainability:

The proposed Coastal Highway has sown a commitment to social sustainability by engaging communities, addressing grievances, and prioritizing safety. In order to ensure that the persons and assets along the proposed alignment do not get adversely impacted, this project has conducted a Resettlement Action Plan (RAP), which ensured that all persons doing business or living within the Right of Way were all captured and documented. The RAP was prepared as stand-alone document and appropriate mitigations such as compensations and assistance were proffered. Also, project specific social and environmental management activities to ensure social sustainability of the proposed project has been developed as part of the overall project management plan.

This highway project prioritizes the well-being of local communities and safety as follow:

1. **Robust and Sustained Stakeholder Engagement**:

The Federal Government engages with affected communities in a structured and culturally appropriate manner. Tailored consultations consider risks, impacts, language preferences, decision-making processes, and the needs of vulnerable groups. Community engagement during the Environmental and Social Impact Assessment (ESIA) work and the development of a comprehensive Resettlement Action Plan (RAP) demonstrate this commitment.

2. **Establishment of a Grievance Mechanism**:

A grievance mechanism will be designed to receive and address concerns and grievances related to environmental and social performance. It will ensure transparency, accountability, and conflict resolution. The Potential sources of grievances, including community youth groups and tribal conflicts, will be considered.

3. **Security Surveillance of the Highway**:

Monitoring efforts will include:

- Preventing unauthorized interference with the highway.
- Ensuring security against intentional harm.

The key strategies for community engagement would include:

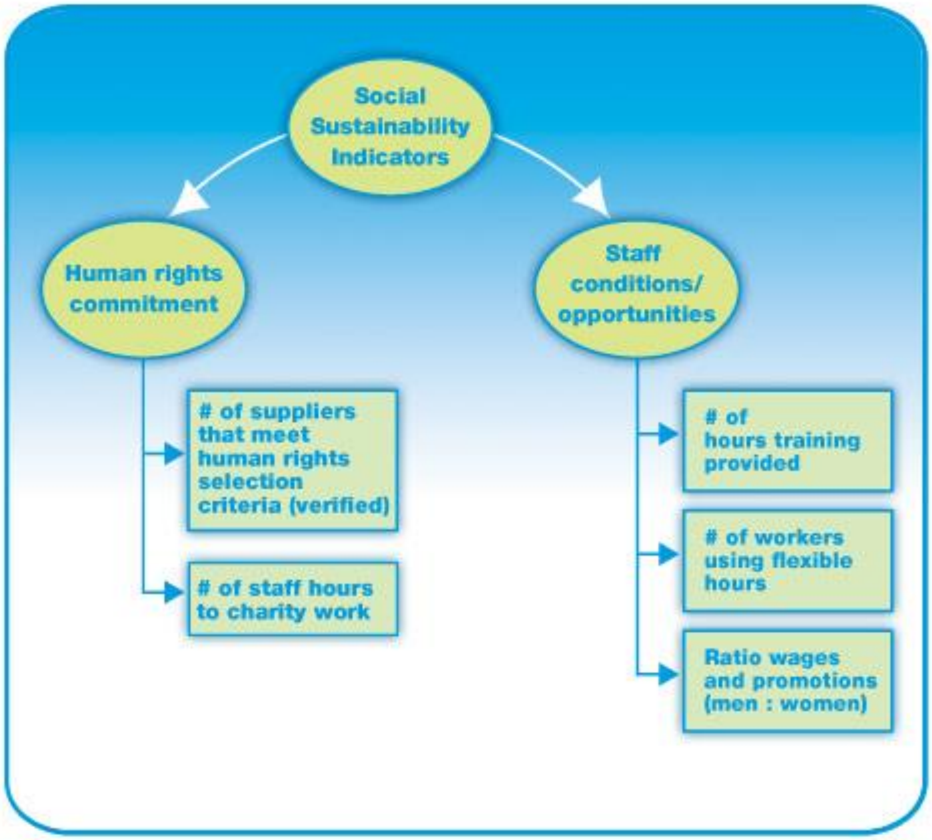
1. **Stakeholder Consultations**:
   - Organize regular **meetings and consultations** with community leaders, residents, and relevant stakeholders.
   - Seek input on environmental issues, potential impacts, and mitigation measures.
2. **Environmental Awareness Campaigns**:
   - Conduct **awareness programs** to educate communities about the Project's environmental aspects.
   - Explain the benefits, risks, and steps taken to minimize adverse effects.
3. **Community Participation in Decision-Making**:
   - Involve communities in **decision-making processes** related to the highway.
   - Seek consensus on environmental protection measures.
4. **Environmental Impact Assessment (EIA) Workshops**:
   - Host workshops to present the **EIA findings** to local communities.
   - Address concerns, clarify doubts, and gather feedback.

5. **Community Liaison Officers (CLOs)**:
   - Appoint CLOs to serve as **a bridge between the project team and communities**.
   - CLOs can relay information, address grievances, and ensure transparency.
6. **Mitigation Measures and Compensation**:
   - Communicate **mitigation plans** for environmental impacts.
   - Discuss compensation for any adverse effects on livelihoods or property.
7. **Monitoring and Reporting**:
   - Establish a system for **ongoing monitoring** of environmental aspects.
   - Regularly update communities on progress and any necessary adjustments.
8. **Cultural Sensitivity**:
   - Respect local customs, traditions, and cultural practices.
   - Consider sacred sites, burial grounds, and other sensitive areas.

As part of ensuring Social Responsibility and Sustainability in the Project Development, the businesses about the project shall be conducted in a manner that safeguards both the environment and the well-being of workers and community. When considering social sustainability, the proposed project shall adhere to the following principles:

- Positive Impact: The project should contribute positively to the host community.
- Meeting Human Needs: It must address an extended range of human needs.
- Preserving Nature: The project design should ensure the long-term preservation of nature's reproductive capabilities.
- Social Justice and Dignity: Normative claims related to social justice, human dignity, and participation should be fulfilled.

The project Management's obligation extends to the welfare of the host community. Ethical practices benefit society at large while maintaining a balance between the economy and ecosystems. Figure 2.3 illustrates the path toward social sustainability. Additionally, specific Corporate Social Responsibility (CSR) activities will enhance the socio-economic stability of the project. Employing local unskilled laborers from the host and surrounding communities contributes to their economic well-being.



Source : http://www.sustainabilityskills.net.au

Fig. 2.9: Social Sustainability

2.9.5 Environmental Sustainablity

The proposed project is guided by commitment to cost reduction, environmental responsibility, safety, and community health:

1. The project is guided by principles that focus on Minimization of negative environmental and social impacts Adequate attention will be given to Environmental, public safety, and health aspects and Implementation of appropriate mitigation measures and an Environmental Management Plan
2. ESIA: Preparation of the Environmental and Social Impact Assessment (ESIA) to identify upfront the impacts and suggest mitigation measures.
3. **Biodiversity Conservation**: The project during implement would protects natural habitats. Measures to be taken to safeguard biodiversity along the highway route are embedded in the ESIA.
4. **Climate Resilience**: Climate change effects have been considered in planning and design. The highway is designed to withstand potential climate-related challenges.

5. **Environmental Management System (EMS)**: The project adopts an EMS based on ISO 14001:2015 standards. This proactive approach ensures responsible environmental practices.
6. **Eco-Friendly Design**: During construction, the project shall minimize its environmental impact. It will Sustainable practices reduce harm to natural ecosystems.
7. The FMW will work with FMENv to enforce compliance with statutory regulations and its own corporate guidelines on Health, Safety, and Environment (HSE). Simultaneously, the project aims for continuous performance improvement. All project facilities will be designed and constructed to keep environmental impacts at minimal and acceptable levels.
8. All operations will conform to relevant International, national, and state regulations**.** The project adheres to national and international environmental regulations. Responsible execution aligns with global industry practices.
9. Beyond environmental aspects, the project focuses on Occupational Health and Safety and Community Health and Safety**.** Handling, storage, and disposal of solid and liquid wastes will follow regulatory requirements and company Standard Operational Procedures.
10. Engaging with local communities ensures that environmental concerns are heard and integrated into project planning, and this has started during the ESIA preparation.

The FMW working with FMENv shall cause the contractors to carry out the Project in accordance with the ESIA and the applicable national legislation in a manner and in substance that is satisfactory to the potential funders. The contractor shall not commence implementation of any works on any section of the road, unless all project affected persons (PAPs) on such sections have been compensated and/or resettled in accordance with the RAP.

2.10 Project Options and Alternatives

2.10.1 Project Options

By carefully analyzing the options and alternatives, making informed decisions that balance development goals with environmental preservation is possible. The ultimate aim is to create a sustainable and efficient transportation corridor for Nigeria. The project options and alternatives for the Lagos-Calabar Coastal Highway were weighed through an evaluation that ensures that it considers environmental and social factors while making informed decisions.
In Table 2.5, the key options are appraised.

Table 2.5: Key Project options

No	**Project Options:**	**What it means**	**Considerations**
1	No Project Options:	This scenario involves not proceeding with	• The “No Project” option seems prudent in the short term. However, it risks stifling Nigeria’s growth potential, considering the nation's aspirations to pursue viable infrastructure projects

Table 2.5: Key Project options

No	Project Options:	What it means	Considerations
		the highway project. It would mean maintaining the status quo without any new infrastructure.	remain crucial. In this choice, which was rejected, the implications include: • Economic Impact :Without the highway, Nigeria's local and national economies would miss out on significant growth opportunities. The proposed development promised various socioeconomic and industrial benefits: • Increased Business Opportunities: The highway would have facilitated trade, transportation, and connectivity, leading to more business ventures. • Government Revenue: The Project would have generated revenue through taxes, tolls, and other sources. • Foreign Exchange Earnings: Improved infrastructure attracts foreign investment and boosts foreign exchange reserves. • Employment Opportunities: Construction, maintenance, and related jobs would have provided employment. • These potential gains would be forfeited by opting for the "No Project" route. As a developing country, Nigeria relies on infrastructure development to spur economic growth. The highway would have bridged regions, fostering national integration and development. The absence of the Project could hinder progress and limit opportunities. • The decision against the Project assumes that feasibility studies deemed it non-viable. However, it's essential to weigh long-term benefits against short-term challenges.
2	Delayed Project Options:	In this case, the Project could be postponed later.	• The highway's development is anticipated to proceed without delay as it contributes to Nigeria's growth and connectivity.

Table 2.5: Key Project options

No	Project Options:	What it means	Considerations
		This might allow further studies, adjustments, or better alignment with environmental goals.	• However, project implementation may face delays in certain circumstances due to various factors. This option is not needed for the Project due to the following: • Unfavourable Conditions: Civil unrest, hostilities, or unfavourable government policies can hinder progress. Malicious public opinion and economic downturns may also contribute. • Stakeholder Communities: The highway project involves various stakeholders—local communities, authorities, and investors. If these stakeholders face challenges, the Project could be delayed. • Force Majeure: Natural disasters, pandemics, or unforeseen events fall under force majeure. Such events disrupt schedules and require adaptation. • Current Scenario: Interestingly, none of these delaying factors currently exist for the Lagos-Calabar Coastal Highway. Conditions are conducive to progress. • Preferred Option: Given the absence of hindrances, the "Delayed Project" option was not selected. Instead, the focus remains on timely execution and reaping the benefits.

Table 2.5: Key Project options

No	**Project Options:**	**What it means**	**Considerations**
3	Go-Ahead Option:	The highway project proceeds as planned, with the aim of timely completion and implementation.	• The Lagos-Calabar Coastal Highway represents a path toward prosperity, connecting people, commerce, and aspirations. Acknowledging the vital need for the planned Lagos-Calabar Coastal Highway, the following are the positive aspects of the option to go ahead with the Project: • Economic Boost: The highway project promises substantial benefits. • Increased Production: Improved connectivity facilitates efficient movement of goods and services, enhancing production. • Revenue Enhancement: The Project generates revenue through tolls, taxes, and economic activity. • Job Creation: Construction, maintenance, and related jobs provide employment opportunities. • Socioeconomic Impact: The highway positively affects livelihoods and communities. • National Progress: Nigeria's growth hinges on strategic infrastructure development. The highway bridges regions, fostering national integration and economic expansion. It aligns with the nation's vision for progress. • Viability and Execution: The "Go-Ahead" option is deemed viable. Implementation should proceed as planned, considering feasibility studies and stakeholder support Implementation will lead to social and environmental impacts including displacement of assets and people

- **2.10.2 Project Alternatives**

A thorough consideration of alternatives ensures that the chosen Project aligns with environmental sustainability, social well-being, and economic viability. By evaluating trade-offs and making informed decisions, creating a more resilient and responsible future is possible.

During the scoping phase, project planners considered various potential sites or locations for the proposed development. These alternatives involved different geographical areas, land parcels, or regions. Each site's advantages and disadvantages were assessed, considering factors such as accessibility, environmental sensitivity, and social impact. Feasibility from both technical and environmental perspectives were crucial.

The alternatives to ensure informed decision-making relate to the different aspects of other options within the ESIA framework:

1. **Alignments Consideration Alternatives**:

The Lagos-Calabar Coastal Highway project is crucial for economic growth and connectivity, and the government is actively seeking solutions that balance development with environmental and community considerations. The Lagos-Calabar Coastal Highway has been a topic of significant discussion and planning. The involvement of stakeholders, experts, and community representatives have helped shape the route alignment ensuring a well-informed decision.

The assessment using various factors/criteria as outlined in the Appendix 2.2 based on location, design, and local context.

Below were the proposed alternatives:

a. **Original Right-of-Way/Alignment via Water Corporation Road**:

Initially, the Lagos-Calabar Coastal Highway was planned to follow a specific alignment that would have affected private businesses, including the $200 million Landmark Beach Resort, a popular tourist destination.

The original right-of-way designated for the highway passed through the Water Corporation Road median. Along this 1.5 km coastal road route, there were no permanent structures whatsoever. This original alignment remained unused and undeveloped until now.

However, access to this corridor from the most viable options such Ajose Adeogun Street or other alternate route to this original right of way encountered significant challenges. The existing traffic situation is already congested, and adding the Coastal Road would further exacerbate the congestion. This was rejected.

b. **Discontinuation of Proposed Realignment:**

At the conclusion of the 3rd Stakeholders Meeting in Lagos, the Federal Government of Nigeria announced that it would discontinue with the proposed Lagos-Calabar Coastal Highway realignment. The reason for discontinuation was the presence of submarine cables along the coastline, which posed challenges to the original plan.

The decision not to proceed with the proposed realignment was welcomed by the Okun-Ajah community, as it would have led to the demolition of ancestral homes. Members of the community expressed gratitude for the government’s reconsideration of the route

c. **Redesigned Right of Way:**

To mitigate the loss of direct beach access due to the new highway alignment, a key solution proposed was the construction of artificial pools at Landmark Beach Resort.

d. **Current Proposed Route and Right-of-Way Choice**:

The Lagos-Calabar Coastal Highway will link several key infrastructure points :Lagos-Badagry Expressway superhighway, Fourth Mainland Bridge, Lekki Deep Sea Port Road It will also connect various points in Northern Nigeria via Ogoja-Ikom.

Additionally, the project will feature rail lines running in the middle of the main carriageways. reasons for why the proposed Lagos-Calabar Coastal Highway (Section 2) right-of-way was chosen over available alternatives.

The choice of the current right-of-way was a testament to the balanced approach, carefully weighing infrastructure preservation, operational considerations, and environmental impact. This decision was made with the utmost consideration for all aspects, instilling confidence in stakeholders about the commitment to a sustainable and efficient project.

The choice of the right-of-way for the Lagos-Calabar Coastal Highway (Section 2) involved careful considerations. The reasons why the proposed route was selected over available alternatives include the following:

i. **Traffic flow**.

- The chosen current right-of-way balances the need for development with the practical realities of traffic flow.

ii. Public Opinion.

- Resistance from residents and developers is a common, yet challenging, aspect when enforcing the 'right of way.' This is especially true when these regulations often involve the difficult decision of demolishing structures built within setbacks.
- Thus, the project was designed with a clear aim-to strike a balance between progress and public sentiment, a balance that is essential for sustainable development. In other words, the project was not just about infrastructure development, but about understanding and respecting the public's voice. Public opinion was not just considered, but actively sought and incorporated, influencing the delicate dance between infrastructure development, environmental protection, and political dynamics in Lagos. This was particularly evident in the choice of the right-of-way for the Lagos-Calabar Coastal Highway (Section 2), where public sentiment played a significant role. Public opinion, therefore, is not just a factor, but a cornerstone, influencing land use, infrastructure, and environmental protection decisions.

iii. Complex Interplay of Factors:

- Integration with other infrastructure projects, such as the Lagos Master Plan, which involves infrastructure development, environmental stewardship, and political manoeuvring, was also key.
- The Proposed Coastal Road Already Part of Masterplan—The Proposed Coastal Road is

already part of the Strategic Transport Masterplan (Figure 2.6 and 2.7).

- The "right of way" chosen ensures infrastructure projects have the necessary space for safe operation. This decision was made after careful consideration of the benefits it brings, including improved safety, reduced environmental impact, and enhanced operational efficiency. Clearances around electric power networks, water bodies, and drainage channels are crucial.
- The redesign of the highway, now tracing the coastal path, was a meticulous and necessary step. This decision was driven by unwavering commitment to preserve the extensive infrastructure along the original route, demonstrating practical and resourceful approach to the project, and reassuring stakeholders of the project's dedication to infrastructure preservation.

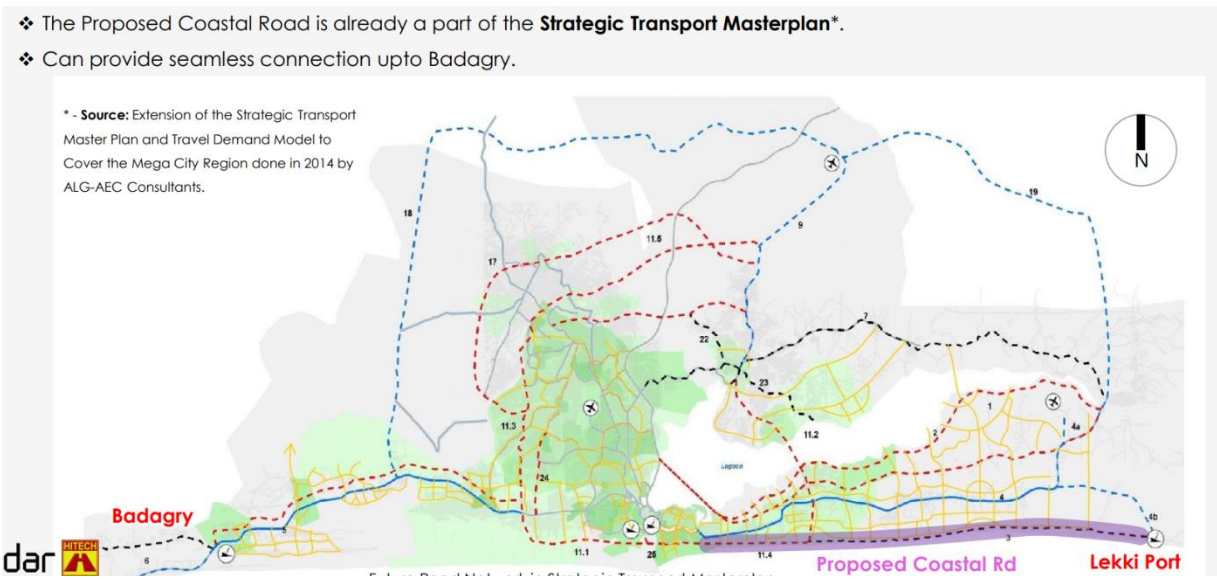


Figure 2.10: Strategic Transport Masterplan to which the Proposal falls.

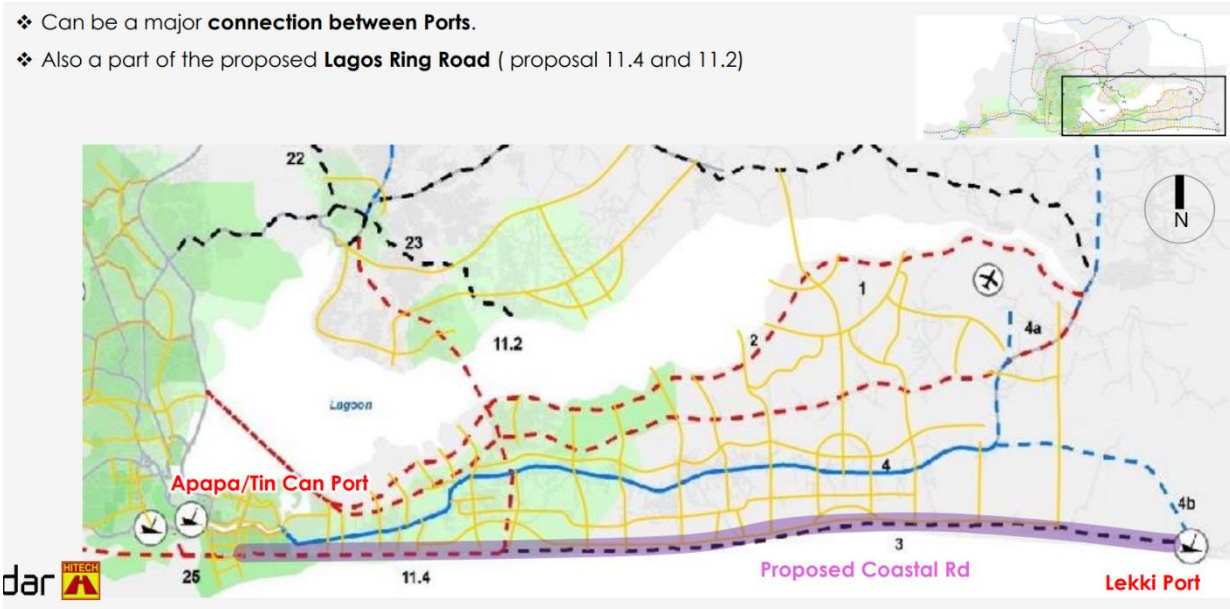


Figure 2.11: The proposed Lagos Ring Road and Proposed Coastal Road

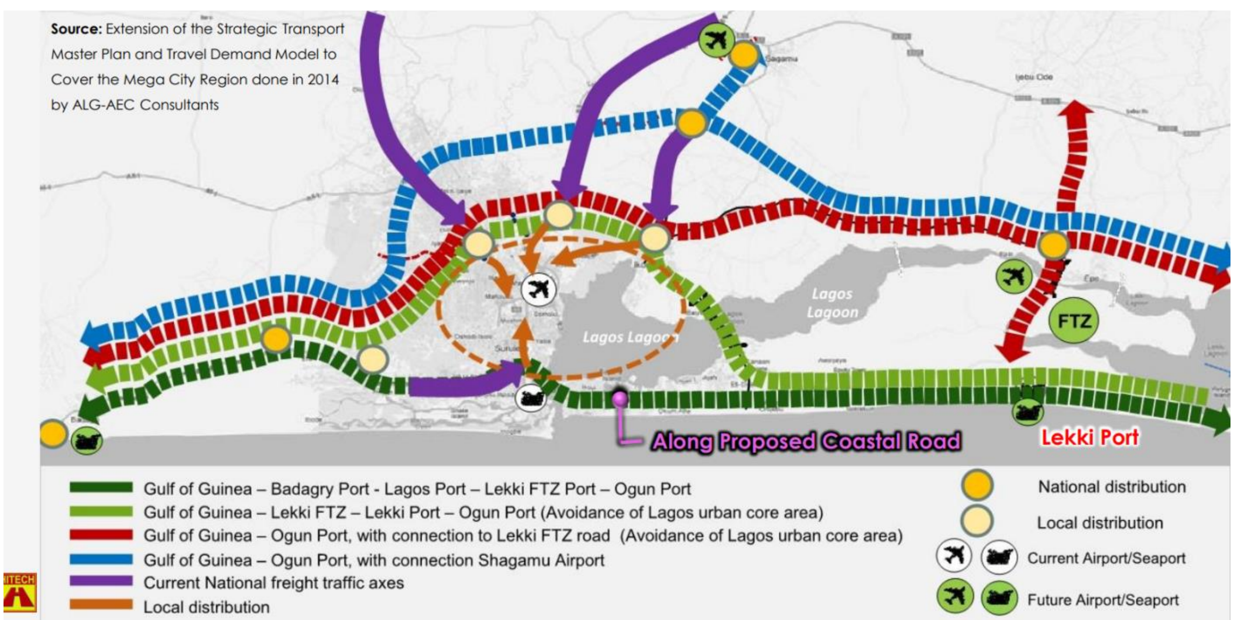


Figure 2.12: Proposed Coastal Road Vision for Freight Transportation

Thus, in summary the alignment proposals were considered using various factors to minimize impacts. These factors include safety, environmental concerns, traffic flow, and economic feasibility as outlined in Table 2.6

Table 2.6 Summary of Factors Considered in the Alignment Proposals

S/No	Factors	Consideration
14.	Alignment Options:	Engineers evaluate multiple alignment options, considering factors like terrain, existing infrastructure, land use, and community impact. Common alignment types include straight alignments, curves, tangents, and intersections.
15.	Traffic Flow and Safety:	Engineers analyze traffic patterns, volume, and safety requirements. They consider factors like sight distance, turning radii, and vehicle speeds. Alignments that enhance traffic flow, reduce congestion, and improve safety are prioritized.
16.	Cost-Benefit Analysis:	Economic feasibility plays a crucial role. Engineers compare the costs of construction, maintenance, and operation for each alignment. Benefits include reduced travel time, improved connectivity, and economic development.
17.	Geotechnical Considerations:	Soil conditions impact pavement performance. Engineers assess soil stability, bearing capacity, and settlement potential. Rigid pavement requires a strong foundation. Soil tests guide decisions on subbase and subgrade preparation.
18.	Alignment Optimization:	Iterative optimization involves adjusting alignment parameters (curvature, slope, etc.) to minimize impacts. Trade-offs occur—for example, a steeper curve may reduce environmental impact but increase construction costs.
19.	Public Participation and Stakeholder Engagement:	Community input matters. Public meetings, consultations, and feedback help shape alignment decisions. Balancing stakeholder interests ensures a more just and acceptable outcome.
20.	Final Alignment Selection:	Based on the analysis, engineers recommend the alignment that best balances safety, environmental impact, cost-

		effectiveness, and community needs. Rigid pavement design specifics (thickness, reinforcement, joint spacing) are then tailored to the chosen alignment.

2. **Alternative Design/Technology/Structural Alternatives**:

Exploring various engineering designs and construction methods. This could involve assessing sustainable materials, innovative road layouts, or eco-friendly features.

Structural alternatives pertain to the Project's design, layout, and configuration. Variations in road alignment, bridge designs, tunnels, and interchanges could affect infrastructure projects like highways. Evaluating structural alternatives helps identify the most efficient, cost-effective, and environmentally sound options. Trade-offs between different designs are considered, balancing benefits and drawbacks.

3. **Feasibility and Impact Assessment**:

Feasibility is a key criterion for alternative selection. An alternative must fulfill the Project's purpose while minimizing adverse impacts. The ESIA process estimates the extent and scope of assessment required for each alternative. Recommendations are made regarding whether a full ESIA study is necessary. Time frames and resource requirements are also considered.

4. **Incremental Alternatives**:

These emerge during the ESIA process as responses to identified impacts.
Incremental alternatives address specific issues and are closely tied to mitigation measures.
They may involve project components, operational practices, or construction phasing adjustments.
The goal is to minimize negative effects and enhance positive outcomes.

5. Engineering Alternatives

a. **Road Engineering**:

Road engineering focuses on designing, constructing, and maintaining roads and pavements. Engineers aim to create durable, safe, and efficient vehicular and pedestrian traffic routes. Key considerations include selecting the right materials, layer thicknesses, and pavement types.

b. **Types of Pavements in Road Construction**:

Pavements are the part of the road that carries traffic. There are two main types of road surfaces:

- Rigid Pavement:
    - Consists of a single layer (e.g., Portland cement concrete).
    - Provides high durability and strength.
    - It is commonly used for highways and major roads.
- Flexible Pavement:
    - They are typically made up of multiple layers (e.g., asphalt).

  - Distributes loads effectively.
  - Suitable for various traffic volumes and soil conditions.
- Other road surface materials include artificial stone, flagstone, cobblestone, bricks, tiles, and timber.

c. **Construction Alternatives**:

Beyond pavement types, engineers consider various construction alternatives:

- White topping Roads: Using concrete overlays on existing asphalt surfaces.
- Polymer Fiber Reinforced Concrete Roads: Enhancing concrete durability with polymer fibers.
- Bituminous Roads: Traditional asphalt roads.
- Composite Solutions: Combining different materials for optimal performance.
- Recycling Techniques: Reusing materials for sustainable construction.

d. **Designing for Strength and Longevity**:

Engineers measure road strength based on the number of vehicles they can support. Specifications include material choices, layer thickness, and pavement type. The goal is to create serviceable roads that withstand traffic and last their design life.

e. **Concrete Pavement Design**:

The Lagos-Calabar Coastal Highway's first phase comprises a 47.47-kilometers dual carriageway. It is constructed using 11-inch-thick concrete roads with 20-millimeter reinforcement.
This innovative design improves local cement manufacturing and boosts steel production from Ajaokuta.

1. The Chosen Engineering Option -Rigid Pavement

As shown above, the proposed project requires road engineering, a multifaceted field that involves careful planning, design, and construction. It encompasses a range of disciplines, from material selection to pavement design. By considering alternatives and optimising construction methods, durable, cost-effective, and sustainable road networks can be built.

Based on the different types of engineering considered, the choice of rigid pavement reflects a commitment to building a robust, enduring highway that will serve future generations. This choice is not just a technical detail but a strategic decision crucial in achieving the project's durability, safety, and long-term performance goals. We value your input and understand that this decision affects not just us but also the community. We believe that by choosing rigid pavement, we are making a decision that aligns with our shared goals of sustainability and long-term value. This should reassure you about the quality of our chosen engineering option and the transparency of our decision-making process.

Rigid pavement, in stark contrast to flexible pavement (asphalt), is a road surface constructed using rigid materials such as concrete. It does not just offer durability, load-bearing capacity, and resistance to deformation, but it excels in these aspects. Unlike flexible pavement, which distributes loads through the entire structure, rigid pavement relies on the inherent strength of the concrete slab itself, ensuring a superior performance. This superiority instils confidence in the quality of the chosen engineering option.

2. **Cement and Asphalt**

Cement and asphalt are both commonly used materials for paving surfaces, but they have different climate impacts. It is well known that darker surfaces get hotter in sunlight than lighter ones. Climate scientists use a metric called 'albedo' to help describe this phenomenon. **Box 2.3 comprehensively compares cement and asphalt materials for paving surfaces and climate impacts**, clearly understanding why the rigid payment was a significant factor in the decision. T**he proposed project is based on using Cement for the rigid pavement, which is considered superior to asphalt.** This choice ensures a durable road and contributes to a more sustainable environment, keeping you well-informed and engaged in the project's positive climate impact.

Table 2.7 shows a comparison of cement and asphalt materials for paving surfaces and climate impacts

Albedo is a measure of surface reflectivity. Surfaces with low albedo absorb lighter and tend to be darker, while high-albedo surfaces are brighter and reflect more light. Albedo is a central factor in cool pavements. Cement and asphalt are both commonly used materials for paving surfaces, but they have different climate impacts.

It is well-known that darker surfaces get hotter in sunlight than lighter ones. Climate scientists use a metric called "albedo" to help describe this phenomenon. Typical paving surfaces, like conventional asphalt, possess a low albedo and absorb more radiation and emit more heat. In contrast, cool pavements have brighter materials that reflect more than three times as much radiation and, consequently, re-emit far less heat (Logan, A (2021: Countering climate change with cool pavements, MIT Concrete Sustainability Hub).

Box 2.5: Cement and asphalt Materials with Climate impacts

Table 2.7: Comparison of Cement and Asphalt Materials for paving surfaces and Climate impacts

s/No	Element	Asphalt:	Concrete:
1	Heat Absorption and Emission:	Conventional asphalt has a low albedo (reflectivity) and absorbs more solar radiation. As a result, it emits more heat, contributing to the urban heat island effect. In hot climates, asphalt can soften and even melt, causing bumps and ruts on the surface.	Concrete pavements, especially reflective concrete, have higher albedo and reflect more solar radiation. They emit less heat, helping mitigate the urban heat island effect. In some cases, concrete performs better than asphalt due to its rigidity at high temperatures, which minimizes vehicle fuel consumption.
2	Greenhouse Gas Emissions:	Asphalt: The production of asphalt involves energy-intensive processes and emits greenhouse gases. Additionally, asphalt surfaces contribute to the urban heat island effect, indirectly affecting climate change.	Concrete: While concrete production also emits greenhouse gases, it has the potential to reduce emissions if carbon reduction strategies are implemented. Research suggests that emissions for pavements and buildings could fall dramatically with optimized concrete use.
3	Implementation Considerations: Location: The choice between asphalt and concrete depends on the local climate.	replacing conventional asphalt with cool options (such as reflective asphalt) is preferred due to its impact on reducing heat and emissions.	concrete pavements (whether reflective or not) perform better because of their rigidity at high temperatures.
4	Traffic Configurations:	conventional asphalt with cool options has impact on reducing heat and emissions.	Cool pavement strategies should be selected based on neighbourhood-specific factors like traffic patterns

2.11 Conclusions

Overall, the Lagos-Calabar Coastal Highway, beyond being just a road, it is a testament to collaboration, foresight, and commitment. The Lagos-Calabar Coastal Highway project (Section 2) stands on solid ground, supported by multiple pillars of assurance as outlined below:

- Social and Cultural Acceptance:
  - The project aligns with societal norms and cultural values.
  - Communities find it appropriate and acceptable.
- Technical Soundness:
  - Rigorous engineering design ensures technical feasibility.
  - The highway's construction and operation are sustainable.
- Environmental Considerations:
  - Environmental impact assessments have been thorough.
  - Mitigation measures are in place to minimize harm.
- Economic Viability:
  - Leveraging private sector resources and funding.
  - The project's financial sustainability is assured.
- Government Commitment:
  - Key ministries (Federal Ministry of Works, Federal Ministry of Environment, and Federal Ministry of Finance) champion the project.
  - Regulatory frameworks and flexible financing instruments are actively implemented.

CHAPTER THREE
PROJECT DESCRIPTION

3.0 Background Information

This chapter mainly focuses on Section 2 of the proposed Lagos Coastal Highway. It provides a concise overview of the project activities, facilities, equipment, operations, personnel, and the implementation schedule. Additionally, the chapter sheds light on the potential environmental and social impacts that may arise in different phases of the project.

3.1 Overview of the Overall Lagos-Calabar Coastal Project

The Lagos Coastal Road is a roadway project that aims to improve road connectivity along the coastline. It will run parallel to the coast, connecting various cities and towns, including Lagos, and other coastal areas. The road will primarily serve motor vehicles, including cars, buses, and trucks. It aims to reduce travel time, enhance trade, and improve access to coastal regions.

The Lagos-Calabar Coastal Highway Project is a monumental infrastructure initiative in Nigeria. The project involves constructing a modern road spanning approximately 700 kilometres.

It will connect Lagos (Nigeria's economic hub) to Calabar (a major coastal city).

Beyond Lagos and Calabar, the highway will link other major urban centers, industrial hubs, and seaports along the southern coast. By bridging key regions, the highway aims to enhance national connectivity. Access to major seaports and industrial centers will promote economic growth and development. The project promises to uplift living standards in the region.

The project goes beyond roads. It includes plans to incorporate rail lines within the median strips of the main roads. These integrated rail lines will provide seamless intermodal transport, allowing passengers and freight to transition smoothly between road and rail modes.

The ambitious highway project will revolutionize Nigeria's road network by connecting several major roads across the country: Lagos-Badagry Expressway Superhighway, Proposed Fourth Mainland Bridge, Lekki Deep Sea Port Road and Ogoja-Ikom Road (linking to points in Northern Nigeria). Table below shows Key Details of the Project Information.

Table 3.3: Key Details of The Project Information

S/No	Aspect*	Details
11.	Project Length	• Approximately 700 kilometres
12.	Rail Integration	• Rail lines within median strips of highways
13.	Number of Section of the Road	• 9
14.	Start and End of Section 2	• The first phase of the highway covers a 55.6kilometer section starting from Eleko in Lagos.
15.	Economic Impact of the coastal Road	• Boosting trade, industry, and livelihoods
16.	National Importance	• Enhancing Nigeria's coastal connectivity
17.	Construction and Features:	• It features five lanes on each side of the dual carriageway, with a train track running through the middle.
18.	Alignment Considerations:	• Eko Atlantic's Ahmadu Bello Road: The alignment starts here, running parallel to the coastline • Cross-State Connection: Extends across Ogun, Ondo, Delta, Bayelsa, Rivers, and Akwa Ibom States, terminating in Calabar, Cross River State. • Trans West African Highway Connection: Links with the Lagos-Benin-Enugu-Abakiliki-Ikom-Cameroon-Mombasa route.
19.	Ecological Considerations:	• Deflection to Avoid Sensitive Areas: The alignment avoids ecologically sensitive zones, such as mangrove swamps and turtle nesting areas.
20.	Existing Infrastructure/Utilities Considerations	• Avoidance of infrastructures/utilities like Telecommunication corridor (marine cables) that are existing along the proposed corridor. • Oil Pipelines: Existing pipelines influence the alignment in certain segments.

- **3.2 Proposed Project Location**

a. The Entire Proposed Project Alignment

The road starts from Lagos, near the Lekki Deep Seaport, and runs through several states: Lagos, Ogun, Ondo, Delta, Bayelsa, Rivers, Akwa Ibom and ends in Cross River State. The Lagos-Calabar

The project will be implemented in stages, allowing for incremental opening of completed segments for public use. Thus, the project will start with Section 2 which is the focus of this report.

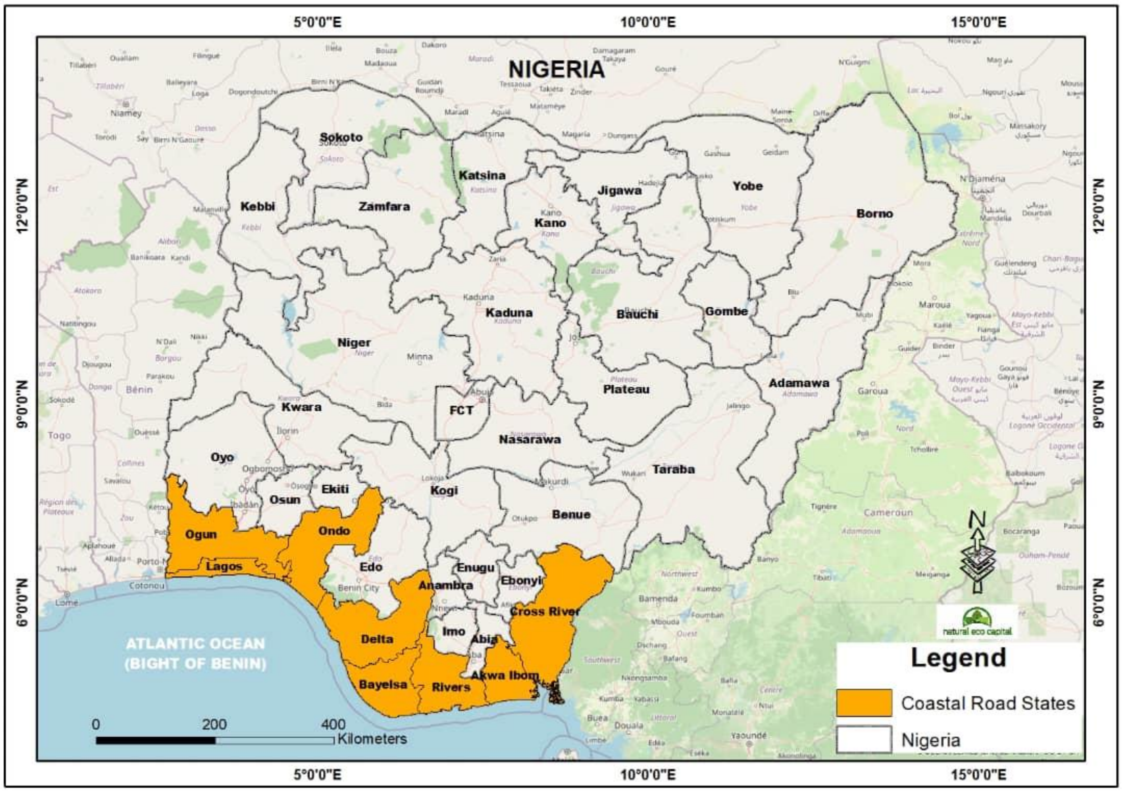


Figure 3.1 Nigeria Map showing the Coastal States of Project

b. Proposed Alignment (Section 2) of the Project

The alignment begins at **Eleko (47 km)** and terminates at Ode-Omi (104 km) for the Section 2 from Lagos to Ogun state, Nigeria.

This is initial phase spans 55.6 kilometres. It commences from **Eleko** and extends to **Ode-Omi**, a bustling commercial hub in Lagos, serves as the starting point. The highway then winds its way through the coastal landscape, connecting various regions. The journey culminates at **Ode-Omi**, which borders and connects with Ogun state.

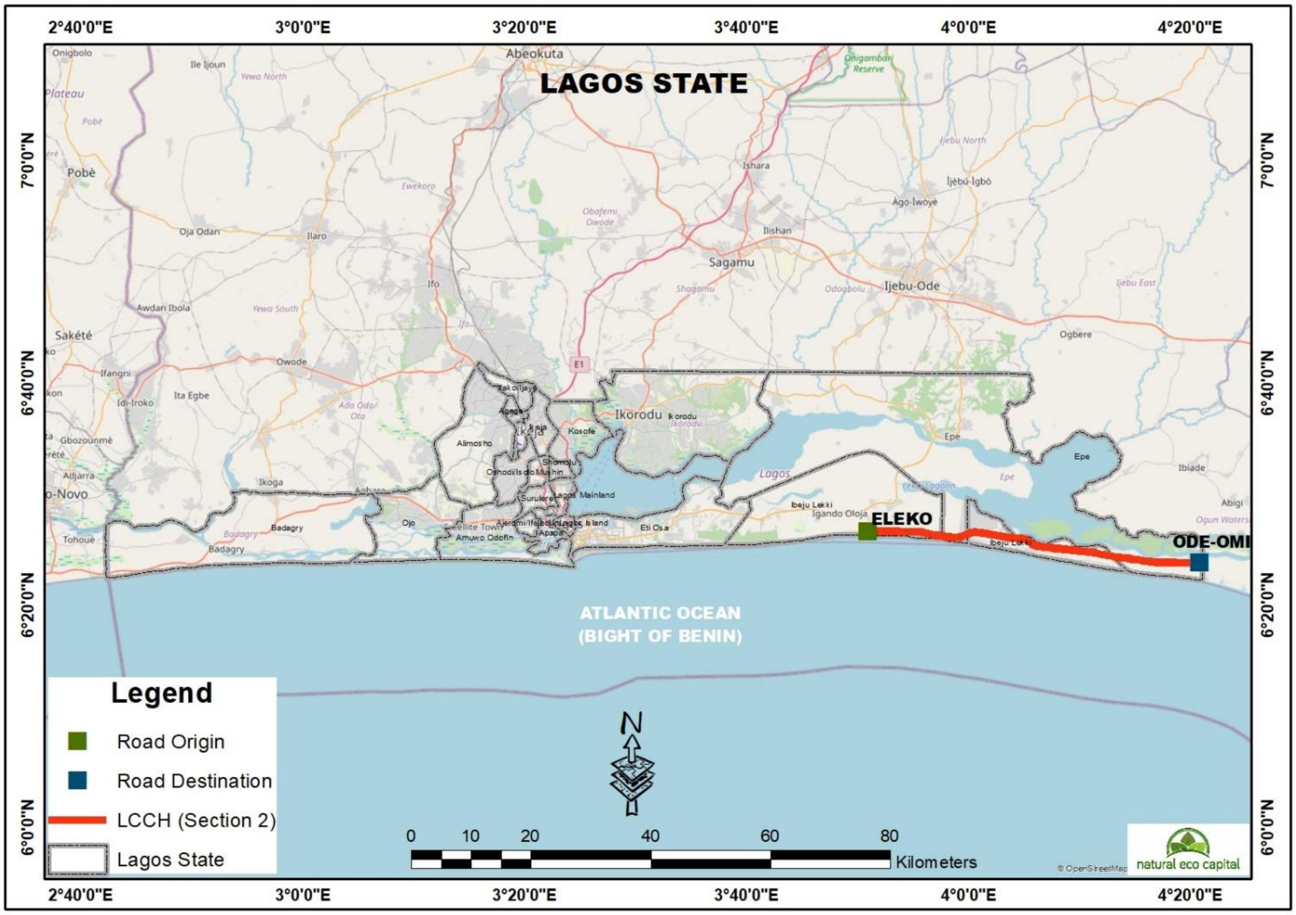


figure 3.2 proposed project alignment for section 2

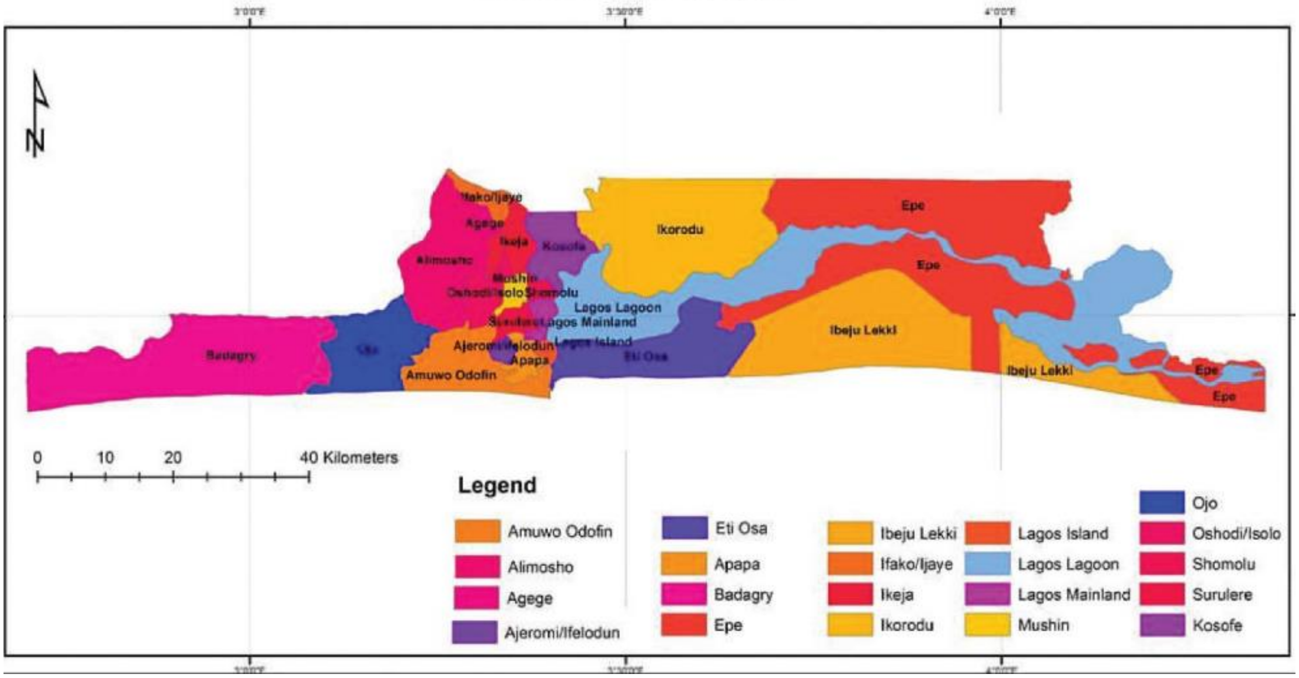


Figure 3.3 Map of Lagos showing the Local Government Areas.
Source: Ministry of Physical Planning.

- 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

The following are the tasks involved in road construction:

- Establish temporary access to work areas and create clearance zones while controlling access.
- Construct temporary diversions for roads that need upgrading to manage existing traffic.
- Clear and level the corridor and perform major earthworks such as cuttings and embankments.
- Locate and develop borrow pits and quarries, and import materials like gravel, clay, and
- bitumen as needed.
- Source and establish a water supply from surface and/or groundwater. - Improve existing drainage and introduce new road drainage, including culverts if necessary.
- Surface and seal the carriageway, including using bitumen mixing plants where applicable.
- Build water crossings such as bridges and culverts, including concrete batching for structures.
- Establish or improve safety arrangements such as modifying camber, barriers, and sight lines.
- Perform landscaping as needed.

Other tasks include:

- Set out, reference, and take cross sections
- Clear the site and remove topsoil
- Perform earthworks.
- Construct drainage structures such as box and pipe culverts, including protection works
- Construct the pavement, which includes bitumen surfacing, cement-stabilized base, and improved material sub-base
- Ensure the safe and convenient passage of traffic through works
- Provide road furniture such as signs, guardrails, marker posts, wire fencing, etc.
- Perform ancillary operations such as constructing offices, laboratories, and staff housing, accommodation works, diversion of services, operations in quarries and borrow areas, providing water supply, and diverting existing services.

3.3 Engineering/Geometric Design

Functional, safe and contextually appropriate roadways are created by integrating geometric designs. The proposed project considered the following objectives and considerations while designing. Geometric design shapes road for drivers, vehicles and traffic behavior. It balances safety, convenience and efficiency for road users. The geometric considerations for road design were based on the following:

1. **Location** - best route considering physical constraints and terrain.
2. **Alignment -** horizontal and vertical alignment of the road.
    - **Horizontal Alignment**:
        - Determines the road's lateral position.
        - Balances safety, comfort, and efficiency for drivers.

        - Considers curves, tangents, and transitions.
    - **Vertical Alignment**:
        - Defines the road's vertical profile (elevation changes).
        - Ensures smooth transitions between different grades.
        - Considers hills, valleys, and crests.
3. **Cross Section** - width of the road, lanes, shoulders, and medians.
    - Describes the road's width, lanes, shoulders, medians, and slopes.
    - Influences safety, drainage, and aesthetics.
4. **Intersections -** safe and efficient design.
5. **Highway Types -** function of the road (urban, rural, expressway, etc.).
6. **Simplicity**: Strive for straightforward geometry within physical limitations.
7. **Safety Margin**: Ensure consistent safety margins at expected operating speeds.
8. **Adequacy and Convenience**: Provide a facility that meets user needs under anticipated traffic conditions.
9. **Stability and Sustainability**: Design for long-term stability and minimal environmental impact.
10. **Harmony with Community**: Preserve natural and cultural resources while integrating with the community.
11. **Economic Returns**: Balance costs and benefits for an economically viable project.
12. **Context-Sensitive Design (CSD)**:
    - Collaborative approach involving all stakeholders.
    - Develops transportation facilities that fit their physical settings.
    - Preserves scenic, aesthetic, historic, and environmental resources.
    - Balances safety, mobility, and community needs.

- Road Design and Structural Standards

    - ***Methodologies and Standards***

Methodologies used in pavement design, earthworks, drainage and structures are in conformity with the latest international techniques to ensure economical use of available materials and a balance between capital and maintenance costs

Standards to traffic conditions:

1. **High Traffic Volumes**:

For roads with heavy traffic, higher design standards are necessary. These standards include:

- Wider Carriageways: To accommodate more vehicles.
- Gentle Curves: Easier for vehicles to navigate.
- Flatter Vertical Gradient: Reduces steep slopes.
- Full Overtaking Distances: Allows safe passing.

2. **Low Traffic**:

Roads with lower traffic volumes can have more modest design standards. These may include narrower lanes, simpler curves, and less extensive infrastructure.

Adapting Design to terrain

1. **Flat Terrain**:
    - Contours: 0-10 five-meter contours per kilometres.
    - Characteristics: Minimal elevation changes, suitable for straightforward road alignment.
2. **Rolling Terrain**:
    - Contours: 11-25 five-meter contours per kilometres.
    - Characteristics: Gentle slopes, moderate elevation changes.
    - Design considerations: Curves and transitions to accommodate rolling landscape.
3. **Mountainous Terrain**:
    - Contours: Above 25 five-meter contours per kilometres.
    - Characteristics: Steep slopes, significant elevation variations.
    - Design challenges: Address sharp curves, steep grades, and stability.

- ***Functional classification***

Adopted it the Federal Republic of Nigeria Highway Manual guidelines for existing and future road classification as outlined below which was adopted:

1. **Road Function**:
    - Relates to the primary purpose of the road.
    - Considers travel types, trips, and service characteristics.
    - Balances mobility (speed) and land access (low speeds).
2. **Design Criteria Alignment**:
    - Once the road's function is established, appropriate design criteria can be applied.
    - These criteria encourage the intended use of the road.
3. **Design Features for Classification**:
    - **Width of Roadway**: Reflects the road's capacity and intended use.
    - **Alignment Continuity**: Consistent alignment enhances safety.
    - **Intersection Spacing**: Varies based on road function.
    - **Access Points Frequency**: Influences mobility and convenience.
    - **Building Setbacks**: Considered for safety and aesthetics.
    - **Alignment and Grade Standards**: Tailored to road function.
    - **Traffic Controls**: Reflect road hierarchy and function.

- ***Geotechnical Design Criteria***

This section presents the design basis for the foundations of various proposed road structures, pavements, site class, subsurface concrete and evaluation of liquefaction potential of top-soil layers. The **geotechnical design criteria** play a crucial role in ensuring the stability and longevity of the Lagos-Calabar Coastal superhighway.

1. **Foundation Design**:
    - Geotechnical criteria guide the design of foundations for road structures.

- Proper foundation design ensures stability and load-bearing capacity.

2. **Pavement Design**:
   - Geotechnical considerations impact pavement thickness and material selection.
   - Adequate pavement design prevents premature deterioration.
3. **Site Class and Liquefaction Evaluation**:
   - Site classification helps assess soil behavior and seismic risks.
   - Evaluating liquefaction potential ensures safety during earthquakes.

- ***Design Hydrology and Design Return Periods***

1. **Hydrological Study**:

The purpose of the hydrological study was to compute and evaluate **peak discharges** for watercourse crossings. Key steps involved:

- **Site Observations**: Gathering data from the project site.
- **Condition Survey**: Assessing existing conditions.
- **Drainage Design Procedures**: Following guidelines from the design manual.
- **Peak Discharge Calculation**: Determining the required hydraulic opening sizes and waterway structure types.

2. **Preliminary Determination**:

Based on hydrological/hydraulic investigation and other relevant factors (such as geometric and subsurface soil properties), the **opening size** and **span** of drainage structures were preliminarily determined.

3. **Major Drainage Design**:
   - **Bridge Opening Size:**
     The hydrologist's recommendation guided the determination of the bridge opening size.
     - The span size was also determined based on hydrologic/hydraulic requirements.
   - **Free Board**:
     - The free board (vertical clearance above the water level) for bridge structures adheres to the Nigerian drainage design manual.

- Profile and Sections

- ***Cross-Section Elements***

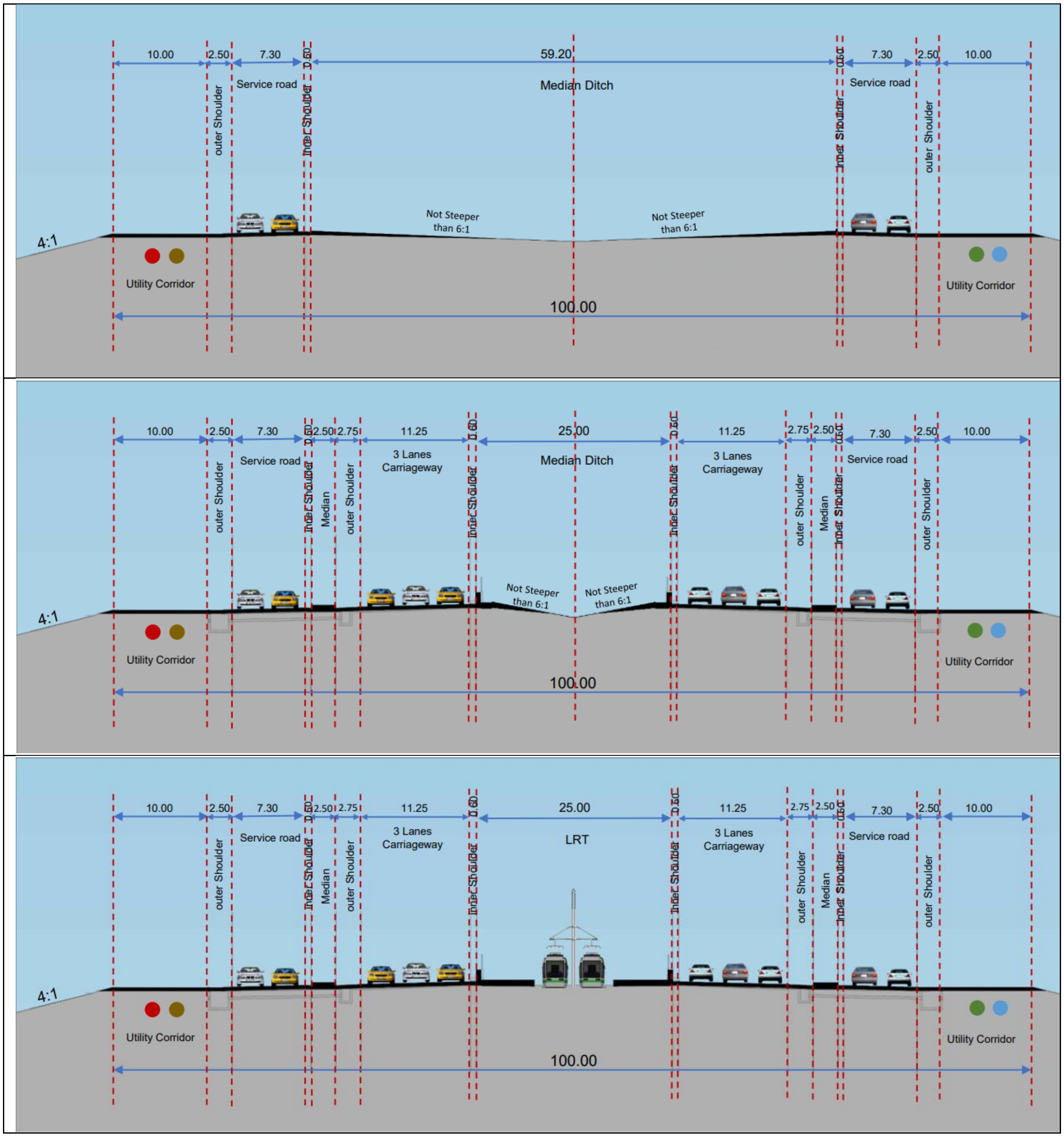


Figure 3.4 Typical Cross Sections

Description of the Coastal Road and Rail System Design Factors

Coastal rail station design

Coastal rail station design involves a delicate balance between aesthetics, functionality, and resilience. By addressing these considerations, designers create stations that enhance both travel experiences and coastal landscapes. When designing coastal rail stations, several crucial considerations come into play.

Design factors for the rail:

1. **Passenger Experience and Human-Centric Design**:

Experiential Focus: Modern rail stations prioritize passenger experience. Designers aim to create spaces that are more relaxed, cleaner, and simpler.

Efficiency and Flow: Efficient passenger flow is essential. Curved corners and clear wayfinding help travelers move comfortably without bumping into others.

2. **Transparency and Connection**:

Transparency: Coastal rail stations benefit from transparent elements like glass walls or ceilings. These allow natural light, views of the coastline, and a sense of openness.

Urban Connectivity: Stations should seamlessly connect with urban areas, integrating with other modes of transportation (buses, ferries, etc.) and nearby attractions.

3. **Thermal Comfort and Inclusiveness**:

Tropical Environment: designers must consider thermal comfort. Proper ventilation, shading, and materials play a role.

Inclusiveness: Design-for-all principles ensure that stations accommodate passengers of all abilities, including those with disabilities.

4. **Environmental Factors**:

Coastal Adaptation: Stations near the coast face unique challenges such as saltwater exposure, high winds, and potential flooding. Resilient design is crucial.

Wave Energy Dissipation: Coastal structures should dissipate wave energy to prevent erosion and damage.

Environmental Impact Assessment: Assessing the station's impact on the local ecosystem is essential.

5. **Structural Design and Geotechnical Aspects**:

Foundation Stability: Coastal soil conditions may vary. Proper geotechnical investigations ensure stable foundations.

Structural Resilience: Stations must withstand coastal weather conditions, including storms and saltwater corrosion.

6. **Maintenance and Monitoring**:

Regular Inspections: Coastal stations require frequent inspections due to exposure to salt, humidity, and wind.

Corrosion Protection: Materials and coatings should resist corrosion.

Emergency Preparedness: Coastal stations need contingency plans for extreme weather events.

3.4 Project Installation Details

The activities for the Installation of the Lagos-Calabar Highway shall include the following components:

- ***Pre Works Activities***

Earthworks shall include the following:

A. SITE CLEARING
Clearing and grubbing
B. Excavation
C. Soil filling and backfilling
D. Subgrade construction

Removal or Realignment of Obstruction and Utilities

The Project Contractor shall remove wholly or in part and dispose of all obstructions, buildings, fences, abandoned pipelines and others, as indicated on drawings or as directed by the Engineer. In some alignment on the path of the Project, and were indicated on the Drawings, utilities are to be realigned or salvaged as directed by the Engineer.

Excavation of topsoil and materials shall be a key activity.

In some cases, depending on the findings on the path, the excavation shall be for land-grading or for ground preparation as appropriate. The Excavation may be rock excavation or road excavation. The excavation operations shall be accompanied by utilization where possible or proper disposal of the excavated materials.

The above shall be followed by

ROADWORKS which shall include in this order

A. Granular subbase and base courses and subsurface drainage blanket system
B. Bituminous layers
C. Curbs, gutters, sidewalks and paved medians
D. Road signages
E. Pavement markings for traffic
F. Steel guardrail and concrete safety barrier
G. Concrete block pavement

WET UTILITIES for the Project and some general requirements to be installed shall include

A. Pipes, fittings and accessories
B. Bedding, surround, haunching, encasement and thrust blocks
C. Manholes, chambers inlets and gullies

CONCRETE AND STEEL WORKS are the major component of the Lagos- Calabar Project works to be executed and shall include:

A. Concrete and concrete mixes and testing
B. Concrete handling, placing and curing
C. Steel reinforcement and fixing
D. Forms, formwork and falsework building
E. Plain and reinforced concrete structures installation
F. Prestressed concrete construction

G. Concrete bridges & erection procedures
H. Reinforced concrete box culverts installation

- Proposed Engineering Works

Pavements

Pavements are the backbone of any road infrastructure, and their design is critical to ensure durability and cost-effectiveness. To achieve this objective, the proposed project adheres to the following principles:

- Objective of Pavement Design: Our primary goal is to select an economical pavement thickness and quality of materials, limit stresses in the subgrade due to anticipated traffic loads and ensure that pavement layers remain serviceable throughout the design period.
- Design Inputs: To accomplish the objective of pavement design, we must consider the following inputs: - Design Subgrade Strength: Determines the load-bearing capacity of the subgrade. - Design Traffic Class: Considers the expected traffic volume and type. - Material Availability: Sufficient construction materials are essential.
- Pavement Thickness Design: To design the pavement thickness, we follow the Nigerian Federal Highway Manual Part 1 (2013) guidelines. We also consider the traffic catalogue (Tn) and subgrade strength catalogue (Sn). The manual accounts for experience and current country conditions. By following these principles, we can ensure that the pavement is durable, cost-effective, and can withstand the anticipated traffic loads.

Hydraulic

The hydraulic concept for the project is designed to ensure the road benefit the users and the environment. The hydraulic design of any road project is a critical aspect that needs to be carefully considered. This involves evaluating the existing hydraulic structures, such as bridges and culverts, and assessing their adequacy, economy, and sustainability. It is important to consider site conditions and design discharge to ensure that the project is effective and sustainable. When it comes to waterway design, the size of openings for drainage structures must be determined to handle flood runoff and the volume of runoff passing through watercourse crossings.
The selection of drainage structures is based on site-specific needs, taking into account factors like flow rate, water volume, and environmental impact.

3.4.1 Engineering Design and Nigerian Content

- **Options Selection and Project Definition Studies**:
  - These critical early-stage activities carried out entirely in Nigeria.
  - Feasibility studies, site selection, soil tests (essential for foundation design), and other preliminary data gathering conducted locally.
  - Nigerian companies will handle process study reporting, risk analysis, and preliminary engineering studies.
- **Detailed Engineering Design for General Facilities**:
  - The detailed design work for general facilities domiciled in Nigeria.
- **Fabrication**:

- **In-Country Fabrication**:
  - All fabrication work related to piles, pipe racks, and bridges (including galvanizing) will take place within Nigeria.
  - Third-party services, such as mechanical tests and certification of welding procedures and welders, will also be carried out locally.
  - The relevant Nigerian Institute, in collaboration with international accreditation bodies, will certify these tests.
- **Construction**:
  - **Site Preparation and Infrastructural Development**:
    - Nigerian companies will be responsible for site preparation and developing necessary infrastructure.
  - **Civil/Structural, Piping, and Mechanical Construction**:
    - Competent Nigerian companies (or their foreign affiliates) will handle civil/structural, piping, and mechanical construction.

- **Selection of Contractors and Vendors**:
  - The Federal Government is committed to empowering more Nigerians and Nigerian companies. Ensure services that can be effectively carried out by Nigerian vendors, either independently or in collaboration with other companies.
  - Ensure **Quality Assurance through** Bids maximizing local content without compromising job quality will be prioritized.
  - Give **Financial Consideration** for Bids within 1% of the best commercial qualifying bid will receive special attention.
- **Fabrication of Structural Fittings**:
  - **Local Service Companies and Mills**:
    - Leveraging existing local resources, 45% of pipe spools will be sourced from within Nigeria.

- **OUTDOOR AND ROAD LIGHTING INSTALLATIONS**

The proposed project will ensure proper planning, design, and execution of critical components that include electricity. Designing a solar road lighting system involves several critical components and considerations. A well-designed solar road lighting system can significantly reduce energy costs, enhance safety, and contribute to sustainable infrastructure

The following key aspects have been taken into consideration:

1. **Outdoor and Road Lighting Installations**:
   - This includes the installation of luminaires (light fixtures) along the roadways and outdoor areas.

- Luminaires are essential for providing visibility and safety during night-time or low-light conditions.
- Proper placement and design of these fixtures are crucial to ensure effective illumination.

2. **Earthing**:
    - Earthing (also known as grounding) involves connecting electrical systems to the ground to prevent electrical hazards.
    - It ensures safety by dissipating fault currents and preventing electric shock.
    - Proper earthing is essential for road lighting systems to protect against lightning strikes and other electrical faults.
3. **Builder’s Works**:
    - Builder’s works refer to the construction activities necessary for the successful implementation of the project.
    - In this context, it includes tasks such as:
        - Column foundations: Constructing stable foundations for lighting columns.
        - Cable pits: Excavating and installing pits for cable management.
        - Cable trenches: Creating pathways for electrical cables.
        - Ductwork: Installing conduits or ducts for cable routing.
4. **Testing and Additional Requirements**:
    - Rigorous testing and commissioning are essential to ensure that the lighting system operates as intended.
    - Compliance with safety standards and regulations is crucial.
    - Additional requirements may include specific performance criteria, energy efficiency, and maintenance guidelines.
5. **Electrical Installation Equipment Data**:
    - This involves documenting details about the electrical equipment used, including specifications, ratings, and installation locations.
    - Proper record-keeping facilitates maintenance and future upgrades.
6. **Rehabilitation of Existing Utilities**:
    - If there are existing electrical and telecom utilities along the Lagos-Calabar Superhighway, they may need relocation or removal.
    - This ensures that the new lighting system can be seamlessly integrated without disrupting existing infrastructure.
7. **Road Crossing Ducts/Service Ducts**:
    - These ducts are designed for future expansion of the electrical and telecom network.
    - The specified dimensions (4x160mm for electrical and 4x110mm for telecom) indicate the size of the ducts.
    - They allow for the installation of additional cables or fiber optics as needed.
8. **LED Luminaires**:
    - LED luminaires are energy-efficient light fixtures that use light-emitting diodes (LEDs) as the light source.
    - Compliance with standards such as BS EN62722-1, BS-EN62722-2-1, BS EN13032-4, and IEC60598 ensures quality and performance.

- LED luminaires offer benefits like longer lifespan, reduced energy consumption, and better color rendering.

9. **Photovoltaic (PV) Panel/Modules and Mounting Structure**:
   - PV panels (solar panels) capture sunlight and convert it into electricity.
   - Proper mounting structures ensure optimal positioning for maximum solar energy absorption.
   - The panels should withstand environmental conditions, including UV exposure and temperature variations.
10. **Charge Controller**:
   - The charge controller regulates the charging and discharging of batteries connected to the PV panels.
   - It prevents overcharging and ensures efficient battery management.
11. **Converter (Inverter)**:
   - The converter (inverter) converts the direct current (DC) generated by the PV panels into alternating current (AC) for powering the LED luminaires.
   - It must be reliable and efficient.
12. **Batteries and Enclosures**:
   - Batteries store excess energy generated during the day for night-time operation.
   - Enclosures protect batteries from environmental factors and ensure safety.
13. **Interconnecting Wires and Cables**:
   - High-quality wires and cables connect all components, including PV panels, charge controllers, batteries, and luminaires.
   - Proper sizing and insulation are crucial for minimizing energy losses.
14. **Lighting Columns**:
   - Concrete columns with double brackets provide structural support for mounting LED luminaires.
   - The design should consider wind loads, aesthetics, and ease of maintenance.
15. **Environmental Conditions**:
   - The system must withstand high temperatures (up to 40°C) and humidity (100%) during direct sunlight exposure.
   - UV resistance is essential due to the high content of ultraviolet rays.
16. **Qualified Installation**:
   - Qualified personnel would handle the installation to ensure safety and compliance.
   - Integration with other works (such as road construction) is crucial for seamless operation.
17. **Local Codes and Regulations**:
   - Adherence to local codes of practice, power authority regulations, and international standards is essential.
   - Confirm system earthing requirements with the local power authority.

EARTHING SYSTEM

Proper earthing and bonding are critical for electrical safety. Compliance with local codes, regulations, and international standards is essential. The essential aspects of earthing and equipotential bonding in electrical installations:

1. **Main Earthing Terminals or Bars**:
   - These serve as central points for connecting all earthing conductors.
   - The main earthing terminal (MET) or earthing bar provides a low-resistance path to the ground.
   - It ensures that fault currents are safely directed away from electrical equipment and structures.
2. **Exposed Conductive Parts of Electrical Equipment**:
   - Exposed conductive parts include metal enclosures, frames, and other components of electrical equipment.
   - These parts must be effectively earthed to prevent electric shock hazards.
   - Proper earthing ensures that any fault current flows directly to the ground, minimizing the risk to users.
3. **Extraneous Conductive Parts**:
   - Extraneous conductive parts refer to metallic elements that are not part of the electrical system but can become energized during faults.
   - Examples include metal pipes, ducts, and structural elements.
   - Bonding these parts to the earth ensures that they remain at the same potential as the equipment, reducing the risk of electric shock.
4. **TN-S System Arrangement**:
   - The TN-S system is a common earthing arrangement.
   - In this system:
     - "T" stands for "terre" (earth), indicating that the neutral (N) and earth (E) are separate.
     - "N" is the neutral conductor.
     - "S" represents the protective earth (ground) conductor.
   - The TN-S system ensures that the neutral and earth are distinct, enhancing safety.

- ***3.4.2 Construction Method and Materials (new placement)***

5. **Design Considerations**:
   - The project aims to utilize all available technology and resources.
   - Key factors include **simple techniques**, readily available construction materials, and efficient labour input.
6. **Structural Materials**:
   - **Reinforced Concrete (RC)**:
     - All super structural and sub structural elements will be constructed using reinforced concrete.
   - **Reinforcement Steel**:

- Grade 60 reinforcement steel for bars with a diameter equal to or greater than 20mm.
- Grade 40 steel for bars with a diameter less than 20mm.
- Minimum yield strength: 420MPa for grade 60 and 300MPa for grade 40.
- Minimum clear cover for reinforcing bars will be as recommended and shown on drawings.

7. **Concrete**:
   - **Superstructure**:
     - Design parameters for C-30 concrete will be used in structural computations.
     - Compressive strength: 30MPa for 150mm cube samples and 25MPa for 150mm cylindrical samples.
   - **Substructure (Plain Concrete Leveling)**:
     - C-15 class of concrete will be used.
     - Compressive strength: 15MPa for 200mm cube samples and 10MPa for 150mm cylindrical samples.
     - These parameters are specified in design drawings and technical specifications for attainment during the construction stage.
8. **Resistance Factors**:
   - To account for imperfections in production, resistance factors are recommended.
   - Appropriate factors for shear and bending moment of structural components were considered during the design phase.

3.4.3 Independent Verification and Certification

By involving independent experts, the project aims for excellence, safety, and adherence to standards. The commitment to **independent verification and certification** is crucial for ensuring the quality and compliance of the Lagos coastal road project.

1. **Third-Party Experts**:
   - The **Federal Ministry of Works** will engage independent third-party experts.
   - Their role is to **witness, audit, and participate** in all project aspects.
   - These experts will verify that the engineering work aligns with relevant **international and national codes and standards**.
2. **Scope of Verification**:
   - The verification process covers various stages:
     - **Design**: Ensuring the project design meets quality standards.
     - **Fabrication**: Verifying the quality of materials and components.
     - **Installation**: Checking proper installation procedures.
     - **Pre-commissioning**: Ensuring readiness for operational use.
     - **Handover**: Validating compliance during project handover.
3. **Surveillance and Verification**:

- **Manufacture, Fabrication, and Installation**:
  - Surveillance activities will monitor these critical phases.
  - A third party, in collaboration with **State Government representation**, will oversee the process.
  - This approach enhances transparency and accountability.

3.5 Project Phases

A comprehensive and well-articulated phased approach ensures a well-executed project with lasting benefits for stakeholders. Hence the articulated project phases plan is outlined below:

3.5.1 Mobilization or Pre-construction Phase:

The activities during this phase include:

- **Project Components Assessment**:
  - Evaluate the road design, including road surface specifications, crossings (bridges, culverts), drainage structures, and safety features.
  - Identify the road reserve ("hard shoulder") and other necessary elements (signage, lighting).
- **Ancillary Facilities Planning**:
  - Plan lay-bys or service areas for rest stops and maintenance.
  - Establish temporary construction facilities (workshops, laydown areas, workers' accommodation).
  - Determine security post locations.
  - Design access roads within and between temporary facilities and the road being developed.
  - Consider landscaping features for aesthetics and environmental impact.

- **Key Activities Include**:
  - **Planning**: Detailed project planning takes place.
  - **Feasibility Study & Engineering Design**: Assessing technical feasibility and designing the road.
  - **Procurement of Works**: Acquiring necessary materials and services.
  - **Securing Bonds & Insurances**: Ensuring financial security.
  - **Land Acquisition & Clearing**: Obtaining land rights and clearing the construction site.
  - **Worksite Organization**: Setting up camps, workshops, and schedules.
  - **Resource Allocation**: Identifying and organizing essential resources.
  - **Land Dispossession & Property Evaluation**: Addressing land ownership changes.
  - **Relocation & Compensation Arrangements**: Managing affected communities.

3.5.2 Construction Phase:

The heart of the project is where physical construction occurs. The activities during this phase include:

- **Earthworks and Clearing**:
  - Clear the construction site and remove topsoil.
  - Perform major earthworks, including cuttings and embankments.
- **Materials Sourcing and Import**:
  - Locate and develop borrow pits and quarries.
  - Import materials such as gravel, clay, and bitumen.
- **Infrastructure Installation**:
  - Establish water supply from surface and/or groundwater.
  - Improve existing drainage and introduce new road drainage (culverts if needed).
  - Surface and seal the carriageway using bitumen mixing plants.
  - Construct water crossings (bridges, culverts).
  - Enhance safety arrangements (modify camber, barriers, sight lines).
  - Perform landscaping as needed.
- **Monitoring and Quality Control**:
  - Set out, reference, and take cross sections.
  - Monitor construction progress and adherence to specifications.
- **Other Tasks Include**:
  - Scarification of Failed Sections: Repairing damaged road segments.
  - Stone Base Provision: Laying a stable foundation.
  - Prime Coat Application: Preparing the surface for asphalt.
  - Asphalt Overlay/Construction: Paving the road.
  - Shoulder Reinstatement: Ensuring proper road edges.
  - Concrete Lined Drains & Earth Drains Construction: Managing water flow.
  - Bridge Construction & Maintenance: Building bridges along the route.
  - Dredging, Excavation, De-watering, and Sand filling: Preparing the terrain.
  - Crushed Stone Base Placement: Creating a solid base.
  - Cement Stabilization of Base Course: Strengthening the foundation.
- **Closure of Construction Phase**:
  - The final steps before operational use.
  - Focus on quality roads and environmentally responsible site management.

3.5.3 Operation and Maintenance Phase:

After construction, the road becomes operational, meeting transportation needs of the communities and various stakeholders. Toll collection may begin to recoup the investment. Regular monitoring and maintenance to ensure sustainability shall be implemented. During

the operation phase, road maintenance shall be prioritized to ensure safety, functionality, and longevity.
The key considerations in this phase shall include:

- **Regular Inspections**:
    - Scheduled inspections to assess road conditions, identifying areas needing attention.
    - Focus on high-traffic sections, vulnerable spots (such as bridges), and safety features (signage, barriers).
- **Emergency Repairs**:
    - Address urgent issues promptly, such as potholes, damaged guardrails, or collapsed drainage structures.
    - Emergency repairs prevent accidents and minimize disruptions.
- **Routine Maintenance**:
    - Regularly clean debris, remove vegetation, and repair minor defects.
    - Maintain road markings, signs, and lighting for visibility and safety.
- **Pavement Management**:
    - Prioritize pavement rehabilitation based on condition assessments.
    - Address cracks, rutting, and surface distress to prevent further deterioration.
- **Drainage Systems**:
    - Keep drains clear to prevent water accumulation and erosion.
    - Address clogged culverts and blocked ditches.
- **Safety Features**:
    - Ensure guardrails, crash barriers, and reflective markers are intact.
    - Repair damaged safety elements promptly.
- **Budget Allocation**:
    - Allocate funds based on critical needs and available resources.
    - Balance preventive maintenance with reactive repairs.
- **Community Feedback**:
    - Engage with road users and local communities.
    - Address reported issues promptly.
- **Performance Metrics**:
    - Monitor road performance (ride quality, skid resistance, load-bearing capacity).
    - Use data to prioritize maintenance tasks.
- **Long-Term Planning**:

Plan for major rehabilitation or reconstruction cycles.

- Consider life-cycle costs and sustainability.

3.5.4 Decommissioning Phase:

While unlikely, if decommissioning occurs, it will involve **upgrading or rehabilitation** rather than abandonment. The focus is on **maintaining and improving** the road rather than dismantling it.

- **Specific Actions**:

- **Temporary Facilities Decommissioning**:
  - Close down temporary facilities such as workshops, laydown areas, and workers' accommodations.
  - Ensure proper removal of equipment and materials.
- **Restoration of Disturbed Areas**:
  - Restore any land disturbed during construction to its natural state.
  - Replant vegetation, stabilize slopes, and address erosion.
- **Project Evaluation**:
  - Evaluate the overall success of the project.

3.6 Project Resources

- ***Mechanized Equipment and Types***

The fleet of mechanical equipment required for the project and the technical specifications of the batching plant:

1. **Fleet of Mechanical Equipment**:
   - The project will utilize a range of heavy construction equipment to facilitate various tasks.
   - These equipment types include excavators, bulldozers, cranes, loaders, and more.
   - Each machine serves a specific purpose in construction, such as earthmoving, lifting, or material handling.

The list of the fleet of mechanical equipment to be used for the construction phase of the project is presented in the Table below:

Table 3.4: List of Fleet of mechanical Equipment and Usage

S/N	DESCRIPTION	TYPE	SUPPLIER	USAGE	QTY
1	CAT DOZER D6GC LGP ne	CAT	CAT	*CLEARING*	3
2	VOLVO EXCAVATOR 350	VOLVO	VOLVO	*CLEARING*	7
3	VOLVO DUMPER A40	VOLVO	VOLVO	*CLEARING*	2
4	VOLVO DUMPER A45	VOLVO	VOLVO	*CLEARING*	5
5	SOIL COMPACTOR ROLLER 21T CA 610P/DYNA	DYNA	DYNA	*LAYERWORKS*	1
6	SOIL COMPACTOR ROLLER 12T/DYNA CA25P	DYNA	DYNA	*LAYERWORKS*	8
7	VOLVO DUMP TRUCK WATER TANKER 25,000 LT	VOLVO	VOLVO	*LAYERWORKS*	8
8	SINO WATER TANKER 6X4 CNG , 20,000L	SINO	SINO	*LAYERWORKS*	6

9	SINO TRACTOR 6X4 CNG	SINO	SINO	*STEEL SUPPLY*	14
10	FLATBED 3 AXLE 50T	SINO	SINO	*STEEL SUPPLY*	13
11	SINO TRANSIT MIXERS CIMC 9CUB CNG	SINO	SINO	*KERBING AND BARRIRES*	24
12	GRADER SDLG 9290-23t/20.5x25	SDLG	SDLG	*LAYERWORKS*	4
13	PNEUMATIC ROLLER 24T/DYNA CP275	DYNA	DYNA	*LAYERWORKS*	3
14	WIRTGEN WR 240	WIRTGEN	WIRTGEN	*CRCP*	2
15	WIRTGEN SP25	WIRTGEN	WIRTGEN	*BARRIER AND KERB*	3
16	WIRTGEN PAVER SP124	WIRTGEN	WIRTGEN	*CRCP*	2
17	WIRTGEN TCM 180	WIRTGEN	WIRTGEN	*CRCP*	2
18	WIRTGEN CONCRETE PLACER WSP 102	WIRTGEN	WIRTGEN	*CRCP*	2
19	WRITGEN Darin Mold	WIRTGEN	WIRTGEN	*CRCP*	
20	WRITGEN Jersey Mold	WIRTGEN	WIRTGEN	*BARRIER*	2
21	WRITGEN Curb Mold	WIRTGEN	WIRTGEN	*CURB*	2
22	WRITGEN Insert Mold	WIRTGEN	WIRTGEN	*INSERT*	1
23	MAN Truck 6x6 Cement Spreader	MAN	MAN	*LAYERWORKS*	2
24	SINO TIPPER 8X4 21 CUB CNG	SINO	SINO	*LAYERWORKS*	40
25	XCMG CRANE 30 Tones Rough Terrain	XCMG	XCMG	*STEEL LIFTING*	2
26	HI-UP 15T 6X4 SINO/ XCMG /CNG	SINO	SINO	*TRANSPORT STEEL*	1
27	SINO TAR BOILER 10,000LTRS	SINO	SINO	*PRIME LAYER*	1
28	BOBCAT SKIDTEER	BOBCAT	BOBCAT	*PRIME LAYER*	4
29	BOBCAT ANGLE BROOM 173CM	BOBCAT	BOBCAT	*BROOMING PRIME LAYER*	4
30	MOBILE BATCH PLANT SPANOS 135m3	SPANOS	SPANOS	*SUPPLY OF CONCRETE*	4
31	Mobile Horizontal Silos 80t	SPANOS	SPANOS	*SUPPLY OF CONCRETE*	12
32	VOLVO PAYLOADERS L120GZ	VOLVO	VOLVO	*SUPPLY OF STONE TO BATCH PLANT*	4
33	JCB/TLB	VOLVO	VOLVO	*BACKFILLING*	4
34	MIKASA WALKBEHIND ROLLER	MIKASA	MIKASA	*BACKFILLING*	2

35	PICK UP TOYOTA HILUX	TOYOTA	TOYOTA	*TRANSPORT*	8
36	SINO 4X2 DIESEL TANKER 15,000 LTRS	SINO	SINO	*LAYERWORKS*	1
37	DIESEL TANKER BOWSERS	SINO	SINO	*SUPPLY OF DIESEL ON SITE*	1
38	Volvo FM4X2 Complete Mobile Workshop	SINO	SINO	*MAINTENANCE MACHINES ON SITE*	1
38	LIGHT TRUCK	TATA	TATA	*TRANSPORT GOODS*	2
39	LOW BED	SINO	SINO	*TRANSPORT HEAVY MACHINERY*	1
40	GENERATOR 250 KVA NIGHT SHIFT	CAT	CAT	*BATCHPLANT SUPPLY AND OFFICES*	3
46	Tower Lights	CAT	CAT	*TEMPORARY LIGHTING*	6

2. **Technical Specifications of the Batching Plant**:
   - The batching plant is a critical component for concrete production.

The specific technical details for the batching plant are presented below:

1. ***equipment using this table below (remove what is irrelevant)***

S/N	DESCRIPTION	TYPE	SUPPLIER	USAGE	QTY
1	Batching Plant 135 M3/H	SPANOS	SPANOS	CONCRETE	4
2	Batching Plant Aggregate Pre-Feeding Belts (Radial Type)	PAYLOADER	VOLVO	SUPPLY AGGREGATE	4
3	Batching Plant Silos	SPANOS	SPANOS	CONCRETE	12
4	Water Chiller System: Icw180 For Batching Plant - 15 M3/Hour	SPANOS	SPANOS	CONCRETE	4
5	Cement Air Compressor Electrical (Offloading From Bulk Truck)	SPANOS	SPANOS	CONCRETE	4

2. **Specific technical details for the batching plant:**

i. Model: ……SPANOS 135 M3…………………………………………………….
ii. Capacity ………1080 M3 PER DAY…………………………………………….
iii. Mixer Type: ……DRUM TYPE ………………………………………………….
iv. Mixer Capacity (Compacted Concrete) …3 M3……cubic meters per cycle
v. Mixer Power: ……300………kW
vi. Aggregate Hoisting Machine: ……………………………………………………
vii. Belt Conveyor: ……………………………………………………….
viii. Water Pump: …TEMPAX……………………………………………………
ix. Cement Weighing Capacity:2000 KG……………
x. Water Weighing Capacity: 1000 LITERS………………………………………

xi. Additive Weighing Capacity: …105 LITERS…………………
xii. Cement Screw Conveyor: ……………………………………………………….

3.6.1 Materials Management

Managing material acquisition efficiently is crucial for construction projects. In fact, efficient material acquisition and storage contribute to smooth project execution and cost-effectiveness.
The type of materials and volumes of materials required for project briefly described below:

1. **Storage and Usage**:
   - Materials will be stored at the **General Support Yard** until they are used for both **concrete production** and **construction site activities**.
   - This approach ensures proper inventory management and timely availability.
2. **Local Sourcing**:
   - The materials will be **locally sourced** from different quarries and suppliers in the region.
   - Local procurement reduces transportation costs and supports the regional economy.
3. **Volume Estimates**:
   - The table below provides an overview of the estimated volumes of materials required for the project.
   - These materials include aggregates, cement, water, and other essential components.

Table 3.3: Volumes of materials required

Materials	Quantity (tons)	Volume (m^3)	Supplier	Supplier Location
Pipes 600 Dia	80218	No	Hitech	Eko Atlantic Eko Ekete
Pipes 900 Dia	2250	No	Hitech	Eko Atlantic Eko Ekete
Steel Reinforcement	58459	Tons	African Foundaries	Ibadan
Cement (Bulk)	463,766.61	Tons	Dangote	Ibadan
Cement (Bags)				
Granite	622,542.93	Tons	Ratcon	Ibadan
Sand (for Concrete)	451,035.20	m^3	Local Suppliers	Epe
Sand (for Stabilized Filling)	488,838.42	m^3	Local Suppliers	Epe
Sand (Filling)	15,919,683.73	m^3	Local Suppliers	Epe
Stone Base	488,838	m^3	Ratcon	Ibadan

TABLE 3.4: MATERIAL TRANSPORT

Material Transported	Location (from where to where	Tons	Average Truck/Vessel capacity	Frequency
Concrete	Eko Akete to site	2479464.00 tons	40 ton	4 times per day
Reinforcement Steel -	African Foundries	58459 tons	30 ton	3 times per day
Sand and stone base for filling –	Eko Akete	31839367.00 tons	40 ton	5 times per day
Bulk Cement Delivery Supplier	Dangote	463,766.61 tons	30 ton	1 per day
Stone Base – Quarry X to General Storage Yard	Ratcon	1173211.00 ton	45 ton	1 per day
Diesel		9,337,885.97 Liters	30000 liters	1 per day
Offshore	Dredging International	26000.00 tons	26 000 ton	4 times per day
Please, provide				

3.6.2 Traffic Management

During the construction period, managing project traffic is crucial to ensure safety, efficiency, and minimal disruption. Some key aspects related to project traffic management include:

1. **Delivery and Removal of Mechanized Fleet**:
    - The movement of mechanized equipment (such as excavators, cranes, and bulldozers) to and from the project location is essential.
    - Proper coordination ensures timely delivery and efficient removal.

2. **Operation of Mechanized Fleet Along the Alignment**:
    - While construction is on-going, the mechanized fleet operates within and along the alignment.
    - Traffic control measures are necessary to prevent conflicts with other vehicles and pedestrians.
3. **Raw Material Delivery to Batching Plant and Construction Site**:
    - Raw materials (such as aggregates, cement, and water) are delivered from supplier sources to the **batching plant**.
    - Upon concrete production, these materials are transported to the **construction site**.
4. **Dredging of Sand from the Sea for Alignment Filling**:
    - Dredging involves extracting sand from the sea to fill the alignment.
    - Proper traffic management ensures safe movement of dredging equipment and trucks.

5. **Material Supply Vehicles**:
   - Heavy motor vehicles (dump trucks, cement trucks, water tankers, flatbeds, barges, and tugboats) are used for material supply.
   - These vehicles traverse between material sources and points of use (such as batching plants and construction sites).
6. **Onshore and Offshore Material Supply Traffic**:
   - The primary material supply traffic occurs between **ancillary sites** (support yards) and the **construction site**.
   - Both onshore and offshore transportation routes are considered.

In summary, effective traffic management shall be ensured to minimizes disruptions, ensures safety, and supports smooth project operations.

3.6.3 Raw Materials and Hazardous Materials

Raw Materials

These include:

- **Fine-grained soil**: Used for roadbed preparation and stabilization.
- **Gravel**: Essential for road base layers and drainage.
- **Blocks**: Used in structures like retaining walls and bridges.
- **Laterite**: A locally available material used for road construction.

These raw materials form the **building blocks** of the road.

The sand for filling shall be **sourced from the Atlantic Ocean/sea**. Proper sourcing and utilization of these materials contribute to efficient and sustainable construction.

Table 3.5 Estimated Quantities of Materials

ITEM	Unit	Quantity	NOTES
Cut	m3	4,002,058	
Fill	m3	Up to 17 million	
CRCP Service Lanes (Phase 1)	m3	290,400	2 lanes for each direction for main road (Shoulders are not paved)
Base &Subbase (Phase 1)	m3	441,600	icluding shoulders
CRCP Main Carriageways (Phase 2)	m3	390,000	3 lanes for each direction for main road + 2 lanes for service road (Shoulders are not paved)
Base &Subbase (Phase 2)	m3	656,640	including shoulders
Number of Streetlight	Number	2,377	
Interchanges	Number	4	

3.6.4 Hazardous Materials

The storage and management of fuel and lubricants during the construction and operation phases of the project would include:

1. **Fuel and Lubricant Storage**:
   - The operation of mechanized equipment requires the use of **fuel (diesel and petrol) and lubricants (oils and greases).**
   - These materials will be stored in the **General Support Yard.**
   - Specifically:
     - **Oils and Greases**: These will be supplied by an oil distributor in drums and stored in a designated container.
     - **Refueling Tanker**: The refueling tanker will be refilled at a tank located in the General Support Yard.
     - The installation of this tank meets the supplier's criteria, including **retention tank** requirements for fire safety.

3.6.5 Materials Supply -Local Content and Sourcing

Local content and sourcing for the project are considered essential for achieving the project outcomes. Integrating local resources and suppliers contributes to sustainable development and community engagement.

1. **Local Content**:
- Utilizing local resources, expertise, and labour fosters community involvement and economic development.
- When local communities participate in the project, it creates jobs and supports livelihoods.
- Local suppliers play a crucial role by providing materials and services.
- Overall, promoting local content strengthens the regional economy.

2. **Local Sourcing**:
- The project prioritizes sourcing materials locally within Nigeria.
- While local sourcing is emphasized, trans-state movement may occur based on specific material needs.
- Materials like crushed rock, gravel, sand, and clay are essential for road construction.
- By sourcing locally, the project reduces transportation costs and supports local industries.

▪ *3.6.6 Water Management and Supply*

Water is vital for various construction activities, including:

- Concrete preparation: Water is a key ingredient in concrete mixing.
- Dust control: Water helps suppress dust during construction, improving air quality.
- Cooling machinery: Water is used to cool equipment and prevent overheating.

Water supply and management is crucial for the construction project, especially in Lagos with varying water availability.

Outline below are the potential water needs/uses of the project

1. **Sources of Water Supply:**

- **Boreholes**: Boreholes will be drilled at the General Support Yard to meet the project's water needs.
- **Storage**: Pumped water will be stored in dedicated tanks.
- **Quality Assurance**: Water analysis campaigns will ensure its portability and suitability for concrete manufacturing.
- **Monitoring**: Groundwater levels and quality will be monitored at abstraction points.

2. **Drinking Water**:
   - The daily demand for **drinking water** at the support yard and sites is 5000 **liters** for the workforce.
   - Water treatment plants, including **sedimentation**, **rapid sand filters**, and **disinfection stages**, will ensure water quality and supply for the workforce.

The water demand for various project activities:

1. **Concrete Batching Plant**:
   - The concrete batching plant requires 200,000 **cubic meters per day** for mixing concrete.
   - Water is essential for the hydration process during concrete production.
2. **Batching Plant Cleaning and Maintenance**:
   - Cleaning and maintaining the batching plant consume 100,000 **cubic meters per day**.
   - Proper cleaning ensures efficient operation and prevents material build-up.
3. **Workforce Facilities and Offices**:
   - The workforce facilities and offices need 3492 **cubic meters per day** for drinking, sanitation, and other purposes.
   - Providing clean water for personnel is essential for their well-being.
4. **Site Activities (Sand Compaction, Cleaning Rig, and Concrete Curing)**:
   - Sand compaction, rig cleaning, and concrete curing activities require **1,230 cubic meters per day**.
   - These processes contribute to construction quality and safety.
5. **Water Usage Estimate**:
   - Based on a total of **site workers**, the estimated water supply is **20952 cubic meters per day**.
   - **Sewage generation** is estimated at **2 %**, approximately **1,880 cubic meters per day**.

The project's water management plan will ensure sustainable practices, efficient water use, and environmental responsibility.

3.6.7 Energy Supply

In Lagos, Nigeria, electricity supply can be **unreliable**, characterized by frequent power outages and fluctuations. The national grid, operated by the government-owned **Transmission Company**

of Nigeria (TCN), faces challenges in meeting the high-capacity energy demands of Lagos, Africa's largest city.

Some key points regarding the electricity situation in Lagos which are have been considered in the project:

1. **Power Grid Challenges**:
    - The national power grid experiences frequent **grid collapses**, leading to blackouts.
    - In July 2022, the grid collapsed for the sixth time in seven months, resulting in significant power disruptions in Lagos[1].
2. **Energy Poverty**:
    - Lagos, with its population boom, faces **energy poverty** due to inadequate power supply.
    - Even well-off neighborhoods experience power reductions during maintenance or grid failures.

3. **Privatization Challenges**:
    - The 2013 privatization of the electricity market did not yield the desired results.
    - Consumers complain about paying high electricity bills while receiving insufficient power[1].
4. **Backup Diesel Generators**:
    - Given the unreliable grid supply, having **backup diesel generators** for Ancillary Sites is crucial.
    - These generators ensure uninterrupted operations, especially during critical construction activities.

Table 3.6 Characteristics of diesel generators

Location	**Diesel Generator**				
	Capacity	Type	age	duration to run/month	Other information please add
Support Yard/ Lay down Yard	400kVA	4		953days	

- ***Workforce and Subcontractors Management***

Managing the project workforce efficiently is crucial for successful project execution. The breakdown of the workforce requirements and skill levels for the proposed project are outlined below:

1. **Direct Labor**:
   - The project aims to employ a total of **1000 people** for direct labor.
   - This includes:
     - **300 Specialists**: Highly skilled professionals with expertise in specific areas.
     - **400 Tradesmen**: Skilled workers in various trades (e.g., carpenters, electricians, plumbers).
     - **300 Unskilled**: Workers for manual tasks such as digging, carrying, and basic construction.
2. **Indirect Labor**:
   - Indirect labor involves **400 people**, including subcontractors, suppliers, and transporters.
   - These individuals play supporting roles in the project.
3. **Expatriate Personnel**:
   - The project will have **50 expatriate personnel** who bring specialized knowledge and experience.
4. **Specific Roles and Skill Levels**:
   - Key roles and their required skill levels:
     - **Project Director, Project Manager, E&S Manager, Chief Accountant, Human Resources Manager, Procurement Manager, Health and Safety Manager**: All require **skilled** expertise.
     - **Nurse**: Skilled healthcare professional.
     - **Lab Attendant, Office Assistant (Administrative)**: Semi-skilled roles.
     - **Accountant, Purchasing Officer**: Skilled positions.
     - **Environmental Officer**: Semi-skilled with expertise in environmental matters.
     - **Community Liaison Officer**: Skilled in community engagement.
     - **Batching Plant Manager, Batching Plant Operators**: Skilled roles related to concrete batching.
     - **Project Security Manager, Security Staff**: Skilled security personnel.
5. **Waste Collection Staff**:
   - The exact number of waste collection staff will be determined by the **Waste Subcontractor**.
6. **Workforce Categories**:
   - **Unskilled Labor**: Basic manual tasks.

- **Semi-Skilled Labor**: Specialized skills (e.g., masons, carpenters).
- **Skilled Labor**: Engineers, surveyors, equipment operators, and project managers.

Security Management

The security arrangements for the project would ensure safety and monitoring on-site activities for successful project execution,

1. **Security Coverage**:
   - Security personnel will be available **24/7** through numerous shifts.
   - Coverage includes both the **construction site** in the port regions and the **yards**.
2. **Internal Security Management**:
   - Security services are provided **internally** by the **HR department** rather than subcontracted.
   - This approach allows direct control and coordination of security measures.
3. **Collaboration with Regional Police**:
   - A **relationship** is established with the **regional police station**.
   - Their support will be available in case of emergencies or critical situations.
4. **Non-Armed Security Personnel**:
   - On-site security personnel are **not armed**.
   - Their role is to **monitor** and **control** situations to prevent rapid escalation.

Subcontractors Management

Subcontractors play a crucial role in construction projects, and their engagement requires careful management. The key aspects related to subcontractors are:

1. **Mobilization of Subcontractors**:
   - Subcontractors will be **mobilized** to perform various works within the project.
   - Their expertise and specialized services contribute to efficient project execution.
2. **Contractual Agreements**:
   - The **contractor** will enter into **contractual agreements** with these subcontractors.
   - These agreements outline responsibilities, deliverables, timelines, and compliance with project policies.
3. **Supervision and Compliance**:
   - The contractor will **supervise** subcontractors' activities throughout the project.
   - This supervision ensures that subcontractors adhere to project requirements and industry standards.

Effective collaboration with subcontractors contributes to successful project outcomes.

3.6.8 Environmental Releases of Emissions, Discharges and Wastes

- ***Air Quality***

Managing emissions during construction is crucial for minimizing environmental impact and protecting human health. During the construction phase, various activities contribute to greenhouse gas (GHG) emissions as outlined below:

1. **Vehicle Movement**:

- Dust generated by vehicles traveling on unpaved surfaces can release **particulate matter** and contribute to air pollution.
- These emissions occur due to vehicle movement during construction.

2. **Material Handling**:
    - Construction materials and stockpiles can also emit dust.
    - Activities like material handling contribute to **particulate emissions**.
3. **Power Generators**:
    - The project would use power generators. Their collective input in terms of air pollutant emissions could be significant
4. **Additional Emissions during Construction**:
    - Beyond the mentioned sources, other activities during construction contribute to emissions:
        - **Dredging of sand from the sea**
        - **Concrete Batching Plant Operations**: These can release dust and particulate matter.
        - **Demolition of Existing structures**: Dust emissions may occur during this process.
        - **Backfilling**: Another potential source of dust.
        - **Execution of Rear Barrette and Bored Piles**: Heavy machinery emitting exhaust fumes adds to air emissions.
        - **Installation of other Facilities**: Machinery involved in this process also contributes.
5. **Health and Environmental Impacts**:
    - The total suspended particulate component can result in **nuisance dust**, particularly affecting receptors immediately adjacent to the construction site.
    - The finer particulate component (PM10 and PM2.5) poses **health risks** to receptors, even those located at some distance from the emission source.
    - Diesel generators and machinery are significant sources of air pollutants, including **particulate matter**, **nitrogen oxides (NO2)**, **sulfur dioxide (SO2)**, and **carbon monoxide (CO)**, which can have environmental and health impacts.

- ***Greenhouse gas (GHG) Emissions***

Managing GHG emissions during construction and ensuring sustainable practices for long-term operation are critical for minimizing environmental impact.

1. **GHG Emissions during Construction**

The specific GHGs emitted during construction include:

- **NO2 (Nitrogen Oxides)**: Released by vehicle combustion.
- **CO (Carbon Monoxide)**: Produced during fuel burning.
- **SO2 (Sulfur Oxides)**: Emitted from fuel combustion.
- **<u>PM10 and PM2.5</u>**: Fine particulates generated by vehicles

The standard seven greenhouse gases usually considered include: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3).

Units	capacity	Number	Emission Factor (kg CO2e/hr/unit)	Maximum Days of Operation	Estimated Emissions (tons CO2e)	Remarks
Crane	24.5/ hour	4	3129.92	351	3306.3	
Excavator	24.5	8	6279.84	351	6612.7	
Dredgers	625 / h	6	2306.88	351		
Pneumatic Road Roller	12L/hr	6	2306.88	351	2204.2	
Grader	16L/h	6	3075.84	351	3238.9	
Soil compactor	12/L	6	2306.88	351	2429.1	
Wheeled loader	12L/hr	6	2306.88	351	2429.1	
Other						
Power Generators	18L/hr	4	1409.76	351	1484.5	
Dumper	15L/hr	4	2204.2	35 1	2024.3	
Wirtgen						
Water/diesel tankers	35L/6 2mile	8 (Diesel 6, water - 2)	13008	35 1	37651	
Others, add, please and specify						
Total	10955412				t85897.3C Oe	

2. **GHG Emissions during Operation**

Once operational, the highway will facilitate movement of goods, services, and people along the coast. Despite the direct and indirect emissions, the highway's positive impact on transportation and economic development remains significant. It will enhance connectivity along the coast, benefiting businesses, communities, and regional trade. During this phase, the project is fully operational, and various factors come into play. Emissions are a consideration in the following regard during operation:

1. **Direct Emissions from Vehicles**:
   - During the operational phase, the primary direct emissions to the air will come from **maintenance vehicles and equipment**.
   - These vehicles and equipment used for upkeep and repairs will release pollutants into the atmosphere.
   - These emissions include pollutants such as **nitrogen oxides (NO2)**, **carbon monoxide (CO)**, and **particulate matter (PM)**.
2. **Indirect Emissions**:
   Beyond direct emissions (such as those from maintenance vehicles), roads contribute indirectly to increased emissions. These **indirect emissions** are related to several factors:
   - **Fuel Consumption**: As more vehicles travel along the road, their fuel consumption adds to emissions.
   - **Vehicle Maintenance**: Regular vehicle maintenance (including engine tuning, tire changes, etc.) also contributes indirectly.
   - **Infrastructure Provision**: The construction and maintenance of road infrastructure (e.g., roads, petrol stations) play a role in emissions.

2. Managing GHG Emission

Sustainable practices during construction and operation shall take the following into consideration:

- **Green Construction Practices**: Using eco-friendly materials and minimizing emissions during construction.
- **Public Transportation Integration**: Encouraging use of public transport to reduce individual vehicle emissions.
- **Monitoring and Compliance**: Regular monitoring of emissions and adherence to environmental regulations.

- ***Noise***

The expected activities that will generate noise emissions during the construction phase of the Lagos-Calabar Coastal Highway project:

1. **Demolition of Existing structures**:
   - Demolition work typically produces significant noise as structures are dismantled.
2. **Formwork for Capping Beams**:
   - Formwork construction involves assembling molds for concrete structures. This activity can generate noise.
3. **Backfilling Behind**:

   - Backfilling operations involve moving soil or other materials, which can result in noise emissions.
4. **Execution of Rear Barrette and Bored Piles**:
   - The execution of these foundation elements often requires heavy machinery, contributing to noise levels.
5. **Installation of Guide Walls**:
   - The process of installing guide walls can create noise due to construction equipment and machinery.
6. **Installation of various Facilities**:
   - As facilities are constructed, noise from equipment and construction activities is expected.
7. **Operation of Diesel Generators**:
   - Diesel generators, used for power supply during construction, emit noise.
8. **Operation of Batching Plants**:
   - Batching plants, where concrete is mixed, also contribute to noise emissions.
9. **Traffic by All Vehicles and Heavy Machinery**:
   - Movement of vehicles and heavy machinery on-site generates continuous noise.
10. **Underwater Noise to the Marine Environment**:
    - Activities related to dredging operations and offshore transportation can introduce underwater noise.
    - This underwater noise affects marine ecosystems and organisms.

Water/Wastewater

Effective wastewater treatment and responsible construction practices are crucial for safeguarding both surface water and underground water quality during the project. The wastewater management and potential risks associated with construction activities:

1. **Wastewater Treatment in Construction**:
   - All wastewater generated by the project will be stored in **septic tanks**, which are underground structures providing **primary treatment**.
   - Specifically, wastewater from the batching plant and yard facility will be directed into the septic tank.
   - The septic tank allows **heavy solid waste** to settle down from the wastewater.
   - The designed tank should have a capacity to retain **1,000 liters** of wastewater and a depth of approximately **3 meters**.
   - The septic tank treatment removes disease-causing organisms, organic matter, and most nutrients (except nitrogen and some salts).

  - The partially cleaned wastewater then either moves to the groundwater or evaporates from the soil[1].

2. **Surface Water Contamination Risks**:
   - Various construction activities pose risks of contaminating **surface water**:
     - **Exposure of In-Situ Materials during Earthworks**: Disturbing natural materials can release pollutants.
     - **Hydrocarbon Spillages from Mechanized Fleet**: Fuel spills can impact nearby water bodies.
     - **Runoff from Hazardous Material Storage Areas**: Proper containment is crucial.
     - **Shoreline Construction Activities**: Land reclamation and offshore transportation introduce contaminants to water bodies.
3. **Diesel Spills and Pollutants**:
   - There is a potential for **spills of diesel** and other pollutants to pollute the soil and **underground water**.
   - Leaks or spills of hazardous chemicals used in construction (such as lubricants, solvents, or concrete additives) can also impact underground water sources.

Careful Management of all these are needed to prevent adverse impacts on the terrestrial and aquatic environment. Proper handling, containment, and monitoring are essential to minimize environmental damage.

- *Solid Waste Management*

1. **Construction Phase Waste**:

During construction, various types of waste are generated:

- **General Waste**: This includes waste from offices, canteens, and toilets.
- **Medical Waste**: The clinic generates medical waste, which requires proper handling and disposal.
- **Maintenance and PPE Waste**: Deteriorated personal protective equipment (PPE), oil filters, and tires contribute to waste.
- **Excavation Materials**: Soil, rocks, and other materials excavated during construction.
- **Demolition Debris**: Waste resulting from demolishing existing structures.
- **Packaging Materials**: Materials used for packaging construction supplies.

Table 3.7 Estimated Waste Generation

Waste Description	**Waste Quantity**
Steel Pile Excavation Spoils –	Will not be use on this project
Concrete Pile Excavation Spoils –	N/A
Rear Barrette Excavation Spoils	N/A
Steel Reinforcement Waste –	230 cubic meter
Concrete Waste –	195000 cubic meters

Workforce Sewage Generation	28,320
Workforce Waste Generation – Average 0.15 kg/person per day	87.3kg

2. **Contractor's Waste Management Plan**:
The contractor is responsible for managing all these waste streams. A **Waste Management Plan** that outlines procedures for waste handling, segregation, recycling, and disposal would be developed. Proper waste management ensures compliance with environmental regulations and minimizes negative impacts. Thus, effective waste management practices are essential to reduce environmental impact and promote sustainability throughout the project's lifecycle. All solid and wastewater will be collected by a Nigerian LAWMA certified waste collector.

Dredging for Reclamation

Dredging from the sea plays a crucial role in the proposed project. However, it likely going to have significant environmental impacts that need careful consideration such as the following:

1. **Turbidity in the Water**:
   - Dredging stirs up sediments from the bottom of water bodies, leading to increased **turbidity** (cloudiness) in the water.
   - Elevated turbidity affects light penetration, impacting aquatic plant growth and photosynthesis.
2. **Contaminant Release**:
   - As sediments are dredged, contaminants (such as heavy metals, organic pollutants, and nutrients) can be released into the water column.
   - These contaminants may have adverse effects on water quality and aquatic organisms.
3. **Habitat Destruction**:
   - Dredging disrupts benthic habitats, including small invertebrates, shellfish, and bottom-dwelling fish.
   - Intricate biological habitats on rock formations and substrates targeted for dredging are dismantled.
4. **Water Quality Degradation**:
   - Increased turbidity reduces sunlight penetration, affecting photosynthesis by aquatic plants and phytoplankton.
   - Diminished photosynthetic activity impacts the marine food web.
5. **Air Pollutant Emissions**:
   - Dredging equipment emits **air pollutants**, including greenhouse gases.
   - These emissions contribute to environmental impact during the dredging process.
6. **Mitigation Strategies**:
   - Responsible management is essential to balance economic progress through dredging with environmental conservation.

- Strategies include:
    - **Beneficial Reuse**: Up cycling dredged sediments for beach restoration and other purposes.
    - **Monitoring and Planning**: Regular monitoring of water quality and ecological impacts.
    - **Eco-Friendly Technologies**: Integrating sustainable practices and technologies.

3.7 Environmental, Health, and Safety Management (EHS)

The following have been taken into consideration in the EHS Management

6. **Sediment and Erosion**:
    - Implement measures to prevent soil erosion and sediment runoff during construction.
    - Techniques include silt fences, sediment basins, and erosion control blankets.
7. **Runoff Control**:
    - Manage storm water runoff to prevent pollution and soil erosion.
    - Construct proper drainage systems, retention ponds, and swales.
8. **Neighbourhood Effects: Noise and Dust**:
    - Minimize noise and dust impacts on nearby communities.
    - Use noise barriers, schedule noisy activities during off-peak hours, and control dust with water sprays or dust suppressants.
9. **Landscaping and Green Cover**:
    - Enhance aesthetics and ecological balance by incorporating green spaces.
    - Plant trees, shrubs, and grass to improve air quality and provide shade.
10. **Solid Waste**:
    - Properly manage construction waste.
    - Sort and recycle materials, dispose of hazardous waste safely, and maintain clean work areas.

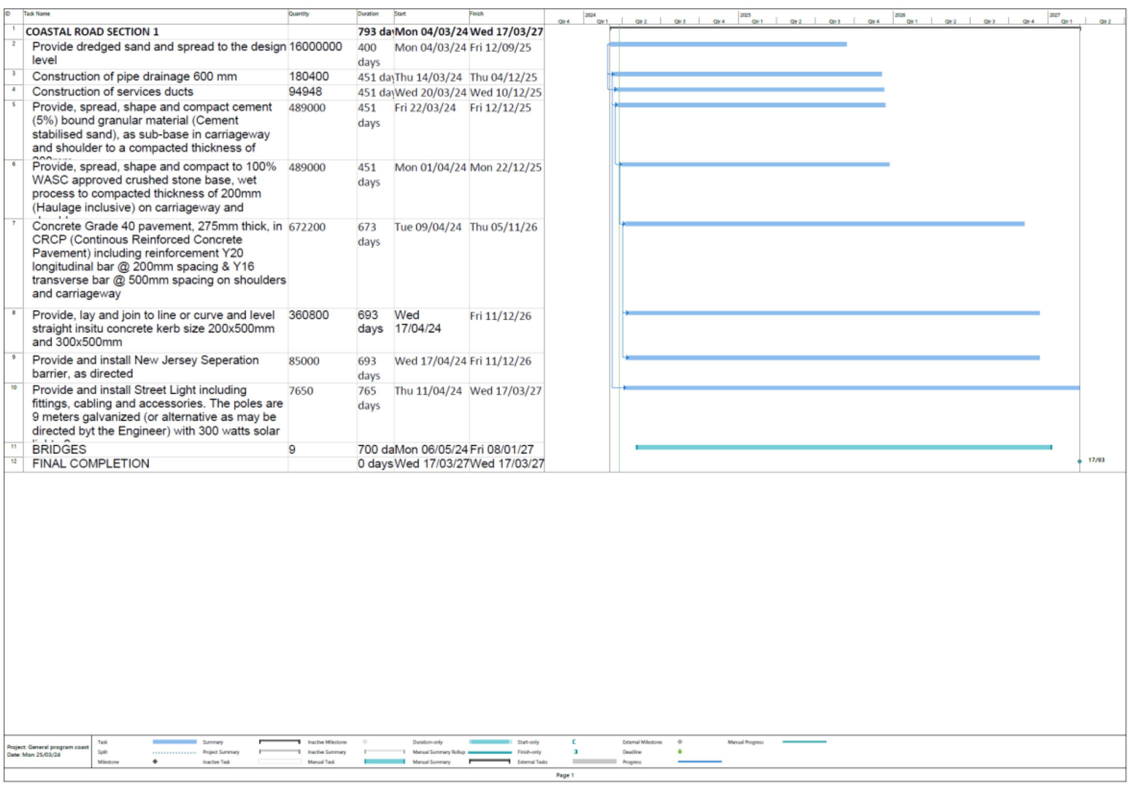
3.8 Project Implementation Schedule (Estimated)

The proposed project is expected to be completed in 36 months,

TABLE 3.8 THE CONCEPTUAL PROJECT SCHEDULE FOR THE PROJECT

S/N	Activity	2024		2025				2026				2027			
		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	Commissionin g														



ID	Task Name	Quantity	Duration	Start	Finish
1	**COASTAL ROAD SECTION 1**		**793 da**	**Mon 04/03/24**	**Wed 17/03/27**
2	Provide dredged sand and spread to the design level	16000000	400 days	Mon 04/03/24	Fri 12/09/25
3	Construction of pipe drainage 600 mm	180400	451 da	Thu 14/03/24	Thu 04/12/25
4	Construction of services ducts	94948	451 da	Wed 20/03/24	Wed 10/12/25
5	Provide, spread, shape and compact cement (5%) bound granular material (Cement stabilised sand), as sub-base in carriageway and shoulder to a compacted thickness of	489000	451 days	Fri 22/03/24	Fri 12/12/25
6	Provide, spread, shape and compact to 100% WASC approved crushed stone base, wet process to compacted thickness of 200mm (Haulage inclusive) on carriageway and	489000	451 days	Mon 01/04/24	Mon 22/12/25
7	Concrete Grade 40 pavement, 275mm thick, in CRCP (Continous Reinforced Concrete Pavement) including reinforcement Y20 longitudinal bar @ 200mm spacing & Y16 transverse bar @ 500mm spacing on shoulders and carriageway	672200	673 days	Tue 09/04/24	Thu 05/11/26
8	Provide, lay and join to line or curve and level straight insitu concrete kerb size 200x500mm and 300x500mm	360800	693 days	Wed 17/04/24	Fri 11/12/26
9	Provide and install New Jersey Seperation barrier, as directed	85000	693 days	Wed 17/04/24	Fri 11/12/26
10	Provide and install Street Light including fittings, cabling and accessories. The poles are 9 meters galvanized (or alternative as may be directed byt the Engineer) with 300 watts solar	7650	765 days	Thu 11/04/24	Wed 17/03/27
11	BRIDGES	9	700 da	Mon 06/05/24	Fri 08/01/27
12	FINAL COMPLETION		0 days	Wed 17/03/27	Wed 17/03/27

1. **Summary of Project Area Description**:
    - **Section Details**:
        - The initial phase spans 57 kilometres.
        - It starts from **Eleko** and extends to **Ode-Omi**.
    - **Geographical Context**:
        - **Eleko**, has a close proximity to the Lagos Free Trade Zone and a small community located along the Lagos coastline
        - The highway then winds its way through the coastal landscape, connecting various regions.
    - **Termination Point**:
        - The journey culminates at **Ode-Omi**, is situated in OgunWaterside, Ogun which serve as border between Lagos and Niger Delta Area/States
2. **Summary of Activities in Project Phases**

A. **Construction Phase**:
- Tasks Involved in Road Construction:
    - Establish temporary access to work areas and create clearance zones while controlling access.
    - Construct temporary diversions for roads that need upgrading to manage existing traffic.
    - Clear and level the corridor, perform major earthworks (cuttings, embankments).
    - Locate and develop borrow pits and quarries, import materials (gravel, clay, bitumen).
    - Source and establish a water supply from surface and/or groundwater.
    - Improve existing drainage and introduce new road drainage (including culverts if necessary).
    - Surface and seal the carriageway (using bitumen mixing plants where applicable).
    - Build water crossings such as bridges and culverts, including concrete batching for structures.
    - Establish or improve safety arrangements (modify camber, barriers, sight lines).
    - Perform landscaping as needed.

B. **Operation Phase**:
- The road becomes operational, serving transportation needs.
- Regular maintenance, monitoring, and safety checks are essential.

C. **Demobilization Phase**:
- Decommission temporary facilities (workshops, laydown areas, etc.).
- Restore any disturbed areas to their natural state.
- Evaluate the project’s success and lessons learned.

CHAPTER FOUR
DESCRIPTION OF BASELINE ENVIRONMENTAL AND SOCIAL CONDITIONS

4.0 Introduction

This Chapter presents the physical, biological, socio-economic, and cultural conditions of the proposed project area. It establishes a detailed profile of the area as derived from the baseline data collection which includes literature review, field investigations, and laboratory analyses. The chapter also informs impact assessments as presented in the Chapter 5, which could aid informed decision-making for sustainable transport corridor development that benefit the environment, local communities and the economy at large

4.1 The Area of Influence and Relevant Environmental Components

The consideration of the Area of Influence (AOI) was deemed pivotal in evaluating the potential environmental repercussions of the proposed Lagos-Calabar Coastal Highway project. The AOI encompasses the geographical expanse where direct, indirect, and cumulative effects of the project might manifest or are anticipated. This area extends beyond the immediate project pathway to include adjacent areas where project-related activities could induce environmental and societal alterations. Within this scope, specialists conducted a thorough examination of the environmental and social parameters to establish baseline conditions. The Baseline Study furnishes vital insights into the pre-existing environmental and societal state in proximity to the proposed highway and its environs. Comprehending these spatial boundaries enabled the execution of environmental impact studies and the formulation of risk mitigation approaches in the subsequent chapters to this Chapter 4.

4.2 Study Approach/Data Acquisition Methods

4.2.1 Study Area Delineation

The alignment for this section begins at **Eleko (47 km)** and terminates at **Ode-Omi (104 km**) for the Section 2 from Lagos to Ogun state, Nigeria.

This phase spans 53 kilometres commencing from **Eleko** and extends to **Ode-Omi. Eleko** is a neighbourhood to the Lekki Free Trade Zone in Lagos, serves as the starting point. The highway then winds its way through the coastal landscape, connecting various regions. The journey culminates at **Ode-Omi**, which borders and connects with Ogun state.

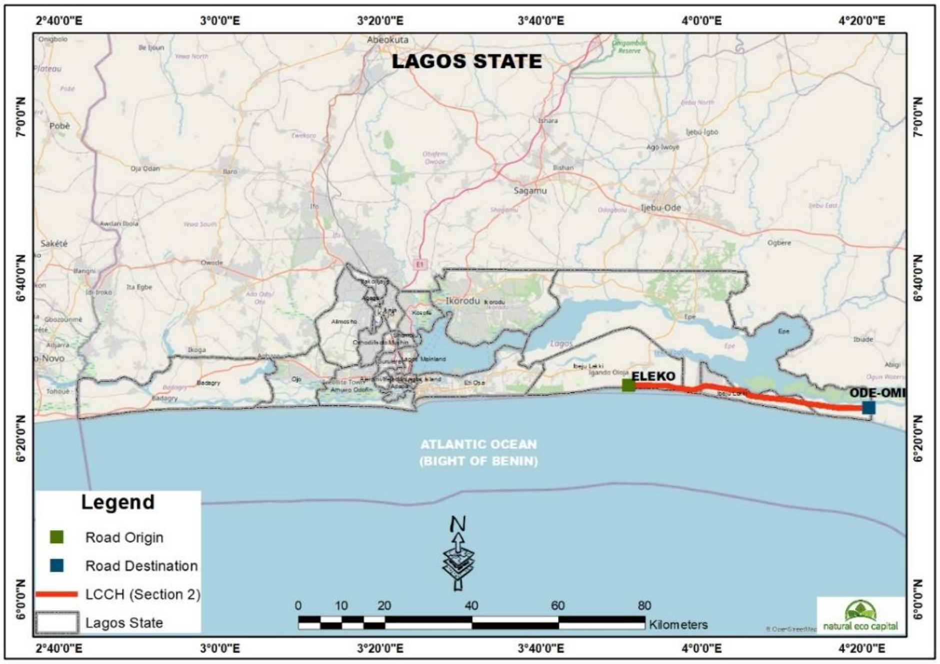


Figure 4.1: Map of Lagos State Showing Study Stretch, Section.

Source: Natural Eco Capital Fieldwork April, 2024

4.2.2: Sampling Locations

The graphical presentation of the data and samples collection points along the proposed corridor and adjacent areas are presented in Figure 4.2 and Table 4.1.

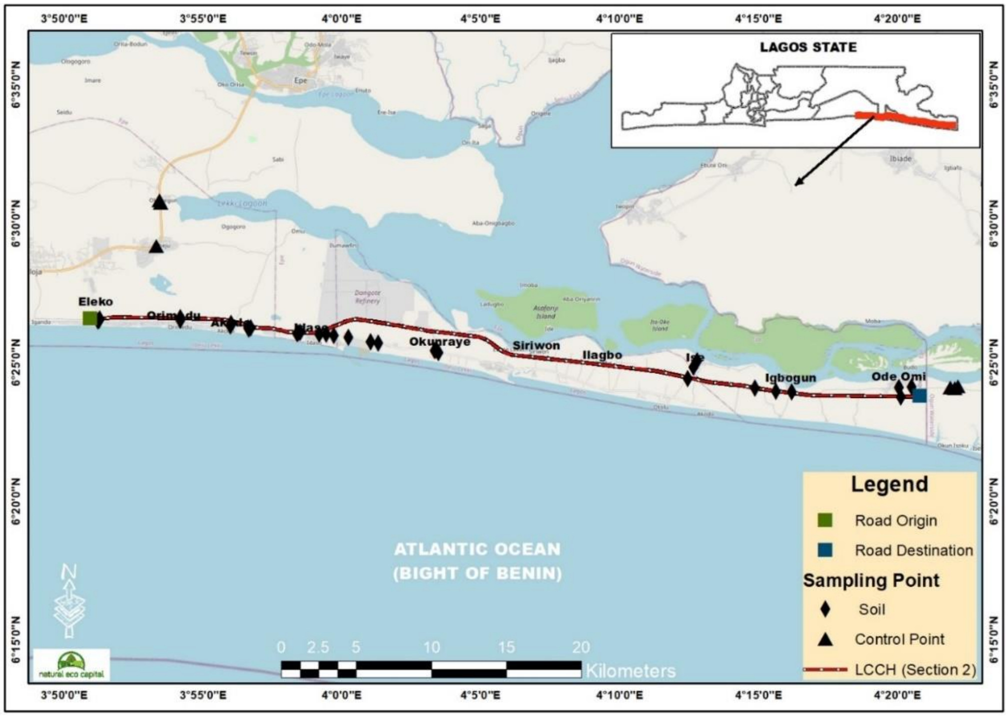


Figure 4.2: Study Area Showing Sampling Locations.

Source: Natural Eco Capital Fieldwork April, 2024

Table 4.1: Sampling Points and their Coordinates

S/N	Community	Sampling Location	Type	Lat	Long
1	Ise 1	1	Soil	6.406906	4.207254
2	Ise 2		Soil	6.413490	4.210916
3	Ise 3		Soil	6.417552	4.212994
4	Igbogun 1	2	Soil	6.401163	4.247610
5	Igbogun 2		Soil	6.399334	4.260452
6	Igbogun 3		Soil	6.398695	4.269925
7	Ode Omi 1	3	Soil	6.401252	4.334082
8	Ode Omi 2		Soil	6.401663	4.341785
9	Ode Omi 3		Soil	6.395569	4.335370
10	Eleko Roundabout 1	4	Soil	6.442656	3.854385
11	Eleko Roundabout 2		Soil	6.441755	3.854326

12	Eleko Roundabout 3		Soil	6.441458	3.853600
13	Okegun (Control 1A)	C1	Control Point	6.512039	3.891176
14	Okegun (Control 1B)		Control Point	6.513786	3.890255
15	Okegun (Control 1C)		Control Point	6.486289	3.888355
16	Akodo 1	5	Soil	6.439740	3.933244
17	Akodo 2		Soil	6.439013	3.933244
18	Akodo 3		Soil	6.438185	3.933000
19	Ode Omi (Control 2A)	C2	Control Point	6.401459	4.365061
20	Ode Omi (Control 2B)		Control Point	6.401180	4.367645
21	Ode Omi (Control 2C)		Control Point	6.402152	4.369541
22	Tiye 1	6	Soil	6.437302	3.943529
23	Tiye 2		Soil	6.437090	3.945107
24	Tiye 3		Soil	6.436374	3.944088
25	Orimedu 1	7	Soil	6.443294	3.902946
26	Orimedu 2		Soil	6.442378	3.903057
27	Orimedu 3		Soil	6.441729	3.902843
28	Ilege 1	8	Soil	6.433706	3.972979
29	Ilege 2		Soil	6.434181	3.973876
30	Ilege 3		Soil	6.434614	3.974704
31	Idaso (Dangote Refinery) 1	9	Soil	6.433275	3.990481
32	Idaso (Dangote Refinery) 2		Soil	6.433328	3.986107

33	Idaso (Dangote Refinery) 3		Soil	6.432466	3.994990
34	Udotu (Lekki Deep Sea Port) 1	10	Soil	6.431522	4.003752
35	Udotu (Lekki Deep Sea Port) 2		Soil	6.428932	4.017043
36	Udotu (Lekki Deep Sea Port) 3		Soil	6.428018	4.021780
37	Okunraye 1	11	Soil	6.423855	4.056561
38	Okunraye 2		Soil	6.423444	4.055578
39	Okunraye 3		Soil	6.422472	4.057810

Source: Natural Eco Capital Fieldwork April, 2024

The graphical presentation of the data sampling framework for the field observation and data collection along the proposed corridor is as presented in the box of way points in Figure 4.3.

4.2.3 Relevant Environmental Components

Baseline information was established across a number of environmental indices in the Areas of Interest (AOIs). Essentially, the environmental indices included: air quality, noise flooding and hydrology, flora and fauna, shoreline changes, dredging and soil placement. land cover loss and land use changes.

Samples of environmental indices or components of relevance to project impacts and project affected communities within the area of interest were obtained as presented in Table 4.2.

***c.* Soil Sampling**

Systematic sampling design (systematic line transect) was employed to collect soil by establishing plots across the sampled area. Soil samples were collected from each of the stations with the aid of a Dutch Hand Auger, Hand gloves, a spool and hammer at depths of 0-15cm and 15-30cm, representing top and bottom samples. These are the soil depths at which most (>80%) of the plants feeder roots and soil micro-organisms are concentrated.

At each sampling station, three (3) samples were taken for each depth and composited to give one representative sample. All sampled points were geo-referenced in the field using the Garman Geographic Positioning System (GPS) Equipment. Furthermore, field investigations on soil morphological properties as it affects slope, drainage/flooding, presence of soil structure impediments, texture mottling, were conducted. The physical appearances of contaminants such as hydrocarbons were also examined, alongside the land use practices. All soil samples connected were analyzed in the laboratory using standard methods. The following sub-samples were taken for each depth, namely:

Samples for physico-chemical parameters which were put into polythene bags; Samples for hydrocarbon analysis which were put into glass bottles; Samples for microbiological analysis collected with McCartney bottles and stored in ice-packed coolers

d. Water Quality Sampling

Surface and groundwater samples were collected along the coastal road project in Lagos for physico chemical analysis**.** Key sampling locations along rivers, streams, estuaries, and other water bodies that could be impacted by the coastal road project were identified. These locations represent various environmental conditions and potential sources of pollution, such as urban runoff, industrial discharge, and agricultural activities.

Water samples were collected using clean, sterile containers to prevent contamination. Samples were collected at a consistent depth and location within the water body, following standard protocols to ensure accuracy and reproducibility. They were then subjected to analysis for a range of physical, chemical, and biological parameters, including pH, dissolved oxygen, turbidity, nutrients (nitrogen and phosphorus), heavy metals, pesticides, and fecal coliform bacteria. These parameters provided insights into water quality, pollution levels, and ecological health

c. Groundwater Sampling

Ground water samples for this study were collected from 11 study locations within the study area. Table 1 below shows some of the locations where the groundwater samples were collected, their geographic coordinates and depth. The groundwater samples were collected in high density polyethylene bottles prewashed with 1 N hydrochloric acid followed by distilled water and then rinsed two to three times with the sampled water. The collected water samples were taken to Bato Chemical Laboratories Ltd for comprehensive analyses. The samples were filtered using 0.45 µg cellulose membrane before the analyses. The analytical procedures employed were as documented by the American Public Health Association (APHA, 2017).

d. Air Quality Sampling

Assessment of the sampling locations was done taking into cognizance the predominant wind direction and other requisite criteria as stipulated by the World Bank to have good representative sampling points for the locations. These criteria include:

Predominant Wind Direction; Unobstructed flow of air to equipment probe or inlet from 3 out of the 4 cardinal points (270 degrees) of the location including the predominant wind direction;

Distance from trees (minimum of 10meters); Distance from nearby tall buildings – > twice the difference in elevation (of the building and inlet of the equipment); Distance from roadways to equipment probe or inlet 2-10 and 10-100 meters (depends on average daily traffic in vehicles per day with 2-10 for micro-scale site, except for a designated traffic site, and 10-100 for middle and neighbourhood scale site with upper limit for ~40,000 – 70,000 vehicles per day).

In addition, a control sampling point is located at Folu Community in Ibeju Lekki LGA of the State. The location represents an area with baseline conditions unaffected by the proposed project but similar in environmental characteristics to the proposed project sites. Aeroqual Series 500 with the respective sensor heads was used to collect the air quality data.

e. **Shoreline Dynamic Mapping - Shoreline Dynamics in the Last 45 Years (1979-2024)**

Historic shoreline dynamics across the project area were calculated using the DSAS tool on ArcGIS. Spatial dataset used include satellite imageries acquired in different years and covering a time span of 45 years (1986). The images were sourced from the USGS Landsat online data archive (*www.glovis.org*, *www.earthexplorer.org*) and were carefully selected based on the conditions that little or no cloud coverage was present and the tide period was the same, e.g. low tide and small tidal range. Table 4.2 shows the characteristics of each of the dataset.

Table 4.2: Characteristics of Satellite Imagery

Date	Satellite data/Sensor	Path/row	Pixel size (M)	Coordinate system/datum	Zone
1979	Landsat-5/TM	188/57	30	UTM/WGS84	32
1991	Landsat-5/TM	188/57	30	UTM/WGS84	32
2000	Landsat-7/ETM	188/57	30	UTM/WGS84	32

2005	Landsat-7/ETM	188/57	30	UTM/WGS84	32
2014	Landsat-7/ETM	188/57	30	UTM/WGS84	32
2018	Landsat-8/OLI	188/57	30	UTM/WGS84	32
2021	Landsat-8/OLI	188/57	30	UTM/WGS84	32
2024	Landsat-8/OLI	188/57	30	UTM/WGS84	32

Source: Natural Eco Capital Fieldwork July, 2024.

The image processing methodology, a crucial aspect of this study, began with a meticulous check for any defects in the images, such as band striping. We then proceeded to extract the shorelines using a semiautomatic method based on the dry/wet boundary, which approximates the high waterline (HWL). To reduce subjectivity in delineating the shoreline, we used the band ratio between the mid-infrared/shortwave infrared (band 5 [b5]/ band 6 [b6]), the near-infrared (band 4 [b4]/ band 5 [b5]) and the green (band 2 [b2]/ band 3 [b3]) for the Landsat images. This band ratio computation was implemented using the band math's model in the ENVI software (Formular1) b2/b4 * b2/b5 >1 formula 1. After the image processing, the resulting image with ratio values between 0 and 3 was classified into two classes. This classification was done using the ISOCLUST unsupervised classification tool in ENVI, a tool that plays a crucial role in our image classification process. The resulting binary image had values less than 1 classified as water and values greater than 1 classified as land. The land class was then converted from raster to vector and exported as shape files for overlay in ArcMap where the shorelines were extracted.

Shoreline dynamics in the project area were measured by creating perpendicular transects for measurement locations across multiple shorelines. The transect lines were made perpendicular to the baseline and drawn to intersect all the extracted shorelines. The intersected points were spatially joined to the baseline to create a field that calculated the shortest perpendicular distance from each end to the baseline. The transect-shoreline intersections were therefore used to calculate various rates of movement. This study computed shoreline change rates using the Net Shoreline Movement (NSM) and End Point Rate (EPR). The NSM reports the distance between the oldest (1979) and the youngest (2024) shorelines, while the EPR converts the NSM into an annual rate of shoreline change by dividing the distance of the shoreline movement from the oldest to the most recent shorelines as the period passed.

f. Microbiology Analysis

Water and sediment samples for microbiology analysis were collected in sterile glass bottles and stored in ice packed containers before transfer to the refrigerator prior to laboratory investigation. Enumeration of heterotrophic bacteria and fungi was carried out by pour plating technique. This was done by inoculating 0.1 ml tenfold serially diluted samples onto nutrient agar (Bacterial), acidified potato Dextrose agar containing Streptomycin (1mg /100 ml) (fungal) and mineral salt Agar (MSA) (Hydrocarbon degraders). The mineral salt media of Mill *et al.*, 1978 as modified by Okpokwasili and Amanchukwu (1988) contains the following composition in gram per litre of distilled water NaCl 10g, $MgSO_4$. $7H_2O$, 0.42 g, KCl, 0.29 g, K_2HPO_4, 1.2 g, KH_2PO_4, 0.83 g, $NaNO_2$, 0.42 g, Agar –Agar, 15 g, pH 7.2 and 2ml of petrol/diesel. The inoculated nutrient Agar plates were incubated at 370C for 24 hours while the potato dextrose Agar plates were incubated at room temperature for 3-5 days. Observed colonies were counted and expressed as colony forming units per gram (cfug- 1). The bacterial and fungal isolates were characterized based on their cultural, biochemical properties and microscopic appearances as described by Cheesbrough (2005).

g. MarineWildlife Studies

An inventory of wildlife species in the study stretch was obtained through literature review, field survey and interaction with indigenous and resident fisher folks.

Note: The methodology for relevant environmental components (MarineWildlife Studies) is presented in appendix 4.2.

4.3 Physicochemical Components of Project Environment

4.3.1 General Description of the Climate and Weather Patterns of Lagos

Lagos, Nigeria, experiences a transitional tropical climate shaped by the Guinean and Sudanian variants. Key atmospheric systems such as the St. Helena anticyclone, Egypto-Lybian anticyclones, and Saharan depression influence its distinct rainy and dry seasons. Major wind patterns like harmattan, Saharan low-pressure system, and monsoons impact weather and rainfall, defining Lagos as humid tropics with two dominant air masses. They are the dry Northeasterly Tropical Continental (cT) from across the Sahara and the wet Southwesterly Tropical Maritime (mT) from across the Atlantic Ocean. The Inter Tropical Convergence Zone (ITCZ) separates these air masses, oscillating with the sun's apparent location and accounting for the dominant seasons of the area. Marginal alterations are also recorded due to landform characteristics, ocean currents, surrounding shoreline configuration, and the flat topography of the region.

Temperature: The data collected for a period of 37 years from 1986 to 2023 for Lagos State showed an average maximum temperature of 31.6°C and an average minimum temperature of 23.9°C. The average maximum temperature range is 5.5°C while minimum range is 2.3°C.

Figure 4.3 shows the average warmest temperature in Lagos is recorded in February and March, while the lowest is in June.

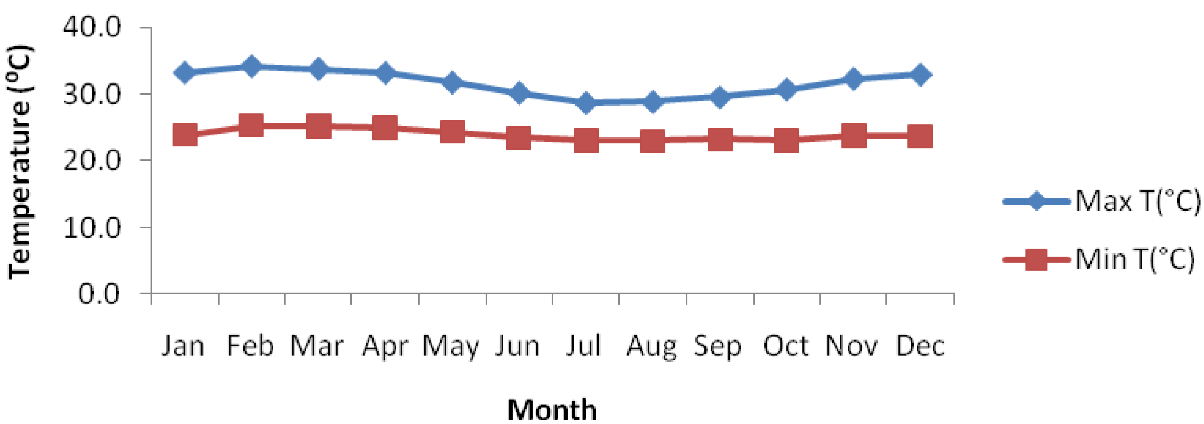


Figure 4.3: Temperature of the Study Area (1986-2023)

Extreme temperatures have been known to cause cracking and deterioration of road due to expansion and contraction the materials used. The road design must take into consideration, the temperature range of 21^{o}C to 34^{o}C.

Rainfall**:** Lagos has 2 rainfall peaks in May and June, as shown in the table and charts

Lagos experiences rainfall throughout the year. Data spanning 37 years (1986-2023) indicates June with the highest rainfall (304.2mm) and January with the lowest (typically a dry season month). The average rainfall over this period is 131.8mm, representing the expected pattern, as illustrated in Table 4.6 and Figure 4.5. Furthermore, 30 years of hourly weather model simulations and observed historical climate and weather data, confirm the period of the wet and dry season in the project area.

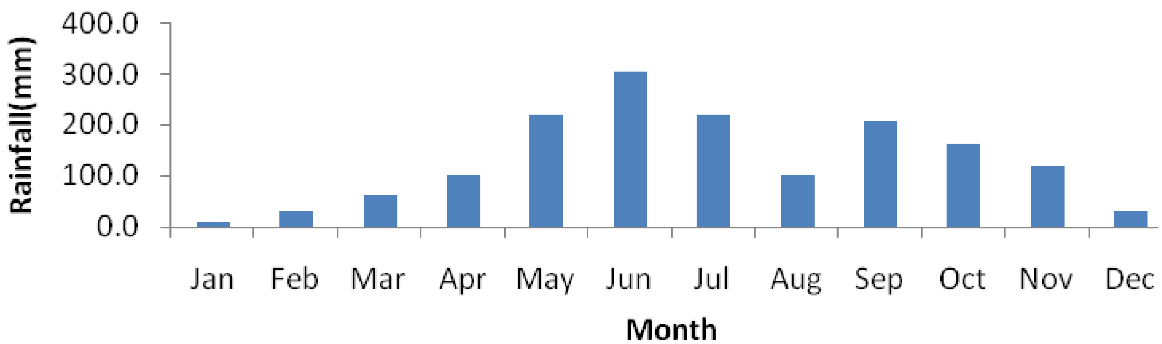


Figure 4.4: Rainfall of the Study Area (1986-2023)

Relative Humidity: Relative humidity, linked to air temperature, influences cloud formation and precipitation types. A 37-year data span (**1986-2023**) shows average yearly humidity at 82.4%, varying from 71.1% in January to 87.6% in July.

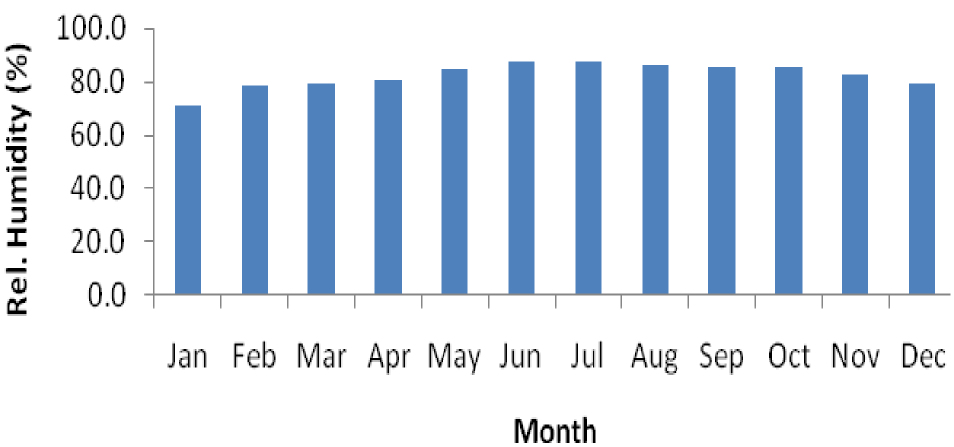


Figure 4.5: Relative Humidity of the Study Area (1986-2023)

Throughout 1986-2023, Lagos consistently maintains relative humidity above 70% monthly, irrespective of season. June and July peak at 87.3% and 87.6% respectively, correlating with the rainy season. High humidity, typical during the wet season, results from Lagos' location and near-constant rainfall. Peaks reach 78% from June to October, with February's low at 57%.

Wind Speed: The winds that prevail over Lagos State are the same with that which prevail over Nigeria, and these are the Tropical Maritime Air mass and the Tropical Continental air mass.

Strong winds pose risks like erosion, debris on roads, and visibility issues, mitigated by wind barriers and road design. Northward winds increase salt spray, corroding infrastructure, crucial in coastal road stability planning. Figure 4.9 depicts consistently high wind speeds, especially March to September, slightly lower in October/February, with prevailing southwesterly winds but northward winds at 6%, sufficient for corrosion near the ocean.

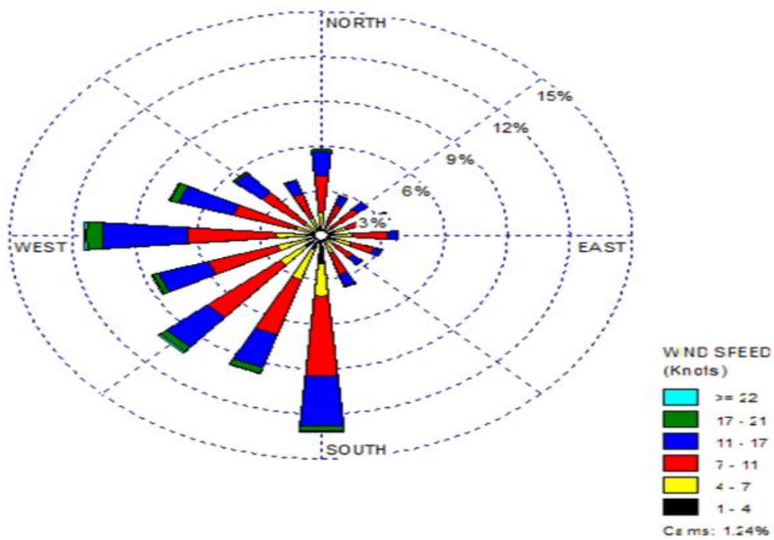


Figure 4.6: Annual Prevailing Wind Directions in the Project Area

According to the statistics available for the last ten years the prevalent wind directions is South-westerly. Often, the South-westerlies dominate the wetter period of the year in the area while North-easterlies dominate the drier season.

Radiance: Figure 4.6 present maps for a. Global Horizontal Irradiation (GHI), b. Direct Normal Irradiation (DNI), and c. Photovoltaic Power Potential (PVOUT)

a. b. c.

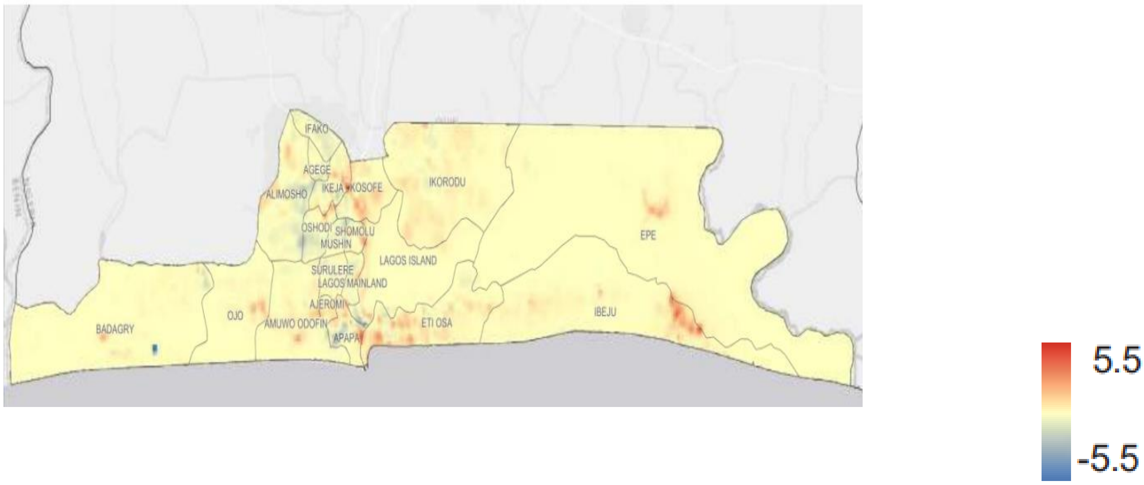
Figure 4.7: Solar Resource Maps of Nigeria

***Source**: The World Bank (2020): Global Solar Atlas 2.0, Solar resource data: Solargis*

GHI map provides a summary of the estimated solar energy available for power generation and other energy applications. It represents the long-term average of yearly/daily sum of global horizontal irradiation (GHI). DNI solar resource map provides a summary of the estimated solar energy available for power generation and other energy applications. It represents the long-term average of yearly/daily sum of direct normal irradiation (DNI). The PVOUT map provides a summary of estimated solar photovoltaic (PV) power generation potential. It represents long-term average of yearly/daily potential electricity production from a 1 kW-peak grid-connected solar photovoltaic (PV) power plan.

Figure 4.8: Average nighttime light radiance (2013–2019) Nanowatts cm^2 per steradian

Figure 4.8 shows the rate of change in nighttime radiance (2013–2019) Average change in nanowatts per square centimeter per steradian per month.



(nW·cm-2
·sr-1
·month-1)

Figure 4.9: Rate of change in nighttime radiance (2013–2019) Average change in nanowatts per square centimeter per steradian per month. ***Source:*** *World Bank, 2023, Map data from NOAA, "VIIRS Daily Mosai*

Microclimatic Data: Microclimatic data were acquired for the study area during the EIA field study. During field work survey, a weather monitoring equipment (Kestrel) was used to monitor the weather parameters essentially the temperature, wind speed, humidity, barometric pressure. The results obtained for the weather parameters are presented in Table 4.8 while the summary of values for the weather parameters is presented in Table 4.9.

Table 4.3: Weather Pattern Recorded within Study Area.

S/N	Monitoring Locations	Meteorological Parameters			
		Temp (^oC)	Humidity (%)	Wind Speed (m/s)	B. Pressure (hPa)
1.	Igbogun	26.9	90.8	1.5	1013.5
2.	Ode-Omi	27.4	90.3	1.3	1014.3
3.	Ise Junction	27.6	89.0	1.0	1011.0
4.	Eleko Road	27.4	86.3	2.1	1014.3

5.	Eleko Roundabout	29.1	82.6	1.8	1014.2
6.	Amen Estate	29.3	85.2	3.2	1013.7
7.	Eleko Junction	30.1	87.5	1.9	1010.8
8.	Okoyogun Lekki/Epe Expy	29.1	85.5	1.7	1014.5
9.	General Hospital Igbodu	28.6	84.9	2.1	1013.6
10.	Dangote Chainage Zero	24.4	87.8	3.8	1013.0
11.	Dangote Refinery - Along	25.2	97.8	3.3	1014.7
12.	Lekki Deep Sea Port	25.1	95.7	3.1	1013.3
13.	Dangote Refinery	24.6	95.3	1.4	1014.5
14.	Ilege	24.9	100.0	3.3	1011.0
15.	Lekki Free Zone	24.0	93.9	2.1	1010.8
16.	Tiye	24.7	98.2	3.8	1011.5
17.	Orimedu	25.3	98.4	3.6	1012.4
18.	Ilado Magbon	25.7	86.8	2.5	1011.9
19.	Hitech	25.2	90.7	1.8	1013.8
20.	Ode Omi – Control	29.2	82.2	3.0	

Source: Natural Eco Capital Fieldwork April 2024

Table 4.4: Summary of Results for the Weather Parameters

	Temp (ºC)	**Humidity (%)**	**Wind Speed (m/s)**	**B. Pressure (hPa)**
Minimum	**24.0**	**82.2**	**1.0**	**24.0**
Maximum	**30.1**	**100.0**	**3.8**	**30.1**
Average	**26.7**	**90.5**	**2.4**	**26.7**

Source: Natural Eco Capital Fieldwork April 2024

4.3.2 Inference from the Weather Parameters Results

Study parameters: ambient temperature from 24.0 to 30.1°C, relative humidity from 82.2 to 100.0%, wind speed from 1.0 to 3.8 m/s, and barometric atmospheric pressure from 1010.5 to 1012.0 hPa. The average values for these parameters were: temperature at 26.7°C, humidity at 90.5%, wind speed at 2.4 m/s, and barometric pressure at 1012.0 hPa.

Ambient Temperature

The temperature in the study locations varied from 24.0°C to 30.1°C. This range indicates that the area experienced conditions from relatively cool to warm temperatures. The average temperature was 26.7°C, suggesting a generally moderate to warm climate throughout the study period. The graphical illustrations of the average values of the weather parameter across the sampling locations is presented in figure 4.6 below:

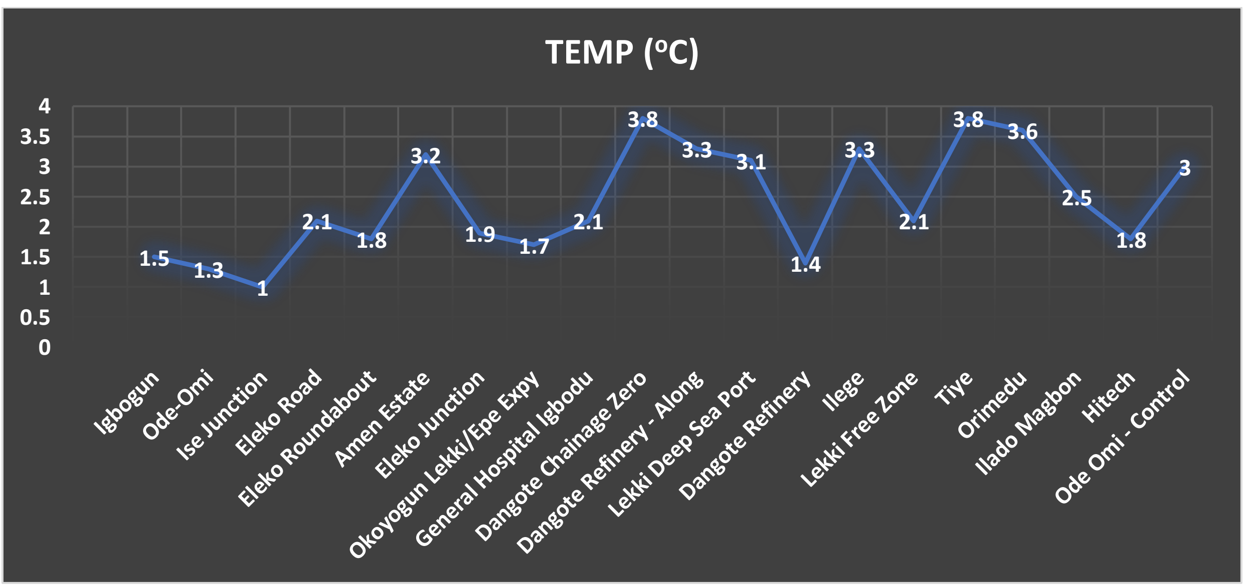


Figure 4.10: Graphical illustration of the temperature recorded within the study area.

Humidity

Humidity levels ranged between 82.2% and 100.0%, reflecting a consistently high moisture content in the air. The average relative humidity was 90.5%, indicating that the environment was predominantly very humid. Such high humidity levels reflect areas with substantial moisture with proximity to water bodies. The graphical illustrations of the average values of the weather parameter across the sampling locations is presented in figure 4.7 below:

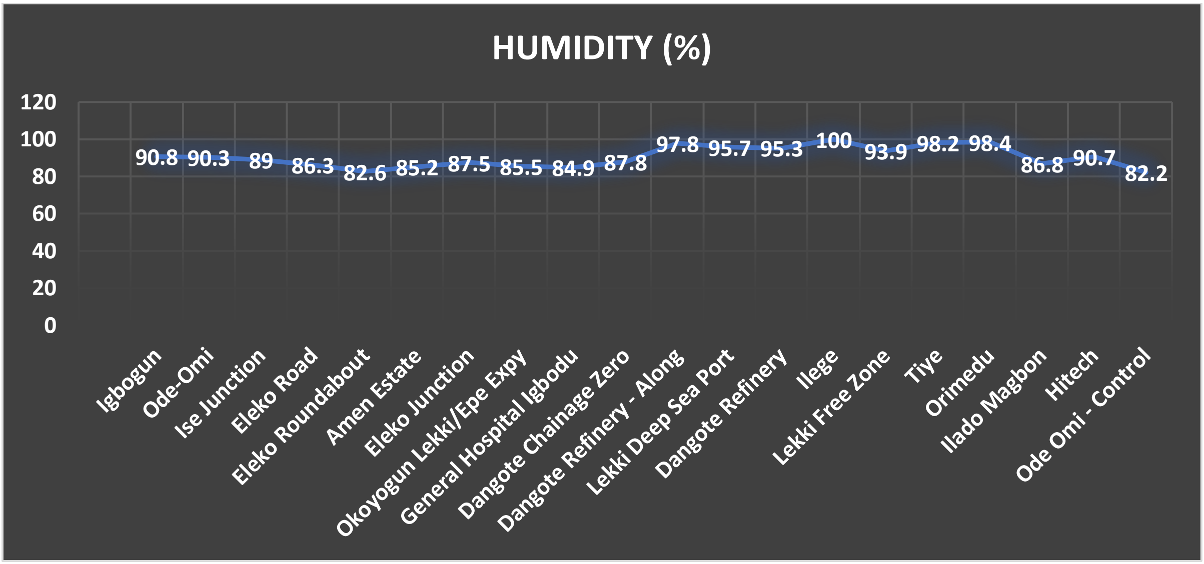


Figure 4.11: Graphical illustration of the humidity recorded within the study area.

Wind Speed and Wind Direction

Wind speeds recorded during the study ranged from 1.0 m/s to 3.8 m/s. This range suggests a variety of wind conditions from light breezes to moderate winds. The average wind speed was 2.4 m/s, indicating that the environment experienced generally calm to slightly breezy conditions. As regards the wind direction, it is predominantly south-westerly. The graphical illustrations of the average values of the weather parameter across the sampling locations is presented in figure 4.8 below:

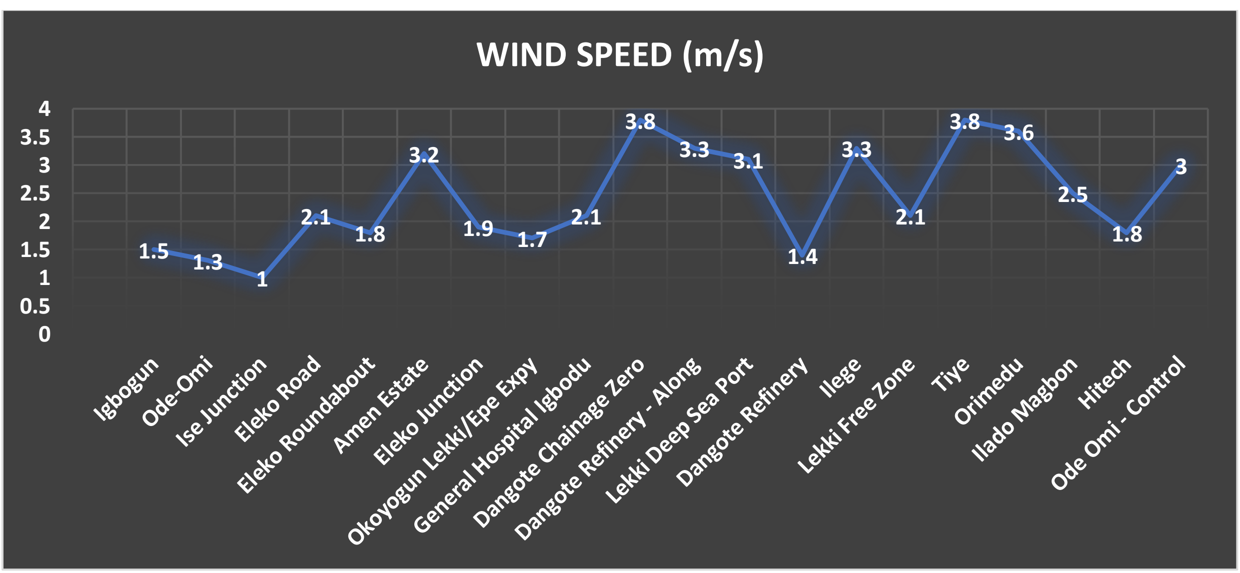


Figure 4.12: Graphical illustration of the wind speed recorded within the study area.

Table 4.5: Summary of Local Meteorological Data for the Project Area

Month	MEAN ITD position (°N)	Wind Direction	Mean Wind Speed (Kts)	Mean Min. Temp. (°C)	Mean Max. Temp. (°C)	R.fall (mm)	Surf. Pres. st. Helena hPa
July	18.9	South westerly	10kts	26.1	31.8	250.2	1024
August	19.9	South westerly	18kts	25.5	31.2	10.4	1036
September	18.0	South westerly	22kts	23.4	31.5	184.5	1028

4.4 Climate Projections

Considering the projected changes, planners and engineers must incorporate climate resilience measures into the design, construction, and maintenance of the coastal road project to ensure its long-term viability and adaptability to future climate conditions. This may include implementing coastal protection measures, improving drainage infrastructure, using climate-resistant materials, and considering future sea level rise in design standards. Box 4.1 outlines Projected changes that could affect the coastal road project in Lagos in the future.

- **Increased Temperatures:** Climate models indicate a general trend of rising temperatures due to global warming. This could lead to higher temperatures along the coast, impacting the performance of road surfaces and infrastructure materials.
- **Changes in Precipitation Patterns:** While projections vary, some models suggest alterations in precipitation patterns for Lagos, potentially resulting in more intense rainfall events during the wet season and longer dry spells during the dry season. This could increase the risk of flooding and droughts, respectively, affecting the road's stability and drainage systems.
- **Sea Level Rise:** Climate models consistently predict sea level rise due to melting ice caps and thermal expansion of seawater. This poses a significant threat to the coastal road project, as higher sea levels can lead to coastal erosion, saltwater intrusion into freshwater sources, and increased vulnerability to storm surges.
- **Increased Frequency and Intensity of Extreme Weather Events:** Climate models suggest that extreme weather events such as storms, hurricanes, and heatwaves may become more frequent and intense in the future. These events can cause significant damage to infrastructure along the coastal road and disrupt transportation networks.
- **Impacts on Ecosystems and Biodiversity:** Climate change could also affect the coastal ecosystems and biodiversity along the road project, influencing vegetation patterns, habitat suitability for wildlife, and shoreline stability.

Box 4.1: Projected Changes that Could Affect the Coastal Highway Project in Lagos in the Future

Daily Max Temperatures Projection, by Season:

This represents the projected average single-day maximum value of the daily maximum temperatures over the data aggregation period, shown below by season. It is necessary in understanding heat risks and needs for the hottest part of the day and gives insight into extreme heat conditions. The identified sub-national units with the highest and lowest values reflect the projected time period, 2040-2059.

Table 4.6 is the quarterly projection of average daily maximum temperature in Lagos. The identified sub-national units with the highest and lowest values reflect the projected time period, 2040-2059. It is necessary to understand the heat risks and needs for the hottest part of the identified sub-national units with the highest and lowest values reflect the projected time period, 2040-2059.

Table 4.6: The Quarterly Projection of Maximum Temperature for 100 years in Lagos

Units:°C	**2020-2039**					**2040-2059**				**2060-2079**				**2080-2099**		
Scenario	**DJF**	**MAM**	**JJA**	**SON**	**DJF**	**MAM**	**JJA**	**SON**	**DJF**	**MAM**	**JJA**	**SON**	**DJF**	**MAM**	**JJA**	**SON**
SSP1-1.9	33.31 (32.41, 34.12)	33.51 (32.68, 34.24)	31.2 (30.5, 31.75)	31.86 (31.35, 32.52)	33.53 (32.27, 34.47)	33.74 (32.86, 34.64)	31.44 (30.71, 32.11)	32.03 (31.49, 32.74)	33.44 (32.34, 34.22)	33.66 (32.84, 34.45)	31.35 (30.65, 31.95)	31.99 (31.41, 32.67)	33.33 (32.42, 34.1)	33.55 (32.78, 34.35)	31.25 (30.53, 31.87)	31.85 (31.37, 32.48)
SSP1-2.6	33.56 (32.54, 34.35)	33.67 (32.87, 34.35)	31.34 (30.58, 31.9)	32.06 (31.54, 32.72)	33.82 (32.29, 34.9)	34.05 (33.16, 35.1)	31.71 (30.92, 32.36)	32.18 (31.57, 32.88)	33.99 (32.28, 34.9)	34.08 (33.1, 35.12)	31.85 (30.94, 32.51)	32.52 (31.61, 33.34)	33.86 (32.49, 34.9)	34.05 (33.08, 35.32)	31.94 (30.88, 32.76)	32.39 (31.62, 33.42)
SSP2-4.5	33.42 (32.56, 34.18)	33.54 (32.79, 34.24)	31.26 (30.64, 31.78)	31.99 (31.52, 32.64)	34.03 (32.99, 34.91)	34.07 (33.4, 35.03)	31.93 (31.15, 32.76)	32.49 (31.89, 33.3)	34.32 (32.86, 35.47)	34.49 (33.82, 35.61)	32.37 (31.58, 33.23)	32.88 (32.13, 33.98)	34.72 (33.49, 36.03)	34.91 (33.85, 36.35)	32.9 (31.51, 33.79)	33.25 (32.26, 34.33)
SSP3-7.0	33.25 (32.11, 34.22)	33.59 (32.43, 34.31)	31.26 (30.54, 32)	31.8 (31.19, 32.52)	33.95 (32.22, 35.41)	34.21 (32.54, 35.5)	31.88 (31.11, 32.74)	32.52 (31.87, 33.54)	34.69 (32.37, 35.95)	34.92 (32.93, 36.35)	32.83 (31.5, 33.74)	33.2 (32.26, 34.67)	35.54 (32.86, 37.1)	35.58 (33.63, 37.1)	33.72 (32.26, 35.17)	33.85 (32.68, 35.22)

https://climateknowledgeportal.worldbank.org/country/nigeria/climate-data-projection

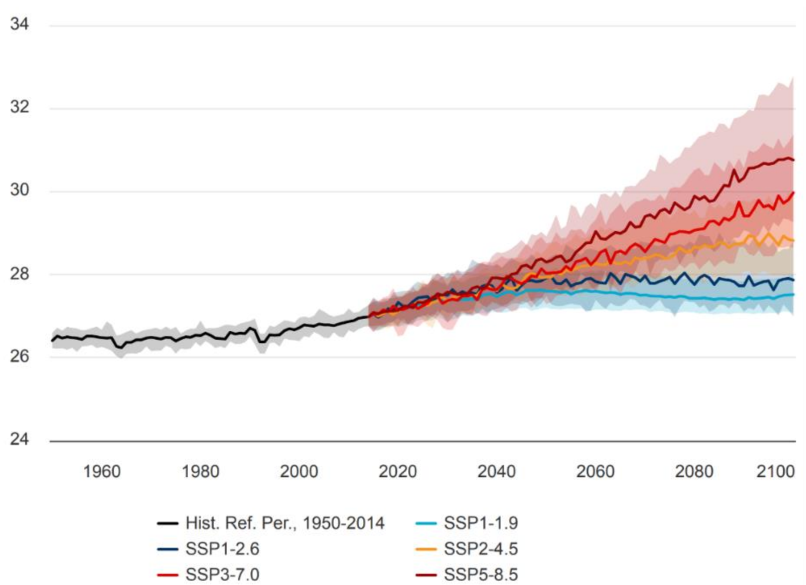


Figure 4.13: Projected Average Mean Surface Air Temperature Lagos, Nigeria; (Ref. Period: 1995-2014), Multi-Model Ensemble

The chart in Figure 4.14 is the quarterly projection of maximum temperatures around Lagos for the next 100 years

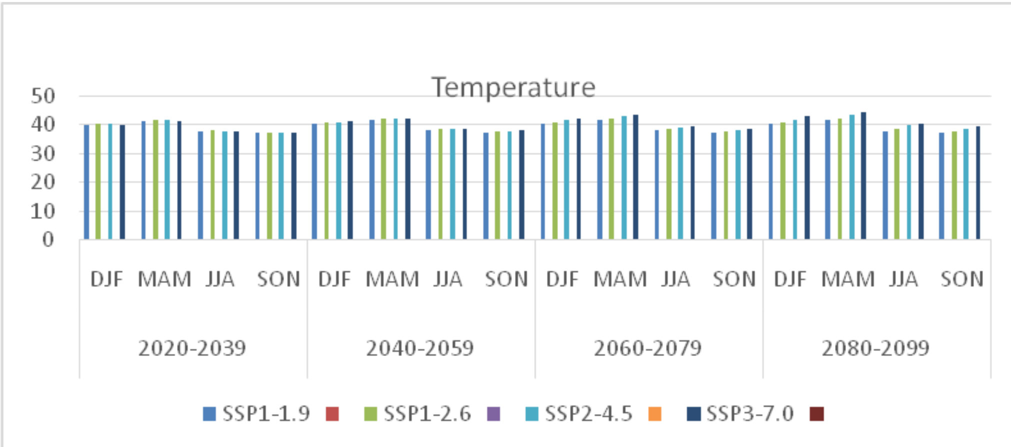


Figure 4.14: Projected maximum temperatures around Lagos for the next 100 years

Projected Change in Seasonal Precipitation as Percentage - Projected percent change in total precipitation for the data aggregation period, shown below by season. This is a useful indicator for contextualizing projected precipitation anomalies, or changes. Percent change should be compared with precipitation anomalies to understand absolute values of precipitation (mm) to gain a more complete understanding of projected changes in precipitation dynamics. The identified sub-national units with the highest and lowest values reflect the projected time period, 2040-2059.

Units:%	**2020-2039**					**2040-2059**				**2060-2079**				**2080-2099**		
Scenario	**DJF**	**MAM**	**JJA**	**SON**	**DJF**	**MAM**	**JJA**	**SON**	**DJF**	**MAM**	**JJA**	**SON**	**DJF**	**MAM**	**JJA**	**SON**
SSP1-1.9	99.26 (77.8, 119.7)	98 (87.59, 110.67)	100.39 (90.53, 110.91)	102.39 (90.45, 115.73)	97.81 (75.58, 118.94)	96.69 (85.87, 107.98)	99.49 (89.21, 110.54)	101.6 (89.38, 116.39)	97.6 (77.94, 116.81)	97.33 (87.43, 107.04)	98.82 (90.1, 109.88)	100.46 (89.5, 114.79)	97.94 (80.47, 115.82)	97.62 (88.13, 107.64)	98.72 (89.95, 108.64)	100.06 (88.94, 112.25)
SSP1-2.6	102.62 (75.73, 125.65)	98.47 (87.66, 111.51)	100.11 (91.36, 110.76)	103.06 (89.87, 113.19)	99.96 (76.96, 120.38)	96.53 (85, 109.8)	101.19 (88, 112.86)	103.76 (88.34, 118.92)	100.08 (73.19, 119.86)	98.36 (87.25, 110.71)	102.28 (91.12, 114.75)	103.24 (89.88, 121.59)	98.51 (77.45, 122.67)	96.6 (86.89, 112.2)	101.16 (90.86, 114.36)	103.1 (87.56, 118.95)
SSP2-4.5	99.04 (77.62, 118.56)	98.34 (89.02, 109.42)	100.43 (90.51, 111.16)	103.94 (90.63, 118.33)	96.7 (70.3, 118.93)	95.19 (82.09, 108.58)	99.18 (88.54, 111.45)	103.59 (90.69, 118.89)	98.69 (68.53, 125.35)	94.31 (83.84, 108.51)	99.91 (91.58, 112.64)	104.41 (91.31, 130.55)	97.59 (63.9, 122)	96.26 (80.56, 110.43)	103.16 (86.47, 115.94)	105.71 (88.09, 132.26)
SSP3-7.0	98.29 (72.24, 120.33)	96.7 (84.97, 114.84)	100.53 (89.73, 113.47)	100.9 (90.72, 117.1)	96.78 (62.39, 133.29)	94.99 (82.4, 109.8)	100.92 (87.25, 115.71)	103.1 (87.48, 129.37)	96.71 (57.69, 139.99)	92.18 (76.5, 106.73)	99.44 (81.2, 123.63)	105.61 (85, 138.27)	106.66 (55.12, 147.11)	89.02 (71.08, 108.99)	97.69 (79.7, 127.23)	109.07 (84.12, 152.17)

Table 4.7 Projection for Percentage Change in Annual Rainfall over Lagos

Projected Change in the Average Largest 1-Day Precipitation - Projected anomaly, or change, in the average highest precipitation amount in a 1-day period during each month in the data period, shown below by season. This indicator can be useful in understanding potential change in large precipitation events; this should not be confused with extreme precipitation events. Average Largest 1-Day Precipitation can be compared with mean precipitation anomalies to Identify differences and changes in precipitation dynamics. The identified sub-national units with the highest and lowest values reflect the projected time period, 2040-2059.

Table 4.8: Projected Change in the Average Largest 1-Day rainfall in Lagos

Units: mm	**2020-2039**				**2040-2059**				**2060-2079**				**2080-2099**			
Scenario	**DJF**	**MAM**	**JJA**	**SON**	**DJF**	**MAM**	**JJA**	**SON**	**DJF**	**MAM**	**JJA**	**SON**	**DJF**	**MAM**	**JJA**	**SON**
SSP1-1.9	18.3 (12.92, 25.14)	35.01 (25.16, 51.38)	62.15 (45.3, 80.8)	47.83 (32.08, 69.67)	18.08 (12.98, 24)	34.54 (24.51, 53.09)	63.7 (45.37, 84.45)	48.23 (32.8, 72.99)	18.41 (13.22, 24.46)	35.26 (25, 53.66)	64.36 (47, 85.73)	47.97 (32.26, 73.91)	18.34 (13.5, 24.18)	35.41 (25.14, 53.19)	63.85 (46.4, 86.4)	47.53 (32.3, 73.25)
SSP1-2.6	18.74 (13.05, 26.47)	34.48 (25.04, 50.45)	59.81 (45.64, 77.74)	46.8 (33.87, 62.55)	18.04 (13.3, 23.66)	32.25 (24.9, 47)	64.75 (45.89, 83.62)	48.37 (29.62, 69.36)	18.8 (13.36, 24.72)	36.95 (25.96, 55.3)	65.46 (47.94, 80.82)	48.66 (31.91, 72.75)	17.83 (13.27, 24.13)	37.78 (26.49, 50.98)	63.52 (46.84, 80.92)	47.42 (32.11, 69.26)
SSP2-4.5	18.57 (12.99, 24.14)	35.23 (24.96, 48.64)	60.75 (44.08, 76.25)	47.62 (31.84, 68.62)	17.54 (12.69, 23.07)	36.74 (25.14, 55.82)	61.23 (42.47, 78.62)	49.54 (35.85, 73.09)	18.17 (12.31, 24.47)	36.85 (25.67, 52.63)	64.33 (47.09, 84.05)	48.95 (35.45, 71.88)	17.31 (12.45, 23.82)	36.16 (26.55, 48.72)	65.31 (47.9, 84.15)	52.64 (36.49, 75.82)
SSP3-7.0	17.54 (12.33, 25.33)	35.78 (25.7, 55.47)	64.87 (44.61, 84.48)	47.94 (27.87, 74.77)	17.74 (11.9, 23.75)	33.22 (22.5, 56.43)	63.93 (45.18, 85.3)	50 (33.29, 75.15)	18.15 (11.01, 26.18)	35.28 (24.63, 53.32)	66.63 (46.76, 85)	51.62 (32.59, 82.44)	19.5 (12.16, 25.74)	37.48 (23.69, 61.19)	67.97 (42.85, 92.07)	54.45 (33.01, 83.67)

https://climateknowledgeportal.worldbank.org/country/nigeria/climate-data-projections

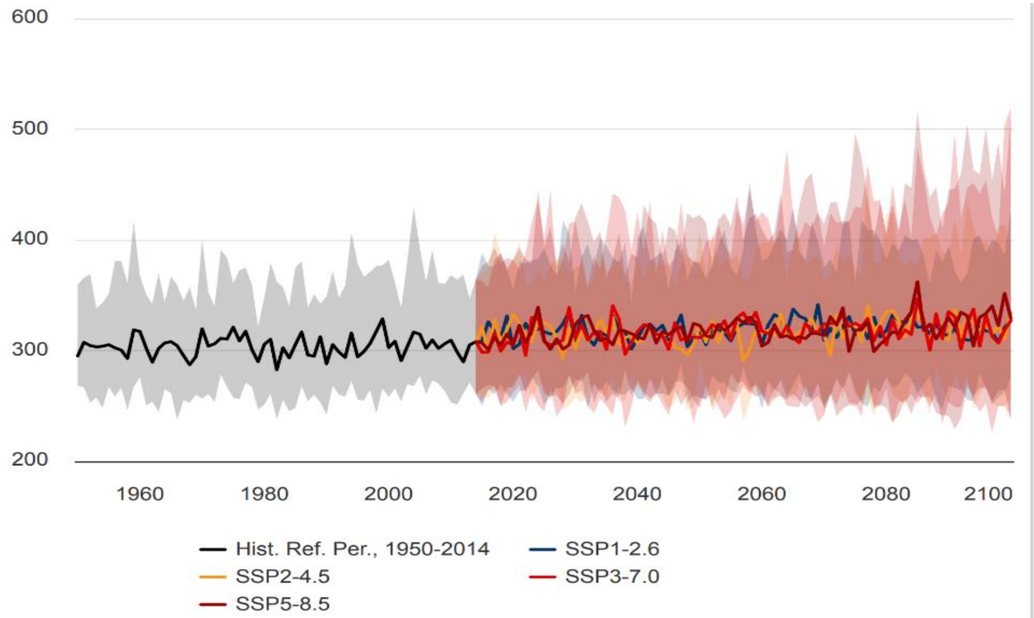


Figure 4.15: Projected Average Largest Monthly Cumulative Precipitation Lagos, Nigeria; (Ref. Period: 1995-2014), Multi-Model Ensemble

The projected annual amount of rainfall during wettest days Anomaly for 2080-2099 in Nigeria is presented in Figure 4.16.

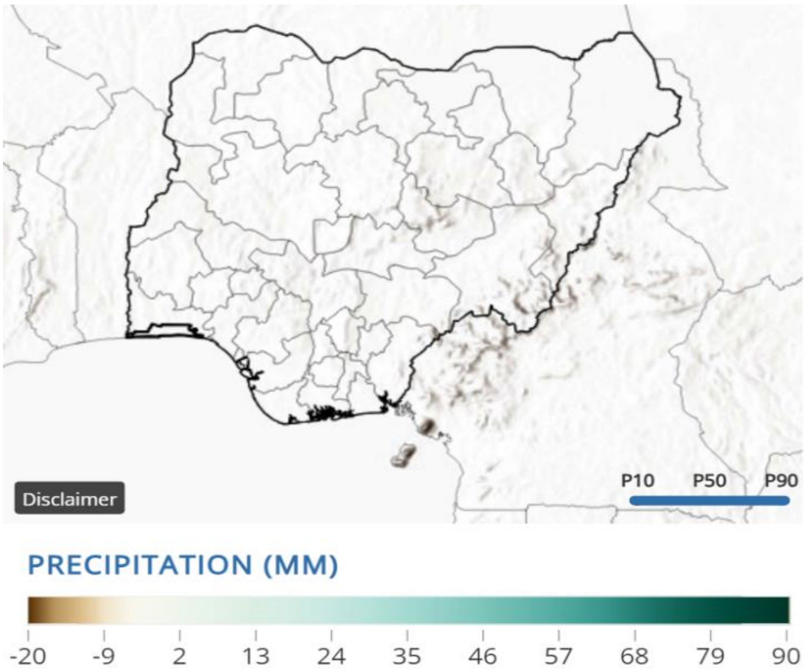


Figure 4.16: The projected anomaly for annual amount of rainfall during wettest days for 2080-2099. (Ref. Period: 1995-2014), SSP5-8.5, Multi-Model Ensemble

4.4.1 Topography and Geology

Lagos, Nigeria, sits on diverse topography, ranging from coastal plains to marshlands. Geomorphologically, it features a mix of low-lying areas, elevated plateaus, and scattered hills. Understanding its topography, geomorphology, and geology is crucial for urban planning, infrastructure development, and mitigating natural hazards, ensuring sustainable growth in one of Africa's largest and most dynamic metropolitan areas.

Terrain: The digital elevation and contour lines at 20-meter interval for Lagos is presented in **Figures** 4.17 and 4.18 respectively.

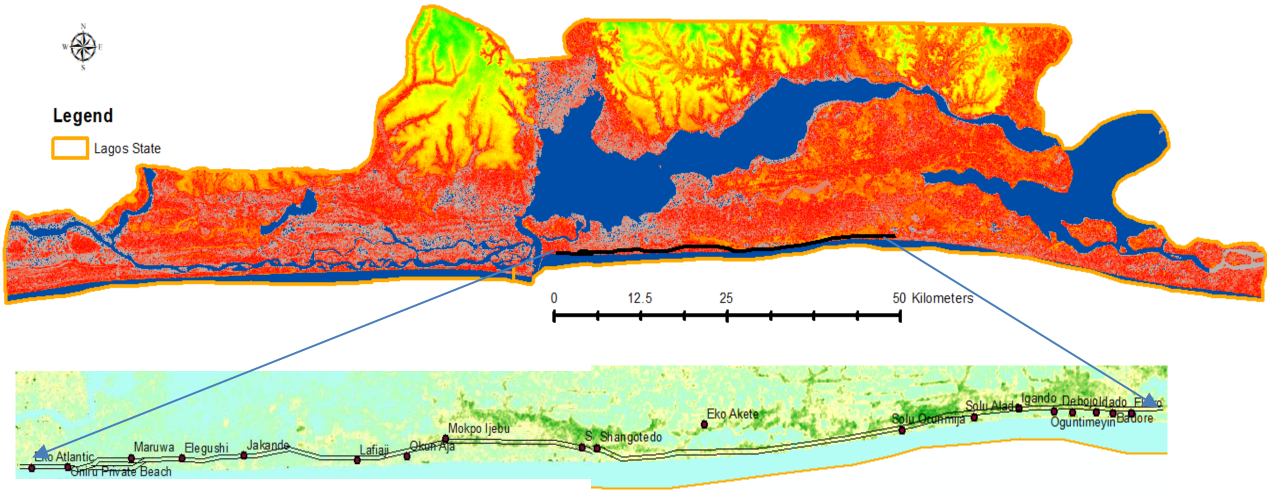


Figure 4.20: Digital Elevation Model of Lagos

Figure 4.17: Contour/Isolines of Lagos

The contour lines show that the southern end of Lagos, particularly the south eastern portion, shows large invariance in the topography. Most of the locations fall between 0 and 5 meters above mean sea level.

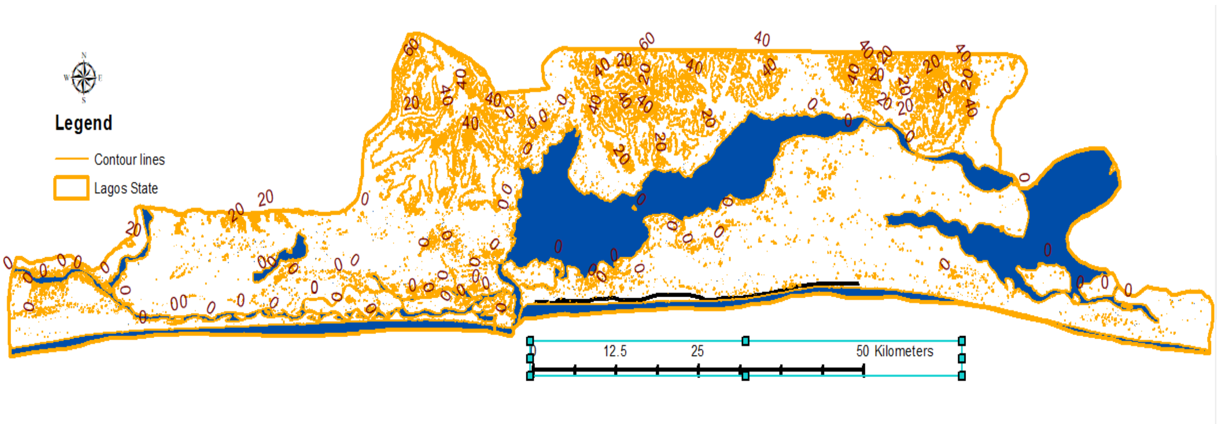


Figure 4.18: Contour/Isolines of Lagos

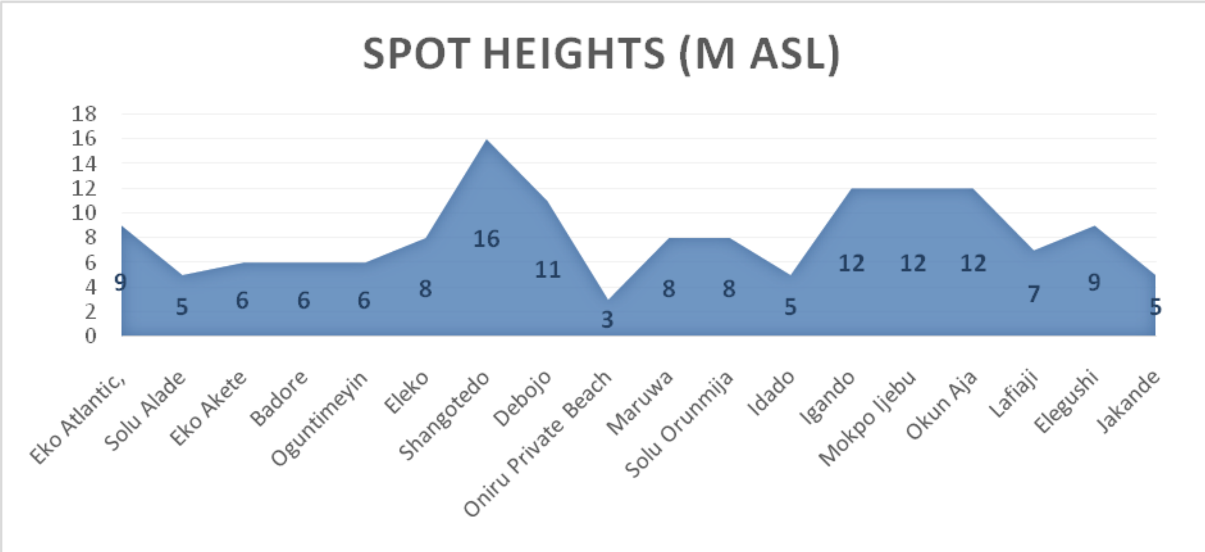


Figure 4.19: Spot heights of the sampling locations

Conducting topographic surveys and analyzing elevation, slopes, and contours, engineers and planners can make informed decisions about road design, alignment, and infrastructure placement to ensure the safety and efficiency of the coastal road project in Lagos.

4.4.2 Geology of Lagos

The geology of the coastal areas of Lagos, Nigeria, is characterized by a complex interplay of sedimentary and alluvial deposits. The region primarily features Quaternary sediments, including sandy, silty, and clayey materials deposited by historical marine and riverine processes. The coastal zone of Lagos is underlain by a variety of sediment types, such as deltaic deposits and coastal plains, which are shaped by dynamic processes including erosion, sediment transport, and deposition.

These geological conditions present significant challenges for coastal road construction. The loose, unconsolidated sediments are prone to high compressibility and low shear strength, which can lead to issues such as ground subsidence and instability. Additionally, the high-water table in the coastal areas increases the risk of flooding and soil saturation, further complicating construction efforts. Erosion and sedimentation can also undermine road foundations and lead to frequent maintenance needs.

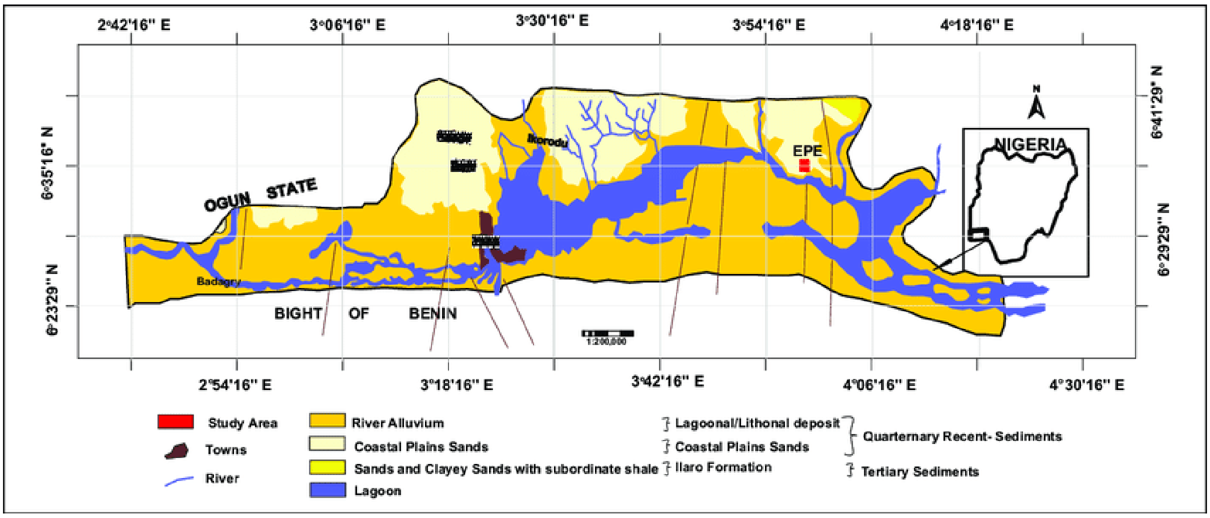


Figure 4.20: Geology Map of Lagos (Akintunde et al., 2021)

4.4.3 Geomorphology

The general geomorphology of Lagos as described by Akintunde et al., (2021) can be represented in the map below.

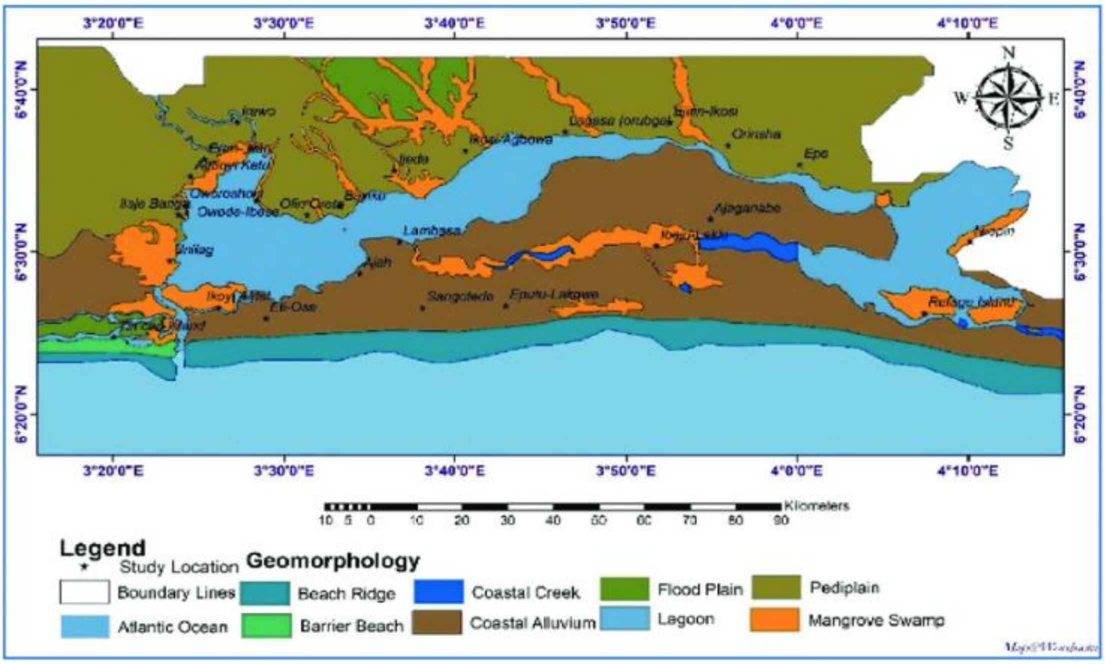


Fig. 4.21: Geomorphology of Lagos (Akintunde et al., (2021)

An excerpt from the map shows that the study area is mainly composed of Coastal creek, Coastal Alluvium, Beach ridge and mangrove swamp as shown in figure 4.21 above. The implication of the geomorphology is found in the push-cost of the road construction which includes search for road bed materials to replace the relatively unstable alluvium. The other coast is loss of sensitive ecological areas including mangroves.

Groundwater Level Measurements

Groundwater level measurements in coastal areas of Lagos are critical for assessing the potential impacts on coastal road construction. High groundwater levels can lead to soil instability, increased erosion, and foundation challenges, compromising road integrity and safety. Monitoring groundwater helps in predicting these risks and designing appropriate mitigation measures.

The baseline data collection involves direct measurement of static water levels of wells from Ode-Omi (end of section 2) to Eleko junction (end of section 1).

The result of this reveals an average well depth of 2.5 m and below surface water level of level less than 1 m. The result of water quality assessment is presented in the tables and spatial maps as presented below.

Fig. 4.22: Water level measurement at different locations in the study area

Geophysical Survey (VRT and ERT)

The geophysics of coastal areas in Lagos reveals significant complexities that impact coastal road construction. The region's geology includes a mix of sandy, silty, and clayey soils, often with a high-water table, which can lead to challenges such as soil liquefaction and erosion. The coastline is subject to dynamic processes including wave action, tidal forces, and sediment transport, which can exacerbate coastal erosion and affect the stability of construction sites.. Figure 5.4 is the map of Transverse resistance across Lagos state.

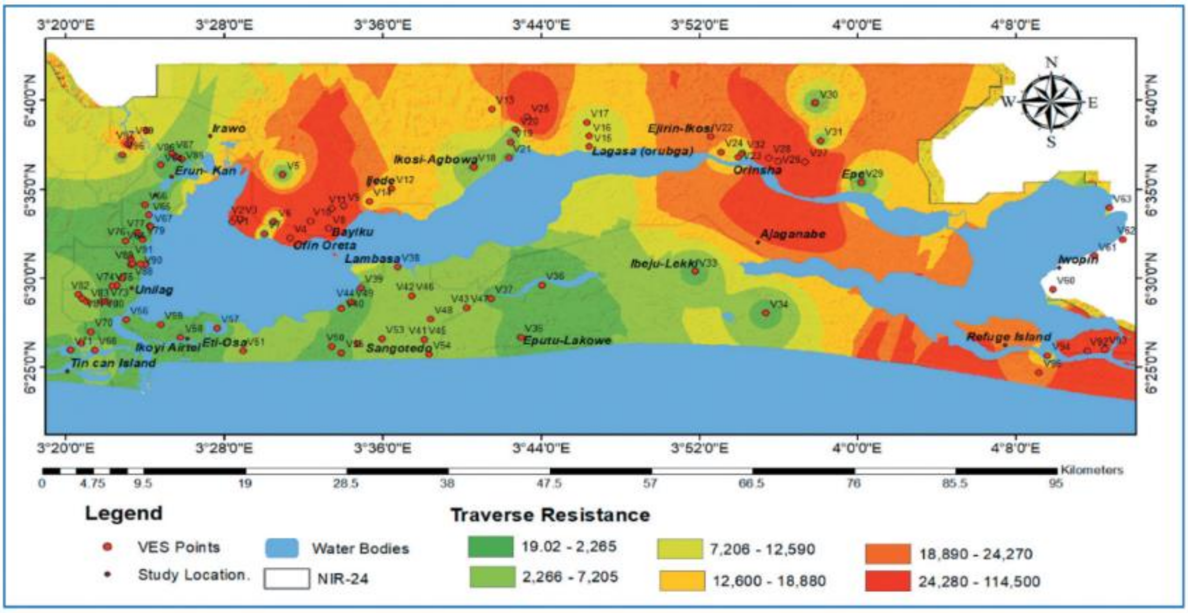


Fig. 4.23: Transverse Resistance around Lagos Coastal areas.

Resistivity measurements in geophysical surveys, such as those conducted using Electrical Resistivity Tomography (ERT), can provide valuable insights into groundwater flow direction and behavior.

High Resistivity is often associated with materials like dry sands, gravels, or rocks, while Low Resistivity typically indicates wet soils, clays, or areas with higher moisture content. Mapping these variations, shows zones of high and low resistivity, which can help in understanding the distribution of groundwater and potential flow pathways. Groundwater typically flows from areas of higher hydraulic head (potential energy) to areas of lower hydraulic head. From the map resistivity in figure 5.4, we can infer the groundwater how groundwater might be moving through different geological units. For instance, low-resistivity zones might represent more permeable or saturated areas, suggesting preferred pathways for groundwater flow.

Drainage Pattern Analysis

The drainage networks of the project area are intricate systems designed to manage both surface runoff and tidal influences. These networks are vital for preventing flooding and maintaining coastal stability. Lagos, with its extensive coastline and dense urban development, faces significant challenges in integrating drainage systems with coastal road construction. Poorly managed drainage can lead to frequent flooding, road deterioration, and increased maintenance costs. Additionally, coastal erosion exacerbates these issues, undermining road foundations and requiring continuous reinforcement.

Effective drainage planning is crucial to mitigate these impacts, involving strategies such as incorporating elevated roadways, enhancing stormwater management systems, and utilizing coastal protection measures. Failure to address these factors can result in increased vulnerability to climate change impacts, including rising sea levels and intensified storm events, further complicating road construction and maintenance in these sensitive coastal zones. The map below shows the dendritic nature of the drainage networks.

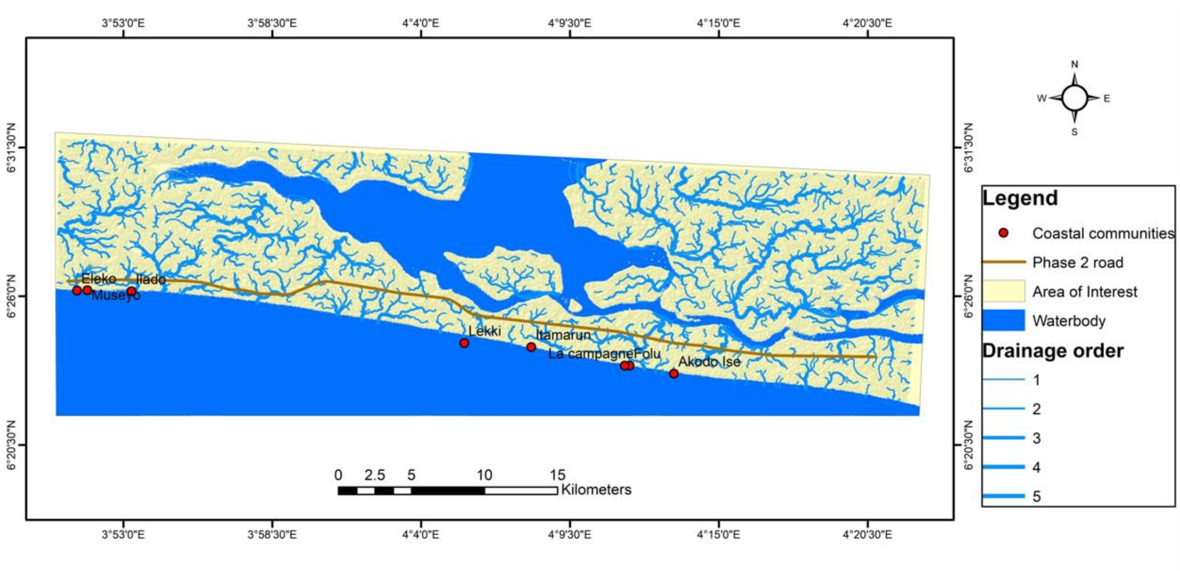


Fig. 4.24: Convolution of drainage networks in the project area.

Despite these convolutions, the area close to the ocean are heavily water logged because of slope and recharge from the ocean. Similarly, the creeks do not drain directly into the ocean, they usually end up with sand ridge blocking their direct access to the ocean. Hence, the flow rate is usually imperceptible.

Flood characteristics and potentials

Flooding in coastal areas of Lagos is a significant concern due to a combination of natural and anthropogenic factors. These regions experience high water table levels and are frequently impacted by heavy rainfall, storm surges, and tidal fluctuations. Lagos' coastal topography and low elevation exacerbate the flooding risks, making these areas particularly vulnerable. The interplay between urbanization and inadequate drainage infrastructure further amplifies the flood potential, leading to frequent and severe inundation events.

The map in figure 5.6 is the flood risk simulation for the project area.

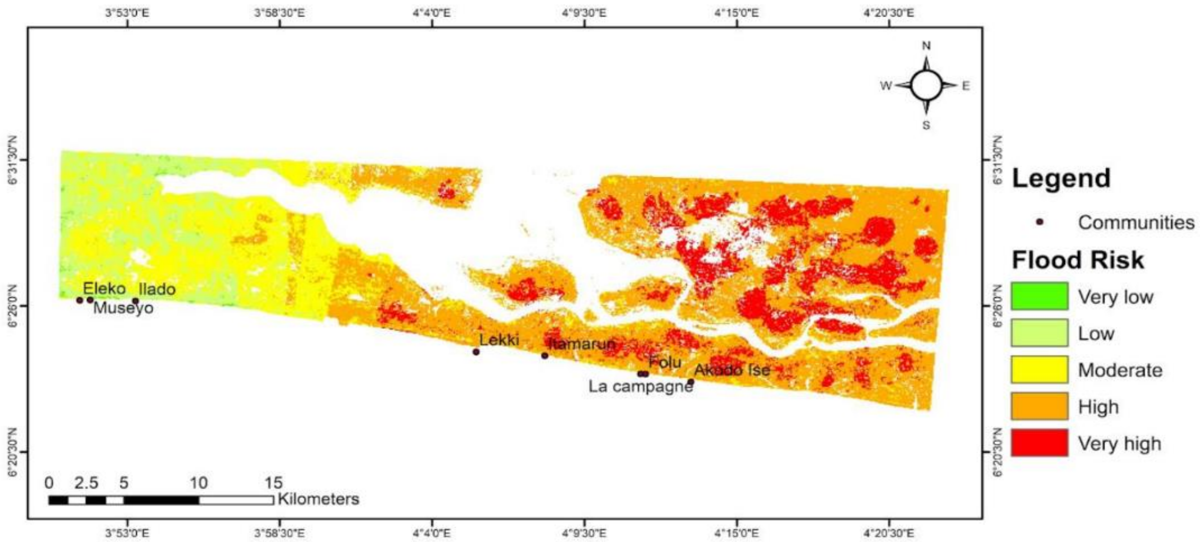


Fig. 4.25: Flood risk map of the project area.

The map indicates that from the eastern portion of section II namely; Idaso, Itamarun, Lacampaigne, Folu up to Akodo-Ise and beyond are prone to high to very high flood risks compared to the western portion including Eleko, Museyo, Ilado, Magbon and Orimedu.

Figures 5.7 and 5.8 show the drainage density and drainage length respectively. These maps help to explain the flood risk map in figure 5.6. Higher values of drainage density imply a landscape that is highly dissected by streams and rivers

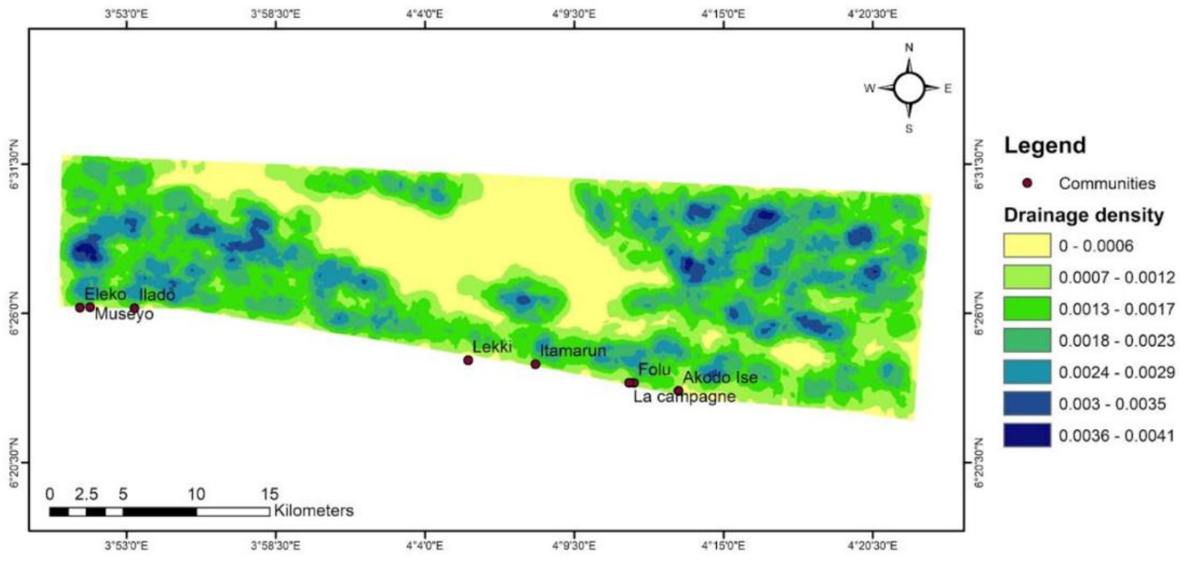


Fig. 4.26 Drainage density map of the project area

In regions with high drainage density, the concentration of water flow into numerous channels can lead to the rapid onset of flash floods, especially during heavy rainfall events. High drainage density often means that water quickly flows over the surface, leading to faster runoff during rainfall. This can increase the likelihood of flooding in the area, especially if the drainage network is dense and closely spaced. Areas with high drainage density are typically more prone to erosion, as the numerous channels can transport sediment more efficiently. This can lead to the degradation of soil and landscape stability over time. High drainage density suggests that the landscape may have lower permeability, reducing the amount of water that infiltrates into the ground. This can lead to a higher volume of surface runoff and reduced groundwater recharge. In coastal areas, high drainage density might also indicate a more fragile ecosystem that could be easily disturbed by changes in land use, such as road construction, necessitating careful management and mitigation strategies.

The total length of all the streams and rivers in a drainage basin otherwise regarded as drainage length, is a crucial factor in evaluating flood risks for coastal road projects, influencing the design and placement of infrastructure. Figure 5.8 shows the drainage length in the project area.

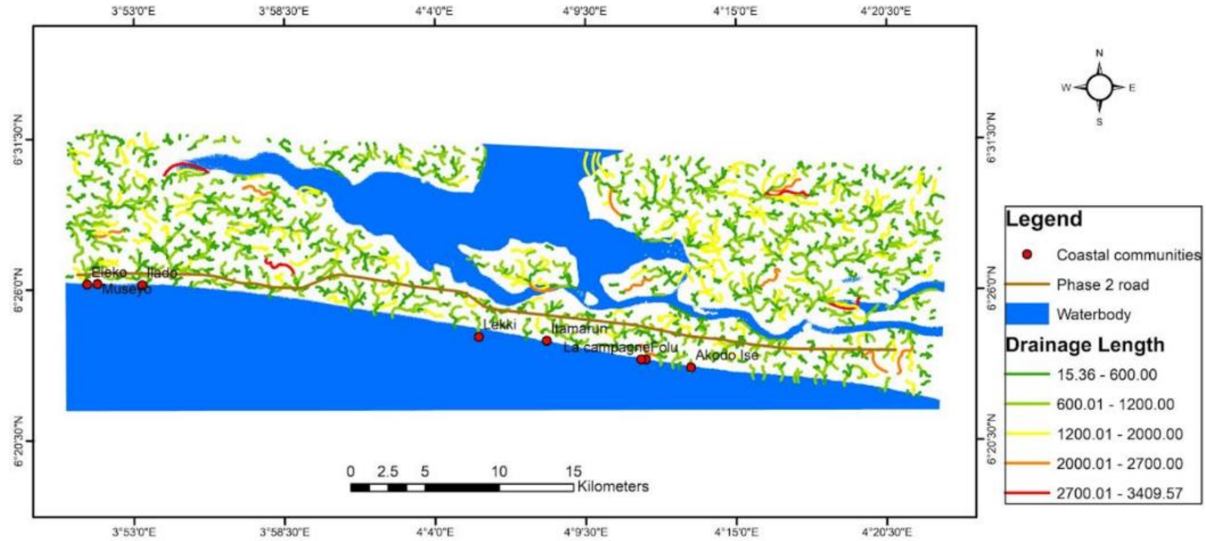


Fig. 4.27: Drainage length map of the project area

Longer drainage lengths can lead to the concentration of water flow along defined channels. If these channels are not adequately managed, they can direct large volumes of water towards specific areas, increasing the risk of flooding, particularly during heavy rainfall. The drainage length also affects how water is routed through the landscape. In areas with longer drainage networks, floodwaters may take longer to move through the system, potentially causing prolonged flooding. Conversely, in shorter drainage systems, water may move rapidly, leading to flash floods. In the eastern potion of the project area, the drainage is generally, longer and as such the water drains slowly and more flood are noticed after slight rainfalls.

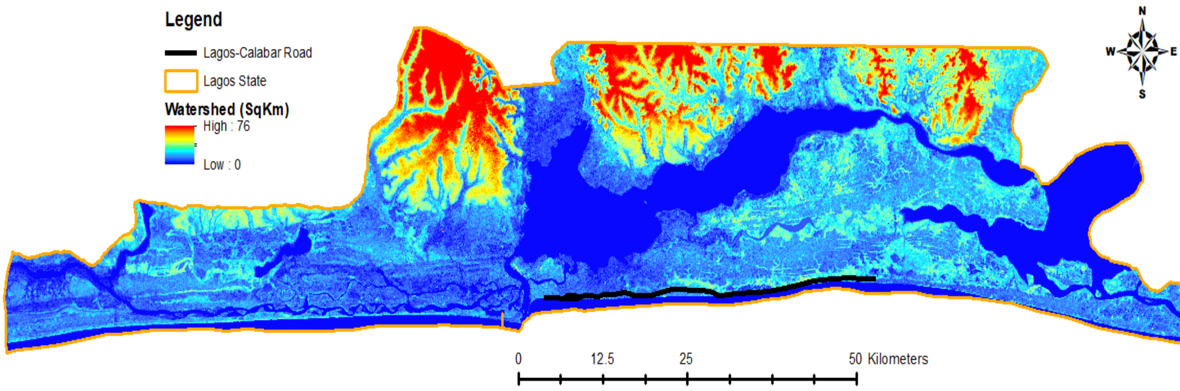


Figure 4.28: The Map of Watershed in Lagos State

A cursory look at the image also suggests that the coastal areas where the proposed road project is located also have moderately high watershed of up to 50 percent of the ones from the north. The drainage basin or catchment area, where all the water, including runoff, drains into common outlet at the southern part of the state is not pronounced because of the topography between 0 to 15 meters ASL. This merely suggests that the flow rate is not as fast as it is in the upper basins, hence the pronounced swamps and marishes at the south. Road compaction could further arrest the rate of flow thereby constituting in more stagnation and creation of ponds along the northern side of the corridor and also at locations on the southern side of the road where, nested settlements form obstructions to run offs.

***Flow Direction*:**: These maps are essential in hydrological modeling, aiding the simulation of surface water movement across landscapes. They determine drainage patterns, contribute to flow accumulation calculations, and assist in terrain analysis by identifying watershed boundaries and slope characteristics. Crucial for flood modeling and erosion prediction, these maps help understand water behavior in ecosystems. They are fundamental tools for studying and managing watersheds, guiding decisions related to water resource management and environmental conservation. Generally, a southwesterly direction is prevalent. Incidentally, the flow direction reveals that water will not collect along the corridor. This is particularly helpful in the design of the concrete drainage channels along both sides of the proposed corridor. Most of the water accumulating in section one of the road should be channeled into a concrete drainage westward while run offs from section two of the corridor should be channeled eastwards as presented in Figure 4.28.

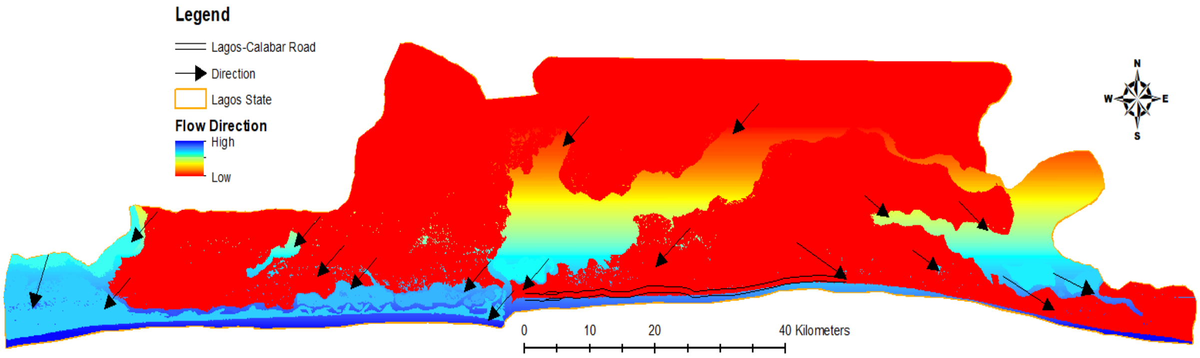


Figure 4.29: **The prevailing direction of runoff water flow**

Basin, Flow Length and Flow Accumulation: Further analysis reveals that the project areas do not have varying values in flow length, flow accumulation, and basin. This clearly suggests that the terrain lacks significant variations in slope or relief. Essentially, it indicates a relatively flat or uniform landscape where water flow is evenly distributed, without preferential pathways or concentrated drainage patterns. In hydrological terms, this may imply a gentle or uniform terrain where water movement is relatively consistent across the entire area, with no pronounced channels or basins of accumulation.

While the uniformity of flow characteristics may simplify some aspects of road design, careful planning and consideration of various factors are still necessary to ensure the construction of a safe, resilient, and environmentally sustainable coastal road. In designing such roads several considerations should arise:

Drainage Planning: The area lacks pronounced drainage patterns, and this implies proper drainage planning is still necessary to ensure that rainwater and runoff are efficiently managed. Even in uniform landscapes, localized drainage issues can arise, so designing effective drainage systems to prevent water accumulation on and around the road is crucial.

Erosion Control: Although the terrain appears relatively flat, erosion control measures are essential to mitigate the potential impact of rainfall and runoff on the road and surrounding areas. Strategies such as vegetative buffers, retaining walls, and erosion-resistant materials should be considered as mitigations to minimize erosion risks.

Flood Management: Even in areas with uniform flow characteristics, flooding can still occur during heavy rainfall or storm events. Incorporating flood management measures such as adequate road elevation, storm water retention ponds, and flood barriers can help minimize the risk of flooding and protect the road infrastructure.

Road Alignment*:* In uniform landscapes, road alignment may be more flexible compared to areas with complex terrain. However, considerations such as coastal erosion, sea level rise, and future development should still be considered when determining the optimal road alignment to ensure long-term resilience and sustainability.

Environmental Impact: Designing the coastal road also requires careful consideration of its environmental impact. Preservation of natural habitats, conservation of biodiversity, and minimization of disturbance to sensitive ecosystems should be prioritized to maintain the ecological integrity of the area.

Sea Dredging, and Soil Placement

The sand used for reclamation along the coastal highway is primarily dredged from the sea. This dredged sand serves as a stable foundation for soil placement during highway construction. The project aims to reclaim lost shoreline areas by dredging up to 8 meters of sand. After dredging, the excavated soil is carefully placed along the highway alignment. Suitable soil types (such as granular soils, clay soils, and lateritic soils) are used to create a durable roadbed.

The Baseline Assessment for coastal road projects, focusing on the evaluation of the existing environment and key considerations. Kindly refer to the relevant section on the following environmental component which have been considered in this same chapter. Physical environment (examining landforms, topography, and geological features, identifying coastal dynamics, erosion patterns, and sediment transport), ecological environment (assessing biodiversity, habitats (such as wetlands, mangroves, and beaches), and species distribution, understanding ecological processes and interactions), air quality (monitoring air pollutants (e.g., particulate matter, gases) in the project area. considering emissions from construction and traffic), water quality (analyzing parameters like turbidity, nutrients, ph, and contaminants, evaluating impacts on aquatic ecosystems), socio-economic factors (engaging with local communities, assessing livelihoods, cultural heritage, and economic activities)

- In other words, the marine ecosystems and other relevant parameters have been captured in other aspects of this report. Kindly refer to the relevant subsections of the various environmental components

4.4.4 Water Quality

Sampling and analysis of water was done on the groundwater and surfacewater within the area of influence of the project site. The following section presents the report on the quality of the existing groundwater resource of the area.

a) Water Quality Sampling Methodology (Groundwater and Surface water)

Groundwater samples were collected from 11 existing boreholes (10 samples and 1 control) while surface water samples were collected from 10 sampling stations (8 samples and 2 control). These samples were immediately analysed for parameters with short holding analytical time such as pH, dissolved oxygen (DO), electrical conductivity, salinity, temperature, and turbidity. Samples were collected into sterilized and appropriate sampling containers. Samples for physicochemical and heavy metals analyses were collected in plastic containers while those for hydrocarbons were collected in glass bottles. Samples for microbiological analyses were collected in 15ml McCartney sample containers. Collected samples were properly labelled, preserved, stored in an ice chest thermos cooler and transported to the laboratory for analyses. Parameters with short holding analytical time were analyzed in situ, while others were analyzed at the lab. A summary of the laboratory methods used for the various water quality analyses is presented in Table 4.9.

Plate 4.1: Water Sampling Activity and insitu water analysis

Table 4.9: Summary of Laboratory Methods for Water Analysis

Water Parameter	**Analytical Method**
Organics:	
Total Hydrocarbons (THC)	N-Hexane Extract using GC
Total Organic Carbon (TOC)	Dichromate Wet Oxidation (Walkley and Black, 1934)
Metals:	
Alkali Metals (Ca, Mg, Na and K)	Flame Photometry (Jone, 1988
Other Metals: (Cr, Cu, Fe, Ni, V, Pb, Zn, Cd, Hg, and Mn)	Atomic Absorption Spectrophotometry (AAS)
Physico-chemistry:	

TDS/TSS	TDS/TSS meter (APHA 209C)
BOD_5	Titrimetric (Winklers APHA 422)
TOC	Titrimetric, wet digestion (APHA 422)
Anions (SO42-, NO3-, PO43-, Cl-)	Colorimetric, autoanalyzer (ASTM 3867, APHA 427C)
Alkalinity	Titrimetric (APHA 427C)
Microbiology:	
Heterotrophic Bacteria	Plate count
Culturable Fungi	Plate count
Coliform Bacteria	Plate count, MPN (Crickshank, 1975)

b) Microbiology

Surface and groundwater, bottom sediments and soil samples were collected into sterile plastic bottles and polythene bags, kept at 2-6°C and analysed for microbial contents.

- ***Heterotrophic Bacterial Counts***

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

- ***Determination of Fungal Content***

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

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

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

Laboratory Analysis Procedures

Sample collection, handling, storage, transfer to the laboratory, data coding and documentation followed the FMEnv's EIA procedural guidelines. All the samples collected on the field were preserved in ice chests and immediately taken to the laboratory. The samples were then stored adequately with the sediment samples stored in designated freezers at - 4°C and water samples stored in well cooled refrigerators prior to analysis. ***Table 2*** shows analysis procedures employed.

Table 4.10: Analytical procedure

Parameter	***Method/Instrument***
Temperature (°C)	Hanna portable digital meter
pH	Hanna portable digital meter
Conductivity (µS/cm)	Hanna portable digital meter
TDS (mg/L)	Hanna portable digital meter
TSS (mg/L)	Gravimetry
Turbidity (NTU)	Turbidity meter
DO (mg/L)	Hanna DO Meter and Test Kit
BOD_5 (mg/L)	DO measurement after 5 days
COD (mg/L)	Dichromate/titrimetry
Alkalinity ($mgCaCO_3/l$)	Titrimetry
Salinity as chloride (mg/L)	Titrimetry
Total hardness ($mgCaCO_3/l$)	Titrimetry using EDTA
Sulphate (mg/L)	Turbidimetry
Phosphate (mg/L)	Spectrophotometry
Nitrate (mg/L)	Spectrophotometry
Ammonia (mg/L)	Nesslerisation
Hydrogen sulphide (mg/L)	Titrimetry
Oil and grease (mg/L)	Extraction / Spectrophotometry
Total hydrocarbon (mg/L)	Extraction / Gas chromatography
Calcium (mg/L)	Titrimetry using EDTA
Magnesium (mg/L)	Titrimetry using EDTA
Cadmium (mg/L)	Atomic Absorption Spectrophotometer (AAS)
Chromium (mg/L)	AAS
Copper (mg/L)	AAS

Parameter	***Method/Instrument***
iron (mg/L)	AAS
Lead (mg/L)	AAS
Manganese (mg/L)	AAS
Nickel (mg/L)	AAS
Vanadium (mg/L)	AAS
Zinc (mg/L)	AAS

AAA: Atomic absorption spectrometry, GC, Gas chromatography

Source: FEPA, 1991

The samples were analysed at Bato Chemical Laboratory Limited, Lagos, Nigeria except plankton and benthos samples which were analysed at the Global Oikos Solutions Ltd. Laboratory analysis was carried out in line with the respective samples analytical time as recommended in FEPA (1991) and APHA *et al*, 1989; Golterman *et al*., 1978; and US EPA (1979).

Quality Control/Quality Assurance (QA/QC) Procedures

QA/QC procedures cover all aspects of the study, including sample collection and handling, laboratory analyses, generation of data and coding, data storage and treatment and report preparation. The quality assurance programme employed in the fieldwork and laboratory analyses were in accordance with *FMEnv guidelines.*

- ***Sample Collection and Handling***

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

- ***Sample Identification***

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

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

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

The various instruments and equipment for measuring physico-chemical parameters used were in good working condition. Periodic control checks were usually carried out on such instruments/equipment and the performance record maintained. The pH meters were calibrated using HACH commercial buffer standards. Appropriate colour standards of diluted potassium dichromate or potassium permanganate solutions are frequently used to check the wavelength settings and sensitivities of the absorption spectrophotometer. For analytical determination requiring the use of calibration curves, such curves were plotted using standard solutions prepared from analytical grade reagents. Records of such calibration curves were maintained and frequent re-calibration checks were carried out. Analytical blanks were incorporated per specific batches of samples to compensate for the sample preparation and determination steps. All the analyses were replicated and the means were reported.

- ***Storage/Preservation***

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

- ***Chain of Samples Custody Procedure***

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

a) sample reference number;

b) nature or type of sample;

c) site of collection;

d) date and time of collection; and

e) Mode of preservation (depends on nature of material) and analytical data from the field

And results of laboratory analyses of representative samples.

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

- ***Evaluation of Results***

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

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

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

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

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

A. **Groundwater Baseline Description**

Temperature

The temperature of water influences the chemical and biological processes. The temperature of the water sampled at different locations including the control location ranged from 28.1 to 28.3 ^{O}C in the wet season. This temperature quality agrees with the National water quality temperature range of 20 - 33^{o}c of water used to support life (FEPA, 1991).

pH

The measurement of pH in water is the measurement of the negative logarithm of the hydrogen ion concentration. The pH scale ranges from 1 to 14 and a value of 7 is neutral. Acidic conditions have a pH value less than 7 and basic conditions have a value greater than 7. The measurement of the pH of groundwaters is important because many pollutants increase in toxicity with changes in pH and the ability of aquatic organisms to survive greatly diminishes as the pH falls below 5 or increases above 9.

The pH values of the groundwater samples during the wet season ranged from 6.8 to 7.5 in all the sampling locations including the control location where the pH was 6.9, this pH range falls within the neutral range of 6.5-8.5 specified by WHO and FMEnv.

Turbidity

The turbidity of water is a measure of the extent to which the intensity of light passing through is reduced by suspended or colloidal matter (McKee and Wolf, 1963). The turbidity unit for all the groundwater sampling locations including the control ranged from 0.25 – 18.3NTU in the wet season. Typically, turbidity values for groundwater are expected to be higher during the rainy season than dry season levels due to the ingression of floodwaters that typically carry a high sediment load during the wet season.

Total Dissolved Solids

Total dissolved solids (TDS) in water consist of dissolved mineral salts that change the physical and chemical properties of the water. The TDS values of the wet season study ranged from 81- 459.7 mg/L for groundwater. The TDS values are lower than the limit set by both FMEnv and WHO.

Dissolved Oxygen

The Dissolved oxygen (DO) is the measure of the amount of oxygen dissolved in water and is considered a direct indicator of water quality. The oxygen content of a water sample is largely determined by a balance between: (a) the exchange of atmospheric oxygen with the upper layer, (b) net increase due to photosynthetic processes and (c) net decrease due to respiratory demands and heterotrophic processes. Concentrations of oxygen below 2 mg/L may lead to the death of most aquatic organisms. The DO values for groundwater in the wet season ranged from 6 – 6.7 mg/L in all the sampling locations including the control, the values obtained were higher than 2 mg/L recommended by FMEnv.

Conductivity

This is the ability of an aqueous solution to carry an electric current. The conductivity of a medium depends on the presence of ions, their total concentration, mobility, valence, relative concentration and the temperature of the system. Electrical conductivity determinations are useful in aquatic studies because they provide a direct measurement of dissolved ionic matter in the water. The conductivity of an aqueous solution is also roughly proportional to the concentration of dissolved solids it contains. Thus, conductivity is useful as an index of total dissolved solids in water. The conductivity values of the groundwater sampled during the wet season ranged from 108.1 - 613 µS/cm.

Chloride

Chloride concentration is a good conservative element to use for quality assurance in a mass balance model because no natural biological or chemical processes remove or add chloride to the groundwater, therefore the mass of dissolved chloride remains constant in the groundwater unless there is a discharge to or withdrawal from the water body. The chloride level for the wet season study ranged from 3.7 – 160.8 mg/L in the groundwater sample. The chloride level of the groundwater exceeded the FMEnv and WHO standard of 600mg/L. Though chloride does not react chemically with species in water and harmless at relatively low concentration, the higher level observed is an indication of excess salinity and mineral pollution.

Nitrate

The nitrate values for the groundwater samples ranged between 2.2- 14.7 mg/L in the wet season. These concentrations were less than the FMEnv standard and WHO standards in all the sampling stations. This indicates a very low nutrient loading of the water body. Typically nitrate concentrations are increased in groundwaters as a result of wastewater discharge, runoff from land application of fertilizers, and groundwater polluted by fertilizers.

Sulphate

Sulphate is an abundant ion in the earth's crust and high concentrations may be present in water due to leaching of gypsum, sodium sulphate, and some shales. As a result of oxidation of pyrites, mine drainage may contain high concentration of sulphate. Sulphate also results from sulfur-containing organic compounds and is also present in many industrial waste discharges. The sulphate concentration in the groundwater body during the wet season study ranged from 5.5– 63.2 mg/L in wet season and it is lower than control and the FMEnv limit.

Chemical Oxygen Demand

The chemical oxygen demand (COD), which represents the total oxygen requirement for all chemical processes within the water body, ranged from a concentration of 8- 20 mg/L for all the groundwater samples collected and analysed during the wet season. The average concentration of Chemical oxygen demand levels (11.60 mg/L) obtained from all the groundwater sampled stations in the wet season study were lower than permissible limit specified by FMEnv. Chemical oxygen demand is fraction of dissolved oxygen, a decrease in dissolved oxygen will lead to increase in Chemical oxygen demand values.

Metals

Many metals are toxic to human life with documented implications on human health as well as environmental health. The metals determined in the groundwater analyses include: silver (Ag), calcium (Ca), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), potassium (K), magnesium (Mg), manganese (Mn), sodium(Na), nickel (Ni), lead (Pb), and zinc (Zn) table below for metal values derived in the wet season of the study.

Calcium

The wet season values of calcium ranged from 13.4 – 40.3 mg/L in the groundwater. These values do not exceed the limit specified by FMEnv. Calcium dissolves out from practically all rocks, and is practically detected in all waters. The level of concentration of the calcium reveals its level of dominance in relation to other ions in the groundwater. Calcium impacts the property of hardness to water.

Magnesium

Like calcium, magnesium ions with all other divalent cation contribute to the hardness of water. The geology surrounding the water body is largely the source of hardness, although some industrial wastes and irrigation drainage could contribute to hardness. The wet season values for the magnesium ions in the groundwater ranged from 1.8 – 7.8 mg/L. These values do not exceed the acceptable limit specified by FMEnv for groundwater samples.

Total Hardness

Total Hardness in water neutralizes the activity of soap, inversely as hardness increases the solubility of the heavy metal decreases. In waters with low hardness, also described as “soft” water, fish and other aquatic organisms become more sensitive to heavy metal uptake because the metals are more water-soluble and this could introduce heavy metals into the food chain. The total hardness in groundwater in the wet season ranged from 10- 200 mg/L.

Iron

Iron is an abundant element in the earth’s crust, but exists generally in minor concentration in natural water systems. The form and solubility of iron in natural waters are strongly dependent upon the pH and the oxidation-reduction potential of the water. The concentration of iron measured in the groundwater during the wet season varied from 0.06 to 3.9 mg/L. The values obtained for the groundwater is within the limit specified by FMEnv.

Zinc (Zn)

Zinc is an abundant element in rocks and ores but it is present in natural water only as a minor constituent because of the lack of solubility of the free metal and its oxides. It is present in trace quantities in most alkaline waters, but more may be present in acid waters. The groundwater had a concentration range of 0.06 – 0.22 mg/L at all sampling stations in wet season.

Nickel (Ni)

The concentration of Nickel for groundwater sampling stations during the wet season was <0.001mg/L. All the values of nickel obtained in the stations sampled during the wet season were lower than the FMEnv limit. The principal sources are minerals and industrial wastes. The metal is carcinogenic. It has variable harmful effects on aquatic life.

Cadmium (Cd)

All the sampling stations for groundwater had concentrations of <0.001 mg/L during the wet season Cadmium in water is due to nearly exclusively industrial discharges (e.g electroplating, paint making, manufacture of plastics etc). It is highly toxic, hence the severe restriction on its concentration in water. The principal physiological effects of cadmium are bone damage and chronic kidney disease. It is also highly toxic to aquatic life.

Lead (Pb)

Lead is a relatively minor element in the earth's crust but is widely distributed in low concentrations in uncontaminated sedimentary rocks and soil. High concentrations of lead result from atmospheric input of lead originating from its use in leaded gasoline or from smelting operations. Wet season values of Pb was not detected in all the groundwater sampling locations.

Potassium (K)

Even though potassium ranks 7th in elemental abundance, its concentration in most natural waters, remains relatively low, seldom reaching 2 mg/L in natural waters. The wet season value of K ranged from 5.8 – 20 mg/L.

Sodium (Na)

Dissolved sodium from weathering of rocks and other sources of sodium salts are very soluble in water and any sodium that is dissolved in groundwaters tends to remain in solution. The wet season sodium values of the groundwater ranged from 4.8 – 50.4 mg/L.

Table 4.11: Results of the Physico-chemical Analysis of the Groundwater Samples analysed during the wet season

PHYSICO-CHEMICAL PARAMETERS	LIMIT	MINIMUM	MAXIMUM	MEAN	CONTROL
GENERAL APPEARANCE	Clear	Brownish	Clear	Clear	Brownish
ELECTRICAL CONDUCTIVITY, umhos/cm	1000	108.1	613	251.61	444.0
TURBIDITY, NTU	NS	0.25	18.3	9.275	2.3

pH, 25 oC	6.0-9.0	6.8	7.5	7.09	6.9
TOTAL DISSOLVED SOLIDS, mg/L	2000	81	459.7	188.67	333.0
TOTAL PETROLEUM HYDROCARBON, mg/L		<0.01	<0.01	<0.01	<0.01
POLY AROMATIC HYDROCARBON, mg/L		<0.001	<0.001	<0.001	<0.001
BTEX, mg/L		<0.001	<0.001	<0.001	<0.001
CHLORIDE, mg/L	600	3.7	160.8	29.79	40.5
NITRATE, mg/L	20	2.2	14.7	7.14	0.76
PHOSPHATE (Total), mg/L	5	0.15	0.39	0.29	1.3
SULPHATE, mg/L	500	5.5	63.2	21.69	4.5
SODIUM, mg/L	NS	4.8	50.4	17.08	16.7
POTASSIUM, mg/L	NS	5.8	20	10.65	12.3
CADMIUM, mg/L	<1	<0.001	<0.001	<0.001	<0.001
CALCIUM, mg/L	200	13.4	40.3	22.75	49.3
CHROMIUM (Hexavalent), mg/L	<1	<0.001	<0.001	<0.001	<0.001
NICKEL, mg/L	<1	<0.001	<0.001	<0.001	<0.001
IRON (Total), mg/L	20	0.06	3.9	0.63	2.5
LEAD, mg/L	<1	<0.01	<0.01	<0.01	<0.01
MAGNESIUM, mg/L	200	1.8	7.8	4.45	16.2
MANGANESE, mg/L	<1	0.03	0.17	0.0831	0.25
ZINC, mg/L	<1	0.06	0.22	0.1319	0.084
DISSOLVED OXGEN, mg/l	>2	6	6.7	6.48	6.3
BIOCHEMICAL OXYGEN DEMAND, mg/l	30	4.5	8.9	6.49	22.8

CHEMICAL OXYGEN DEMAND, mg/l	40	8	20	11.6	40.0
MICROBIOLOGICAL PARAMETERS					
Coliforms, , CFU/ml	0	0	5	2	0
E.Coli, , CFU/ml	0	0	7	1.7	0
Pseudomonas, (HUB), CFU/ml	--	0	17	2.8	0
Bacillus (HUB), CFU/ml		0	15	2.4	0
Yeast/Moulds, , CFU/ml	--	0	20	7.8	05
Total plate count, , CFU/ml	100	264	1737	569.5	186

Source: Natural Ecocapital, 2024

- **B. Surface Water Quality**

Temperature

The temperature of water influences the chemical and biological processes and the aquatic life present in water bodies. The amount of sunlight, rainfall, air temperature, groundwater discharge, and thermal point sources all influence the surface water temperature. Increased water temperature lowers the amount of dissolved oxygen available for the aquatic life present and promotes excessive growth of aquatic plants. The temperature of the water sampled at different locations including the control location ranged from 28.1 to 28.2 ^{o}c. This temperature quality agrees with the National water quality temperature range of 20 - 33^{o}c of water used to support aquatic life (FEPA, 1991).

pH

The measurement of pH in water is the measurement of the negative logarithm of the hydrogen ion concentration. The pH scale ranges from 1 to 14 and a value of 7 is neutral. Acidic conditions have a pH value less than 7 and basic conditions have a value greater than 7. The measurement of the pH of surface waters is important because many pollutants increase in toxicity with changes in pH and the ability of aquatic organisms to survive greatly diminishes as the pH falls below 5 or increases above 9. The pH values of the surface water samples during the wet season ranged from 6.00 to 9.00 in all the sampling locations including the control location where the mean pH was 7.4, this pH range falls within the neutral range of 6.5-8.5 specified by WHO and FMEnv for surface water.

Turbidity

The turbidity of water is a measure of the extent to which the intensity of light passing through is reduced by suspended or colloidal matter (McKee and Wolf, 1963). The turbidity unit for all the surface water sampling locations including the control ranged from 5.0-85.4 NTU in the wet season. Typically, turbidity values for surface water are expected to be higher during the rainy season than dry season levels due to ingression of floodwaters that typically carry a high sediment load during the wet season.

Total suspended solids affect turbidity, the degree of turbidity in water is not equal to the concentration of suspended solids. Turbidity is a measure of only one effect of suspended solids on the quality of water. Other sources of turbidity are microorganisms, algae, dead plant matter, silica or other mineral substances, clay, silt, and fibers. Excessive turbidity affects the aquatic ecosystem in many ways. The penetration of light is reduced therefore reducing photosynthesis and the productivity of aquatic plants. This in turn reduces the amount of food available to the aquatic animals. The low visibility can make food difficult for the aquatic animals to find. Turbidity also affects the temperature of surface waters, where the bottom temperatures are lower in turbid waters than in clear waters.

Total Dissolved Solids

Total dissolved solids (TDS) in water consist of dissolved mineral salts that change the physical and chemical properties of the water. The TDS values of the wet season study ranged from 36.6-39686.00.8mg/L for surface water. The TDS values are higher than the limit set by both FMEnv and WHO. The concentration of TDS in a water body is critical to the aquatic life inside the water body. Although fish can acclimate slowly to higher TDS concentrations than they are accustomed to, they cannot survive a sudden exposure to a high TDS concentration.

Dissolved Oxygen

Dissolved oxygen (DO) is the measure of the amount of oxygen dissolved in water and is considered a direct indicator of water quality. The oxygen content of a water sample is largely determined by a balance between (a) the exchange of atmospheric oxygen with the upper layer, (b) net increase due to photosynthetic processes and (c) net decrease due to respiratory demands and heterotrophic processes. Concentrations of oxygen below 2 mg/L may lead to the death of most aquatic organisms. The DO values for surface water in the wet season ranged from 6.0 – 6.90 mg/L in all the sampling locations including the control, the values obtained were higher than 2 mg/L recommended by FMEnv.

Conductivity

This is the ability of an aqueous solution to carry an electric current. The conductivity of a medium depends on the presence of ions, their total concentration, mobility, valence, relative concentration and the temperature of the system. Electrical conductivity determinations are useful in aquatic studies because they provide a direct measurement of dissolved ionic matter in the water. The conductivity of an aqueous solution is also roughly proportional to the concentration of dissolved solids it contains. Thus, conductivity is useful as an index of total dissolved solids in water. The conductivity values of the surface water sampled during the wet season ranged from 48.9 – 47,900.00 µS/cm.

Chloride

Chloride anion is generally present in natural waters. Chloride concentration in surface waters occurs naturally from the geology but high concentrations typically result from anthropogenic interference, such as runoff of salty storm water or sewage. Chloride concentration is a good conservative element to use for quality assurance in a mass balance model because no natural biological or chemical processes remove or add chloride to the surface water, therefore the mass of dissolved chloride remains constant in the surface water unless there is a discharge to or withdrawal from the water body. The chloride level for the wet season study ranged from 3.3 – 18272.50 mg/L in the surface water sample. The chloride level of the surface water exceeded the FMEnv and WHO standard of 600mg/L. The lower concentration could be due to less pollution by organic wastes. Though chloride does not react chemically with species in water and harmless at relatively low concentration, the higher level observed is an indication of excess salinity and mineral pollution.

Nitrate

Nitrate represents the most oxidized form of nitrogen in the stream. The nitrate values for the surface water samples ranged between 0.12- 1.50 mg/L in the wet season. These concentrations were less than the FMEnv standard and WHO standards in all the sampling stations. This indicates a very low nutrient loading of the water body. Typically nitrate concentrations are increased in surface waters as a result of wastewater discharge, runoff from land application of fertilizers, and groundwater polluted by fertilizers. They are a primary nutrient for rooted aquatic plants and algae and are a concern for water users. Nitrate is less toxic than either ammonia or nitrite, but can cause methemoglobinemia ("blue baby" syndrome) in small children and fish; it can also contribute to algal bloom or produce undesirable taste and odour in a water body.

Sulphate

Sulphate is an abundant ion in the earth's crust and high concentrations may be present in water due to leaching of gypsum, sodium sulphate, and some shales. As a result of oxidation of pyrites, mine drainage may contain high concentration of sulphate. Sulphate also results from sulfur-containing organic compounds and is also present in many industrial waste discharges. The sulphate concentration in the surface water body during the wet season study ranged from 1.4– 2958.00 mg/L with average of 826.43 mg/L in wet season and it is higher than the FMEnv limit.

Chemical Oxygen Demand

The chemical oxygen demand (COD), which represents the total oxygen requirement for all chemical processes within the water body, ranged from a concentration of 12- 2416.0 mg/L along the surface water samples collected and analysed during the wet season for surface water. The average concentration of Chemical oxygen demand levels (497.50 mg/L) obtained from all the surface water sampled stations in the wet season study were higher than permissible limit specified by FMEnv. Chemical oxygen demand is fraction of dissolved oxygen, a decrease in dissolved oxygen will lead to increase in Chemical oxygen demand values.

Hydrocarbon

The hydrocarbon constituent such as Total Petroleum Hydrocarbon, Poly Aromatic Hydrocarbon and BTEX analyzed in the surface water samples across all the sampling location indicate low abundance.

Metals

Many metals are toxic to aquatic animals. They can also bioaccumulate through food chains and this has implications for human health as well as environmental health. The metals determined in the surface water analyses include: silver (Ag), calcium (Ca), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), potassium (K), magnesium (Mg), manganese (Mn), sodium (Na), nickel (Ni), lead (Pb), and zinc (Zn) table below for metal values derived in the wet season of the study.

Calcium

The wet season values of calcium ranged from 1.3 – 1808.40 mg/L in the surface water. These values exceed the limit specified by FMEnv. Calcium dissolves out from practically all rocks, and is practically detected in all waters. The level of concentration of the calcium reveals its level of dominance in relation to other ions in the surface water. Calcium impacts the property of hardness to water.

Magnesium

Like calcium, magnesium ions with all other divalent cation contribute to the hardness of water. The geology surrounding the water body is largely the source of hardness, although some industrial wastes and irrigation drainage could contribute to hardness. The wet season values for the magnesium ions in the surface water ranged from 0.45 – 502.50 mg/L. These values exceed the acceptable limit specified by FMEnv for surface water samples.

Iron

Iron is an abundant element in the earth's crust, but exists generally in minor concentration in natural water systems. The form and solubility of iron in natural waters are strongly dependent upon the pH and the oxidation reduction potential of the water. Surface waters in a normal pH range of 6 and 9 rarely have more than 1 mg of dissolved iron per litre. The concentration of iron measured in the surface water during the wet season varied from 0.63 to 2.1 mg/L. The values obtain for the surface and groundwater is within the limit specified by FMEnv.

Copper (Cu)

Copper is a widely distributed trace element but because most copper minerals are relatively insoluble, only low concentrations are normally present in natural waters. The surface water had no copper detected in wet season.

Zinc (Zn)

Zinc is an abundant element in rocks and ores but it is present in natural water only as a minor constituent because of the lack of solubility of the free metal and its oxides. It is present in trace quantities in most alkaline waters, but more may be present in acid waters. The values of zinc in the surface water during the wet season ranged from 0.04 to 0.27mg/L.

Manganese (Mn)

Manganese values for groundwater ranged from 0.004 - 0.05 mg/L in the wet season. These concentrations achieved at each of the sampling stations are within the permissible limit. Manganese is a relatively common element in rocks and soils where it exists as oxides or hydroxides in the (II), (111), (IV) oxidation states. The solubility of manganese in natural water is largely a function of pH and the oxidation reduction potential. It is therefore not unusual to have these relatively trace values.

Nickel (Ni)

The concentration of Nickel for surface water sampling stations during the wet season <0.001mg/L. All the values of nickel obtained in the stations sampled during the wet season were lower than FMEnv limit. The principal sources are minerals and industrial wastes. The metal is carcinogenic. It has variable harmful effect on aquatic life.

Cadmium (Cd)

All the sampling stations for surface water had the concentrations <0.001 mg/L during the wet season Cadmium in water is due to nearly exclusively industrial discharges (e.g electroplating, paint making, manufacture of plastics etc). It is highly toxic, hence severe restriction on its concentration in water. The principal physiological effects of cadmium are bone damage, chronic kidney disease. It is also highly toxic to aquatic life.

Lead (Pb)

Lead is a relatively minor element in the earth's crust but is widely distributed in low concentrations in uncontaminated sedimentary rocks and soil. High concentrations of lead result from atmospheric input of lead originating from its use in leaded gasoline or from smelting operations. Wet season values of Pb was not detected in all the surface water sampling locations.

Chromium (Cr)

Chromium concentrations in natural waters are always very small. The values of Cr detected during the wet season was <0.001 mg/L in the surface water.

Potassium (K)

Even though potassium ranks 7th in elemental abundance, its concentration in most natural waters, remains relatively low, seldom reaching 2 mg/L in natural waters. The wet season value of K ranged from 7.60 – 237.90 mg/L.

Sodium (Na)

Dissolved sodium from weathering of rocks and other sources of sodium salts are very soluble in water and any sodium that is dissolved in surface waters tends to remain in solution. The wet season sodium values of the surface water ranged from 6.20 – 800.90 mg/L.

Surface Water Microbiology

The microbial load of the surface water samples revealed the presence of different groups of micro-organisms including bacteria and fungi during the wet season study. Heterotrophic bacteria density was not detected in all the samples during the wet season study. No densities of these heterotrophs are a pointer to the low organic matter load of the ecosystem.

The microbial analyses indicate the low absence of hydrocarbon utilizing organisms in the representative samples. Faecal coliform was detected to range from 0-17.00 cfu/ml in all the sampling stations. An indication of the sanitary quality of a water body is determined from faecal coliform bacteria counts. Faecal coliform bacteria are used as an indicator for water contamination and possible existence of waterborne enteric pathogens. This is because coliform bacteria are derived from the digestive tract of mammals. Sources for faecal coliform in surface water are untreated wastewater, failing septic systems, and animal waste. High faecal coliform counts can render the affected water body unsuitable for swimming.

Table 4.12: Summary of Physico-Chemical and Microbiological Analysis Results of Surface Water Samples Collected at the study area

PHYSICO-CHEMICAL PARAMETERS	METHOD	LIMIT	Area of Influence (n=8)			Control (n=2)		
			Minimum	Maximum	Mean	Minimum	Maximum	Mean
GENERAL APPEARANCE		Clear	Brownish	Slightly Brownish	Slightly Brownish	Brownish	Slightly Brownish	Slightly Brownish
ELECTRICAL CONDUCTIVITY, umhos/cm	ASTM D1175	1000	48.9	47900	11925.10	414	47900	24157
TURBIDITY, NTU	ASTM D6855-03	NS	5	5.8	5.23	5.8	85.4	45.6
pH, 25 oC	ASTM D1193	6.0-9.0	6.9	8.4	7.41	6.8	8	7.4
TOTAL DISSOLVED SOLIDS, mg/L	ASTM D5907-03	2000	36.6	39686	9423.20	310.5	39686	19998.25
TOTAL PETROLEUM HYDROCARBON, mg/L	GC - MS		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
POLY AROMATIC HYDROCARBON, mg/L	GC - MS		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BTEX, mg/L	GC - MS		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CHLORIDE, mg/L	ASTM D512B	600	3.3	18272.5	4535.18	34.5	17907.1	8970.8
NITRATE, mg/L	ASTM D922	20	0.12	1.5	0.53	0.34	1.5	0.92
PHOSPHATE (Total), mg/L	ASTM D515	5	0.11	1.2	0.40	0.11	0.13	0.12

SULPHATE, mg/L	ASTM D516	500	1.4	2958	826.43	28.2	2754	1391.1
SODIUM, mg/L	ASTM D859-00	NS	6.2	800.9	197.76	9	800.9	404.95
POTASSIUM, mg/L	ASTM D2972A	NS	7.6	237.9	68.41	7.6	237.6	122.6
CADMIUM, mg/L	ASTM D3557	<1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CALCIUM, mg/L	ASTM D511	200	1.3	1808.4	434.90	9.2	1808.4	908.8
CHROMIUM (Hexavalent), mg/L	ASTM D1887	<1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
NICKEL, mg/L	ASTM D1887	<1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
IRON (Total), mg/L	ASTM D1068A	20	0.63	2.1	1.11	0.63	3.9	2.265
LEAD, mg/L	ASTM D3559	<1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
MAGNESIUM, mg/L	ASTM D511	200	0.45	502.5	101.11	2.3	297	149.65
MANGANESE, mg/L	ASTM D858-02	<1	0.004	0.05	0.04	<0.01	0.3	0.3
ZINC, mg/L	APHA D1691A	<1	0.043	0.271	0.14	0.1	0.12	0.11
DISSOLVED OXGEN, mg/l	ASTM D888-03	>2	6	6.9	6.55	5.4	6.7	6.05

BIOCHEMICAL OXYGEN DEMAND, mg/l	APHA 5210B	30	5.9	1582.8	317.23	29.2	902.8	466
CHEMICAL OXYGEN DEMAND, mg/l	ASTM D1252-00	40	12	2416	497.50	52	1464	758
MICROBIOLOGICAL PARAMETERS	**METHOD**							
Coliforms, , CFU/ml	APHA 9221E	0	0	17	4.00	0	0	0
E.Coli, , CFU/ml	APHA 9221E	0	0	15	2.75	0	0	0
Pseudomonas, (HUB), CFU/ml	APHA 9215B	--	0	6	1.00	0	4	2
Bacillus, (HUB)			0	8	1.13	1	2	1.5
Yeast/Moulds, , CFU/ml	APHA 9610A	--	0	9	4.00	8	9	8.5
Total plate count, , CFU/ml	APHA 9215A	100	427	849	565.50	438	464	451

Source: Natural Ecocapital, 2024

4.6 Air Quality Assessment

The results of air quality measurements from the study area is presented in the Table 4.11. The gases monitored are nitrogen (IV) oxide (NO_2), Sulphur (IV) oxide (SO_2) carbon monoxide (CO), Ozone (O_3) Volatile Organic Compound (VOCs), Hydrogen (II) Sulphide (H_2S), Ammonia (NH_3) and suspended particulate matter (SPM) specifically those of sizes 2.5 and 10 microns ($PM_{2.5}$ & PM_{10}). Generally, the concentrations of the measured air pollutants in the ambient atmosphere suggest that the locations are relatively pristine. More so the values recorded were within acceptable regulatory limits except for few parameters in few locations as depicted in the graphical illustrations of the parameters across the sampling locations in figures 4.10- 4.15.

Essentially, the concentrations of the gaseous pollutants recorded within the area of influence of the project represent background levels or baseline conditions of the proposed project areas. The low concentrations of the pollutants obtained in the project area during this study may be due to the absence of major activities that could generate high pollution level that would be of serious health concern. Table 4.10 provides the National Air Quality Standards as well as the World Health Organization (WHO) which the air quality results from this study are compared with.

Table 4.11: Ambient Air Quality Standard (FMENV 1991 & WHO)

POLLUTANTS	TIME OF AVERAGE	FMENV	WHO
$PM_{2.5}$	Daily average of daily		25.0 µg/m^3
PM_{10}	Daily average of daily		50.0 µg/m^3
Carbon monoxide	Daily average of hourly values. 1-hour mean	10ppm (11.4 µg/m^3) 20ppm (22.8 µg/m^3)	
Nitrogen Oxides	Daily average of hourly values (range)	0.04ppm-0.06 ppm (75.0 µg/m3 -112 µg/m3)	
Ozone	Daily average of hourly values	0.65 ppm	
Volatile Organic Compounds (VOCs)	Daily average of hourly values	0.25 ppm	

Table 4.12: Mean Measured Air Quality Pollutants in the Project Location

S/N	MONITORING LOCATIONS	GASEOUS POLLUTANTS (ppm)							PARTICULATE (µg/m^3)	
		CO	NO_2	VOC	O_3	H_2S	NH_3	SO_2	$PM_{2.5}$	PM_{10}
1.	Igbogun	0.0	0.038	0.63	0.00	1.0	2.5	0.003	12.0	11.0
2.	Ode-Omi	0.0	0.033	0.51	0.00	0.0	6.8	0.005	11.0	11.0
3.	Ise Junction	0.0	0.033	0.63	0.00	0.0	10.2	0.010	5.0	7.0
4.	Eleko Road	0.0	0.104	0.58	0.00	3.0	12.5	0.010	13.0	19.0
5.	Eleko Roundabout	3.8	0.052	0.71	0.00	2.0	15.5	0.010	19.0	44.0
6.	Amen Estate	0.0	0.049	0.55	0.00	0.0	2.6	0.002	15.0	24.0
7.	Eleko Junction	0.2	0.036	0.42	0.00	3.0	21.5	0.010	14.0	23.0
8.	Okoyogun Lekki/Epe Expy	0.1	0.055	0.41	0.00	0.0	10.5	0.004	58.0	92.0
9.	General Hospital Igbodu	0.0	0.042	0.40	0.00	2.0	10.5	0.003	17.0	31.0
10.	Dangote Chainage Zero	0.0	0.090	0.49	0.00	1.0	20.2	0.005	4.0	4.0
11.	Dangote Refinery - Along	0.0	0.070	0.57	0.00	5.0	15.0	0.010	7.0	5.0
12.	Lekki Deep Sea Port	0.7	0.048	0.56	0.00	3.0	18.6	0.005	7.0	8.0
13.	Dangote Refinery	0.1	0.044	0.40	0.00	3.0	22.2	0.010	10.0	8.0
14.	Ilege	0.9	0.045	0.58	0.00	0.0	19.3	0.004	21.0	32.0
15.	Lekki Free Zone	0.0	0.022	0.52	0.00	1.0	5.8	0.008	10.0	16.0
16.	Tiye	0.4	0.067	0.45	0.00	0.0	9.2	0.002	15.0	28.0
17.	Orimedu	0.0	0.065	0.45	0.00	0.0	9.5	0.002	17.0	23.0
18.	Ilado Magbon	0.0	0.067	0.40	0.00	0.0	12.0	0.003	13.0	22.0
19.	Hitech	0.0	0.122	0.36	0.00	0.0	10.0	0.005	17.0	27.0
20.	Ode Omi – Control	0.0	0.033	0.35	0.00	0.0	11.8	0.005	12.0	19.0

	Minimum	***0***	***0.022***	***0.35***	***0***	***0***	***2.5***		***4***	***4***
	Maximum	***3.8***	***0.122***	***0.71***	***0***	***5***	***22.2***		***58***	***92***
	Average	***0.31***	***0.05575***	***0.4985***	***0***	***1.2***	***12.31***		***14.85***	***22.7***
	FMEnv Limit	**10.0**	**0.04**	**0.25**	**0.65**	**10.0**				
	WHO Limit								**25.0**	**50.0**

Source: Natural Eco Capital field work April, 2024

Plate 4.2: Air Quality Measurement with the aid of Aeroqual Series 500

4.6.1 Discussion of the Air Quality Parameters Results

4.6.2 Nitrogen dioxide (NO_2)

The average NO_2 level across the sampling locations is 0.045 ppm, which is slightly above the FMEnv standard of 0.04 ppm. The highest reading, 0.122 ppm at Hitech, is significantly above the standard, while the lowest value, 0.022 ppm at Lekki Free Zone, is well below the standard. With a standard deviation of 0.025 ppm, there is moderate variability in NO_2 levels around the mean.

Overall, while most locations are close to or slightly above the standard, several readings exceed the FMEnv threshold which could be attributed majorly to the myriads of activities along the industrial zone where you have Dangote refinery, fertilizer, Lekki Deep sea port among others.The variation of the NO_2 values are provided in figure 4.10 below:

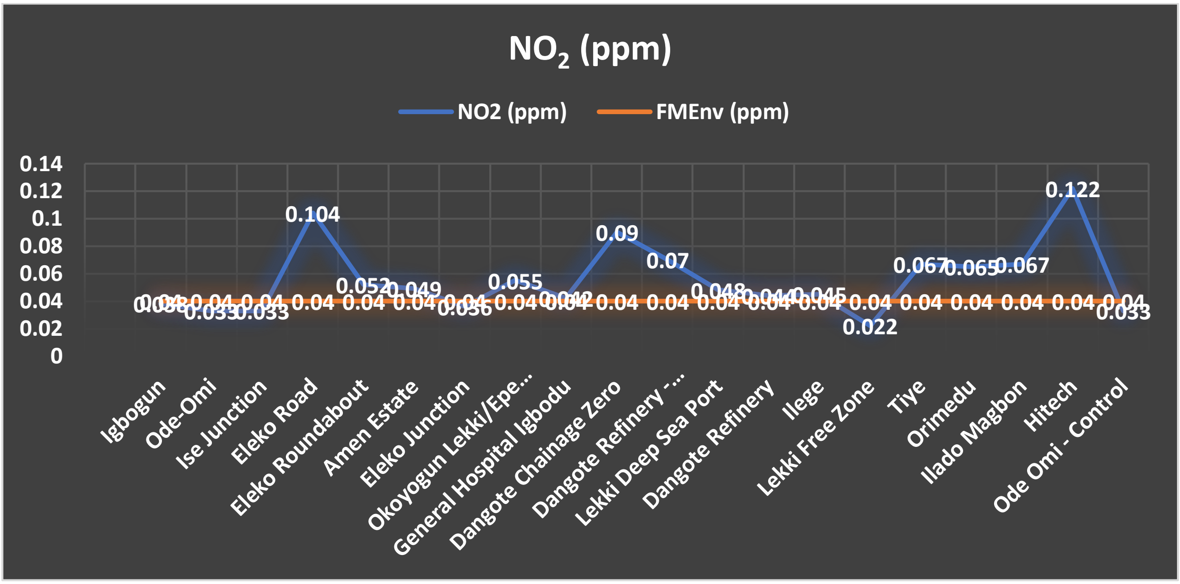


Fig. 4.30: Graphical illustration of the concentrations of NO_2 at the proposed projection area.

4.6.3 Carbon monoxide

The data reveals that CO levels across most locations are either zero or very low, suggesting generally good air quality with respect to carbon monoxide. Notably, the highest CO level recorded is 3.8 ppm at Eleko Road, while other locations like Dangote Refinery and Dangote Refinery - Along report 0.9 ppm and 0.7 ppm, respectively. The average CO level is 0.26 ppm, and the standard deviation is 0.58 ppm, reflecting minimal variability around the mean. Even at locations with higher readings, such as Eleko Road, the CO levels are well within the FMEnv standard of 10 ppm. Thus, all sampling locations are in compliance with safety standards, indicating that CO concentrations are generally safe and not a cause for concern. The variation of the CO values is provided in figure 4.11 below:

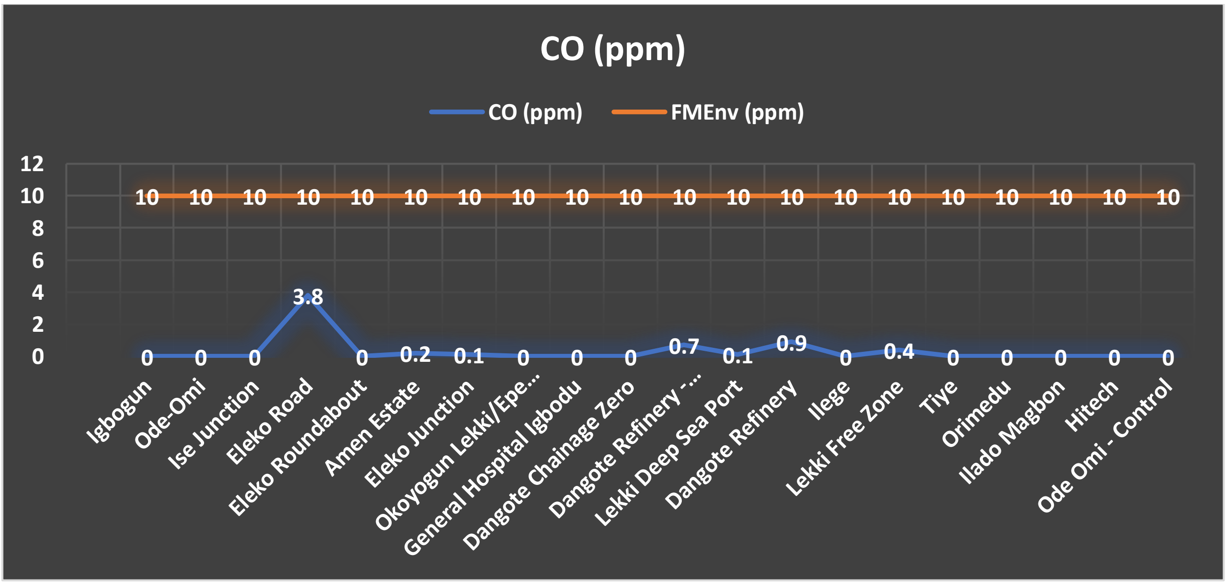


Fig. 4.31: Graphical illustration of the concentrations of CO at the proposed projection area.

4.6.4 Volatile Organic Compounds (VOCs)

The VOC levels measured at various locations substantially exceed the FMEnv standard of 0.25 ppm, with an average concentration of approximately 0.50 ppm. This widespread exceedance indicates a significant issue with elevated VOC emissions. Potential reasons for these high values could include industrial activities, such as emissions from the nearby Dangote Refinery and other industrial sites, which are known sources of VOCs. Additionally, traffic emissions and activities in the areas around Lekki Deep Sea Port and the Lekki Free Zone could contribute to higher VOC levels. The variability in VOC concentrations, as reflected by the range and estimated standard deviation, suggests that local sources and environmental conditions may influence the distribution of the VOCs. The variation of the VOC values is provided in figure 4.12 below:

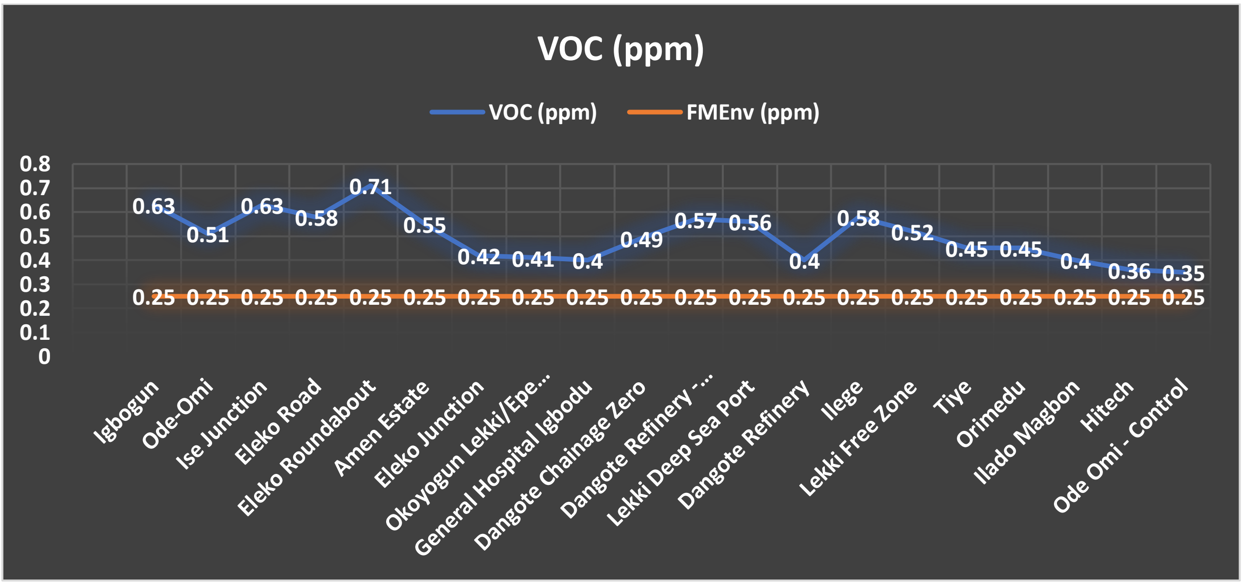


Fig 4.32: Graphical illustration of the concentrations of VOCs at the proposed projection locations.

4.6.5 SO_2

The SO2 concentrations across the locations range from 0.002 ppm to 0.01 ppm, with an average of approximately 0.00465 ppm, well below the FMEnv regulatory limit of 0.01 ppm. The standard deviation of about 0.0025 ppm indicates minimal variability in the SO2 levels. This suggests that the SO2 levels are consistently low and compliant with the regulatory standards. The graphical illustration of variation of concentrations of the pollutant is depicted in figure 4.13 below:

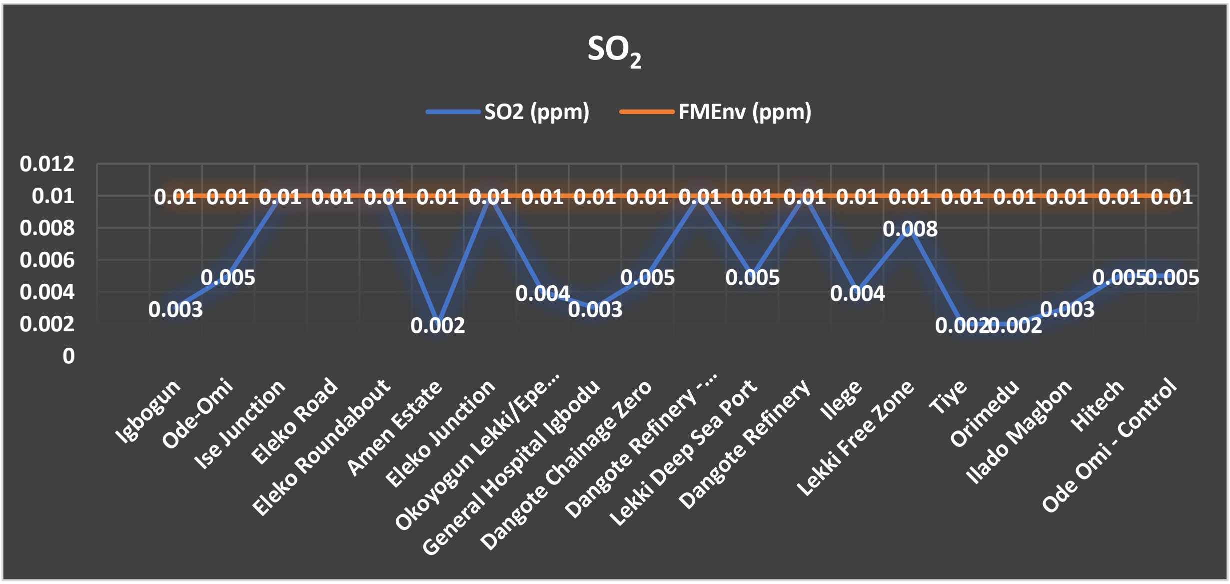


Fig 4.33: Graphical illustration of the concentrations of SO_2 at the proposed projection locations.

4.6.6 H_2S

The values for hydrogen sulfide (H_2S) at various locations range from 0 to 5 ppm. The average concentration across these measurements is 1.1 ppm. The standard deviation, which measures the spread of the data around the average, is approximately 1.3 ppm. Compared to the regulatory limit set by the Federal Ministry of Environment (FMEnv) of 10 ppm, the observed levels are significantly below this threshold, indicating that H_2S concentrations in these locations are well within safe limits. The graphical illustration of variation of concentrations of the pollutant is depicted in figure 4.14 below:

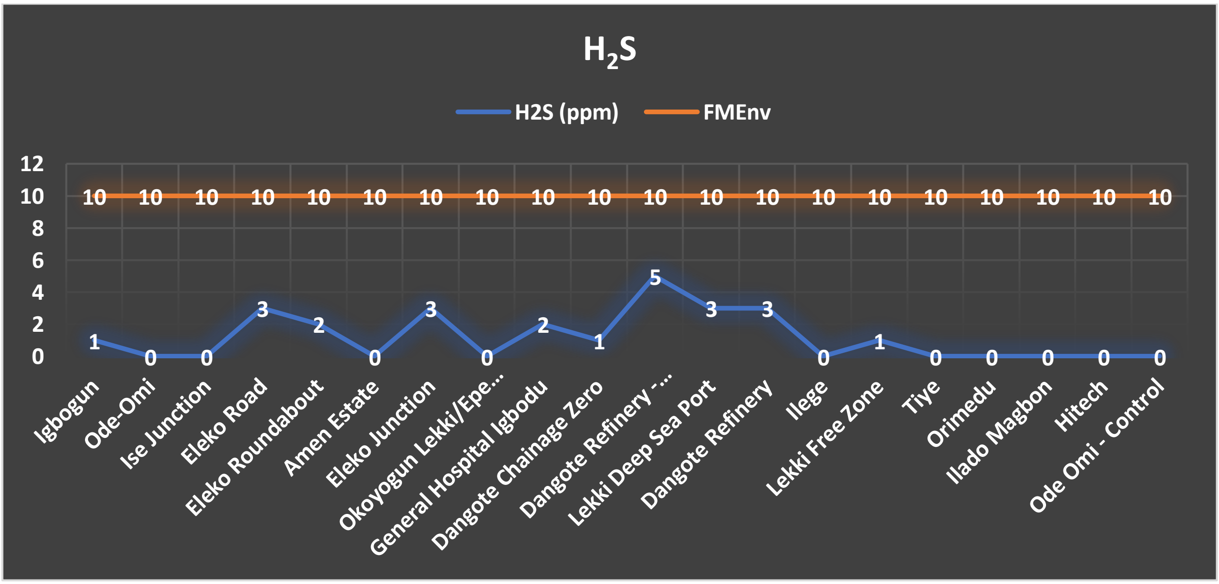


Fig 4.34: Graphical illustration of the concentrations of SO_2 at the proposed projection locations.

4.6.7 $PM_{2.5}$

The $PM_{2.5}$ concentrations measured at various locations range from 4 µg/m³ to 58 µg/m³, with an average of 14.4 µg/m³ and a standard deviation of 8.1 µg/m³. The World Health Organization (WHO) sets a daily average limit for $PM_{2.5}$ at 25 µg/m³. Most of the recorded values are below this limit, indicating generally acceptable air quality in these areas. However, at Okoyogun Lekki/Epe Expy, the concentration reaches 58 µg/m³, significantly exceeding the WHO standard.

Several factors could contribute to the high $PM_{2.5}$ levels at Okoyogun Lekki/Epe Expy. These may include high traffic volumes leading to increased vehicle emissions, ongoing construction activities that generate dust and debris, and proximity to industrial sources that emit particulate matter. Additionally, local environmental factors such as wind patterns and temperature inversions might exacerbate the pollution levels. The graphical illustration of variation of concentrations of the pollutant is depicted in figure 4.15 below:

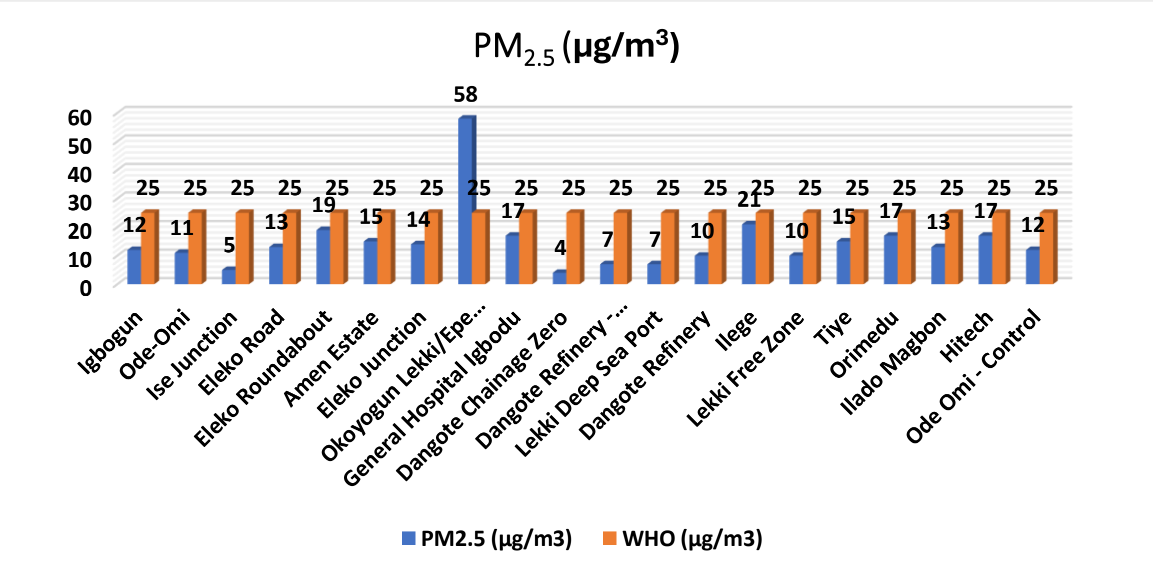


Fig 4.35: Graphical illustration of the concentrations of $PM_{2.5}$ at the proposed project locations.

4.6.8 PM_{10}

The PM_{10} values obtained from various locations indicate that the range of PM_{10} concentrations spans from a low of 4 µg/m³ at Dangote Chainage Zero to a high of 92 µg/m³ at Okoyogun Lekki/Epe Expy. The average PM10 concentration across these locations is approximately 22 µg/m³, and the standard deviation is around 20 µg/m³, indicating a significant variability in PM10 levels across the different locations.

Comparing these values to the WHO standard of 50 µg/m³ for PM10, most locations have concentrations well below this limit. Notable exceptions include Okoyogun Lekki/Epe Expy, where PM10 levels significantly exceed the standard. This exceedance at Okoyogun Lekki/Epe Expy could be attributed to factors such as its proximity to the Lekki-Epe Expressway, which experiences high vehicular traffic, and the presence of a local gin production facility. The generally low PM10 levels at other locations are likely due to the wet weather during the monitoring period, which had a significant scrubbing effect on the pollutant. The graphical illustration of variation of concentrations of the pollutant is depicted in figure 4.14 below:

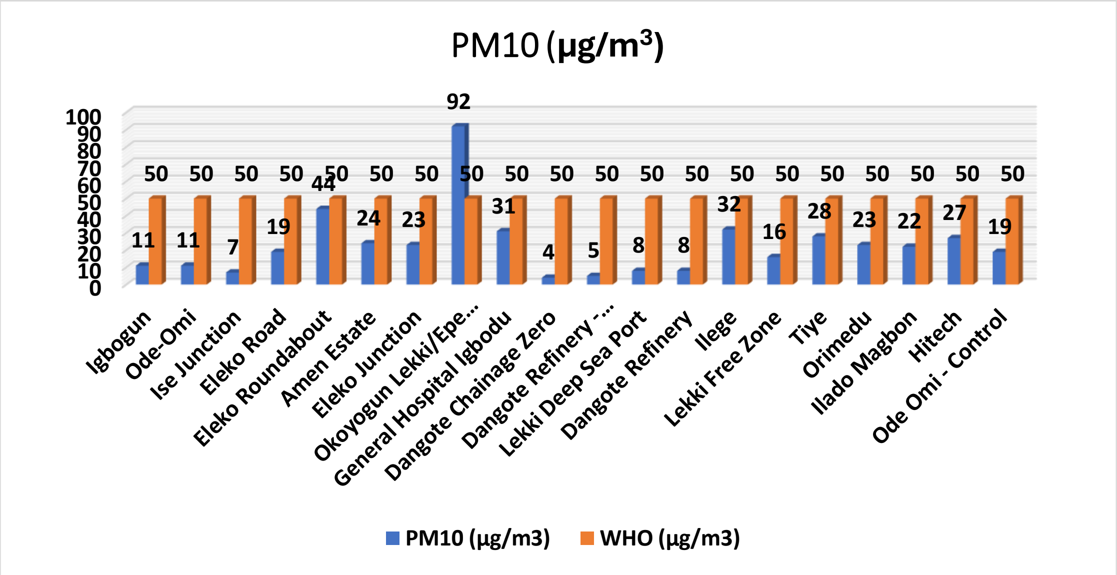


Fig 4.36: Graphical illustration of the concentrations of PM_{10} at the proposed project locations.

4.7 Noise Level

Noise is a periodic fluctuation in air pressure. Beyond disrupting daily activities, prolonged exposure to excessive noise can harm health and lead to psychological effects (SIEP, 1995). The impact of noise on residents typically involves annoyance or nuisance from both short- and long-term high noise levels. Additionally, noise can significantly disturb wildlife, particularly during breeding seasons or in areas where rare species are present.

The National Environmental Standards and Regulations Enforcement Agency (NESREA) provides guidelines for community noise exposure for different land use types ranging from pure residential location to mixed residential, commercial and industrial. These guidelines are detailed in table 4.13. Also, in Nigeria there are specific noise exposure limits set by FMEnv/NESREA as outlined in Table 4.14 for workers in industrial facility or workshops and their corresponding durations.

Table 4.13: NESREA Noise Exposure Limits for General Environment

	FACILITY	Maximum Permissible NOISE Limit dBA	
		DAY	NIGHT
A	Any building used as hospital, convalescence home, home for the aged, sanatorium and institutes of higher learning, conference rooms, public library, environmental or recreational sites,	45	35
B	Residential Buildings	50	35
C	Mixed Residential (with some commercial and entertainment)	55	45
D	Residential + Industry or Small-scale production + Commercial	60	50
E	Industry (outside perimeter fence)	70	60

Source: NESREA National Environmental (Noise Standards and Control) Regulations, 2009

Time Frame	**Use Duration**
Day	6:00am – 10:00pm
Night	10:00pm – 6:00am

The time frame takes into consideration human activity.

Table 4.14: FMEnv Occupational Noise Exposure Limits for Workers in Factory or Workshop.

Duration per Day, Hour	Permissible Exposure Limit dB (A)
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25 or less	115

Source: NESREA Guidelines & standards for Environmental Pollution Control in Nig. 1992)

Note: Exposure to impulsive or impact noise should not exceed 140 dB (A) peak sound pressure level.

The average noise level results obtained at each of the proposed project locations with their respective land use patterns and corresponding NESREA regulatory limits are provided in table 4.15 below:

Table 4.15: Average Noise Levels at Sampling Locations with their Respective Land uses

S/N	MONITORING LOCATIONS	LANDUSE	NOISE (dBA) Av.	NESREA LIMITS
1.	Igbogun	Residential	65.8	50.0
2.	Ode-Omi	Residential	56.1	50.0
3.	Ise Junction	Mixed Residential	55.1	55.0
4.	Eleko Road	Commercial	69.7	60.0
5.	Eleko Roundabout	Commercial	73.9	60.0
6.	Amen Estate	Residential	61.0	50.0
7.	Eleko Junction	Commercial	79.6	60.0
8.	Okoyogun Lekki/Epe Expy	Commercial	71.2	60.0
9.	General Hospital Igbodu	Institutional	59.4	45.0
10.	Dangote Chainage Zero	Industrial	66.8	70.0
11.	Dangote Refinery – Along	Industrial	77.0	70.0
12.	Lekki Deep Sea Port	Industrial	73.7	70.0
13.	Dangote Refinery	Industrial	62.6	70.0
14.	Ilege	Residential	73.7	50.0
15.	Lekki Free Zone	Industrial	67.7	70.0
16.	Tiye	Residential	70.7	50.0
17.	Orimedu	Residential	69.9	55.0
18.	Ilado Magbon	Residential	70.4	55.0
19.	Hitech	Commercial	70.5	60.0
20.	Ode Omi – Control	Residential	65.3	50.0

Plate 4.3: Noise Level Measurement with the aid of Extech Noise Meter

The noise level data indicates that several locations exceed the NESREA regulatory limits, which are intended to control noise pollution across different land uses. Residential areas such as Igbogun, Amen Estate, Ilege, Tiye, Orimedu, Ilado Magbon, and Ode Omi - Control have average noise levels surpassing the 50 dBA limit. These elevated levels could be due to proximity of the locations to main road, nearby construction, or encroaching industrial activities. Commercial areas, including Eleko Road, Eleko Roundabout, Eleko Junction, Okoyogun Lekki/Epe Expy, and Hitech, also exceed the 60 dBA limit, likely because of intense commercial activities in those areas exacerbated by the traffic volumes.

In industrial zones, Dangote Chainage Zero, Lekki Deep Sea Port, and Lekki Free Zone remain within the 70 dBA limit, while Dangote Refinery - Along is slightly above the standard but not excessively so. The exceedances in residential and commercial areas suggest a need for stricter noise control measures, as these areas face higher-than-acceptable noise levels. Ensuring compliance with noise regulations and addressing potential sources of excessive noise could help mitigate these issues and protect affected communities.

4.8 Discussion of Ground Vibration Results

Vibration levels were determined for a duration of 1 hour at all sampling locations. The results of the vibrations in millimetres per second (mm/s) are provided in table 4.16 below:

Table 4.16: Results of Vibration at the Sampling Locations

S/N	MONITORING LOCATIONS	VIBRATION (mm/s)
1.	Igbogun	0.7
2.	Ode-Omi	0.8
3.	Ise Junction	1.0
4.	Eleko Road	1.4
5.	Eleko Roundabout	1.8
6.	Amen Estate	0.5
7.	Eleko Junction	1.3
8.	Okoyogun Lekki/Epe Expy	1.6
9.	General Hospital Igbodu	0.8
10.	Dangote Chainage Zero	0.7
11.	Dangote Refinery – Along	1.3
12.	Lekki Deep Sea Port	0.8
13.	Dangote Refinery	1.0
14.	Ilege	0.5
15.	Lekki Free Zone	0.6
16.	Tiye	0.5
17.	Orimedu	0.7
18.	Ilado Magbon	0.8
19.	Hitech	1.5
20.	Ode Omi – Control	0.4
Minimum		**0.935**
Maximum		**0.4**
Average		**1.8**
STANDARD		**2.8**

The levels of vibration were all contained within the regulatory limit of 2.8mm/s with the highest value obtained at Eko Roundabout and the lowest at Ode-omi. The graphical illustration of the variation of the levels of vibration across the location is depicted in figure 4.17 below:

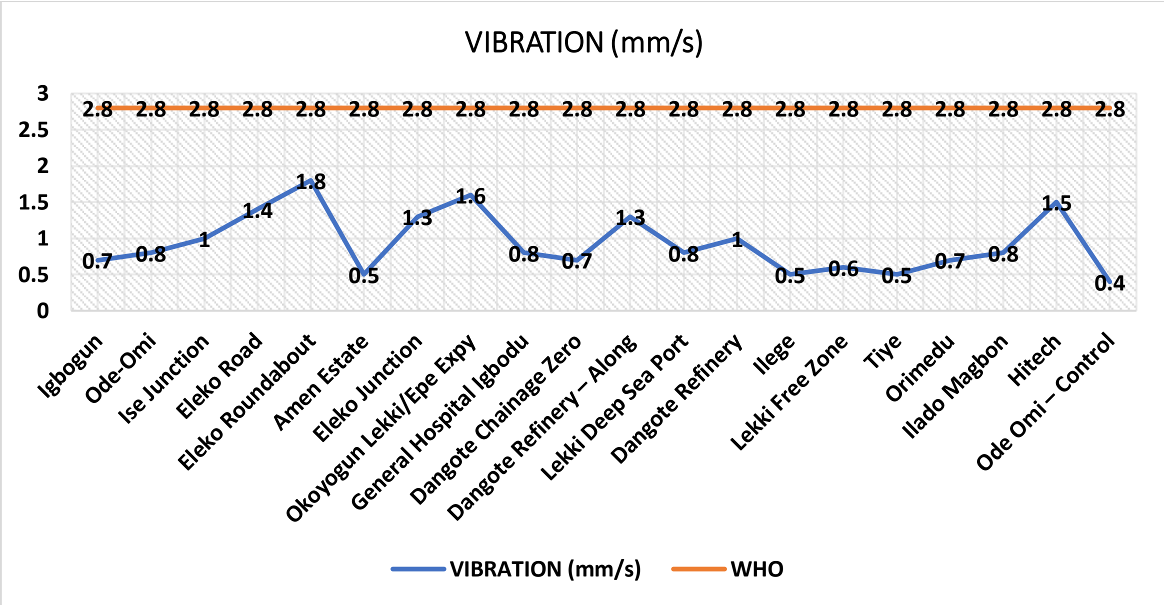


Fig 4.37: Graphical illustration of vibrations level at the proposed project locations.

4.9 Erosion and Accretion Pattern

The Lagos coast is characterized by west-east trending barrier islands, fortified by the Badagry Creek, the Lagos, and Lekki lagoons as depicted in Figure 4.38.

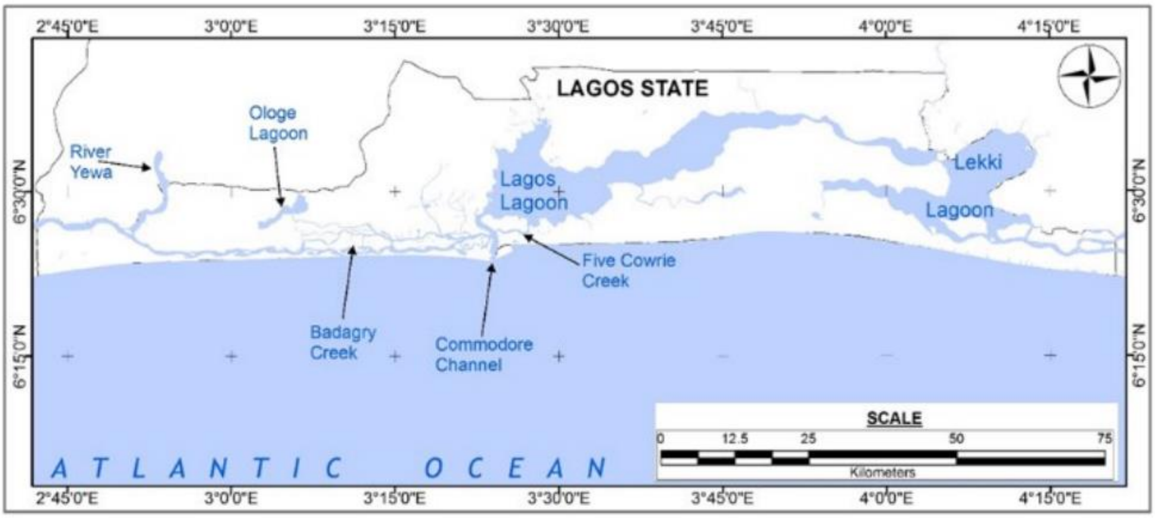


Figure 4.38: Map showing the Lagos coastal area.

Source: Nwilo, Ibe, Adegoke and Nwabufo (2020)

The study of the shoreline changes is crucial for understanding coastal erosion and accretion. The construction of breakwaters between 1908 and 1912 at the entrance to Lagos harbor disrupted the natural flow of the longshore drift, leading to accelerated erosion in the Victoria Island area and accretion on the western side (Plate 4.4)

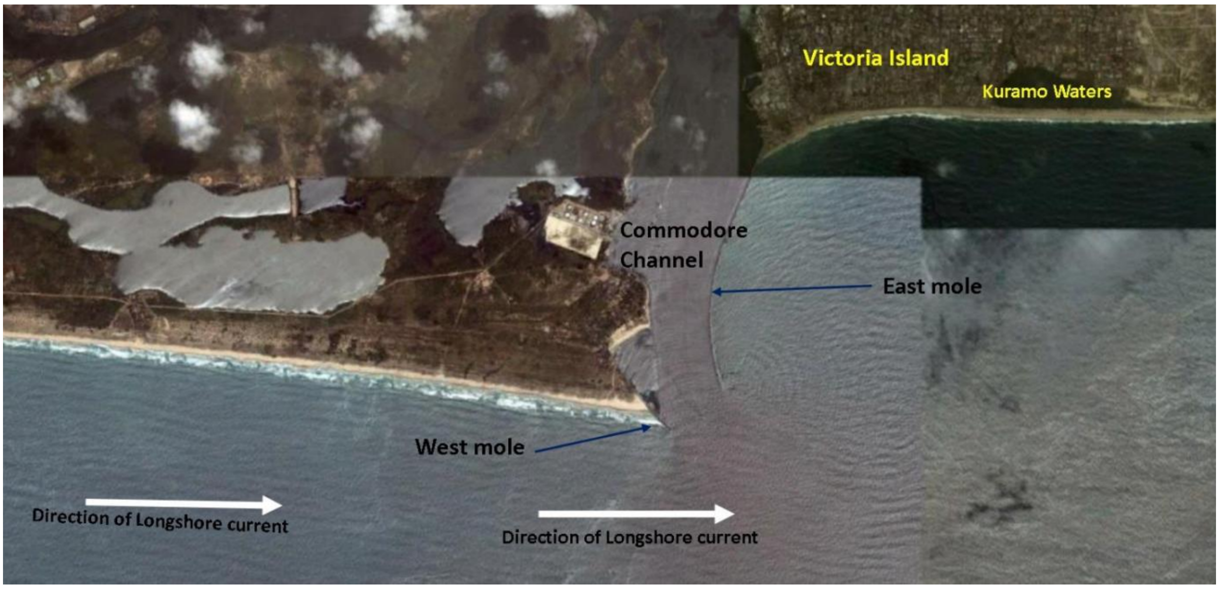


Plate 4.4: East and West Moles with the Prevailing Long shoreCurrent Direction

Source: Nwilo, Ibe, Adegoke and Nwabufo (2020) -Google Earth, October 2002

Available records have it that the estuary at the Commodore channel which was the main entrance from the Atlantic into Lagos Lagoon was becoming challenging and dangerous for navigation. Sedimentation by the longshore current was silting up the shorelines along with the lagoon inlet. This was because the tidal inlet had a highly dynamic morphology. Hence, Sir John Coode proposed in 1892 to dredge the entrance channel and construct two breakwaters (moles) to prevent further siltation. The map in figure 4.39 below is a segment of the topographical map showing Light house to the left and bar beach to the right without the present day east and west moles.

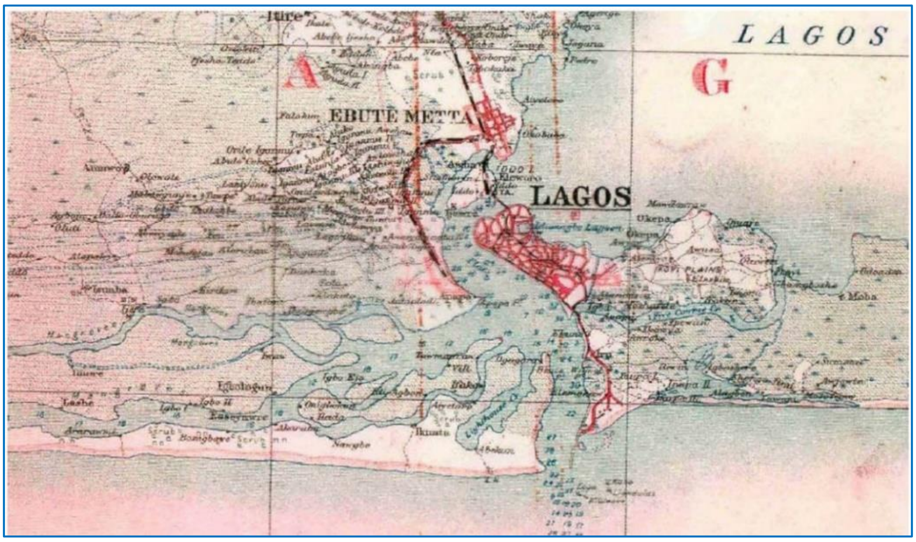


Fig. 4.39: Coastal area of Lagos before the construction of the West mole

The construction of the western and eastern moles consequently altered the physical processes around the inlet significantly. The western mole acted as a barrier, obstructing the westward sediment transport that naturally supplied the beaches. As a result, sand began accumulating at the light house beach on the western side of the mole, leading to accretion, while the Bar Beach to the right suffered severe erosion as depicted by the map in figure 4.40.

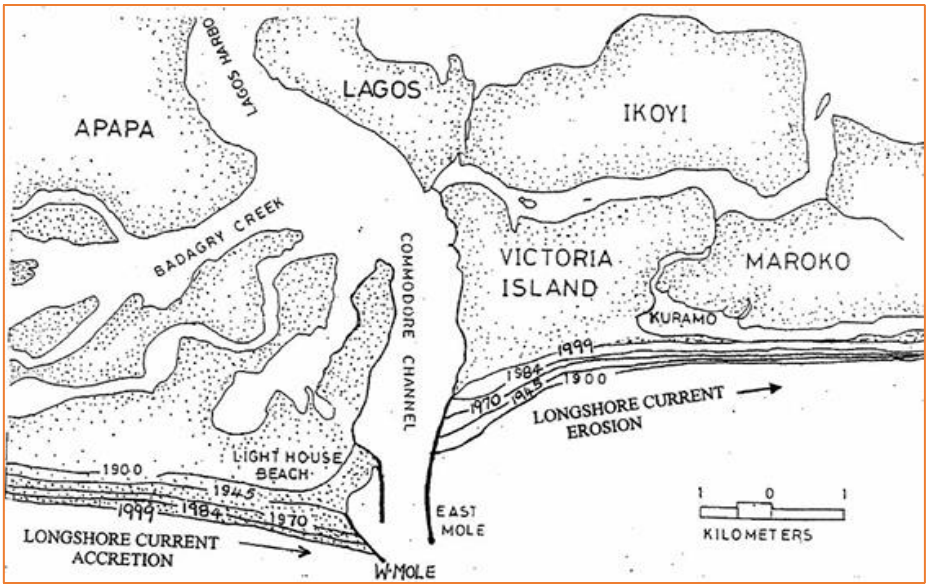


Fig. 4.40: Historical coastal erosion since construction of the east mole

According to historical records, including those by Pugh (1954) and Webb (1960), Bar Beach experienced average erosion rates of 20-30 meters annually due to the reduced sand supply. Between 1900 and 1959, the beach retreated over 1 km near the eastern mole, with the erosion impact decreasing to around 400 meters some 3 km east of the mole, near the Kuramo waters. Meanwhile, Lighthouse Beach, near the western breakwater, accreted over 500 meters during the same period.

A comparison of early maps of Lagos with the current coastline reveals that the shoreline at Bar Beach has receded by approximately 1-2 km since the moles were erected at the mouth of Lagos Harbour.

Oyegun (1990) as well as Okude and Ademiluyi (2006), reported that the Nigerian coastline, particularly the Lagos area, experienced significant erosion between 1986 and 2002. The Bar Beach section on Victoria Island, stretching over 6 km, recorded the highest erosion rates in Nigeria, with an average loss of 25-30 meters annually. Further analysis of this by Awosika et al. (1991) indicated even higher erosion rates near the moles, averaging 66 meters over a 14-month period translating to a mean monthly erosion rate of 4.71 meters occurring between 1990 and 1991.

Table 4.16 presents the annual erosion rates, which range from 1.53 to 22.29 meters.

Table 4.16: annual erosion rates

Periods	Net change (m^3/m)	Annual erosion rate (m)
1986-1990	-4814.74	22.29
1986-1995	-5325.18	10.56
1986-2002	-5942.33	6.63
1990-1995	-414.41	1.53
1990-2002	-1113.55	1.72
1995-2002	-632.08	1.61

The maximum rate of 22.29 meters per year occurred during the 1986-1990 period, while the minimum rate of 1.53 meters per year was observed from 1990 to 1995. This significant variation might be attributed to beach nourishment activities undertaken along the coast during these times.

The eastern beaches in Lagos farther from the Bar beach namely, Eleko, Folu, Lekki, Ebute-lekki, up to Akodo-Ise and beyond were not known to suffer noticeable erosion in times past. Information gathered from the community leaders indicate that the challenges of coastal erosion and high wave energies started less than ten years ago. Coastal erosion in these enclaves became perceptible after the construction of the two harbours (Lagos Deep Sea port and Dangote Sea Port). The Google Earth image below showing the artificial harbours for Lagos deep sea port on the left and the Dangote Sea port to the right.

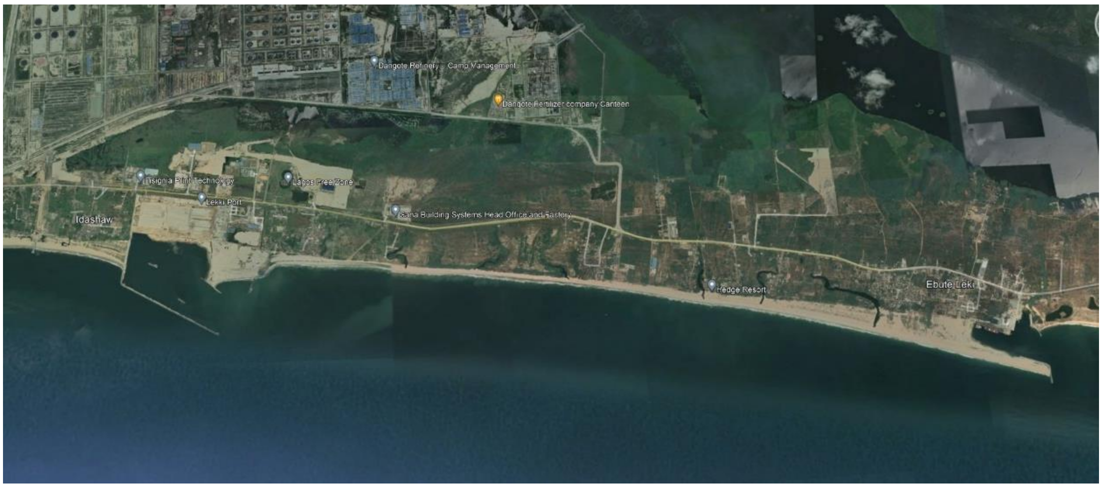


Plate 4.5: Google Earth image of the two harbours (deep sea ports) at Idaso and Ebute-Lekki

The two harbour couple with the influence of sea level rise are capable of altering the oceanic sedimentation process that creates erosion to the beaches on the right. This is similar to the experience arising from the construction of the moles at the entrance of the Lagos commodore channel, where the longshore wave dynamics was accreting at the west and heavily eroding at the eastern portion of the shorelines.

Fasae et al. (2022) in a recent assessment of the coastal erosion in Ibeju-Lekki and Eti-Osa local government areas (LGAs) in Lagos State, reported massive reshaping of the beaches (inland or seawards) by coastal erosion. Using Google Earth Pro images from 1984, 1999, and 2021 to analyze shoreline movement along with community interviews, the findings indicate that Eti-Osa LGA experienced the highest erosion distance (98.54 meters) at a rate of 8.88 meters per year. The negative effects of the coastal erosion, according to them includes; loss of homes, and properties (Boats, coconut groves), groundwater quality issues, relocation, and threats to tourism, also vary significantly across the communities. Figure 4.4 shows the eroding (red) and accreting (blue) portions as analysed by Fasae et al., (2022) along the shorelines in Ibeju-Lekki coastal areas.

Eti-Osa which essentially consists of the section one of the proposed Lagos-Calabar express way exhibits the most significant average negative shoreline movement, with an average erosion distance of 98.54 meters and a total erosion distance of 328.65 meters (Fig. 4.2). In contrast, it shows an average positive movement of 576.82 meters of shoreline accretion, with a total accretion distance of 3277.58 meters.

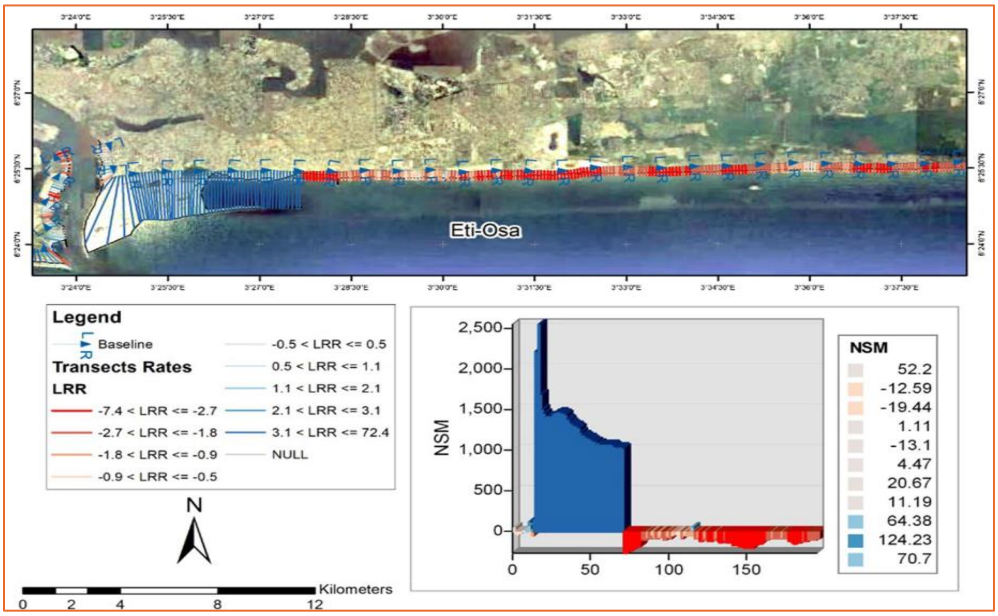


Fig. 4.41: Shoreline characteristics at Eti-Osa Local Government Area

The total erosion and accretion distances for Ibeju-Lekki (consisting of section 2 of the coastal road) are 232.53 meters and 550.98 meters, respectively. This area has a mid-range average negative shoreline movement of 50.7 meters and an average positive movement of 73.41 meters of shoreline accretion (Figure 4.5).

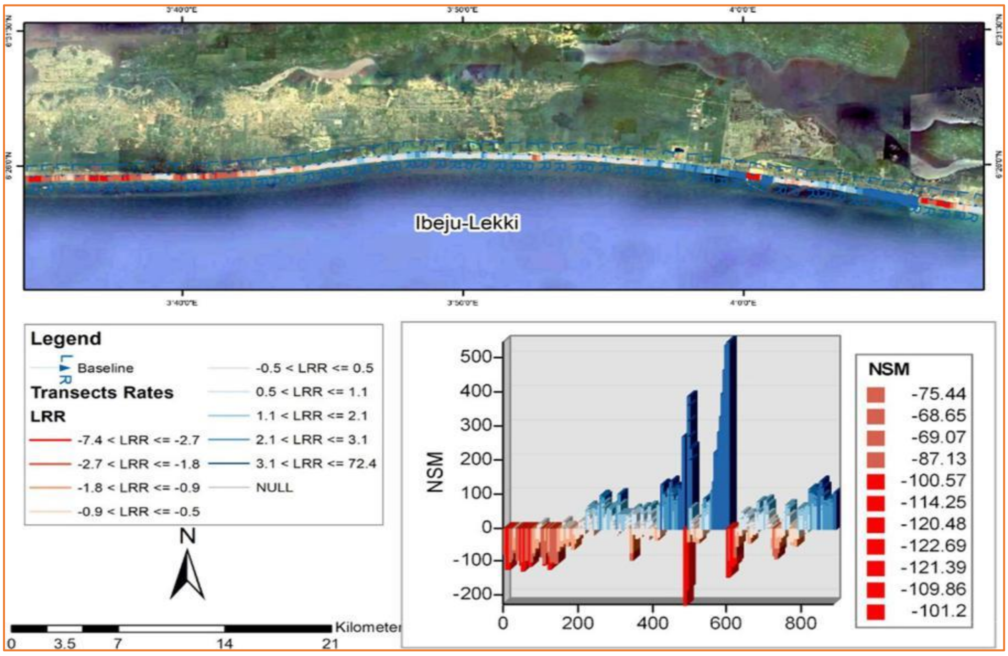


Fig. 4.42: Shoreline characteristics at Ibeju-Lekki Local Government Area

Net shoreline movement

The results of the above net shoreline movement (NSM) analysis as are presented in Figures 4.4 and 4.5, Eti-Osa has the highest average negative distance of 98.54 m of shoreline movement (erosion), with a total erosion distance of 328.65 m. It has an average positive distance of 576.82 m of shoreline movement (accretion), and a total accretion dis-tance of 3277.58 m. The total erosion and accretion distances for Ibeju-Lekki are 232.53 m and 550.98 m, respectively. This LGA has a mid-average negative distance of 50.7 m of shoreline erosion, and an average positive distance of 73.41 m of shoreline accretion.

Rate of shoreline changes

Average and maximum erosion rates of Eti-Osa LGA according to EPR were 8.88 m/yr and 2.66 m/yr, respectively, having the highest erosional rate out of the three LGAs (see Table S2). The average and maximum accretion rates were observed to be 15.61 m/year and 88.59 m/yr, respectively. Eti-Osa LGA has the highest accretion rate because of the land reclaim project on Eko Atlantic. In Ibeju-Lekki, the maximum and average erosion rates were 6.28 m/yr and 1.37 m/yr, respectively; the maximum and average accretion rates were 14.89 m/yr and 1.98 m/yr, respectively.

- **Coastal aerodynamics and Wind energy**

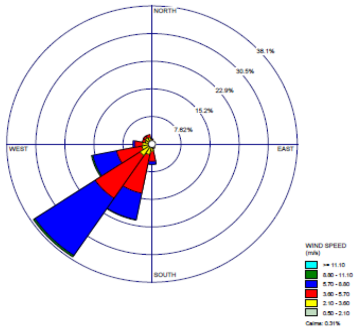
The meteorological data of the study area are presented in Table 5. Figures 8 and 9 presents the windrose and rain rose observed from July 2023 to July 2024. The roses indicated prevalence of southwesterly winds, which also could be responsible for rainfall patterns.

Table 4.17: Temporal variations of meteorological study of the study area

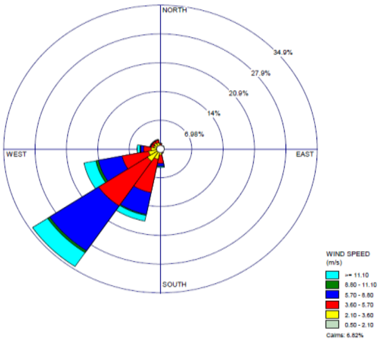
time	wind_speed_10 m (km/h)	wind_speed_100 m (km/h)	wind_direction_10 m (Â°)	wind_gusts_10 m (km/h)
2024-07-15T00:00	6.5	14.8	146	10.1
2024-07-15T01:00	8.9	20.8	130	15.5
2024-07-15T02:00	11	23.7	139	17.6
2024-07-15T03:00	9.7	23.2	149	18
2024-07-15T04:00	8.7	19.4	150	15.8
2024-07-15T05:00	9.2	17.3	141	15.8
2024-07-15T06:00	7.8	10.7	167	17.3
2024-07-15T07:00	6.8	8.5	205	17.3
2024-07-15T08:00	5.7	7.5	235	17.6

2024-07-15T09:00	7.4	9.4	247	20.2
2024-07-15T10:00	9.8	12.3	242	23.8
2024-07-15T11:00	11.9	15.2	235	27.4
2024-07-15T12:00	11.6	14.5	244	27.7
2024-07-20T02:00	10.2	22.3	80	17.6
2024-07-20T03:00	9.3	20.9	74	16.6
2024-07-20T04:00	10.8	22	75	17.6
2024-07-20T05:00	10.8	23.7	90	19.1
2024-07-20T06:00	11.4	17.1	103	21.6
2024-07-20T07:00	11.5	15.5	104	24.1
2024-07-20T08:00	13.4	17.6	114	27.7
2024-07-20T09:00	15	19	117	31.7
2024-07-20T10:00	11.3	14.1	121	31.3
2024-07-20T11:00	10.8	13.1	120	26.6
2024-07-20T12:00	11.3	13.7	117	26.3
2024-07-20T13:00	9.4	11.2	90	24.5
2024-07-20T14:00	12.5	15	72	27

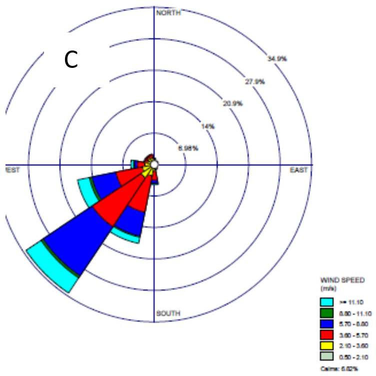
A


NORTH
SOUTH
EAST
WEST
WIND SPEED
(m/s)

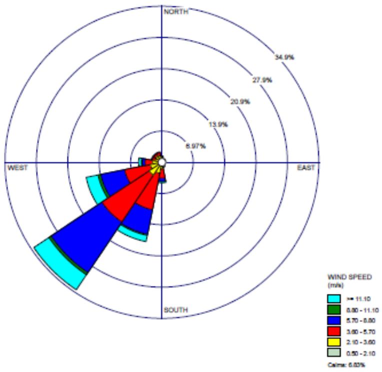
B


NORTH
SOUTH
EAST
WEST
WIND SPEED
(m/s)

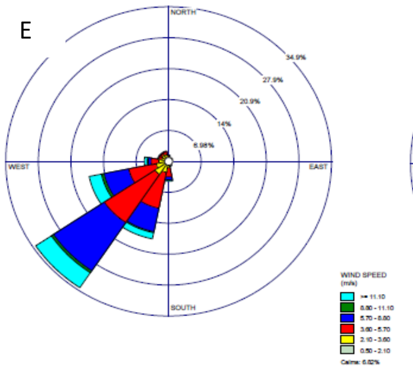
C


NORTH
SOUTH
EAST
WIND SPEED
(m/s)

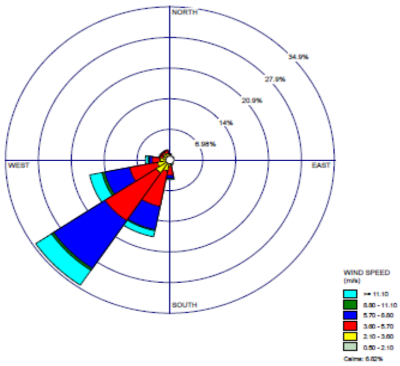
D


NORTH
SOUTH
EAST
WEST
WIND SPEED
(m/s)

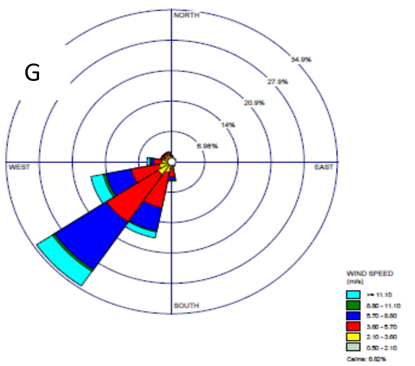
E


NORTH
SOUTH
EAST
WEST
WIND SPEED
(m/s)

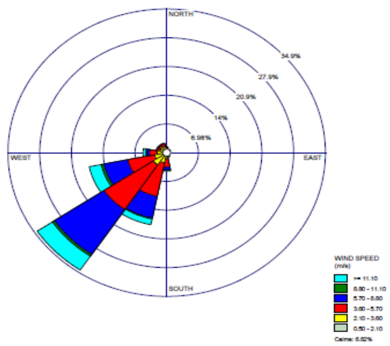
F


NORTH
SOUTH
EAST
WEST
WIND SPEED
(m/s)

G


NORTH
SOUTH
EAST
WEST
WIND SPEED
(m/s)

H


NORTH
SOUTH
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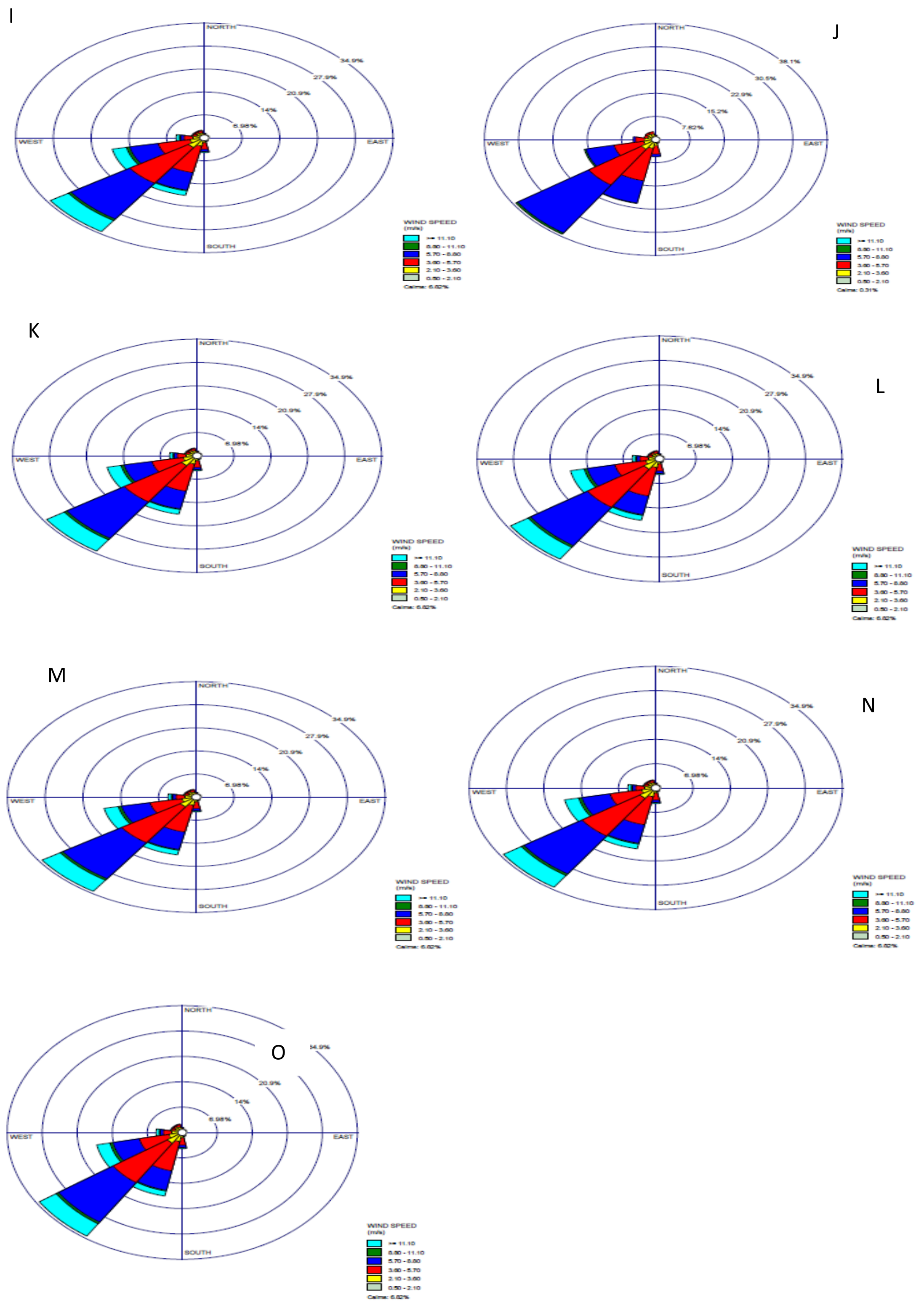
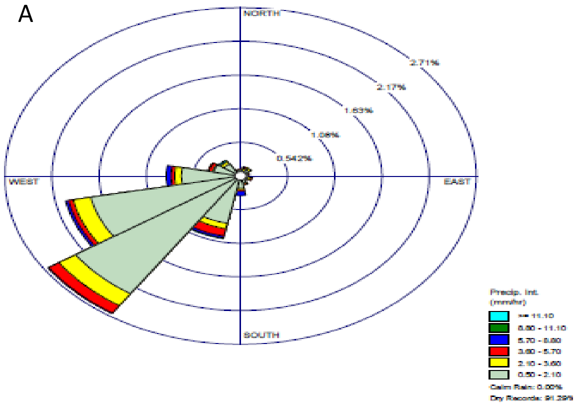
WEST
WIND SPEED
(m/s)



One year wind roses at the study area (A – Akodo, B-Akodo-Ise, C-La-Champaigne, D- Dangote, E-Eleko, F-Folu, G-Idaso, H-Igbogun, I-Itamarun, J-Magbon, K-Mobido, L-Lekki, M-Odeomi, N-Orimedu, O-Tiye)

A


NORTH
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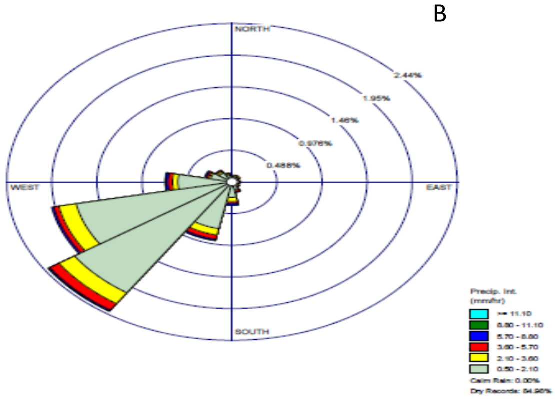
2.17%
1.63%
1.08%
0.542%
WEST
EAST
SOUTH
Precip. Int.
(mm/hr)

B


NORTH
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1.95%
1.46%
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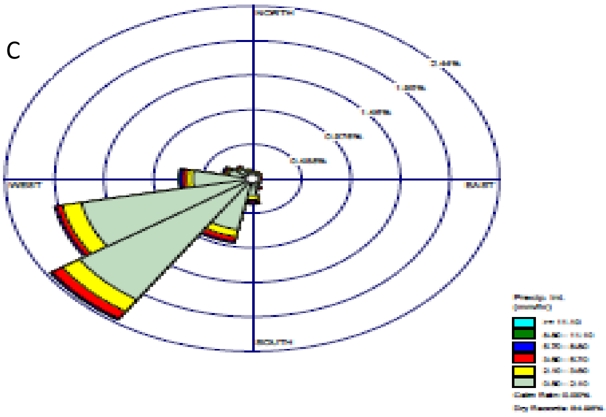
0.488%
WEST
EAST
SOUTH

C


NORTH
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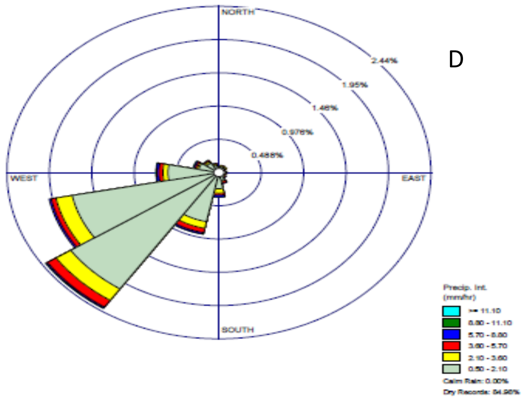
SOUTH

D


NORTH
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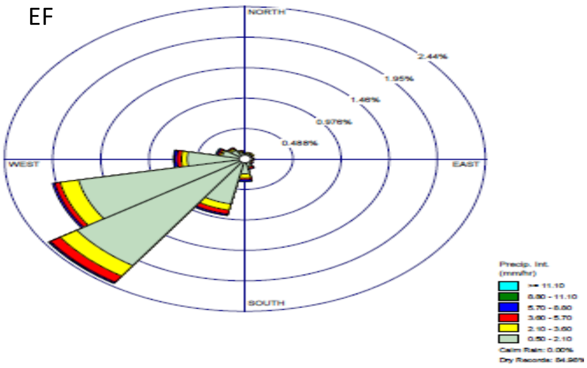
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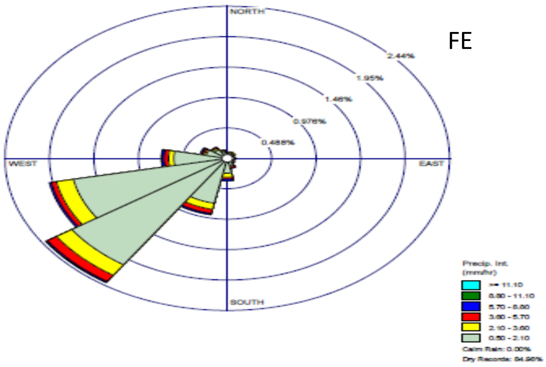
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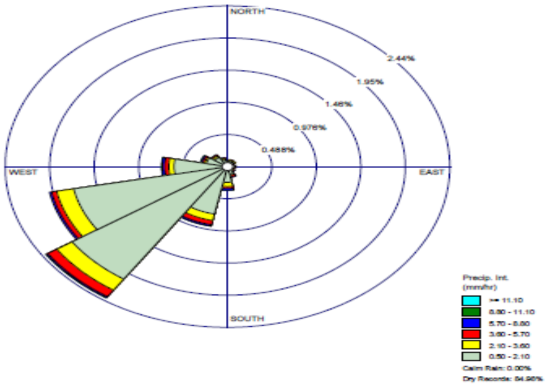

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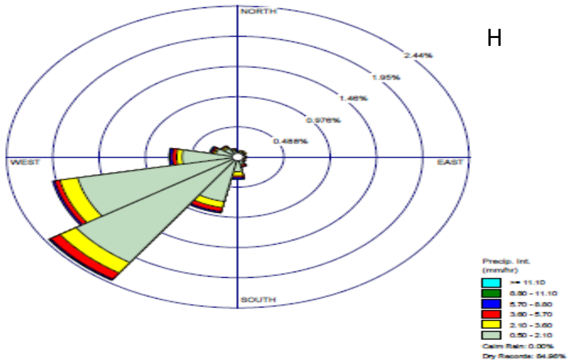

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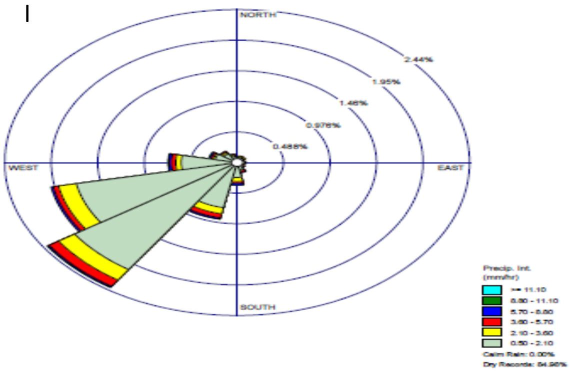

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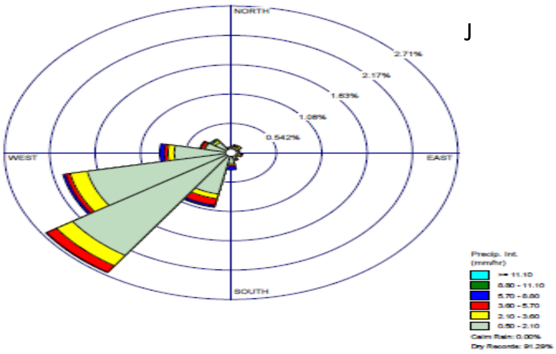

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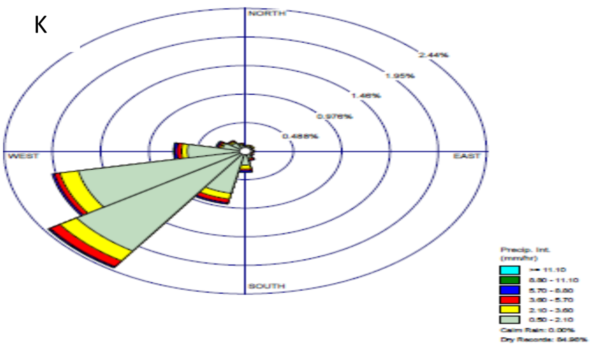

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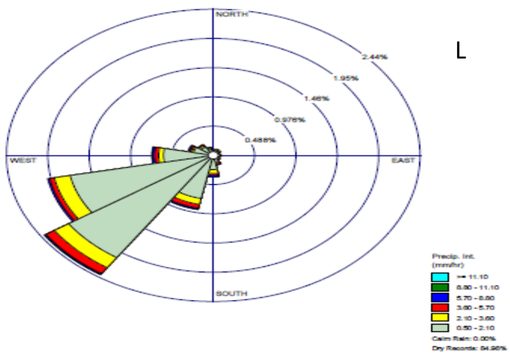

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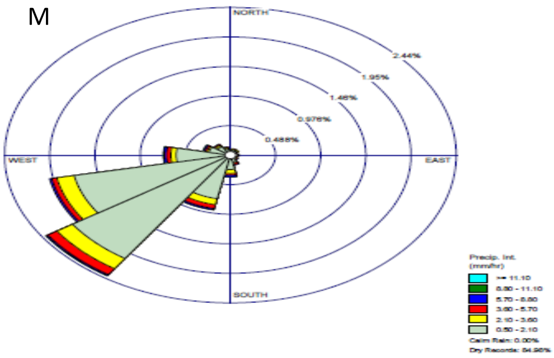

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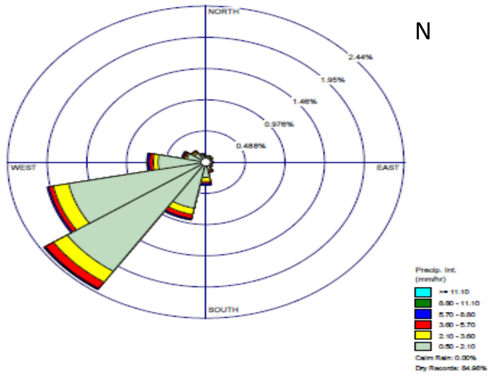

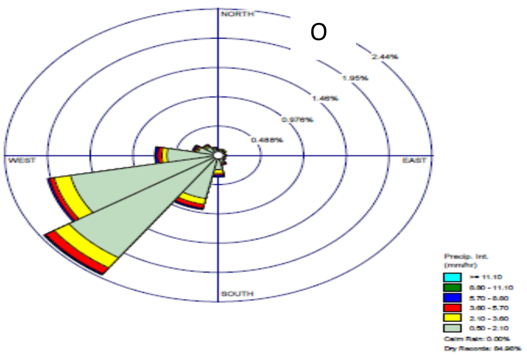

One year rain roses at the study area (A – Akodo, B-Akodo-Ise, C-La-Champaigne, D- Dangote, E-Eleko, F-Folu, G-Idaso, H-Igbogun, I-Itamarun, J-Magbon, K-Mobido, L-Lekki, M-Odeomi, N-Orimedu, O-Tiye)

- **Wave characteristics**

The ocean wave characteristics such as strength, height, period, and other related parameters were measured at different locations in the project area. These parameters understanding coastal erosion processes are essential for understanding and analysing ocean wave behaviour so as to determine potential locations for accretion and erosion. The parameters were defined as listed below:

Wave Height: The vertical distance between crest (top) and trough (bottom) of a wave.

Wave Period: The time for two successive wave crests or troughs to pass a fixed point.

Wave Frequency: The number of waves passing a point in a given period.

Wave Length: The horizontal distance between successive wave crests or troughs.

Wave Speed: The speed at which a wave travels through the water.

Wave Direction: The direction from which the waves are coming.

Wave Energy: The amount of energy carried by the wave, which is influenced by wave height and period.

Table 4.17 presents the wave characteristics along the shorelines of Ibeju-Lekki LGAs.

Table 4.17: Ocean wave parameters accessed from locations

Community	Wave height	Wave frequency	Wave Period	Wave length	Wave Speed	Wave Strength
Eleko	1.45895		9.12708			16.1622
Museyo	1.46024		9.13444			16.1725
Ilado	1.46482		9.16763			16.2282
Lekki	1.50093		9.54216			16.7908

Itamarun	1.49436	9.57134	16.8193
La campaigne	1.48923	9.60759	16.8502
Folu	1.48891	9.60966	16.8502
Akodo-ise	1.48407	9.62892	16.8478

For all sites, the wave height and period are within the same brackets; for instance, no shoreline had wave height greater than 1.5 meters and a wave period greater than 10 seconds. The wave energy or wave strength can be seen to be slightly lower at Eleko, Museyo and Ilado (16.16 -16.23 Kw/m) compared to the roughly 17 Kw/m at the eastern shorelines. Although at 16 or 17 Kw/m, the wave energy is still potent enough to cause severe erosion of sand beaches.

These figures are better appreciated in graphical form, particularly with isolines or spatial interpolations, the variabilities of the wave characteristics are clearly understood. The section below presents the wave characteristics in maps.

Wave Duration: The length of time a wave train or group of waves lasts as it travels across a specific point. Along the east coastline of Lagos, wave duration is influenced by the interaction between local wind patterns and oceanic conditions. Typically, wave duration along this coast varies, with longer durations associated with more persistent and steady wind conditions. Coastal zones in Lagos experience seasonal variations in wave duration, influenced by the monsoon winds and local climatic factors.

Figure 4.7 is the map of wave duration revealing that wave may take 8.6 to 10 days to reach the shore. The duration is particularly longer and slightly more energetic as one move eastwards

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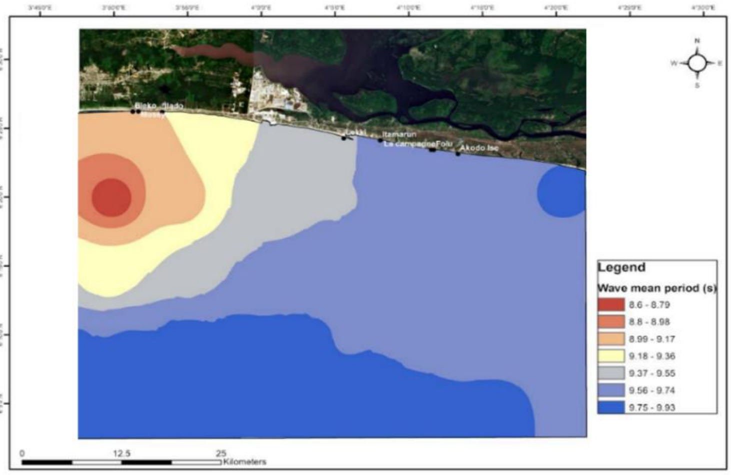
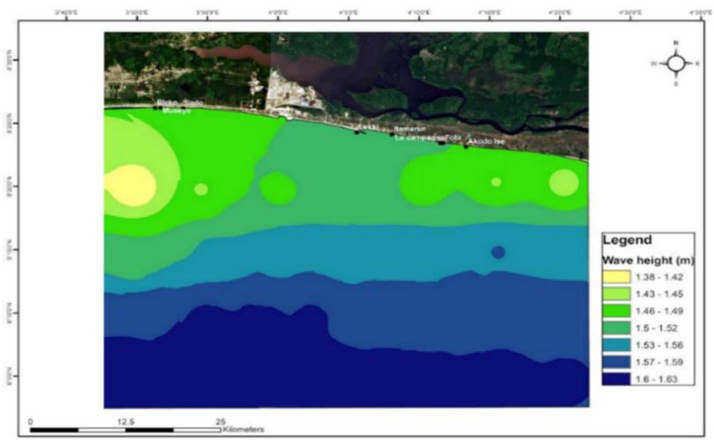


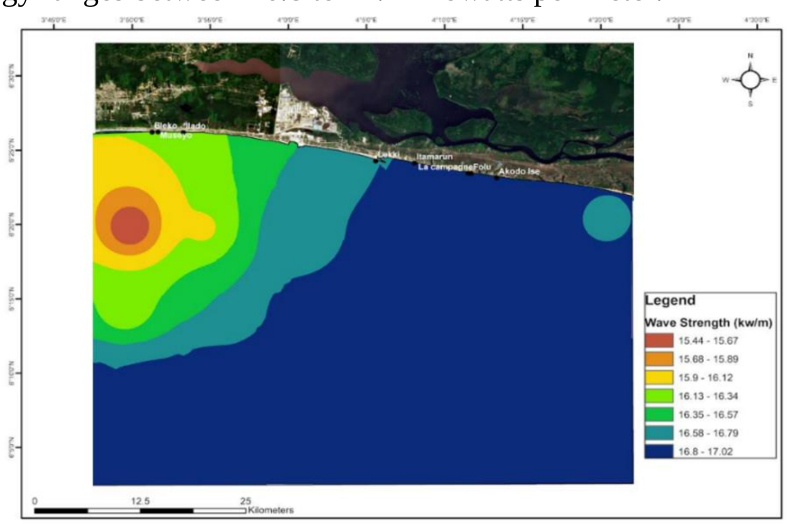
Fig. 4.43(a-c): Map of wave period in the area

Wave Heights: the vertical distance between the crest and trough of ocean waves along Lagos' east coastline, exhibit considerable variation depending on the time of year and prevailing weather conditions. However, the average wave heights range from relatively low values during calm weather to significantly higher values during storm events. Coastal areas of Lagos experience a mix of low to moderate wave heights under normal conditions, but occasional high waves can occur due to intense weather systems or tropical storms. The map in figure ZXCV reveal that close to the land, the wave heights does not exceed 1.52 meters; taking periods from 6 to 8 seconds. Although the heights are shorter in the eastern portion, the waves are still more energetic at these points.



(b)Map of wave heights in the area

Wave Strength: The measure of the energy carried by waves (Wave strength), along the coast of the Lagos-Calabar Road project (LAC) is a function of wave height, wave period, and the density of water. On the east coastline of Lagos, wave strength can vary significantly due to a combination of factors such as storm activity, seasonal changes, and regional wind patterns. During the wet season, the coastline does experience stronger waves due to intensified storm systems and increased wind speeds. Conversely, in the dry season, wave strength typically diminishes as the intensity of weather systems decreases. From the map in figure 4.9 below, it is clear that the wave energy decreases westwards. It is more energetic in the east coast for instance from Akodo-Ise through Lacampaigne to Itamarun, the wave energy ranges between 16.8 to 17.2 kilowatts per meter.



(c)Map of wave strength in the area

This magnitude could be quite damaging as far erosive force is concerned. The physical evidence of this is seen at Akodo-Ise where the beach has receded landwards by 150 meters over the last ten years.

Wind energy: the persistent erosion, frequent ocean surges, and flooding along West Africa's coast, particularly Nigeria, due to the impact of wave energy, especially from plunging waves. A focus on Akodo-Ise, Folu, Imagbon, Idaso and other beaches in east coast of Lagos, in conjunction with marine meteorological data, shows that southwesterly winds are predominant during the rainy season, with average velocities around 10 knots. This is in line with Olaniyan and Afesimama (2002) who reported on the analysis of winds, waves, and coastal swells from 1999 to 2001

- **Erosion and Accretion Rate**

The assessment of net shoreline movement (NSM) in this study showed that significant shifts have occurred over the years and the shorelines have been grossly reshaped. The shorelines have been considerably reshaped as reported by Fasae (2022). While there are evidences of accretion at some points there have been moderate to severe erosion at other points. Table 4.4 points out the communities in which the erosion or accretion are taking place.

Table 4.18 Erosion accretion

Community	Coast characteristics	NSM (m)	Rate m/yr
Eleko	Mild erosion		
Museyo	Accretion		
Ilado	Mild erosion		
Lekki	Pseudo-accretion		
Itamarun	erosion		
La campagne	Steady erosion		
Folu	Steady erosion		
Akodo-ise	Severe erosion		

Virtually all the shorelines along section two of the Lagos-Calabar project are experiencing substantial erosion. Where there are massive deposition of sediments and sand, there are evidences that these were not natural. For instance, the accretion along the shorelines at Idaso up to Lekki resulted from sand filling and land reclaim activities to create a harbour/sea port. This is similar to the land reclaim at the Bar beach in Eti-Osa Local Government Area.

The creation of these harbours namely: Lagos Deep Sea Port and Dangote Sea port has amplified the effect of sea level rise in the erosive wave actions consistently operating along the eastern shorelines in Lagos. The dynamics at the shorelines along the section 2 of the Lagos-Calabar coastal road presented in figure 4.6 shows clearly that the wave energies are higher after the Lagos deep sea port from Ebute-Lekki towards Akodo-Ise and beyond.

The map in figure 4.10 is the delineation of the position of the shoreline in 1986 and the position in 2024. The redline is the current position of the shoreline in 2024 while the yellow line depicts the position of the shoreline in 1986. The assessment over a 38-year period shows that the shorelines have shifted considerably; either landwards or seawards.

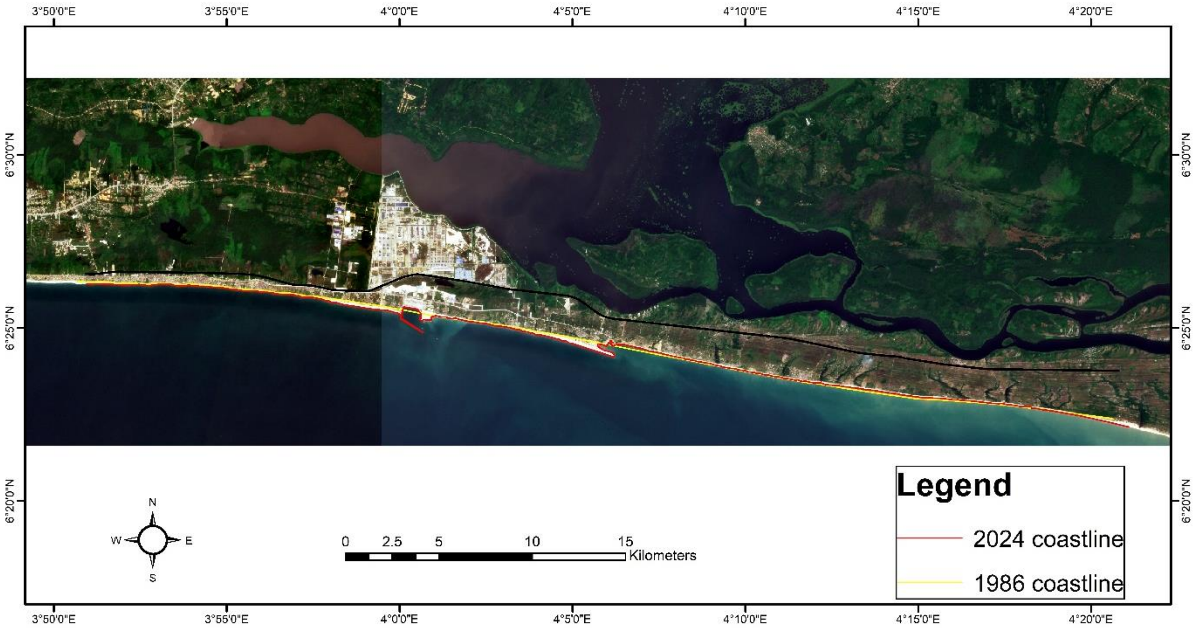


Fig. 4.43: Map of shoreline movement between 1986 and 2024

A closer look shows that the coastline from Eleko to Ebute-lekki has generally shifted backwards into the ocean. The sand deposit is more pronounced at Idaso (Lagos Deep Sea port) and Ebute-Lekki (Dangote Sea Port) due to the massive sand filing and land reclaim works carried out at these two locations. In contrast however to this is the coast from Ebute-Lekki up to the Ode-Omi coastline; this corresponds to the end of section 2 of the proposed Lagos-Calabar express way. Below are annotated snippets showing the shoreline movements.

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Shoreline from Eleko to Idaso

The snippet on the left shows the red line in front of the yellow line, implying that sediment deposits have been added to the shores between 1986 and 2024

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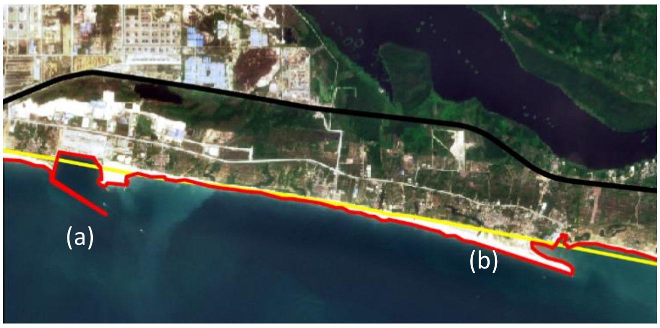

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Shoreline from Idaso to Ebute-Lekki

The shorelines have increased here as the redline is still in front of the yellow line. The land gained is however massive due to sand filling at (a) the Lagos Deep Sea Port and (b) the Dangote Sea Port

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Ebute-Lekki to OkunFolu/Akodo-Ise

The snippet here shows that from Ebute-Lekki after the Dangote Sea port, the redline shifted backwards; behind the yellow line. This implies eroding of the shorelines

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Akodo-Ise to Ode-Omi coastline

The Recession of the Shorelines Continued towards the coast of Ogun and Ondo States as shown

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</table>

The description of erosion or accretion of the shorelines shown above is depicted better in figure 4.43 below. The transects with observation points at 10-meter intervals showed that a few points were actually eroding from Eleko to Ebute-Lekki as explained above.

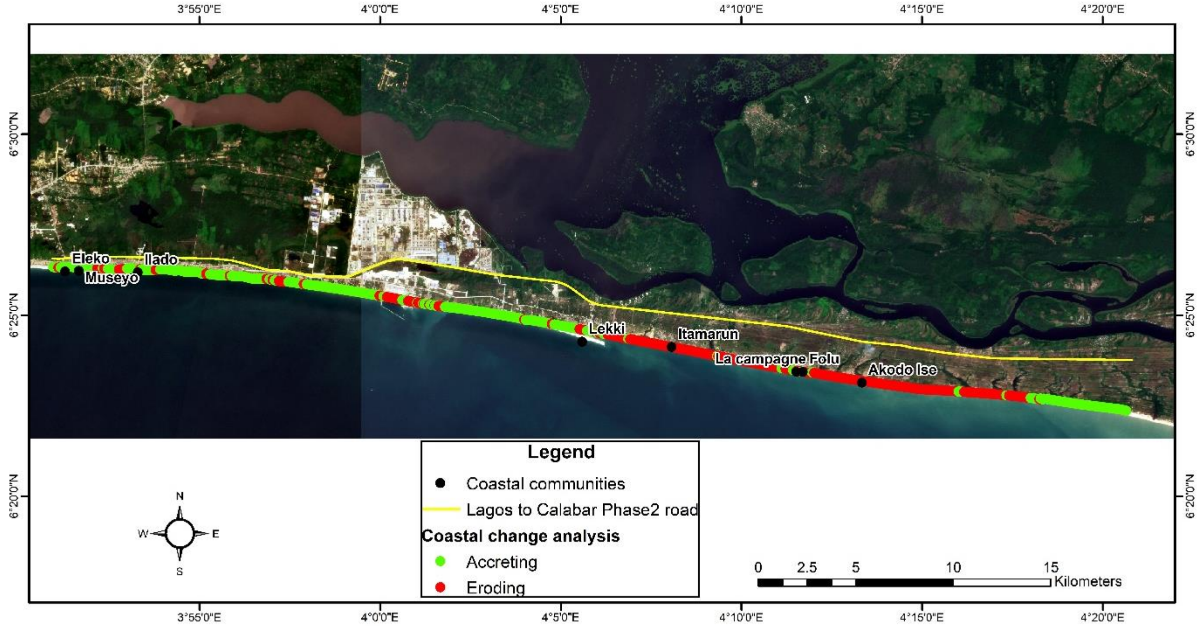


Fig. 4.44: Map showing accreting and eroding points along the shorelines

The green points depict accretion while the red depicts erosion. This reveals that the eroding beaches are actually sited between Ebute-Lekki and about 9mkilometers beyond Akodo-Ise. Evidences of erosive impacts of the ocean wave can be seen in these communities as relics of buildings, schools and graves. The table below show the net shoreline movement between Eleko and the coast at the end of section 2 of the proposed road.

Plate 4.5 (a-c): Eroded coconut trees' roots at Ebute Lekki Plate b : Erosion of La Chnampaigne's beach

Plate c: Community leader's house at Akodo-Ise continuously being sandfilled by the ocean

○

Table 4.19: Net Shoreline Movement (NSM) and End Point Rate (EPR) at different locations

S/N	Location	NSM	EPR	Change type
1	Eleko	116.07	3.05	Accreting
2	Ilado	-46.01	-1.21	Eroding
3	Mobido	-57.04	-1.50	Eroding
4	Akodo-Ise	-106.3	-2.80	Eroding
5	La Campaigne	-57.51	-1.51	Eroding
6	Ode-Omi	-202.36	-5.33	Eroding
7	Ebute-Lekki	393.72	10.36	Accreting
8	Orimedu	78.01	2.05	Accreting
9	Akodo	-33.45	-0.88	Eroding
10	Itamarun	-56.78	-1.49	Eroding
11	Ilagbo	-16.3	-0.43	Eroding
12	Ololu	-16.98	-0.45	Eroding
13	Folu	-67.03	-1.76	Eroding
14	Igbogun	12.96	0.34	Accreting

The Net Shoreline Movement (NSM) was obtained by finding the difference in distance between the shoreline point in the base year; 1986 and the current shoreline location in 2024. The EPR was then calculated by dividing the Net Shoreline Movement (NSM) by the number of years in the assessment period, namely; EPR = NSM/Period of change.

The map in figure 4.12 show that huge losses in shorelines were recorded at some locations such as the beaches before and after Ebute-Lekki.

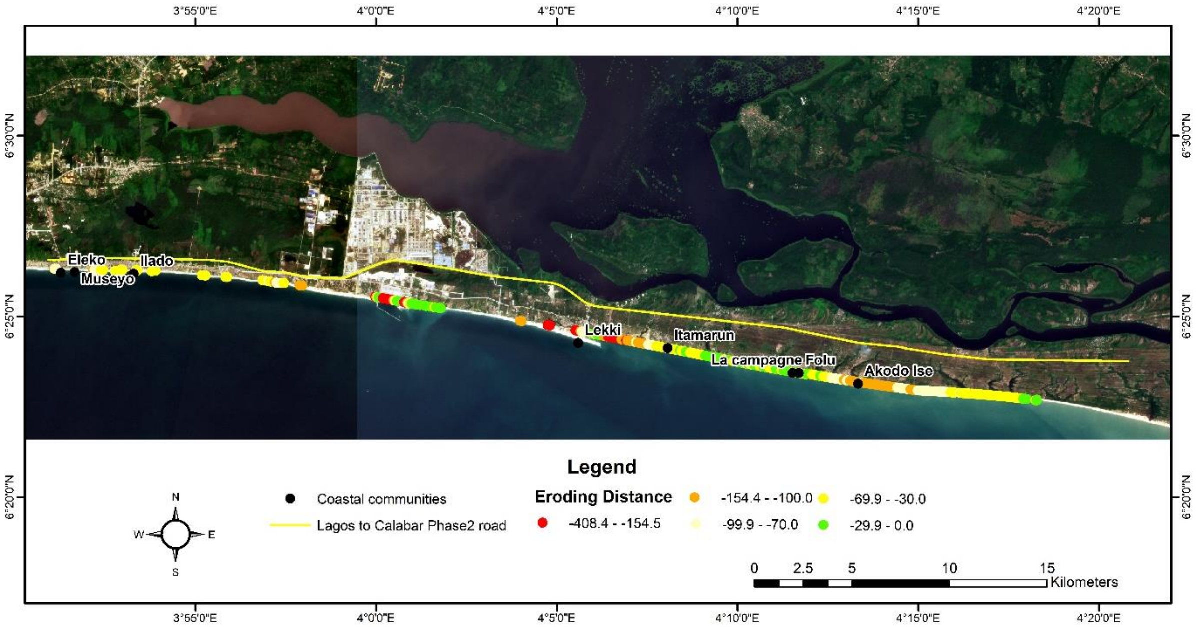


Fig. 4.45: Map of eroding distances along the shorelines

Similarly, figure 4.13 reveals that sedimentation along the shorelines

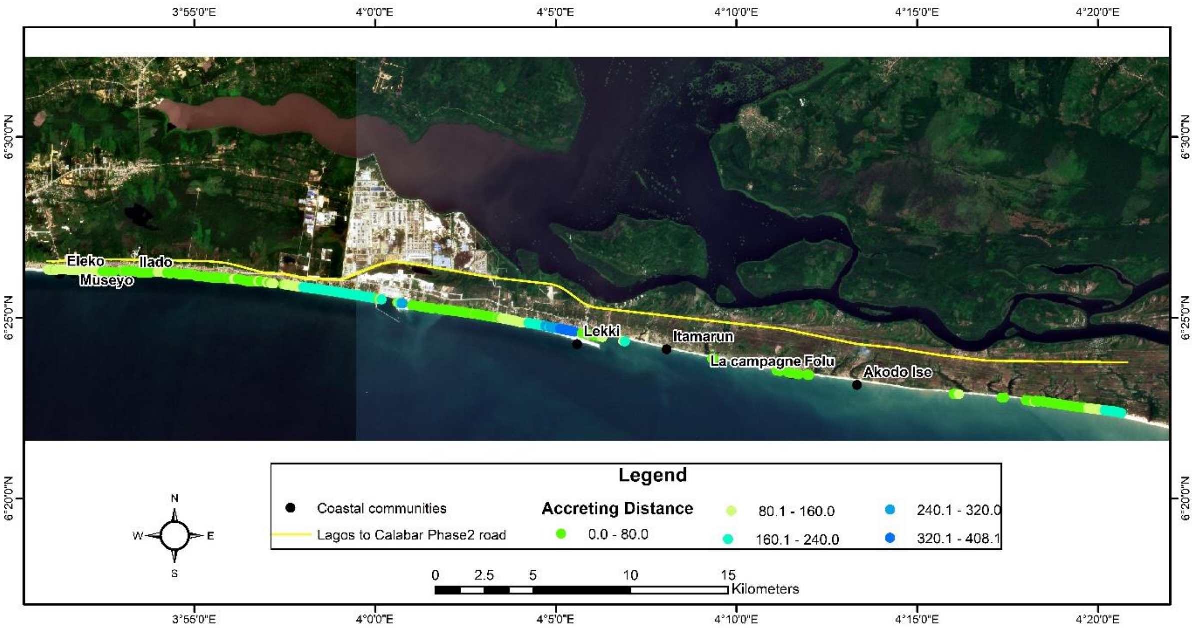


Fig. 4.46: Map of accreting distances along the shorelines

Accretion of over 400 meters recorded were the result of human interventions such as sand filling at Lagos deep sea port in Idaso and Ebute-Lekki.

- **Topographic Survey (STRM data and batymetry)**

Topography: The land topography along Lagos' east coast is characterized by a low-lying, flat coastal plain with gentle slopes. This region is predominantly urbanized with Victoria Island, Lekki, and other residential and commercial areas. The land elevation is generally low, making it susceptible to flooding, particularly during heavy rains and high tides.

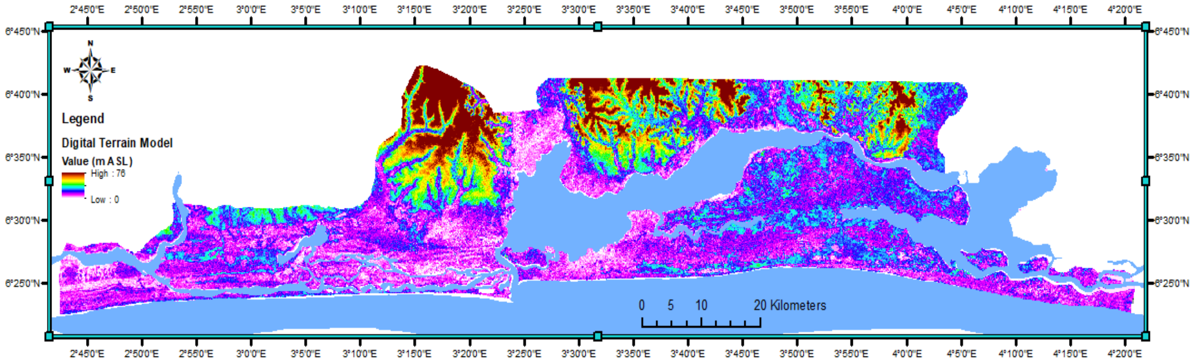


Fig. 4.47: The general digital elevation of Lagos State.

Bathymetry: The oceanic bathymetry off the east coast of Lagos features a relatively shallow continental shelf. The sea floor gradually deepens as it moves using a wave model to reveal that wind strengths increase from east to west, with wave heights ranging from 0.3 to 2.8 meters and periods from 2.8 to 6.5 seconds. Waves typically take 2-8 days to reach the coast as swells, with coastal swells rarely exceeding 2 meters, though they can surpass 2.5 meters during high spring tides. The study found that 2000 had more frequent high waves compared to 1999 and 2001.

Table 4.20: Bathymetry at some locations

Community	Ocean Bathymetry (m)
Eleko	-746.487
Museyo	-751.549
Ilado	-750.731
Lekki	-610.713
Ita-marun	-485.399
La campagne	-586.123
Folu	-581.712
Akodo-ise	-537.83

The bathymetric profile influences wave dynamics, coastal erosion, and sediment transport in the areas away from the shore.

The figure 4.48 below is an expression of the bathymetry of the ocean within the project area. The ocean close to the shores shows variation in depth. The beaches at Eleko, Ilado, Mobido are quite deeper than those at Ebute-Lekki, Itamarun, La Campaigne, Folu, Akodo-Ise.

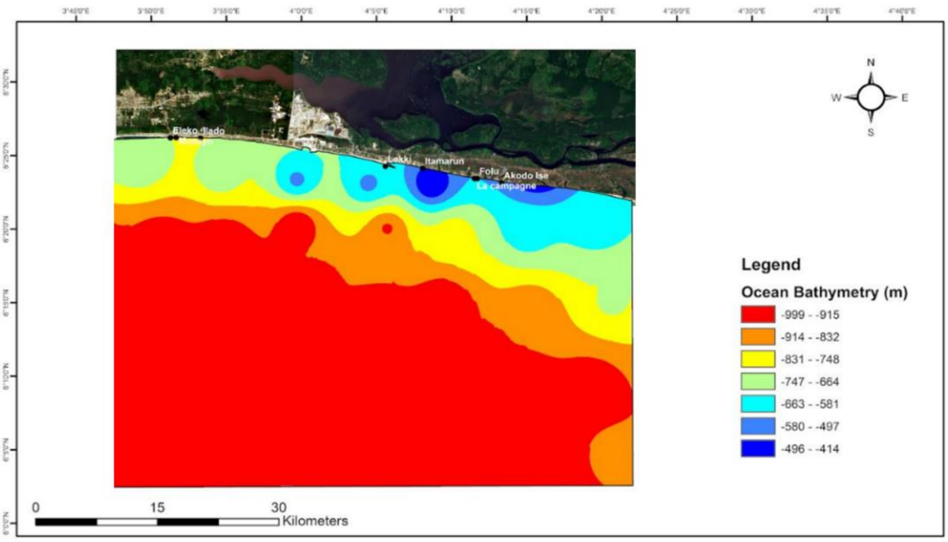
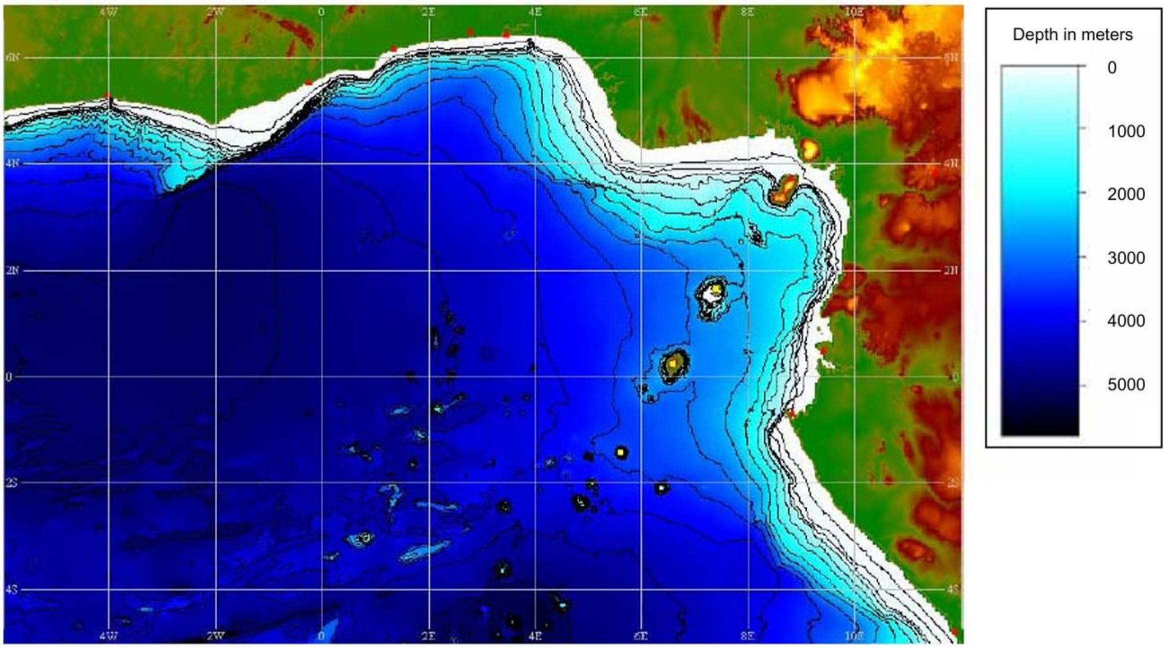


Fig. 4.48: The Bathymetry of the ocean at some locations in the study area.

This could be a factor contributing to the rapid erosion in the eastern portion compared to the western coastlines.

Generally, the bathymetry of the continental shelf could be described by the map in figure 4.16. The key features include a broad shelf that extends several kilometers from the coastline, with water depths ranging from a few meters near the shore to over 50 meters further out.



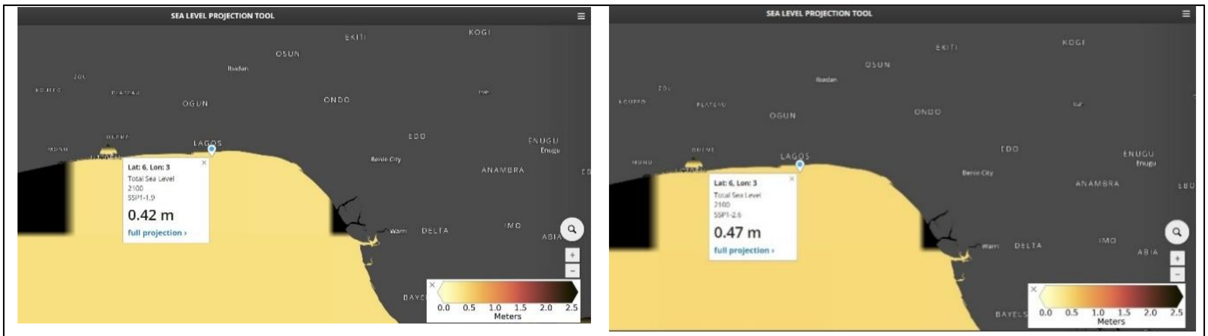
4.10 Sea Level Rise

Considering long-term trends in sea level rise is essential for the coastal road project in Lagos to address climate change impacts and ensure the resilience of coastal infrastructure. Sea level rise has been incorporated into the project:

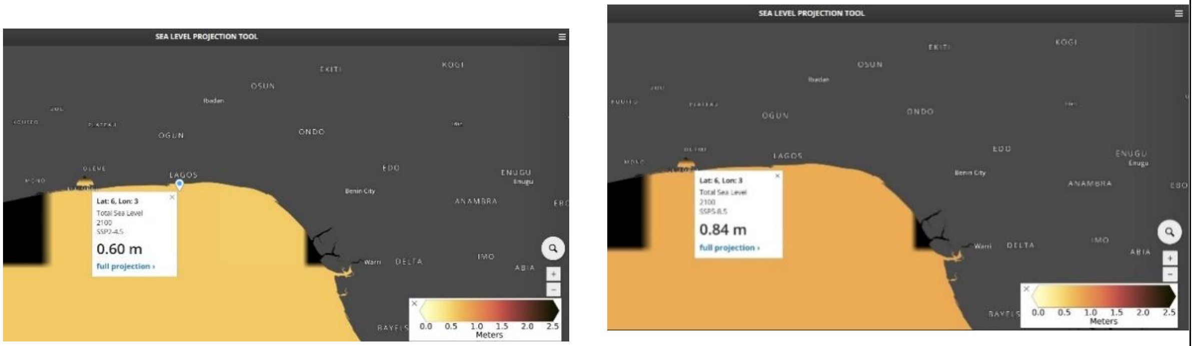
Evaluating coastal areas at risk of inundation due to sea-level rise is essential for the coastal road project in Lagos to mitigate potential risks and plan for adaptation measures. By evaluating coastal areas at risk of inundation due to sea-level rise, the coastal road project in Lagos can proactively address climate change impacts, minimize risks to infrastructure and communities, and ensure the long-term resilience and sustainability of coastal development efforts.

NASA's 2100 sea level rise projections for Lagos vary by Shared Socioeconomic Pathways (SSPs). Under SSP1-1.9, with very low emissions and strong climate policies, the rise is 0.42 meters. SSP1-2.6, with slightly less stringent efforts, projects a 0.47-meter rise. SSP2-4.5, a moderate pathway, projects 0.60 meters, while SSP5-8.5, with high emissions, projects 0.84 meters. Higher emissions result in greater sea level rise, emphasizing the impact of policy choices as presented in Figure 4.56.

Sea-Level Rise: **Evaluate Coastal Areas at Risk of Inundation*:*** Projections based on warming thresholds show a clear correlation: a 1.5°C rise results in 0.48 meters, 2.0°C in 0.55 meters, 3.0°C in 0.65 meters, 4.0°C in 0.75 meters, and 5.0°C in 0.86 meters. Limiting temperature increases is crucial to mitigate sea level rise impacts. **Figure 4.49** is the projection of sea level rise till 2100 A.D.



SSP1-1.9 **SSP1-2.6**



SSP2-4.5 SSP5-8.5

Figure 4.49: Sea Level Rise Projections

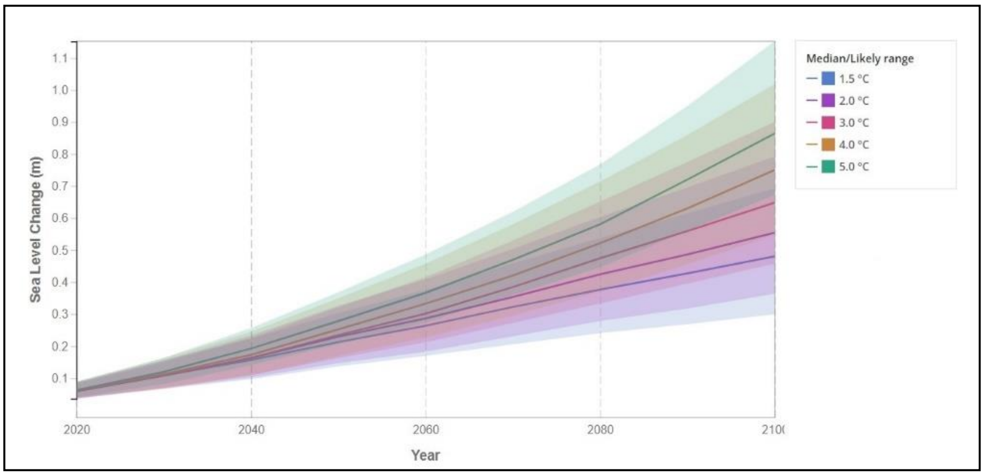


Figure 4.57: Projection of sea level rise till 2100 A.D.

Using the Coastal Risk Screening Tool developed by Climate Central, it was observed that a water level rise of 0.5 meters around the coast of Lagos will not affect the proposed Lagos-Calabar coastal road. Figure 4.58 shows the areas that will be submerged by 2100 with 0.5 increases in water level.

Figure 4.50: Areas that will be Submerged In 2100 with 0.5m Increase in Water Level

The red spots show the locations that can become inundated with a 0.5-meter rise in sea level which has been projected for 2100 under the present climate change scenario. This indicates that the elevation and design of the road are sufficient to withstand a moderate rise in sea level, ensuring its resilience against potential coastal flooding scenarios anticipated from such a rise. This assessment provides confidence in the infrastructure's ability to remain functional and safe even as sea levels increase.

4.11 Risk Assessment

Flood Risk Assessment: The flood risk assessment results provide essential information for planning and mitigating potential hazards.

As summarized in Table 4.25, the flood risk coverage along the kilometer corridor of the Lagos-Calabar Highway (Section 2) shows the obtained results. The key findings are further depicted in Figure 4.59 and described briefly below.

Table 4: 21: Flood Risk of Lagos Coastal Road Section 2

S/N	Flood Risk Category	Area of Coverage (Hectares)	Remarks
1	Very Low	0.00	no area along the road corridor was completely free from flood hazard.
2	Low	0.00	Even in regions classified as having very low or low flood risk, some level of risk persists.
3	Moderate	1022.34	Moderate flood hazard areas were identified in specific locations: • Marwa • Akinlade • Sangotedo • MosereIkoga • Iwerekun • Solu Alade
4	High	4981.07	High flood hazard was observed along the proposed road, particularly in the following sections: • Marwa to MosereIkoga • MosereIkoga to Lakowe
5	Very High	3873.15	The most critical flood risk areas were identified along the coastal road, including: Oniru Jakande Ojun Ajah Sangotedo Igand to Eleko These regions face significant flood threats.

S/N	Flood Risk Category	Area of Coverage (Hectares)	Remarks
Total		976.56	Overall, the combined flood risk coverage within the corridor is 9876.56 hectares.

Source: Natural Eco Capital Fieldwork April 2024

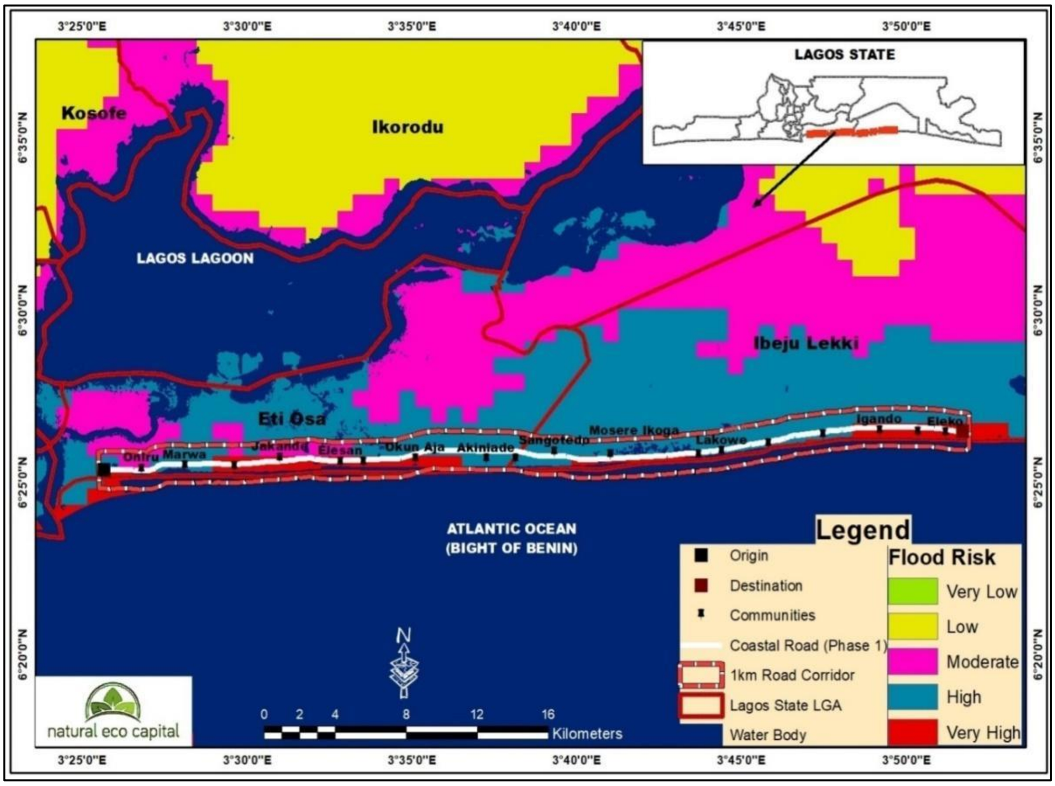


Figure 4.51: Flood Risk Map

Climate Risk Assessment-Vulnerability and Resilience*:* Lagos, Nigeria's foremost city, confronts profound vulnerability to climate-induced flooding due to inadequate resilience measures amidst escalating climate impacts. Situated along the coast, it contends with rising sea levels and extreme weather, exacerbating flooding risks. Vulnerability assessments pinpoint 6,983 susceptible features, notably floodplains, riverbanks, and Alfa Beach, exacerbated by projects like Eko Atlantic City, culminating in substantial losses.

The vulnerability analysis of Lagos State, using GIS, analysed four climate change impact scenarios: coastal flooding, urban flood, coastal subsidence, erosion, heat waves, and ecosystem services depreciation. An evaluation of the population distribution also revealed that diverse vulnerable groups, consisting of 12,910,948 individuals existed in Lagos as of 2020, and projecting to 2025, the city will have 25,012,637 vulnerable individuals. It is therefore important to emphasize the urgent need for resilient strategies amidst population growth.

Risk of climate change to the tourism sector: Lagos State's aspiration as Africa's premier tourist destination faces a grave threat from climate-induced coastal flooding and ocean surge, particularly affecting the coastline encompassing the lagoon and Atlantic Ocean. Alfa Beach, once a vibrant tourist hub hosting events like Lekki Sunsplash, succumbed to the Atlantic's encroachment. Urgent action is imperative to mitigate recurrent coastal flooding, given the critical role of the coastal road in the national economy.

Plate 4.6: Submerged and damaged building at Alfa Beach, Eti Osa LGA

Land Surface Temperature in Lagos State: Figures 4.52 (a-c) is the map of Land Surface Temperature (LST) in Lagos for 1999, 2009 and 2019 respectively. LST data for the year 1999, 2009 and 2019 were used to evaluate the spatial variability in heat waves and assessment of heat island in Lagos State.

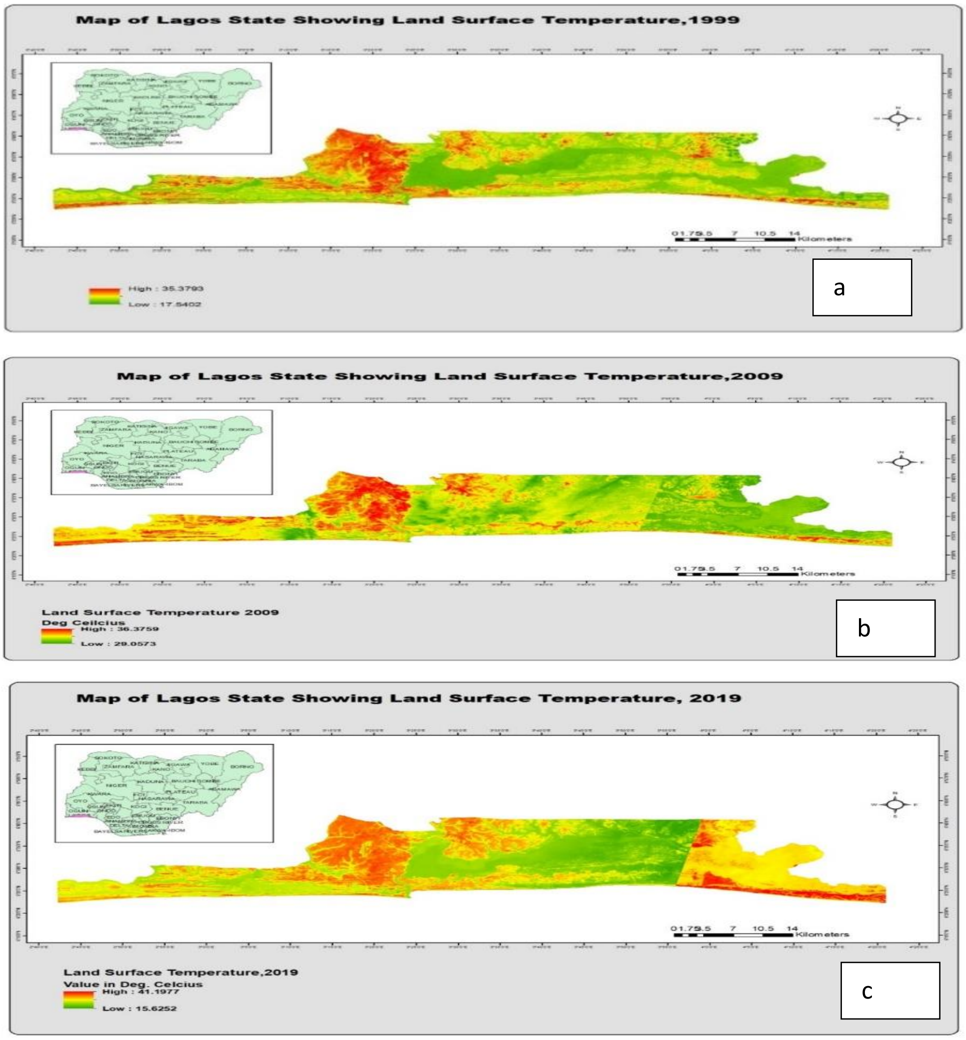


Figure 4.52 (a-c): Land surface temperature of Lagos State 1999, 2009 and 2019

Figure 4.52a showed that the surface temperature in Lagos state in 1999 is very mild having majority of the space with low temperature ranging between 17^0C to 25^0C. The built-up areas and some parts of the state have temperatures in the range of 35^0C which was very high at that time. However, in the year 2009, the area with low surface temperature has significantly reduced and the areas with extreme surface temperature have increased as shown in Figure 4.60b**.** The average low temperature has increased to about 29^0C. In the year 2019, the highest surface temperature recorded was 41^0C and the area with extreme temperature has increased across the state. Moderately high surface temperature has also increased throughout the study area such as some communities Epe and Ibeju Lekki.

Risk of land cover change and ecosystem vulnerability: The depletion rate of ecosystem services of Lagos State and project the depletion rate for the year 2030, 2050 and 2070 was computed from Landsat images of 2006 and 2016 The specific ecosystem used in the analysis and modelling of ecosystem services depletion in Lagos state are as follows: undisturbed forests, coastal vegetation, freshwater vegetation, planted forests, disturbed forests, tree crop vegetation, wooded savannah, grassland/vegetated bluff, arable land, settlements, bare surfaces, and water bodies.

Ecosystem services decline over ten-year intervals and projections for 2030, 2050, and 2070 were made using Markov Chain modeling in IDRISI software. The 12 ecosystems were categorized into forest-based and non-forest-based. Degraded forests reduce ecosystem services, impacting forest-based economy and livelihoods. Lagos central is heavily urbanized, while areas like Lekki and Epe are rich in forest-based ecosystems. Water bodies, including lagoons and coasts, dominate the landscape. The two-time results were used for the change projections into the near, medium, and distant future as shown in Table 4.26. The table shows that the major ecosystems in the year 2006 are waterbodies 21.69%) settlements 18.41%), freshwater vegetation (14.21%).

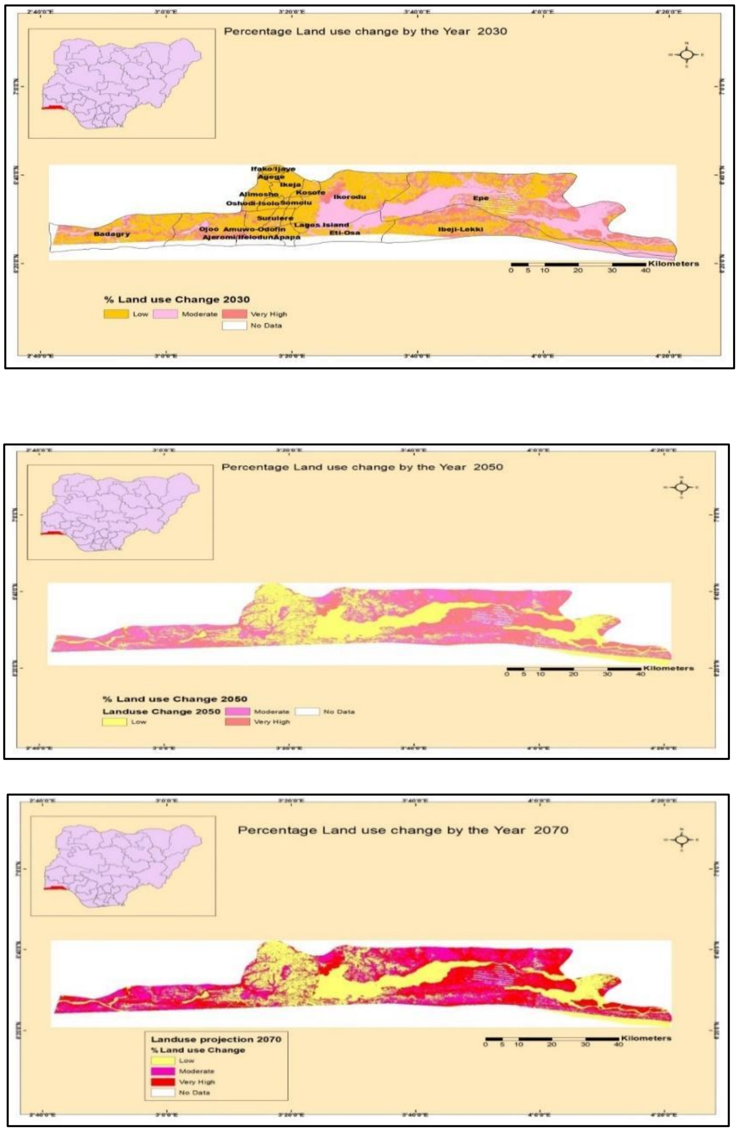
Table 4.22: Land use Analysis of Lagos State 2006 and 2016

Ecosystem	Area in Hectares (2006)	Percentage (%) Ecosystem (2006)	Areas (Hectares) in 2016	Percentage (%) Ecosystem (2016)
Undisturbed forest	2118.42	0.60	11907.54	3.42
Coastal vegetation	13872.96	3.95	10739.16	3.09
Freshwater vegetation	49881.15	14.21	30783.15	8.85
Forest plantation	6565.59	1.87	8287.38	2.38
Disturbed forest	16007.58	4.56	15404.13	4.43
Tree crop plantation	40012.29	11.40	27990.99	8.04
Savannah woodland	5983.29	1.70	19868.58	5.71
Grassland	712.71	0.20	4446.18	1.28
Arable land	26740.53	7.62	60265.44	17.32
Settlements	64650.78	18.41	69453.9	19.96
Bare Surfaces/cleared areas	48377.34	13.78	15873.84	4.56
Water bodies	76159.08	21.69	72931.59	20.96
Total	351081.72	100.00	347951.88	100.00

Source: Natural Eco Capital Fieldwork April 2024

In 2016 the major ecosystems have slightly changed and were water body (20.96%), settlements (19.96%), arable land (17.32%) and freshwater vegetation (8.85%). This shows significant depletion in the freshwater vegetation (from 14.21 to 8. 85%) and slight depletion in the water body from 21.69 to 20.96 %) This is due to an increase in building development projects in the State.

Figures 4.61 (a-c) the projected land use changes for 2030, 2050 and 2070 are presented in maps.



Figures 4.53 (a-c): Percentage projected change in Lagos state 2030, 2050 and 2070 respectively

Figures 4.53a shows that Lagos area will have a high percentage of notice able ecosystem change around the upper Ikorodu axis. The ecosystem change projection extends to 2050 (b), primarily affecting rural areas, notably the northeastern part of Lagos with available lands. Minimal changes are anticipated in water bodies and already urbanized zones. No growth by attrition is expected (c) shows that the projected land use changes for 2070 will ratify the entire state including the project area. The implication of this on the coastal road is the harshness of weather on the infrastructure. It is advisable to plant trees along the roadsides and on the road median.

The tabulated probability of ecosystem changes from 2016 to 2070 is crucial for climate change analysis. Vegetation cover acts as a carbon sink in urban centers, impacting carbon emissions and indirectly affecting the ozone layer, as highlighted by the REED+ project. Ecosystem changes in Lagos influence residents' ability to cope with climate change effects, especially with the urban landscape contributing to high emissions and microclimatic modifications. These impacts underscore the significance of ecosystem management in mitigating climate change repercussions in Lagos. The socio-economic implications of increased hard landscape and decreased soft landscape in Lagos include a slight rise in outdoor temperature, affecting human comfort and potentially leading to associated health challenges.

Enhanced coastal access presents economic prospects, stimulating local businesses and tourism. However, it triggers challenges: rising land costs and gentrification threaten resident displacement, while increased traffic poses safety risks. The coastal road's construction will reshape the environment, impacting communities, industries, and schools. Heavy machinery disturbs habitats like wetlands, displacing wildlife, and jeopardizing biodiversity. Construction disrupts livelihoods and exacerbates erosion, polluting waters with sediment and chemicals.

For the communities nestled along these coastlines like Eleko and other villages, the impacts will be deeply felt. Families may be uprooted to make way for roadways, severing ties to ancestral lands and cultural heritage. Meanwhile, the influx of construction activities brings with it noise pollution and the constant hum of machinery, disrupting daily life and posing health risks to residents especially those in the hospitals. For schools situated nearby, construction poses its own set of challenges. The noise and disruptions can disrupt learning environments, affecting students' concentration and academic performance.

Amidst these complexities, there's a pressing need for careful planning and mitigation strategies. Comprehensive impact assessments, stakeholder engagement, and monitoring efforts are essential for sustainable progress, balancing development with conservation to preserve coastal communities' rich tapestry of coastal life.

Climate Risk Assessment - Green House Gas Emission: The Lagos-Calabar coastal road is a critical artery for transportation and commerce, which will be expected to be one of the busiest roads in Nigeria. It will be traversing through densely populated and industrial zones of Lagos areas and as such, contributing significantly to GHG emissions. Vehicle emissions, particularly from heavy traffic congestion, will be a primary source, compounded by industrial activities along the route. Assessment of potential greenhouse gas (GHG) emissions along Lagos' coastal road with a means of providing climate mitigations is essential due to its environmental and societal implications.

A comprehensive climate risk assessment of GHG emissions along the Lagos coastal road is imperative for informed decision-making and policy formulation. Strategies to mitigate emissions, such as promoting public transportation, implementing emission standards for vehicles, and transitioning towards renewable energy sources, are critical for building climate resilience and ensuring a sustainable future for Lagos and its residents.

- *An assumption of operation of 1000 diesel-powered trucks per hour with individual operation capacity of an average of 10 hours per day, could guide in emissions estimates based on typical factors for diesel engines.*
- *If average distance travelled by each truck per hour is 10 kilometers and its average fuel consumption per kilometre: 4 liters (for heavy-duty trucks), then the Carbon dioxide (CO2) emission factor for diesel fuel will be approximately 2.68 kg CO2 per litre. With the above assumption, the total CO2 emissions per hour per truck 107.2kg of CO_2 per hour Total fuel consumption per hour per truck = 10 km/hour * 4 liters/km = 40 liters/hour*
- *Total CO2 emissions per hour per truck = 40 liters/hour * 2.68 kg CO2/liter = 107.2 kg CO2/hour. Now, multiply the emissions per truck by the number of trucks:*
- *Total CO2 emissions per hour = 107.2 kg CO2/hour/truck * 1000 trucks = 107,200 kg CO2/hour.*

Box 4.2: Carbon Emission Scenario Based on Truck Movement

The above calculation provides an estimate of the CO2 emissions from the coastal road due to truck movements. However, it's important to note that actual emissions may vary depending on factors such as traffic congestion, vehicle efficiency, and fuel quality.

Moreover, the coastal road's proximity to the Atlantic Ocean amplifies the risks associated with climate change, as rising sea levels and coastal erosion threaten infrastructure and livelihoods. Additionally, the reliance on fossil fuels for transportation exacerbates the region's carbon footprint, necessitating urgent action to transition towards cleaner and more sustainable transportation solutions.

Climate Risk Assessment - Hazards in Lagos

Like other cities in Nigeria, Lagos faces several hazards that result in significant damage and setbacks of developmental progress:

- River flood hazard (High)
- Water scarcity hazard (Medium)
- Urban flood hazard (High)
- Extreme heat hazard (Medium)
- Coastal flood hazard (Medium)
- Wildfire hazard (Medium)

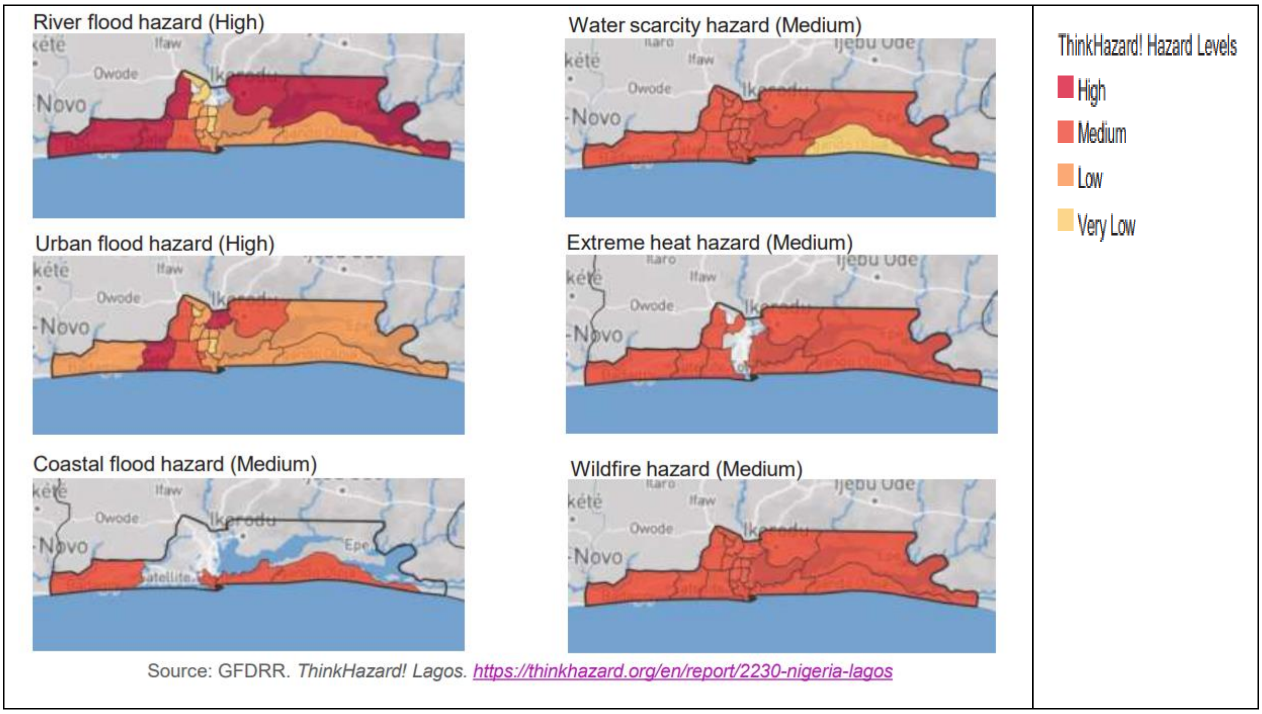


Figure 4.54: Frequent Hazards in Lagos

Source: Lagos State Bureau of Statistics (2022)

Lagos is at high risk of both river (fluvial) flooding and urban (pluvial) flooding, with estimated annual flood damages (to assets, economic production, and mortality) costing almost $4 billion. Other prominent risks include coastal flooding, erosion, extreme heat, droughts, and wildfires, with an estimated cost of $1.7 billion each year in loss of assets, economic production, and land due to coastal erosion. Additionally, climate change is exacerbating these risks. 18% of land is on low-lying coastal plain, prone to regular flooding. Eti-Osa is one of the LGAs said be one of the most exposed when considering a 100-year flood (Figure 4.117).

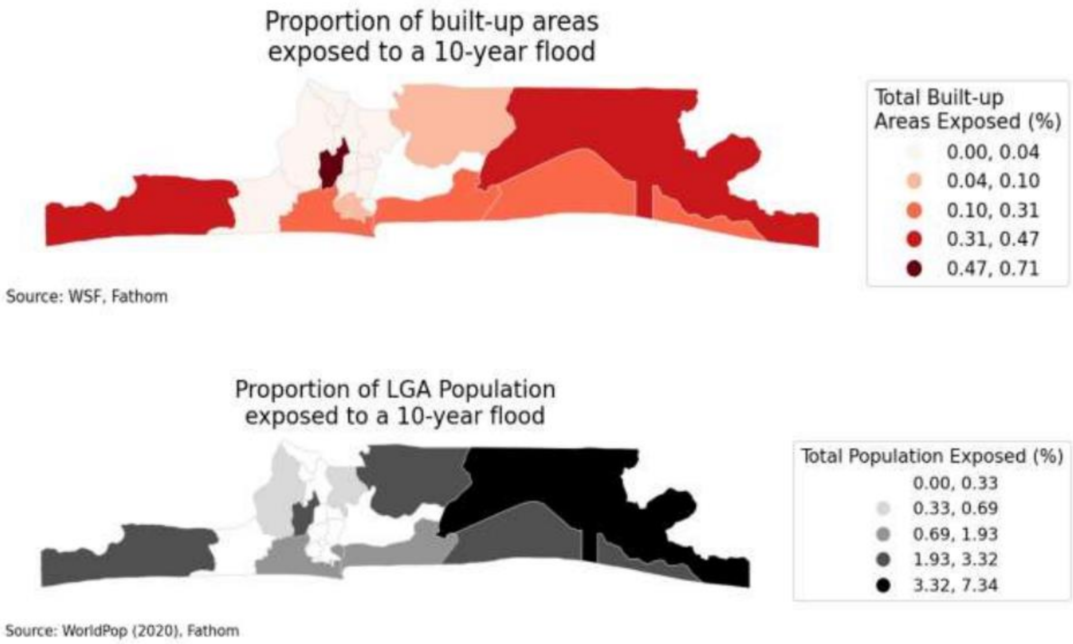
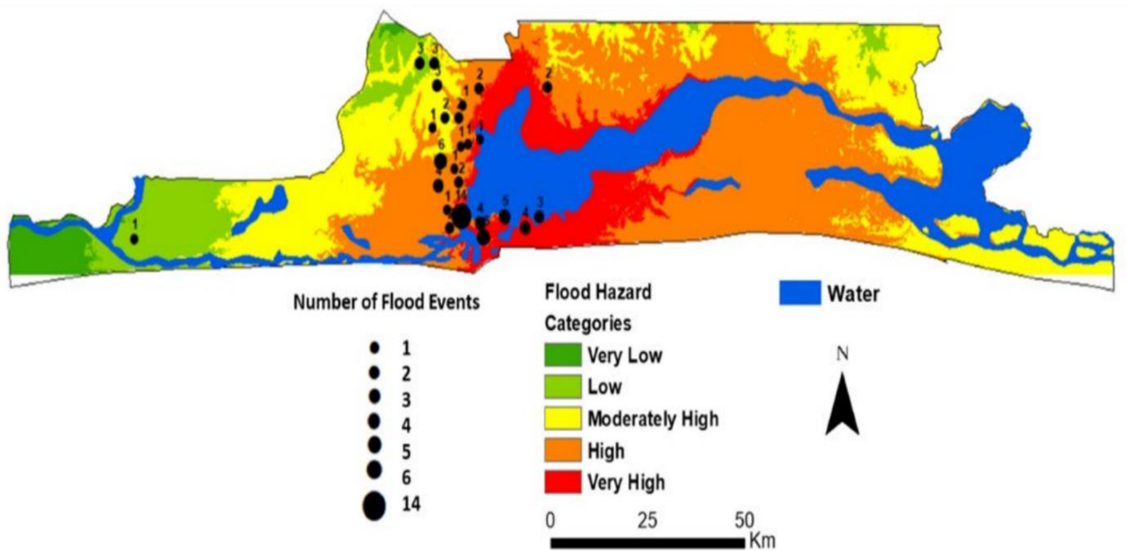


Figure 4.55(a-b): Low-lying Coastal Plain, Prone to Regular Flooding

World Bank, SURGE, and SECO (2023)



b) Flood Hazard in Lagos

Higuera Roa, Jack O’Connor, Taiwo Seun Ogunwumi, Christopher Ihinegbu, Josefine Reimer Lynggaard, Zita Sebesvari, Caitlyn Eberle, Margaret Koli (2022): Lagos floods, Technical Report

Lagos’ coast is affected by severe pressures: unplanned urbanization has increased people’s exposure to floods and erosion risks. The erosion process is threatening coastal communities along the Lagos shoreline: 86% of the state's coastline is subject to erosion, with an 8% average annual erosion rate of 8.2 meters per year 1. The eastern coast is at higher risk as it is more developed with buildings and infrastructure.

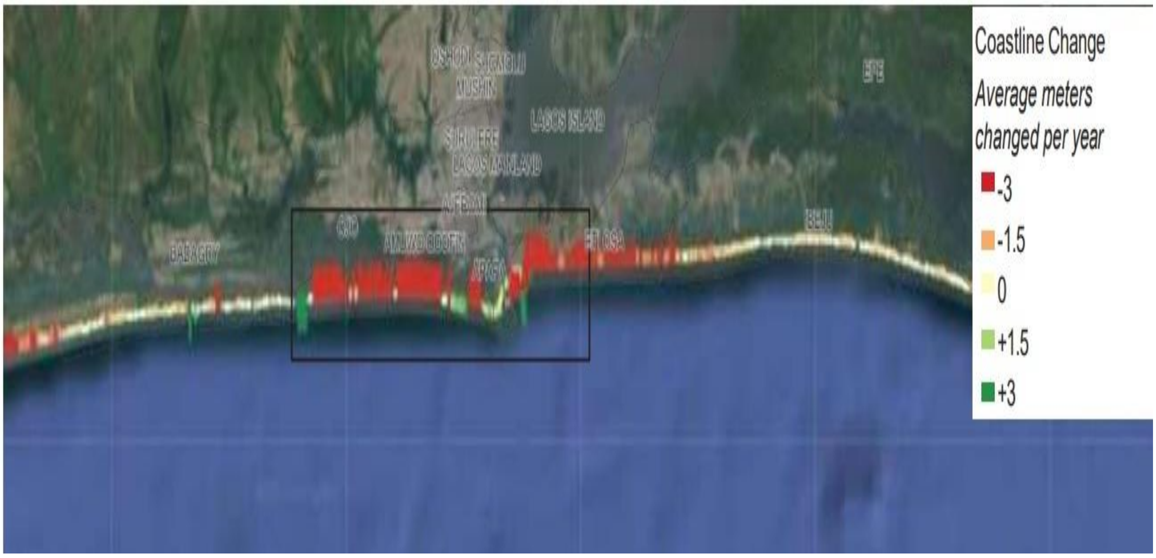
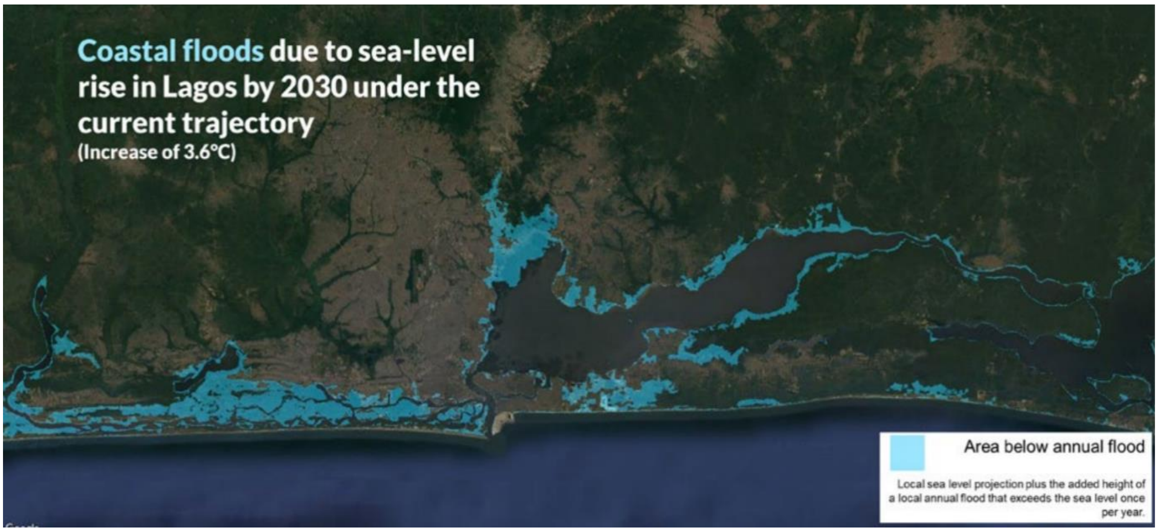


Figure 4.56(a-b): Lagos Coastline Affected by Erosion

Source: World Bank, SURGE, and SECO (2023)



b): Coastal Floods due to Sea Level Rise in Lagos by 2030 SSP3.0-7

Source: Extracted from Climate Central (2021)

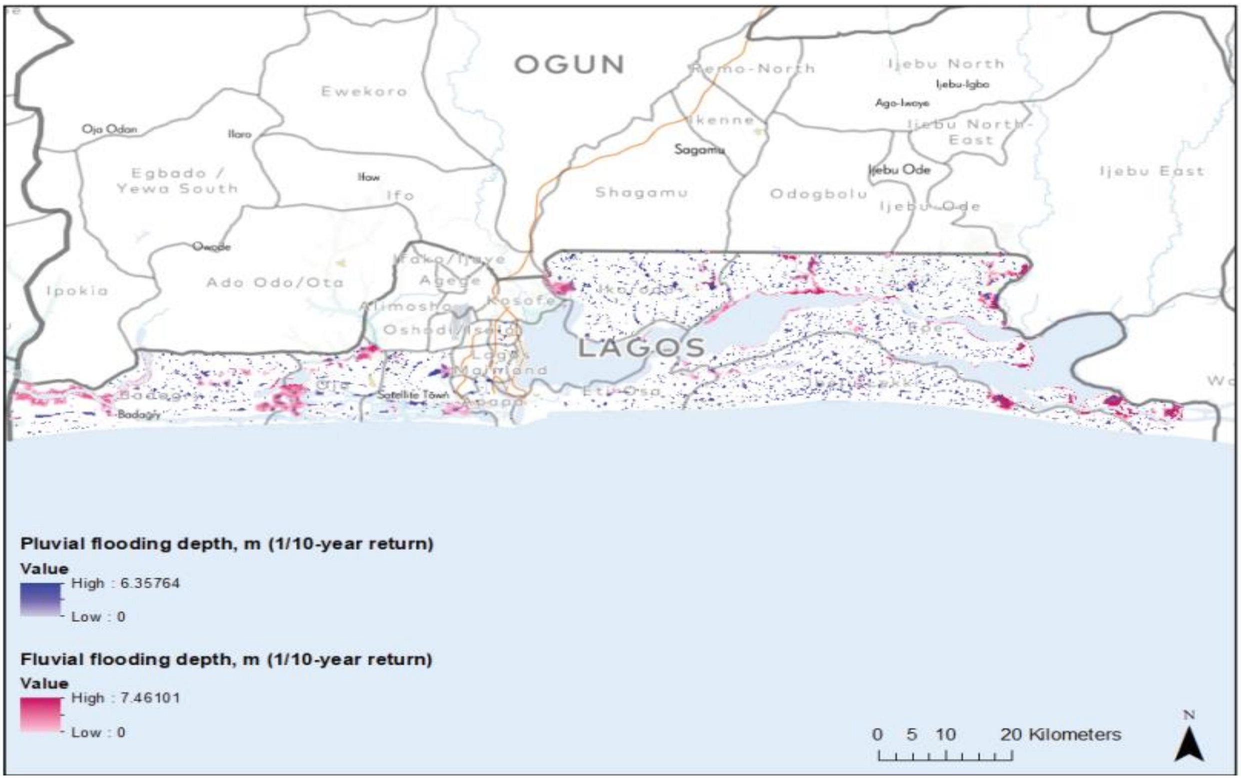


Figure 4.57: Fluvial and Pluvial Types of Erosion in Lagos

Source: World Bank, using SSBN Global Flood Hazard Model data, based on Sampson et al., (2015)

Table 4.23: Estimate the Impacts of Erosion

	No
Production lost*	124
Land lost	691
Assets lost	835
Total cost of erosion	1,650
% of the States' GDP	1.7%

Lelia Croitoru, Juan José Miranda, Abdellatif Khattabi and Jia Jun Lee (October 2020)

The Cost of Coastal Zone Degradation in Nigeria: Cross River, Delta, and Lagos States

Risk and Vulnerability of Infrastructures: Like other physical structures, infrastructural facilities such as roads, schools, and hospitals are also vulnerable to flooding. Road facilities are so crucial, even in the period of flooding for rescue, support services and could equally provide temporary succour for flood victims. Infrastructures tend to fail faster to flood and the failure no doubt would deprive the people of the area the opportunity to use the infrastructure while replacing such infrastructure may not be so easy in this period of economic melt-down.

Plate 4.7: Failed access road in Alfa beach, Eti-Osa LGA

The spatial distribution of vulnerable infrastructure in Lagos State is presented in Tables 4.24 to 4.25. Eti-Osa, Ikorodu, Amuwo-Odofin, and Ojo are vulnerable to the threats of flooding. The distribution of severely affected infrastructures is presented in **Table 4.24** while the vulnerability maps are equally presented in the appendix (flood risk vulnerability maps) for the affected Local Government Area and for the entire State.

Table 4.24: Lagos Flood Risk Vulnerability Statistics (Severely Affected)

Description	Ikorodu	Kosofe	Ojo	Amuwo-Odofin	Alimosho	Eti-Osa
No. of PAPs	342	2,169	52	218	35	465
Residential	296	1,862	40	197	27	385
Commercial	1	62	2	-	-	25
Mixed	25	110	4	10	5	18
Industrial	2	1	-	-	-	1
Institutional buildings	13	89	5	5	2	18
Roads	5	45	1	5	2	9
Recreational	-	-	-	1	-	9
Estimate (N‘000)	2,092,930.00	34,735,930.00	385,150.00	6,367,500.00	493,000.00	29,577,697.00

Source: Natural Eco Capital Fieldwork April 2024

A buffer of 500m was set to determine the total number of infrastructures that are moderately affected by flooding. The analysis however revealed that a total of 339 infrastructures (residential, commercial, mixed, industrial) were moderately exposed to the threats of flooding with an estimated value of N4, 991,800,000.00. In determining the estimate of the least affected infrastructures, a buffer of 700m was set along the coastline.

Table 4.25: Lagos Flood Risk Vulnerability Statistics (Moderately Affected)

Description	Amuwo-Odofin	Alimosho	Eti-Osa
No. of PAPs	83	62	25
Residential	67	46	16
Commercial	1	1	-
Mixed	11	4	4
Industrial	-	-	-
Institutional buildings	4	7	3
Roads	-	4	2
Recreational	-	-	-
Estimate (N)	2,339,500,000.00	1,094,000,000.00	1,558,300,000.00

Source: Natural Eco Capital Fieldwork April 2024

Conversely, the total distribution of infrastructures that are susceptible to the threats of flooding across the State based on the vulnerability mapping of the CRA project for Lagos State is 6,983 with varying degrees of impact ranking viz, severely affected (6563), moderately affected (339) and least affected (81).

Climate Risk Assessment-Forest Carbon Audit: The assessment, spanning 47.8km, utilized remote sensing, field surveys, and carbon accounting to estimate forest carbon equivalents. Data on vegetation types, carbon density, and biomass were analysed to quantify carbon storage. Climate risk scenarios assessed project impacts on carbon sequestration. **Figure 4.58** details the sampling design.

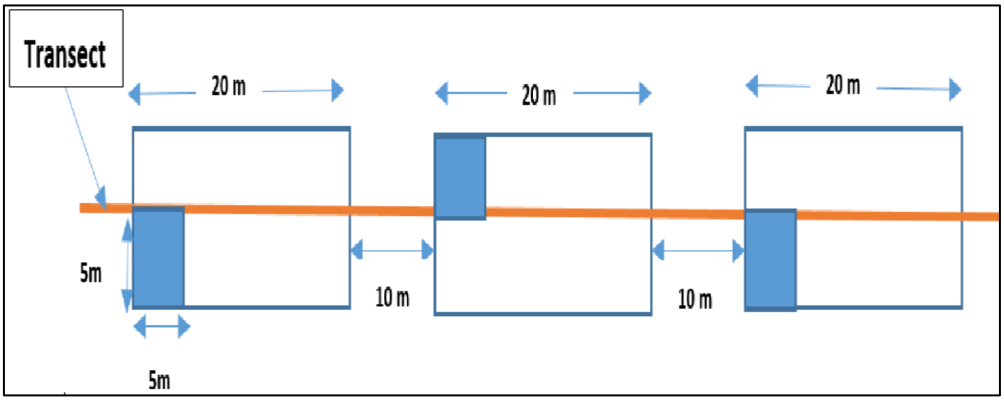


Figure 4.58: Sketch Diagram of Sample Transect Sampling Design

In this project, the total amount of sequestered CO2eq. (t ha-1) in the above-ground biomass was 6.7340 t CO2eq. ha-1 for the entire sample plots while the standard error and standard deviation had values of 0.0005 and 0.0106 with an uncertainty value of 35%. This findings corroborate the report of Alongi, (2014) and it states that the mangrove plants are very productive and it is estimated that the average annual carbon sequestration rate of mangrove ecosystems is between 6 and 8 Mg CO2e/ha (tons of CO2 equivalent per hectare) (Murray et al., 2011). However, mangroves are considered as potential sinks of atmospheric carbon due to their significant role in the global carbon cycle and cultural ecosystem services (Matsui et al., 2010).

The estimation of sequestered carbon stock in the landscape was done in accordance with the Nigeria Forest Carbon Inventory Field Manual supervised by Food and Agricultural Organization of the United Nations (2020). Moreover, carbon sequestration potentials for the landscapewas estimated according to the tree composition and structure.The total estimated CO_2 equivalent for the landscape was **6.7340**t$CO_{2eq.}$ha^{-1}for the entire sample plotswhile thestandard error and standard deviation had values of 0.0005 and 0.0106 at confidence level of 0.09% with an uncertainty value of 35%as presented below:

Estimation of CO_2 sequestered of the above-ground biomass for the Landscape

	AGB (kg ha^{-1})	CO_2eq. (t ha^{-1})
Standard Error	0.2839	0.0005
Standard Deviation	6.1017	0.0106
Total	2144.837	6.7340
Count	412	412
Confidence Level (95%)	55.78%	0.09%
Uncertainty	26%	35%

4.12 Biological Baseline Assessment

Soil quality investigation

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

Plate 4.8: Soil Sampling Activity

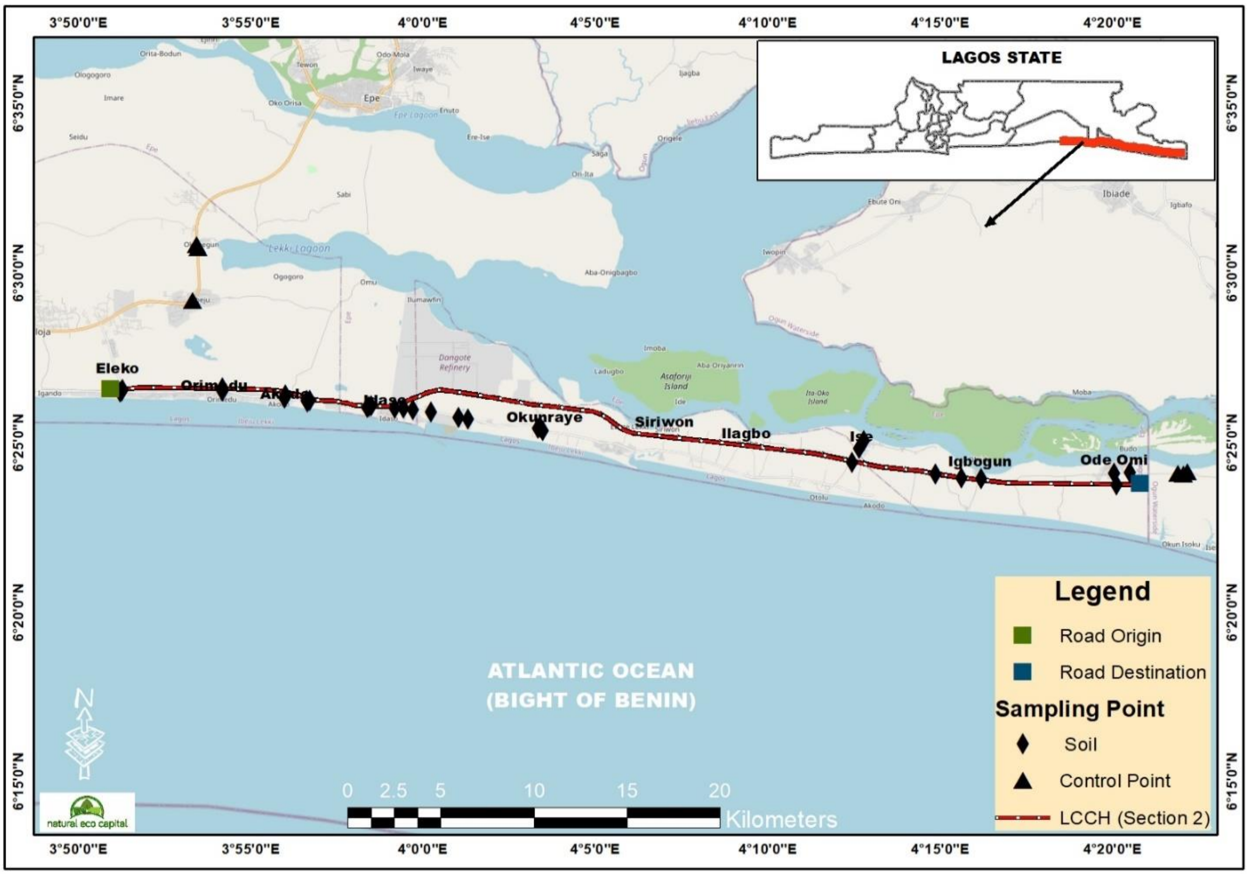


Figure 4.59: Map showing sampling location for soil

S/N	Community	Sampling Location	Type	Lat	Long
1	Ise 1	1	Soil	6.406906	4.207254
2	Ise 2		Soil	6.413490	4.210916
3	Ise 3		Soil	6.417552	4.212994
4	Igbogun 1	2	Soil	6.401163	4.247610
5	Igbogun 2		Soil	6.399334	4.260452
6	Igbogun 3		Soil	6.398695	4.269925
7	Ode Omi 1	3	Soil	6.401252	4.334082
8	Ode Omi 2		Soil	6.401663	4.341785
9	Ode Omi 3		Soil	6.395569	4.335370
10	Eleko Roundabout 1	4	Soil	6.442656	3.854385
11	Eleko Roundabout 2		Soil	6.441755	3.854326

12	Eleko Roundabout 3		Soil	6.441458	3.853600
13	Okegun (Control 1A)	C1	Control Point	6.512039	3.891176
14	Okegun (Control 1B)		Control Point	6.513786	3.890255
15	Okegun (Control 1C)		Control Point	6.486289	3.888355
16	Akodo 1	5	Soil	6.439740	3.933244
17	Akodo 2		Soil	6.439013	3.933244
18	Akodo 3		Soil	6.438185	3.933000
19	Ode Omi (Control 2A)	C2	Control Point	6.401459	4.365061
20	Ode Omi (Control 2B)		Control Point	6.401180	4.367645
21	Ode Omi (Control 2C)		Control Point	6.402152	4.369541
22	Tiye 1	6	Soil	6.437302	3.943529
23	Tiye 2		Soil	6.437090	3.945107
24	Tiye 3		Soil	6.436374	3.944088
25	Orimedu 1	7	Soil	6.443294	3.902946
26	Orimedu 2		Soil	6.442378	3.903057
27	Orimedu 3		Soil	6.441729	3.902843
28	Ilege 1	8	Soil	6.433706	3.972979
29	Ilege 2		Soil	6.434181	3.973876
30	Ilege 3		Soil	6.434614	3.974704
31	Idaso (Dangote Refinery) 1	9	Soil	6.433275	3.990481
32	Idaso (Dangote Refinery) 2		Soil	6.433328	3.986107
33	Idaso (Dangote Refinery) 3		Soil	6.432466	3.994990
34	Udotu (Lekki Deep Sea Port) 1	10	Soil	6.431522	4.003752

35	Udotu (Lekki Deep Sea Port) 2		Soil	6.428932	4.017043
36	Udotu (Lekki Deep Sea Port) 3		Soil	6.428018	4.021780
37	Okunraye 1	11	Soil	6.423855	4.056561
38	Okunraye 2		Soil	6.423444	4.055578
39	Okunraye 3		Soil	6.422472	4.057810

Result of Soil Properties

Soil pH

The pH levels of the soil samples were slightly acidic and alkaline ranging from 6.50 – 8.10 in the top soil while the subsoil had a mean level of 7.26. This range of soil pH falls within the optimum limit for plant growth.

Soil Organic Carbon and Matter

Soil organic carbon is a measureable component of soil organic matter which makes up about 2–10% of most soil's mass and has an important role in the physical, chemical and biological function of soils. Organic matter is relevant in the soil's ability to retain nutrient and moisture, its structure, and capacity to degrade pollutants. It promotes structural stability, supplies and stores nutrients (particularly Nitrogen, Phosphorus and Sulphur), which are slowly released in usable form as it decomposes.

Organic carbon in soils is formed from decayed remains of roots, plant residues and soil organisms. The organic carbon levels were comparatively low in the soil samples as common in sandy soils. The mean organic carbon level in the top soil and sub soil was 0.99% and 1.24% respectively. Studies previously carried out by Udo (1986) show that the organic matter content of these soils is classified as low.

Exchangeable Bases (Ca, Mg, K and Na)

The exchangeable bases (Ca, Mg, K and Na) are positively charged ions usually absorbed by electrostatic or columbic attraction to soil surface colloids. Plants absorbed it in exchangeable form (Donahue, 1990). The levels of the base metals in the samples were generally low and typical of sandy soil compared to agricultural clayey soils. The base saturation showed a predominance of $Mg2+$ ions in the top soil samples with a concentration range of 89.40 – 852.70 mg/Kg and range from 59.80— 1145.10 mg/Kg in sub soil. In the top soil, the respective concentration ranges of Na, K and Ca were 98.40 – 415.50 mg/Kg, 304.50–855.90 mg/Kg and 210 – 1869.70 mg/Kg. In the sub soil, the respective concentration ranges of Na, K and Ca were 147.90 – 234.90 mg/Kg, 292.30 –999.50 mg/Kg and 210.40 – 4533.00 mg/Kg.

Nutrients' Concentration in the Soil Samples

The availability of plant nutrient species, such as Phosphorus and Nitrogen, is an indication of the soil's productivity. These nutrients species are usually incorporated in organic matter and released into the soil by the decay process. Atmospheric depositions can also be sources of nutrient enrichment in soil (Abayomi et. al., 2011; Olayinka et al, 2016). These nutrients can also be exchange in the soil via anion exchange of where the soil has a net positive surface charge. The mean concentrations of nutrients determined in the top soil samples were 392.50 mg/kg for Nitrate and 25.22 mg/kg for Phosphate while in the sub soil samples were 630.40 mg/kg for Nitrate and 20.57 mg/kg for Phosphate. Concentrations of these nutrients in soils are reflective of the soil type, level of vegetation to enhance nutrient cycling and potential sources of nutrient pollution. The results obtained for Nitrate and Phosphate showed that they are high in the samples using the classifications by Udo (1986) for Nitrogen and Sobulo and Adepetu (1987) for Phosphate showing that the levels of nutrients in the soil samples are low. This comparative low level is common to the soil types in the well drained coastal fringes of Nigeria (Agboola, 1986).

Concentration of Organic Compounds in the Soil Samples

The soil samples were also analyzed for their organic based pollutants. The monitored parameters include Total Petroleum Hydrocarbon (TPH); Polyaromatic Hydrocarbons (PAHs); Benzene, Toluene, Ethyl Benzene and Xylene (BTEX). While some organic compounds are natural constituents of the soil, however, indexed presence of some compounds could be an indicator of pollution, especially petroleum product compounds. PAH was not detected in both surface and subsurface soil respectively.

Total Petroleum Hydrocarbon (TPH), which comprises both the aromatic and aliphatic components of hydrocarbons were not detected in all the sampled stations.

Concentration of Heavy Metal in the Soil Samples

Exposure to heavy metal contamination remains one of the major concerns of environmental pollution due to their debilitating health effects, especially in humans. Heavy metal pollution may occur naturally through releases from metal containing ores or anthropogenically from numerous metal containing products of everyday use. Sources of metal pollution in soil include the discharge of metal containing wastes into the soil environment and pollution from industrial and traffic emissions (Tanee and Albert, 2013; Adesuyi et al., 2015). When present in soil, plant and animals may absorb or ingest these toxic elements which can impair proper growth and physiological development of the affected plants and animals. The soil of the study area was analyzed for the presence of heavy metals to determine their baseline concentration prior to the commencement of the project. Cadmium was not detected in any of the samples at all the study stations. Mean concentrations of heavy metals of concern such as Pb, Cu and Cr were 3.25, 19.34 and 5.98 mg/kg and 4.79, 1.85 and 6.38 mg/kg for top soil and subsoil respectively. Comparatively, the concentration observed for the control Station were not significantly different from those of the study stations. The metal concentrations observed in the samples were lower than concentrations reported by Olukami and Adeoye, 2012 in soil, and also lower than reported natural background levels in soil by Robert and Grenato, 2000. Nevertheless, the presence of the metals could lead to the possibility of surface water pollution especially through overland flow and/or by sub-surface water flow by percolation through the well drained sandy soil of the study area during rainfall.

Results of Microbiological Analysis of Soil Samples

While the soil environment is full of a plethora of microorganisms, some of which are vital to the biological and chemical dynamics and balance in the environment, their presence at elevated levels or counts could be an indication of environmental pollution. Also, the presence of certain microbes, i.e. faecal coliforms, strongly hints at anthropogenic influences on the environment which should call for clearly outlined mitigation measures. The soils obtained from the Control and Study stations were analyzed for their microorganism contents. Total plate count observed in the top soil samples ranged from 19000 to 91000 cfu/g while in the subsoil it ranged from 10400 to 92000 cfu/g. Total yeast and mould were lowest in the Surface soil with an average count of 2536.36 cfu/g while in the sub soil the average count was 727.27 cfu/g.

Table 4.26: Summary of Results of the Physico-chemical Analysis of the Soil Samples analysed during the wet season

PHYSICO-CHEMICAL PARAMETERS	Top Soil (0-15 cm)						Sub Soil (15-30 cm)					
	Area of Influence (n=11)			Control (n=2)			Area of Influence (n=11)			Control (n=2)		
	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM	MEAN	MINIMUM	MAXIMUM	MEAN
MOISTURE CONTENT, %	6.90	16.50	12.26	14.1	15.2	14.65	6.80	17.00	12.56	9.2	16.6	12.9
CONDUCTIVITY, umhos/cm 10% solution	11.90	50.30	27.10	16.5	20.7	18.6	14.00	93.40	35.48	15.4	191.2	103.3
pH (10% solution), 25 oC	6.50	8.10	7.25	6.9	7.1	7	6.50	8.40	7.26	3.6	6.5	5.05
TOTAL ORGANIC CARBON, %	0.14	1.80	0.99	1.3	1.7	1.5	0.60	1.90	1.24	0.64	1.5	1.07
SULPHATE CONTENT, mg/Kg	9.20	943.40	329.30	<0.01	<0.01	<0.01	404.20	404.20	404.20	<0.01	<0.01	<0.01
TOTAL PHOSPHATES, mg/Kg	9.00	56.40	25.22	4.2	9.4	6.8	8.20	42.50	20.57	12.6	15	13.8
NITRATE, mg/Kg	182.00	797.80	392.50	16.9	190.7	103.8	22.40	1675.20	630.40	22.4	37.7	30.05
OIL/GREASE (Chloroform Extract), %	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
MAGNESIUM, mg/Kg	84.90	852.70	424.90	84.9	88.6	86.75	59.80	1145.10	399.46	66.1	229	147.55
SODIUM, mg/Kg	98.40	415.50	200.15	157.4	159.5	158.45	147.90	234.90	177.82	154.9	187.6	171.25
POTASSIUM, mg/Kg	304.50	855.80	455.78	318.9	328.8	323.85	292.30	999.50	395.07	344.8	351.2	348
TOTAL IRON (as Fe2O3), mg/Kg	92.90	1350.50	472.33	52.8	99.3	76.05	23.50	1802.80	522.96	23.5	682.1	352.8
CALCIUM, mg/Kg	210.00	1869.70	777.70	210	219.2	214.6	210.40	4533.00	939.18	254.5	755.5	505
CADMIUM, mg/Kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CHROMIUM, mg/Kg	1.70	16.10	5.98	<0.001	5.9	5.9	3.80	9.40	6.38	6.4	7	6.7
COPPER, mg/kg	0.50	183.30	19.34	0.495	1.2	0.8475	1.20	2.80	1.85	1.1	1.4	1.25
NICKEL, mg/Kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

LEAD, mg/Kg	1.70	5.70	3.25	<0.01	5.3	5.3	2.10	7.40	4.79	2.4	5.8	4.1
ZINC, mg/kg	4.50	75.90	28.31	9.7	11.4	10.55	10.20	21.30	16.55	16.8	19.3	18.05
SAND, %	40.00	90.00	69.09	90	90	90	40.00	90.00	76.82	80	90	85
CLAY, %	0.00	50.00	21.00	0	0	0	3.00	50.00	18.00	10	10	10
SILT, %	8.00	12.00	9.91	10	10	10	10.00	20.00	12.90	10	10	10
TOTAL PETROLEUM HYDROCARBON, mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TOTAL POLY AROMATIC HYDROCARBON, mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
MICROBIOLOGICAL PARAMETERS												
Bacillus, (HUB), CFU/g	0	3000	645.45	700	800	750	0	800	336.36	0	600	300
Pseudomonas, (HUB), CFU/g	0	1000	500	600	700	650	0	800	354.54	400	500	450
Yeast/Moulds, CFU/g	600	9000	2536.36	1000	1100	1050	400	1200	727.27	700	800	750
Total plate count, CFU/g	19000	91000	42000	90000	90000	90000	10400	92000	59036	57000	82000	69500

Source: Natural Ecocapital, 2024

4.12.1 Soil Fauna

The soil macro-fauna identified in the study area include various arthropods (*Myricarid striata*, *Dorylus fimbriatus, Glomens marginata*), Annelids (Earthworms) and Nematodes (*Acanthamoeba polyphaga*, *Acrobeloides sp*, *Porcellia scraber*). These organisms are primary consumers; decomposers, mixers and utilizers of energy stored in plants and plant residues, and contribute to the recycling of nutrients. Others are secondary consumers such as centipedes and spiders. These animals consume smaller sized animals and they, also may serve as food for organisms occupying higher levels of the food chain.

Soil fauna are notable and are critical in the biological turnover and nutrients release of plant residues by fragmenting the plant residues, resulting in enhanced microorganism activities and grazing of microflora by fauna. Anderson and Fletcher (1988) noted a symbiotic interaction between earthworm and microorganism in the breakdown and fragmentation of organic matter.

4.12.2 Soil Flora

Materials and Methodology

To establish the species composition of the above ground vegetation, complete enumeration of the floristic composition of each study plot was done. Field botanical characters used for identification include flowers, fruits, leaves (types and arrangements), and slash exudates. All the plant of the varying habits namely trees, shrubs, forbs, climbers and grasses were enumerated and identified to species level. Plants identification followed the guidelines of Hutchinson & Dalziel, 1954, 1958, 1963, 1968), Hutchinson et al., (1972), Akobundu and Agyakwa (1998), Keay (2011) and Ayodele and Yang (2012). In instances where on-site identification was not possible, the preserved plant specimens were compared with the dried samples in the University of Lagos Herbarium (LUH). Also, we maintained a genuslevel identification in situations where species-level identification was not possible due to a lack of distinct morphological characters. The final scientific names and authorities followed the International Plant Name Index 2020 (www.ipni.org) while the family classification was written according to the Angiosperm Phylogeny Group [The Angiosperm Phylogeny Group (APG), 2016].

Data were collected from along the road alignment (Section 2). Within each sampling plot, the plants were identified to species level and the occurrences of each species were recorded in each plot. The occurrence of each species was described in semi-quantitative terms in accordance with the method used by Edwin-Wosu and Edu (2013). Species with a wide frequency of distribution with many stands within a plot and across majority of plots are described as *very abundant* (++++). Some species with similarly wide frequency of distribution, but with few stands are said to be *less frequent or abundant* (+++), while species of limited geographical distribution and with a few stands are termed *scarce* (++) and *very scarce* (+) species.

The structure of the vegetation type of each plot in terms of vertical stratification of the component plant groups (forbs, trees, shrubs and climbers) was described.

The field data on species identification and density on each plot were used to establish species composition in terms of species, genera and families. The data from the complete enumeration of woody species were used to determine the stem densities per hectare for woody species which were calculated using the number of individuals divided by sample area while the basal area for each species was calculated using the formula

1. **Basal area (m2 ha-1) = $C^2/4\pi$**

Where C is girth at breast height in metre and π, is pie (3.142).

The basal area for each species was determined by adding the basal area of individuals of the species and the plot basal area was calculated by adding basal areas of all the species in each plot while the site basal area for the entire vegetation was calculated as mean woody species basal of all the sample plots of the vegetation type.

Species richness was expressed by the number of observed species in each vegetation type while Species diversity was calculated for each plot as Shannon-Weiner diversity using the formula:

2. **$H' = -\Sigma Pi \ln Pi$,**

Where H' = Shannon-Weiner index, ln = log.

Pi = Relative abundance of each species, calculated as the proportion of individual of a given species to the total number of individuals (Ni) in the plot (ni/N)

In = natural logarithm

- **Family and Species Importance Value Indices**

For each identified species and family in each plot, the relative dominance, relative density and relative frequency were calculated and used to determine the species importance value indices and family importance value indices. The relative density, relative dominance and relative frequency was calculated using the following equations:

3. **Relative density = <u>Number of individual of one species/family</u> x100**

Total number of all individuals counted

4. **Relative Dominance = <u>Basal Area per species/family</u> x100**

Total Basal Area

5. **Relative frequency = <u>Frequency of each species/family</u> x100**

Sum of frequency values of all species

6. **Importance Value = Relative density +Relative Dominance +Relative frequency**

Importance Value is the sum of relative density, relative dominance and relative frequency

The dominance of family and species was calculated based on Family Importance Value Index (FIV) (Mori *et al.*, 1983) and the Species Importance Value Index (IVI) (Curtis and McIntosh, 1950).

Conservation status assessment

The conservation status of the species was classified as Not Evaluated (NE), Data Deficient (DD), Least Concern (LC), Near Threatened (NT), Vulnerable (VU), Endangered (EN), Critically Endangered (CR), Extinct in The Wild (EW), and Extinct (EX) based on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (IUCN, 2021).

4.12.3. Vegetation Description

This floristics assessment of the vegetation cover along the stretch from Lekki (Eleko) to Ode-Omi (Ogun Waterside), a region known for its rich and diverse ecological zones. The area under study encompasses three major vegetation types: Mangrove Wetlands, Grassland/Savanna, and freshwater Swamp Forests. Each of these vegetation types contributes to the ecological balance of the region and supports a variety of plant and animal species.

a. **Freshwater Swamp Forest**

The vegetation of freshwater swamp forest or flooded forests which are inundated with freshwater either permanently in some part or seasonally in other part. The climate is tropical and belongs to Afrotropic freshwater swamp forest. There is an enormous supply of freshwater from inland rivers and run offs from abundant rainfall in the area. The intricate network of creeks and lagoons results in inaccessible swamps of forest vegetation in some parts of the study area. Swamp forests, located in low-lying areas, are dominated by waterlogged soils and high humidity. These forests are dense, with a rich undergrowth of ferns, shrubs, and climbers. The swamp forests play a critical role in maintaining water quality and regulating hydrological cycles.

The dominant plant Species in this area are

- Raphia hookeri (Raffia Palm)
- Alstonia congensis (Patterned Alstonia)
- Uapaca heudelotii (False Macaranga)
- Ficus exasperata (Sandpaper Fig)
- Anthocleista vogelii (Cabbage Tree)
- Hallea ledermannii (Hallea)

These peculiar floristics are of the ecological importance:

- Serves as a water reservoir, mitigating floods and maintaining the water table.
- Supports a diverse range of wildlife, including amphibians, reptiles, and birds.
- Acts as a carbon sink, storing large amounts of carbon dioxide.

Plant species Composition, Distribution and Density of Vegetation

The most common species of the study area of freshwater swamp forest is the raffia palm which dominates the swamps (Plate 1). The better-drained area supports oil palm trees (*Eleais guinensis*), coconut trees and vast array of valuable tree species which constitute the dominant layer of closed canopy with few and scattered emergent tree species (Plate 2). The ferns, few grasses and herbs constitute the understorey species and occupy the floor of the forest.

Plate 4.9: Swamp Forest Showing Raffia Palms

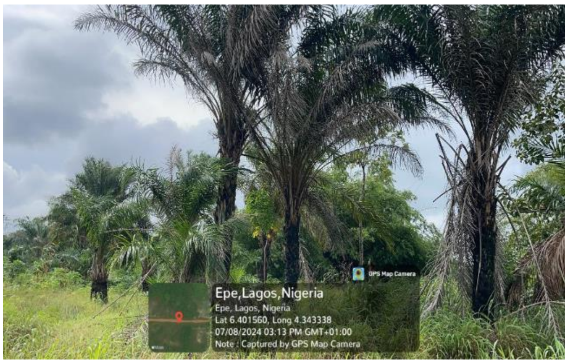


Plate 4.10: Oilpalm trees

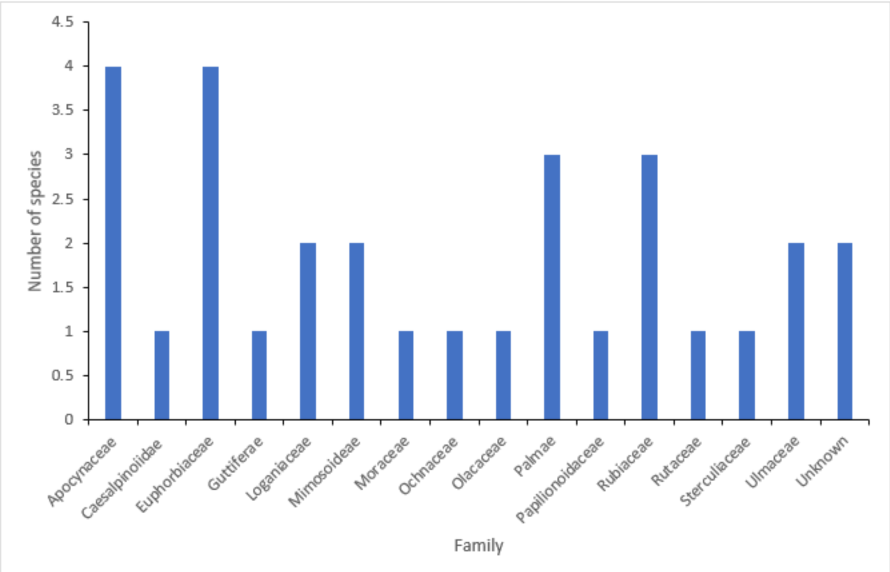


Figure 4.60: Family Distribution of tree species encountered in the project area

A total of 78 plant species belonging to 33 families and comprising of trees, raffia palm, oil palm, ferns and herbs were encountered within the site of the proposed project. The families with the highest frequency of species include *Rubaceae*, *Euphorbiaceae*, *Ulmaceae*, *Apocynaceae*, *loganiaceae*, *Guttiferae* and *Mimosoideae* (Figure xxx). Based on 'DAFOR' scale which is an ordinal or semi-quantitative scale for recording the relative abundance of plant species (George *et al.* 2011), the frequent tree species in the study area include Mitragyna ciliata, Harungana madagascariensis, Raphia farinifera, Elaeis guineensis, Alchomea cordifolia, Celtis Zenkeri, Alstonia boonei, Anthocleista djalonesis, Trema orientalis, Mitragyna stipulosa, Rauvolvia romitoria,Albizia ferruginea and phyllantus descoideus.

Tree species that were occasionally encountered include Macaranga bateri, Capolobia lutea, Lophira alata, Picralima nitida, Anthocleista nobilis and Mitragyna stipulosa, while the rare species include Fagara microphylla, Lophira alata, Albizia zygia, Bambusa vulgaris, Uapaca togoensis, Strombosia pustulaca, Cassia nodusa and Baphia nitida (Table 4.29).

Herbs were predominantly abundant in the study area. They were represented by 48 species distributed among 21 families. The families *Asteraceae* was the most diverse with 6 species, followed by *Poaceae* and *Euphorbiaceae* with 4 species each. *Rubiaceae*, *Apocynaceae* and *Mimosoideae* have 2 species each. Other families which include *Commelinaceae*, *Sapindaceae*, *Gultiferae,Zingiberaceae*, *Cucurbifaceae* and *convolrulaceae* were represented by one species (**Table 4.27**).

Table 4.27 Relative Occurrence of Tree Species in the Study Area Based on 'DAFOR' Scale

S/N	*Species*	Frequency	Status of occurrence
1	*Alstonia boonei*	28	Frequent
2	*Alstonia congensis*	1	Rare
3	*Alchornia cordifolia*	11	Frequent
4	*Anthocleistha djalonensis*	12	Frequent
5	*Anthocleistha nobilis*	4	Occasional
6	*Albizia zygia*	3	Occasional
7	*Albizia ferruginea*	9	Frequent
8	*Bambusa vulgaris*	1	Rare
9	*Baphia nitida*	1	Rare
10	*Carica papaya*	3	Occasional
11	*Cocos nucifera*	2	Rare
12	*Celtis zenkeri*	5	Frequent
13	*Elaeis guineensis*	8	Frequent
14	*Fagara microphylla*	2	Rare
15	*Harunganamadagascariensis*	16	Frequent
16	*Lophira alata*	3	Occasional
17	*Marcaranga barteri*	8	Frequent
18	*Mitragyna stipulosa*	7	Frequent
19	*Mitragyna ciliate*	8	Frequent
20	*Mussanga cecropoides*	1	Rare
21	*Phyllanthus discoideus*	11	Frequent
22	*picralima nitida*	3	Occasional

23	*Rauvolvia vomitoria*	10	Frequent
24	*Raphia farinifera*	2	Frequent
25	*Rothmannia megalostigma*	3	Occasional
26	*Sterculia tragacantha*	1	Rare
27	*Stombosia postulate*	1	Rare
28	*Trema orientalis*	16	Frequent
29	*Uapaca togoensis*	1	Rare
	Total	**181**	

Frequent *– Commonly encountered species*

Occasional *– Species with low frequency of occurrence*

Rare *– Species found only once or a very few times.*

Within the study area, the tree density of frequent species ranged from 260 per hectare to 980 per hectare (Table 4.30). The density of herbs within the study area ranged from 50 per hectare to 1,120 per hectare. The findings of the floristic composition and plant density in the study area agree with earlier results from similar environment in Nigeria (Agbara and Chimezie, 2011). Similar families have also been reported in tropical forests elsewhere in the world (Deri and Yadara, 2006; Prasad *et al.*, 2007). Diversity studies in ecosystems have become increasingly important to our understanding of the complexity and fragility of the natural world. By quantifying and describing diversity in different habitats, we can identify factors that influence the diversity of species that are supported in an area. Also, by comparing biological diversity in a specific area at different points in time, we can examine the effects of natural or human-induced perturbations on diversity within biological communities.

The Shannon-Weiner index of tree diversity in the study area is 1.16 while that of the understorey plants (herbs) 2.26. Although the tree species diversity in the study area is high compared to other ecosystems, the diversity index of the understorey plants is 1.9 times higher than that of the tree species. Similar high diversity index was reported for understorey plants in a logged over rainforest ecosystem in Nigeria (Onyekwelu *et al.*, 2010). These different studies independently confirmed the floristic diversity and richness of tropical forest ecosystems in terms of number of species, genera and families which also typified the vegetation structure observed and being reported for the freshwater swamp forest in Lekki. Even though the plant species diversity is high in the study area, the stem girth measurement of the tree species encountered during the field survey are small ranging between 10 cm and 20 cm dbh, with few trees exceeding 30 cm dbh. The current status of the forest is attributed to high rate of uncontrolled timber exploitation in the freshwater swamp forest where accessibility is permissible.

Table 4.28: Density of Herbs Species in the Study Area

Species name	**Family name**	**Species density No/ha**
Mitragyna ciliate	Rubiaceae	210
Elaeis guineensis	Palmae	30
Rothmannia megalostigma	Rubiaceae	370
Harunganamadagascariensis	Gittiferae	390
Alchornea cordifolia	Euphorbiaceae	300
Ravolvia vomitoria	Apocynaceae	510
Fagara microphylla	Mimosoideae	210
Baphia nitida	Papilionoidaceae	330
Blighia sapida	Sapodaceae	60
sterculia tragacantha	Sterculiaceae	480
Macaranga barteri	Euphorbiaceae	180
Pentacleithra macrophylla	Mimosoideae	210
Picralima nitida	Apocynaceae	520
Ageratum conyzoidess	Asteraceae	160
Andopogon sp	Poaceae	40
Commelina sp	Commelinaceae	130
Elusin indica	Poaceae	250
Petandra virginica	-	150
Pontederia cordial	-	300
Cephalantus sp	-	180
Aspilia Africana	Asteraceae	120
Brucharia lata	Poaceae	80
Scleria naumanniana	Cyperaceae	250
Veronia sp	Asteraceae	160
Aspilia Africana	Asteraceae	120
Chromolaena odorata	Asteraceae	280
Panicum maximum	Poaceae	80
Euphorbia hirta	Euphorbiaceae	300
Portulaca olerecea	Portulaceae	550
Acanthus monianus	Acanthaceae	80

Mimosa pudica	Mimosaceae	50
Centrosema sp	Caesalpinaceae	80
Phyllanthus amarus	Euphorbiaceae	480
Telfairia occidentalis	Cucurbitaceae	360
Custus afer	Zingiberaceae	1120
Diplazium sammatii	Athyriaceae	520
Emilia sp	Asteraceae	620
Mimosa pudica	Mimosaceae	120
Ipomea sp	Convolvulaceae	60
Calotropis procera		20
Sida acuta	Malvaceae	160

Table 4.29: Density of Frequent Tree Species in the study site

Species Name	**Family Name**	**Density No./ha**
Alchornia cordifolia	*Euphorbiaceae*	650
Harungana madagascariensis	*Guttiferae*	490
Mitragyna stipulosa	*Rubiaceae*	380
Mitragyna ciliate	*Rubiaceae*	460
Raphia farinifera	*Palmae*	980
Elaeis guineensis	*Palmae*	780
Celtis zenkeri	*Ulmaceae*	480
Alstonia boonei	*Apocynaceae*	330
Anthocleistha djalonensis	*Loganiaceae*	420
Trema orientalis	*Ulmaceae*	260
Rauvolvia vomitoria	*Apocynaceae*	500
Phyllanthus discoideus	*Euphorbiaceae*	490
Albizia ferruginea	*Mimosoideae*	600

Table 430 : Flora Diversity Index in the Study Area of Freshwater Swamp Forest

Flora category	**Shannon-weiner diversity index**
Tree	1.16
Understorey	2.26
Microphytes	0.41

Aquatic Macrophytes

The aquatic macrophytes encountered during the survey are those at the marginal floral zone. The most abundant in the zone include *Anthopteris palisofi, Cytospermum sensgalense, Ipomea erecta, Echinodoa pyramidalis, Eulophia sp, Ludiriga ereta, Polygonum senegalense, Thalia geniculata* and *Carex ehinochloa*. The macrophytes are important vegetation communities that serve as food for herbivoral fish and some aquatic insects. They therefore occupy an important trophic level in the aquatic food chain.

b. **Derived Savanna/Grassland**

The grassland or savanna region of the study area is characterized by open landscapes dominated by grasses, with scattered trees and shrubs. This vegetation type is typically found in areas with well-drained soils and experiences a marked dry season. This vegetation is typically found in the transitional zones between the coastal mangroves and the lowland rainforests, extending inland. The Savanna in this region is characterized by open grasslands with scattered trees such as Terminalia macroptera, *Terminalia avicennioides*, Annona senegalensis and *Anogeissus leiocarpa*. Grasses such as *Andropogon gayanus* and *Hyparrhenia rufa* dominate the landscape, alongside shrubs and small trees. The dominant plant species in this area are:

- Andropogon gayanus (Gamba Grass)

- Panicum maximum (Guinea Grass)

- Hyparrhenia rufa (Jaragua Grass)

- Sorghum arundinaceum (Savanna Sorghum)

- Annona senegalensis (African Custard Apple)

- Terminalia macroptera (Large-leaved Terminalia)

This characteristics vegetation are of the following ecological importance:

- Supports herbivorous wildlife and provides grazing land for livestock.

- Maintains soil fertility through nutrient cycling.

- Acts as a firebreak in regions prone to wildfires.

Plant species Composition, Distribution and Density of Vegetation

The dominant grass species include *Andropogon gayanus*, *Panicum maximum*, and *Hyparrhenia rufa*. Scattered trees such as the *Annona senegalensis* (African Custard Apple), Terminalia macroptera (Large-leaved Terminalia) are also common. Shrubs and woody plants such as *Combretum* species and *Acacia* species add structural diversity to the landscape.

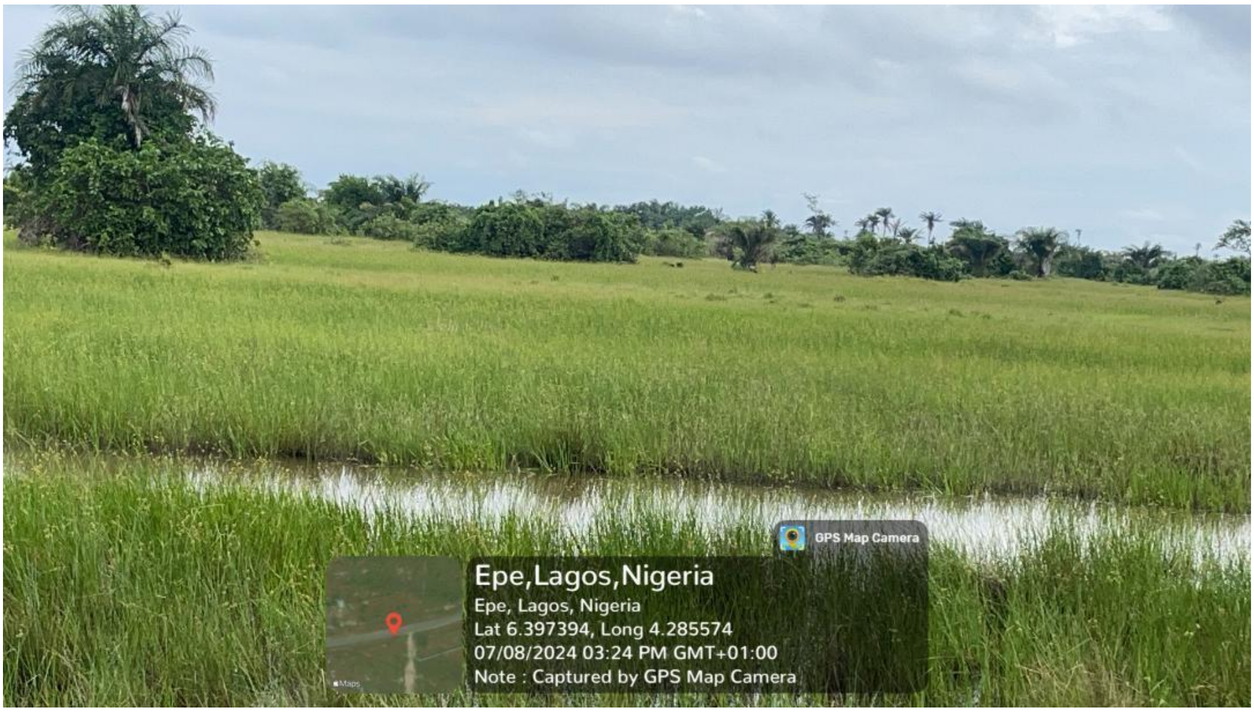


Plate 4.11: Grassland with Scatter Trees

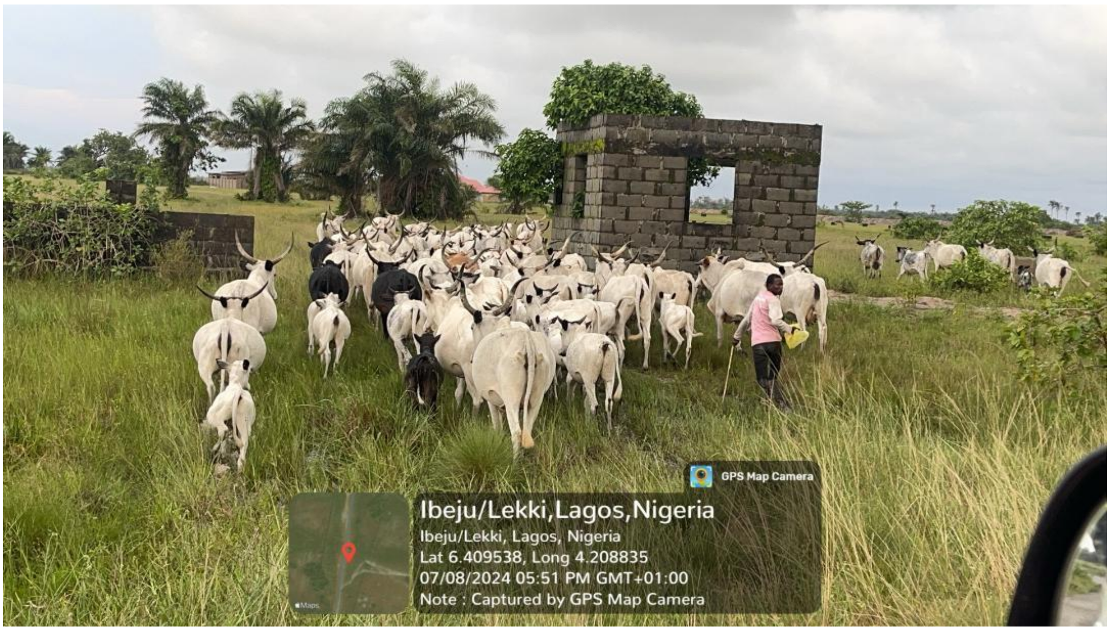


Plate 4.12: Herbivory activities on the grassland

c. Mangrove Vegetation

Mangrove vegetation is a distinctive and ecologically significant plant community found along the coastal regions of Eleko to Ode-Omi in Lagos State, Nigeria.

Mangrove wetlands are found in the intertidal zones along the coastline. These ecosystems are characterized by the presence of salt-tolerant plant species, which thrive in waterlogged, saline conditions. The mangrove vegetation is crucial for coastal protection, sediment stabilization, and providing breeding grounds for aquatic species.

Dominant Plant Species:

- *Rhizophora mangle* (Red Mangrove)
- Avicennia germinans (Black Mangrove)
- Laguncularia racemosa (White Mangrove)
- Nypa fruticans (Nipa Palm)
- Acrostichum aureum (Golden Leather Fern)

Ecological Importance:

- Acts as a natural barrier against storm surges and erosion.
- Provides habitat for fish, crustaceans, and birds.
- Plays a significant role in carbon sequestration

Plate 4.13: Acrostisticum species **Plate 4.14: Rhizophora species with Prop roots**

d. Farmland

Some portion of land encountered along the alignment are used in the cultivation of cassava (*Manihot esculentum),* maize,

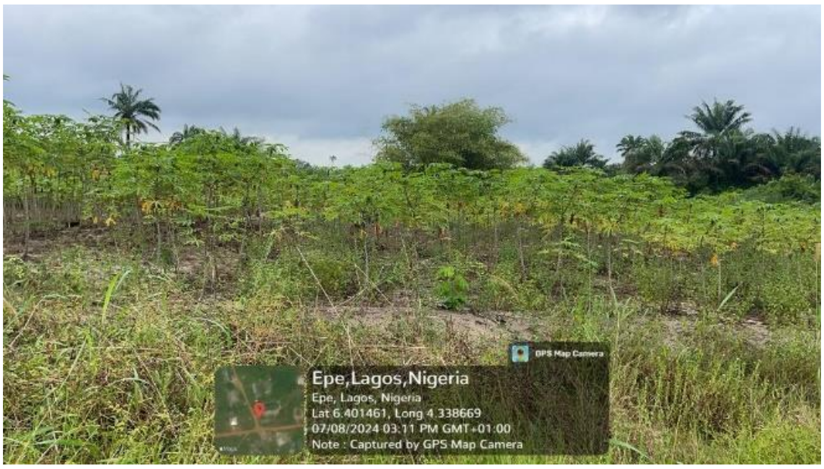


Plate 4.15: Cassava Farmland

Invasive Species Encountered

Overview of Invasive Species:

Invasive species are non-native plants that can spread rapidly, outcompete native species, and alter ecosystem functions. During the floristic survey, several invasive species were identified, raising concerns about their potential impact on local biodiversity and ecosystem services.

The following invasive plant species were documented during the survey:

1. **Chromolaena odorata (Siam Weed):**
    - **Description:** A fast-growing perennial shrub known for its aggressive spread. It forms dense thickets that suppress native vegetation.
    - **Ecological Impact:** Displaces native flora, reduces biodiversity, and can alter soil chemistry. Commonly found in disturbed areas along the proposed road alignment.

Plate 4.16: Thicket of Siam Weed Encountered

2. **Aspilia africana:**
    - **Description:** An annual or perennial herbaceous plant with large, bright yellow flowers. It spreads rapidly and is often found in disturbed areas.
    - **Ecological Impact:** Competes with native species for light, water, and nutrients, leading to reduced native plant diversity.
3. **Nypa fruticans (Nipah palm):**
    - **Description:** The spread of nipa in the coastal zones of Nigeria threatens the mangrove vegetation of the zone by outcompeting and displacing the native mangrove species, thereby lowering biodiversity.
    - **Ecological Impact:** Alters aquatic ecosystem, reduces biodiversity, and can alter sediment chemistry.

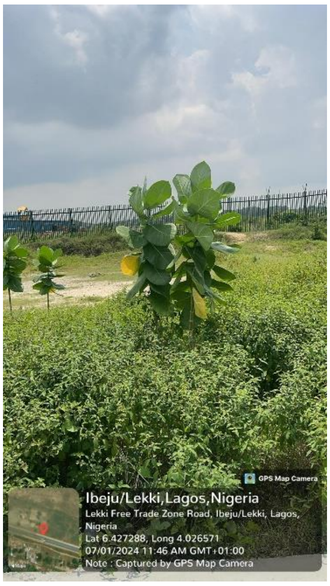
Plate 4.17: Nypa fruticans

4. **Nympaea lotus**
    - **Description:** *Nymphaea lotus*, a floating leafed macrophyte, is a perennial aquatic herb with large white flowers held above the water.
    - **Ecological Impact:** Displaces native flora, reduces biodiversity.

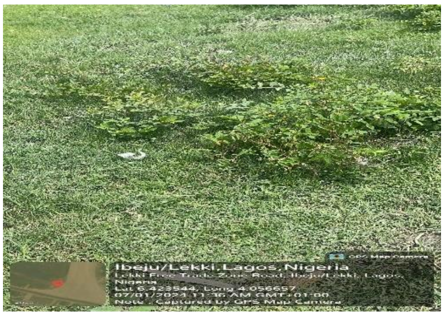
Plant Pathology

The plants encountered in the study area are generally healthy except for pockets of pathological problems like chlorotic and necrotic leaf spot diseases recorded which were caused by *cercospora* spp. There was no devastation effects of insect or animal pest observed in the study area. Few of the common diseases observed were in the agricultural fields and they include cassava mosaic caused by virus and bacteria strip on maize caused by pseudomonas. It is important to note that the plant communities in the study area are generally in a normal state of health. The disease severity indices revealed that the few diseases encountered in agricultural fields was of very light infections. There was no evidence of endemic vegetation problems. It is pertinent to remark that none of the diseases encountered was unusual either in nature or severity. The few diseases observed are common and are comparable in nature and intensity to those on plant species in similar ecotypes in Nigeria.

Plate 4.18 A portion dominated with herbaceous species



Calotropis procera *Fruit of Cocos nucifera* *Carica papaya*



Elaeis guineensis *Sida acuta*

4.13 Land Use Land Cover Changes of Lagos – Calabar Coastal Highway Project (LCCH)

The results of the Spatio-Temporal Mapping of Land Use and Land Cover Changes within 1km Buffer of Lagos – Calabar Coastal Highway Project (LCCH) Section 2for the years 2004, 2014 and the year 2024 are shown in Figures 1-3.

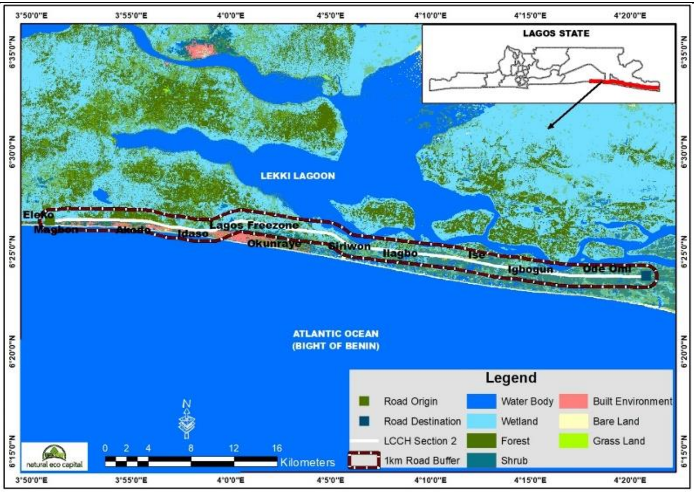
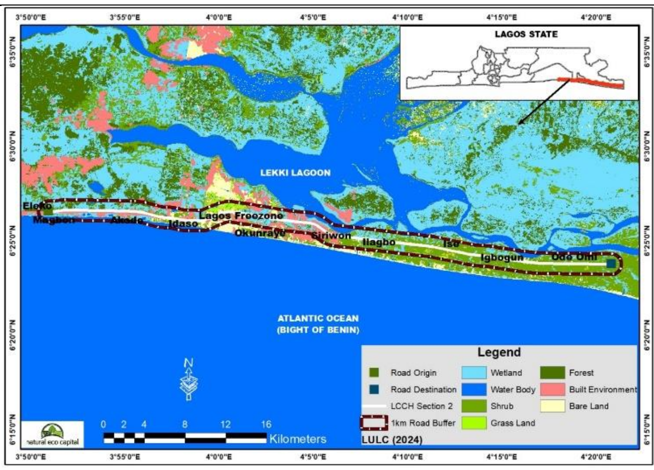


Figure 4.61 (a-b): Map showing Land Use and Land Cover for the year 2004



b: Map showing Land Use and Land Cover for the year 2014

From Figure 4.61, which showed the LULC for the year 2004 within and outside the area of influence of the road (1km Road Corridor), it was observed that that wetland, forest and water body were the dominant cover. A mixture of mixed vegetation (Forest, shrub, and grass land) including wetland were the dominant LULC types present from the origin to the destination of the road. Water body was observed from Lekki Free Zone area down to the road destination which is Ode Omi.

In the year 2014 (Figure 4.62), bare land was dominant around Lekki Free Trade Zone, which signified conversion of mixed vegetation (Forest, shrub, and grass land) and wetland into bare land. Expansion of built environment was observed from the road origin (Eleko) to Idaso area. Around Ode Omi, concentration of shrub was observed.

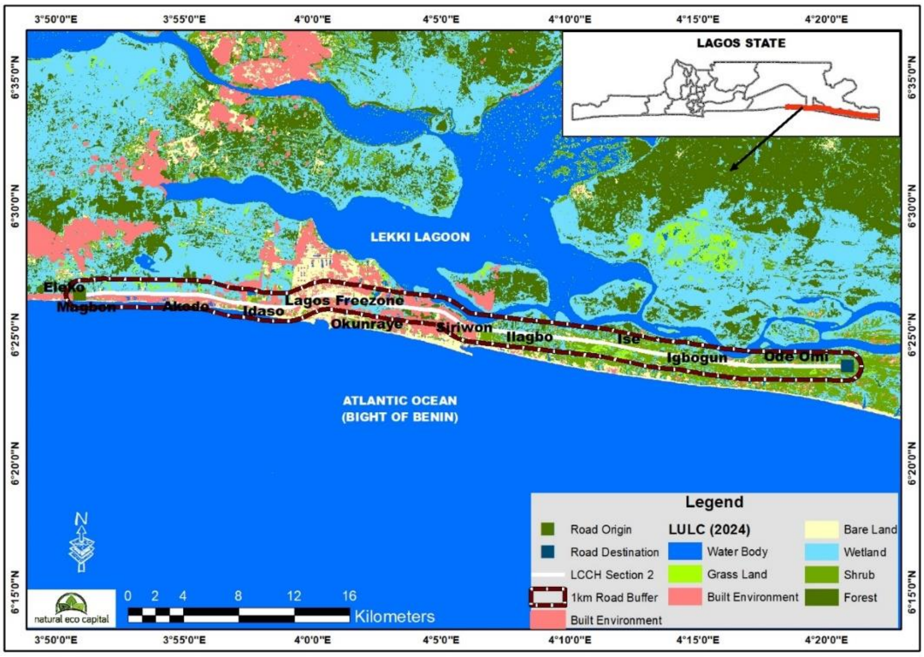


Figure 4.62: Map showing Land Use and Land Cover for the year 2024

In the year 2024, the coverage of bare land and built environment have increased massively compared to the years 2004 and 2014. The increase in bare land and built environment was observed along Lagos Free Zone, Lekki Deep Sea Port and Dangote Refinery. Built environment was observed to also increase at Eleko, along Lekk-Epe Express way (Road Destination). Wetland was still dominant towards the road destination (From Akodo, along Orimedu, Magbon, then to Eleko).

The spatial extent of the LULC types were then calculated in order to determine the changes that have occurred in the LULC types present within the project influence are from the year 2004 to the year 2024.

Table 4.31: Table showing the spatial extent of each LULC classes from the year 2004 to the year 2024

S/N	**LULC**	**Area of Coverage (Hectares)/yr**		
		2004	**2014**	**2024**
1	Water Body	2965.80	2357.19	1837.69
2	Wetland	4880.60	3665.78	2997.63
3	Bare Land	312.30	722.25	1019.11
4	Grass Land	205.31	578.25	540.99
5	Forest	1278.54	675.9	447.17
6	Shrub	772.47	1154.52	845.45
7	Built Environment	1077.74	2338.87	3804.72
Total		**11492.76**	**11492.76**	**11492.76**

From Table 4.31, it was deduced that the spatial extent of water body decreased within the area of influence from the year 2004 to the year 2024. In the year 2004, the spatial extent water body was 2965.80 Hectares, then reduced to 2357.19 Hectares in the year 2014 and finally reduced to 1837.69 Hectares in the year 2024 (Figure 4.63). This signified that the spatial extent of waterbody is reducing from the year 2004 to the year 2024.

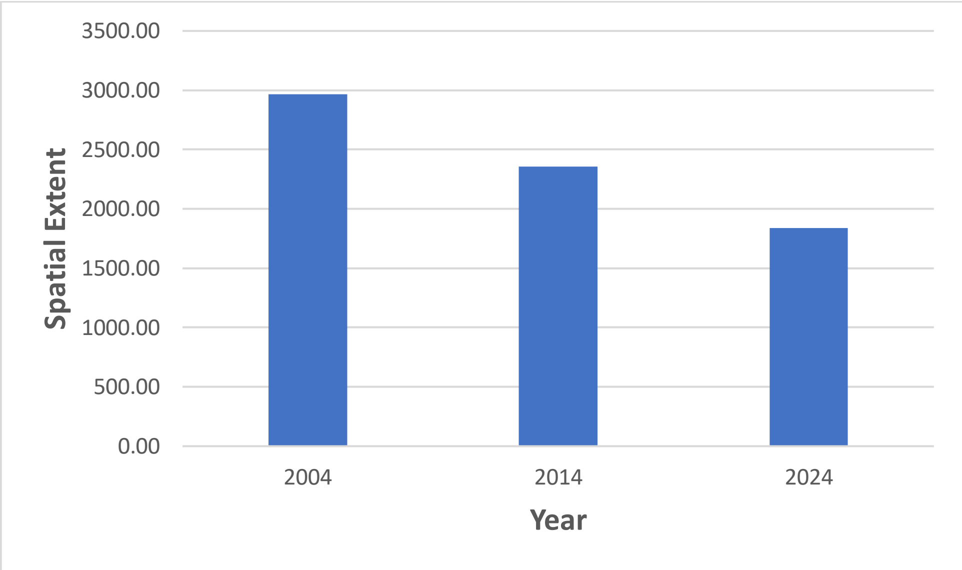


Figure 4.63: Chart showing the spatial extent of water body from the year 2004 to the year 2024

In the year 2004, the spatial extent of wetland was 4880.60 Hectares, which declined to 3665.78Hectares in the year 2014 and finally declined to 2997.63 Hectares in the year 2024 (Figure 4.64). The declination of wetland was as a result of increased built environment around the corridor of the road and also, sand filling along the road alignment due to industrialization.

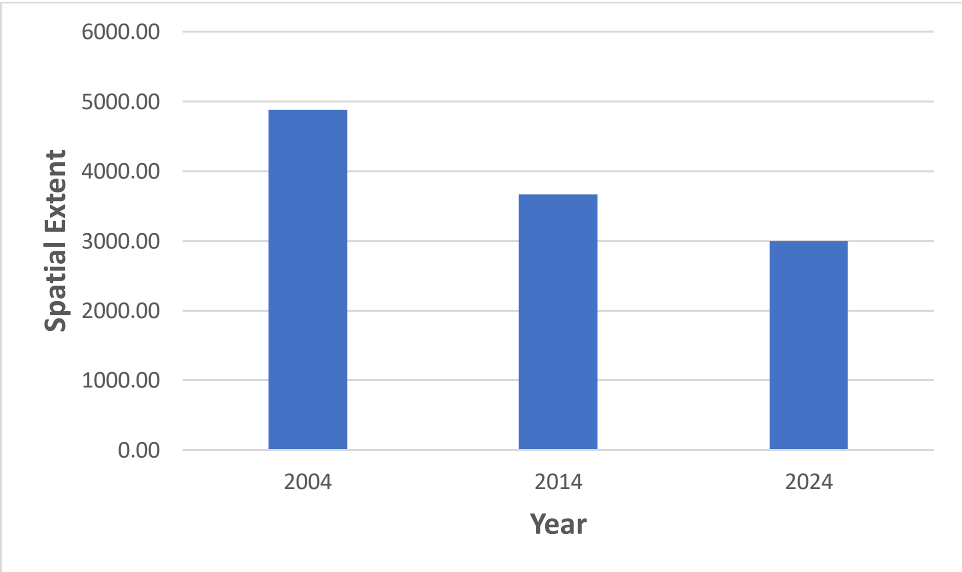


Figure 4.64: Chart showing the spatial extent of wetland from the year 2004 to the year 2024

Bare land increased massively between the years 2004 and 2024, as the spatial extent was 312.30 Hectares in the year 2004 and increased to 722.25 Hectares in the year 2014 and finally increased to 1019.11 Hectares in the year 2024 (Figure 4.65). This was as a result of converting wetland and vegetation to bare land through sand filling along the road alignment corridor.

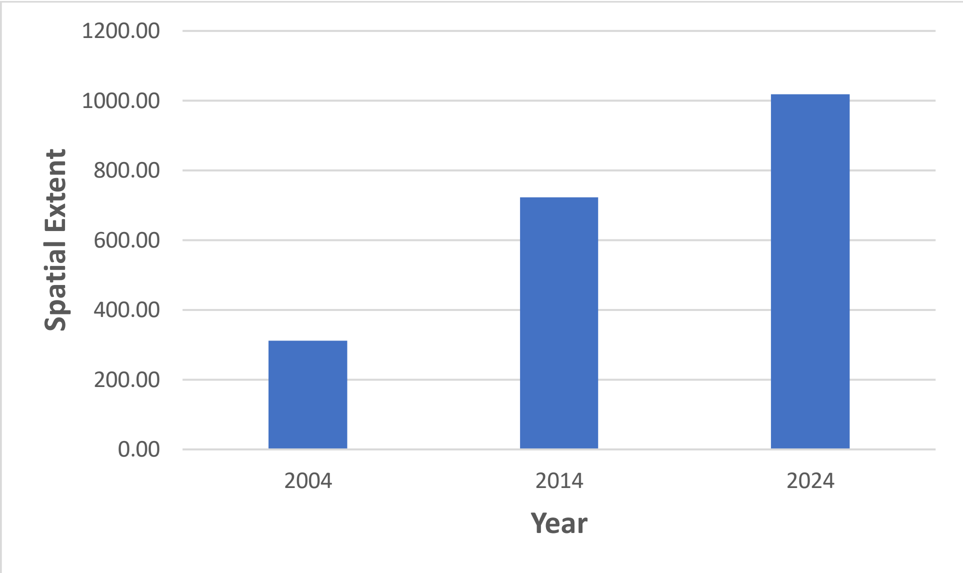


Figure 4.65: Chart showing the spatial extent of bare land from the year 2004 to the year 2024

Grassland experienced declination in the spatial extent, as its coverage was 205.31 Hectares in the year 2004, and increased to 578.25 Hectares in the year 2014 but declined to 540.99 Hectares in the year 2024 (Figure 4.66).

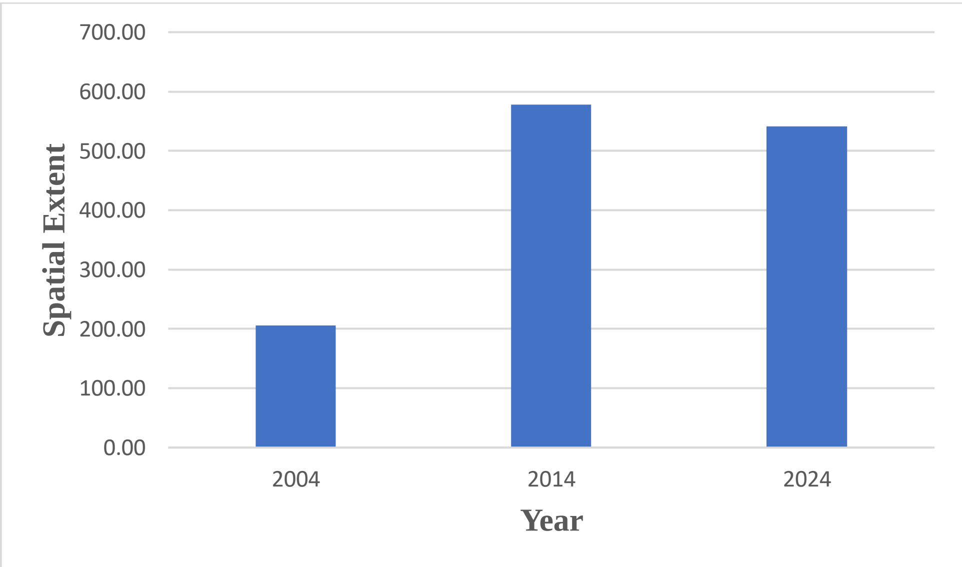


Figure 4.67: Chart showing the spatial extent of grass land from the year 2004 to the year 2024

Forest experienced declination in the spatial extent, as its coverage was 1278.54 Hectares in the year 2004, and declined to 675.90 Hectares in the year 2014 and finally declined to 447.17Hectares in the year 2024 (Figure 4.67). This was as a result of increased built environment along the corridor and also, majorly through industry development along the road alignment due to the road project.

Shrub increased between the year 2004 and the year 2024. In the year 2004, the spatial extent of shrub was 772.47Hectares, and increased to 1154.52 Hectares in the year 2014 and finally declined to 845.45 Hectares in the year 2024 (Figure 4.68).

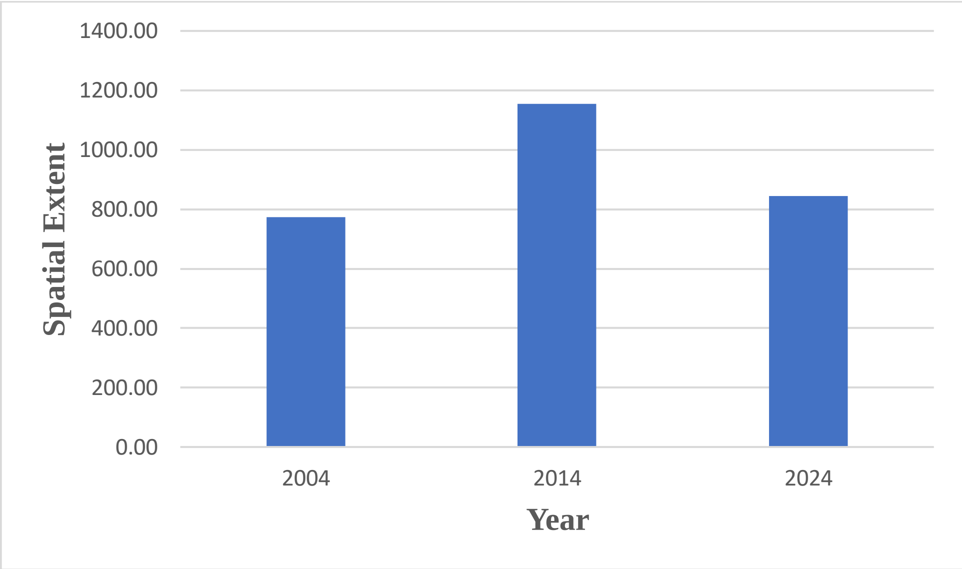


Figure 4.68: Chart showing the spatial extent of shrub from the year 2004 to the year 2024

Built environment also experienced a significant increase between the years 2004 and 2024, as the spatial extent was 1077.74 Hectares in the year 2004 and increased to 2338.87 Hectares in the year 2014 and finally increased to 3804.72 Hectares in the year 2024 (Figure 10).

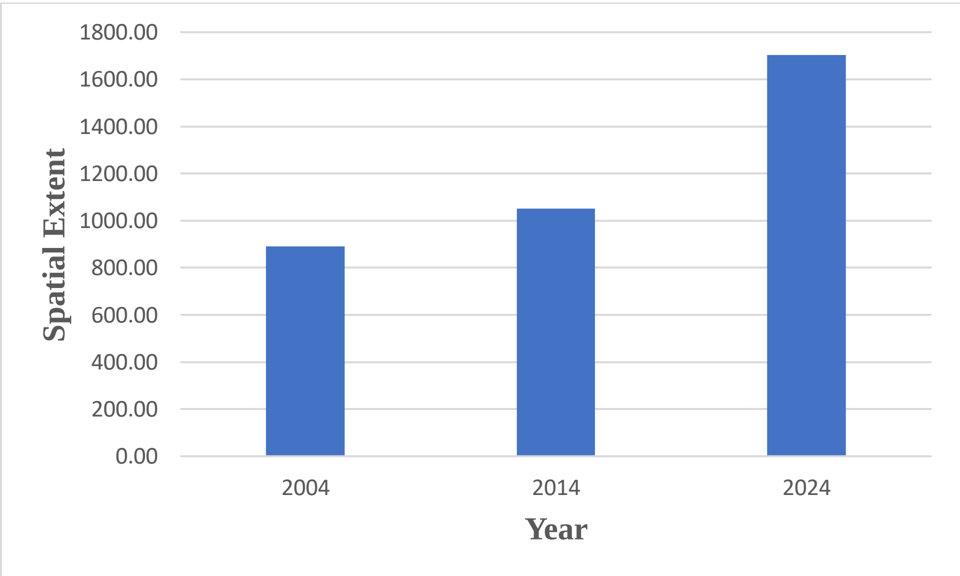


Figure 4.69: Chart showing the spatial extent of built environment from the year 2004 to the year 2024

The study showed that built environment, bare land and grass land increased between the years 2004 and 2024 within the area of influence of road (1km Road Corridor) due to the increase in industrial activities within the road corridor. While the loss of vegetation and wetland occurred due to the conversion of these LULC types to built environment through industrialization and residential land uses.

The results of the Normalized Difference Vegetation Index (NDVI) for the years 2004, 2014 and the year 2024 are shown in Figures 4.70(a-c). The results showed the vegetation density and health of the project area.

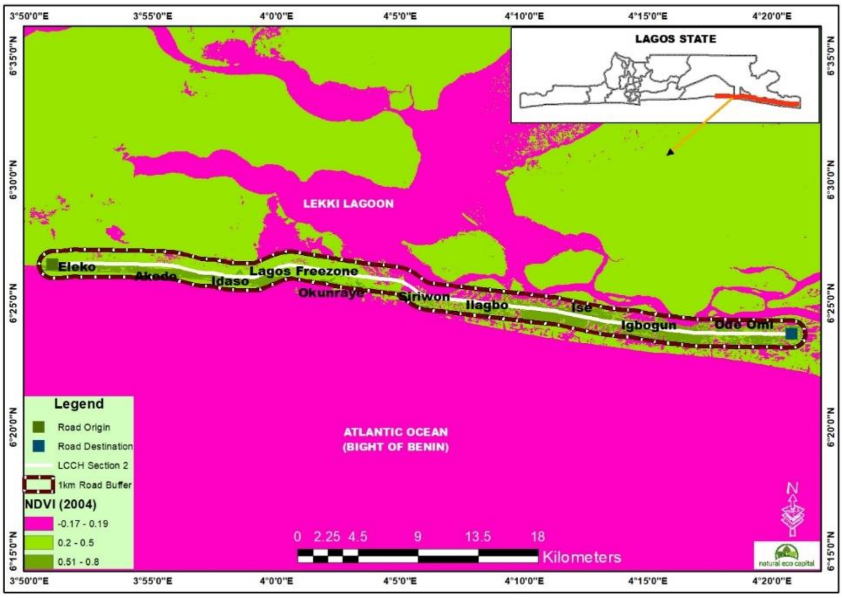
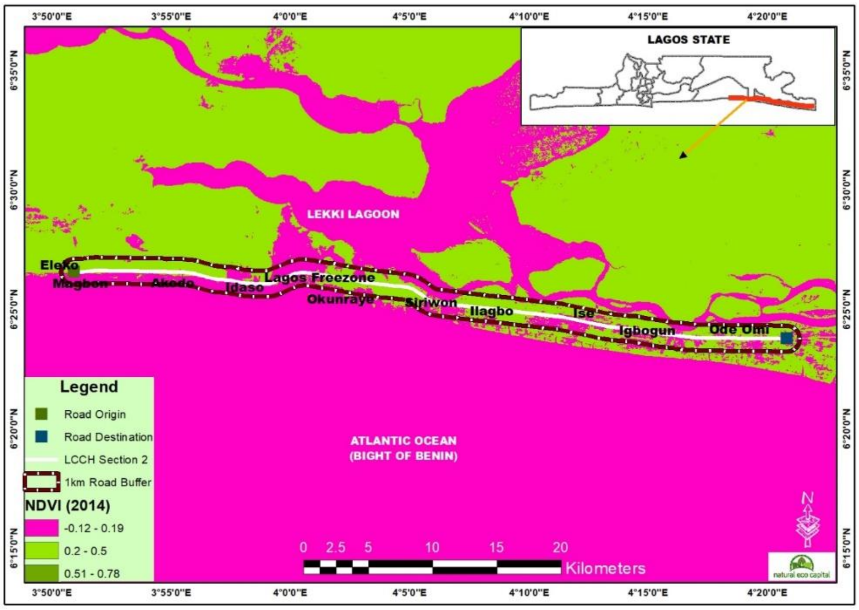


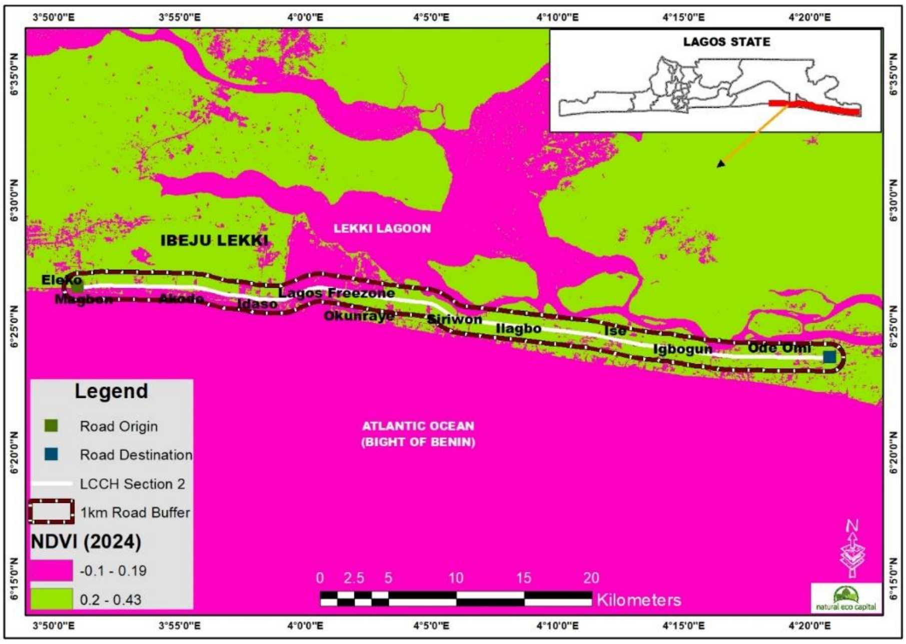
Figure 4.70: NDVI result for the year 2004

Figure 4.70a showed the vegetation density and health for the year 2004. It was observed that the NDVI values ranged from -0.17 to 0.80, in which the higher values signify high vegetation density and health while low NDVI values signified low vegetation density and health. In the year 2004, areas with low NDVI values within and beyond the project area are areas covered by water body (Ocean, lagoon and lakes), which were observed around Lekki Free Zone, Siriwon, Ilagbo, Ise, Igbogun and Ode Omi. These areas with the lowest NDVI values were area covered by water body along the project area (Figure 1). Areas with high NDVI values were observed around Eleko, Akodo, Idaso etc., which signified high vegetation density/health.



b) NDVI result for the year 2014

Figure b showed the vegetation density and health for the year 2014. It was observed that the NDVI values ranged from -0.12 to 0.78, in which the higher values signify high vegetation density and health while low NDVI values signified low vegetation density and health. In the year 2014, it was observed that areas with moderate NDVI values were vast in the project area, which signified that the vegetation density and health is diminishing compared to the year 2004, as their NDVI values decreased. Areas with diminishing vegetation density/health were observed along Eleko, Magbon, and Idaso. Also, vegetation density/health was observed from Ise to Ode Omi (Figure 2), when compared to the year 2004. Moderate vegetation density/health was concentrated along the second part from Eleko to Idaso, Lekki Free Zone area, Ilagbo, Igbogun, and large areas around Ode-Omi areas within the project area. High NDVI values were unevenly distributed from Ilago to Ode-Omi (b).



c): NDVI result for the year 2024

Figure C showed the vegetation density and health for the year 2024. It was observed that the NDVI values ranged from -0.1 to 0.43, which signified the vegetation density/health are between low and moderate. In the year 2024, it was observed that areas with moderate NDVI values were vast in the project area, which signified that the vegetation density and health also diminished compared to the year 2004, as their NDVI values decreased. Areas with diminishing vegetation density/health were observed along Eleko, Magbon, and Idaso. Also, vegetation density/health was observed from Ise to Ode Omi (Figure 3), when compared to the year 2004. Moderate vegetation density/health was concentrated along the second part from Eleko to Idaso, Lekki Free Zone area, Ilagbo, Igbogun, and large areas around Ode-Omi areas within the project area. High NDVI values were also unevenly distributed from Ilago to Ode-Omi (Figure 3).

The spatio-temporal spatial extent of NDVI classification within the area of road influence (1km road corridor) was carried out in order to determine the level of changes in vegetation density within the project area from the year 2004 to the year 2024 (Table 1).

Table showing the spatial extent of each NDVI class in the year 2004 to the year 2024

S/N			Area of Coverage (Hectares)/yr

	Vegetation Class	NDVI Value	2004	2014	2024
1	No Vegetation	-1 to 0.19	604.76	1547.01	3541.62
2	Moderate Density	0.2 to 0.5	6897.49	8788.08	7951.14
3	High Density	0.5 to 1	3990.51	1157.67	0.00
Total			**11492.76**	**11492.76**	**11492.76**

In the year 2004, the spatial extent of areas covered by No vegetation was 604.76 Hectares, which was 5% of the total coverage area. Areas with moderate vegetation density covered 6897.49 Hectares, which was 60% of the total coverage area. Areas with High Density covered 3990.51 Hectares, which was 34.7% of the total coverage area (Figure 4.71).

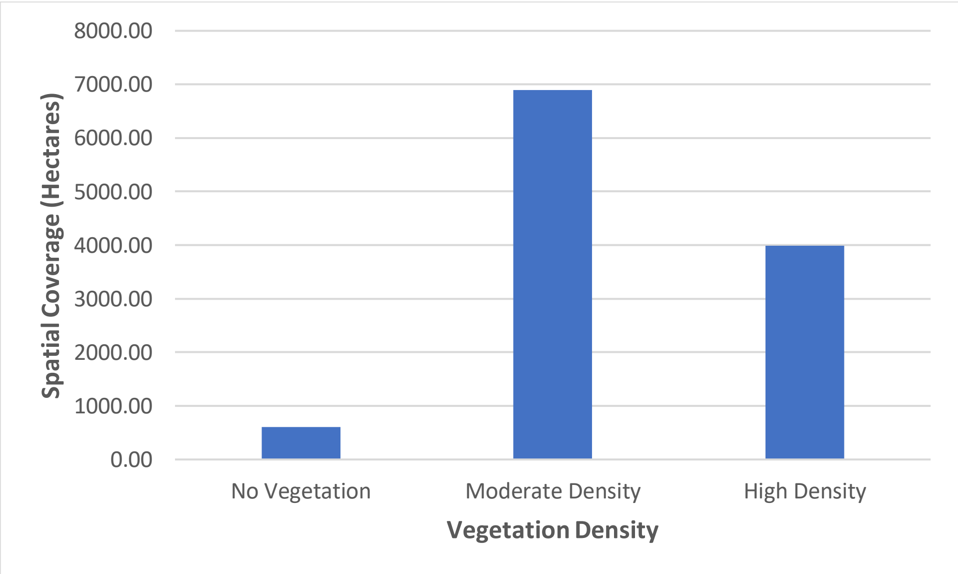


Figure 4.71: Chart showing the spatial extent of Vegetation Density/Health in the year 2004

This signified those areas with Moderate Vegetation (NDVI Values between 0.2 to 0.50) had the highest coverage in the year 2004.

In the year 2014, the spatial extent of areas covered by No vegetation was 1547.01Hectares, which was 13.5% of the total coverage area. Areas with moderate vegetation density covered 8788.08 Hectares, which was 76.5% of the total coverage area. Areas with High Density covered 1157.67 Hectares, which was 10.1% of the total coverage area (Figure 5).

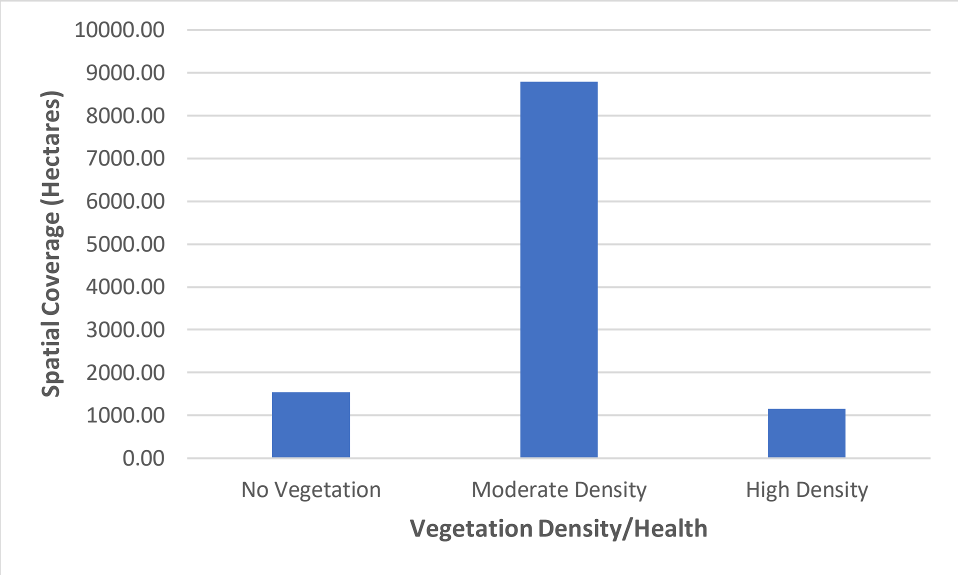


Figure 4.72: Chart showing the spatial extent of Vegetation Density/Health in the year 2014

This signified those areas with Moderate Vegetation Density (NDVI Values between 0.2 to 0.5) had the highest coverage in the year 2014.

In the year 2024, the spatial extent of areas covered by No vegetation was 3541.62 Hectares, which was 30.8% of the total coverage area. Areas with moderate vegetation density covered 7951.14 Hectares, which was 69.2 % of the total coverage area. Areas with High Density covered 0.00 Hectares, which was 0% of the total coverage area (Figure 4.72).

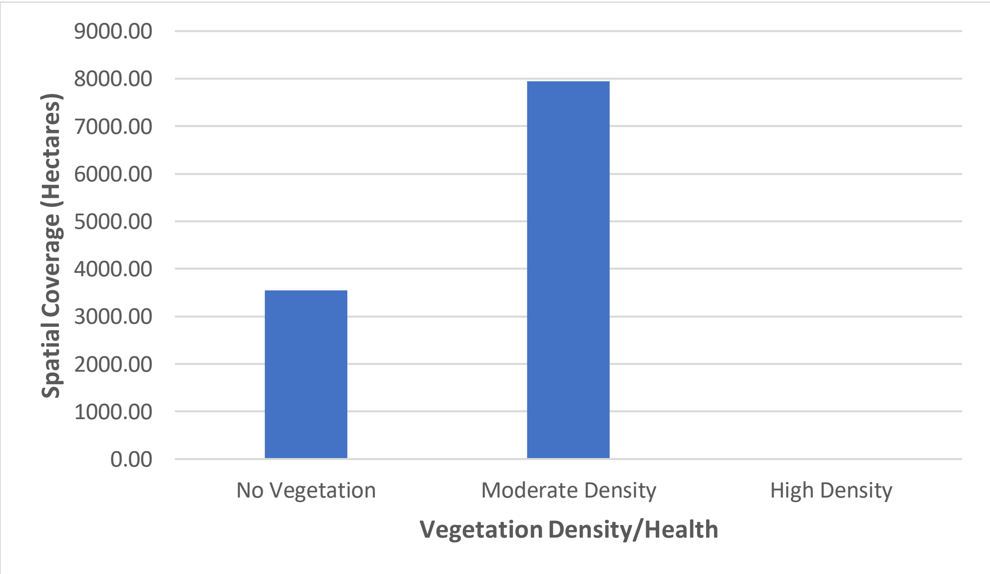


Figure 4.73: Chart showing the spatial extent of Vegetation Density/Health in the year 2024

This signified those areas with Moderate Vegetation (NDVI Values between 0.2 to 0.50) also had the highest coverage in the year 2004.

The study showed that High Density Vegetation was lost within the project area between the year 2004 to the year 2024, while No vegetation increased between these years, which is due to development of urban through industrialization in the study area.

4.13.1 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 this section.

The wildlife species associated with the study area are the invertebrates represented mainly by insects (Table 1) and the vertebrate animals represented by mammals, amphibians, reptiles and birds (Tables 2 and 3).

Table 4.32: List of Observed Invertebrates within the study Area

Scientific Name	Common Name
Mantis religiosa	Praying mantis
Zonocerus variegates	Variegated Grasshoper
Acrae terpicore	Butterfly
Orthetrom branchiale	Dragon fly
Apis mellifera	Honey Bee
Anopheles sp	Mosquito
Simulium sp	Blackfly
Glossina sp	Tse-tse fly

Table 4.33: Check-list of Vertebrates Reported within the Study Area

Group	Species	Common name	Population status
MAMMALS	*Tragelaphus spekei*	Sitatunga	+
	Tragelaphus scriptus	Bush buck	++
	Cercophitecus mona	Mona monkey	+++
	cercophitecus nictitans	Putty nose monkey	+++

	Thryonomys gregarianus	Cane rat	+++
	Potamochoerus porcus	Red river bog	+
	Atherus africanus	Porcupine	++
	Manis tricuspis	Pangolin	++
	Cephalophus maxwellii	Maxwells duiker	+++
	Choeropsis liberiensis	Pigmy hippo	++
	Civettictis civetta	Civet cat	+++
	Funiscinrus spp	Tree squirrels	+++
	Xerus erythropus	Ground squirrels	+++
	Dendrohyrax dorsalis	Tree hyrax	+++
	Perodicticus potto	Potto	+
REPTILES	*Veranus niloticus*	Monitor lizard	++
	Osteolalaemus tetrapis	Dwraf crocodile	+
	Bitis gabonica	Gabon riper	++
	Echis pyramidium	Egyptian saw-scaled riper	++
	Naja nigricolis	Spitting cobra	++
	Dendroaspis angusticeps	Green mamba	+++
	Python regius	Royal python	+++
	Monamona	puff adder	+
AMPHIBIA	*Bufo bufo*	Toad	+++
	Rana sp	Frog	+++
	Platysternis sp	Water turtle	+++
	Achatina sp	Snail	+++
	Testudinus sp	Tortoise	+++

Key

+ *Present*

++ *Common*

+++ *Abundant*

Table 4.34: Check-list of Birds Associated with the Study Area

Scientific name	Common name
Mitrus migrans	Black kite
Treron calra	Green pigeon
Streptopelia semitorguata	Red-eye dove
Stretopelia senegalensis	Laughing dove
crinifer piscator	Plantain eater
Gypohierax angolensis	Vulture
Tockus nasutus	Gray hornbill
Circus spp	Mash hamer
pteronetta hartlanbii	Hartlanb's duck
Charadrius tricollaris	Three banded flover
Vanellus leucurus	White tailed lapwing
Ixobrychus starmii	Little bittern
Ciconia episcopus	Abdimis stork
Phalacrocorax africanus	Comorrant
Alcedo cristala	Malachite kingfisher
Cery lerudis	Pied kingfisher
Halcyon malimbica	Blue-breasted kingfisher
fendrocygna viduata	White face whisling duck
Bycanistes fistulator	Piping Hornbill
Treoncalca sp	African Green pigeon
Lonchura bicolor	Black and White Mannikin
Actophilornis africana	Africana jacana
Merop pusillus	Little bee eater
Malibuss cutatus	Red vented malimbe
Andropadus viriens	Little greenbul

Insects

The species of insects encountered in the study area include *Mantis religiosa*, *Zonocerus varigatus*, *Apis mellifera*, *Acrae terpicore* and others (Plate 4-39). Insects population is the key to ecological balance of any ecosystem particularly the trophic levels. In particular they forage on terrestrial and aquatic weeds while they also serve as food (prey) for other carnivorous invertebrates and vertebrates including birds. In a study conducted in the rainforests of Nigeria, insects in the order *Orthoptera, Coleopteran, Odonata, Hemiptera,* and *Lepidoptera* were isolated from three specimens of chameleons (Akani *et al, 2001).* Others such as mosquitoes constitute health hazards by spreading malaria fever among the forest dwelling communities.

Mammals

Many species of animals in the mammalian category were associated with the study area of Lekki fresh water swamp forests. Some of the abundant species include *Cercophitecus mona* (Mona monkey), *Thryonomys gregarianus* (cane rat), *Funiscinrus* spp. *Cephalophus maxwelli* (maxwells duiker), *Choropsis liberiensis* and others (Table 2). There are no studies in Nigeria to show the role of aquatic mammals in the preservation and disturbance of fresh water ecology. However, it is often reported in National newspapers about the menace of hippopotamus on farmlands, and to fishing communities. These events have often necessitated the intervention of the armed forces to kill such nuisance animals.

Some animals such as otter, civet, genet and mongoose feed on fish and small aquatic animals. They therefore play some role in the population dynamics of such aquatic fauna. Bacterial diseases particularly those caused by pseudomonas sp can be transmitted to fish via the droppings of aquatic mammals which contaminate the environment and increase the risk of zoonotic bacterial disease of fish. The large mammals such as hippopotamus, otter, bush buck and others serve as important local sources of bush meat especially during the dry season (December to April). Their meat is also an important international trade commodity because of the considerable demand for the meat. These animals are also hunted for other products such as their skins for leather, their cartilaginous parts, faeces, skin and hoofs for traditional medicine.

Amphibians

The amphibian groups are represented by *Bufo bufo* (Toad), *Rana sp* (Frog), *Platysternis* sp (Water turtle) and *Testudimus sp* (Tortoise) (Table 3). The Amphibians are the dominant group of aquatic vertebrates other than fish in terms of their numbers and distribution, particularly the frog and toads. The *Rana* sp (frog) are edible in Nigeria and are harvested as wild bush meat from ponds and waterlogged areas in both rural and urban centres. Dried, skinned meat of frogs and fresh frogs has been found useful in the feeding of catfish and poultry either as raw materials for processed feed or whole as food for catfish. In Nigeria, it is a common practice for fish farmers to supplement the feeding of *Clarias* sp, and *Heterobranchus bidorsalis* in pond culture by feeding them frogs and toads

Reptiles

The reptiles associated with the study area include *Veranus niloticus* (monitor lizard), *Osteolaeleamus tetraspis* (dwarf crocodile) and many snakes species which include *Dendroaspis angusticepts (*green member) *Python regius* (royal python),*Bitis gabonica* (gabon viper) were particularly abundant in the study area (Table 3). Among this group of animals are those that feed on fish and those that feed on fish predators, including snakes. While crocodiles and terrapins are among the first group and spend most of their time in water, the tortoises, monitor lizards and snakes spend a greater part of their time on land near water. They all however, contribute to the biological function of the aquatic community. Crocodiles, terrapins and monitor lizards feed on fish while snakes feed on frogs, toads, lizards, and small rodents that inhabit water bodies. Active predation among these groups of animals therefore contributes to the stabilization of the animal communities. Crocodiles and monitor lizards are hunted extensively, even to the point of extinction, for their meat and skins which are important foreign exchange earners. The high demand for crocodile skins, meat and body parts for traditional medicine certainly have contributed to the noticeable decline in their populations in Nigeria. Around the late 1960s, most large bodies of water in Nigeria harbored crocodiles, but now both crocodiles and monitor lizards are listed as threatened species in Nigeria (Ebin, 1983, Anon,1986)

Birds

Birds are one of the best known faunal group in the world (Tvardikova, 2010). They are ecologically highly diverse and inhabit wide range of habitats. They are frequently used taxa to indicate the effects of environmental changes (Carignan *et al*, 2002). Several birds were encountered in the study area. They include *Treron calva* (green pigeon), *Streptopedia semitorguata* (Red-eye dove), *S.senegalensis* (laughing dove), *Tockus nasutus* (Gray hornbill), *Crinifer piscator* (plantain eater) and many others (Table 4-45). The presence of feathers in birds has distinguished the class and with the advantage of high mobility and their extraordinary hardness made them to be described as earth's ambassadors as they do not recognize human boundary except those set by nature (Matthews, 2008). While in many countries, aquatic birds are hunted for sport, in Nigeria they are predominantly regarded as a source of meat (Ajayi, 1971). Waterfowl and other large birds such as *Golliath heron* and fish eagles are hunted around River Niger and Lake Kainji (Okaema *et al;* 1988). The Lekki fresh water swaps forest where the study was conducted is an important habitat for birds for drinking, feeding, resting, sheltering, nesting, rearing of young, foraging and social interaction.

4.13.3 Hydrobiology of the study

4.14 Plankton and Zooplankton Analysis

The characteristics of the plankton community were determined by adopting the Margelef's Species Richness Index, Shannon-Wiener Index and the Evenness coupled with the dominance approach so as to determine the densities of the different groups within the sampling stations that make up the study area and the community. The dominance will provide information about the ecological dominants or dominant species that exert a major controlling influence by virtue of their size, numbers, or activities (Verma and Agarwal, 2006). The benthic population did not meet the criteria for diversity indices where appropriate, tables and graphs shall be employed so as to have a *"Birds-Eye-View"* of the spatio-temporal distribution of the species within the project area.

Benthic fauna

Quantitative samples for benthic fauna were collected at each station using the Ekman Grab ($0.0225m^2$) and sieved in the field using 250 and 500µm Tyler sieves. All samples were preserved in wide mouthed plastic containers by adding some quantities of 40% formaldehyde and stained with Rose Bengal solution.

Laboratory analysis was carried out by using the binocular dissecting microscope and Nikon compound microscope for sorting, dissection of relevant taxonomic parts, and preparation of slides. Specimens were identified to the lowest possible taxonomic level using reliable identification keys and texts (Pennak, 1978; Barnes, 1980).

Statistical Analysis

Indices of diversity and evenness were used to characterize biotic communities. The following indices were used:

a. Margalef's index (d) of taxa richness

$$d = \frac{S-1}{In\ N}$$

Where S = number of taxa

N = total number of individuals

In = Natural log.

b. Shannon's Index (H')

$$H' = -\sum_{i=1}^{s} pi\ \ In\ pi$$

where pi is the proportion of individuals found in the ith species (i.e. $pi = {ni}/{N}$, N being the total abundance).

c. Evenness Index (E')

$$E' = \frac{H'}{In\ S}$$

Evenness is constrained between 0 and 1.0 with 1.0 representing a situation in which all species are equally abundant. Evenness measures the degree of uniformity in the distribution or spread of individuals among the species. (Odum, 1971; Zar, 1983; Ogbeibu, 2005).

Fisheries

Interviews, consultations and literature review were used to obtain information on species diversity and relative abundance of fish species in the study area. Fishes were caught using the services of local fishermen. Funnel entrance traps were used and fishes caught were stored in the cooler containing ice blocks. This study was supplemented by observations of fishing gear. The fishermen were interviewed on the common fish species available in the area, their seasonality of abundance, sizes and palatability/commercial value. In the laboratory, fish samples were identified using reliable identification keys (Holden and Reed, 1972), analyzed for measurement of morphometric features and determination of condition factors.

The condition factor (kF), an index of the well-being of the fish was computed using the formula.

$$kF = \frac{100W}{L^3}$$

Where,

W = weight of fish in grams

L = standard length of fish in centimetres

Phytoplankton Spectrum.

Phytoplanktons are microscopic plants found in aquatic habitats where they function as primary producers. A total of 41 phytoplankton taxa were recorded (**Table 4.34**). The phytoplankton diversity was dominated by the diatoms followed by Dinophyta. *Coscinodiscusoculus – iridis* Ehrenberg and *Thalasionema longissima* Cleve & Grunow were the most important species in terms of number. *Actinoptychus splendens*Ehrenberg and*Amphiprora alata* Ehrenbergwere also frequently occurring. Other species recorded were *Coscinodiscus centralis* Ehrenberg, *Coscinodiscus eccentrius* Ehrenberg, *Coscinodiscus radiatus* Ehrenberg, *Cyclotella meneghiniana* Kutzing and *Cyclotella striata* (Kutzing) Grunow (Centric diatoms). *Fragillaria construens* Ehrenberg, *Fragillaria islandica* Grunner, *Navicula ergadensis* (Ralfs), *Synedra crystallina* (Ag) Kutzing (Pennate diatoms).*Oscillatoria limnosa*Agardhand *Trichodesmium thiebautii Gomont*. *Ceratium fusus* Ehrenberg, *Ceratium lineatum*Ehrenberg and Ceratium macroceros (Ehr) Cleve and *Ceratium massilense* Gourret.

The occurrence of pennate diatoms in the plankton during the survey may be reflections of possible stirring of the lagoon phytobenthic community into the plankton. According to Onyema *et al.* (2003) frequently occurring pennate forms in the plankton samples from the Lagos lagoon was a likely reflection of the mixing of the shallow lagoon and phytobenthic community by tides and flood waters at According to Nwankwo (1984), the occurrence of pennate forms during the rainy season suggests their dislodgement from the substratum probably during high water discharge, while tidal inflow accounted for the appearance of some marine forms in the plankton at the same period. In this regard, the presence of known marine forms like *Amphiprora alata*, *Ditylum brightwellii*,*Melosira moniliformis, M. nummuloides*,*Triceratium favus* and the various species of *Coscinodiscus, Odontella*,*Rhizosolenia*,*Thalassosira* and *Thalassionema* further confirms the incursion of seawater to the lagoon as they were recorded in the midhigh brackish water situation only (Nwankwo and Onyema, 2003; Onyema *et al*., 2008).

According to Kadiri (1999) *Actinoptychus splendens* had a wide distribution. *Oscillatoria* spp. according to Vanlandingham (1982) is by far the most significant of all blue-green algae genera in determining water quality and it is highly important as a diagnostic indicator among other major algal groups. Palmer (1969) is of the view that only *Euglena* is more important than *Oscillatoria* as a genus of algae indicative of organic pollution.

Hallegraeff *et al.* (1995) and Nwankwo *etal.* (2003) have reported that *Trichodesmium thiebautii* is commonly found in the supra thermocline, nutrient poor and warm waters of the tropics. Further to this, Nwankwo *et al.* (2003) reporting for the Nigerian coast has reported massive blooms of *Trichodesmiumthiebautii* clogging fishing nets and reducing fish catch. The presence of *Trichodesmium thiebautii*, the only true marine cyanobacteria also confirmed the water chemistry at the time (Nwankwo and Onyema, 2003; Onyema *etal*., 2008). Its source to the lagoon is definitely the sea (Atlantic Ocean) via the Lagos harbour.

The species richness was evaluated using Margalef's (d) and Menhinick's (D) indices. Margalef's index ranged between 2.47 (SW4) and 4.02 (SW 5) while Menhinick's index ranged between 1.17 (SW6) and 1.33 (SW1). Evaluating the species diversity in the study area, Shannon-Weiner index (Hs) ranged between 2.49 (SW 4) and 2.89 (SW 7), Equitability index (j) ranged between 0.85 (SW 3) and 0.93 (SW 2) while Simpson's Dominance index (C) ranged between 0.05 (SW4) and 0.09 (SW1 & 3) (**Table 4.74**). These species are known indigenous forms of phytoplankton. They have also been previously recorded in our waters before now (Nwankwo 1988, Onyema 2008, Onyema and Ojo 2008, Onyema and Emmanuel 2009).

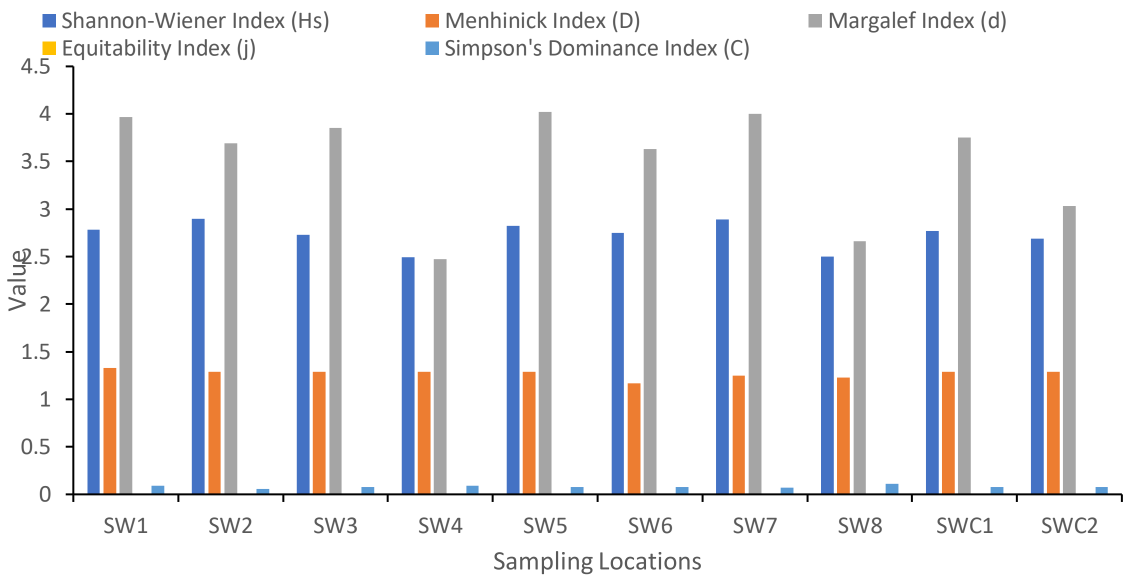


Figure 4.74: Diversity Indices of Phytoplankton in Sampling Locations

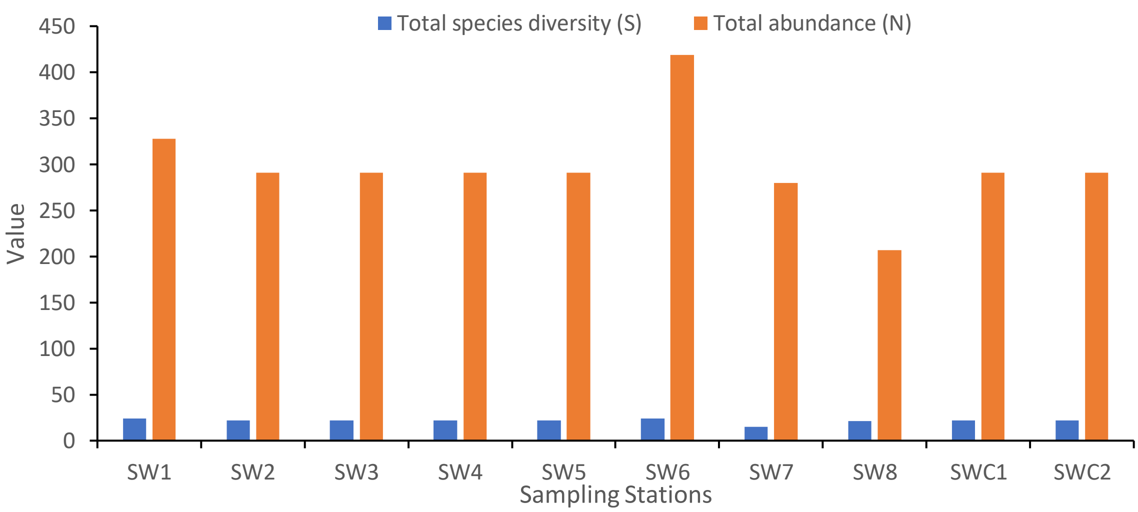


Figure 4.75: Abundance and Diversity of Phytoplankton in Sampling Locations

Table 4.34: Phytoplankton Community of Surface water

Stations	**SW1**	**SW2**	**SW3**	**SW4**	**SW5**	**SW6**	**SW7**	**SW8**	**SWC1**	**SWC2**
DIVISION – BACILLARIOPHYTA										
CLASS- BACILLARIOPHYCEAE										
ORDER I – CENTRALES										

Actinoptychus splendens Ehrenberg	10	-	23	-	34	-	45	-	10	-
Amphiprora alata Ehrenberg	15	20	45	30	45	52	59	66	10	10
Meloseira moniliformis Agardh	-	10	-	-	5	5	-	10	-	-
Meloseira nummuloides Agardh	10	-	5	-	10	-	15	-	5	5
Campylodiscus clypeus (Ehr.) Kutzing	5	-	-	-	5	-	-	-	-	-
Chaetoceros atlanticum Cleve	5	5	-	5	5	5	-	5	-	15
Chaetoceros convolutus Castracane	-	-	15	-	-	-	15	-	5	-
Odontella laevis Ehrenberg	-	-	5	-	-	-	5	-	-	-
Odontella mobilensis Bailey	25	10	5	10	0	5	10	15	15	10
Odontella regia (Schultze) Ostenfeld	-	-	5	-	-	-	5	-	-	-
Odontella sinensis Greville	-	5	-	5	-	5	-	5	-	15
Coscinodiscus centralis Ehrenberg	5	5	-	15	5	10	-	5	-	5
Coscinodiscbgbgus eccentrius Ehrenberg	-	-	5	-	-	-	5	-	5	-
Coscinodiscus gigas Ehrenberg	10	11	-	-	12	13	-	-	-	7
Coscinodiscus oculus-iridis Ehrenberg	58	32	48	40	35	30	25	24	35	20
Coscinodiscus radiatus Ehrenberg	-	25	50	35	-	40	50	35	-	30
Coscinodiscus sub-bulliens Jorg	5	-	-	-	5	-	10	-	5	-
Cyclotella menighiniana Kutzing	-	15	5	10	-	5	5	15	-	10
Ditylum brightwelli (T. West) Grunow	-	-	5	-	-	-	5	-	-	-
Skeletonema coastasum Cleve	5	-	-	-	5	-	-	-	5	-
Terpsinoe musica (Ehr) Hustedt	-	15	5	10	-	5	5	10	-	10
Thalasiosira subtilis (Ostenfeld) Gran	5	-	-	-	5	-	-	-	5	-
Triceratium favus Ehrenberg	6	10	-	8	8	10	-	10	4	8
Order II – PENNALES	-	-	-	-	-	-	-	-	-	-

Bacillaria paxillifer (O.F. Muller) Hendey	3	-	10	7	10	-	15	15	5	7
Cymbella affinis Kutzing	15	20	45	25	20	10	15	10	10	25
Fragillaria islandica Grunner	-	5	-	-	-	5	-	-	-	-
Fragillaria oceanica Cleve	10	-	5	-	10	-	15	-	5	-
Gomphonema parvulum Grunner	5	-	-	-	5	-	-	-	5	-
Gyrosigma balticum (Ehr.) Rabenhorst	5	5	-	-	5	5	-	-	-	12
Gyrosigma scalproides (Rabh) Cleve	-	-	15	-	-	-	15	-	-	-
Navicula ergadensis Ralfs	-	-	5	-	-	-	5	-	-	-
Nitzschia closterium Wm. Smith	25	10	5	15	5	15	20	10	10	10
Nitzschia sigmoidea (Witesch) W. Smith	-	-	5	-	-	-	5	-	-	-
Parabelius delognei E.J. Cox	-	5	-	-	-	5	-	-	-	-
Pleurosigma angulatum (Quekett) Wm Smith	5	5	-	-	5	5	-	-	5	-
Synedra crystallina (Ag) Kutzing	-	-	5	-	-	-	5	-	-	-
Thalasionema longissima Cleve & Grunow	58	32	25	40	35	30	26	24	35	40
Thalassionema nitzschioides Cleve &Grunow	-	25	50	35	-	34	16	24	-	35
Thalaiossira gravida Ehrenberg	12	13	-	-	14	15	-	-	10	-
DIVISION – DINOPHYTA	-	-	-	-	-	-	-	-	-	-
CLASS – DINOPHYCEAE	-	-	-	-	-	-	-	-	-	-
ORDER – PERIDINALES	-	-	-	-	-	-	-	-	-	-
Ceratium fusus Ehrenberg	12	-	5	-	2	-	9	-	8	-
Ceratium macroceros (Ehr.) Cleve	12	13	-	-	14	15	-	-	10	-

Source: Natural Ecocapital, 2024

Table 4.35: Biological Indices of Phytoplankton Community in Surface water

Biological indices	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SWC1	SWC2
Total species diversity (S)	**24**	**22**	**22**	**22**	**22**	**24**	**15**	**21**	**22**	**22**
Total abundance (N)	328	291	291	291	291	419	280	207	291	291
Log of Species diversity (Log S)	1.38	1.34	1.34	1.34	1.34	1.38	1.18	1.32	1.34	1.34
Log of abundance (Log N)	2.52	2.46	2.46	2.46	2.46	2.62	2.45	2.32	2.46	2.46
Shannon-Wiener Index (Hs)	2.78	2.9	2.73	2.49	2.82	2.75	2.89	2.5	2.77	2.69
Menhinick Index (D)	1.33	1.29	1.29	1.29	1.29	1.17	1.25	1.23	1.29	1.29
Margalef Index (d)	3.97	3.69	3.85	2.47	4.02	3.63	4.00	2.66	3.75	3.03
Equitability Index (j)	0.004	0.003	0.004	0.004	0.004	0.003	0.005	0.005	0.004	0.004
Simpson's Dominance Index (C)	0.09	0.06	0.08	0.09	0.08	0.08	0.07	0.11	0.08	0.08

Zooplankton Spectrum.

These are minute animals found mainly in the pelagic zone of water bodies, where they drift along with water currents because locomotory structures are poorly developed. They include the meroplankton (temporary zooplankton) and holoplankton (permanent zooplankton).

Zooplankton includes crustaceans (14 species), cladocerans (2 species), chaetognaths (1 species), chordates – (1 species), decapods (1 species), mysids (1 species), and an array of juvenile stages (10 forms). The crustaceans were represented by the calanoid and Cyclopoid copepods (70%), cladocerans (10%), mysids, chaetognath, chordate, and decapods (5% each) were represented in terms of diversity (Table 7).

Acartia clausii, *Acartia discaudata*, *Paracalanus parvus* and *Temora stylifera* (calanoid copepods) were notable forms for the study terms of frequency of occurrence. Other species included *Oithona plumifera* Baird, *Oncaea venusta* (cyclopoid copepods), *Lucifer foxonii* (decapod) and *Sagitta enflata* (chaetognaths).

With regard to the juvenile stages, apart from the copepod and fish eggs recorded, the others were larvae of other species. Nauplii larvae of barnacle and copepod were more important in terms of number.

The species richness for the rainy season was evaluated using Margalef's (d) and Menhinick's (D) indices. Margalef's index ranged between 0.24 (SW 1) and 0.37 (SW 2) while Menhinick's index ranged between 1.21 (SW 3) and 1.72 (SW1). Evaluating the species diversity in the study area, the Shannon-Weiner index (Hs) ranged between 2.31 (SW 2) and 3.05 (SW5), the Equitability index (j) ranged between 0.06 (SW 1) and 0.14 (SW2) (Table 8).

In the zooplankton spectrum, the copepods particularly the calanoid forms were the more important members in terms of occurrence and frequency. *Alona* sp. and *Penilia avirostris* Dana (Cladoceran) are known seawater cladocerans (Winnipenny 1966, Newell and Newell 1966: Olaniyan 1975) and these confirm the water quality situation of the Lagos Harbour. Similarly, *Lucifer foxonii*, *Sagitta enflata* and *Oikopleura dioica* fall into the same category as sea species that have been previously reported by the aforementioned authors. These marine species have also been recorded in the Lagos harbor, lagoon and the Opobo channel (Niger delta) over the year during high salinity periods in the dry season (Akpata *et. al*. 1993; Kusemiju *et. al*. 1993; Onyema *et al*. 2003, 2007).

Eggs, larvae and spores of pelagic and benthic organisms are often a conspicuous part of the plankton of neritic waters and some of the obvious seasonal changes are related to the reproductive seasons / times of the sea organisms (Tait, 1981). The diversity of forms of juvenile plankton recorded in this study is similar to that recorded by Harvey *et al*. (1935) and Harvey (1950).

Table 4.36: A checklist of zooplankton species in Surface water

TAXA	STATIONS									
	SW1	**SW2**	**SW3**	**SW4**	**SW5**	**SW6**	**SW7**	**SW8**	**SWC1**	**SWC2**	
CLASS: CRUSTACEA											
SUB-CLASS: COPEPODA											
ORDER I: CALANOIDA											
Acartia clausii Giesbrecht	3	-	8	5	6	8	9	10	-	5	3
Acartia discaudata Giesbrecht	5	-	5	-	5	-	10	-	5	5	5
Acartia tonsa Giesbrecht	5	5	24	10	20	28	12	16	-	-	5
Calanus finmarchicus (Gunn.)	5	-	7	-	5	-	6	-	5	5	5
Centropages furcatus Dana	10	10	-	5	7	1	-	8	10	6	10
Metridia longa (Lubbock)	-	5	-	-	-	5	-	-	-	-	-
Paracalanus parvus Claus	18	10	4	12	5	6	5	3	12	8	18
Paracalanus scotti Fruchtl	5	7	16	-	11	15	18	-	8	6	5
Temora stylifera Dana	5	-	3	-	1	-	1	-	5	5	5
ORDER II: CYCLOPOIDA	-	-	-	-	-	-	-	-	-	-	-
Corycaeus obtusus Dana	-	5	-	-	-	5	-	-	-	-	-
Cyclopina longicornis Claus	5	-	27	5	19	-	18	21	9	5	5
Cyclops sp.	10	5	32	15	17	23	30	26	-	-	10

Oithona plumifera Baird	25	38	11	10	3	6	15	24	20	20	25
Oncaea venusta Phillipi	5	-	45	-	32	-	51	-	5	18	5
SUB-CLASS II: BRANCHIOPODA	-	-	-	-	-	-	-	-	-	-	-
ORDER: CLADOCERA	-	-	-	-	-	-	-	-	-	-	-
Alona sp.	5	5	6	5	6	6	6	6	5	5	5
Penilia avirostris Dana	-	4	-	7	-	5	-	-	-	3	-
CLASS: MYSIDACEA	-	-	-	-	-	-	-	-	-	-	-
FAMILY: MYSIDAE	-	-	-	-	-	-	-	-	-	-	-
Mysis sp	7	-	3	-	2	-	1	-	5	4	7
Order II-DECAPODA	-	-	-	-	-	-	-	-	-	-	-
Lucifer foxonii Borrad	15	5	-	8	9	7	-	10	-	12	15
PHYLUM-CHAETOGNATHA	-	-	-	-	-	-	-	-	-	-	-
ORDER-APHRAGMORPHA	-	-	-	-	-	-	-	-	-	-	-
Sagitta enflata Vogt	5	-	3	4	3	-	3	3	3	3	5
PHYLUM: CHORDATA	-	-	-	-	-	-	-	-	-	-	-
CLASS: LARVACEA	-	-	-	-	-	-	-	-	-	-	-
Oikopleura dioica Vogt	8	-	5	-	6	-	4	-	5	3	8
JUVENILE STAGES	-	-	-	-	-	-	-	-	-	-	-

Copepod eggs	-	-	-	-	-	-	-	-	-	-	-
Bivalve larva	7	-	5	4	8	-	5	6	4	-	7
Fish eggs	-	-	-	-	-	-	-	-	-	-	-
Fish larvae	6	-	3	7	5	-	4	5	-	2	6
Gastropod larva	-	-	-	-	-	-	-	-	-	-	-
Lucifer zoea larva	5	-	5	5	5	-	5	5	5	5	5
Megalopa larva	-	-	-	-	-	-	-	-	-	-	-
Nauplii larva of Barnacle	12	6	8	4	10	6	12	8	10	5	12
Nauplii larva of copepods	3	12	8	3	5	7	6	2	-	4	3
Zoea larva	5	-	5	-	5	-	5	-	5	10	5
PHYLUM: CNIDARIA	-	-	-	-	-	-	-	-	-	-	-
CLASS: SCYPHOZOA	-	-	-	-	-	-	-	-	-	-	-
ORDER: SIPHONOPHORA	-	-	-	-	-	-	-	-	-	-	-
Unidentified jelly-fish	-	2	-	4	-	2	-	-	-	1	-

Source: Natural Ecocapital, 2024

Table 4.37: Biological Indices of Zooplankton Community Biological Indices

Biological indices	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SWC1	SWC2
Total species diversity (S)	**23**	**14**	**21**	**17**	**23**	**15**	**21**	**15**	**17**	**22**
Total abundance (N)	179	119	233	113	195	130	226	153	121	140
Log of Species diversity (Log S)	1.36	1.15	1.32	1.23	1.36	1.18	1.32	1.18	1.23	1.34
Log of abundance (Log N)	2.25	2.08	2.37	2.05	2.29	2.11	2.35	2.18	2.08	2.15
Shannon-Wiener Index (Hs)	2.99	2.31	2.7	2.72	3.05	2.42	2.64	2.46	2.7	2.87
Menhinick Index (D)	1.72	1.28	1.38	1.60	1.65	1.32	1.40	1.21	1.55	1.86
Margalef Index (d)	0.24	0.37	0.27	0.30	0.24	0.35	0.27	0.36	0.30	0.24
Equitability Index (j)	0.06	0.14	0.10	0.07	0.09	0.11	0.10	0.10	0.11	0.15
Simpson's Dominance Index (C)	0.94	0.86	0.90	0.93	0.91	0.89	0.90	0.90	3.70	3.87

Source: Natural Ecocapital, 2024

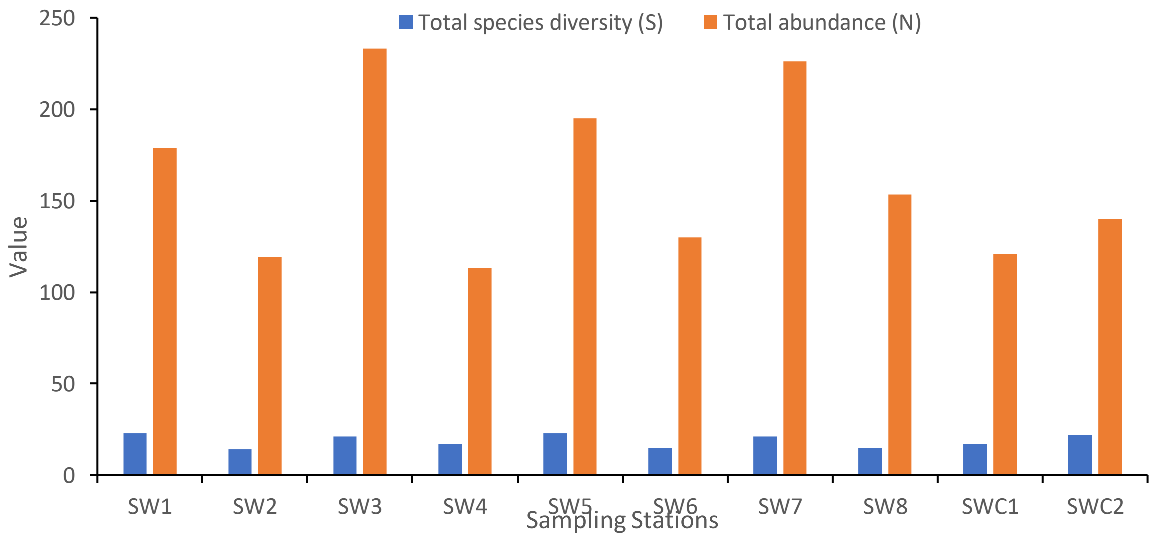


Figure 4.75: **Species Diversity and Abundance of Zooplankton Community**

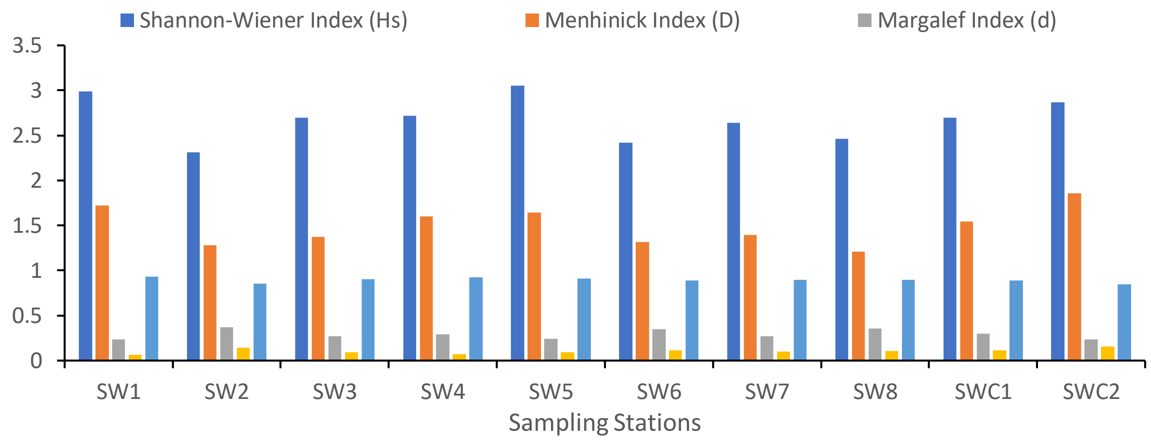


Figure 4.76: **Diversity Indices of Zooplankton Community**

Macroinvertebrate in the Project Area

The composition, abundance and distribution of the macroinvertebrate as well as relative abundance of major benthic fauna in the study area are presented in Table 4.38. Seven taxa were identified from a total of twelve individuals collected. The species identified were *Anadara senegalensis*, *Mactra glabrata*, *Thais nodosa*, *Natica adansonii*, *Tympanotonus fuscata*, *Tagellus adansonii* and *Ostrea cucullate* from Arcidae, Donacidae, Mactridae, Muricidae, Melaniidae, Naticidae, Neritidae, Potamididae, Psammobiidae and Ostreidae families respectively. The macroinvertebrate abundance and composition were low and the most occurred species were *Ostrea cucullata*, *Tympanotonus fuscata* and *Tagelus adansonii*.

Some important factors governing the abundance and distribution of macroinvertebrate benthic communities include, water quality, immediate substrates for living and food availability (Dance and Hynes, 1980). Most of the stations with no organism had fine clay sediment. Any ecological imbalance arising from any severe alterations of these factors may affect the macrobenthos. Therefore, it appears that the low macrobenthic invertebrate community abundance, composition and diversity may have been greatly affected by stress imposed by land based pollutants, as well as substrate instability possibly arising from frequent dredging of the creek for marine traffic.

The species richness for rainy season was evaluated using Margalef's (d) and Menhinick's (D) indices. Margalef's index ranged between 0.52 (SW4) and 0.83 (SW 2) while Menhinick's index range between 1.09 (SW3) and 1.46 (SW4). Evaluating the species diversity in the study area, Shannon-Weiner index (Hs) ranged between 1.24 (SW2) and 1.87 (SW4), Equitability index (j) ranged between 0.67 (SW2) and 0.84 (SW1) while Simpson's Dominance index (C) ranged between 0.16 (SW 1) and 0.33 (SW2) (Table 10).

In addition, there are large amount of organic debris in the sediment possibly as a result of land runoffs which are likely to have smothered benthic organisms (Uwadiae *et al*, 2009) and resulted in poor oxygen availability. This low diversity of benthic macrofauna in this study according to Goerge *et al* (2009) is not unusual in the area. Oyenekan (1975); Ajao and Fagade (1990) reported varied results of species composition of benthic organisms in Lagos Lagoon. George *et al* (2009) associated the differences in species composition recorded to the ecological differences of the geographical locations and depth of investigation. The distribution pattern of the macroinvertebrates in all the stations of the studied area did not show major differences. This pattern of distribution could be explained by the similarity in the environmental conditions across the stations. The overall differences observed in the abundance and species richness may be due to the slight variations in the physico-chemical and sediment quality of the aquatic habitat. Wood (1987) explained that species have to contend with environmental changes and biological interaction, which may produce significant alterations in overall community structure.

Table 4.38: Macroinvertebrate community of the Proposed Site

TAXA	**STATIONS**									
	SW1	**SW2**	**SW3**	**SW4**	**SW5**	**SW6**	**SW7**	**SW8**	**SWC1**	**SWC2**
Arcidae										
Anadara senegalensis	**4**	**-**	**6**	**5**	**3**	**-**	**2**	**4**	**4**	**-**
Donacidae	-	-	-	-	-	-	-	-	-	-
Mactridae	-	-	-	-	-	-	-	-	-	-
Mactra glabrata	6	2	4	3	-	5	4	-	1	2
Muricidae	-	-	-	-	-	-	-	-	-	-
Thais nodosa	2	2	-	2	5	4	1	-	2	2
Melaniidae	-	-	-	-	-	-	-	-	-	-
Naticidae	-	-	-	-	-	-	-	-	-	-
Natica adansonii	3	-	5	4	1	2	-	3	2	4
Neritidae	-	-	-	-	-	-	-	-	-	-
Potamididae	-	-	-	-	-	-	-	-	-	-
Tympanotonus fuscata	1	2	-	2	-	1	3	1	-	2
Psammobiidae	-	-	-	-	-	-	-	-	-	-
Tagellus adansonii	2	-	4	2	2	-	1	3	3	2
Ostreidae	-	-	-	-	-	-	-	-	-	-
Ostrea cucullata	8	6	2	5	4	-	3	2	6	-

Source: Natural Ecocapital, 2024

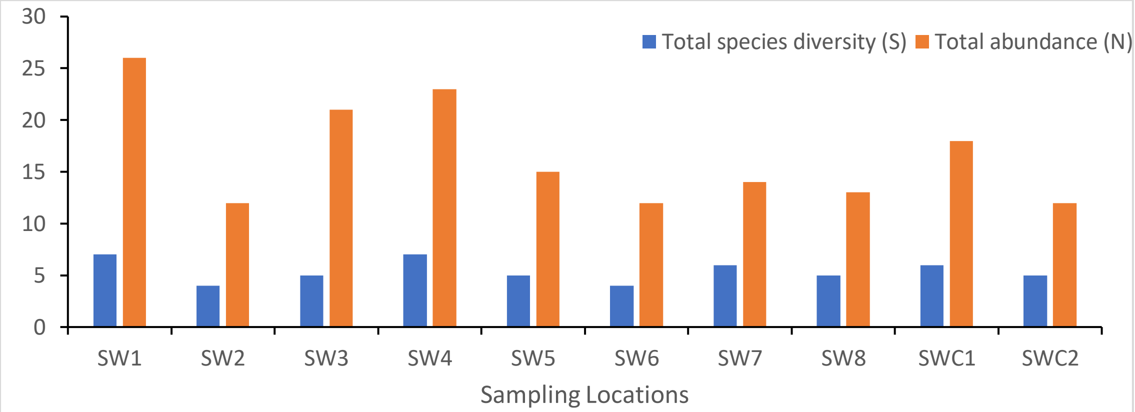


Figure 4.77: Abundance and Diversity of Macrobenthic Organisms

Table 4.39: Biological Indices of Macroinvertebrate Community

Biological indices	**SW1**	**SW2**	**SW3**	**SW4**	**SW5**	**SW6**	**SW7**	**SW8**	**SWC1**	**SWC2**
Total species diversity (S)	7	4	5	7	5	4	6	5	6	5
Total abundance (N)	26	12	21	23	15	12	14	13	18	12
Log of Species diversity (Log S)	0.85	0.60	0.70	0.85	0.70	0.60	0.78	0.70	0.78	0.70
Log of abundance (Log N)	1.41	1.08	1.32	1.36	1.18	1.08	1.15	1.11	1.65	1.56
Shannon-Wiener Index (Hs)	1.67	1.24	1.56	1.87	1.49	1.23	1.67	1.52	2.70	1.11
Menhinick Index (D)	1.37	1.15	1.09	1.46	1.29	1.15	1.60	1.39	1.41	1.44
Margalef Index (d)	0.54	0.83	0.76	0.52	0.68	0.83	0.53	0.64	0.58	0.62
Equitability Index (j)	0.84	0.67	0.78	0.84	0.76	0.68	0.80	0.77	0.78	0.78
Simpson's Dominance Index (C)	0.16	0.33	0.22	0.16	0.24	0.32	0.20	0.23	0.22	0.22

Source: Natural Ecocapital, 2024

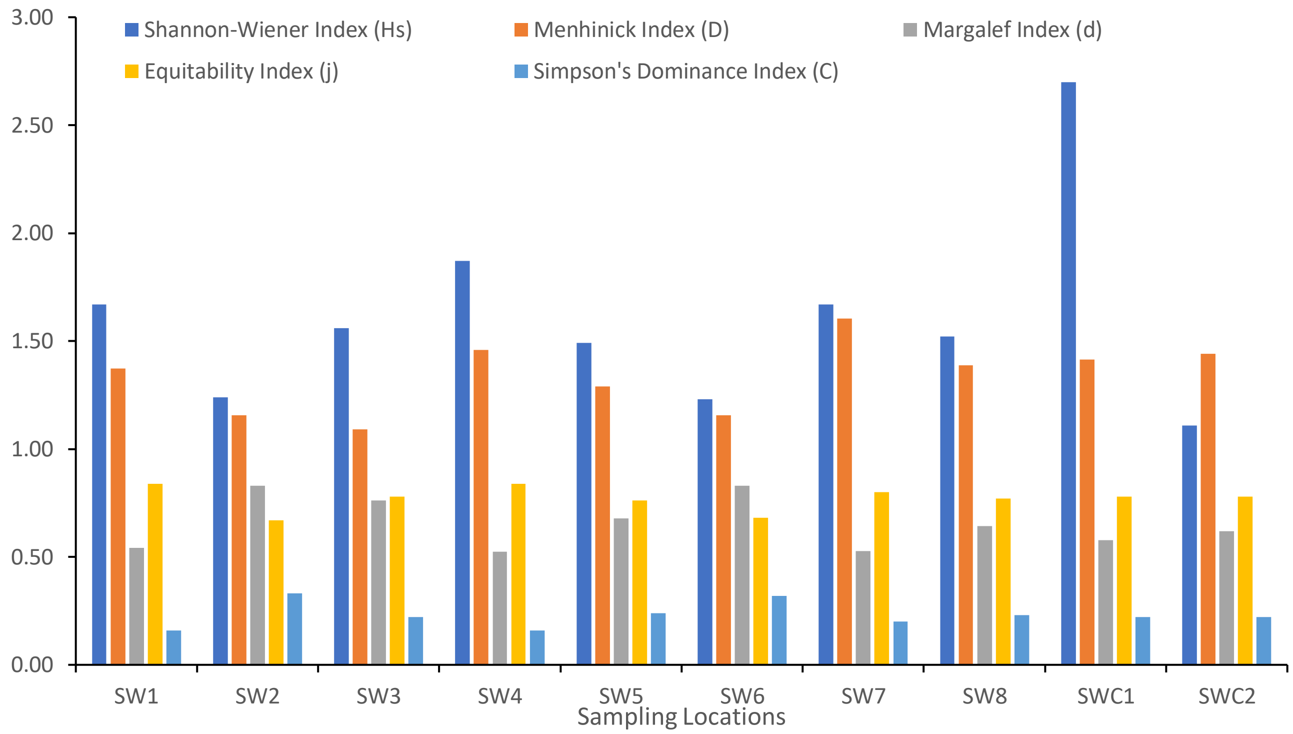


Figure 4.78: Diversity indices of Macrobenthic organisms in Sampling Stations

Fisheries study

The increased concern on the rapid ecological changes in the natural environment has provided major challenges to the scientific community (Chindah 1998). According to Olaniyan (1957), Hill and Webb (1958), two physiographic factors, rainfall and salinity, determine the hydro-climatic conditions of the coastal lagoons of south-western Nigeria. Rainfall in this region is concentrated in one season (May to October) and has two peaks (June and September) but varies from year to year. The dry season is known to extend from November to April. Hill and Webb (1958), Olaniyan (1969) and Nwankwo (2004) highlighted the importance of rainfall in the ecology of the lagoons of south-western Nigeria. Lekki Lagoon is also a relatively shallow body of water. It has three arms, one of which extends to form the Omu Creek by which it is linked with the Mahin Lagoon in Ondo State (Emmanuel, 2009; Emmanuel and Chukwu, 2010). The entire lagoon creek system (Lagos – Lekki – Omu Creek – Mahin Lagoon) constitutes the major coastal feature of southwest Nigeria.

The limited fishing range and lack of other tangible employment opportunity in the coastal communities confine them to fishing (Mathew, 2000). Following this, the artisanal fisher folks have no option but to continue exploiting the available fish resources. Hence, the consequences of remaining in fishing have resulted to over fishing and its attendant effect of stocks depletion. Even with the problem of over fishing, the fisher folks still employ various unorthodox means to continue exploiting the degraded stocks (Solarin and Kusemiju, 2003).

This problem of over fishing may have been having serious implication on fish supply for the Lagos population (UNDP, 1998). Also, when the fish resources are exploited intensively and frequently than what the water body can supply, even though it has the capacity to renew itself naturally, the water body will begin to deplete and the fisher folks' income, welfare and sustenance will begin to be affected.

Fishing has always been an important activity in coastal states due to economic, geographic, traditional, and cultural factors. Therefore, in Nigeria, as in many other countries, the most intensive users of coastal zone have been fishermen. Today, small-scale fisheries employ 50 million (99%) of the world's 51 million fishers, practically all of whom are from developing countries (Berkes *et al.,* 2001; FAO, 1999; Santen, 2003), and together, they produce 40 percent of the world's annual marine and inland fish catch (FAO, 2001 estimation stated in Whitmarsh et al., 2003), supplying most of the fish consumed in the developing world. Industrial fisheries are seemed to be the most productive on a world-wide scale, but FAO (1995) and Freire and Allut (2000) stated that the small-scale coastal fisheries have a much greater social significance than industrial fishery.

The project area includes the fishing grounds in Lagos Lagoon that connect the harbour within a 10 to 20 km radius of the project area. This fishing ground is a brackish water environment. This ground supports euryhaline species and some marine species. This is a fishing ground for operations of cast nets, gillnets, hooks and lines, hand nets and stow nets.

Fishery Sampling

Study Approach

- In this study, fisheries sampling was done between 10th and 11th of July, 2024.The types of fishing gears used in the area were examined, the fishermen operating in the area were approached and their catches were observed. The fish species were classified to family level using some available identification texts like Schneider (1990), Olaosebikan and Raji (1998) and Emmanuel (2009). Some fishing operation pictures were taken to complement the information acquired. The abundance of each species was estimated according to the following criteria as described by Benech *et al.* (1983):
-
- ≥ 10% = dominant
- 1 to 9% = subdominant
- < 1% (but caught more than once) = occasional
- < 1% (and caught only once) = rare.

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

Observation

- The fishing gears used by fisher folks in this area were bamboo traps (Oparun), castnets (obiriki), gillnets (atafo), setnets (Atamu), pole and hooks (Poro), basket traps (Igun/ Ogun), long line (Ewoolokun), Manatee trap (Ipa), Net trap (Keteku) and liftnets (Awo Salapore). From the list of identifies fish species in these creek/Lagoon, it is obvious that this area exhibits rich biodiversity which must be seriously protected by the upcoming projects. The various fishing gears used are described as follow:
- **1.** **Bamboo trap** – This trap is constructed from bamboo tree holed with a blunt end (Plate 1). It is pegged to the water bed with a pole which served as the marker. It is operated by two able men/women without bait. These traps target *Chrysichthys spp.* The traps are set for 15 days (they are checked two times a month).
-

Plate 4.19: A - Bamboo trap bundle after fishing B- A group of pegged bamboo traps

- **2.** **Basket trap**: It is used in the sides of the lagoon and the creek, in between the water hycianths (Plate 2). They are baited with giant ant nest locally known as *Kukumaye* (Plate 3) and raphia fruit (Iregbe) (Plate 4).

Plate 4.20 (a-c): Basket Trap
used as bait for the basket trap

Plate b: Giant Ant Nest (Locally called Kukumaye)

Plate c : Raphia Palm Fruit used as bait for basket trap (Igun)

3. **Gillnet-** Netting wall hanging vertically in water by the combined actions of the floats (slippers, raphia) attached to the headline and the lead/ stone sinkers attached at intervals of (1.35 – 2.00) metres to the foot rope to sink the net to the water bed while the floats attached at intervals of (1.1 – 1.95) metres to the headline which allow the heads of the net to float thereby maintaining the vertical opening of the net (Plate).These nets are operated throughout the year (rainy and dry season). They are operated day and night. The departure time at the base for day operation is 6.00 am while that of night operation is at 4.00 pm. The arrival time for day operation is 6.00 pm and 7.00 am the next day for night operation. These net are operated 4 to 5 times in a week and about 16 to 20 times in a month.

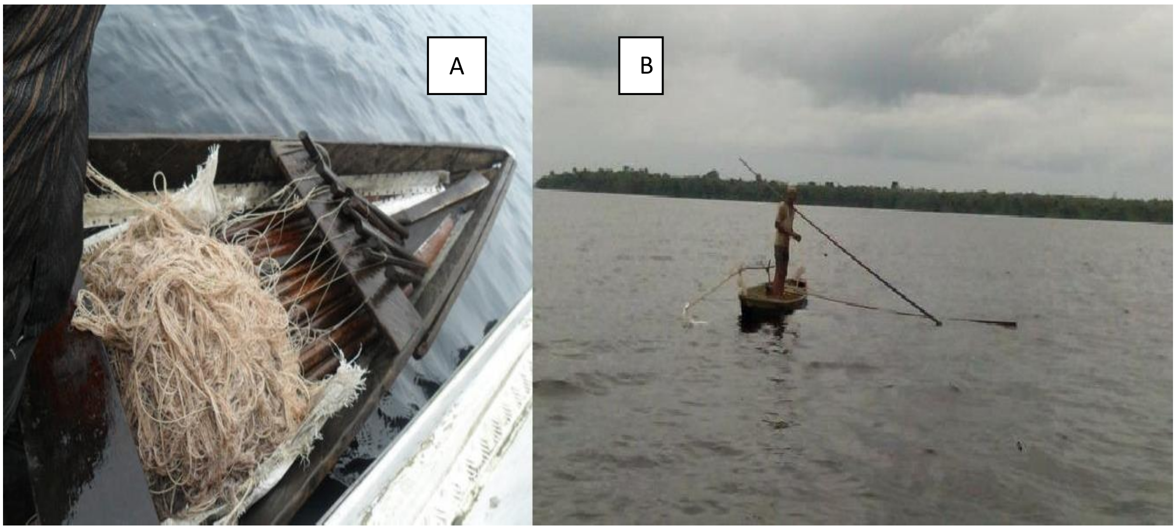


Plate 4.21(A-b) : A- Gillnet with raphia floats B – A man setting gill net

It is operated mainly by men in the project area, although women at times do participate. They use ratio 3:1 owner to assistant sharing formula for their catches. Other netting materials used for gillnets construction are monofilament polyethylene used for small fishes like *Ethmalosafimbriata, Tilapiaspp, Hepsetusodoe, Hemichromisspp* and so on. These nets can last for 6 to 1 year depend on the maintenance.

Cast nets: it is conical in shape and panels varied from 3 to 4 panels. The sinkers are leads with weight ranging from 46.0 – 86.0 g and are attached to the foot rope at almost regular intervals. The numbers of the sinkers ranged between 71 and 100 depending on the net size. The cast nets are operated between 3 to 4 hours in a day per trip either during the day or at night. This net is operated by both men and women throughout the year. It not species bias because it catches all fishes cover that the girth are bigger than the meshes (Plate).

Plate 4.22: Castnet Operation

Longline – It consists of 210D/10 (No.10) main line with No. 9 twine ganglions of variable length (0.25 to 0.35m) spaced 1.5 – 3 m apart. The longline were coiled in round plastic tub or basket with cork rims for fixing the hooks. Each tub contains between 300 and 500 hooks. The most commonly used hook design in the project area was 'Mustard' round bent flattened hooks (Plate). It is operated throughout the year targeting fish species like *Gymnarchusniloticus, Sphyreana barracuda, Clariasgariepinus* and so on.

Plate 4.23: Long Line Fishery

Fishing operations in Lagoon around the project

Lagoon fishing in the area is for both male and female sexes and sometimes children are involved. Fishes caught from the lagoon are shown in Table 7.

Plate 4.24: Collage of Fish species observed at study area

Table 4.40: Species of fish caught at the project area

S/N	Local Name	English Name	Family	Scientific Name	IUCN Conservation Status
1.	Aforigboko	African lookdown	Carangidae	*Selene dorsalis*	Least Concern
2.	Awodun	Guinean Barracuda	Sphyraenidae	*Sphyraena afra*	Least Concern
3.	Kafara	West African Croaker	Sciaenidae	*Pseudotolithus senegalensis*	Vulnerable
4.	Akaraba	African sicklefish	Drepanidae	*Drepane Africana*	Data Deficient
5.	Abo	Bonga Shad	Clupeidae	*Ethmalosa fimbriata*	Least Concern
6.	Asugbon	Bigeye Grunt	Haemulidae	*Brachydeuterus auritus*	Least Concern
7.	Onirugbon	African Threadfin	Polynemidae	*Galeoides decadactylus*	Vulnerable
8.	Doje	Largehead hairtail	Trichiuridae	*Trichiurus lepturus*	Least Concern

9.	Alapo	Guinean Butterfish	Stromateidae	*Stromateus fiatola*	Least Concern
10.	Iyefunfun	Common Octopus	Octopodidae	*Octopus vulgaris*	Least Concern
11.	Konkon / Ikurunmalokun / Opolo Okun	Guinean Snapper	Lutjanidae	*Lutjanus agennes*	Least Concern
12.	Kote / Biodun	Atlantic Horse Mackerel	Carangidae	*Trachurus trachurus*	Least Concern
13.	Alaganga	Guinean Grunt	Haemulidae	*Pomadasys incisus*	Least Concern
14.	Ofun	West African Guitarfish	Rhinobatidae	*Rhinobatos cemiculus*	Vulnerable
15.	Ede	Southern pink shrimp	Penaeidae	*Penaeus notialis*	Least Concern
16.	-	West African Blue Crab	Portunidae	*Callinectes amnicola*	Least Concern
17.	-	Lobster	Palinuridae	*Panulirus regius*	Least Concern
18.	-	Barracuda	Sphyraenidae	*Sphyraena afra*	Least Concern
19.	-	African SickleFish	Drepanidae	*Drepane africana*	Data Deficient
20.	-	Puffer Fish	Tetraodontidae	*Lagocephalus laevigatus*	Data Deficient
21.	-	Ray fish	Dasyatidae	*Dasyatis margarita*	Vulnerable
22.	-	Anguilloidei	Anguillidae	*Anguilla obscura*	Data Deficient
23.	Olorun/Baba Dudu	West African Goatfish	Mullidae	*Pseudupeneus prayensis*	Least Concern
24.	Apo	Silver Catfish	Claroteidae	*Chrysichthys nigrodigitatus*	Least Concern

Source: Natural Ecocapital, 2024

Trace metal levels in the fish species in the study area

Bio-accumulation of trace metals in aquatic life, especially fish is of interest, owing to the potential detrimental effect and direct toxic effects on human health. A comparison between the concentration of each metal found in males and females showed significant differences between the sexes for all metals. The data represented in this study showed that the highest concentration of trace metal was found in the female species of *Eucinostomus melanopterus*, with concentration of 31.60 mg $kg^{-1}$for Fe. The female fish species, except *Tilapia guineensis*, accumulated higher Fe and Zn values than the male species. The female species of *Psettias sebae* was noted as a good bio-indicator of trace metal contamination in the lagoon.

The values obtained in this study are in agreement with the trace metal levels in *Chrysichthys nigrodigitatus*, in a recent investigation (Ladigbolu, 2011). Cadmium and nickel were not detected in any of the fish species. This may have been due to the dry ashing of the fish samples. Pb levels in the fish were above the maximum acceptable limit for human consumption (USFDA, 1993), confirming earlier studies carried out in the lagoon (Unyimadu *et al.* 2008). The level in female *Eucinostomus melanopterus* (52.42 mg kg-1) was significantly high. The high Pb levels could be traceable to the dumping and discharge of industrial wastes into the lagoon. It could be an indication of leakage of oil, grease and antifouling paints, which are serious pollution sources for Pb (Aderinola *et al.*2012). The Zn levels were within the recommended limit. Zn is an essential element which is regulated and maintained at certain concentrations in fish (Wildianarko *et al.* 2000), due to homeostatic regulation. Fe is not considered toxic to aquatic organisms.

Female species, except *Tilapia guineensis*, accumulated higher Fe and Zn values, when compared with the male species. The female species of *Eucinostomus melanopterus* was particularly noted as a good bio-indicator of trace metal contamination. Cd and Ni were not detected in any of the fish species. Pb levels in the fishes were above the maximum acceptable limit for human consumption and could have been sourced from the discharge of industrial wastes into the lagoon (Table 4.41).

Table 4.41: Trace metal levels in fish samples.

Fish Species	**Fe (mg/kg) Male female**		**Zn (mg/kg) Male Female**		**Cd (mg/kg) Male Female**		**Pb (mg/kg) Male Female**		**Ni (mg/kg) Male Female**	
Tilapia guineensis	16.82	19.02	13.66	11.41	ND	ND	18.00	10.80	ND	ND
Liza falcipinnis	16.20	18.00	12.39	13.67	ND	ND	12.81	10.80	ND	ND
Chrysichthys nigrodigitatus	29.68	30.50	21.33	28.13	ND	ND	15.70	32.10	ND	ND
Eucinostomus melanopterus	21.85	31.60	16.30	26.50	ND	ND	11.66	52.40	ND	ND

Source: Natural Ecocapital, 2024

4.14.3 Ecotoxicological Assessment:

Ecotoxicology study was carried out on aquatic organisms in the project corridor. The samples collected were evaluated based on select **bioindicators**, biomarkers, and multi-response indicators to gauge health and integrity of aquatic ecosystems. In ecotoxicology studies, bioindicators are organisms or biological parameters that help assess environmental health and exposure to pollutants. Common bioindicators: algae and phytoplankton, macroinvertebrates, fish, microorganisms, plants and terrestrial bioindicators.

Biomarkers include measures of molecular, biochemical, cellular, and physiological responses in key species exposed to contaminants or stressors. Examples inlcude:

Behavioral biomarkers (changes in behavior due to exposure), reproductive biomarkers (assess reproductive health), energy metabolism biomarkers (indicate metabolic changes), lysosomal integrity biomarkers (reflect cellular health), immunotoxicity biomarkers (assess immune system responses) and genotoxicity biomarkers (detect genetic damage).

- The choice of bioindicators and biomarkers depended on the specific ecosystem and pollutants being studied based on their sensitivity and relevance.
-

4.14.4 Ecosystem Services and Natural Capital

This section presents and assesses the key ecosystem service considerations relevant to the topics presented in other chapters of this ESIA Report. This includes key inter-linkages to ensure that the values which ecosystem service beneficiaries attach to ecosystem goods and services are appropriately considered and addressed throughout the ESIA process.

Ecosystem services are the benefits provided by ecosystems to humans. Ecosystem services is “the benefits that people, including businesses, obtain from ecosystems” (International Finance Corporation Performance Standard (PS) 6 (IFC,2012). They can be directly used or consumed, as well as used as inputs in the production of other goods and services. Examples include Air filtration by trees (improving human health) is an ecosystem service. Trees also provide timber (used in construction), which is an indirect ecosystem service.

The benefits of ecosystems are conferred at many scales and often to multiple different beneficiaries. At the local level, ecosystem services are frequently the basis for rural livelihoods and subsistence, particularly for the poor. Artisanal fishing, for example, provides both cash income and food for low-income families. Benefits can also be regional—such as the fisheries that contribute to the Gross Domestic Product (GDP) of various coastal countries—or national, such as sites that form part of a country’s cultural heritage. At a global scale, ecosystems regulate climate and support the biodiversity which underpins all biological production.

Natural capital refers to the components of ecosystems (excluding humans and their contributions) that generate goods and services valuable to people. Examples include soil as natural capital. It contributes to the production of crops, which is an ecosystem service.

Natural Capital Accounting (NCA) measures ecosystems and their services, allowing them to be incorporated into national economic accounts. It treats nature as a form of capital, recognizing ecosystems as productive assets with tangible value.

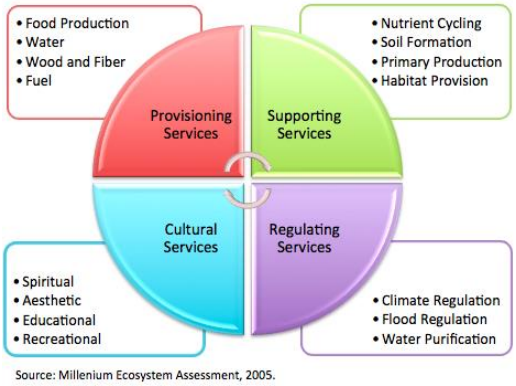


Figure 4.79: Ecosystem Services

Businesses and projects may also benefit from ecosystem services through, for example, the direct use of inputs, such as water, or through protection from natural hazards. Identifying and protecting such services can have further benefits such as avoiding punitive regulation and negative publicity, strengthening the organisation's reputation and, in some cases, providing effective natural alternatives to more expensive engineering solutions.

Specifically, the purpose of this section is to:

- Systematically identify and assess the likely impacts of project activities on Ecosystem Services (ESS) and the nature and significance of these impacts on ESS beneficiaries;
- Evaluate Project dependence on ESS to help manage risks and take advantage of opportunities related to ecosystem change; and
- Help inform, for unavoidable impacts, the selection of appropriate mitigation measures which aim to maintain the value and functionality of priority ESS and enhance the resource efficiency of Project operations.

The ecosystem services assessment process in the ESIVI tool comprises four stages:

1. Scoping: to identify the key services provided by affected ecosystems that could potentially be impacted by the Project or that the Project may depend upon;

2. Baseline establishment: to assess the status of key services within the affected ecosystems in the absence of the Project, as well as the location of ecosystem service beneficiaries and the extent to which they benefit from the services provided;

Approach

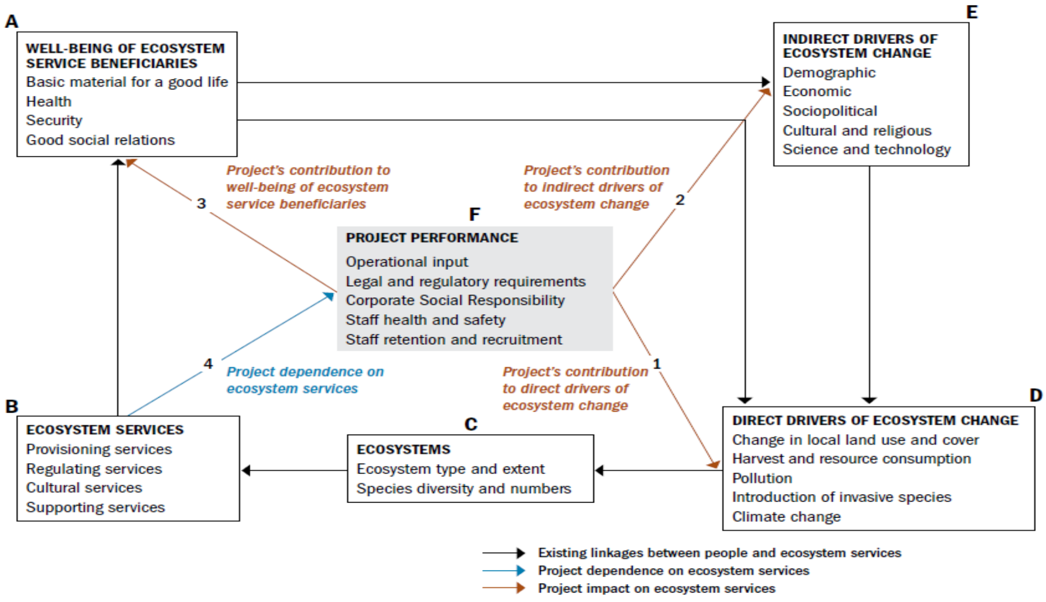
There are different approaches to assessing the **Ecosystem Services (ES)** for the Lagos Coastal Road.

To complement the ESIA process and routinely addressed, considerations were given to ecosystem service (Figure 1, blue and black text respectively) using Ecosystem Services Review for Impact Assessment (ESR for IA). The ESR for IA helps identify measures to mitigate project impacts on ecosystem service benefits, ensuring a more comprehensive assessment. The ESR for IA can be used for two purposes. First, it identifies measures to mitigate project impacts on the benefits provided by ecosystems. Second, it identifies measures to manage operational dependencies on ecosystems.

The ESR for IA is a structured methodology developed by the World Resources Institute. A six-step method to address project impacts and dependencies on ecosystem services as part of the environmental and social impact assessment process. The steps build on assessments routinely conducted by social and environmental practitioners to better reflect the interdependence between project, ecosystems, ecosystem services, and people. It guides practitioners through six steps to incorporate ecosystem services into environmental and social impact assessments (ESIAs). These steps cover scoping, baseline analysis, impact assessment, and mitigation stages.

This is therefore anticipated to address project impacts and dependencies on ecosystem services and would help enhance our understanding of project impacts and their interdependence with ecosystems.

Fig. 4.80 relates to the Project Impact to Dependence on Ecosystem Services



Source: WRI, adapted from MA 2003.

Fig. 4.80: Project Impact and Dependence on Ecosystem Services

The ESR for IA provides a conceptual framework to link the project to ecosystems, ecosystem services, and the benefits derived from ecosystem services. It outlines six steps for conducting the ESR for IA throughout the ESIA scoping, baseline and impact analysis, and mitigation stages, including the use of Excel spreadsheets. Figure 4.81 illustrates the Standard Environmental and Social Impact Assessment Process, Complemented by the ESR for IA.

In terms of Valuation, there are Monetary Methods and Non-Monetary Methods: Monetary Methods include Market-Based Valuation (estimating ES value based on market prices, e.g., timber sales), Cost-Benefit Analysis (comparing costs and benefits of ES interventions), and Hedonic Pricing (analyzing property prices influenced by environmental quality). Non-Monetary Methods include Stated Preference Methods (surveys to assess people's willingness to pay for ES), Ecological Production Function (quantifying ES based on ecological processes), and Benefit Transfer (adapting existing valuation studies to new contexts).

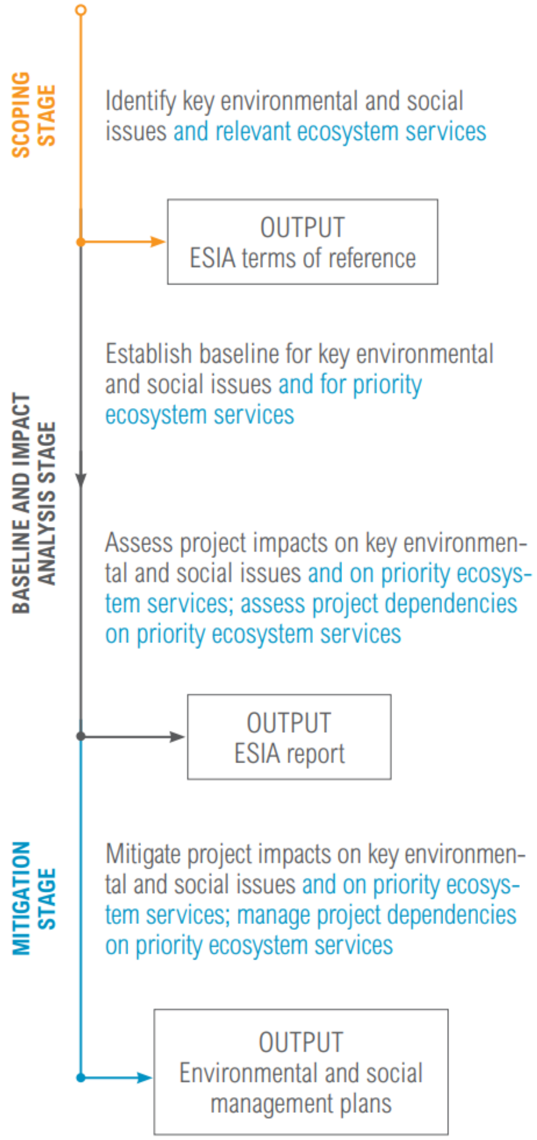


Figure 4.81: Standard Environmental and Social Impact Assessment Process, Complemented by the ESR for IA

Table 4.42: Degree of Impact and Dependency of Ecosystem Services in the Project Areas				
Ecosystem Service	**Degree of Impact (Type I)**	**Degree of Dependence (Type II)**	**Relevance to Affected Community (Type I)**	**Degree of Management Control (Type I/II)**
PROVISIONING				
Fisheries				
All fishes in the Area	High	High	High	Medium
Crops				
Zea mays	High	High	High	Medium
Ananas comosus	,,	‘ ’		
Elaeis guineensis	,,	‘ ’		
Manihot esculenta	,,	High		
Mangifera indica	,,	Moderate		
Carica papaya	Low	Low		
Musa sapientum	Low	Low		
M. paradisiaca	Low	Low		
Wild foods				
Maesobotrya arborea	Low	Low	Moderate	Medium
Spondia mombin	,,	,,		
Gambeya albida	,,	,,		
Irvingia gabonensis	,,	,,		
Sphenocentrum joliyanum	,,	“		
Artocarpus atilitis	“			
Timber				
Alstonia boonei	High	Low	High	
Milicia exelcia	,,			Low
Bombax sp.	Low			
Bambusa vulgaris	Low			
Gmelina arborea	Low			

Table 4.42: Degree of Impact and Dependency of Ecosystem Services in the Project Areas

Ecosystem Service	Degree of Impact (Type I)	Degree of Dependence (Type II)	Relevance to Affected Community (Type I)	Degree of Management Control (Type I/II)
Raphia hookeri	Low			
Fibers				Low
Elaeis guineensis	Low	Low	High	
Triumfeta rhomboldea	,,	,,		
T. cordifolia	,,	,,		
Cocos nucifera	,,	,,		
R. hookeri	‘‘	‘‘		
Biomass fuel				Medium
Alchornea cordifolia	Low	Low	High	
Elaeis guineensis	High	,,		
Anthonotha macrophylla	Low	,,		
Genetic Resources				Medium
Ananas comosus	High	High	High	
Dacryodes edulis		,,		
Persea americana				
Dioscorea rotundata				
Biochemicals, natural medicines, and pharmaceuticals				
Dioscorea rotundata				
Momordica charantia	Low	Low	Moderate	Low
Mangifera indica	,,	,,		
Carica papaya	,,			
Alstonia boonei		,,		

Table 4.42: Degree of Impact and Dependency of Ecosystem Services in the Project Areas				
Ecosystem Service	**Degree of Impact (Type I)**	**Degree of Dependence (Type II)**	**Relevance to Affected Community (Type I)**	**Degree of Management Control (Type I/II)**
Rauvolfia vomitoria *Pcynanthus angolensis*	Medium Low ,,	,, ,, ,,		
2. REGULATION *Gmelina arborea* *Alchornea cordifolia* *Elaeis guineensis* *Anthonotha macrophylla* *Zea mays* *Alstoniaboonei* *Rauvolfia vomitoria* *Pcynanthus angolensis*	 High Low High Low High Low	 Low ,, ,,, ,, ,,	 Moderate	 Low
Air quality regulation All Plants In The Area	High	High	High	Medium
Local, Regional Global climate regulation All Plants In The Area	High	High	High	Medium
Water regulation All Plants In The Area	High	High	Moderate	Medium

Table 4.42: Degree of Impact and Dependency of Ecosystem Services in the Project Areas

Ecosystem Service	Degree of Impact (Type I)	Degree of Dependence (Type II)	Relevance to Affected Community (Type I)	Degree of Management Control (Type I/II)
Erosion regulation All Plants In The Area	high	Low	High	Medium
Water purification and waste treatment	Medium	High	Moderate	Medium
Pest regulation Plants in polyculture	High	Low	Low	Low
Pollination All plants in the area	High	Low	Low	Low
Natural hazard regulation All Plants In The Area	High	High	Moderate	Medium
3. CULTURAL **Sacred or spiritual sites**	Low	Low	Low	Low
Areas used for religious purposes	None	Low	Low	Low
4. SUPPORTING **Nutrient capture and recycling** All Plants in The Area	High	Low	High	Low

Table 4.42: Degree of Impact and Dependency of Ecosystem Services in the Project Areas				
Ecosystem Service	**Degree of Impact (Type I)**	**Degree of Dependence (Type II)**	**Relevance to Affected Community (Type I)**	**Degree of Management Control (Type I/II)**
Primary production All The Plants In The Area	High	High	High	Low

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4.15 SOCIAL ENVIRONMENT

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4.15.1 SocioEconomics

Study Introduction

- The study was purported to furnish an all-inclusive description of the prevailing socio-economic situations prior to the construction of the Section 2 of the Lagos – Uyo Coastal Road Project area which is about 56km starting from 47km to 103km of the 700km coastal road The specific objectives of the study are therefore to:
  - Identify all neighbouring communities around the project area;
  - Establish and document the prevailing socio-economic characteristics of the inhabitants of these communities, and
  - Elicit empirical information on infrastructural facilities/economic activities of the communities.
  - Incorporate Socio-economic and Health factors in decision making
-
- The study therefore provides baseline information for assessing the cumulative positive and negative impacts of the Lagos–Calabar coastal Road project on the communities' social and economic livelihoods. In essence, the information provided by the study will to a large extent assist to reinforce strategies for maximizing the positive socio-economic impacts and simultaneously minimizing to the barest the negative effects of the proposed road in the project area.

Approach and Methodology

- In order to attain the objectives of the study the following approach was adopted:

❖ **Pre-Engagement Talk with Community Leaders**

This took place prior to the commencement of the study to create awareness about the project and clear any grey area that relates to the project.

❖ **Desk Review:**

This involved a thorough study of all available documents (both published and unpublished) that are related to the project. These include existing EIA Reports on projects in the Zone, maps of the area and documents on relevant socio– economic and demographic information about the people including their real-life experiences.

❖ **Preparation of Data Collection Framework:**

In view of the activities to be carried out, effective strategy to obtain field data was developed. Having come up with the data collection method plan, the following instruments for data collection were developed:

a) Observation Guide
b) In-depth Interview Guide
c) Focus Group Discussion Guide
d) Ranking Checklist
e) Validated Questionnaire
f) Photo characterization

- To accomplish the study tasks, both formal and informal methods were used in investigating the socio-economic components of the area. The *formal* method includes administration of pre-tested and validated instrument of data collection (Questionnaire) on respondents. This is with a view to obtaining quantitative data that will provide empirical basis for the study output especially socio–economic, demographic variables, household activities, community capacity analysis and infrastructural issues among others.
-
- The questionnaires were administered based on the size of the communities. Considering the homogeneity of the population, this sample size is considered adequate. In administering the questionnaire, random sampling technique was adopted. A total of 170 questionnaires were administered, and 158 (92.9%) retrieved from the respondents.
-
- Simple descriptive statistics such as percentages and graphs were used to analyze the field data. This ensured that the most outstanding factors of socio-economic relevance in the various communities were clearly identified. All questionnaires retrieved were cross-checked and examined for errors and inconsistency.

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- The *informal method* involved the use of Participatory Approach using Participatory Rural Appraisal (PRA) technique specifically. The relevant PRA tools that were used in the study include:
  - **Direct Observation:** This includes observation of objects, events, processes, people's behaviour and other relevant indicators that were developed for the study. Project team members with the aid of relevant tools captured real time record of the processes to be observed. Some of these include household activities, social and physical infrastructure, agricultural production and marketing, social organization activities, local development strategies among others.
  - **Semi Structure Interview (SSI) Checklist:** This includes the following:

    a) ***Semi structure Interview with Opinion leaders*****:** Interviews with individuals in the communities who have deep (local) knowledge of the areas of the study interest and who can give an objective view from their experience and expertise was carried out. These include in-depth interviews with youth leaders, women leaders, Chairmen of Communit y Development Associations, resident teachers, and community leaders (Plate 4).

Plate 4.25(a-b):In depth interview with the community head in Alasia and Itoke community

b) ***Group Interviews and Discussions:*** This is a process of interacting with relevant groups of stakeholders to facilitate access to the knowledge of several people at once. The group consisted of 5–20 people and each member was encouraged to speak and keep discussion to the point (Plate 4..) Members of each group were made up of all strata in the community such as Adults (Male and Female), youths, physically challenged, and specifically selected relevant social groups.

b): **Group interview in Okunraye community**

-

  - ***Focus Group Discussion*****:** This involved interview with carefully selected group of people (5-10) with adequate knowledge in the specific area of discussion (Plate 4.26). The areas include; demographic issues, Infrastructures, social services, economic issues, environmental issues and development activities among others. This method helped to clarify specific issues discussed by a larger group. The focus group discussions were also used as a way of involving target segments of the communities (youths, women and opinion leaders) and mainstreaming their responses with those acquired from the structured questionnaire administered. At least two (2) key elderly indigenes knowledgeable in the history and culture of the various communities were interviewed on a one-on-one basis.

-
- In general, income, housing, level of education, occupation and employment were used as indices to assess the Quality of Life (QoL) of the inhabitants of the selected communities. Major facilities and infrastructure such as water facilities, school buildings, town halls, markets, electricity projects, healthcare facility, and other informal economic sectors were physically inspected by the ESIA team to ascertain their functionality. For the study, all the communities within project's influence zone were surveyed.(Plate 4.)
-

Plate 4.26: Focus group discussion in Akodo community

4.15.2 Human Settlements

The proposed coastal Road will be constructed within the Ibeju Lekki Local Government Area with its corridors in thirty-one (31) communities from Eleko to Ode Omi. Based on the findings of the socioeconomic studies, the communities located at the corridors of the proposed road are urban, semi urban settlements and rural communities that are either moderately or sparsely populated and fall under Ibeju Lekki LGA and administratively under the Lekki LCDA, the Lekki LCDA is administratively under Ibeju Lekki LGA. More than half of these communities are fishing communities; the main settlers are believed to be migrants from Epe and Ile Ife. Other tribes have also migrated and are resident in the communities till date like the Ilajes, Ijaws, Calabars, Ghanaians, Togolese etc. The project affected communities are listed in the table below. The socioeconomic questionnaire used for the study is included in

Table 4.43. **Project Affected Communities**

S/NO	Communities	LGA/LCDA	Settlement
1,	Okunraye	Ibeju Lekki	Urban
2.	Alasia	Ibeju Lekki	Urban
3.	Itoke	Ibeju Lekki	Semi Urban
4.	Idotun	Ibeju Lekki	Urban
5.	Alagbon Segun	Ibeju Lekki	Urban
6.	Oke Iyanta	Ibeju Lekki	Urban
7.	Ilekuru	Ibeju Lekki	Urban

8.	Idasho	Ibeju Lekki	Urban
9	Ilede	Ibeju Lekki	Urban
10.	Imobido	Ibeju Lekki	Urban
11.	Tiye	Ibeju Lekki	Urban
12.	Akodo	Ibeju Lekki	Urban
13.	Orofun	Lekki	Urban
14.	ELeko	Lekki	Urban
15.	Iberekodo	Lekki	Urban
16.	Orimedun	Lekki	Urban
17.	Magbon Ilado	Lekki	Urban
18.	Magbon Oga	Lekki	Urban
19.	Museyo	Lekki	Urban
20.	Ogogoro	Lekki	Urban
21.	Igbo Olomi	Lekki	Urban
22.	Idata	Lekki	Urban
23.	Ilagbo	Lekki	Urban
24.	Kajola	Lekki	Urban
25.	Siriwon	Lekki	Urban
26.	Ebute Lekki	Lekki	Urban
27.	Ise	Lekki	Urban
28.	Igbohun	Lekki	Urban
29.	Abakeji	Lekki	Rural
30.	Mafogunde	Lekki	Rural
31.	Ode- Omi	Lekki	Rural

Age-Sex Distribution

In the project affected communities, adult population (45–54 years) constitutes 39.24% of the total population. 35.44% are above 55 years while 20.25% are between 35 and 44 years, while the age groups of 18-24 and 25-34 are 1.27 and 3.95% respectively. (Figure 4.82.). The communities have more of middle aged men followed by able-bodied labour force and very less amount of youths within the ages of 18-24. On the average, females constitute about 55% of the population in these communities.

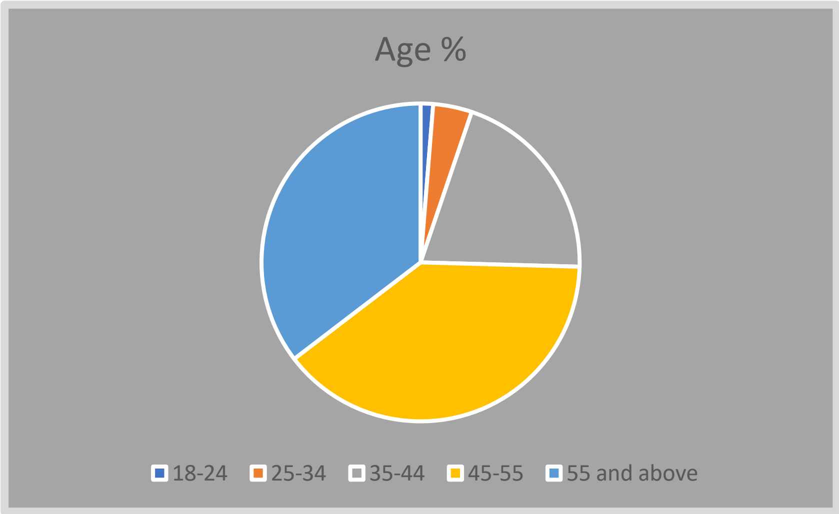

Figure 4.82: Age distribution within the study area

Occupation

About 80% of the surveyed communities were engaged in fishing business either as the only means of livelihood or alongside other business-like trading, real estate, hospitality etc.

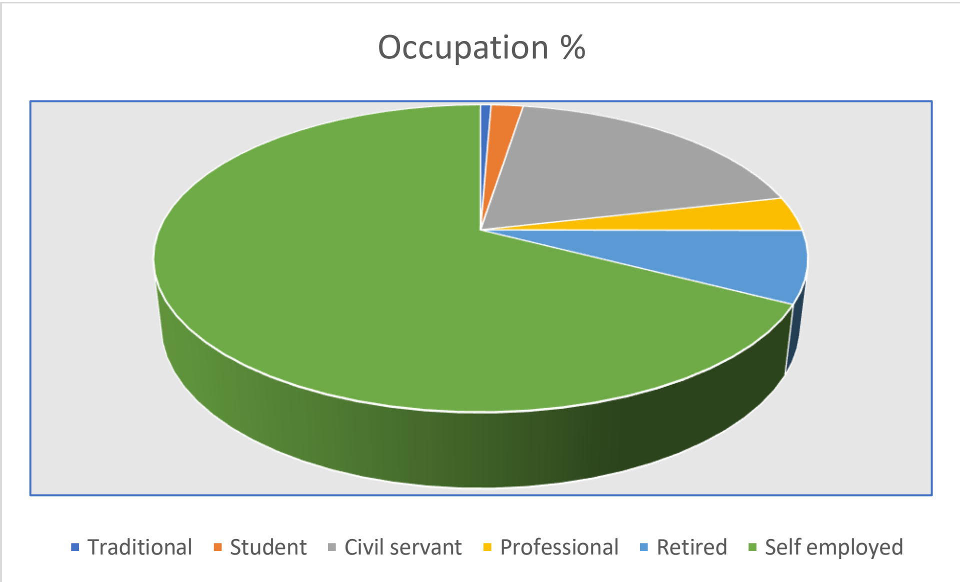

Figure 4.83: Occupation distribution within the affected communities

Languages

The common language spoken in all the surveyed communities is the Ijebu dialect of Yoruba language. Most strangers who couldn't speak the Ijebu dialect could express themselves well in Yoruba. In addition to these traditional languages, English is the official language spoken in the local government and at all public functions.

Religious Profile

The predominant religion within and the affected communities is Islam. More than half of the people interviewed identified themselves as Muslims, next to that proportion was Christian religion. The traditional way of worship and practice is still held by some members of these practicing faith.

Demographic Profile

Lagos State Population

Lagos, a fast-growing city, had a population of 15,388,000 in 2022 and is projected to reach 16.5 million by 2024. The population density in Lagos state is approximately 3304.55 people per square kilometer. Children (0-14 years) make up 30.3% of the population, while individuals aged 15-44 make up 49.3%. The Lagos State Government projects the overall population of Lagos State to be 29,753,282.35 by 2030 and an estimated 36,592,784.37 by 2050.

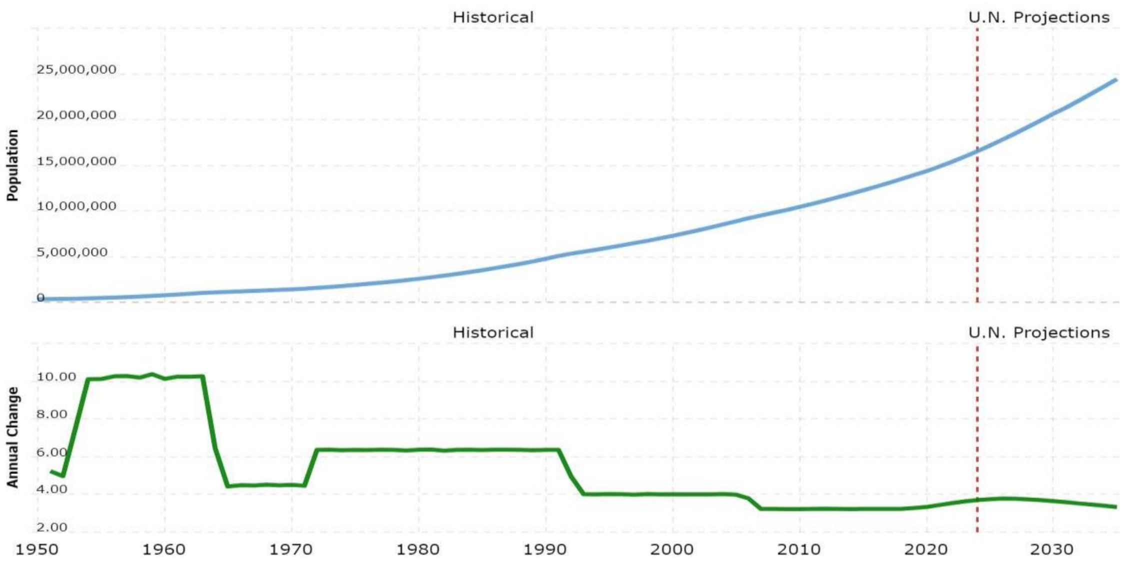

Figure 4.84: Projection of the Lagos State Population

www.macrotrends.net (2024) drawn from United Nations - World Population Prospects

Population of the Project Host Local Government Area

The estimated population of the Ibeju Lekki government as at 2023 is 168,726.23 while Lagos State population is projected to be 29,753,282.35. By 2030, Ibeju Lekki is projected to grow further to 207,511.98 while the population of Lagos is predicted at 36,592,784.37 by 2050 as depicted in (**Figure 4.85**).

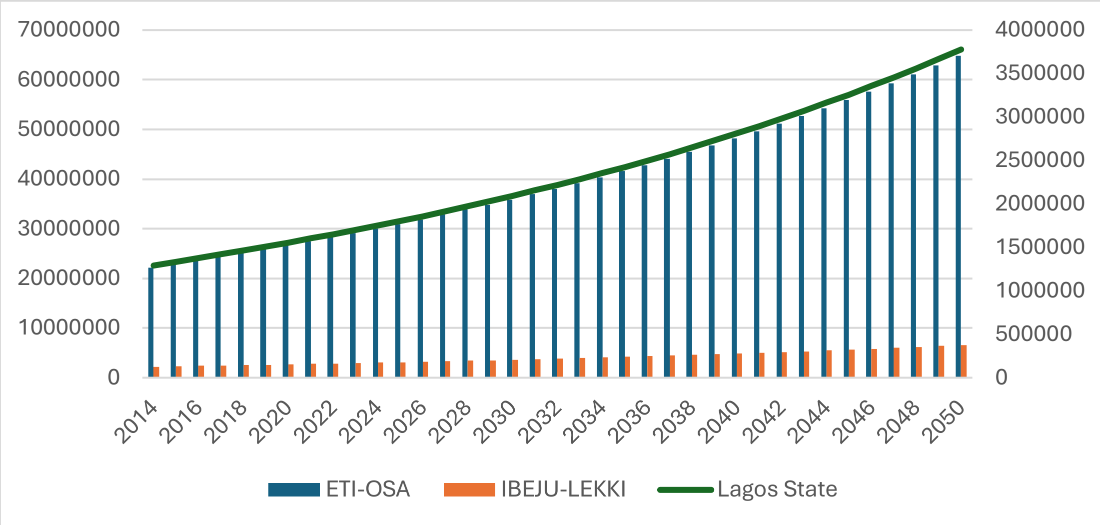

Figure 4.85 Population Projections of the Host LGAs

4.15.6Education Status

There are government owned primary schools in more than half of the communities surveyed but for secondary school education before now the students had to leave their communities to Magbon Segun and Idotun being the only communities with a government owned secondary school but more secondary schools have been added to the Ibeju Lekki LGA in Akodo, Orimedun and Magbon Alade, Siriwon, Ebute Lekki, Ise, Igbogun. A common situation in all the surveyed communities is lack of basic facilities especially for water and sanitary use. Instruction materials are also grossly inadequate. These inadequate educational facilities has caused some parents to send their children or wards to either private schools for those who can afford it or go to schools in bigger towns in order to access secondary school education. Table 4.44 shows the communities in project area with schools while Plate 4.27 shows some of the schools within the project area.

The consultation team noted the following educational challenges throughout the area of influence. These are as follows:

- Some of the school require an upgrading of some of its facilities to adequately and safely accommodate all students;
- Parents complained of lack of qualified teachers, most of them relied on the services of the NYSC staff for its teaching services.

- There is a widespread lack of basic educational equipment such as blackboards, chairs, tables and other learning aids.

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- **Plate 4.27.: Some Schools within the affected communities**

Table 4.44 Communities with Public schools in the affected communities

S/N	Name of Community	No of Government pry schools	No of Government Sec schools
1	Okunraye	-	1
2.	Alasia	-	-
3	Itoke	-	-
4	Idotun	1	1
5	Alagbon Segun	-	1
6	Oke Iyanta	-	-
7	Ilekuru	-	-
8	Idasho	-	-
9	Ilede	1	-
10	Imobido	-	-
11	Tiye	-	-

12	Akodo	1	1
13	Orofun	-	-
14	ELeko	-	-
15	Iberekodo	1	-
16	Orimedun	1	1
17	Magbon Ilado	-	-
18	Magbon Oga	1	1
19	Museyo		
20.	Ogogoro		
21.	Igbo Olomi		1
22.	Idata	1	
23.	Ilagbo		
24.	Kajola		
25.	Siriwon	1	1
26.	Ebute Lekki		1
27.	Ise	1	1
28.	Igbohun	1	1
29.	Abakeji		
30.	Mafogunde		
31.	Ode- Omi		

4.15.7Settlement Pattern and Housing Structure

The communities located within the area of influence are spread over thirty one (31) villages/semi-urban, urban and rural settlements in addition to smaller fishing/faming enclaves. Settlements in the area is moderately populated and generally linear as they have developed along roadsides. Other settlements are located as isolated groups due to topography of the environment.

There were two main types of houses observed. These included the semi-modern bungalows consisting of cemented/non-cemented mud walls with a zinc roof; modern bungalows consisting of block walls with a zinc. Plate 4.28 Shows some of the building structures observed in the project area.

Plate 4.28: **Housing structures in the project area**

Land Tenure

- As discussed in Section 2.9, the Land Use Act of 1978 nationalized land holdings in Nigeria. The Act vests all land in a State, excluding land vested in the Federal Government or its agencies, solely in the Governor of that State who is to hold such land in trust for the people and is thus responsible for its allocation in all urban areas to individual residents and businesses in the State. The legal status of land users in Nigeria is thus one of occupancy rather than ownership.

Land Mass and Land Use Analysis of Lagos State

Lagos State is the smallest state in Nigeria, with a land mass of 3,345 km2. With a population density of 4,713/ km2, rising to 12,000 in some low-income areas. Lagos also has the densest population conurbation in Nigeria. Its urban area has expanded at an average annual rate of 2.6% since 2000. The Area of land mass/water area of Ibeju local government area and that of Lagos state are shown in **Table 4.45.**

Table 4.45: Land Mass and Land Use Analysis of Lagos State.

Place	Landmass in Sq Km	Water area in Sq Km	Total In Sq Km
Ibeju-Lekki LGA	643	10	653
Lagos State	2,797.72	779.56	3,577.28

Source: *Natural Eco Capital Fieldwork April 2024*

Lagos State's dynamic land use reflects its growth, challenges, and efforts toward sustainable development as outlined below:

a. ***Residential Areas*****:** Lagos has a diverse range of residential areas, from high-end luxury estates to informal settlements (often referred to as slums). These residential areas accommodate a mix of residents, including wealthy individuals, middle-class families, and low-income earners.

b. ***Commercial Hubs*****:** Lagos is a bustling commercial hub with numerous business districts, markets, and commercial centers. Areas like Victoria Island, Ikeja, and Apapa are known for their concentration of office buildings, banks, and corporate headquarters.

c. ***Industrial Zones*****:** Lagos State is home to various industrial zones and manufacturing clusters. The Ikeja Industrial Estate, Oshodi Industrial Area, and the Apapa Port Complex are notable industrial areas. Ibeju Lekki, one of the proposed project's host local government areas, is growing with notable industries today with the presence of Deep-Water Port, Dangote Refinery and Fertilizer facilities, etc.

d. Transportation Infrastructure: Lagos boasts extensive transportation infrastructure, including roads, bridges, ports, railways, and airports. The city's land use includes areas dedicated to transportation hubs such as bus terminals, train stations, ports, and airports.

e. Green Spaces and Recreation: Despite its urban density, Lagos also features recreational parks, gardens, and waterfront promenades. These green spaces provide residents with areas for relaxation, leisure activities, and outdoor recreation.

f. ***Educational Institutions:*** Lagos is home to numerous educational institutions, including universities, colleges, schools, and research centers. These institutions occupy significant land areas across the city and contribute to its intellectual and cultural vibrancy.

g. ***Mixed-Use Developments:*** A growing trend in Lagos is mixed-use developments, which combine residential, commercial, and recreational spaces within the same area. These developments aim to create more sustainable and liable communities. The proposed project corridor typifies mixed-use developments in Lagos.

h. ***Changes in ecosystems***: Available statistics show that Lagos has a significant rise in built up areas in the past two decades. This increase has led to a decline in vegetation by 376.3km^2 during the same period.(Table 4.46) Other significant changes are reduction in bare land, wetlands on the other have experienced a minor increase due to government intervention for its preservation. Table 4xx below shows the overall land use land cover change from 2000 to 2020.

Table 4.46: Land use cover from 2000-2022

	2000		2010		2020	
LULC Class	**Area in km^2**	**Percentage (%)**	**Area in km^2**	**Percentage**	**Area in km^2**	**Percentage**
Bare land	631.383	16.6	345.280	9.12	194.643	5.14
	598.426	15.80	1083.654	28.61	1271.286	33.57

Built up	574.335	15.16	693.595	18.31	809.944	21.39
Vegetation	1200.728	31.70	887.113	23.42	824.428	21.77
Water	746.997	19.732	770.434	20.34	648.795	17.13
Wetland	35.535	0.94	7.328	0.19	38.307	1.01
Total	3787.404	100	3787.404	100.00	3787.404	100

Source:html.scirp.org/file_3-26303f94_2htm

LULC: Land use land cover

Figure 4.86 shows the projected land use change in the year 2030, it showed that the area where high percentage ecosystem change will be noticed in the state will be around the upper Ikorodu axis.

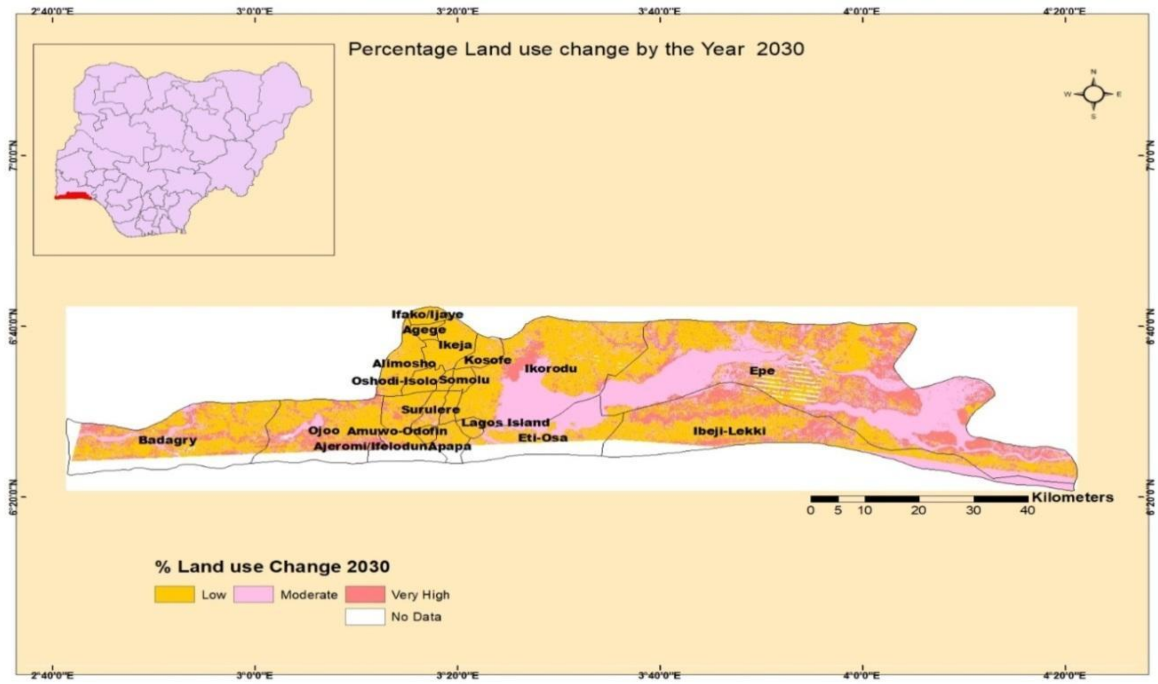


Figure 4.86: Percentage projected change in Lagos state 2030

Land Use in the project area

Settlements within the study area are mostly located outside the Lekki Free Zone along the coastline and the bank of the Lekki lagoon probably because of the nearness to fishing grounds. The agricultural land use within the area include Oil palm plantation, raffia plantation, maize and leafy vegetables, pepper and tomatoes.

The development of the project study area as Lekki Free Zone (Plate 4) had attracted multinational companies to invest in the area and this trend is fast changing the land use pattern in the area. The area is fast turning into an industrial area with the presence of companies like the Dangote refinery, Dangote fertilizer, Lekki deep sea port etc. The larger freshwater swamp forest and farmlands is being reduced to accommodate the residential houses, hotels, office complex and factories.

Other notable land uses include fishing and logging activities

Plate 4.29: **Lekki free trade zone**

The major land use or cover observed in the area is classified into Communities, Bare land, Developing Area and Wetlands.

Figure 4.87(a-b): is the land use cover for the year 2006 and 2022. It shows an increase in built up area in the project are over the years.

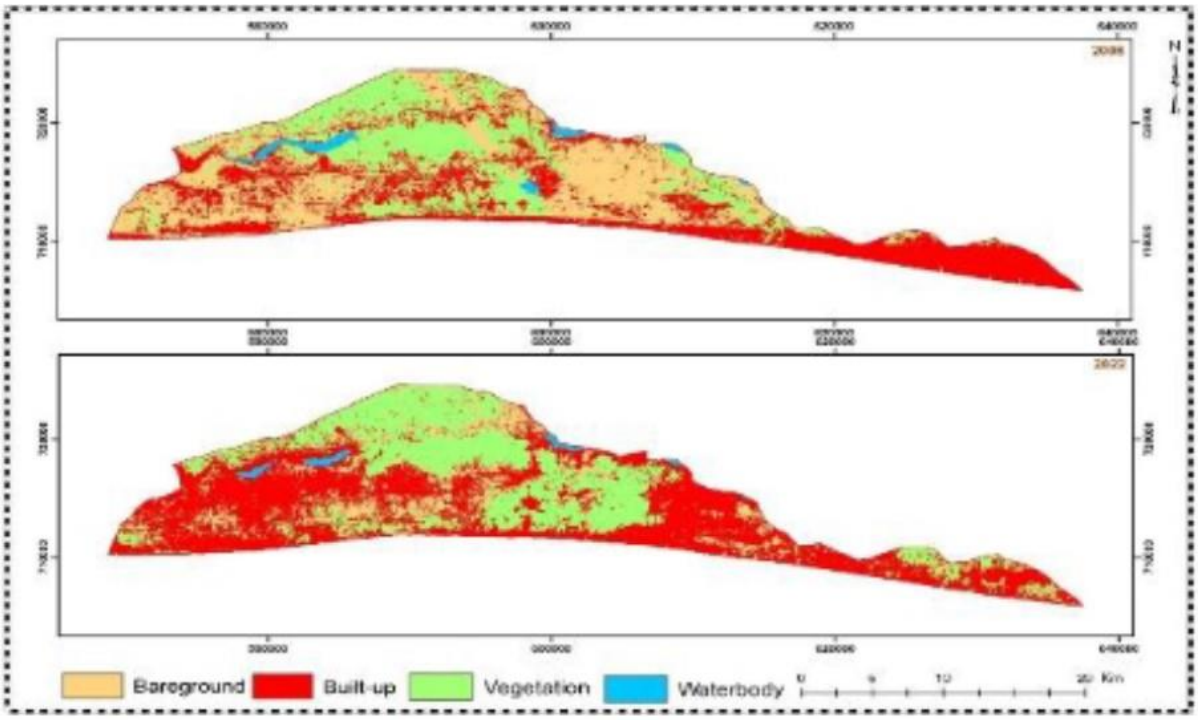
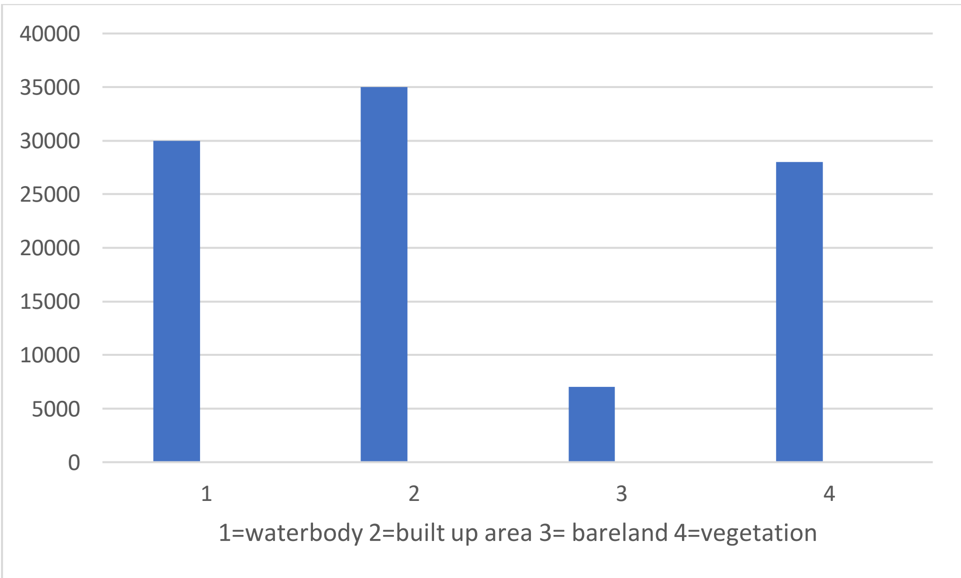


Fig 4.87(a-b): Land use cover 2006 and 2022

Source:html.scirp.org/file_3-26303f94_2htm



b) Land use distribution in Ibeju Lekki 2022

Source:html.scirp.org/file_3-26303f94_2htm

4.15.8 Economic Profile

Occupational Profile

The proximity of the communities in the project area to the Atlantic Ocean and the Lagoon gives them a comparative advantage in fishing which is the typical occupation of the various communities including farming both as subsistence or commercial. Most of the land used for commercial farming of crops like cassava, yam, maize etc has been acquired for the Lekki free zone. About 67.7% of the residents are self employed (Figure 4..); they engage in Palm wine tapping, trading, artisanship, livestock rearing, processing of farm produce and sand mining as their means of livelihood while about 18.9% are civil servants; only a small fraction of the residents are retired and and not productive. Figure 4.88 shows the percentage of the residents as it relates to their means of livelihood.

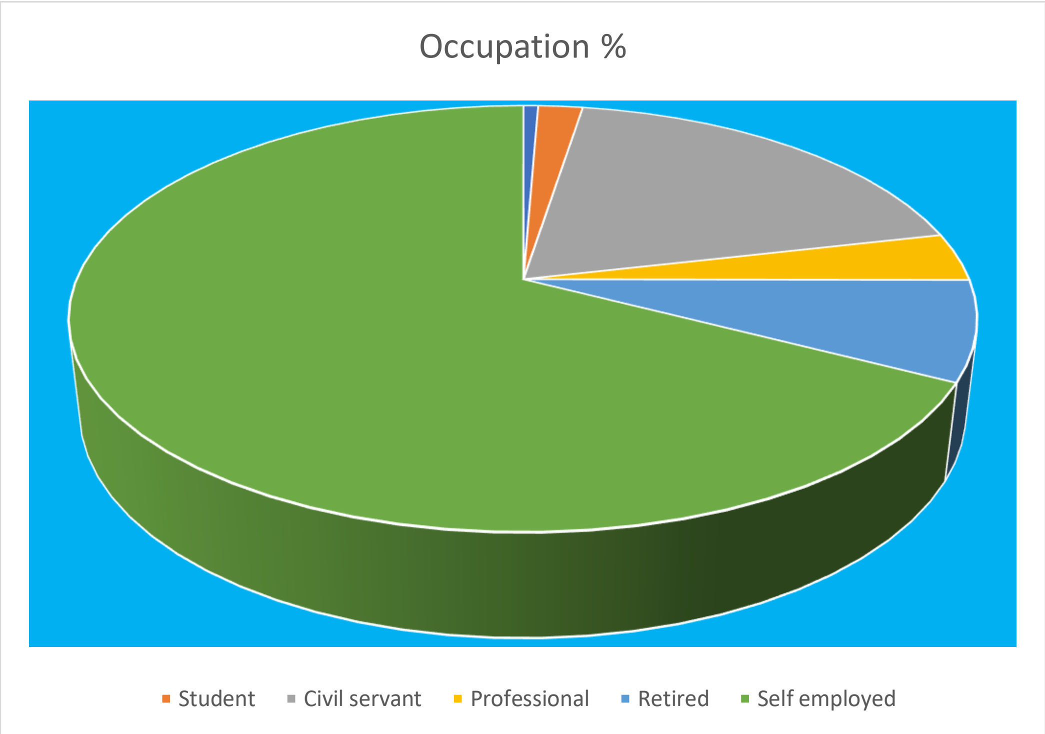


Plate 4.88.: Occupational Status

Source: Natural Eco Capital Team Field work

It should be noted that fishing activities has drastically reduced due to a reduction in the amount of fishes caught in the sea or lagoon affecting the economics of the local traditional fishermen. The use of more sophisticated fishing boats which is not affordable to the locals is in great need by the fishermen. Plate 4… shows a typical fishing community.

Plate 4.30: A typical fishing community with fishermen getting ready to fish

Source: Natural Eco Capital Team Field work

Women also contribute greatly to the economic profile of the communities as the males are mainly involved in fishing especially in the open sea while the females are involved in fish processing and fishing in the immediate waters as depicted in the picture below.

Plate 4.31 Fishing activities by both men and women

Source: Natural Eco Capital Team Field work

Income Distribution

The Field survey report provides a summary of the average income for individuals within the communities. The average income in the area is low with the majority of individuals earning below the national average income of N300,000 per annum.

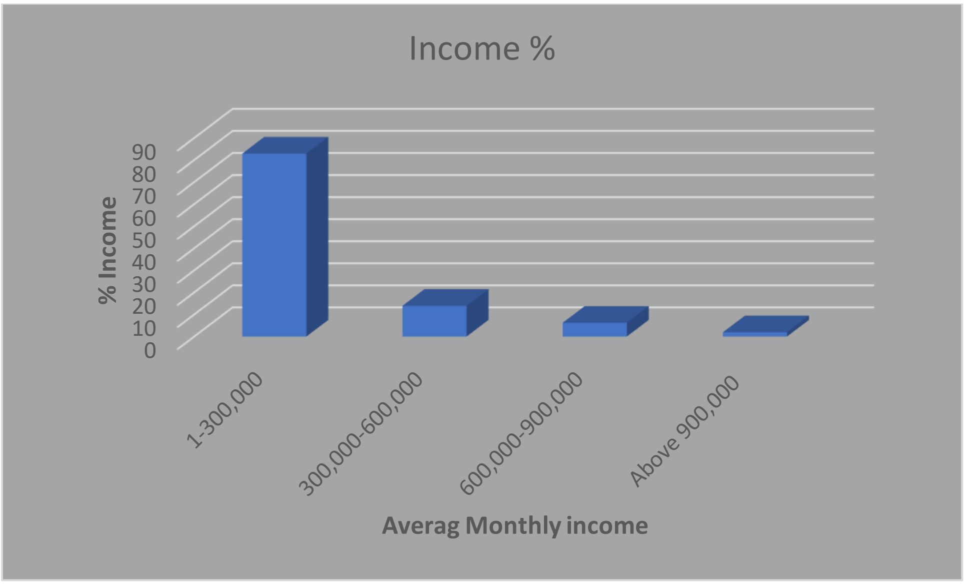


Figure 4.88- Average Annual Income in Affected Communities

Source: Natural Eco Capital

An estimate of the average income earned /Annually for various economic activities acquired from the thirty-one (31) coastal communities located along the corridors for the proposed road.

4.15.9 Public Utilities

- **Electricity**

Most of the communities in the area of influence lack electricity for over a decade. In the few communities that have electricity, the power supply is sporadic.

Energy source for most of the households in the urban communities is either from Solar energy or fuel powered generating sets. Many of the communities declared that they have been without electricity for over a decade. Although the communities in the urban areas is observed to have electricity poles with electric cables and transformers and connected to the national grid but have not been enjoying its services. Only two communities had electricity but say it is a very poor supply.

The rural communities also lack electricity and depend on solar energy to charge their phones and torch lights for those who can afford it otherwise they use candle.

The source of energy for cooking is majorly cooking gas for the urban communities while charcoal and firewood is majorly used in the rural areas.

Generally, improvement in electricity supply would result in an increase in commercial activities while boosting the production of small and medium industries including laundry service and tailoring etc. In brief, it would facilitate all rounded economic growth in these communities and create employment opportunities for the people, including women, thereby increasing income levels and reducing poverty.

- ❖ **Potable Water**

Findings from the survey shows that most of the communities have a common borehole sunk for its members but none of them was in use as at the time of visit due to lack of maintenance repair or the high cost of fueling the power generator sets to power on the machines. Members have to resort to alternative means of water supply like shallow well water as their primary source of water for domestic purposes. Those communities close to the sea complained of poor water quality from their hand drawn wells. Some households also used Rainwater harvesting tanks/containers. A few households also reported using a combination of different water sources.

The more urbanised communities had residents who could afford to have personal borehole in their residences.

Plate: 4.32: Two non-functional water projects and shallow wells

❖ Market facilities

There are several markets in most of the communities with make shift sheds for display of their wares. The fish market is an onsite business that occurs at the seashore immediately the fishermen arrive the shores from their fishing activities. The market is a platform for trading of goods among the rural dwellers and interested buyers. The major market for all the communities is the Akodo market which was recently relocated from its former location into a more standard market facility that will attract traders from all the project affected communities to trade and as well form an outlet to reduce post-harvest losses and increase the income of farmers. There is no other modern market facility in the other communities in the study area and this has a lot of negative consequences on the socio economic life of the community. Traders from outside Akodo have stalls in the Akodo market production. The high cost of transportation fares to these markets adversely affects their margin of profit.

❖ Transport Facilities and Accessibility

The rapid growth of population and infrastructure along the Lagos coast presents challenges. The pressure to provide adequate infrastructure and services for residents is significant. Lagos State has been investing in infrastructure to support its growing population and economic activities. The project area is traversed by the Lagos - Ibeju - Lekki - Epe highway and smaller feeder unpaved roads linking the highway with the impacted towns, villages and fishing settlements.

Communities in the area have poor intra-community access roads which are usually swampy and waterlogged during the wet season except Imobido and Magbon Segun where tarred roads link them with other communities. None of the rural access road linking farmlands is tarred. Virtually all the communities in the study area are accessible through waterways (Lagoon and Sea) by local boats. However, this medium usually attracts very high costs while communities along the coastline are easily linked by tarred road coming from Lekki in Lagos

Public buses, cars and motorcycles are the major means of transportation in the project area Figure 4.89 Public motor vehicles ply roads that link the project communities to major towns such as Ajah, Lekki and Epe etc while motorcycle transport is used for shorter shuttles between and within smaller towns in the project area. Motorcycles and bicycles are the most commonly owned means of transportation in the project area, while a small percentage own cars. Canoes (with or without outboard engines) are owned and used in communities fringing the Ebute Lekki and Ode Omi in Lekki lagoon as well as other notable creeks.

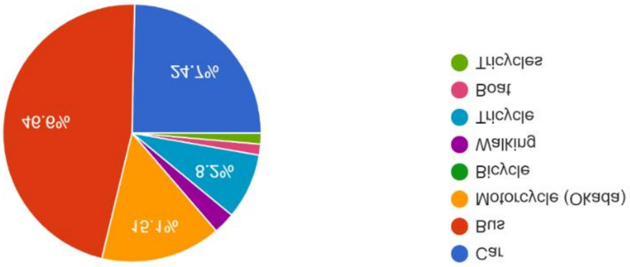


Figure 4.89: Means of transportation within the project area

Source: Field work, Natural Eco team 2024

Plate 4.33: Waterways transportation along the coastal communities

Source: Field work, Natural Eco team 2024

❖ **Health care**

There are twenty-five (25) Primary Health Care Centres in Ibeju Lekki LGA, the government owned facilities are not evenly distributed within the LGA, while private health care centers tend to concentrate in places where the rich and affluent live. Some communities have local drug stores for over the counter drugs.

There are Eleven (11) PHCs in the project area; findings from the field study indicate that many people rely on traditional medicine because their communities do not have any affordable clinic in their communities, while others still use traditional mean despite having the public clinics in their communities because of inadequate care which may be due to the shortage of modern medical facilities in the areas, although there is a General hospital in Akodo town with a more modern facility, medical cases that cannot be handled in the PHCs in Ibeju Lekki are referred there for attention.

Currently the greatest health threats in the communities are malaria, diarrhea, cough and catarrh, which have been attributed to unhygienic environment and dust impact because of the prevalence of unpaved roads where the people live as well as their closeness to the sea. These are diseases associated with contaminated drinking water. Malaria is rife in this area, with a high incidence noted among children and women. Table 4.47 shows the communities that have the primary health centers and General hospital. Plate 4.34 (a-f)show some of the Primary Health centers in some of the communities.

	
Idasho PHC (a)	**Akodo General Hospital (b)**
	
Idotun PHC (c)	**Iberekodo PHC (d)**
	
Igbo Olomi PHC (e)	**Okunraye PHC (f)**

Plate 4.34(a-f) show some of the Primary Health centers in some of the communities.

Table 4.47: List of communities with Government owned Hospitals

S/No	Communities	No of Govt Hospitals
1.	Okunraye	1
2.	Alasia	-

3.	Itoke	1
4.	Idotun	1
5.	Magbon Segun	1
6.	Oke iyanta	-
7.	Ilekuru	-
8.	Idasho	1
9.	Ilege	-
10.	Imobido	-
11.	Tiye	-
12.	Akodo	1
13.	Orofun	-
14.	Eleko	-
15.	Iberekodo	1
16.	Orimedun	1
17.	Magbon Ilado	-
18.	Magbon Oga	-
19.	Museyo	-
20.	Ogogoro	-
21.	Igbo olomi	1
22.	Idata	-
23.	Ilagbo	-
24.	Kajola	-
25.	Siriwon	-
26.	Ebute Lekki	-
27.	Ise	1
28.	Igbogun	1
29.	Abakeji	-
30.	Mafogunde	-
31.	Ode Omi	-

❖ Prevalence of Water Borne Diseases in the Communities

In all the communities the people agree that the common prevalent diseases are malaria, catarrh, cough, dysentery, diarrhea, gastroenteritis and body pains. The survey shows that the prevalent water borne diseases in the communities as reported by the respondents are diarrhea (34%), typhoid (38%) and abdominal pains (19.76%), As shown in Figure 4.117, blood in faeces mixed with mucus (15.5%), blood in urine (hematuria) 10.26%, and yellowness of the eyes (23.8%) are also common Members of the communities are health conscious as they readily seek medical attention from the health institutions available within and outside the communities when they fall sick.

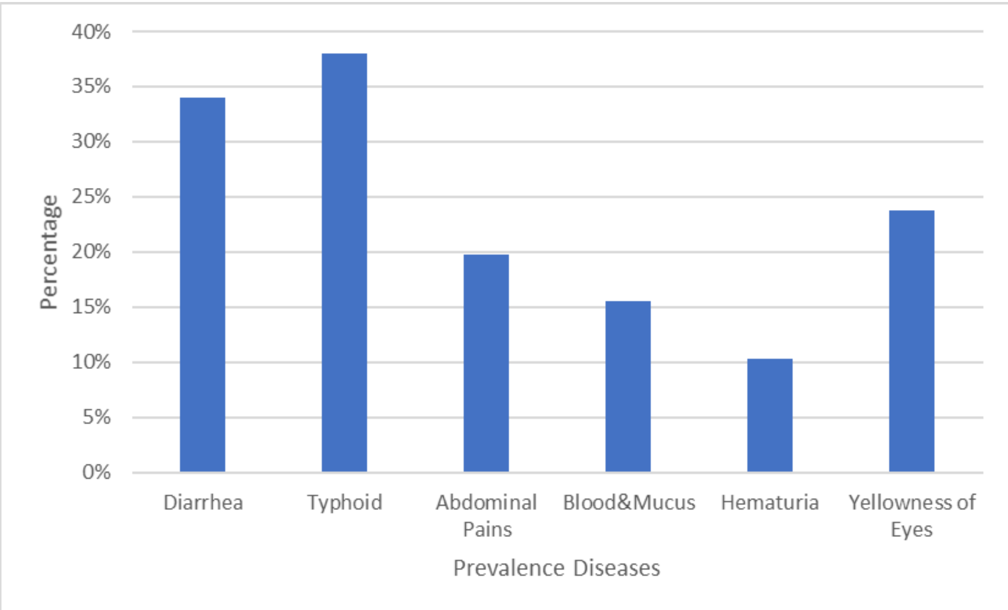


Figure 4.90: Prevalence Rates of Some Common Water-borne Diseases in the Communities.

Source: *Natural Eco Capital (2024)*

(a) Sexually Transmitted Diseases and HIV/AIDS and COVID 19

All respondents claimed that there were no prostitutes in the community but that a few people were said to go outside the community to patronize prostitutes. There were no cases of STD or HIV/AIDs recorded in the entire community but about 10% of the sampled elders claimed to have had gonorrhea infection when they were younger. The knowledge of HIV/AIDs in these communities is high. Majority of the people claimed to have heard about the ailment but nobody has it or knows anyone who died of it. The knowledge they have about it is basically based on several campaigns on it at a point. About 50% of the population affirms that they have gone for medical test and know their HIV/AIDs status while the rest says they do not need to go because they do not have it.

(b) Death Rates

There is also no data on the death rate but from answers to questionnaire, but people estimated that the rate is said to be moderately high with about 20-30 people dead yearly most of them (say about 15) are children. Death of people, particularly children, are said to be due to malaria fever and the fact that there is lack of good medical attention: Maternal mortality is said to be very low or very rare.

(c) Health-related Lifestyle

Alcohol intake: In the communities about 65% of the total population of adults which includes the youth take alcohol but the level of intake differs from one group to another. More intake are observed amongst the youth who asserts that they take 1-2 bottles of beer/alcohol at least thrice a week or more if activities or events permit. The women who take alcohol say that 1 bottle is enough for them and it is occasionally during celebrations that they take it. The aged men claim that if there are meetings and shrine visitations, alcohol must be consumed.

Smoking: Very few of the youth, approximately 10% of the youths in this community, involve in smoking. This could be interpreted as the youthful exhibitions. The aged men say they prefer snuff (a grounded substance made from tobacco which is inhaled through the nostrils).

Nutrition: The nutritional status of the respondents in the communities is closely tied to the food items they consume. The main staple food includes garri (processed cassava), yam, rice, plantain and banana. Fruits and vegetables, including cashew nuts, pineapple, orange and pawpaw are readily available. Fish, shrimps and snails also provide main source of protein for the affected coastal communities. Other sources of protein include local ducks and fowls, as well as hunted animals such as antelopes, grasscutters and giant rats.

Leisure: The inhabitants in the community have no recreational facilities or games to keep the body healthy but spend their time of leisure sitting together discussing current issues while drinking alcohol and smoking cigarettes. Some of the youths said that they sometimes play local football within the environment.

Life expectancy: Most respondents claimed that elderly people live up to 90 years and above. Most elderly people particularly the women look very physically fit as they still engage in farming activities and apart from the labour of farming and carrying of loads of farm products/firewood they still do a lot of laborious domestic work.

Knowledge about health and other health-related attitudes: Many of the stakeholders in the communities are aware of the nature and causes of common diseases they suffer from, but due to poverty indulge in self-medication. Pregnant women often rely on Traditional Birth Attendants (BTAs) for childbirth instead of hospitals. There is a general inadequate toilet facilities and sanitation is poor, and lack of proper personal hygiene exacerbates the health challenges of various communities. Many members of the various communities also demonstrate some knowledge about key environmental challenges that may have significant impact on their health. They include flooding and shoreline erosion that have reduced their biodiversity resources for herbal medicine significantly.

4.15.12 Social and Health Hazard Matrix

The matrix highlights various hazards, including malaria, cough/respiratory infections, air pollution, poor sanitation, and poor living conditions. Some hazards have a high rating, indicating their severity.

The social and health hazard matrix showing the severity of effects, hazard rating, capability of social and health protection agency and mitigation measure of each identified hazard is given in **Table 4.48.** It is clear from the table that a few hazards like contacting malaria disease, cough/respiratory infection, air pollution, poor sanitation and poor living conditions have high rating while the rest are moderate or low in rating.

Also, it is very clear that all community members are at risk and capability of mitigation against the health and socio-economic hazards in the area is poor. It could therefore be recommended that good social and health facilities be provided and monitoring programmes be put in place in the community. All community members are at risk, and the capability for mitigation against health and socio-economic hazards is poor. Recommendations include providing good social and health facilities and implementing monitoring programs.

1. ***Prevalent Diseases****:*

Typical tropical diseases endemic in local communities include malaria, dysentery/diarrhea, rheumatic/body pains, cough, skin rashes, and sores/wounds. Malaria fever remains a significant health hazard due to the presence of the Anopheles mosquito, which breeds year-round. Poor environmental sanitation contributes to the prevalence of dysentery/diarrhea and stomach ache. Intestinal worm infestations may also be linked to poor sanitation and living conditions.

2. ***Socio-Economic Studies and Infrastructure****:*

The communities along the alignment at both highly developed such as in Chainage 0-24km and then semi urban-rural in chainage 24-47.5km lacking in some basic infrastructure for an improved modern way of life. Proper mitigation measures during the project are crucial for enhancing people’s lives and development. Strict adherence to understanding with the communities and memoranda of understanding (MOUs) and continuous education and consultation with the community are essential. Addressing other infrastructure gaps, implementing mitigation measures, and promoting health awareness are critical for the well-being of the community.

Table 4.48 Some Baseline Social and Health Hazards Matrix of the Communities/LGA

Social and Health hazard	**Environmental Factors and Causes**	**Severity of Effect**	**Communities Vulnerability and population risk**	**Capability of health/social protective agencies in the community**	**Control and Management**
Environmental and Socials 1. Poor sanitation	Improper waste disposal	Low	All	Poor	Introduction of modern methods of waste disposal Enlightenment campaign.
2. Air pollution	Poor Sanitation and possible emissions from the tanks.	Low	Low	Low	Termination of gas flaring Improved environmental Sanitation
3. Poor water	Ring wells and river water	Low	All	Nil	Maintenance & establishment of bore holes.
4. Accidents	Disregard to Traffic regulations	Low	All	Nil	Enlightenment campaign.
5. Noise	Traffic, Commercial and flow station activities	Low	All	Nil	Enlightenment campaign.
6.Occupational hazards	Laborious jobs.	High	A101bout 70%	Nil	Provision of jobs Prompt treatment of cases.

7. Life style habits	Drinking smoking, etc.	Moderate	About 60- 80%	Nil	Enlightenment campaign
8. Nutritional status	Poor economy	Low	Nil	Nil	Health education campaign Economic empowerment
9.Poor living conditions	Enhance. Poor economy	Moderate	About 80%	Nil	Economic empowerment
Health 1.Malaria	Abundance of the mosquitoes vector	High	All	Poor	Use of repellants nets and insecticides Treating of infected people control of the mosquito Vector insecticide
2.Cough and respiratory diseases	Poor sanitation & poor source of water.	High	All	Poor	Reduction on removal of gas flaring Treatment of infected persons
3.Measles/ contagious disease	Poor sanitation & poor source of water	Low	Nil	Good	Treatment of infected cases Immunization of inhabitants Improved environmental sanitation
4. Diarrhea /Dysentery	Poor sanitation & poor source of water	Low	All	Poor	Improved sanitation. Treatment of infected persons.

5. Skin rashes	Poor sanitation & poor source of water.	Low	Low; All communities	Average	Improved environmental sanitation Treatment of infected cases
6. Sore/wound	Enhance. Due to manual labour.	Moderate	Low; The labourers	Poor	Introduction of modern equipment Improve economy Improved medical care.
7.STDs	Prostitution & migration	Very low	About 70%	Poor	Treatment of infected cases Health and moral education Enlightenment campaign

Source: *Natural Eco Capital Fieldwork, 2024*

4.15.13 Cultural Resources

Most of the communities are riverine communities and celebrate many traditional festivals associated with fishing and farming. Findings from the field observed that they had articles of sacrifice in strategic locations in the community, they also had shrines which were not only visited by its worshippers but also revered to by other religious worshippers. (plate 4.35.)

Plate 4.35: Some shrines in the affected communities

They had their festivals which is well celebrated to the extent that friends, families from outside the communities grace their presence with it. The occasion is significant for them as they noted that it had not only traditional and spiritual importance but also socio-economic importance. Because of the perceived significance of these festivals some of which are to appease the deities, some of the communities reportedly spent as much as 10 million Naira to prepare for just one of the festivals. Some of festivals are as follows:

Oluweri, Obaluwaye, Egungun, Odun-moko, Esu, Sango, Etutu Ilu, Odun-ota, Odun-Ikele, Ogun, Aaye, Odun-Eriyo, Oro, Eid-El Fitri (Itunu Aawe) and Eid-El Kabir (Odun-Ileya)

Sacred places exist in these communities. Some of these are documented in Table 4... Most of these places could only be accessed at designated time of the year and by selected group of people especially the initiates. Some of the elders complained of not been granted access into some of the shrines which could not be evacuated for relocation from the LFZ.

Table 4.49 Sacred Places/Shrines, Taboos and Festivals in Project Area

S/NO	Community	Festival	Taboo
1	Okunraye	Kilajolu, Esu, Olueri, Oja, Ogun, Sango, Odu, Oro, Onilu, Eid il Kabir, Eid il Fitri	1. No fetching of well water at night. 2.No female must see the Oro
2	Alasia	Eid il Kabir, Eid il Fitri, Ayelala, Ogun,Obatala, Oro	No female must see the Oro
3	Itoke	Oluweri, Okesa	
4	Magbon Segun	Ileya, Malara, Esu	1.No one must throw a fetcher into a well
5	Oke Iyanta	Malara, Ayeyo,Esu, Ogun	1. No fetching of well water at night.
6	Ilekuru	Ileya, Malara, Esu, Eid il Kabir, Eid il Fitri	1.No woman must cut firewood at night
7	Idasho	Eid il Kabir, Eid il Fitri, Oro, Ogun, Esu	1.No whistling 2. No stranger must come out during oro
8	Imobido	Eid il Kabir, Eid il Fitri, Oluweri, Christmas	

Source: Field work Natural Eco Team,2024

Archaeological Resources

Review of available studies has shown no evidence of archaeological resources in the area of influence.

Consultations

The consultation team met with various communities located within the area of influence to discuss the proposed Project and to receive their input and concerns in this regard. A community-wide interactive meeting involving the leadership of the surveyed communities (i.e. community head, spokesman for elders, his deputy, chief priest, and women leaders, CDC chairman, youth chairman, women leaders and several members of the community.

Information on settlement/communities' history, structure, population and demography, culture, political economy, traditional and modern authority structures, landownership, farming and fishing rights, availability and status of infrastructures, issues of potential conflicts and resolution, the concerns, and expectations of the population as well as perceptions of impacts of the proposed road project (both construction and operation) were solicited from those interacted with.

The administration of structured questionnaire as a survey instrument and primary data collection method was employed to incorporate socioeconomic and environmental issues The simple random technique was used in selecting respondents from the surveyed communities both at the community gathering (meetings) and across a cross section of respondents on the streets/compounds with the adult population as the target. Hard and soft copies of the questionnaire were administered face-to-face to respondents with the assistance of field/technical assistants who were knowledgeable about survey techniques. Community members that were found literate were also allowed to self-administer/respond to the questionnaire after clarifications on how to do so by the SIA Consultant. In all, one hundred and seventy (170) copies of the structured questionnaire were administered randomly to different class or/groups namely the elders, women, youth and community development groups across the surveyed communities. The response rate amounted to approximately 92.9%.

4.16 Stakeholders' Awareness about the Impact of Proposed Project Activities

All the respondents interviewed all agreed that the project is desirable while about 85% were aware about the Coastal road project indicating widespread stakeholder awareness but at different degrees of awareness; about 13.29% of the respondents claim that they were extremely informed while 34.18% were somewhat informed and 31% of the respondents were moderately informed. Almost all of the respondents (98.1%) believe that the project will have a positive impact on the local economy, Figure 4.91 Shows the degree of expectations that the respondents expect economic benefits by increasing trade and business opportunities. Almost all respondents have concerns about potential environmental impacts concerning habitat loss at varying degrees of concerns as depicted in figure b) while figure c) shows the extent of concerns they have about potential disruptions to marine ecosystem being fishing communities and are hopeful that effective mitigation measures will be put in place also 70% of respondents claim they have economic trees along the corridors that will be impacted by the project and all agree that by cutting them down they would be affected economically. Additionally, only 38% believe the project will contribute to environmental sustainability; Almost all the respondents agree that improved road connectivity to enhance access to essential services for the communities only a small fraction (1.26%) of the respondents feel otherwise. Finally, all respondents agree that the project will impact positively on their local businesses while 20% of respondents foresee job creation during the project's construction and maintenance phases.

Many respondents believe the project will affect their assets like houses, lands, businesses etc; the value of properties would increase in their communities and bring about increase in social interactions in the communities. Only 20% of the respondents were extremely concerned about their property disruptions due to the project and were ready to evacuate their asset provided adequate notice and compensations are given by the government.

Not all the respondents agree to the use of Toll gate along the coastal road (22.78%). About 44.9% agree that it is a fair way to fund the road construction while 475% are neutral about the use of the toll gate.

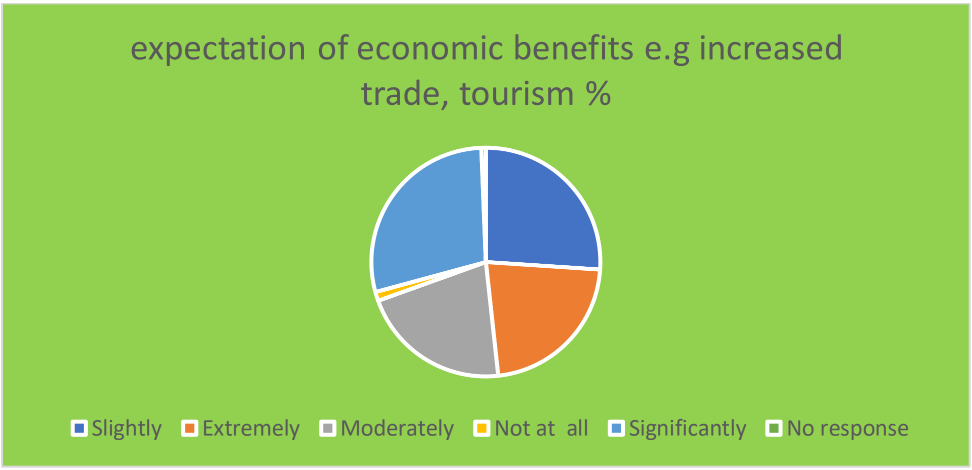
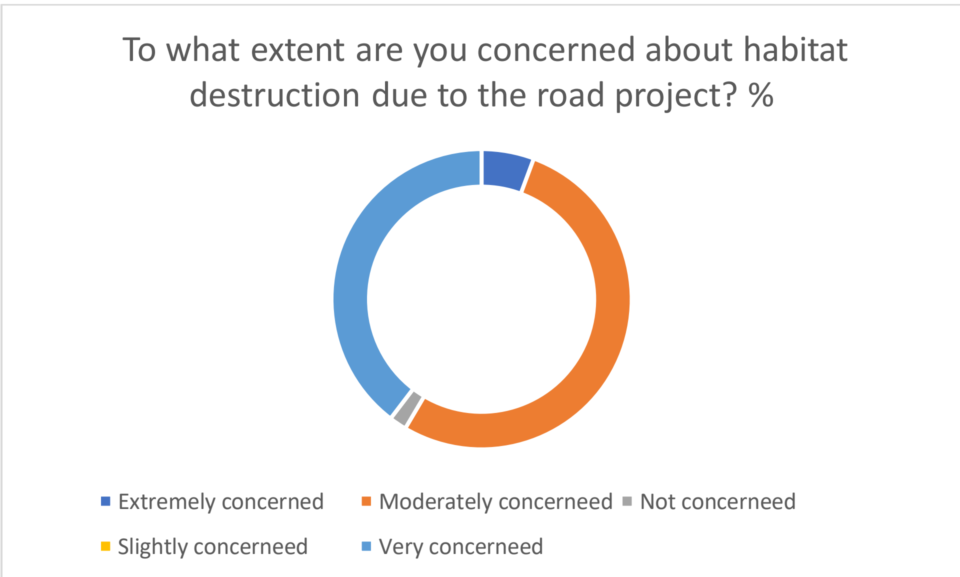
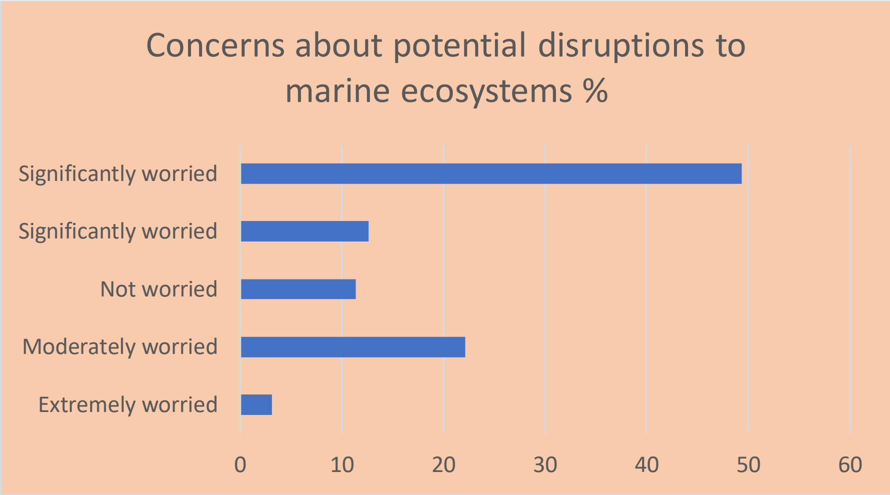


Figure 4.91(a-c)Degree of expectations of economic benefits



b) Degree of concerns for habitat loss



c): Potential disruption to marine ecosystem

The concerns of the various communities consulted bordered on the same issues. These have been summarized as follows:

a. Enumeration, Compensation and Property Realignment

The stakeholders' feedback centered on enumeration, compensation, and property realignment. Here are the key comments raised:

- **Realigning to Avoid Affected Assets:** Stakeholders expressed the need for careful realignment to minimise the impact on affected properties.
- **Actual Width of Acquisition Zone:** Concerns about the discrepancy between the initially communicated meter width and the observed reality were raised.
- **Request for Additional Time to Relocate:** Stakeholders requested more time to relocate from affected properties.
- **Properties on the Right-Hand Side Outbound:** The fate of properties on the right-hand side of the corridor remains a valid concern.

b. ***Environment and Social***

The stakeholders' feedback centered on cultural Heritage, financial empowerment and property realignment. Here are the key comments raised:

- **Cultural Heritage**: Deities that the community worships should not be wiped out but appeased to avoid fatal consequences after highway construction. The Cultural Heritage should not be overlooked. They want to be given time and place to relocate the deities.
- **Financial empowerment to boost fishing business**; Fishing is the major primary means of livelihood in these communities. Fishermen from the project affected communities claim that the activities of industries in and around their communities have negatively impacted on the sea and lagoon causing the fishes to migrate
- further into the dangerous zone of the sea for fishing and therefore need a more specialized equipment for fishing such as fishing trowel
- **Compensation of other nearby communities and not just the host communities:** The effects of environmental pollution affect both close and far communities, and thus, impacted communities should be compensated accordingly.
- **Deployment of Tolls gate to recover funds spent on project:-**no narration: more than 90% of the residents did not perceive the introduction of polls on the road as a good for economic resons. They claim that they would be more affected ass residents who are daily commuters.
- **Dust/Emission issues**: emissions into the air and noise from truck movements and vibrations due to the ongoing construction are affecting the community people, especially around Eleko.
- **Flood issues**: The height of the road is higher than the level of the community nearby, making it vulnerable to erosion/flooding during the rainy season.
- **Safety issue in relation to transport:** Truck drivers should be warned to stop over speeding to avoid causing accidents, and the contractor should attend to community members with respect whenever a complaint is made to them.
- **Bus stops restoration:** Restoration of bus stops to their original places at the entrance of each community as the disruption of the former makes careless truck drivers and commercial drivers to park carelessly; there have been reported cases of accidents even death of school children.
- **Community entrance accessibility:** There are concerns that the access roads to the communities from the highway should be repaired and upgraded for entrance into the communities by vehicles.
- **Habitat loss**: The economic trees along the corridors that would be affected should be compensated for. Some require compensation in cash others require portIons of land for the trees to be replanted.

- **An alternative road** should be made for truck movements as the road is damaged and must be fixed to avoid accident
- **Employment:** To facilitate the maximum cooperation of the communities in the execution of the project, stakeholders consulted indicate the need for the project to consider making employment opportunities available to the affected communities for improved living conditions.

Photographs taken during socio- economic and community consultations are also shown in **Plates 4.36**

1. **OKUNRAYE COMMUNITY, LEKKI LCDA, LAGOS STATE.**

2. **ALASIA COMMUNITY, LEKKI LCDA, LAGOS STATE.**

3. IDOTUN COMMUNITY, LEKKI LCDA, LAGOS STATE.

4. ITOKE COMMUNITY, LEKKI LCDA, LAGOS STATE.

5. MAGBON ISEGUN COMMUNITY, LEKKI LCDA, LAGOS STATE.

6. OKEYANTA COMMUNITY, LEKKI LCDA, LAGOS STATE.




7. ILEKURU COMMUNITY, LEKKI LCDA, LAGOS STATE.


8. IDASHO COMMUNITY, LEKKI LCDA, LAGOS STATE.

9. IMOBIDO COMMUNITY, LEKKI LCDA, LAGOS STATE.

10. TIYE COMMUNITY, LEKKI LCDA, LAGOS STATE.

11. AKODO COMMUNITY, LEKKI LCDA, LAGOS STATE.

12. ISE KINGDOM, LEKKI LCDA, LAGOS STATE.

AKODO MARKET, LEKKI LCDA, LAGOS STATE.

14. OROFUN COMMUNITY, LEKKI LCDA, LAGOS STATE.

15. ELEKO COMMUNITY, IBEJU-LEKKI LG, LAGOS STATE.

16. IBEREKODO COMMUNITY, LEKKI LCDA, LAGOS STATE.

17. MAGBON ALADE COMMUNITY, IBEJU-LEKKI LG, LAGOS STATE.

18. MAGBON ILADO COMMUNITY, IBEJU-LEKKI LG, LAGOS STATE.

19. LAGOS STATE BLOCK & CONCRETE MAKERS ASSOCIATION, LEKKI LCDA, ZONE 4 CHAPTER.

20. MEETING WITH IBEJU-LEKKI LOCAL GOVERNMENT, LAGOS STATE.

21. MEETING WITH LEKKI LCDA, LAGOS STATE.

4.16.1 Conflict Resolution Management

Conflicts and contentious issues are resolved in the area by collaboration among the various organs. In the event that a community member is in error of the law, the issue is handled first by dialogue at the family level, if it is not within the means of family to get involved for a resolve, the elders in the community like the chiefs, youth or women leader might summon meetings in that regard and if no solution is in sight; the conflict terminates at the feet of the community head (Baale) or King,(Oba) depending upon the nature and gravity of the offence. The deviant is punished according to the gravity of the offence; smaller crimes could lead to monetary fines, while more serious ones could involve meting out serious punishment, including being given up to the police.

Conflicts is not common between the communities in the Ibeju Lekki local government area as a whole but from time to time there might arise issues within community members. In addition, appeals and summons are common processes utilized at community level. Issues are referred to the police and courts, when they are criminal offences that are mandatory to be reported and when the resolution of the conflict overwhelms community leadership.

4.17 Traffic Impact Assessment

A Traffic Impact Assessment (TIA) is required for developments, which are of a size or type that would generate significant additional traffic and have an impact on the adjacent road network. The TIA would determine whether the development necessitates changes to the existing or planned road infrastructure or public transportation services.

A TIA is an important tool or study that identifies the need for any improvements to a transportation system to reduce congestion, improve safety, provide adequate access, and mitigate the impact associated with the project. Basically, it is needed to forecast the traffic impact of a road network upon the completion of a new development. Subsequently, TIA suggests improvement alternatives based on the forecast. It assists developers and local authorities in decision making. It is a powerful tool for engineers and planners to determine the possible effects of any project on the transportation and traffic system. TIA is applied only to the areas that have a direct impact on the development. It also acts as the countermeasures for potential negative impacts and responsible in predicting or addressing the potential transportation and traffic problems that will occur from the development. Adding to that, TIA is needed to forecast the traffic that helps to estimate whether the project brings positive or negative impacts on its surrounding area’s land use and transportation system. Other scholar agreed that TIA is to assess the impact that a new development will have on all aspects of the transport network. TIA is able to determine the impact of a project or development on the transportation and traffic system .In addition, the roles of TIA are also to estimate the mean trip rates per gross floor area, test and validate the adoption of mean trip rates, quantify the impact in terms of level of service (LOS) on the neighbouring road network, and propose appropriate transport improvement measures for the existing road network. The vital things required to assess the traffic impact are the data of traffic volume, speed, and density to determine the LOS. Analysis of trip generation is also important to find the number of trips which is basically calculated using a formula. Thus, TIA's definition can be concluded as to forecast the impact of a development on traffic condition and transportation network or in simple words, a projection of the future traffic impact due to a new development.

1. Existing Traffic conditions: This scenario analyses the existing traffic conditions (2024) on the road network surrounding the corridor. It includes the traffic generated by the main corridor and others connected to it.

2. Horizon Year Traffic conditions: The horizon year is the future year which includes background traffic growth plus the proposed expansion traffic. This will be for the 5-year horizon - Year 2029.

4.17.1 Traffic Counts

The existing traffic volumes on the surrounding road network along the primary haul route were obtained from classified traffic counts undertaken for a period of 7 days.

The traffic counts were undertaken from 06:00 to 18:00. Traffic conditions during the traffic counts were analyzed.

The Traffic Impact Assessment on the Lagos -Calabar Coastal Highway is almost at the conclusion phase. Two weeks ago, our team carried out traffic counts along some adjoining corridors. These were Dangote Road, from Eleko junction which is on Lekki expressway. Three major screen lines were identified for traffic count. They are screen line 1, located at Paradiso hotel on Dangote road before the refinery. The second screen line was located at Nasco hotel after La Campyne Tropicana and the third screen line was located at the junction leading to Ise Town and Igbogun town as well. This third screen line is the only point that aligns with the coastal highway.

The three screen lines mentioned above were manned by field assistants who were trained to capture traffic volume from 6am-6pm daily for 7days.At the moment the figures collected are being analyzed and a daily average is obtained. It is with these figures that the projections are going to be made. The popular movements towards Igbogun are mainly by motor bikes. The trucks recorded at the third screen line are mainly construction workers vehicles.

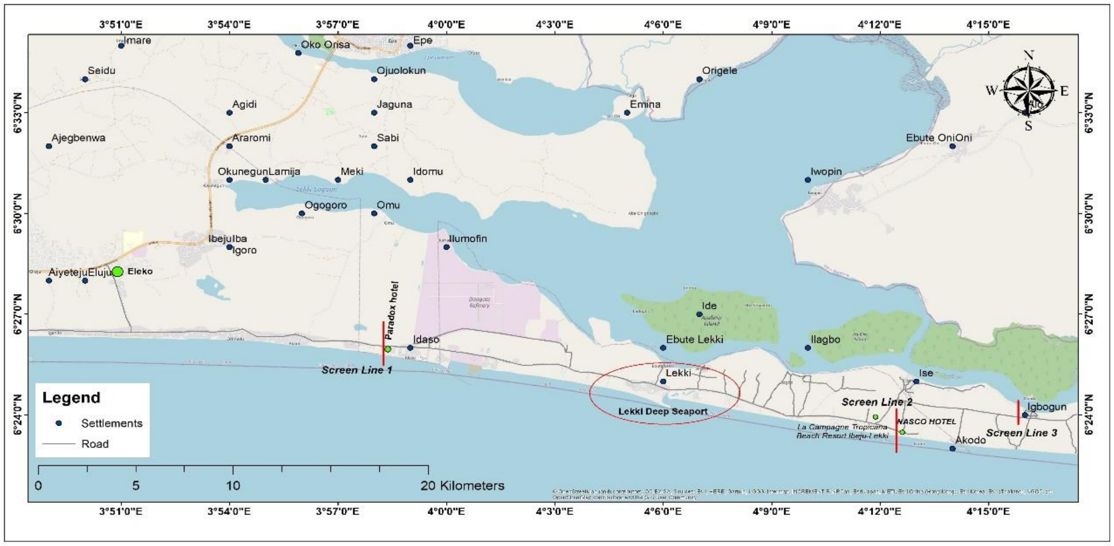


Figure 4.92:The figure above shows the screen lines which are Paradiso screen line 1, Nasco hotel close to la campyne Tropicana and the junction between Ise Town and Igbogun after Folu town.

Table 4.50 Eleko Junction

TRAFFIC COUNT OF VEHICULAR MODES							
Location: ELEKO	**Direction: TO LEKKI/AJAH**						
Type of Vehicle: MINI, MIDI AND PRIVATE BUSES							
Time	**WEDNESDAY, 13TH JULY**	**THURSDAY, 14TH JULY**	**FRIDAY, 15TH JULY**	**SATURDAY, 16TH JULY**	**SUNDAY, 17TH JULY**	**MONDAY, 18TH JULY**	**TUESDAY, 19TH JULY**
6:00-7:00am	92	60	70	44	20	91	69
7:00-8:00am	83	44	73	50	26	89	76
8:00-9:00am	52	73	55	61	33	75	58
9:00-10:00am	56	42	56	56	30	73	51
10:00-11:00am	64	39	45	39	31	69	63
11:00am-12:00Noon	90	33	41	38	36	88	84
12:00-1:00pm	45	38	44	46	27	69	80
1:00-2:00pm	50	33	48	48	21	53	74
2:00-3:00pm	55	41	38	61	14	62	61
3:00-4:00pm	37	70	53	55	32	54	54
4:00-5:00pm	37	50	36	42	22	56	58
5:00-6:00pm	29	46	69	39	39	41	46
6:00-7:00pm	26	44	32	37	31	47	32
7:00-8:00pm	37	36	31	39	25	38	24
TOTAL	**753**	**649**	**691**	**655**	**387**	**905**	**830**

The Table 4.50 above shows the traffic volume at Eleko junction. This count was carried out in 2022 and the vehicular traffic on this table1 are the Mini buses, the Midi and private buses.

Table 4.51. Different vehicular Traffic at Eleko junction along Lekki Ajah expressway

TRAFFIC COUNT OF VEHICULAR MODES							
Location: ELEKO Direction: TO LEKKI/AJAH							
Type of Vehicle: CARS / JEEPS / SUV / TAXI							
Time	**WEDNESDAY, 13TH JULY**	**THURSDAY, 14TH JULY**	**FRIDAY, 15TH JULY**	**SATURDAY, 16TH JULY**	**SUNDAY, 17TH JULY**	**MONDAY, 18TH JULY**	**TUESDAY, 19TH JULY**
6:00-7:00am	236	211	227	223	207	201	177
7:00-8:00am	227	206	184	196	139	245	195
8:00-9:00am	201	186	178	185	150	289	247
9:00-10:00am	198	178	184	194	137	275	249
10:00-11:00am	136	176	185	201	131	299	253
11:00am-12:00Noon	178	165	154	225	159	301	264
12:00-1:00pm	172	188	161	209	134	325	366
1:00-2:00pm	164	189	132	231	139	331	271
2:00-3:00pm	146	176	152	222	159	345	275
3:00-4:00pm	166	165	136	198	149	292	244
4:00-5:00pm	172	158	148	199	156	284	213
5:00-6:00pm	152	155	136	201	136	244	198
6:00-7:00pm	145	180	118	206	131	214	195
7:00-8:00pm	130	162	122	175	129	198	188
TOTAL	**2423**	**2495**	**2217**	**2865**	**2056**	**3843**	**3335**

Different streams of traffic were captured in Table 4.51 which depicts a high volume of vehicular traffic on Epe lekki corridor. It is expected that the volume of traffic will likely reduce on this corridor when the coastal highway is opened to traffic.

Table 4.52. Traffic Count along the Dangote Road

TRAFFIC COUNT OF VEHICULAR MODES							
Location: PARADOX HOTEL Direction: TOWARDS ELEKO							
Type of Vehicle: CARS							
Time	**SUNDAY, 21ST JULY**	**MONDAY, 22ND JULY**	**TUESDAY, 23RD JULY**	**WEDNESDAY, 24TH JULY**	**THURSDAY, 25TH JULY**	**FRIDAY, 26TH JULY**	**SATURDAY, 27TH JULY**
6:00-7:00am	47	54	44	42	33	44	61
7:00-8:00am	49	48	42	51	42	46	55
8:00-9:00am	72	73	65	70	61	51	66
9:00-10:00am	75	85	95	81	67	65	70
10:00-11:00am	80	125	102	88	69	81	88
11:00am-12:00Noon	44	126	115	101	82	89	84
12:00-1:00pm	55	50	99	62	55	42	81
1:00-2:00pm	66	46	52	60	51	36	87
2:00-3:00pm	48	36	50	51	42	30	70
3:00-4:00pm	80	80	88	81	60	74	73
4:00-5:00pm	52	105	91	101	78	116	77
5:00-6:00pm	59	92	101	105	99	121	81
TOTAL	**727**	**920**	**944**	**893**	**739**	**795**	**893**
AVERAGE	60.58	76.67	78.67	74.42	61.58	66.25	74.42

The Table 4.52 above shows the total number of cars that were captured along the Dangote road. The screen line was at the paradiso hotel before the tank farm which is close to the refinery.

Table 4.53 Traffic Count showing cars moving on the opposite direction .along Dangote Road.

TRAFFIC COUNT OF VEHICULAR MODES							
Location: PARADOX HOTEL Direction: TOWARDS ELEKO							
Type of Vehicle: CARS							
Time	**SUNDAY, 21ST JULY**	**MONDAY, 22ND JULY**	**TUESDAY, 23RD JULY**	**WEDNESDAY, 24TH JULY**	**THURSDAY, 25TH JULY**	**FRIDAY, 26TH JULY**	**SATURDAY, 27TH JULY**
6:00-7:00am	47	54	44	42	33	44	61
7:00-8:00am	49	48	42	51	42	46	55
8:00-9:00am	72	73	65	70	61	51	66
9:00-10:00am	75	85	95	81	67	65	70
10:00-11:00am	80	125	102	88	69	81	88
11:00am-12:00Noon	44	126	115	101	82	89	84
12:00-1:00pm	55	50	99	62	55	42	81
1:00-2:00pm	66	46	52	60	51	36	87
2:00-3:00pm	48	36	50	51	42	30	70
3:00-4:00pm	80	80	88	81	60	74	73
4:00-5:00pm	52	105	91	101	78	116	77
5:00-6:00pm	59	92	101	105	99	121	81
TOTAL	**727**	**920**	**944**	**893**	**739**	**795**	**893**
AVERAGE	60.58	76.67	78.67	74.42	61.58	66.25	74.42

Table 4.53 above shows the volume of cars moving on the opposite direction of Dangote road in Lekki free trade zone.

Table 4.54. Number of Trucks on Dangote Road moving towards Eleko junction

TRAFFIC COUNT OF VEHICULAR MODES							
Location: PARADOX HOTEL Direction: TOWARDS ELEKO							
Type of Vehicle: TRUCKS							
Time	**SUNDAY, 21ST JULY**	**MONDAY, 22ND JULY**	**TUESDAY, 23RD JULY**	**WEDNESDAY, 24TH JULY**	**THURSDAY, 25TH JULY**	**FRIDAY, 26TH JULY**	**SATURDAY, 27TH JULY**
6:00-7:00am	9	8	5	5	8	9	7
7:00-8:00am	14	13	11	7	7	11	10
8:00-9:00am	11	4	6	8	6	6	9
9:00-10:00am	11	10	7	11	8	6	10
10:00-11:00am	15	15	10	10	7	11	12
11:00am-12:00Noon	10	18	12	12	8	10	12
12:00-1:00pm	7	15	15	10	11	9	16
1:00-2:00pm	6	15	15	8	8	8	19
2:00-3:00pm	3	15	13	12	10	12	17
3:00-4:00pm	9	19	10	13	14	14	12
4:00-5:00pm	2	10	19	10	11	10	14
5:00-6:00pm	8	15	17	11	15	14	16
TOTAL	**105**	**157**	**140**	**117**	**113**	**120**	**154**
AVERAGE	8.75	13.08	11.67	9.75	9.42	10.00	12.83

Table 4.55 shows the volume of Trucks moving towards the Refinery

TRAFFIC COUNT OF VEHICULAR MODES							
Location: PARADOX HOTEL Direction: TOWARDS DANGOTE REFINERY							
Type of Vehicle: TRUCKS							
Time	**SUNDAY, 21ST JULY**	**MONDAY, 22ND JULY**	**TUESDAY, 23RD JULY**	**WEDNESDAY, 24TH JULY**	**THURSDAY, 25TH JULY**	**FRIDAY, 26TH JULY**	**SATURDAY, 27TH JULY**
6:00-7:00am	25	11	11	9	15	8	10
7:00-8:00am	32	8	12	12	10	16	12
8:00-9:00am	30	16	14	11	11	12	11
9:00-10:00am	28	10	12	14	15	18	10
10:00-11:00am	38	19	19	12	15	20	14
11:00am-12:00Noon	14	28	16	15	16	12	8
12:00-1:00pm	17	7	8	13	13	7	7
1:00-2:00pm	22	15	3	10	12	6	8
2:00-3:00pm	25	10	8	9	10	4	9
3:00-4:00pm	11	18	12	12	11	9	11
4:00-5:00pm	23	12	6	10	10	17	13
5:00-6:00pm	16	8	3	14	12	17	17
TOTAL	**281**	**162**	**124**	**141**	**150**	**146**	**130**
AVERAGE	23.42	13.50	10.33	11.75	12.50	12.17	10.83

Table 4.56

TRAFFIC COUNT OF VEHICULAR MODES							
Location: IGBOGUN / ISE JUNCTION Direction: TOWARDS IGBOGUN							
Type of Vehicle: CARS							
Time	**SUNDAY, 21ST JULY**	**MONDAY, 22ND JULY**	**TUESDAY, 23RD JULY**	**WEDNESDAY, 24TH JULY**	**THURSDAY, 25TH JULY**	**FRIDAY, 26TH JULY**	**SATURDAY, 27TH JULY**
6:00-7:00am	0	5	5	7	6	0	3
7:00-8:00am	2	12	3	6	7	4	1
8:00-9:00am	5	5	4	3	6	8	1
9:00-10:00am	0	15	4	4	6	9	3
10:00-11:00am	2	16	3	6	5	10	1
11:00am-12:00Noon	3	12	4	2	7	13	6
12:00-1:00pm	0	9	6	3	6	15	7
1:00-2:00pm	2	13	14	8	10	10	2
2:00-3:00pm	4	17	16	12	14	9	8
3:00-4:00pm	3	16	14	10	11	12	6
4:00-5:00pm	5	13	12	8	10	8	2
5:00-6:00pm	3	14	12	10	5	5	7
TOTAL	**29**	**147**	**97**	**79**	**93**	**103**	**47**
AVERAGE	2.42	12.25	8.08	6.58	7.75	8.58	3.92

Table 4.56 shows the traffic volume of cars along the junction of Ise town and Igbogun which flows from Folu or toward Folu. The importance of this junction is that this is the only point so far where the coastal road aligns with an existing traffic flow. All the others are currently running parallel to the coastal highway. When eventually the coastal road starts moving traffic from Victoria Island along the Ahmmadu Bello way, the traffic at this point will change drastically. This junction has to attract a fly over in the future in order to avoid accidents. The underlying objective

of intersection analysis is to quantify the performance of an intersection with regard to specified traffic volumes and environmental conditions. This traffic operational performance can be measured in terms of 'Level of Service' (LOS). Six levels of service exist, ranging from A to F.

LOS A represents the best operating conditions (free-flow conditions and no delay or congestion) whereas **LOS F** represents the worst, (breakdown conditions with congestion and very high delays).

LOS D is deemed the minimum acceptable level of service.

The legend hereafter is used to depict the LOS of each movement at the intersections.

LOS A: No delay or congestion

LOS B: Negligible delay or congestion

LOS C: Low delay or congestion

LOS D: Some delay or congestion

LOS E: Moderate delay or congestion

LOS F: Congestion and very high delays

The Junction Turning Counts (JTCs)

The Junction Turning Counts (JTCs) are 24-hour counts broken down into 1 hour -segments over a full day. All main junctions along the Proposed Scheme have been included and provide information on the volume, and types of vehicles, making turning movements at each location. This data is utilized within the models to ensure that the flow of vehicles through the main junctions on the network is being represented accurately.

The ATC data provides information on:

• The daily and weekly profile of traffic within the study area of the Proposed Scheme;

• Busiest time periods and locations of highest traffic demand on the network;

CHAPTER FIVE
ASSOCIATED AND POTENTIAL ENVIRONMENTAL IMPACTS

5.0 Introduction

The chapter details the identification and evaluation of environmental and social risks and impacts of the project. In this Chapter, the ESIA identified, described, and evaluated the potential environmental and social impacts of the proposed project. The ESIA assessed the significance of these impacts to inform decision-making and risk management. It also serves as the basis for optimisation of resources wherever possible as part of the planning and design process to maximize its benefits.

5.1 Scope of Assessment

a. Scope of Assessment- Project Phases

The assessment covers the potential and negative impacts during **Pre-Construction, Construction, Operation and Decommissioning** phases (Figure 5.1). It should be noted that after the sequence of activities of the construction, there will be the handing over of the completed project to FMW, which will be in charge of the operational phase of the project. *The contractor may not be part of the operational phase of the project.*

Regarding the decommissioning of the infrastructure, there is no information available at this stage. Decommissioning of the road project itself will take more than 50 years, which is the designed lifespan. Hence, it is not possible at this stage to precisely determine the nature and extent of the impacts of the project's decommissioning phase. The FMW will have to develop a decommissioning assessment a few years before decommissioning to formulate a complete Decommissioning Plan that is tailored to the context. Thus the decommissioning here focused on the readily foreseeable aspects which the evacuation of equipment and materials and clean up after the construction phase.

Thus, the impact assessment investigated each phase of the proposed project phase as outlined in Figure 5.1 to ensure that all potential impacts are taken into account.

Figure 5.1: Phases of the Proposed Project to Assess Impacts

b. Scope of Assessment - 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, CO_2, H_2S, NOX, NO_2, SOX,
3.	Noise & Vibration	On-site & off-site disturbance, noise related health problems, communication interference.
	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	Coastal Processes,	Shoreline, hydrodynamics, 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

5.1.1 Impact Assessment Methodology

a. Elements of Impact Assessment. The impact assessment is a dynamic process that involves collaboration, data collection, and continuous refinement. The key elements of impact assessment adopted include the following:

1. Identification and Description:
    - This involves understanding the project's context, activities, and how they interact with the environment and society.
2. Prediction of Probability:
    - This included assessing the likelihood of each impact occurring by predicting probabilities, and then prioritizing the risks.
3. Assessment of Significance:
    - The significance of impacts was evaluated based on several factors:
        - Severity: How severe is the impact? Minor, moderate, or severe?
        - Duration: Consider whether the impact is short-term or long-lasting.
        - Spatial Extent: Does it affect a small area or a larger region?
        - Positive and Negative Effects: Both need consideration.
    - Significance informs decision-making and risk management.
4. Attention to ESMS Standards:
    - The Environmental and Social Management System (ESMS) standards played a crucial role which enable focusing on impacts that are relevant such as in connection with soil erosion, livelihoods, cultural heritage, and biodiversity.
    - Compliance with these standards ensures responsible project development.

5. Other Social Impacts:
    - Beyond ESMS standards, also considered are social impacts which may affect women, vulnerable groups, or result from inadequate climate change considerations. This ensures social equity and inclusivity.
6. Iterative Process:
    - The ESIA is not static and so as more detailed information becomes available, new significant issues may emerge. Hence flexibility allows for better-informed decisions.

b. Dimension of Impacts. Balancing the assessment of direct, indirect, and cumulative impacts was seen to be essential for robust environmental and social risk management. Integrating all following dimensions was considered good for making informed decisions that balance short-term needs with long-term sustainability. Through indirect and cumulative effects, we can make informed decisions for sustainable development.

1. Direct Impacts:
    - These are immediate effects resulting directly from project activities.
    - Examples include air emissions from factories, habitat destruction during construction, or noise pollution.
    - Addressing direct impacts involves implementing mitigation measures specific to each impact.
2. Indirect Impacts:
    - Indirect effects arise from interactions between the project and its surroundings.
    - They may not be immediately visible but can have significant consequences over time.

- Examples include.
  - altered water flow downstream due to dam construction or secondary impacts like increased traffic from a new development.
  - Knock-On Effects: These occur when a change in one aspect of the environment triggers a chain reaction of other changes. For instance, altering water flow in a river due to a dam can affect downstream ecosystems and communities.
  - Secondary Impacts: These are consequences that arise indirectly from the project's activities. For example, a mining project might lead to increased traffic, affecting air quality and noise levels in nearby towns.

3. Cumulative Effects:
   - Cumulative impacts accumulate gradually as a result of multiple actions or developments.
   - Consider both temporal and spatial accumulation:
     - Temporal Accumulation: Over months, years, or decades, small impacts add up. For instance, repeated discharges of pollutants into a river can degrade water quality.
     - Spatial Accumulation: Impacts from various projects or activities in the same region. Urbanization, deforestation, and agriculture collectively affect ecosystems.
   - Thresholds matter: Crossing critical thresholds can lead to irreversible damage. Cumulative effects may cross critical thresholds, leading to irreversible damage. For instance, deforestation reaching a tipping point affects climate patterns.
4. Impacts Triggered Over Time: Some impacts may not be immediately evident but emerge gradually:
     - Groundwater Contamination: Chemicals leaching into groundwater may take years to affect drinking water quality. Contaminants from industrial sites or landfills can slowly infiltrate aquifers.
     - Erosion: Soil erosion due to land disturbance (e.g., deforestation, construction) accumulates over time. It affects downstream areas by increasing sediment load in rivers and altering habitats.

- Wider Area of Influence: This included giving consideration beyond the project site impact on the surrounding environment and communities. These included:
  - Direct Area: Impacts within the immediate vicinity of the project.
  - Wider Area: Impacts extending beyond the project boundaries, including neighboring ecosystems, water catchments, and habitats

5. Transboundary Impact: Transboundary impacts occur when the effects of a project extend beyond national borders. Examples:
     - Air Pollution: Emissions from factories in one country affecting air quality in neighboring countries.
     - Water Flow Alteration: Dam construction altering river flow downstream, impacting ecosystems and communities in other countries.

c. Guidelines and Standards for Assessing Environmental and Social Risks. Assessing environmental and social risks is crucial for sustainable project management. Effective risk assessment involves considering both likelihood and impact. Some guidelines and standards followed by some organizations to better manage environmental and social risks in their projects are outlined below:

- World Bank Environmental and Social Standards (ESS): The World Bank has established a set of Environmental and Social Standards (ESS) to guide project development and implementation. These standards cover various aspects, including risk assessment and management which include, ESS1: Assessment and Management of Environmental and Social Risks and Impacts, ESS2: Labor and Working Conditions, ESS3: Resource Efficiency and Pollution Prevention and Management, ESS4: Community Health and Safety, ESS5: Land Acquisition, Restrictions on Land Use, and Involuntary Resettlement and ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.
- European Banking Authority (EBA) Guidelines on ESG Risks: The EBA provides guidelines for financial institutions regarding the identification, measurement, management, and monitoring of Environmental, Social, and Governance (ESG) risks. These guidelines address the risks arising from the transition toward an EU climate-neutral economy2.
- Guidelines for Environmental and Social Risk Management (ESRM) for Banks: These guidelines expand the scope of social assessments and introduce a quantitative scoring methodology for better estimation of environmental and social risks. They also include risk-based screening criteria for evaluating proposed transactions.
- Guidelines for Environmental and Social Screening of Activities (GCF): These guidelines provide guidance for accredited entities on the environmental and social screening of activities proposed for Green Climate Fund (GCF) financing. They are particularly relevant for projects under the Simplified Approvals Process (SAP) Pilot Scheme.
- In addition to international guidelines and standards, national regulations play a crucial role in managing environmental and social risks. National regulations are specific to each country such as the Nigeria EIA Act and provide legal requirements for project development and operation. They address various aspects related to environmental protection, social welfare, and governance. Examples include regulations on qualifications, staff, premises, health and safety, and administrative procedures.

d. Assessing project impacts. Assessing project impacts involves a variety of methods, ranging from qualitative analysis to quantitative modelling. Participatory approach by stakeholders fostered transparency, trust, and better project outcomes. The approaches adopted include the following:

ii. **Expert Judgment**: Experts with considerable experience assess impacts based on their professional opinion. Useful when limited data prevent predictive modelling. Can complement quantitative methods and aid in interpreting results.

iii. **Quantitative Models:** These models use numerical data and mathematical relationships. Examples: Air Dispersion Models: Predict emissions and pollution concentrations from a coal-fired power plant.

iv. **Hydrological Models**: Estimate changes in river flow due to reservoir construction. Ecological Models: Forecast changes in aquatic biota (e.g., fish) from toxic substance discharge.

v. **Cumulative Impact Assessment**: Evaluated the combined effects of multiple existing developments. Impacts from different projects can reinforce each other, leading to more serious consequences. Examples of cumulative impacts include increased pollutant concentrations, reduced water flow, and interference with wildlife movement.

vi. **Social Impact Assessment:** Focused on social consequences of the planned project and alternatives. Standardized procedures assess social issues alongside environmental impacts.

vii. **Data Collection and Quality**. Described the chosen methods for data collection and analysis in the project report. It considered data quality, gaps, and uncertainties associated with predictions.

viii. **Stakeholder Engagement.** This included the involvement of stakeholders (local communities, NGOs, experts) in data collection and analysis. Workshops and Focus Group Discussions were also held to gather input, identify concerns, and explore potential impacts. Furthermore, Community Meetings provided a platform for dialogue and information sharing.

e. **Significance Assessment and Rating environmental and social risks.** Significance assessment informs decision-making and risk prioritization. By considering relevant criteria, environmental and social risks can be better managed. A thorough assessment of risks involved considering likelihood and impact, as well as the availability of effective mitigation measures, leveraging on the methodology that IUCN for assessing the significance of environmental and social impacts/risks. The rating environmental and social risks was based on likelihood and expected impacts:

1. Likelihood:
   - Likelihood represents the possibility that a specific risk event will occur.
   - It uses the following five ratings to establish likelihood:
     - Very Unlikely to Occur (1): The risk event has an extremely low chance of happening.
     - Not Expected to Occur (2): The risk is unlikely but not ruled out entirely.
     - Likely – Could Occur (3): There is a reasonable chance of the risk event happening.
     - Known to Occur - Almost Certain (4): The risk event is highly probable based on historical data or expert knowledge.
     - Common Occurrence (5): The risk event frequently occurs.
2. Impact (Consequence):
   - Impact refers to how negatively a risk event might affect environmental or social receptors.
   - It considers the following criteria to assess impact significance:
     - Sensitivity of the Receptor: Some receptors (e.g., endangered species, cultural heritage) are more sensitive to impacts.
     - Severity of Impacts: Assess whether the impact is minor, moderate, or severe.

    - Expected Duration and Scale: Longer-lasting or larger-scale impacts are more significant.
    - Reversibility: Determine if the impact can be reversed or mitigated.
3. Good Practices and Experience:
    - Consider whether known, acceptable good practices exist to address specific impacts.
    - Stakeholders' experience in applying mitigation measures matters were also given consideration.

f. Criteria for Significance Risk Assessment

This helps prioritize mitigation efforts and informs decision-making. the significance ratings for environmental and social risks based on the provided criteria:

1. **Severe (5)**:
    - **Magnitude**: Very high magnitude.
    - **Scale and Spatial Extent**: Large geographic area, affecting many people. May have trans-boundary impacts.
    - **Duration**: Long-term (permanent and irreversible).
    - **Receptors**: Highly sensitive (e.g., high biodiversity areas, indigenous territories).
    - **Examples**: Severe impacts on biodiversity-rich regions, irreversible displacement, cumulative social conflicts.
2. **Major (4)**:
    - **Magnitude**: High magnitude.
    - **Scale and Spatial Extent**: Large area, affecting a significant number of people. May have trans-boundary impacts.
    - **Duration**: Certain duration but reversible with sufficient mitigation effort.
    - **Receptors**: Sensitive (e.g., biodiversity areas, indigenous lands).
    - **Examples**: Adverse impacts on biodiversity, temporary displacement, social conflicts of limited duration.
3. **Medium (3)**:
    - **Magnitude**: Medium.
    - **Scale and Spatial Extent**: Small area, affecting a limited number of people.
    - **Duration**: Temporary.
    - **Predictability**: Impacts are relatively predictable and manageable.
    - **Examples**: Moderate adverse effects that can be addressed with known solutions.
4. **Minor (2)**:
    - Magnitude: Minor.
    - Scale and Spatial Extent: Very small area, minimal impact on people.
    - Duration: Short-term.
    - Avoidability: Easily avoided, managed, or mitigated.
    - Examples: Small-scale, short-lived impacts.
5. **Negligible (1)**:
    - Magnitude: Negligible or no adverse impacts.
    - Receptors: No significant harm to communities, individuals, or the environment.

To characterize the significance of impacts on the environment, eight parameters are considered. The relationship between these parameters is illustrated in Figure 5.1 .

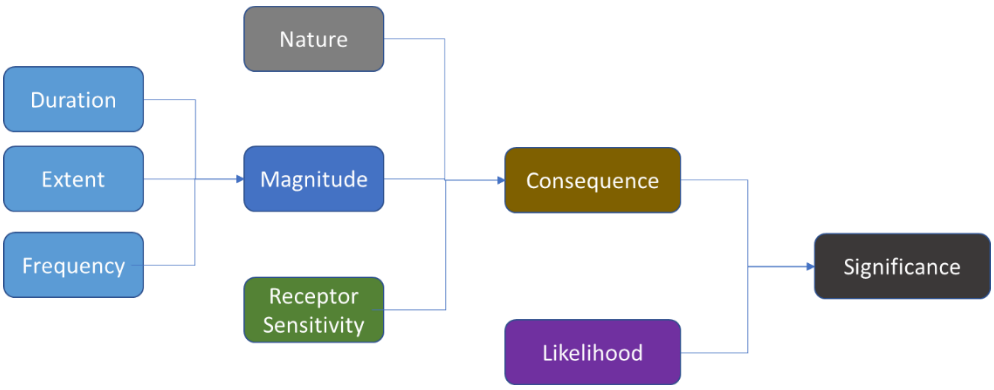


Figure 5.2: Parameters Used to Determine Significance

g. Determining the Risks for the Project

The risks were determined based on likelihood and expected impact described below and shown in Table 5.2:

1. Combining Likelihood and Impact:
   - Significance results from assessing both the likelihood (probability) and the expected impact (consequence) of a risk event.
   - By combining these factors, we gauge the overall importance of addressing the risk.
2. Significance Ratings:
   - The significance rating indicates how much attention a risk event requires during project development and implementation.
   - It also guides the extent of control actions needed.
   - The ratings are typically on a scale (e.g., from 1 to 5).
3. Factors Influencing Significance:
   - Likelihood:
     - Consider the probability of the risk event occurring.
     - Historical data, expert opinions, and project-specific conditions inform this assessment.
   - Impact (Consequence):
     - Evaluate the severity of potential impacts.
     - Factors include sensitivity of receptors (e.g., biodiversity areas), severity, duration, and reversibility.
   - Known Solutions:
     - Assess whether there are established good practices to address the impacts.
     - Stakeholders' experience matters.

Table 5.2: Rating Impact and Significance of a Risk Event

a: Rating impact of a risk event

Severe (5)	Adverse impacts on people and/or environment of **very high magnitude**, including **very large scale** and/or spatial extent (large geographic area, large number of people, transboundary impacts), cumulative, **long-term (permanent and irreversible)**; **receptors** are considered **highly sensitive**; examples are severe adverse impacts on areas with high biodiversity value[11]; severe adverse impacts to lands, resources and territories of indigenous peoples; significant levels of displacement or resettlement with long-term consequences on peoples' livelihood; impacts give rise to severe and cumulative social conflicts with long-term consequences.
Major (4)	Adverse impacts on people and/or environment of **high magnitude**, including **large scale** and/or spatial extent (large geographic area, large number of people, transboundary impacts), of certain duration **but still reversible** if sufficient effort is provided for mitigation; receptors are considered sensitive; examples are adverse impacts on areas with high biodiversity value; adverse impacts to lands, resources and territories of indigenous peoples; significant levels of displacement or resettlement with temporary consequences on peoples' livelihood; impacts give rise to social conflicts which are expected to be of limited duration.
Medium (3)	Adverse impacts of **medium magnitude**, **limited in scale** (small area and low number of people affected), **limited in duration** (temporary), impacts are relatively predictable and can be avoided, managed and/or mitigated with known solutions and straight forward measures.
Minor (2)	Adverse impacts of **minor magnitude, very small scale** (e.g. very small affected area, very low number of people affected) and only short duration, may be easily avoided, managed, mitigated.
Negligible (1)	Negligible or no adverse impacts on communities, individuals, and/or on the environment.

b. Rating significance of a risk event

		Likelihood of occurrence				
		Very unlikely to occur (1)	*Not expected to occur (2)*	*Likely – could occur (3)*	*Known to occur - almost certain (4)*	*Common occurrence (5)*
Impact	*Severe (5)*	Moderate	Substantial	High	High	High
	Major (4)	Low	Moderate	Substantial	Substantial	High
	Medium (3)	Low	Moderate	Moderate	Moderate	Substantial
	Minor (2)	Low	Low	Moderate	Moderate	Moderate
	Negligible (1)	Low	Low	Low	Low	Low

Source: IUCN

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-
- **h. Summary of Impact Identification and Evaluation**

In Box 5.1, a summary of measures used to identify and weigh likely impacts is provided and the Impact Identification and Evaluation process flow adopted for the project are depicted in Figure 5.2. 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.

1. . Overlaying Project Components on Maps:
    - By superimposing project components onto existing condition maps, potential impact areas and issues can be identified.
    - This spatial analysis helps pinpoint where the project may interact with the environment.
2. Experience from Similar Projects:
    - Drawing insights from similar projects provides valuable lessons.
    - Understanding past successes and challenges informs decision-making.
3. Guidance Documents and Legal Provisions:
    - Published and unpublished documents offer guidance on impact analysis.
    - Compliance with Nigerian environmental laws and regulations is essential.
4. Ecosystem Sensitivity and Vulnerability:
    - Assess the sensitivity of ecosystem components to project activities.
    - Vulnerable areas require special attention and mitigation.
5. Understanding Project-Environment Interactions:
    - Consider how the proposed project interacts with its surroundings.
    - Identify potential positive and negative linkages.
6. Envisaged Sustainability:
    - Evaluate the long-term sustainability of the project's environmental impact.
    - Balancing economic benefits with ecological well-being is crucial.
7. Economic Value Assessment:
    - Understand the economic significance of the proposed project.
    - Weigh costs and benefits to inform decision-making.
8. Projected Impact Duration:
    - Estimate how long each project activity will impact various environmental components.
    - Short-term versus long-term effects guide planning.
9. Knowledge of Project Activities and Layout:
    - Familiarity with project activities, equipment types, and facility layout informs impact assessment.
    - Consider how these elements interact with the environment.
10. Baseline Study Observations:
    - Insights from baseline studies provide context.
    - Peculiar observations help tailor mitigation strategies.

Box 5.1: Summary of Measures Used to identify and weigh likely impacts

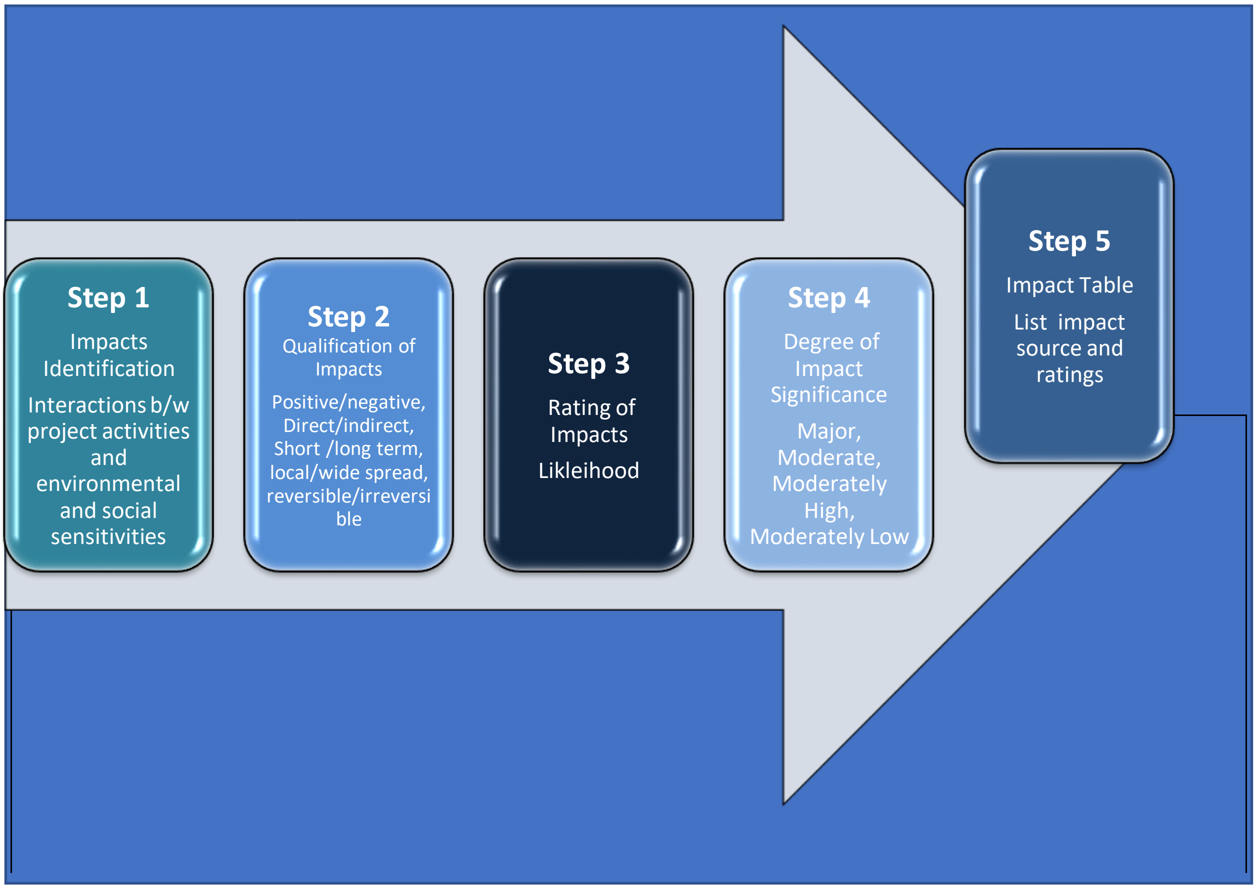

Figure 5.3: Impact Identification and Evaluation Process Flow

- ## 5.2 Summary of Significant Impacts

The Lagos-Calabar Coastal Highway holds immense promise, responsible planning, environmental assessment, and mitigation strategies are essential to balance development with the preservation of natural ecosystems. However, the project also has its own negative impacts. Both negative and positive impacts are summarised below

5.2.1 Significant Positive Impacts

The Lagos-Calabar Coastal Highway spans approximately 650 to 700 kilometers. The project is expected to take eight years to complete. This extensive highway will herald a new era of efficient travel and trade along Nigeria's coastal corridor. The estimated cost of the project is $2 billion (approximately N4 billion per kilometer) with a tentative cost based on other projects within the same budget. The government aims to recoup its investment through tolling the highway after 15 years upon completion.

The Lagos-Calabar Coastal Highway project holds immense promise for Nigeria's economic landscape, and careful consideration of these factors will be essential for its successful implementation. The proposed holds high positive socio-economic impacts. The highway connects major economic hubs, potentially boosting trade and commerce. However, this must be balanced with environmental considerations. Proper planning can ensure that the highway minimizes environmental impact while enhancing connectivity.

1. Distance Compression:

The coastal road will remarkably compress the distance between Lagos and Ondo State.

For instance, the direct distance from Ibeju-Lekki in Lagos to Araromi in Ondo State is approximately 50 kilometres along the coast. This translates to about an hour's journey, significantly reducing travel time compared to existing routes.

2. **Economic Impact**:

The completion of the first phase of the project alone could increase the size of Lagos State's economy by 50%. The connection to the Lekki Deep Seaport and the Lekki economic corridor, where the Dangote Refinery and Petrochemical Complex is situated alongside other multinational industries, will drive economic growth. Upon completion, the highway is expected to significantly improve Nigeria's Logistics Performance Index (LPI) for trade and transport infrastructure. It could contribute at least 0.5 to 1.0 points to the LPI.

3. **Transformational Potential**:

The coastal highway will usher in a new era of ambitious road infrastructural development projects in Nigeria. Similar to the iconic Third Mainland Bridge, which spans over 11 kilometres across the lagoon, the Lagos-Calabar Coastal Road aims to be monumental. When completed, it will enter the world record books alongside iconic coastal routes like the Wild Atlantic Highway in Ireland and the Pacific Coastal Highway in the United States.

4. **Integration and Connectivity**:

The highway will have two spurs linking up with Northern Nigeria, further integrating the north and south in terms of movement of people, goods, and services. It promises to enhance regional connectivity and foster economic exchange.

5. Blue Economy:

The coastal highway connects major economic hubs, including the Lekki Deep Seaport. It facilitates efficient movement of goods, boosting trade and economic growth. Proper waste management along the highway is essential to prevent pollution of coastal waters.

6. **Ecotourism**:

The scenic coastal route can promote ecotourism. Sustainable development, preservation of natural habitats, and wildlife conservation are vital. Interpretive centres, eco-friendly rest stops, and guided tours can enhance the ecotourism experience.

7. **Provision of employment opportunities:**

The highway will contribute to the overall socio-economic wellbeing of the benefiting communities through the provision of employment opportunities (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.

8. **National Impact**:
   - **Improved Transport Conditions:** The Highway enhances connectivity, allowing smoother movement of goods, services, and people.
   - **Sustained Access**: By maintaining the proposed infrastructure, Nigeria ensures long-term accessibility for its citizens.
   - **Economic Growth**: The Highway contributes to Nigeria's economy on a global scale. Efficient transportation fosters trade, investment, and economic expansion.
   - **GDP Contribution:** The coastal Highway facilitates the transit of goods to states along its route, bolstering GDP.
   - **Strategic Importance**: As a major corridor, it supports regional integration and development.

9. **Host Communities**:
   - **Increased Travel Efficiency and Productivity:** Reduced travel time and smoother journeys benefit commuters, businesses, and tourists.
   - **Environmental Improvement:** Proper road construction minimises environmental impact. Sustainable practices enhance the quality of the surroundings. Integrated coastal managed to deal with coastal erosion and ensure biodiversity enhancement
   - **Enhanced Quality of Life and Social Standards:** Access to better infrastructure positively affects residents' well-being. Improved roads lead to safer, more comfortable travel.
   - **Economic Activity Spread:** The Highway connects villages and towns, promoting economic growth. Local businesses thrive due to increased accessibility.
   - **Safety and Security Enhancement:** Addressing poor safety records ensures safer travel for all. Reduced accidents and incidents benefit both travelers and communities.
   - **Stress Reduction:** Smooth roads alleviate stress for commuters and long-distance travelers.
   - **Comfortable Rides:** Adequate facilities, including sidewalks, enhance the overall travel experience.
   - **Environmental Aesthetics and Carbon Reduction:** Proper maintenance and greenery along the corridor reduce the carbon footprint. Aesthetically pleasing surroundings contribute to a better quality of life.

10. Integration with Existing Routes and Rail Lines

The Lagos-Calabar Coastal Highway will integrate significant routes such as the Badagry Expressway, the Fourth Mainland Bridge, and the Lekki Deep Seaport Road. This integration will facilitate seamless movement across various regions in North Nigeria. The project envisions incorporating rail lines within the median strips of main roads, enhancing transportation flexibility.

The Lagos-Calabar Coastal Highway project holds immense promise for Nigeria's economic landscape. It will not only improve transportation infrastructure but also catalyze economic diversification, social progress, and regional integration. By integrating rail systems, the project ensures a seamless and sustainable transportation network for generations to come.

The integration of rail systems enhances connectivity. Passengers can seamlessly switch between road and rail, reducing congestion and improving transportation options. Rail stations along the route become vital hubs for travelers and cargo.

The potential impacts of the Lagos-Calabar Coastal Highway development, considering both the construction phase and the long-term effects, including the integration with the rail system:

a. During Construction (Short-Term Impacts):

1. Economic Growth and Job Creation:

The construction phase will generate employment opportunities for local communities along the route.

Contractors, laborers, engineers, and support staff will be involved in building the highway and rail infrastructure.

2. Infrastructure Development:

The highway's construction will lead to the development of roads, bridges, and rail tracks. Improved infrastructure enhances connectivity and accessibility.

3. Environmental Impact:

Construction activities may disrupt local ecosystems, soil stability, and water bodies. Proper environmental impact assessments and mitigation measures are crucial.

4. Social Disruptions:

Land acquisition and resettlement may affect communities. Ensuring fair compensation and minimizing disruption is essential.

b. During Operation (Long-Term Impacts)

1. Economic Transformation:

The Lagos-Calabar Coastal Highway will stimulate economic growth by connecting major urban centers, industrial hubs, and seaports. It reduces travel times, lowers transportation costs, and enhances market access for businesses.

2. Tourism and Trade:

Improved infrastructure attracts tourists and facilitates trade. Coastal regions become more accessible, boosting local economies.

3. Social Integration:

The highway bridges the rural-urban divide, integrating remote communities into national and regional supply chains. Inclusive development reduces income disparities.

Box 5.2: Positive impact of Integrating Rail System into the Road

5.2.2 Significant Negative Impacts

The proposed development unfortunately is also likely to exert negative impacts on the social and physical environment within which it is executed. This is because, for instance, with regard to the construction phase which is often a rapid and disorderly process when strong emphasis on completing the project is paramount and not on protecting the environment.

Construction activities occur only once but can have lasting effects due to site preparation, earth works, waste generation, traffic and safety which are localized and reversible. During construction, the impacts are rated as significant. However, they are considered minor in duration since construction activities are temporary. Proper construction management practices are crucial to minimize negative impacts. Adherence to safety protocols and environmental safeguards is essential. Proactive measures, responsible construction practices, and continuous monitoring will help mitigate any adverse effects during the construction phase.

Based on the design of the project, these impacts can be divided into two, namely:

b. **Short-term construction-related impacts typical of building construction activities such as:**

13. Community Engagement and Land Acquisition:

- Community Resistance: Some communities may resist land acquisition for the highway, leading to delays and disputes.
- Compensation: Ensuring fair compensation for affected landowners and communities is critical for maintaining goodwill.
- Relocation Challenges: Resettling communities while minimizing disruption requires thoughtful planning and sensitivity.

14. Geological and Environmental Factors:

- Habitat Destruction: The construction of the coastal highway could lead to habitat destruction, disrupting ecosystems along the route.

- Vulnerability to Erosion and Flooding: Altering the coastal landscape may increase vulnerability to erosion and flooding. The coastal region's susceptibility to erosion poses a risk to soil stability and overall highway integrity.
- Swamps, Mangroves, and Wetlands: These natural features along the route complicate foundation work and roadbed construction.
- Ecological Impact: Striking a balance between development and environmental conservation is crucial. Efforts to minimize harm to local ecosystems and wildlife habitats are essential.

15. Infrastructure and Logistics:

- Materials Supply: Transporting construction materials over long distances can be costly and time-consuming.
- Access Roads: Developing access roads to remote construction sites is challenging.
- Bridge Construction: Building durable bridges across rivers and estuaries demands specialized engineering expertise.

16. Security and Safety:

- Security Threats: The highway passes through regions with security challenges (e.g., militancy, banditry). Ensuring safety for workers and equipment is paramount.
- Traffic Management: Coordinating traffic during construction, especially in densely populated areas, requires careful planning.

17. Funding and Budget Constraints:

- Cost Overruns: Unexpected expenses can strain the project budget. Vigilant cost management is essential.
- Government Funding: Consistent funding throughout the eight-year construction period is critical for project continuity.

18. Technical Engineering Challenges:

- Soft Soil Stabilization: Techniques like soil compaction, geotextiles, and deep foundations are necessary for stability.
- Drainage Design: Proper drainage prevents waterlogging and erosion.
- Bridge Durability: Constructing bridges that withstand environmental forces and heavy traffic is a significant task.

19. Noise and Dust Nuisance:

- The preparation of the site and material transportation can lead to increased noise and dust levels.

20. Waste Generation and Disposal:

- Proper management of waste from the site and camp is essential to prevent environmental harm.

21. Soil Contamination:

- Stored fuel, lubricants, and paints can contaminate the soil.

22. Health and Safety Issues:

- Occupational Health: Workers involved in construction (including non-skilled workers, operators, drivers, surveyors, and supervisors) face health risks.
- Workers' Camp: Proper facilities and safety measures must be in place at the workers' camp.
- Public Safety: Ensuring safety for the public near construction zones is critical.

23. Resource Utilization:

- Efficient use of resources is necessary.

24. Potential Social Issues:

- Increased social vices and other community-related challenges may arise.

the long-term operation and maintenance impacts and sustainability

i. **Direct Impacts:**

- Energy Consumption: The operation of the highway will require energy for lighting, toll collection, and other facilities.
- Emissions and Pollution: Increased traffic will lead to emissions from vehicles, affecting air quality and contributing to climate change.
- Waste Disposal and Recycling: Proper management of waste generated during construction and maintenance is crucial. Recycling materials and minimizing landfill use are essential for sustainability.

ii. **Indirect Impacts:**

- Economic Structure and Trade: The highway's presence can influence economic activities along its route. It may lead to the growth of industries, trade hubs, and real estate development.
- Transportation Systems: The highway will impact existing transportation networks, potentially improving connectivity and efficiency.

iii. **Social and Lifestyle Effects:**

- People's Lifestyle: The highway will alter how people travel, commute, and interact. It may change daily routines and social dynamics.
- Social Values: Balancing economic development with cultural and social values is critical. Community engagement and understanding local perspectives are essential.
- The "Rebound Effect": As the highway improves accessibility, there may be increased demand for travel, leading to more traffic and potential negative consequences.

iv. **Maintenance and Long-Term Sustainability:**

- Maintenance Planning: Developing a comprehensive maintenance strategy is vital. Regular inspections, repairs, and upgrades will ensure the highway remains safe and functional.
- Climate Resilience: Considering rising sea levels, extreme weather events, and changing climate patterns during design and construction is essential. Proper drainage, erosion control, and durable materials are crucial for long-term resilience.

The above identified impacts are further outlined below based on the phases of the project.

Table 5.3: Summary of Identified impacts Due to Phases of the Project

S/No	Phase	Potential Impact
1	Pre-Construction and Construction	**Construction Phase Effects**: • Environmental Disruption: During the construction phase, the natural environment will face disruption due to excavation, earthmoving, and road-building activities.

Table 5.3: Summary of Identified impacts Due to Phases of the Project		
S/No	**Phase**	**Potential Impact**
		• Habitat Fragmentation: The highway may fragment habitats, affecting wildlife movement and gene flow. • Soil Erosion: Soil disturbance can lead to erosion, impacting soil quality and stability. • Water Quality: Runoff from construction sites may carry pollutants into nearby water bodies. **Loss of Biodiversity** and **Natural Capital**: • Vegetation Removal: Clearing land for the highway will result in the removal of vegetation, affecting plant species diversity. • Wildlife Displacement: Animals may be displaced from their natural habitats, leading to population declines or local extinctions. • Impact on Endangered Species: Sensitive species, such as nesting seabirds or marine animals, could suffer. • The highway's alignment may pass through habitats that support diverse flora and fauna some identified as sensitive areas and endangered species. • The highway will intersect with valuable natural capital, including coastal ecosystems, **Coastal Erosion and Sedimentation**: • Altered Coastal Dynamics: The highway's construction and maintenance may alter coastal sediment transport patterns. • Beach Erosion: Changes in sediment deposition could lead to beach erosion, affecting coastal ecosystems. • The highway's construction and alteration of the coastal landscape can exacerbate **Waterway Obstruction**: • Bridges and Culverts: Waterways crossed by the highway may face obstruction due to bridge piers or culverts. • Fish Migration: Impaired fish migration routes could impact fish populations and aquatic ecosystems. **Impact on Geology** and **Soil Impact**: • Soil compaction, excavation, and filling can disrupt soil structure. **Water Resources**: • Runoff from construction sites can carry sediment and pollutants into water bodies. **Air Quality and Noise** • Dust emissions from construction activities can degrade air quality and noise can impar hearing for receptors **Noise and Light Pollution**:

Table 5.3: Summary of Identified impacts Due to Phases of the Project		
S/No	**Phase**	**Potential Impact**
		• Traffic Noise: Increased traffic along the highway may disturb wildlife, affecting their behaviour and communication. • Construction machinery, drilling, and blasting generate noise. • Noise pollution can affect nearby communities and wildlife. • Artificial Lighting: Highway lighting can disrupt nocturnal animals and nesting seabirds. **Climate Change -Adaptation and Resilience**: • The geographically location is prone to climate vulnerability • The coastal highway's vulnerability to rising sea levels should be **Climate Change -Green House Gas Emission** • Construction Phase Emissions: During the construction of the highway, emissions from heavy machinery, transportation of materials, and energy-intensive processes contribute to greenhouse gas emissions. • Deforestation and Soil Disturbance: Clearing land for the highway may involve deforestation, releasing stored carbon and reducing natural carbon sinks. • Vehicle Emissions: Once operational, the highway will accommodate vehicles, contributing to air pollution and greenhouse gas emissions. **Waste Management**: • The construction and operation of the highway will generate significant waste, including construction debris, packaging materials, and maintenance waste. **a. Social Negative Impacts** **1. Land Acquisition Challenges:** • Economic Displacement: The road project necessitates land acquisition for the alignment or ROW for accommodating the new highway. **2. Displacement and Destruction of Cultural and Sacred Sites**: • The highway's construction may lead to the displacement or destruction of cultural heritage sites, including sacred areas. • Historical landmarks, burial grounds, and traditional sites could be affected. **3. Threat to Community Culture, Safety, and Security**: • The highway's development may alter the social fabric of local communities. • Traditional practices, community cohesion, and safety dynamics could be disrupted.

<table>
<tr><th colspan="3">Table 5.3: Summary of Identified impacts Due to Phases of the Project</th></tr>
<tr><th>S/No</th><th>Phase</th><th>Potential Impact</th></tr>
<tr><td></td><td></td><td>4. Pressure on Existing Infrastructures in Host Communities:
The influx of traffic, businesses, and population due to the highway can strain existing infrastructure.
Roads, utilities, healthcare facilities, and schools may face increased demand.
5. Security Challenges:
The highway’s length and connectivity may pose security challenges.
6. Social Misfit/Miscreants Taking Over the Site:
Abandoned or partially constructed sites may attract squatters or miscreants.</td></tr>
<tr><td>2</td><td>Operation Phase:</td><td>1. Air Quality Impacts:
Vehicle emissions from highway traffic can impact air quality.

2. Noise Impacts:
Highway traffic noise can affect nearby communities.

3. Geology and Soil Impacts:
Highway operation may cause wear and tear on road surfaces and embankments.

4. Water Resources Impacts:
Highway runoff can carry pollutants into rivers and streams.

5. Security Challenges:
The highway’s length and connectivity may pose security challenges.

Increased movement of goods and people could attract criminal activities.

6. Maintenance of Infrastructure:
Regular maintenance is essential to keep the highway safe and functional. Ensuring road surface quality, signage, lighting, and drainage systems are crucial.

7. Traffic Management and Congestion:
Efficient traffic management is necessary to prevent congestion. Proper road signage, lane discipline, and monitoring are vital.

Health and Safety</td></tr>
</table>

Table 5.3: Summary of Identified impacts Due to Phases of the Project		
S/No	**Phase**	**Potential Impact**
		i. **Health and Safety for Workers and Commuters**: Occupational health and safety protocols must be followed during maintenance activities. Ensuring worker safety and minimizing disruptions to commuters are priorities. **ii. Impact on Community Health and Safety**: The highway's construction and operation can affect community health and safety. Dust, noise, and pollution during construction may impact residents' well-being. ii. **Impact on Occupational Health and Safety (OHS)**: Workers involved in highway construction face occupational hazards. v. **Risk of Sexually Transmitted Diseases, HIV/AIDS Issues, and Other Communicable Diseases**: Labour influx due to construction can lead to social interactions and potential health risks. 8. **Labour Influx**: The highway project will attract a large labour force. 9. **Gender-Based Violence**: Construction sites often witness gender-based violence.
3	Decommissioning Phase	i. **Physical Disturbance Arising from Equipment Removal**: As equipment is dismantled and removed, the surrounding environment may experience physical disruption. Soil compaction, ground disturbance, and alteration of natural features can occur. ii. **Soil Erosion Resulting from Improper Reinstatement of Excavated Soil**: If excavated soil is not properly reinstated, erosion can occur. Unstable slopes, sediment runoff, and loss of topsoil may impact nearby ecosystems. iii. **Air Quality Degradation and Noise Generation**: During equipment removal and building demolition, dust, debris, and noise are generated. Air quality may deteriorate, affecting both workers and nearby communities.

Table 5.3: Summary of Identified impacts Due to Phases of the Project

S/No	Phase	Potential Impact
		iv. **Hazards/Risks and Accidents**: Decommissioning involves handling heavy machinery, hazardous materials, and structural elements. Risks include falls, equipment malfunctions, and exposure to toxic substances. v. **Waste Management Problems**: Disposing of decommissioned materials (concrete, metals, etc.) requires proper waste management. Inadequate disposal can lead to pollution and environmental harm. vi. **Social Misfit/Miscreants Taking Over the Site**: Abandoned decommissioning sites may attract squatters, vandals, or criminal activities. Proper security measures are essential to prevent misuse.

5.2.3 Summary of Impacts Based on Project Phases and Impact Rating

Refer to Table 5.4 for a detailed summary of specific impacts related to the Lagos-Calabar Coastal Highway project. These impacts cover various fields, including environmental, social, and economic aspects.

A more project specific potential negative impacts and the level of impacts that could emanate from the project are summarized in Table 5.4 with some specific fields of impacts briefly described.

Table 5.4: Summary of Impacts Based on Project Phases									
No	Aspect	Identified Impact	Impact Criteria						
			Duration	Extent	Frequency	Magnitude	Likelihood	Consequence	Significance
a.	Pre-Construction and Construction Phases								
1	Soil, Surface and Water Quality	Potential to impact soil and sediment quality through soil compaction, erosion, fuel and lubricant spills, improper waste disposal, and contamination from hazardous materials, which can harm nearby ecosystems and human health	Short-term to Long-term	Local	One-time to Intermittent	Small	Probable	Moderate	Moderate
2		Potential Impact on coastal morphology, affecting shoreline shape, sediment dynamics, erosion patterns, beach profiles, intertidal zones, and marine habitats, with potential impacts on sediment distribution, seabed stability, and soil salinization	Short-term to Long-term	Local	One-time to Intermittent	Small	Probable	Moderate	Moderate
3		Flooding, Erosion and Sedimentation Impact. Land reclamation may increase the risk of flooding, erosion, and sedimentation by altering the natural coastline, disrupting sediment transport patterns, reducing coastal habitats, and disturbing the balance of sediment deposition and erosion.	Short-term	Local	One-time to Intermittent	Small	Probable	Minor	Minor
4		impact the Marine Environment, Hydrology, and Ecosystems through habitat destruction, introduction of pollutants, alteration of water flow patterns,	Short-term to	Local	One-time to	Small	Probable	Moderate	Moderate

Table 5.4: Summary of Impacts Based on Project Phases

No	Aspect	Identified Impact	Impact Criteria						
			Duration	Extent	Frequency	Magnitude	Likelihood	Consequence	Significance
		sediment accumulation, and potential loss of protective coastal features, affecting marine life and ecosystem services.	Long-term		Intermittent				
5		Mobilisation of Pollutants from Contaminated Land Encountered during Earthworks. When contaminated soil is disturbed, it can lead to an increase in the release of pollutants, which may include harmful substances such as heavy metals and hydrocarbons.	Short-term to Long-term	Local	One-time to Intermittent	Small	Somewhat Likely	Moderate	Minor
6	Air Quality	Potential Impact ambient air quality through construction activities like demolition, concrete pouring, and heavy equipment operation, as well as transportation of materials by trucks.	Short-term	Local	One-time to Intermittent	Small	Probable	Minor	Minor
7		The project may lead to increased dust emissions from various construction activities and ancillary sites, potentially affecting air quality	Short-term to Long-term	Local	One-time to Intermittent	Small	Probable	Moderate	Moderate
8		Increase in air pollution through elevated vehicle emissions, including nitrogen oxides, volatile organic compounds, and particulate matter, which can adversely affect human health	Short-term to Long-term	Local	One-time to Intermittent	Small	Planned	Minor	Minor

Table 5.4: Summary of Impacts Based on Project Phases									
No	**Aspect**	**Identified Impact**	**Impact Criteria**						
			Duration	**Extent**	**Frequency**	**Magnitude**	**Likelihood**	**Consequence**	**Significance**
9		combustion activities, including operation of diesel power generators and equipment, are key sources of emissions that can adversely affect human health through pollutants like NO2, SO2, PM10, and PM2.5.	Short-term to Long-term	Local	Intermittent	Small	Planned	Minor	Minor
10	Noise and Vibrations	Impact on ambient noise quality from port construction activities and ancillary sites.	Short-term	Local	Intermittent	Small	Probable	Minor	Minor
11		Potential Impact on Human Health Associated with Increased Noise Levels from Construction Activities to other terminal operators and contractors in the area	Short-term	Local	Intermittent	Small	Probable	Minor	Minor
12		Generate underwater noise and vibrations from activities such as pile driving, and vessel transportation, potentially impacting marine life and ecosystems.	Short-term	Local	Intermittent	Medium	Probable	Moderate	Moderate
13		Impact nearby community structures due to ground vibrations from construction activities, potentially leading to discomfort, stress, and safety risks, particularly for sensitive structures	Short-term	Local	Intermittent	Medium	Probable	Moderate	Moderate
14	Waste	Construction activities will generate various types of waste, including construction debris, excavated soil, packaging waste, chemical waste, metal scraps, wood waste, plastic waste, electrical and electronic waste,	Long-term	Local	Intermittent	Medium	Probable	Moderate	Moderate

Table 5.4: Summary of Impacts Based on Project Phases

No	Aspect	Identified Impact	Impact Criteria						
			Duration	Extent	Frequency	Magnitude	Likelihood	Consequence	Significance
		and hazardous waste, which could potentially impact the local environment and community receptors due to existing waste management challenges in Lagos							
15	Hydrology	Spills or Leaks Resulting in Contamination of Groundwater and Surface Water. The fuels or hydraulic fluids used in the equipment have the potential to spill, which can lead to the release of hydrocarbons. Contamination Risk: The soil, groundwater, and surface water in the area can become contaminated by these	Short-term to Long-term	Local	One-time to Intermittent	Small	Probable	Moderate	Moderate
16		Activities such as quay demolition, drilling and piling, grouting, backfilling, and raw material storage and handling can lead to increased turbidity in nearby water bodies due to the resuspension of bottom sediment, production of fine particulate matter, and inadequate sediment management methods.	Long-Term	Local	Intermittent	Small	Probable	Moderate	Moderate
17	Biodiversity	construction activities may disrupt ecosystem services such as soil stability, nutrient cycling, and habitat provision, while sediment runoff and chemical pollutants can degrade water quality and dust and emissions can impact air quality	Long-Term	Local	One-time	Small	Unlikely	Minor	Not Significant

Table 5.4: Summary of Impacts Based on Project Phases

No	Aspect	Identified Impact	Impact Criteria						
			Duration	**Extent**	**Frequency**	**Magnitude**	**Likelihood**	**Consequence**	**Significance**
18		Disturbance of Marine Ecology due to land reclamation, infrastructure development, release of sediment and construction noise and vibrations.	Long-Term	Local	One-time	Small	Unlikely	Minor	Not Significant
19		Avifauna may experience habitat loss, disturbance from noise and vibrations, and an increased risk of collision with machinery and structures	Long-Term	Local	One-time	Small	Unlikely	Minor	Not Significant
20		Introduction of Marine Invasive Species by Hull Fouling, generating ecological alterations and affecting the ecosystem services.	Long-Term	Local	One-time	Small	Unlikely	Minor	Not Significant
	marine and blue economy	Coastal infrastructure (e.g., roads, bridges, ports) impact marine habitats.							
		Blue Economy Opportunities open for sustainable economic activities related to the ocean, such as aquaculture, tourism, and renewable energy and for investment and job creation within the blue economy							
		Dredging stirs up sediment, affecting water clarity and potentially smothering sensitive habitats like coral reefs and seagrass beds. The removal of sediment can disrupt habitats where marine organisms live, feed, and breed.	Short-term to Long-term	Local	Intermittent	Medium	Probable	Major	Moderate

Table 5.4: Summary of Impacts Based on Project Phases

No	Aspect	Identified Impact	Impact Criteria						
			Duration	Extent	Frequency	Magnitude	Likelihood	Consequence	Significance
		Dredged material may contain pollutants, affecting water quality. Dredging operations can create underwater noise and vibrations, which may stress or harm marine life.							
21	Social	Road Traffic and Transport Risk of Project Vehicle Traffic Accidents due to increased traffic volume during construction on employees, nearby residents, and businesses	Short-term	Local	Intermittent	Medium	Somewhat Likely	Major	Moderate
22		Social Services and Local Lifestyle- The highway's construction may disrupt local lifestyle and values, affecting communities residing near the route. Social services, such as healthcare, education, and utilities, may need to be reconfigured to accommodate the displaced population.	Short-term to Long-term	Local	Intermittent	Medium	Probable	Moderate	Moderate
23		Migration and Settlement Patterns- as people move away from affected areas, Settlement patterns could change due to the highway's impact on property availability and accessibility	Long-term	Local	One-time	Small	Unlikely	Minor	Minor

Table 5.4: Summary of Impacts Based on Project Phases									
No	**Aspect**	**Identified Impact**	**Impact Criteria**						
			Duration	**Extent**	**Frequency**	**Magnitude**	**Likelihood**	**Consequence**	**Significance**
24		Disruption on fishing activities by damaging fishing grounds, polluting waters, and altering fish habitats, leading to potential declines in fish populations and reduced income for local fishermen.	Short-term	Local	Intermittent	Medium	Probable	Major	Moderate
25		Potential Infringement on Workers' Human Rights if not working under safe and fair working conditions	Long-Term	Regional	Intermittent	Medium	Somewhat Likely	Major	Moderate
	Health and safety	Community health and safety may be impacted by physical injury risks, exposure to hazardous materials, respiratory effects from air emissions, spread of communicable diseases, changes to diet and subsistence foods, and strain on local health services and infrastructure.	Long-term	Local	One-time	Small	Unlikely	Moderate	Moderate
		Occupational health and safety issues arose construction activities including physical hazards, chemical hazards, confined spaces, exposure to dust and noise.	Long-term	Local	One-time	Small	Unlikely	Moderate	Moderate
	Operation								

Table 5.4: Summary of Impacts Based on Project Phases

No	Aspect	Identified Impact	Impact Criteria						
			Duration	Extent	Frequency	Magnitude	Likelihood	Consequence	Significance
1	Soil, Surface and Water Quality	Fuel spills from machinery and transport vehicles which can Hydrocarbons (from fuels) can infiltrate the soil, potentially reaching groundwater.	Long-term	Local	One-time to Intermittent	Small	Probable	Minor	Minor
2		Spills during offshore transportation (e.g., ships, vessels). Oil and grease can contaminate coastal soil, impacting vegetation and wildlife.	Short-term to Long-term	Local	One-time to Intermittent	Small	Probable	Minor	Minor
3		Disposing waste outside designated zones with Soil degradation, loss of biodiversity, and harm to ecosystems.	Short-term	Local	One-time to Intermittent	Small	Probable	Minor	Minor
4		Soil exposure to hazardous substances (e.g., heavy metals, pesticides) with soil quality degradation, posing risks to human health and ecosystem integrity.	Short-term to Long-term	Local	One-time to Intermittent	Small	Probable	Moderate	Moderate
5	Air Pollution	Emissions from ships, trucks, and machinery contribute to air pollution.	Short-term to	Local	One-time to	Small	Probable	Moderate	Moderate

Table 5.4: Summary of Impacts Based on Project Phases									
No	Aspect	Identified Impact	Impact Criteria						
			Duration	Extent	Frequency	Magnitude	Likelihood	Consequence	Significance
			Long-term		Intermittent				
6	Noise and Vibrations:	Port operations generate noise and vibrations, impacting nearby communities. Disruptions to sleep patterns and stress levels can occur.	Short-term to Long-term	Local	One-time to Intermittent	Small	Probable	Moderate	Moderate
		Nearby residents experience disturbances, affecting sleep and overall well-being.	Short-term to Long-term	Local	One-time to Intermittent	Small	Probable	Moderate	Moderate
7	**Climate Change Impact**	Port facilities vulnerable to climate-related hazards such as rising sea levels, storm surges, and extreme weather events	Short-term to Long-term	Local	One-time to Intermittent	Small	Probable	Moderate	Moderate
8	Traffic Congestion	Increased cargo handling can lead to traffic congestion around the port. Delays and inefficiencies affect transportation networks.	Short-term to Long-term	Local	Intermittent	Medium	Probable	Major	Moderate
		Infrastructure Strain: Roads and intersections become overloaded.	Short-term to	Local	Intermittent	Medium	Probable	Major	Moderate

Table 5.4: Summary of Impacts Based on Project Phases										
No	**Aspect**	**Identified Impact**	**Impact Criteria**							
			Duration	**Extent**	**Frequency**	**Magnitude**	**Likelihood**	**Consequence**	**Significance**
			Long-term						
8	Social	Potential disruption to roads and access routes, dust emissions affecting social receptors, and interruptions to nearby businesses and food vendors reliant on project activities.	Short-term to Long-term	Local	One-time	Small	Probable	Minor	Minor
		Social Disruption arising from ignoring community concerns which can lead to social unrest, protests, and strained relationships between the port authority and local residents.	Long-term	Local	One-time	Small	Likely	Major	Moderate
9	Health Risk	Air pollution and exposure to hazardous materials pose health risks. Port workers and nearby residents may be affected.	Short-term to Long-term	Local	Intermittent	Medium	Probable	Major	Moderate
		Exposure to Hazardous Materials with Chemical Risks- Handling hazardous cargo or materials poses health hazards and Contaminated Soil:- soil near the port may contain harmful substances.	Short-term	Local	Intermittent	Medium	Probable	Major	Moderate

Table 5.4: Summary of Impacts Based on Project Phases										
No	Aspect	Identified Impact	Impact Criteria							
			Duration	Extent	Frequency	Magnitude	Likelihood	Consequence	Significance	
10	Human Rights Impacts	Salient human rights abuses or risks could arise which include workers' rights, community and land rights, and environmental protection	Short-term to Long-term	Local	Intermittent	Medium	Probable	Major	Moderate	
C.	Decommissioning Phase									
1	Soil, Surface and Water Quality	Increased turbidity and suspended solids due to site clean-up and equipment removal in the case of increased sediment and debris being washed into adjacent Badagry creek.	Long-term	Local	One-time to Intermittent	Small	Probable	Minor	Minor	
2		Saline water intrusion into the freshwater aquifer system due to dewatering activities if not controlled or managed properly.	Short-term to Long-term	Local	One-time to Intermittent	Small	Probable	Minor	Minor	
3		Removal of structures and equipment can lead to bare soil, increasing surface runoff and the mobilization of pollutants into nearby surface water bodies if not managed properly	Short-term	Local	One-time to Intermittent	Small	Probable	Minor	Minor	

Table 5.4: Summary of Impacts Based on Project Phases

No	Aspect	Identified Impact	Impact Criteria						
			Duration	**Extent**	**Frequency**	**Magnitude**	**Likelihood**	**Consequence**	**Significance**
4	Social	Potential disruption to roads and access routes, dust emissions affecting social receptors, and interruptions to nearby businesses and food vendors reliant on project activities.	Short-term	Local	One-time	Small	Probable	Minor	Minor
5		Occupational health and safety issues from decommissioning construction activities including physical hazards, chemical hazards, confined spaces, exposure to dust and noise.	Long-term	Local	One-time	Small	Unlikely	Minor	Not Significant

5.3 Discussion of Some of Identified Impacts

SOIL QUALITY

- **Potential Impacts during Preconstruction and Construction**

  - **Soil, Surface and Water Quality; Potential Impact to Soil and Sediment Quality**
  -

Impact Description

During the Coastal Highway project, construction can impact soil in the following ways:

- Site development can cause soil compaction, erosion, and alter soil properties.
- Unintentional fuel and lubricant spills can contaminate soil and harm nearby ecosystems. –
- Fuel spills from machinery and transport can introduce hydrocarbons into the soil and affect groundwater quality.
- Oil and grease spills during offshore transportation can contaminate soil and impact vegetation.
- Improper disposal of debris and waste can lead to soil pollution and nutrient availability issues.
- Waste disposal outside designated areas can cause soil degradation and harm ecosystems.
- Soil contamination from hazardous materials can harm soil quality and human health.

Receptor Sensitivity

The Coastal Highway project has several sensitive receptors. These include residents and businesses near the project corridor nearby communities and camp site workers.

Residents and businesses near the project corridor are highly sensitive to dust, noise, and other impacts. Host communities are also sensitive receptors.

Nearby communities may experience air quality changes.

It is important to prioritize the health and well-being of these receptors. Effective mitigation measures must be implemented to minimize impacts.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Short-term to Long-term

Parameter	Classification
Extent	Local
Frequency	One-time to Intermittent
Magnitude	Small
Likelihood	Probable
Consequence	Moderate
Significance	Moderate

1.

♦ **Potential Impact to Coastal Morphology**

Impact Description

The Coastal Highway project can impact coastal morphology through specific activities such as land reclamation which has multifaceted impacts on coastal morphology, sediment dynamics, and ecosystem structure. The proposed land reclamation, particularly raising the land by 2.8 meters, as part of the Coastal Highway project, could have significant impacts which include altering the coastline, dredging: offshore soil disposal and loss of intertidal zones. Specifically, these include:

- Altering the coastline, changing the shape of shoreline, sediment transport, and erosion patterns.
- When sand is deposited during reclamation, it modifies the natural coastline, potentially leading to changes in beach profiles, headlands, and bays.
- Disposing of unsuitable soil at an offshore site can disturb the seabed, altering sediment distribution, affecting the stability of the seabed, and marine habitats.
- The newly reclaimed land replaces intertidal zones, impacting the habitat for various organisms. In summary, land reclamation has multifaceted effects on coastal morphology, sediment dynamics, and ecosystem structure.
- Soil salinization often occurs in reclamation regions due to the deposition of salt-rich sediments

Receptor Sensitivity

The Coastal Highway project has several sensitive receptors:

- The Coastal Highway project has several sensitive receptors. These include residents and businesses near the project corridor nearby communities and camp site workers.
- Residents and businesses near the project corridor are highly sensitive to dust, noise, and other impacts. Host communities are also sensitive receptors.
- Habitats within the highway coastline are subject to significant disturbance from construction activities.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Short-term to Long-term
Extent	Local
Frequency	One-time to Intermittent
Magnitude	Small
Likelihood	Probable
Consequence	Moderate
Significance	Moderate

2.

3.

♦ **Flooding, Erosion and Sedimentation Impact**

Impact Description

The proposed project activities, particularly raising the land by 2.8 meters may meet the development needs, but it is also likely to introduce various risks related to flooding, erosion, and sedimentation as outlined below:

- Flooding Impact: Land reclamation can exacerbate coastal flooding by altering the natural coastline. It makes the area more susceptible to inundation during storm surges and high tides, which increases vulnerability. The effects of continued land reclamation are not immediate, but they are profound and can lead to a dramatic increase in expected annual inundation over time.
- Erosion Impact: Land reclamation disrupts natural sediment transport patterns and alters coastal dynamics. It removes coastal habitats, reducing their ability to act as buffers against erosion. The newly reclaimed land may be more susceptible to erosion due to altered wave action and sediment availability. Reclamation often involves dredging and excavation, which removes sediments from the seabed. This loss of sediment can affect adjacent coastal areas and contribute to erosion.
- Sedimentation Impact: Land reclamation also disturbs the balance of sediment deposition and erosion. Sediments that would naturally replenish coastal areas are diverted elsewhere during reclamation, leading to a disturbed sediment balance. Altered sediment dynamics can impact downstream ecosystems, affecting water quality, habitats, and marine life. Accumulation of sediments in newly reclaimed areas may require ongoing maintenance dredging to keep navigation channels clear, posing navigational challenges.

Receptor Sensitivity

At risk due to these potential impacts are local residents, businesses, and ecosystems within the project corridor.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Short-term
Extent	Local
Frequency	One-time to Intermittent
Magnitude	Small
Likelihood	Probable
Consequence	Minor
Significance	Minor

♦ **Potential Impact on Marine Environment, Hydrology, and Ecosystem Services**

The Coastal Highway is likely to impacts on the marine environment, hydrology, and ecosystems in the following ways:

Marine Environment:

- **Habitat Destruction**: The construction activities associated with the coastal highway project pose a threat to marine habitats. These habitats are crucial for various species, including fish, crustaceans, and other marine organisms. Unfortunately, the destruction of these habitats is likely to occur, albeit at a low level.
- **Pollutants**: The construction activities introduce potential pollutants into the marine environment. These pollutants include oil spills, heavy metals, and other toxic substances. Such contamination can harm marine life and disrupt the delicate balance of ecosystems.

Hydrology:

- **Altered Water Flow**: The Construction activities may modify natural water flow patterns. This alteration affects sediment transport, nutrient cycling, and overall hydrological processes. The changes in water flow can have cascading effects on the entire ecosystem.

- **Sediment Accumulation**: The construction activities may cause sediment accumulation, leading to changes in water depth and clarity. Excessive sedimentation can smother benthic habitats (the habitats at the bottom of water bodies) and adversely affect water quality.

Ecosystem Impact:

- **Loss of Protective Services**: Natural coastal features like mangroves and salt marshes play a crucial role in protecting against storm surges and erosion. However, construction activities at the port could reduce these protective services, leaving the coastline more vulnerable to natural forces.
- **Deterioration of Ecosystem Services**: Community members make use of the coast as an ecosystem service. Its deterioration can affect their living conditions.

Receptor Sensitivity

Marine organisms are sensitive to habitat destruction, which can affect their survival. Pollution, altered water flow, sediment accumulation, and loss of natural coastal features can also disrupt marine ecosystems. To ensure sustainable use of resources, balancing development with conservation is crucial.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Short-term to Long-term
Extent	Local
Frequency	One-time to Intermittent
Magnitude	Small
Likelihood	Probable
Consequence	Moderate
Significance	Moderate

4.

♦ **Potential Impact due to pre-construction and construction activities**

Impact Description

Potential Impact due to pre-construction and construction activities associated with the **Lagos-Calabar Coastal Highway Project** can significantly impact aquatic ecosystems. The impacts could be summarised as follow:

1. **Water Pollution Sources**:

During construction, sediments, chemicals, and pollutants from machinery, materials, and site activities can enter nearby water bodies. Concentrations of COD (Chemical Oxygen Demand) and Fecal Coliform in labor camp wastewater may exceed national standards Discharged overflow dredging water contains high levels of turbidity and TSS (Total Suspended Solids), affecting surface water quality

2. **Direct Impacts on Aquatic Ecosystems**:

Increased turbidity due to sediment runoff can reduce light penetration, affecting photosynthesis and aquatic plant growth. Pollutants like heavy metals, hydrocarbons, and pharmaceuticals can harm aquatic organisms, disrupting ecosystems.

Receptor Sensitivity

1. **Water Pollution Sources:**

During construction, various pollutants can find their way into nearby water bodies. These include sediments, chemicals, and contaminants from machinery, materials, and site activities.

Concentrations of COD (Chemical Oxygen Demand) and Fecal Coliform in labor camp wastewater may exceed national standards. These parameters are indicators of organic pollution and bacterial contamination, respectively.

Additionally, the discharge of overflow dredging water can introduce high levels of turbidity (cloudiness) and TSS (Total Suspended Solids) into surface water, affecting water quality.

2. **Direct Impacts on Aquatic Ecosystems:**

Increased turbidity resulting from sediment runoff can reduce light penetration in water. This reduction in available light affects photosynthesis, which is crucial for aquatic plant growth.

Pollutants such as heavy metals, hydrocarbons, and pharmaceuticals can directly harm aquatic organisms. These substances disrupt ecosystems by affecting the health and behavior of fish, invertebrates, and other aquatic life.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Short-term to Long-term
Extent	Local
Frequency	One-time to Intermittent
Magnitude	Small

Likelihood	Somewhat Likely
Consequence	Moderate
Significance	Minor

5.

- **Potential Impact due to Mobilization of Pollutants from Contaminated Land Encountered during Earthworks**

Impact Description

The Coastal Highway Project may encounter contaminated land during excavation, grading, and dredging. When contaminated soil is disturbed, it can lead to an increase in the release of pollutants, which may include harmful substances such as heavy metals and hydrocarbons.

Receptor Sensitivity

The receptor sensitivity for the potential risks of encountering contaminated land during Project activities includes the following sensitive receptors:

- Local Residents: These individuals are vulnerable to changes in soil and water quality, and may be affected by any contamination that may arise as a result of the project.
- Aquatic Ecosystems: Flora and fauna in nearby water bodies may also be impacted by any contamination that may occur during the project.
- Human Health: People living or working in the vicinity of the project may also be susceptible to adverse health effects as a result of exposure to any contaminants that may be present.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Short-term to Long-term
Extent	Local
Frequency	One-time to Intermittent
Magnitude	Small
Likelihood	Somewhat Likely

Consequence	Moderate
Significance	Minor

AIR QUALITY

- **Potential Impact on Ambient Air Quality**

Impact Description

According to the air quality assessment, pollutant concentrations are currently within the guidelines set by FMEnv. Pollutants such as particulate matter (dust), CO, NO_2, SO_2, and Hydrocarbons were all below equipment detection limits. These levels meet the statutory guidelines.

However, the project might have an impact on the ambient air quality due to various construction activities such as demolition, concrete pouring, welding, and heavy equipment operation. These activities are known to contribute to air pollution. Moreover, the transportation of construction materials through trucks can also increase air pollution. The two ancillary sites in existing industrial areas where activities are taking place may also release pollutants into the air.

Receptor Sensitivity:

During the project activities, the following are the impact-sensitive receptors related to air quality:

1. **Construction workers**: They work at the construction site and are exposed to dust, emissions from equipment, and other pollutants. Proper protective measures are crucial for their health.
2. **Local Communities:** Residents living near the project corridor are sensitive receptors. Increased construction activities affect their air quality, and dust, noise, and emissions impact their well-being.
3. **Pedestrians and Commuters:** People passing by the construction areas are indirectly affected. Increased truck movements and dust can harm their air quality. Proper traffic management minimizes exposure.
4. **Workers in Adjacent Areas:** Employees working in nearby industrial facilities are receptors. Emissions from construction activities may affect their workplace air quality, and monitoring and mitigation are essential.
5.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive

Parameter	Classification
Duration	Short-term
Extent	Local
Frequency	One-time to Intermittent
Magnitude	Small
Likelihood	Probable
Consequence	Minor
Significance	Minor

- **Impacts of Other Pollutants/Emissions**

Impact Description

Increased construction traffic and the operation of heavy machinery and equipment can result in elevated vehicle emissions, including nitrogen oxides (NOx), volatile organic compounds (VOCs), and particulate matter (PM), contributing to air pollution. These pollutants have been demonstrated to affect human health from acute and long-term exposure adversely.

The applicable WHO Ambient Air Quality Guidelines for $PM_{2.5}$ and PM_{10} are summarized below.

TABLE 5.5: WHO AMBIENT AIR QUALITY GUIDELINES

Pollutant	Averaging period	Guideline Value
NO2	1 hour	200
	Annual	40
SO2	10 minute	500
	24 hour	20
PM2.5	24 hour	25
	Annual	10
PM10	24 hour	50
	Annual	20

Receptor Sensitivity

The receptors of concern for air quality impacts will be people present in the Area of Influence (AOI). In this case, the most affected air quality-sensitive receptors will be residents in close proximity to the project footprint. This includes residents and businesses near the project area, as human health impacts from particulate matter can occur from both short-term and long-term exposure to elevated levels of particulate matter.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Short-term
Extent	Local
Frequency	Intermittent
Magnitude	Small
Likelihood	Planned
Consequence	Minor
Significance	Minor

6.

♦ **Potential Impact on Human Health Associated with Combustion Emissions**

Impact Description

The key sources of combustion-related emissions from the Project include:

- Operation of diesel and petrol-fired project traffic and equipment; and
- Operation of power generators.

For these types of combustion activities, the key pollutants of concern are NO_2, SO_2, PM_{10}, and $PM_{2.5}$. These pollutants have been demonstrated to adversely affect human health from both acute and long-term exposure.

The World Bank EHS Guidelines require that project sources of emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and that emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines (25% is used as a general rule).

The applicable WHO Ambient Air Quality Guidelines for $PM_{2.5}$ and PM_{10} are summarized in Table 5.6

TABLE 5.6: WHO AMBIENT AIR QUALITY GUIDELINES

Pollutant	Averaging period	Guideline Value

NO2	1 hour	200
	Annual	40
SO2	10 minute	500
	24 hour	20
PM2.5	24 hour	25
	Annual	10
PM10	24 hour	50
	Annual	20

Receptor Sensitivity

The receptors of concern for air quality impacts will be people present in the AOI. The most affected air quality sensitive receptors in this case will be residents in close proximity to the project footprint. This includes residents and businesses near the project corridor, as human health impacts from particulate matter can occur from both short-term and long-term exposure to elevated levels of particulate matter.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Short-term
Extent	Local
Frequency	Intermittent
Magnitude	Small
Likelihood	Planned
Consequence	Minor
Significance	Minor

- **Noise and Vibrations**

1. Potential Impact on Ambient Noise Quality

Impact Description

During the construction phase, noise levels may temporarily increase due to use of heavy machinery and other construction-related activities. Proper planning and scheduling can mitigate this impact.

The applicable WHO Ambient Noise level Guidelines are summarized below. It should be noted that the ambient noise level of the project locations were generally within the limits. The noise generated activities due to the construction-related activities could potentially raise the levels above this and thus impact negatively on the receptors. Elevated noise levels, particularly in times of expected comparative quiet such as night-time and weekends, can be a source of stress and irritation and adversely affect human health.

Table 5.7: Who Noise Level Guidelines

Receptor Type	**One Hour (dBA)**	
	Day-time (07:00-22:00)	**Night-time (22:00 – 07:00)**
Residential, institutional, or educational	55	45
Industrial or commercial	70	70

Receptor Sensitivity

The noise impacts of the construction of TCIPC's quay walls will affect the receptors of concern, including the port communities and nearby residents within the Area of Interest (AOI). The individuals most affected by noise sensitivity will be those located within the project footprint in the port and ancillary facilities. This includes residents and businesses near the ancillary sites. Human health impacts from noise can occur from both short-term and long-term exposure to elevated levels of noise. During the rehabilitation process, port operations may be disrupted, leading to short-term inconvenience and noise-related stress for workers and residents. There is also the possibility that delays or closures caused by the rehabilitation process could affect vessel traffic. Frustrated ship crews or harbor authorities could contribute to additional noise.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	**Classification**
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Short-term

Parameter	**Classification**
Extent	Local
Frequency	Intermittent
Magnitude	Small
Likelihood	Probable
Consequence	Minor
Significance	Minor

2.

- **Potential Impact to Community Structures from Vibration Emissions from Construction Activities**

The construction activities of the Coastal Highway Section 2 may impact nearby community structures. The potential effects include ground vibrations from pile driving, equipment operation, and traffic, which can affect nearby buildings and infrastructure. Sensitive structures are particularly vulnerable. Extended exposure to construction-related vibrations can lead to discomfort and stress, and noise pollution can affect quality of life. Safety precautions are necessary if the construction site is close to residential areas due to risks from falling debris, dust, and heavy equipment movement.

Receptor Sensitivity

Construction activities can cause ground vibrations, noise pollution, discomfort, and stress to host communities and residents close to the project activities and may pose safety risks such as falling debris, dust, and heavy equipment movement. Safety measures are essential.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	**Classification**
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Short-term
Extent	Local
Frequency	Intermittent
Magnitude	Medium

Likelihood	Probable
Consequence	Major
Significance	Major

3.

♦ **Potential Impacts from Project Generated Waste Affecting Local Environment or Community Receptors**

Impact Description

During the project development and construction, the demolition process and construction would involve breaking down existing structures on the project Right of Way (RoW), and removal of vegetation where necessary. These would result in the following that have the potential to impact the local environment and community receptors thus:

- **Construction Debris**: This includes concrete, steel reinforcement bars, formwork, and other construction-related Waste.
- **Excavated Soil:** Digging and excavation activities may yield soil and sediment that needs proper handling and disposal.
- **Packaging Waste:** Packaging materials from construction supplies (such as cement bags, plastic wraps, and pallets) will contribute to the waste stream.
- **Chemical Waste:** Proper disposal of chemical waste is crucial as construction often involves using chemicals (e.g., oil, paints, adhesives, sealants).
- **Metal Scraps:** Any metal waste from cutting, welding, or shaping processes.
- **Wood Waste:** Timber used for formwork, scaffolding, or temporary structures will generate wood waste.
- **Plastic Waste:** Plastic pipes, sheets, and other components contribute to the overall waste volume. Electrical and Electronic Waste: Wiring, cables, and electronic components may need proper disposal.
- **Hazardous Waste:** hazardous materials such as asbestos-containing materials may be encountered during construction. This also includes medical waste from the site clinic.

Receptor Sensitivity

The sensitivity of receptors to each waste type during every project phase to minimize environmental impact and protect human health includes:

- Construction Workers and local residents near the project corridor may experience noise, dust, and vibrations from demolition activities which may affect their health and well-being.
- Water Bodies: Demolition waste runoff may affect water bodies nearby or the ocean with contaminants from debris that could harm aquatic ecosystems.
- Construction Workers: hazardous materials could impact the health and safety of construction workers.
- Local Communities: Noise, dust, and traffic disruptions from construction activities can impact nearby residents.

- Marine Environment: Construction waste entering the water may harm marine life, including fish, and other organisms.
- Wildlife: Although there are no sensitive ecological habitats along the project corridor, demolition activities could impact species like birds and small mammals that lurk around.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Long-term
Extent	Local
Frequency	Intermittent
Magnitude	Medium
Likelihood	Probable
Consequence	Moderate
Significance:	Moderate

4.

- **Post-Construction Clean-Up Project Generated Waste Affecting Local Environment or Community Receptors during the Phases of the project**

Impact Description

Once the construction work is complete, the project area will need thorough cleaning and restoration. Waste generated during demobilization includes:

- Unused Materials: Any leftover construction materials that are no longer needed.
- Temporary Structures: Disassembled scaffolding, formwork, and other temporary structures.
- Equipment Waste: Disposal of machinery, tools, and equipment used during construction.
- Residual Soil and Sediment with chemical waste.
- Soil and sediment remaining after excavation and backfilling.
- General Debris: Miscellaneous Waste accumulated during the project.

Receptor Sensitivity

- Local Residents and Workers: unused materials, equipment, and debris could impact the safety of local residents and workers.
- Ecological Systems: Soil and sediment remaining after clean-up may affect local ecosystems.
- Water Quality: poor management of residual chemicals or contaminants could pollute the water bodies

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Long-term
Extent	Local
Frequency	Intermittent
Magnitude	Medium
Likelihood	Probable
Consequence	Moderate
Significance	Moderate -

- **HYDROLOGY**

♦ **Spills or Leaks Resulting in Contamination of Groundwater and Surface Water**

Impact Description

The Coastal Highway Project would involve the use of equipment and machinery which use fuels or hydraulic fluids and have the potential to spill leading to the release of hydrocarbons. Contamination Risk: The soil, groundwater, and surface water in the area can become contaminated by these.

Receptor Sensitivity

The aquatic ecosystems, including flora and fauna living in and around the coastal shoreline environment, are sensitive receptors that can be affected by changes in pH. Aquatic organisms (fish, invertebrates, and plants) are highly sensitive to changes in pH. Local communities utilize the water body for various activities such as fishing and leisure, hence extreme pH of surface water poses potential threats to their health and well-being.

The Project may be associated with potential risks of spills and leaks. It is critical to manage erosion and maintain water quality to minimize adverse effects on sensitive receptors. These receptors include local residents who are vulnerable to changes in water quality and sedimentation, as well as aquatic ecosystems which include flora and fauna in water bodies.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Short-term to Long-term
Extent	Local
Frequency	One-time to Intermittent
Magnitude	Small
Likelihood	Probable
Consequence	Moderate
Significance	Moderate

- **BIODIVERSITY**

1. Potential Impact on Ecosystem Services

Impact Description

- During construction, ecosystem services such as soil stability, nutrient cycling, and habitat provision may be disrupted due to land clearing, excavation, and infrastructure development.
- Sediment runoff and chemical pollutants from construction activities can degrade water quality, affecting aquatic ecosystems and their services.
- Dust and emissions from construction machinery can impact air quality, potentially affecting respiratory health and vegetation.

It should be noted that proposed development does not involve extensive land reclamation in proximity to sensitive ecosystems. Thus, the scope of land reclamation activities, and the assessment and management of associated environmental impacts, incorporated into the project's design are considered mitigation efforts.

Receptor Sensitivity

The receptor sensitivity includes soil stability, nutrient cycling, and habitat provision, which were disturbed. Water quality is degraded, thus affecting aquatic ecosystems and their services. Air quality was impaired, potentially affecting respiratory health and vegetation.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Long-term
Extent	Local
Frequency	One-time
Magnitude	Small
Likelihood	Unlikely
	Sensitive Receptors
Consequence	Minor
Significance	Not Significant

2.
3.

♦ **Potential Impact on Avifauna during construction phase**

Impact Description

- During construction, avifauna may experience habitat loss due to excavation, and infrastructure development. Sensitive bird species that rely on specific vegetation types or nesting sites could be adversely affected.
- Construction activities generate noise, vibrations, and human presence. Birds may abandon nesting sites or alter their behavior in response to disturbances.
- Birds flying near construction zones face an increased risk of collision with machinery, structures, or vehicles.

Receptor Sensitivity

Sensitive bird species that rely on specific vegetation types or nesting sites could be adversely affected. Birds may abandon nesting sites or alter their behavior in response to disturbances. Birds flying near construction zones face an increased risk of collision with machinery, structures, or vehicles.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Long-term
Extent	Local
Frequency	One-time
Magnitude	Small
Likelihood	Unlikely
	Sensitive Receptors
Consequence	Minor
Significance	Not Significant

- **Potential Impact of dredging and soil placement during Construction phase**

Impact Description

The construction of the road requires winning sand from the sea which placing the dredges the corridor and then also for the s**horeline reclamation to** address the related environmental challenges. It is expected that Up to 8 meters of sand is being dredged from the sea would be used to reclaim lost shoreline areas. This process involves creating new land by depositing dredged material along the coast, effectively expanding the available space for infrastructure development.

Dredged material would be valuable resource for the proposed project. It includes sediment like clay, silt, sand, gravel, and organic matter. The **Applications would include: Flood and Coastal Protection (**Reclaiming lost shoreline areas), **Habitat Improvement (**Enhancing ecosystems and related services), **Land Subsidence Mitigation (**Stabilizing vulnerable coastal areas)

Dredging ensures that the highway has a stable foundation by providing suitable soil for construction. It allows for the creation of embankments, berms, and other protective features. By reclaiming land from the sea, the project maximizes available space for road construction and associated facilities.

Dredging stirs up sediment, affecting water clarity and potentially smothering sensitive habitats like coral reefs and seagrass beds. The removal of sediment can disrupt habitats where marine organisms live, feed, and breed. Dredged material may contain pollutants, affecting water quality. Dredging operations can create underwater noise and vibrations, which may stress or harm marine life.

Receptor sensitivity

Receptor sensitivity to sea dredging and soil placement in the context of environmental impact include m**arine Life and turbidity.** Turbidity refers to the effect of suspended sediment measured by a turbidity sensor. It acts as a proxy for **suspended sediment concentration.** Elevated turbidity due to dredging affects sensitive receptors, including **Sea Grass Habitats:** These underwater meadows are vulnerable to changes in suspended sediment concentrations. Sediment deposition can harm coral reefs by reducing light penetration and affecting their health.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Short-term
Extent	Local
Frequency	Intermittent
Magnitude	Small
Likelihood	Planned
Consequence	Major
Significance	Moderate

- **SOCIAL**

♦ **Potential Impact on Population Resettlement/Displacement**

Impact Description

The proposed alignment Section 2 is made up of mixed development. To construct the highway along this path, existing properties will need to be destroyed.

The highway's construction may disrupt local lifestyle and values, affecting communities residing near the route. Social services, such as healthcare, education, and utilities, may need to be reconfigured to accommodate the displaced population. Land use rights and values will also be impacted, as existing landowners lose their properties. The highway aims to improve cross-country connectivity and foster trade relations. However, it may alter migration patterns as people move away from affected areas. Settlement patterns could change due to the highway's impact on property availability and accessibility.

Receptor Sensitivity

The receptors include owners of businesses and properties and assets along the alignment such and other local residents who reside in the vicinity of the alignment. Also are pedestrians and commuters who use the nearby roads and pathways, property owners whose buildings and structures are situated near the project corridor.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Highly Sensitive
Duration	Short-term
Extent	Local
Frequency	Intermittent
Magnitude	Medium
Likelihood	Somewhat Likely
Consequence	Major
Significance	Moderate

- Potential Road Alignment Siting/Routing On Social Aspect

Impact Description

The highway's alignment passes through mixed development which hold exceptional aesthetic value. It would also include demolitions of some assest for road construction. Lagos is densely populated, and the highway's construction may exacerbate congestion. The highway's path intersects with tourism sites, including beaches and coastal areas. High traffic volume could lead to spontaneous markets along the road. The highway's construction is likely to disrupt existing ecosystems and communities.

Receptor Sensitivity

The sensitivity of receptors relates to the businesses and asset owners and residents and other stakeholders who are involved in various activities in the corridor alignment

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Long-term
Extent	Local
Frequency	One-time
Magnitude	Small
Likelihood	Unlikely
	Sensitive Receptors
Consequence	Moderate
Significance	Moderate

♦ **Potential Impact on Occupational Health and Safety**

Impact Description

Several occupational health and safety issues may arise during the construction phase of the Coastal Highway Project. These include:

- Physical Hazards: Construction sites involve heavy machinery, lifting equipment, and manual labor. Workers face risks such as falls, collisions, and being struck by moving objects.
- Chemical Hazards: Exposure to hazardous substances like asbestos, PCBs, and mercury can occur during construction and demolition.
- Exposure to Dust: Dust from construction materials and demolition waste can pose respiratory risks.
- Exposure to Noise: Construction sites are noisy environments due to machinery, equipment, and tools.

Receptor Sensitivity

The sensitivity of receptors relates to the workers involved in various aspects of the construction who are at risk and directly or indirectly exposed to all the hazards that could manifest.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	**Classification**
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Long-term
Extent	Local
Frequency	One-time
Magnitude	Small
Likelihood	Unlikely
	Sensitive Receptors
Consequence	Moderate
Significance	Moderate

♦ **Potential Impact on Road Traffic and Transport Risk of Project Vehicle Traffic Accidents**

Impact Description

The Project poses a risk of vehicle traffic accidents due to increased traffic volume during construction on employees, nearby residents, and businesses. Various types of vehicular accidents can occur due to the nature of the work and the presence of heavy machinery and vehicles.

- **Collisions**: Collisions between vehicles, such as bulldozers, excavators, dump trucks, and other heavy machinery, can occur due to limited visibility, inadequate signaling, or miscommunication between operators.
- **Rollovers**: Rollover accidents can happen when heavy equipment or vehicles lose stability and tip over due to uneven terrain, improper loading, or excessive speed. Rollovers can result in serious injuries or fatalities to operators and nearby workers.
- **Runovers**: Runover accidents occur when a person is struck or run over by a moving vehicle or piece of equipment. These accidents can happen due to blind spots, improper backing maneuvers, or failure to observe safety protocols.
- **Crush Injuries**: Crush injuries can occur when workers are caught between moving vehicles or pinned against fixed structures by heavy machinery. This can happen during loading, unloading, or maneuvering operations, especially in congested or confined work areas.
- **Falls from Vehicles**: Workers may fall from vehicles or machinery while entering, exiting, or working on elevated platforms. Falls can result from slippery surfaces, unstable footing, or lack of proper safety restraints and harnesses.

Nearby residents

- **Loss of Life and Injury:** The most immediate and severe impact of vehicular accidents is the potential loss of life and injury to workers, bystanders, and community members. Fatalities and injuries can have long-lasting emotional, social, and economic consequences for individuals and their families.

Businesses

- **Disruption of Business Operations**: Vehicular accidents can disrupt the operations of businesses involved in the pre-construction phase of the project, including contractors, subcontractors, suppliers, and service providers. Accidents may result in work stoppages, delays, and additional costs associated with accident investigations, cleanup, and legal proceedings.

At the construction stage, the Project may pose a risk of vehicle traffic accidents due to increased traffic volume during construction and operations. The **Risk Description** include:

- **Vehicle Traffic Accidents**: During construction and operations, there will be increased vehicular movement within the project area.
- **Accident Risk**: The higher the traffic volume, the greater the risk of accidents involving project vehicles.

Receptor Sensitivity

The project traffic poses a significant risk to the safety of all road users as well as nearby individuals and properties. This is mainly due to high receptor sensitivity in the area. The receptors include local residents who reside in the vicinity of the project, pedestrians and commuters who use the nearby roads and pathways, property owners whose buildings and structures are situated near the project area and environmental features such as natural elements including flora, fauna, and water bodies that may be affected by the project activities.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Highly Sensitive
Duration	Short-term
Extent	Local
Frequency	Intermittent
Magnitude	Medium
Likelihood	Somewhat Likely
Consequence	Major
Significance	Moderate

♦ **Potential Impact on Community Health and Safety at Construction Phase**

Impact Description

During the construction phase, several community health and safety issues may arise such as the following

- Physical Injury and Accidents: Construction sites can pose risks due to heavy machinery, construction materials, and ongoing activities.
- Exposure to Hazardous Materials: Construction materials (e.g., paints, solvents, asbestos) can release harmful substances.
- Respiratory Effects from Air Emissions: Dust, emissions, and pollutants generated during construction can impact respiratory health.

- Spread of Communicable Diseases: Population influx during construction can increase disease transmission.
- Gender Based issues, Sexual harassment and exploitation, violence against children etc
- Changes to Diet and Subsistence Foods: Construction may disrupt local food sources and dietary patterns.
- At-Risk Populations: Communities relying on subsistence farming or
- Strain on Local Health Services and Infrastructure: Increased population due to construction can overwhelm existing healthcare facilities.

Receptor Sensitivity

Construction Workers, Nearby Residents, and Pedestrians:

- These groups are considered receptors because they are close to a site where environmental exposures occur. Construction workers who spend significant time at the site are particularly vulnerable due to prolonged exposure.
- Nearby residents and pedestrians may also be affected, especially if the construction area is densely populated or close to residential neighborhoods. Their exposure can result from dust, noise, emissions, or other construction-related activities.

Residents Living Near the Construction Area:

- The construction activities directly impact these individuals. Their homes and daily lives are near the site, making them more susceptible to any pollutants released during construction.
- Dust, noise pollution, and potential chemical emissions can affect their health and well-being.

Both Construction Workers and Local Residents:

- The intersection of these two groups highlights the shared risks associated with the project. Construction workers face occupational hazards, while residents experience environmental exposure.
- It's crucial to consider both groups when assessing the overall impact and implementing protective measures.

Communities Relying on Subsistence Farming or Fishing:

- These communities often have a strong connection to their environment. Subsistence farming and fishing rely on clean air, water, and soil.
- Construction activities can disrupt their livelihoods by contaminating water sources, depleting fish populations, or affecting crop quality.

Local Residents and Vulnerable Groups:

- Vulnerable populations, such as children, the elderly, pregnant individuals, and those with pre-existing health conditions, are at higher risk.
- Residents, especially vulnerable groups, need special attention in exposure assessments and risk management.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Long-term
Extent	Local
Frequency	One-time
Magnitude	Small
Likelihood	Unlikely
Consequence	Minor
Significance	Minor

- **Potential Impacts on Socio-economic Opportunity**

Impact Description

The Project will improve infrastructure, create direct and indirect jobs, foster local sourcing, and stimulate economic growth. The Potential Impacts on Socio-economic Opportunity with regard to jobs shows the direct jobs will be created for construction activities and project office operations and management.

Indirect jobs will be created for upstream industries that manufacture construction site supplies. Unskilled jobs will be sourced locally, fostering growth and supporting local employment. The project will invest in the economy, stimulating growth by increasing income circulation and consumption.

Short-term employment will provide a windfall for workers, allowing them to invest wisely or set up micro-projects. The project will also provide valuable skill development opportunities for previously unqualified personnel.

Receptor Sensitivity

The receptors that would be impacted include the Host Communities, Contractor's Staff, and residents of the surrounding communities, all of whom are considered highly sensitive receptors.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Positive
Receptor Sensitivity	Highly Sensitive
Duration	Short-term
Extent	Regional
Frequency	Intermittent
Magnitude	N/A
Likelihood	Planned
Consequence	N/A
Significance	Positive

♦ **Potential Infringement on Workers' Human Rights**

Impact Description

Under the UN's Universal Declaration of Human Rights,

"Everyone has the right to work, to free choice of employment, to just and favourable conditions of work and to protection against unemployment."

It is important to prioritize safe working conditions and fair labour practices to ensure that basic human rights are being upheld.

The Impact description include:

- Safe Working Conditions: Workers should have access to a work environment that prioritizes their health and safety.
- Fair Labour Conditions: This includes providing fair wages, reasonable working hours, and protection against unemployment.

Receptor Sensitivity

Due to high workforce density during peak construction activities, the workforce will be at its highest with regard to the risk factors**.** So it is important to ensure that safety measures are in place to accommodate the increased number of workers and take the rights of their rights into cognizance.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Highly Sensitive
Duration	Long-term
Extent	Regional
Frequency	Intermittent
Magnitude	Medium
Likelihood	Somewhat Likely
Consequence	Major
Significance	Moderate

- **Potential Impact on Local Content and Procurement**

The Coastal Highway Project will lead to direct local procurement, including meals for workers, increased demand for transportation services, and ad hoc purchases of locally supplied goods and services. These opportunities for local procurement serve as a direct investment in the immediate economy, benefiting local trading and service providers and contributing to profitability and income growth. Ultimately, fostering local procurement not only supports businesses but also strengthens the economic fabric of the community.

Receptor Sensitivity

The immediate traders and residents are the most affected members of the community, given their direct dependence on local trade.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Positive
Receptor Sensitivity	Highly Sensitive
Duration	Short-term
Extent	Regional
Frequency	Intermittent
Magnitude	Small
Likelihood	Planned

Parameter	Classification
Consequence	N/A
Significance	Positive

♦ **Potential Impact related to Influx of People to the Project Area**

Impact Description

It is predicted that the project may result in an influx of people into the project area. Overall, this influx of people can be a catalyst for positive change, driving economic development, social progress in the communities. During the field work for this ESIA study, community members confessed that they do not have problems with the influx of people into their towns. Many noted that such influx will bring in positive change. A resident of one the communities noted that such influx will improve the local domestic economy. They do not really foresee an increase in rent of residential building, with little or no effect on local culture. It will not affect the social cohesion the communities enjoy.

Receptor Sensitivity

The influx of migrants is positive and positively impactful on the residents of the communities.

Impact Significance (Pre-Mitigation)

Parameter	Classification
Nature of Impact	Positive
Receptor Sensitivity	Highly Sensitive
Duration	Short-term
Extent	Regional
Frequency	Intermittent
Magnitude	Small
Likelihood	Planned
Consequence	N/A
Significance	Positive

- **5.3.2 Impact During Operation**

➢ **Potential Impact to Social Issues**

Impact Description

The following could result during operations.

- Increased Vehicular Movement - Increased vehicular movement on better road surfaces will lead positive impact on the host communities thus improving transportation networks.
- Access to amenities – Educational, health and social amenities will become easily accessible.
- Improvement in trade and commerce – businesses and trade will be enhanced as access to places, goods and services becomes easily realizable.

Receptor Sensitivity

The receptor sensitivity related to the impacts are:

- Nearby commuters, businesses, and emergency services are sensitive to traffic flow disruptions which are thus improved
- The quality of life of residents and businesses relying on well-functioning roads are greatly improved.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Short-term to Long-term
Extent	Local
Frequency	One-time to Intermittent
Magnitude	Small
Likelihood	Probable
Consequence	Positive
Significance	Positive

5.3.2 Decommissioning (Site Clean-Up and Equipment Removal after Construction)

- **Soil, Surface and Water Quality**

1. **Increased Turbidity and Suspended Solids Due to Site Clean-Up and Equipment Removal**

Impact Description

Activities such as site clean-up, restoration and removal of construction equipment during the demobilization phase will increase turbidity and suspended solids due to increased sediment and debris being washed into drains and other water channels. Improper handling or containment of residual fuels, oils, and other fluids from the construction equipment can lead to the contamination of groundwater resources. Turbidity and increased suspended solids from demobilization operations can lead to changes in aquatic food webs and disruption of sensitive habitats and ecosystems through changes in water clarity and sedimentation processes. It can also cause blockage or obstruction of the gills and respiratory systems of aquatic organisms, such as fish and invertebrates, leading to respiratory stress and potentially death.

Receptor Sensitivity

Coastal waters are extremely sensitive receptors because they sustain essential marine habitats and are used for navigation, pleasure, and economic purposes. Groundwater aquifers are relatively sensitive receptors because they might be exploited for water supply or linked to surface water sources.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Long-term
Extent	Local
Frequency	One-time to Intermittent
Magnitude	Small
Likelihood	Probable
Consequence	Minor
Significance	Minor

2.

- **Saline Water Intrusion into the Freshwater Aquifer System: Due to Dewatering Activities**

Impact Description

Dewatering activities performed during the demobilization process can reduce the groundwater table and produce drawdown zones in the aquifer system. These drawdown zones can raise the hydraulic gradient, allowing salty water from surrounding sources, such as saltwater or brackish groundwater, to enter the freshwater aquifer. If the dewatering process is not correctly controlled, or the extracted groundwater is not properly disposed of or refilled, salt water may enter the freshwater aquifer.

Receptor Sensitivity

The groundwater aquifers in the vicinity of the project area of influence are highly sensitive receptors, as they may be used for water supply or be connected to surface water bodies. The surface water bodies within the coastal environment are also sensitive receptors, as they support critical marine and estuarine ecosystems and are used for various activities.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Short-term to Long-term
Extent	Local
Frequency	One-time to Intermittent
Magnitude	Small
Likelihood	Probable
Consequence	Minor
Significance	Minor

- **Increased surface runoff and pollutant mobilization**

Impact Description

The removal of temporary structures, construction equipment, and stockpiles during demobilization can result in bare, exposed soil. These exposed soils are more prone to erosion and can cause increased surface runoff, which transports sediments and contaminants into neighboring surface water bodies. Surface runoff can become contaminated if construction debris, leftover materials, and hazardous wastes are not properly managed or disposed of during demobilization. If these pollutants are not confined and managed effectively, they can become mobilized and transported by increasing surface water flows. Changes in site topography and landscaping, as well as the removal or alteration of temporary drainage infrastructure during demobilization, can all affect natural surface water flow patterns. This can reroute or concentrate surface runoff, potentially increasing its volume and velocity, as well as its capacity to mobilize and carry contaminants.

Receptor Sensitivity

The receptors and adjoining ecosystems, and perhaps groundwater resources, are extremely sensitive, since increased surface runoff and pollutant mobilization can have serious consequences on water quality and the general health of the aquatic environment.

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Short-term
Extent	Local
Frequency	One-time to Intermittent
Magnitude	Small
Likelihood	Probable
Consequence	Minor
Significance	Minor

♦ **Social**

Potential Impact on Socio-economics

Impact Description

The Project promises to enhance the transport operations, support local communities, and bolster Nigeria's economy. However, like any major construction endeavor, site decommissioning and equipment removal after construction have potential negative impacts.

- **Roads and Access Routes**: Equipment removal and site clearing may affect nearby roads and access routes, causing traffic congestion or detours.
- **Dust Emissions**: Decommissioning activities might generate dust emissions that will affect the social receptors.
- **Business Interruption**: If nearby businesses and food vendors rely on the project activities, their activities will cease..

Receptor Sensitivity

The sensitivity of receptors (residents, businesses, and the community) to these impacts varies based on the context and magnitude of the changes for these impacts.

The receptor sensitivity to these various impacts:

- Traffic disruptions can affect businesses, commuters, and emergency services affecting residents, businesses and the community.
- Businesses and food vendors near the project sites may rely on the project activities. During equipment removal, their operations could be disrupted. Reduced business activity can lead to financial losses and affect employment.
- Loss of employment by workforce

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Short-term
Extent	Local
Frequency	One-time
Magnitude	Small
Likelihood	Probable
Consequence	Minor
Significance	Minor

Potential Impact on Occupational Health and Safety at Post Construction Phase

Impact Description

The potential impact on occupational health and safety issues from post-construction phase of the Project include:

- Physical Hazards: Construction sites involve heavy machinery, lifting equipment, and manual labor. Workers face risks such as falls, collisions, and being struck by moving objects.
- Chemical Hazards: Exposure to hazardous substances such as asbestos, PCBs, and mercury can occur during construction and demolition.
- Exposure to Dust: Dust from construction materials and demolition waste can pose respiratory risks.
- Exposure to Noise: Construction sites are noisy environments due to machinery, equipment, and tools.

Receptor Sensitivity

The sensitivity of receptors relates to the workers involved in various aspects of the construction who are at risk and directly or indirectly exposed to all the hazards that could manifest

Impact Significance (Pre-Mitigation)

Using the methodology presented in this report, the unmitigated impact has been assessed.

Parameter	Classification
Nature of Impact	Adverse
Receptor Sensitivity	Sensitive
Duration	Long-term
Extent	Local
Frequency	One-time
Magnitude	Small
Likelihood	Unlikely
Consequence	Minor
Significance	Not Significant

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See appendix 5.1 for Human rights

CHAPTER SIX
MITIGATION MEASURES

6.0 Introduction

This chapter outlines the measures that will be taken to mitigate the impacts identified during the evaluation process for the proposed Lagos Coastal Highway Road. The assessment revealed that the project will have both positive and negative impacts on the biophysical, health, and social environments. To minimize the negative effects and bring them to a level of residual impact that is acceptable, several measures are proposed for implementation during the construction and operations phases.

These measures are designed to ensure that suitable procedures or mitigation measures are provided to manage/reduce the identified associated and potential impacts of the proposed project to a level as low as reasonably practicable throughout the life cycle of the project. This chapter therefore presents the mitigation, enhancement and/or alternative measures for the adverse and beneficial impacts of the proposed Project.

6.1 Hierarchy of Mitigation Measures

1. Mitigation Measures come with a variety of levels, and these are commonly called **"mitigation hierarchy."** The mitigation hierarchy (Figure 6.1) consists of steps that can be taken to successfully mitigate environmental and social impacts in the proposed project site. The hierarchy begins from the most beneficial method of mitigation and goes on to the least beneficial method of mitigation (Table 6.1).

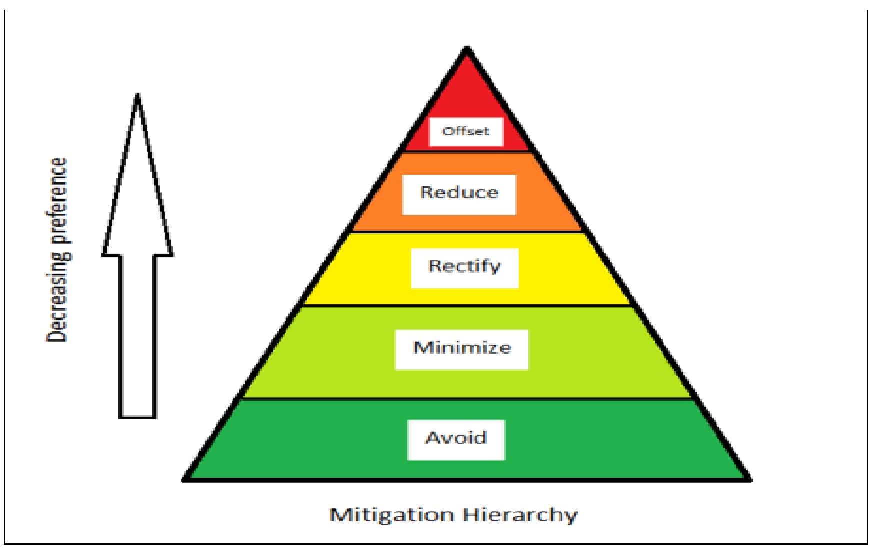

Fig 6.1: Mitigation Hierarchy

Source: https://eco-intelligent.com/2016/12/11/levels-of-mitigation-in-environmental-impact-assessment/

Table 6.1: The Mitigation Hierarchy	
Step	**Focus**
1. Avoidance	Prevent impact from happening.
2. Minimize	Impact cannot be completely side-stepped; so, take steps to ensure minimal damage is done to the environment.
3. Rectify	Implies that the impact has already happened so do damage control.
4. Reduce	Reduce the extent of the impact through management practices and/or change.
5. Environmental Offset	Actions taken outside of the development site to compensate for the impacts in the development site. In effect, this means that the development undertaker carries out environment conservation activities to compensate for what they do in order to achieve "no net environment loss", or more specifically "no net biodiversity loss".

6.2 Managing the Project Beyond Environmental and Social Impacts

Beyond environmental and social impacts, Nigeria projects of these magnitudes often encounter several challenges that impact their successful implementation. The challenges have been identified as captured in Table 6.1. To address the challenges related to the Lagos Coastal Transport Infrastructure project, recommendations have also been provided for these challenges in addition to the specific environmental and social measures due to the impacts identified earlier in this Chapter. The wholistic approach recognises the involvement of the following relevant entities:

1. **Government Commitment:**
    a. Ensuring that the government is fully committed to the project.
    b. This includes allocating necessary resources, creating policies, and providing regulatory support.
2. **Private Sector Collaboration:**
    a. Leveraging expertise and resources from private companies.
    b. The private sector can contribute by investing in infrastructure development, providing technical know-how, and participating in public-private partnerships.
3. **Community Involvement:**
    a. Engaging local communities throughout the project lifecycle.
    b. Community participation ensures that projects align with local needs, minimize negative impacts, and promote sustainable development.

Table 6.2: Potential Challenges and Measures to Successful Implementation of the Project.

Challenges	Suggested Measures
• Funding Constraints: • Insufficient budget allocations and limited access to financing hinder project execution. • Large-scale projects require substantial investment, and securing funding can be a major obstacle.	• Public-Private Partnerships (PPPs): Collaborate with private investors to secure funding. PPPs allow private entities to invest in infrastructure projects in exchange for revenue-sharing or other benefits. • Infrastructure Bonds: Issue government-backed infrastructure bonds to raise capital from the public. • International Financing: Explore loans and grants from international financial institutions like the World Bank or African Development Bank.
• Weak Institutions and Corruption: • Weak regulatory bodies and institutions lead to inadequate oversight and accountability. • Corruption affects project quality, delays, and mismanagement of resources.	• Strengthen Regulatory Bodies: Invest in capacity building for regulatory agencies to enhance oversight and enforcement. • Transparency and Accountability: Implement robust anti-corruption measures, including transparent procurement processes and independent audits.
• Policy Inconsistency: • Changes in government and policy shifts disrupt project continuity. • Consistent policies are essential for long-term planning and execution.	• Long-Term Policies: Develop and adhere to long-term infrastructure policies that transcend political changes. • Legal Framework: Enact legislation that ensures continuity and consistency in project implementation.
• Land Acquisition and Compensation: • Acquiring land for infrastructure projects often faces resistance from affected communities. • Ensuring fair compensation and addressing land disputes is challenging.	• Community Engagement: Involve affected communities early in the planning process to address concerns and negotiate fair compensation. • Land Banks: Create land banks to streamline land acquisition and reduce disputes.

• Technical Capacity and Skills Gap: • A shortage of skilled professionals in engineering, project management, and construction affects project delivery. • Capacity building and training are necessary to bridge this gap.	• Education and Training: Invest in vocational training, universities, and technical institutions to produce skilled professionals. • Knowledge Transfer: Partner with experienced international firms to transfer technical expertise.
• Environmental and Social Impact: • Balancing development with environmental protection is crucial. • Projects must consider ecological impacts, community displacement, and cultural heritage preservation.	• Environmental Impact Assessments (EIAs): Conduct thorough EIAs to assess ecological impacts and propose mitigation measures. • Community Participation: Engage local communities in decision-making and ensure their concerns are addressed.
• Logistics and Supply Chain Challenges: • Efficient transportation of materials and equipment to project sites is essential. • Poor logistics can lead to delays and cost overruns.	• Integrated Logistics Plans: Develop comprehensive logistics plans for material transportation, storage, and distribution. • Infrastructure Hubs: Establish central hubs for material assembly and distribution near project sites.
• Security Concerns: • Insurgency, vandalism, and theft pose risks to infrastructure projects. • Ensuring security during construction and operation is critical.	• Security Task Forces: Collaborate with security agencies to protect project sites from vandalism, theft, and insurgency. • Risk Assessment: Conduct security risk assessments and implement appropriate measures.
• Technical Complexity: • Large-scale projects involve intricate engineering designs and complex systems. • Managing technical challenges requires expertise and innovation.	• Research and Innovation: Invest in research and development to address technical challenges. • Collaboration with Experts: Partner with international experts and universities for innovative solutions.
• Public Perception and Participation: • Public acceptance and engagement are vital.	• Stakeholder Engagement: Involve communities, NGOs, and local leaders in project planning and decision-making.

• Projects that lack community buy-in face resistance and delays.	• Public Awareness Campaigns: Educate the public about project benefits and address misconceptions.

6.3 Criteria for Selection of Mitigation Measures

For the mitigation measures, four criteria were selected based on the engineering design of Lagos coastal highways, practicability of measures, regulatory requirements and industry and international best practices as depicted in Figure 6.2.

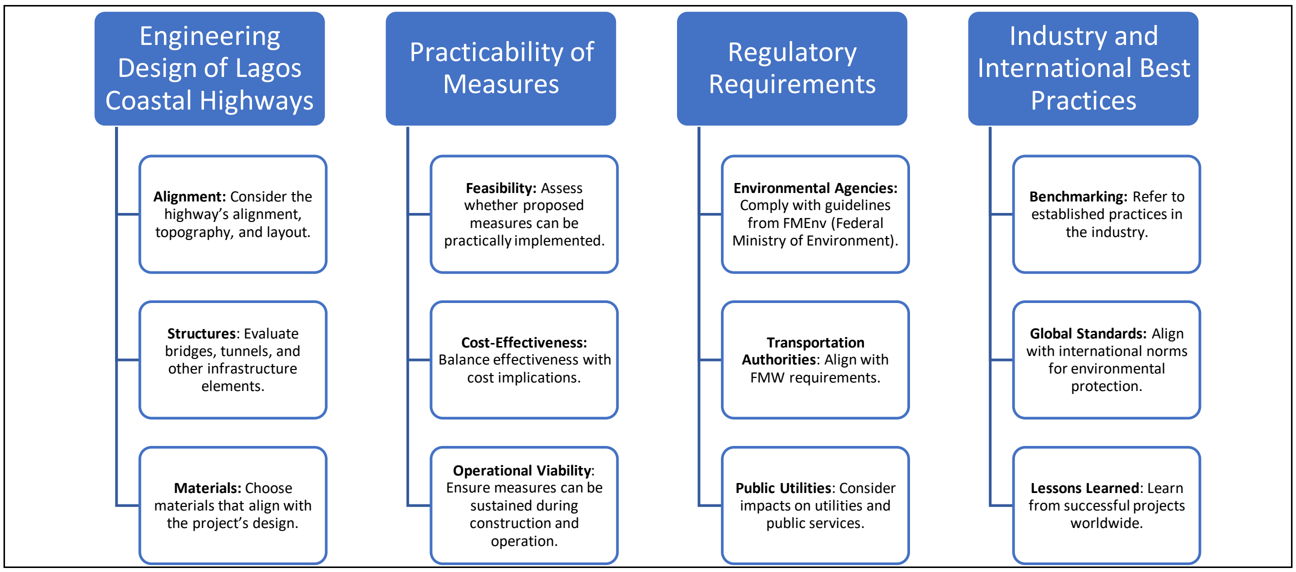

Figure 6.2: Criteria for Selection of Mitigation Measures

6.4 Projects Impacts and Mitigation Measures

In Table 6.3, a summary of the potential impacts associated with the project; together with corresponding mitigation measures are provided. The mitigation 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.

Most of the likely impacts due to the proposed project have been considered in the design and selection of equipment and method of construction.

The mitigation measures recommended in this section may not be exhaustive. However, they are considered adequate to effectively ameliorate or in some cases, eliminate the negative impacts that may arise in this project. From the assessment undertaken, if the measures are applied, all minor and moderate negative impacts will be reduced significantly and will leave, in most cases, negligible and minor residual impacts. However, for accidental occurrences such as fire outbreak and electrocution, the residual impact would remain major, given the costly and sometimes irreversible effect of its occurrence.

In order to verify these assertions, and to ensure that the measures are effective, it is necessary to have in place a sound and cost-effective Environmental and Social Management Plan (ESMP), presented in Chapter Seven of this report.

6.4.1 Managing Residual Impacts after Mitigation

Residual effects are those that remain significant even after applying mitigation measures.

Although reduced, they still need attention. Once the outlined mitigation measures are in place, the residual impacts during construction and operation phases will no longer be significant. (Table 6.3)

<table>
<tr><th></th><th colspan="5">Table 6.3: Summary of Identified Significant Impacts and Measures</th></tr>
<tr><th></th><th>Aspect</th><th>Impact</th><th>Mitigation measures</th><th>Residual Impact</th><th>Responsibility</th></tr>
<tr><td>A</td><td colspan="3">Pre-Construction (Site Establishment) and Construction Phase</td><td></td><td></td></tr>
<tr><td>1</td><td rowspan="4">Soil, Surface and Water Quality</td><td>Potential to impact soil and sediment quality through soil compaction, erosion, fuel and lubricant spills, improper waste disposal, and contamination from hazardous materials, which can harm nearby ecosystems and human health</td><td rowspan="4">• All the construction material will be stored in dedicated storage areas;
• A designated machinery and equipment storage area will be developed for the Project;
• Fuels, lubricants will be stored in dedicated storage area having secondary containment;
• On completion of work all temporary structures, surplus materials and wastes will be completely removed from site;
• Construction and demolition waste (inert materials) will be utilised for filling of site, stored in designated area and finally disposed through third party vendor;
• Separate bins will be provided at construction area for collection of segregated waste as per a waste management plan, and finally disposed through third party;
• Different types of hazardous waste collection bins will be provided for oily substances and non-oily hazardous waste at construction area;
• Hazardous wastes generated from the site establishment stage will be stored in designated waste storage area, having secondary containment;
• Hazardous waste will be finally disposed through third-party subcontractors.</td><td>Not Significant</td><td>HITECH with support from FMW</td></tr>
<tr><td>2</td><td>Potential Impact on coastal morphology, affecting shoreline shape, sediment dynamics, erosion patterns, beach profiles, intertidal zones, and marine habitats, with potential impacts on sediment distribution, seabed stability, and soil salinization</td><td>Not Significant</td><td>HITECH with support from FMW</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Potential impact on the Marine Environment, Hydrology, and Ecosystems through habitat destruction, introduction of pollutants, alteration of water flow patterns, sediment accumulation,</td><td>Not Significant</td><td>HITECH with support from FMW</td></tr>
<tr><td>Not Significant</td><td>HITECH with support from FMW</td></tr>
</table>

	Table 6.3: Summary of Identified Significant Impacts and Measures				
	Aspect	**Impact**	**Mitigation measures**	**Residual Impact**	**Responsibility**
		and potential loss of protective coastal features, affecting marine life and ecosystem services.	• A spill response procedure and associated spill kits to contain any incidental spillage of fuel, • chemicals and hazardous waste;	Not Significant	HITECH with support from FMW
4	Air Quality	The project may lead to increased dust emissions from various construction activities and ancillary sites, potentially affecting air quality	• Use low-emission construction equipment and vehicles that meet or exceed emission standards to reduce air pollutant emissions. • Implement vehicle idling reduction policies and practices to minimize unnecessary emissions from construction vehicles and equipment. • Encourage carpooling, alternative transportation options, and the use of electric or hybrid vehicles among construction workers to reduce overall vehicle emissions. • Regardless of the size or type of vehicle, fleet owners / operators should implement the manufacturer recommended engine maintenance programs. • Drivers should be instructed on the benefits of driving practices that reduce fuel consumption, including measured acceleration and driving within safe speed limits. • Open burning of solid materials will be prohibited on-site • Open burning of improperly disposed materials will be prohibited on-site	Not Significant Not Significant	-HITECH with support from FMW HITECH with support from FMW

	Table 6.3: Summary of Identified Significant Impacts and Measures				
	Aspect	**Impact**	**Mitigation measures**	**Residual Impact**	**Responsibility**
5	Waste	Construction activities will generate various types of waste, including construction debris, excavated soil, packaging waste, chemical waste, metal scraps, wood waste, plastic waste, electrical and electronic waste, and hazardous waste, which could potentially impact the local environment and community receptors due to existing waste management challenges in Lagos	• Encourage to separate waste types at the source (construction sites) to facilitate proper disposal and recycling. • Promote reuse of materials (e.g., wood, metal) and encourage recycling of packaging waste, plastics, and electronics. • Properly manage hazardous waste (e.g., chemicals, electrical components). • Invest in waste collection trucks and equipment for efficient waste removal. • Educate residents, construction workers, and businesses about waste separation and responsible disposal. • Improves accountability, transparency, and data-driven decision-making.	Not Significant	-HITECH with support from FMW
6	Hydrology	Spills or Leaks Resulting in Contamination of Groundwater and Surface Water. The fuels or hydraulic fluids used in the equipment have the potential to spill, which can lead to the release of hydrocarbons. Contamination Risk: The soil, groundwater, and	• Stormwater should be separated from process and sanitary wastewater streams in order to reduce the volume of wastewater to be treated prior to discharge. • Surface runoff from process areas or potential sources of contamination should be prevented, or where not practical, runoff from process and storage areas should be segregated from potentially less contaminated runoff.	Not Significant	-HITECH with support from FMW

	Table 6.3: Summary of Identified Significant Impacts and Measures				
	Aspect	**Impact**	**Mitigation measures**	**Residual Impact**	**Responsibility**
		surface water in the area can become contaminated by these	• Oil water separators and grease traps should be installed and maintained as appropriate at refuelling facilities, workshops, wash bays, fuel storage and containment areas. • Maintain the mechanised fleet to accepted industry standards as documented in a Fleet Maintenance Plan. • Maintenance or repair of mechanised fleet to primarily take place off-site at designated workshop facilities with bunded, impervious floor and oil traps. • Develop and implement an Emergency Response Plan. • Leaking containers will be removed immediately and be appropriately disposed. • Maintain an inventory at the site office for all chemicals and their types and quantity stored on the project site. • Personnel involved in handling hazardous materials, particularly those specifically assigned to storage areas, must be trained on how to respond in case of spill.		
7		Activities such as demolition, drilling and piling, grouting, backfilling, and raw material storage and handling can lead to increased turbidity in nearby water bodies due to the resuspension of bottom sediment, production of fine particulate matter, and inadequate sediment management methods.		Not Significant	-HITECH with support from FMW
	Physical	Dredging	• **Adopt Integrated Approach which c**onsider baseline conditions, dredging operations, sensitive receptors, monitoring, and response options.	Not Significant	-HITECH with support from FMW
8	Social	Road Traffic and Transport Risk of Project Vehicle Traffic Accidents due to increased traffic volume	• Provide separate entry and exit gateways for pedestrians and vehicles.	Not Significant	-HITECH with support from FMW

	Table 6.3: Summary of Identified Significant Impacts and Measures				
	Aspect	**Impact**	**Mitigation measures**	**Residual Impact**	**Responsibility**
		during construction on employees, nearby residents, and businesses	• Create well-drained pedestrian walkways away from vehicle routes. • Ensure drivers can see both ways before entering public roads. • Limit the number of vehicles on-site and plan storage areas strategically.		
9		Occupational health and safety issues arose construction activities including physical hazards, chemical hazards, confined spaces, exposure to dust and noise.	• Provide personal protective equipment (PPE) and training to address physical risks. • Properly handle and store hazardous materials. • Implement safety protocols for working in confined areas. • Use dust control measures and provide hearing protection.	Not Significant	-HITECH with support from FMW
10		Disruption on fishing activities by damaging fishing grounds, polluting waters, and altering fish habitats, leading to potential declines in fish populations and reduced income for local fishermen.	• Prevent excessive sediment runoff into water bodies.	Not Significant	-HITECH with support from FMW
11		Potential Infringement on Workers' Human Rights if not working under safe and fair working conditions	• Ensure fair wages, reasonable working hours, and safe environments. • Respect workers' rights to organize, bargain collectively, and be free from discrimination. • Regularly assess compliance with labour laws and address violations.	Not Significant	-HITECH with support from FMW

	Table 6.3: Summary of Identified Significant Impacts and Measures				
	Aspect	**Impact**	**Mitigation measures**	**Residual Impact**	**Responsibility**
B		Operational Phase			
1	Soil, Surface and Water Quality	Fuel spills from machinery and transport vehicles which can Hydrocarbons (from fuels) can infiltrate the soil, potentially reaching groundwater.	• Implement strict spill prevention protocols during refuelling and maintenance. • Install containment systems (e.g., berms, spill kits) to capture and contain spills. • Regularly inspect equipment and storage areas to identify and address potential leaks.	Not Significant	FMW
2	Waste	Disposing waste outside designated zones leads to soil degradation and Soil exposure to heavy metals and pesticides poses risks	• Ensure waste disposal adheres to regulations and guidelines. • Remediate affected areas through soil restoration • Regularly test soil quality and monitor for contaminants. • Properly manage hazardous substances to prevent soil contamination.	Not Significant	FMW
3	Air Pollution	Emissions from ships, trucks, and machinery contribute to air pollution.	• Create green buffer zones between road corridor and residential areas. • Implement low-emission technologies for vehicles and machinery. • Regularly monitor air quality and adjust operations accordingly.	Not Significant	FMW
4	Noise and Vibrations:	Road operations generate noise and vibrations, impacting nearby communities. Disruptions to sleep	• Install physical barriers to reduce sound propagation. • Schedule noisy activities during off-peak hours. • Involve residents in noise reduction planning.	Not Significant	FMW

	Table 6.3: Summary of Identified Significant Impacts and Measures				
	Aspect	**Impact**	**Mitigation measures**	**Residual Impact**	**Responsibility**
		patterns and stress levels can occur.			
		Nearby residents experience disturbances, affecting sleep and overall well-being.		Not Significant	FMW
5	**Climate Change Impact**	Road facilities vulnerable to climate-related hazards such as rising sea levels, storm surges, and extreme weather events	• Ensure Climate-Resilient Infrastructure through design and upgrade of the highway to withstand rising sea levels and storms. • Provide Emergency Preparedness that include developing evacuation plans and providing early warning systems for nearby residents.	Not Significant	FMW
6	Traffic Congestion	Infrastructure Strain: Roads and intersections become overloaded.	• Strengthen road infrastructure to handle increased loads. • Support road maintenance and regularly maintain and upgrade roads to handle increased loads. • Ensure traffic planning to coordinate activities with urban infrastructure use and development	Not Significant	FMW
		Social Disruption arising from ignoring community concerns which can lead to social unrest,	• Engage with affected businesses to minimize disruptions.	Not Significant	FMW

	Table 6.3: Summary of Identified Significant Impacts and Measures				
	Aspect	**Impact**	**Mitigation measures**	**Residual Impact**	**Responsibility**
		protests, and strained relationships with local residents.			
7	Health Risk	Air pollution and exposure to hazardous materials pose health risks. Construction workers and nearby residents may be affected.	• Use water sprays or suppressants during construction. • Ensure regular checks for workers exposed to pollutants.	Not Significant	FMW
		Exposure to Hazardous Materials with Chemical Risks- Handling hazardous cargo or materials poses health hazards and Contaminated Soil:- soil near the project area may contain harmful substances.	• Ensure regular checks for workers exposed to pollutants. • Use cleaner fuels and emission controls.	Not Significant	FMW
8	Human Rights Impacts	Salient human rights abuses or risks could arise which include workers' rights, community and land rights, and environmental protection	• Stakeholder Engagement to involve communities in decision-making. • Continually evaluate impacts on workers' rights and land rights. • Ensure adherence to labour and environmental laws.	Not Significant	FMW
C		**Decommissioning Phase**			
1	Soil, Surface	Increased turbidity and suspended solids due to site clean-up and equipment removal in the case of	• Install sediment barriers or silt fences to prevent runoff into surface water bodies. • Stabilize exposed soil with vegetation or geotextiles. • Dispose of debris and sediment in designated areas.	Not Significant	FMW

Table 6.3: Summary of Identified Significant Impacts and Measures

	Aspect	Impact	Mitigation measures	Residual Impact	Responsibility
	and Water Quality	increased sediment and debris being washed into surface water bodies			
2		Saline water intrusion into the freshwater aquifer system due to dewatering activities if not controlled or managed properly.	• Monitor groundwater levels and salinity during dewatering. • Create barriers (e.g., injection wells) to prevent saltwater migration.	Not Significant	FMW
3		Removal of structures and equipment can lead to bare soil, increasing surface runoff and the mobilization of pollutants into nearby surface water bodies if not managed properly	• Seed or plant vegetation to stabilize soil. • Properly grade surfaces to direct runoff away from water bodies. Construct sediment basins to capture runoff.	Not Significant	FMW
4	Social	Potential disruption to roads and access routes, dust emissions affecting social receptors, and interruptions to nearby businesses and food vendors reliant on project activities.	• Plan construction activities to minimize disruptions. • Use water sprays or dust suppressants to reduce emissions. • Inform residents about road closures.	Not Significant	FMW
5		Occupational health and safety issues from decommissioning construction activities including physical hazards, chemical hazards, confined spaces, exposure to dust and noise.	• Provide proper training and PPE for workers. • Safely handle and dispose of hazardous materials. • Implement safety protocols for confined areas. • Use protective gear and noise-reducing measures.	Not Significant	FMW

- **6.4.2 Specific Mitigation Measures for the Potential Impacts**

These Specific Mitigation Measures cover some of the critical issues of project at different phases for the project which include Pre-construction (site establishment) and Construction and Decommissioning (Site Clean-Up and Equipment Removal after Construction).

6.4.2.1 Pre-construction (Site Establishment) and Construction

- **Soil, Surface and Water Quality**

1. Mitigation Measures to Potential Impact to Soil and Sediment Quality

Measure	Source of Measure
The following mitigation measures are in place and will be implemented for the site establishment stage of the project: • All the construction material will be stored in dedicated storage areas; • A designated machinery and equipment storage area will be developed for the Project; • Fuels, lubricants will be stored in dedicated storage area having secondary containment; • On completion of work all temporary structures, surplus materials and wastes will be completely removed from site; • Construction and demolition waste (inert materials) will be utilised for filling of site, stored in designated area and finally disposed through third party vendor; • Separate bins will be provided at construction area for collection of segregated waste as per a waste management plan, and finally disposed through third party; • Different types of hazardous waste collection bins will be provided for oily substances and non-oily hazardous waste at construction area; • Hazardous wastes generated from the site establishment stage will be stored in designated waste storage area, having secondary containment; • Hazardous waste will be finally disposed through third-party subcontractors. • A spill response procedure and associated spill kits to contain any incidental spillage of fuel, • chemicals and hazardous waste;	1

Residual Impact

Post-mitigation the residual impact can be considered to be Not Significant.

2. Mitigation Measures to Potential Impact to Coastal Morphology

Measure	Source of Measure
Coastline Alteration: Design structures to minimize erosion and maintain natural features. Continuously monitor shoreline changes and adapt management strategies accordingly.	
Offshore Soil Disposal: Analyse soil properties before disposal to ensure compatibility with the seabed. Implement habitat restoration projects to compensate for any disturbance caused.	
Salinity Control: Leverage rainwater and flood resources to establish a long-term leaching mechanism. This helps reduce soil salinity over time. Plant vegetation adapted to local conditions to enhance salt leaching and stabilize the ecosystem[1].	
Sustainable Dredging: If sand extraction is necessary, follow sustainable dredging practices to maintain sediment balance. Community Engagement and Awareness: Stakeholder Communication: Engage with local communities, workers, and businesses to raise awareness about the project's impacts and mitigation measures.	Section 1.3, page 28, General EHS Guidelines Performance Standard 1
Health and Safety Training: Provide training to workers on health and safety practices during construction. Collaborate with other stakeholders with adherence to best practices, and continuous monitoring.	

Residual Impact

Post-mitigation the residual impact can be considered to be Not Significant.

3. Mitigation Measures to Flooding, Erosion and Sedimentation Impact

Measure	Source of Measure
For a wholistic measure involve environmental experts, engineers, and etc for successful project implementation while minimizing adverse impacts. Ensure Regular monitoring and adaptive management are crucial to ensure the long-term sustainability of project	World Bank EHS Guidelines World Bank EHS Guidelines

Measure	Source of Measure
Flooding Impact Designate and preserve natural buffer zones along the coastline, especially the opposite side to act as protective barriers against storm surges and high tides. Construct infrastructure at an elevated level to reduce vulnerability to flooding. Implement efficient drainage systems to manage excess water during heavy rainfall or storm events. Develop and deploy early warning systems to alert all stakeholders about potential flooding. **Erosion Impact**: Regularly replenish eroded areas with sand to maintain their protective function. Install breakwaters strategically to reduce wave energy and prevent erosion. Introduce native vegetation to stabilize soil and prevent erosion. Plan infrastructure in a way that minimizes disruption to natural sediment transport patterns. **Sedimentation Impact** Develop sediment management plans to ensure a balanced deposition and erosion cycle. This may involve controlled sediment and redistribution. Deploy artificial reefs to encourage sediment accumulation and enhance marine biodiversity. Implement ecosystem-based approaches that consider sediment dynamics and promote healthy habitats. Continuously monitor sediment levels and adjust management strategies accordingly. **Long-Term Leaching Mechanism**: Capture and utilize rainwater and floodwater for leaching purposes. This helps flush excess salts from the soil over time. Plant salt-tolerant vegetation to aid in leaching and stabilize the soil.	World Bank EHS Guidelines World Bank EHS Guidelines

Measure	Source of Measure
Ecosystem Restoration and Maintenance: Plan the structure of soil layers in advance, considering vegetation types and their ability to stabilize soil. Enhance the natural salt leaching process through proper irrigation and drainage practices. Choose vegetation species based on local conditions and ecological suitability.	

4. Mitigation Measures to Potential Impact on Marine Environment, Hydrology, and Ecosystem Services

Measure	Source of Measure
Habitat Destruction: • Implement **ecosystem-based management** during construction to minimize habitat loss. • Designate **protected zones** along the area to safeguard critical habitats. • **Rehabilitate** or create alternative habitats elsewhere to compensate for any losses.	World Bank EHS Guidelines **IUCN**
Pollutants: • **Strictly regulate** the handling and disposal of pollutants during construction. • Use **environmentally friendly materials** and construction techniques. • Establish **emergency response plans** to address accidental spills promptly. • Monitor water quality and conduct regular **pollution assessments**.	WHO World Bank EHS Guidelines
Hydrology: • **Model water flow patterns** to understand alterations caused by proposed infrastructure. • Design **flow control structures** (e.g., weirs, channels) to maintain natural hydrological processes. • **Mitigate sediment accumulation** by implementing effective sediment traps . • **Monitor sediment transport** and adjust management practices accordingly.	World Bank EHS Guidelines

Measure	Source of Measure
Ecosystem Impact: • Enhance the **existing environment** by creating artificial reefs or underwater structures. • **Restore coastal habitats** (e.g., mangroves, seagrass beds) to support marine life where necessary • **Educate stakeholders** about the importance of maintaining ecological balance.	IUCN, Global Biodiversity Framework World Bank EHS Guidelines
Loss of Protective Services: • **Design buffer zones** to protect against storm surges and erosion. • **Implement shoreline stabilization measures** using vegetation planting. • **Raise awareness** about the value of these protective services among policymakers and the public.	IUCN, Global Biodiversity Framework World Bank EHS Guidelines
Compensatory Actions: Offset negative impacts by creating positive contributions through tree planting and vegetal cover	IUCN
Adaptive Management: Continuously monitor and adjust mitigation measures based on real-time data and feedback	
Legal and Regulatory Compliance: Ensure that mitigation measures go beyond existing laws and regulations. They should be above-and-beyond requirements to effectively address impacts.	
Reclamation Planning: Carefully plan reclamation activities to minimize disruption to coastal morphology. Consider reusing dredged material for beach nourishment or habitat creation. Monitor the impact of dredging on nearshore habitats and adjust practices accordingly.	
Stakeholder Engagement: Involve local communities, experts, and relevant authorities in the decision-making process. Their insights can lead to better mitigation strategies. Collaborate with other stakeholders with adherence to best practices, and continuous monitoring.	

Residual Impact

Post-mitigation the residual impact can be considered to be Not Significant.

5. Mitigation Measures to Potential Impact due to Mobilisation of Pollutants from Contaminated Land Encountered during Earthworks

Measure	Source of Measure
Prepare plans and procedures to respond to the discovery of contaminated media to minimize or reduce the risk to health, safety, and the environment consistent with the approach for Contaminated Land in Section 1.6 of the EHS Guidelines. This should include consideration of what level of Personal Protective Equipment is appropriate for employees working in the immediate vicinity of the contaminated land (e.g. face masks).	Section 4.1, page 89-91, General EHS Guidelines
The waste management plan should make provision for the handling and disposal of obsolete, abandoned, hazardous materials or oil consistent with the approach to hazardous waste management described in Section 1.6 of the EHS Guidelines. Successful implementation of any management strategy may require identification and cooperation with whoever is responsible and liable for the contamination.	Section 4.1, page 89-91, General EHS Guidelines
Engage a contaminated land specialist to assess and classify the material. Obtain the necessary FMENv approvals for storage, removal, transport, reuse, treatment, or disposal of the contaminated material.	
Containment and Remediation: Implement measures to contain and remediate pollutants. Address the specific contaminants found in the soil.	
Monitoring and Compliance: Regularly monitor soil quality during and after earthworks to ensure compliance with environmental regulations.	
The waste management plan should make provision for the handling and disposal of improperly disposed materials encountered during earthworks.	

Residual Impact

Post-mitigation the residual impact can be considered to be Not Significant.

- **Air Quality**

1. Mitigation Measures to Potential Impact on Ambient Air Quality

Measure	Source of Measure
• Proper traffic management is necessary to minimize congestion and emissions. • Monitor air quality and take steps to minimize the impact of construction activities and truck movements to prevent air quality impairment.	Section 1.3, page 28, General EHS Guidelines Performance Standard 1

Residual Impact

Post-mitigation the residual impact can be considered to be Not Significant.

2. Mitigation Measures to Potential Impacts Associated with Dust Emissions

Measure	Source of Measure
Prepare and implement a Dust Management Plan (or equivalent). The dust management measures should include measures such as those set out below. This should include both management measures and monitoring measures to control and verify dust levels, as well as details on who will be responsible for implementing these controls. The suitability of these measures shall be verified on an ongoing basis, considering monitoring results and any dust-related community grievances received. **Preparing and Maintaining the Site** Measures should be implemented to avoid site water or mud runoff. Remove materials that have the potential to generate significant dust from the site as soon as possible (e.g. <48 hrs) unless being re-used on site. Where this is not possible, these materials will be covered. Cover or fence any stockpiles of dusty materials. Use enclosed chutes and conveyors and covered skips. Ensure equipment is readily available on-site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods. Only use cutting, grinding, or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g., suitable local exhaust ventilation systems. After all site works are completed, all remaining exposed land should be verified as stable in dust. Suitable water carts in good working condition and of not less than 10,000 Liters capacity, or other appropriate alternatives, shall be	World Bank EHS Guidelines

Measure	Source of Measure
available to commence watering on the site within 2 hours of being required per the Dust Management Plan. **Vehicle Trackout** Vehicles will be kept clean and free of residual dirt and mud Access gates are to be located at least 10m from receptors where possible. **Monitoring** Monitoring may include dust deposition, dust flux, and visual inspections. Ensure adequate quality assurance/quality controls (e.g., equipment calibration) are in place for all monitoring.	
The Project will monitor air quality at several strategic locations along the route before construction (including urban areas and near quarries/borrow pits). This will include an analysis of PM10 and PM2.5, collected over at least three months. This monitoring will consist of upwind and downwind locations and associated meteorological tracking (i.e., wind direction and strength). Suppose ongoing dust complaints are received as part of the Project's stakeholder grievance mechanism. In that case, this monitoring will be extended throughout the duration of the construction, and the results will be used to inform the effectiveness of the dust suppression measures identified in the dust management plan.	
The Project will implement a community grievance mechanism to manage any complaints from surrounding community members, including dust-related ones. In responding to such complaints, the Project will consider dust abatement measures (e.g., dust suppression, suspension of activities during dry and windy periods, and screens) to help manage these impacts.	IFC Performance Standard 1

Residual Impact

Post-mitigation, the residual impact can be considered to be Not Significant.

3. Mitigation Measures to Impacts of Other Pollutants/Emissions

Measure	Source of Measure
• Use low-emission construction equipment and vehicles that meet or exceed emission standards to reduce air pollutant emissions. • Implement vehicle idling reduction policies and practices to minimize unnecessary emissions from construction vehicles and equipment.	World Bank EHS Guidelines

Measure	Source of Measure
• To reduce overall vehicle emissions, encourage carpooling, alternative transportation options, and the use of electric or hybrid vehicles among construction workers. • Regardless of the size or type of vehicle, fleet owners/operators should implement the manufacturer-recommended engine maintenance programs. • Drivers should be instructed on the benefits of driving practices that reduce fuel consumption, including measured acceleration and driving within safe speed limits.	

Residual Impact

Post-mitigation, the residual impact can be considered to be Not Significant.

4. Mitigation Measures to Potential Impact on Human Health Associated with Combustion Emissions

Measure	Source of Measure
• Use low-emission construction equipment and vehicles that meet or exceed emission standards to reduce air pollutant emissions. • Implement vehicle idling reduction policies and practices to minimize unnecessary emissions from construction vehicles and equipment. • Encourage carpooling, alternative transportation options, and the use of electric or hybrid vehicles among construction workers to reduce overall vehicle emissions. • Regardless of the size or type of vehicle, fleet owners / operators should implement the manufacturer recommended engine maintenance programs. • Drivers should be instructed on the benefits of driving practices that reduce fuel consumption, including measured acceleration and driving within safe speed limits. • Open burning of solid materials will be prohibited on-site • Open burning of improperly disposed materials will be prohibited on-site.	EHS Guidelines

Residual Impact

Post-mitigation, the residual impact can be considered to be Not Significant.

- **Noise and Vibrations**

1. Mitigation Measures to Potential Impact on Ambient Noise Quality

Measure	Source of Measure
Design Options: • Consider design modifications that minimize noise generation during construction. For example, using noise-absorbing materials or altering construction layouts. • Arrange construction activities to minimize noise propagation towards sensitive areas. • Plan the order of construction tasks to reduce noise impact. • Include noise-related provisions in sub-contracts to guide contractors' behaviour. **Mitigation at the Source**: • Opt for quieter equipment models. • Regular maintenance and inspection can also reduce noise emissions. • Choose low-noise machinery. Proper training for equipment operators is essential. **Mitigation Along the Path**: • Utilize existing structures or topography to block noise transmission. • Erect barriers or enclosures around noisy activities. • Construct permanent noise barriers or walls. **Health Considerations**: • Minimize disruptions to operations around project area to reduce stress for workers and residents. • Generate Awareness Campaigns. • Recognize that prolonged exposure to elevated noise levels can impact human health.	Section 4.1, page 89-91, General EHS Guidelines Section 4.1, page 89-91, General EHS Guidelines Section 4.1, page 89-91, General EHS Guidelines World Bank Environmental, Health, And Safety Guidelines
The Project will implement a community grievance mechanism to manage any complaints from surrounding community members, including those related to noise. In responding to any such complaints, the Project will consider noise abatement measures (e.g., provision of earplugs, temporary noise barriers, rescheduling of noisy activities) to help manage these types of impacts. Additionally, if significant noise complaints are received, the Project may need to implement ongoing noise monitoring at affected receptors, following the methodology set out in in accordance with *ISO 1996-1: 2016: Acoustics – Description, Measurement and Assessment of Environmental Noise - Part 1 Basic Quantities and Assessment Procedures.*	IFC Performance Standard 1, Section 4.1, page 89-91, General EHS Guidelines

Residual Impact

Post-mitigation the residual impact can be considered not significant.

2. Mitigation Measures to Potential Impact on Human Health Associated with Increased Noise Levels from Construction Activities to other sub contractors in the area

Measure	Source of Measure
• Establishing noise deflection walls • Paving and levelling the terminal area. • Replacing forklifts and reach-stackers with gantry cranes with rubber tires. • Substituting diesel engines with electric power • Reducing noise from warning bells • Insulating machinery and generators	General EHS Guidelines
• Schedule activities during daytime hours and limit noisy activities during early morning or late evening hours to minimize disturbance to nearby residents. • Use noise barriers, sound-absorbing materials, and acoustic enclosures to reduce noise emissions from construction equipment and machinery. • Provide personal protective equipment (PPE) such as earplugs or earmuffs to workers exposed to high levels of noise to mitigate potential health effects.	General EHS Guidelines
Local residents must be informed (i.e., through notice boards and/or direct community consultation) of any periods of night work that may be necessary.	
• Erecting noise barriers around construction areas can reduce noise propagation to nearby residential or sensitive zones. • Restricting noisy activities to specific hours (e.g., daytime) can mitigate the impact on nearby communities. • Regular monitoring of ground vibrations during pile driving and machinery operation can help assess their effects and adjust construction practices accordingly. • Implementing traffic management strategies to minimize congestion and associated vibrations on access roads.	
Prior to pre-construction, the Project will conduct a noise baseline survey in accordance with *ISO 1996-1: 2016: Acoustics—Description, Measurement, and Assessment of Environmental Noise—Part 1 Basic Quantities and Assessment Procedures*. This survey should include representative noise-sensitive receptors adjacent to the yard and other working areas.	
The Project will implement a community grievance mechanism to manage any complaints from surrounding community members, including those related to noise. In responding to any such complaints, the Project will consider noise abatement measures (e.g., provision of earplugs, temporary	Performance Standard 1

Measure	Source of Measure
noise barriers, rescheduling of noisy activities) to help manage these types of impacts. Additionally, if significant noise complaints are received, the Project may need to implement ongoing noise monitoring at affected receptors, following the methodology set out in in accordance with *ISO 1996-1: 2016: Acoustics – Description, Measurement and Assessment of Environmental Noise - Part 1 Basic Quantities and Assessment Procedures.*	

Residual Impact

Post-mitigation the residual impact can be considered to be Minor.

3. Mitigation Measures to Potential impact to community structures from Vibration Emissions from Construction Activities

Measure	Source of Measure
Vibration Control: • **Pile Driving**: To reduce ground vibrations from pile driving, consider using vibration-damping materials or techniques. Pre-drilling holes, using vibratory hammers, or adjusting pile driving techniques can help mitigate vibrations. • **Equipment Operation**: Limit the use of heavy machinery during sensitive hours (e.g., night time) to minimize vibrations. Isolating equipment from the ground using rubber pads or shock absorbers can also help. • **Traffic**: Control vehicular traffic near sensitive structures during construction. Use alternative routes if possible. **Structural Protection**: • **Sensitive Buildings**: Implement protective measures like installing vibration isolation systems or reinforcing foundations. • **Monitoring**: Continuously monitor vibrations during construction. If levels exceed safe thresholds, adjust construction methods accordingly. **Noise Management**: • **Construction Noise**: Use noise barriers, acoustic enclosures, or schedule noisy activities during off-peak hours. Inform nearby residents about construction schedules. • **Quality of Life**: Address noise pollution concerns by minimizing disruptive noise. Consider community feedback and adjust construction practices accordingly. **Safety Precautions**: • **Falling Debris**: Erect safety barriers to prevent debris from falling onto nearby structures. Regularly inspect and maintain these barriers.	, EHS Guidelines, *ISO 1996-1: 2016: Acoustics – Description, Measurement and Assessment of Environmental Noise - Part 1 Basic Quantities and Assessment Procedures.* EHS guidelines

Measure	Source of Measure
• **Heavy Equipment Movement**: Ensure safe movement of heavy equipment. Use designated routes and avoid congested areas.	
Regularly communicate with host communities and nearby residents, provide updates, and address their concerns. Collaborate with local authorities, environmental agencies, and experts to ensure a successful and community-friendly rehabilitation process.	

Residual Impact

Post-mitigation the residual impact can be considered to be not significant.

- **Waste**

1. Mitigation Measures to Potential Impacts from Project Generated Waste Affecting Local Environment or Community Receptors

Measure	Source of Measure
Generally, adopt Circular economy principles to promote sustainability, reduce waste, and optimize resource utilization.	Nigeria National Waste Management Policy
• Segregation and Sorting: Different types of demolition waste such as concrete, steel, and wood will be separated and sorted at the source to facilitate recycling and proper disposal. • Recycling and Reuse: Concrete debris will be crushed to create recycled aggregate for use in new construction. Steel reinforcement bars will be salvaged for reuse or recycling. Wood waste will be repurposed for other projects or biomass. • Erosion Prevention: Erosion control measures will be implemented to prevent soil runoff. • Hazardous Material Handling: Hazardous will be identified and safely removed. Hazardous waste will be disposed of according to regulations. • Waste Management Plan: A comprehensive waste management plan will be developed that outlines procedures for handling different waste types. • On-Site Recycling Centres: Designated areas will be set up for sorting and recycling construction debris. Workers will be encouraged to segregate waste properly.	Section 4.1, page 89-91, General EHS Guidelines Section1.6, page 46-51, General EHS Guidelines Performance Standard 3

Measure	Source of Measure
• Reducing Packaging Waste: Packaging materials will be minimized by ordering bulk supplies. Packaging will be reused where possible. • Safe Chemical Handling: Chemicals will be stored and handled properly. Chemical waste will be disposed of through authorized channels.	
• Generally though the project provides sanitary facilities with capacity to meet sanitation requirements of personnel at all project locations. All personnel must have access to toilet facilities within 500 m of their place of work. Personnel must use the provided facilities, which shall be serviced daily to ensure hygienic conditions. • No facilities containing sewage may be located within 100 m of a surface water resource. • Raw sewage must be contained and subject to treatment and disposal by a registered service provider at an appropriately permitted facility. Records of safe treatment and disposal of sewage must be maintained.	
The project will implement a community grievance mechanism to manage any complaints from surrounding community members, including those related to waste management.	Performance Standard 1

Residual Impact

Post-mitigation waste management practices significantly reduce environmental harm, enhance project sustainability, and promote community well-being and so residual impact is considered Not Significant.

2. Mitigation Measures to Post-Construction Clean-Up Project Generated Waste Affecting Local Environment or Community Receptors during the Phases of the project

Measure	Source of Measure
Generally, adopt Circular economy principles to promote sustainability, reduce waste, and optimize resource utilization.	Nigeria National Waste Management Policy
• An inventory of unused materials and equipment will be created. • Reusable items will be salvaged for future projects. • Residual soil and sediment will be disposed of in accordance with environmental guidelines. Metal scraps, wood, and plastic waste will be recycled. • Vegetation will be replanted, and disturbed areas will be restored. • Water quality will be monitored during clean-up. • Any damage caused during construction will be repaired. • Monitoring and Compliance: Compliance with waste disposal regulations will be ensured.	Section 4.1, page 89-91, General EHS Guidelines Section1.6, page 46-51, General EHS Guidelines Performance Standard 3 Nigeria National Waste Management Policy

Measure	Source of Measure
The project will implement a community grievance mechanism to manage any complaints from surrounding community members, including those related to waste management.	Performance Standard 1

Residual Impact

Post-mitigation waste management practices significantly reduce environmental harm, enhance project sustainability, and promote community well-being and so residual impact is considered Not Significant.

- **Hydrology**

1. Mitigation Measures to Spills or Leaks Resulting in Contamination of Groundwater and Surface Water

Measure	Source of Measure
Strict Control: Implement strict control measures during refuelling and maintenance.	
Emergency Response Plans: Develop protocols for handling spills promptly.	
Training: Train workers on spill prevention and response.	
Prior to taking water from a borehole or well: ● Identify all other boreholes and wells within 100 m of the source. ● Measure the quality of water in these wells. Thereafter measure quality of water on a monthly basis, continuing until two months after abstraction ceases. If monitoring indicates a material reduction in water quality, then abstraction should cease. If the reduction is substantial enough to affect the usability of supply to the users, then the contractor will need to provide and fund an alternate supply.	
Stormwater should be separated from process and sanitary wastewater streams in order to reduce the volume of wastewater to be treated prior to discharge.	Section 1.3, page 28, General EHS Guidelines World Bank Environmental, Health, And Safety Guidelines

Measure	Source of Measure
Surface runoff from process areas or potential sources of contamination should be prevented, or where not practical, runoff from process and storage areas should be segregated from potentially less contaminated runoff.	Section 1.3, page 28, General EHS Guidelines
Oil water separators and grease traps should be installed and maintained as appropriate at refuelling facilities, workshops, wash bays, fuel storage and containment areas.	Section 1.3, page 28, General EHS Guidelines
Where discharging surface water runoff into the environment, water should meet the following levels: • pH 6-9 • TSS 50mg/l • Oil and grease 10mg/l	Section 1.3, page 28, General EHS Guidelines
Maintain the mechanised fleet to accepted industry standards as documented in a Fleet Maintenance Plan. Maintenance or repair of mechanised fleet to primarily take place off-site at designated workshop facilities with bunded, impervious floor and oil traps. Where it is not possible or practical to conduct maintenance and repair offsite, such maintenance and repair on-site must be undertaken at a designated maintenance area, fitted with bunded, impervious floor and oil traps. The maintenance area floor will not discharge to stormwater, sewer, sewage holding tanks, soak-away trenches or to any other external connection. Stormwater runoff, rainwater, and other drainage sources from areas outside of the maintenance area will be prevented from entering the area. Where it is not practicable to move damaged equipment to the designated maintenance area, secondary containment such as catch pans, drip trays, and ground protective sheets must be used during emergency works to prevent contamination of soil or water.	
Develop and implement an Emergency Response Plan. This plan should be communicated to local stakeholders.	Performance Standard 1
Store and handle all hazardous materials to accepted industry standards as documented in a Hazardous Materials Management Plan.	

Measure	Source of Measure
Hazardous materials, including chemicals and fuels, shall only be stored only in the ancillary sites, in a dedicated place. Such sites shall be located away from high risk areas including significant pedestrian or vehicle traffic, residential areas and water flow paths (> 50 m). Storage methods shall be in terms of the MSDS and manufacturers' instructions, typically in facilities with bunded, impervious floor and with provision to exclude rainfall and runoff. The bund for hydrocarbons should have 110% of the maximum storage capacity of the facility. Hazardous material storage sites shall have adequate signage in place identifying hazardous the materials and the nature of hazard. Incompatible materials shall not be placed in common containment and different class of chemicals will be stored separately. Leaking containers will be removed immediately and be appropriately disposed. Maintain an inventory at the site office for all chemicals and their types and quantity stored on the project site. Material Safety Data Sheets for all chemicals must be kept at the site office and in every vehicle used to transport such chemicals. Personnel involved in handling hazardous materials, particularly those specifically assigned to storage areas, must be trained on how to respond in case of spill. Spill containment and clean-up kits, appropriate to the volume and type of materials stored, will be kept on-site.	
Refuelling of mechanised fleet to primarily take place in designated refuelling area at the Ancillary Sites. Refuelling sites shall be located away from water flow paths (> 50 m) and any well. Fuel will only be stored in an industry approved and certified tank, with integrated bunding. The refuelling area will be equipped with a bunded, impervious floor. The refuelling area will not discharge to stormwater, sewer, sewage holding tanks, soak-away trenches or to any other external connection. Stormwater runoff, rainwater, and other drainage sources from areas outside of the refuelling area will be prevented from entering the area.	

Measure	Source of Measure
Personnel involved in handling refuelling, particularly those specifically assigned to refuelling areas/equipment, must be trained on how to respond in case of spill.	
Where refuelling in the designated area is not possible due to the mobility of machinery, implement secondary containment such as catch pans or drip trays during refuelling. Refuelling vehicles / mobile delivery tanker will have the following: i. metal drip tray/s of sufficient capacity; ii. ground protective sheet/s; iii. a labelled, sealable container for storing spilled fuel; iv. any equipment required for transferring fuel captured in drip trays into the storage drum; v. a suitable spill clean-up kit vi. a shovel for use in spill clean-up	
If a project related leak or spillage has the potential to impact on groundwater usability/acceptability to a local user then the contractor must investigate and provide an alternate, equivalent water supply for the duration of the period that an effect occurs.	
Daily visual inspections shall be undertaken and especially at material stockyards, hazardous material storage sites, fleet parking areas and stockpile areas for signs of hazardous material spillages. Daily visual inspections of the mechanised fleet shall be undertaken to observe leaks of hydrocarbons.	

Residual Impact

Post-mitigation the residual impact can be considered to be Not Significant.

- **Biodiversity**

1. Mitigation Measures to Potential Impact on Ecosystem Services

Measure	Source of Measure
• Incorporate green spaces, native vegetation, and wetlands within the project area to enhance ecosystem services. • Implement effective stormwater management systems to prevent runoff pollution. • Protect and restore habitats to maintain biodiversity and ecosystem resilience. • Regularly monitor ecosystem services and adjust management practices based on feedback.	Environmental, Health, And Safety Guidelines Ports, General EHS Guidelines. National Policy on Environment

Residual Impact

Not Significant

2. Mitigation Measures to Potential impact to Marine Ecology

Measure	Source of Measure
• Implement habitat restoration programs to compensate for any loss of the remaining marine ecosystems. • Enforce strict protocols to prevent the introduction of invasive species. • Monitor water quality, sediment deposition, and marine biodiversity regularly. • Ensure compliance with environmental regulations.	Environmental, Health, and Safety Guidelines General EHS Guidelines. National Policy on Environment

Residual Impact

Applying the recommended mitigation measures set out would reduce the probability of affecting the marine ecology, with the residual impact significance still considered to be Not Significant.

3. Mitigation Measures to Potential Impact on Avifauna during construction phase

Measure	Source of Measure
• Create buffer zones around sensitive bird habitats to reduce direct impacts. • Avoid construction near important bird breeding sites or migratory routes. • Use bird-friendly lighting designs to reduce light pollution. • Regularly monitor bird populations to assess the effectiveness of mitigation efforts.	

Residual Impact

Not Significant.

4. Mitigation Measures to Potential Impact of Introduction of Marine Invasive Species (MIS)

Measure	Source of Measure
• Implement strict biosecurity measures to prevent unintentional transport of invasive species. • Monitor and report any signs of invasive species. • Designate specific areas for incoming materials and equipment and quarantine them until verification. • Educate workers and contractors about preventing invasive species. • Develop a plan for swift removal of invasive species • Establish monitoring programs to detect NIASs early. • Regular surveys, sampling, and reporting mechanisms are crucial. • Develop protocols for rapid response in case of NIAS detection. Quarantine and eradication measures should be swift and effective.	

Residual Impact

Applying the recommended mitigation measures set out would reduce the probability of introducing invasive alien species, with the residual impact significance still considered to be Not Significant.

5. Mitigation Measures to Potential Impact due to **sea dredging, and soil placement**

Measure	Source of Measure
Dredging and Soil Placement: • Dredging from the sea plays a crucial role in reclaiming lost shoreline areas. • Ensure proper soil placement ensures stability, functionality, and long-term viability of the highway.	

• Recognise the environmental sensitivity which guides these activities to minimize disruption to marine ecosystems and coastal habitats. • Use sediment containment methods (such as silt curtains or geotextile tubes) to prevent dispersion. **Soil Compaction Quality Assurance-Engineers employ several techniques:** • Ensure field testing: Soil samples should be analyzed for density, moisture content, and compaction properties. • Use proper equipment: Compactors (rollers) achieve uniform compaction during soil placement. • Ensure compaction control: Density gauges or nuclear density meters monitor compaction levels. • Adopt layer-by-layer approach: Soil is placed, compacted, and verified incrementally. • Provide for quality checks: Independent inspectors verify compaction quality. **Provide Marine Sand Watch Platform** to monitors dredging activities. • This will tracks sand, clay, silt, gravel, and rock extraction • This type of platform uses Automatic Identification System (AIS) signals from vessels and Artificial Intelligence (AI) for detection.	

Residual Impact

Applying the recommended mitigation measures set out would reduce the probability of introducing invasive alien species, with the residual impact significance still considered to be Not Significant.

6. Mitigation Measures to Potential Impact due Ecotoxological impacts

Measure	Source of Measure
• Implement erosion control measures during construction to minimize sediment runoff. • Proper treatment of labour camp wastewater to reduce pollutant levels. • Regular monitoring of water quality during construction and post-construction phases.\	

Residual Impact

Applying the recommended mitigation measures set out would reduce the probability of introducing invasive alien species, with the residual impact significance still considered to be Not Significant.

- **Social**

1. Mitigation measures to Potential Impact on Population Resettlement/Displacement

Measure	Source of Measure
• Community Engagement: o Engage with affected communities to understand their preferences and concerns. o Involve community leaders, NGOs, and local representatives in decision-making processes. • Compensation and Relocation: o Affected residents and property owners should be compensated fairly for their losses. This compensation can help them relocate to alternative areas. o The government should provide financial support to facilitate the transition. • Resettlement Planning: o A comprehensive resettlement plan should be developed, considering the needs of displaced individuals and communities. o The plan should address housing, infrastructure, healthcare, education, and livelihood opportunities in the new locations. • Infrastructure Development: o Develop infrastructure (such as roads, schools, and healthcare facilities) in the new resettlement areas to ensure a smooth transition. o Ensure that basic amenities are available to the relocated population. • Livelihood Analysis of Resettlement Outcomes: o For the vulnerability communities, in addition to individual compensation create access to livelihood assets o use of involuntary resettlement in highway project to alleviate poverty and improve living conditions • Environmental Mitigation: o Implement measures to mitigate environmental impact during construction. o Preserve natural habitats and ecosystems where possible. • Legal Framework:	Section 2.3, page 64-69, General EHS Guidelines The World Bank

Measure	Source of Measure
○ Establish legal provisions to protect the rights of displaced individuals. ○ Ensure adherence to international standards for involuntary resettlement.	

Residual Impact

Post mitigation the impact will be Moderate.

2. Mitigation measures to Potential Road alignment siting/routing

Measure	Source of Measure
• Areas of Exceptional Aesthetic Quality: ○ Ensure the balancing development with aesthetic preservation. • Overcrowded Areas: ○ Ensure proper planning and traffic management to prevent further overcrowding. • Tourism Attraction Sites: ○ Since the highway's path intersects with tourism sites, including beaches and coastal areas, ensure careful design to protect these attractions. • Subsisting Infrastructure Network: ○ The highway should be made to integrate seamlessly with existing infrastructure networks. This requires coordination with utilities, transportation, and other services • Market Emergence Due to Traffic Volume: ○ High traffic volume can lead to spontaneous markets along the road. Manage these markets with the stakeholders and ensuring safety. Create zones for such road side markets • Reclining Disturbed Areas: ○ The highway's construction disrupts existing ecosystems and communities. Resettlement plans, compensation, and environmental mitigation are essential in managing the impacts raised. • Integrated Land Use and Transport Planning: ○ Coordinate land use planning with transport planning to reduce travel distances and promote sustainable development. ○ Encourage mixed-use developments near transportation hubs. • Public Participation and Stakeholder Engagement:	Performance Standard 1 Resolution 74/299 adopted by the UN General Assembly on August 31, 2020

Measure	Source of Measure
○ Involve local communities, transport agencies, and other stakeholders in decision-making processes. • Traffic Management Strategies: ○ Develop and enforce traffic management strategies, including traffic signal optimization, lane management, and congestion reduction. • Road Maintenance and Upgrades: ○ Prioritize road maintenance and rehabilitation to improve highway conditions. ○ Upgrade existing roads to accommodate increasing traffic demands and enhance safety. • Smart Traffic Lights: ○ These lights use artificial intelligence (AI) to manage traffic flow. ○ They respond to real-time conditions, adjusting signal timings based on traffic volume and congestion • Traffic Data Collection and Monitoring: ○ Implement regular traffic surveys using modern technology (e.g., automated counters, sensors) to collect accurate and up-to-date traffic data. ○ Monitor traffic patterns, volume, and flow continuously to inform planning decisions.	
• Develop and implement a community grievance mechanism to provide a means for raising concerns. The process should be understandable and transparent, and provide timely feedback to those concerned, without retribution. • Engage with local communities (including the pastoralists) on the traffic management measures being applied and respond to any feedback received. • Use of the mechanism shall be communicated to local communities through the Project's stakeholder engagement process.	

Residual Impact

Post mitigation the impact will be Moderate.

3. Mitigation Measures to Potential Road congestion during Construction

Measure	Source of Measure
Traffic Diversion:	

Measure	Source of Measure
• Divert traffic away from construction zones using alternative routes. • Temporary detours and signage guide drivers to avoid congested areas. Off-Peak Construction: • Schedule construction during off-peak hours (e.g., nights or weekends) to reduce impact on daily commuters. • Minimize lane closures during rush hours. Phased Construction: • Divide the project into phases to maintain traffic flow. • Complete one section before moving to the next. Temporary Traffic Signals and Signs: • Use temporary signals and signs to manage traffic at work zones. • Communicate lane closures, speed limits, and detours clearly. Work Zone Speed Limits: • Enforce reduced speed limits in construction zones. • Fines for speeding in work areas deter reckless driving. Public Awareness Campaigns: • Inform the public about construction schedules and alternate routes. • Use media, websites, and social platforms to raise awareness. Safety Measures: • Enhance road safety through measures such as pedestrian crossings, speed limits, and traffic calming techniques. • Educate the public about safe road behavior and enforce traffic rules. Public Transportation Promotion: • Encourage use of public transit during construction. • Provide incentives for commuters to switch modes. Real-Time Traffic Monitoring: • Monitor traffic flow using cameras and sensors. • Adjust traffic management strategies based on real-time data.	Performance Standard 1

Measure	Source of Measure
• Ensure effective coordination among construction teams, transportation agencies, and the public for successful traffic management during the highway construction	
• Develop and implement a community grievance mechanism to provide a means for raising concerns. The process should be understandable and transparent, and provide timely feedback to those concerned, without retribution. • Engage with local communities (including the pastoralists) on the traffic management measures being applied and respond to any feedback received. • Use of the mechanism shall be communicated to local communities through the Project's stakeholder engagement process.	

Residual Impact

Post mitigation the impact will be Moderate.

High way construction, managing traffic congestion

4. Mitigation Measures to Potential Impact on Road Traffic and Transport Risk of Project Vehicle Traffic Accidents

Measure	Source of Measure
Traffic Management Plan: • Develop a comprehensive traffic management plan that includes speed limits, designated routes, and safe zones. • Clearly mark pedestrian crossings and vehicle paths. **Driver Training and Awareness**: • Train project vehicle drivers on safe driving practices. • Raise awareness about potential hazards and the importance of vigilance. **Regular Vehicle Inspections**: • Ensure that project vehicles are well-maintained and meet safety standards. • Regularly inspect brakes, lights, tires, and other critical components. **Emergency Response Preparedness**: • Establish protocols for handling accidents promptly. • Train staff in first aid and emergency response	

Measure	Source of Measure
Community Engagement: • Engage with local residents and businesses to raise awareness about traffic safety. • Encourage responsible behaviour among all road users. **Speed Control**: • Enforce speed limits within the project area. • Use speed bumps or other traffic calming measures where necessary.	
• Train vehicle operators in the safe operation of specialized vehicles, including safe loading/unloading practices and load limits. • Ensure drivers undergo medical surveillance • Ensure moving equipment with restricted rear visibility is outfitted with audible back-up alarms	Section 2.3, page 64-69, General EHS Guidelines
• Develop and implement a Traffic Management Plan (or equivalent) that evaluates potential routes for the main project related vehicle movements for construction machinery, goods (e.g., deliveries of aggregates, bitumen and concrete), worker transport, and waste removal vehicles. This plan should prioritise routes that, where possible, avoid noise sensitive areas included but not limited to schools and residential areas. If avoidance is not possible, the plan will consider alternative minimisation measures such as timing of vehicle movements, speed restrictions, staff training etc.	Section 2.3, page 64-69, General EHS Guidelines
Develop and implement a community grievance mechanism to provide a means for raising concerns. The process should be understandable and transparent, and provide timely feedback to those concerned, without retribution. Engage with local communities (including the pastoralists) on the traffic management measures being applied and respond to any feedback received. Use of the mechanism shall be communicated to local communities through the Project's stakeholder engagement process.	Performance Standard 1

Residual Impact

Post mitigation the impact will be Moderate.

1. Mitigation Measures to Potential impact on occupational health and safety

Measure	Source of Measure
• Carry out risk assessment of various tasks, situation and of new equipment • Proper training, personal protective equipment (PPE), and clear signage are essential. • Strict handling protocols, proper disposal, and air quality monitoring are crucial. • Respiratory protection, dust control, and regular health checks for workers. • Ear protection, noise reduction strategies, and awareness campaigns. • Record near misses and other incident or accidents. • Ensure zero fatalities (whether directly employed or subcontracted) especially accidents that could result in lost work time, different levels of disability, or even fatalities. • The working environment should be monitored for occupational hazards relevant to the specific project. • Monitoring should be designed and implemented by accredited professionals • Maintain a record of occupational accidents and diseases and dangerous occurrences and accidents. • Evaluate Occupational health and safety performance against internationally published exposure guidelines, examples of which include the Threshold Limit Value (TLV®) occupational exposure guidelines and Biological Exposure Indices (BEIs®) published by American Conference of Governmental Industrial Hygienists (ACGIH),56 the Pocket Guide to Chemical Hazards published by the United States National Institute for Occupational Health and Safety (NIOSH),57 Permissible Exposure Limits (PELs) published by the Occupational Safety and Health Administration of the United States (OSHA),58 Indicative Occupational Exposure Limit Values published by European Union member states,59 or other similar sources	• General EHS Guidelines. • International Labour Organization (ILO) Code of Practice for Safety and Health in Ports (2005); • General Conference of the International ILO Convention concerning Occupational Safety and Health in Dock Work, C-152, (1979); • General Conference of the ILO Recommendation concerning Occupational Safety and Health in Dock Work, R-160; • IMO Code of Practice for Solid Bulk Cargo (BC Code); • International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk (IBC Code); • International Code for the Safe Carriage of Grain in Bulk (International Grain Code); • Code of Practice for the Safe Loading and Unloading of Bulk Carriers (BLU Code); and • International Maritime Dangerous Goods Code (IMDG Code) •

Residual Impact

Not significant if impacts are adequately implemented

2. Mitigation Measures to Potential impact on Community health and safety at construction phase

Measure	Source of Measure
Physical Injury and Accidents: • Implement clear signage and barriers to keep the public away from construction zones. • Provide safety training for workers and enforce strict safety protocols. • Regularly inspect equipment and machinery for maintenance and safety compliance. **Exposure to Hazardous Materials**: • Properly handle, store, and dispose of hazardous materials. • Monitor air quality and conduct regular health assessments for workers. **Respiratory Effects from Air Emissions**: • Implement dust control measures (e.g., water spraying, covering materials). • Use low-emission construction equipment. • Monitor air quality and provide health education to affected communities. **Spread of Communicable Diseases**: • Promote hygiene practices (handwashing, sanitation). • Monitor disease outbreaks and provide healthcare access. • Educate the community about disease prevention. • Develop a community awareness programme	• Environmental, Health, And Safety Guidelines • General EHS Guidelines. • International Labour Organization (ILO) Code of Practice for Safety and Health •

Residual Impact

Not significant if impacts are adequately implemented.

3. Mitigation Measures to Potential Impacts on Socio-economic Opportunity

Measure	Source of Measure
Set up a local labour desk and ensure the staff recruitment policy is transparent.	
Give employment priority to local community members in the project environment, along the project's axes during recruitment in line with requests made during engagement with local communities	

Issue end-of-contract work certificates or attestations to employees to enable them to be more competitive if they are offered another opportunity for similar jobs.	
As far as possible, subcontract certain work to local SMEs.	

Residual Impact

Post mitigation the impact will be Positive**.**

4. Mitigation Measures to Potential Infringement on Workers' Human Rights

Measure	Source of Measure
Health and Safety Protocols: • Implement robust safety protocols, including personal protective equipment (PPE), training, and hazard assessments. • Regularly inspect equipment and machinery to ensure they meet safety standards.	African Charter on Human and Peoples' Rights (Ratification and Enforcement) ILO UN's Universal Declaration of Human Rights and IFC PS2
Fair Labor Practices: • Ensure fair wages, overtime compensation, and adherence to labour laws. • Monitor working hours to prevent excessive fatigue. • Provide access to medical care and welfare facilities.	
Subcontractors and Workers' Rights: • Extend these protections to subcontractors and all workers involved in the project. • Educate workers about their rights and avenues for reporting violations.	
Emergency Preparedness: • Develop emergency response plans for accidents or health crises. • Train workers on evacuation procedures and first aid. **Training** • All employees should be trained on the Occupational Health Management Plan, with particular focus on those risks specific to their roles.	
Ensure fair wages, overtime compensation, and adherence to labour laws.	
Develop a Human Resources Management Plan (or equivalent). This Plan will specify clear contracting procedures and worker rights in	Performance Standard 2

Measure	Source of Measure
accordance with national law and IFC PS2. The Human Resources Management Plan will incorporate human rights and non-discrimination principles as well as standards regarding accommodation, salaries etc. A copy of this document will be provided to each worker and training will be given on how workers can raise any concerns regarding their treatment via the Grievance Mechanism. Priority will be given to local workers provided they are suitably qualified to undertake the work. Implement training for all workers, including contract workers, on the principles of the Human Resources Management Plan including worker rights, non-discrimination, and human rights and the use of the Worker's Grievance Mechanism.	
All contracts for workers, including contract workers, will be in accordance with applicable national labour law and IFC PS2 requirements. Worker contracts must clearly detail workers' rights.	Performance Standard 2
Develop and implement a grievance mechanism for all workers (including direct employees and contractors) to provide a means for raising workplace concerns. The process should be understandable and transparent, and provide timely feedback to those concerned, without retribution. The mechanism shall be communicated to all workers, including subcontractors via accessible means (e.g., notice boards) and in employment contracts.	Performance Standard 2
Ensure the project, including subcontractors will utilise no child or forced labour (as defined by Performance Standard 2).	Performance Standard 2, ILO Conventions 138 and 182

Residual Impact

Post mitigation the impact will be Moderate**.**

5. Mitigation Measures to Potential Impact on Local Content and Procurement

Measure	Source of Measure
Community Engagement Programs: • Organize workshops, skill-building sessions, and vocational training for local residents. • Foster community participation in project-related activities.	,

<table>
<tr><th>Measure</th><th>Source of Measure</th></tr>
<tr><td>Local Procurement and Contracting:
• Prioritize local businesses for supplying materials and services.
• Encourage subcontractors to hire local labour.
Social Infrastructure Investment:
• Invest in local schools, healthcare facilities, and community centres.
• Support education and healthcare access for residents.
Environmental Education:
• Raise awareness about environmental conservation among local communities.
• Engage schools and community groups in eco-friendly initiatives.
Job Placement Services:
• Assist workers in transitioning to other employment opportunities after project completion.
• Facilitate job placements or entrepreneurship support.
Cultural Preservation:
• Celebrate local culture and traditions through events and festivals.
• Preserve historical sites and landmark</td><td></td></tr>
<tr><td>Making meal breaks available and allowing for goods from local vendors to directly supply the work force will be of particular benefit.</td><td></td></tr>
<tr><td>Investing in workforce development, such as employing and training local workers, and developing local suppliers, services, and products, creates additional value known as local content.</td><td>The Local Content Act, 2003</td></tr>
</table>

Residual Impact

Post mitigation the impact will be a Moderate positive.

6. Mitigation Measures to Potential impact related to Influx of People to the Project Area

Mitigation

The Table below details recommended mitigation.

Measure	Source of Measure
Ensure equal access to healthcare services, including preventive care, primary care, mental health services, and reproductive health services, for migrant populations.	

Measure	Source of Measure
Promote social integration and community engagement through neighbourhood associations, cultural events, sports clubs, and other community-based initiatives that welcome and include migrants.	
Offer training in job readiness skills, vocational skills, and entrepreneurship development to enhance the employability of migrant and host communities in order to promote peace in the communities.	

Residual Impact

Post mitigation the impact will moderate.

6.4.2.2 Specific Mitigation Measures for the Decommissioning

- (Site Clean-Up and Equipment Removal after Construction) Soil, Surface and Water Quality

1. Mitigation Measures to Increased Turbidity and Suspended Solids Due to Site Clean-Up and Equipment Removal

Measure	Source of Measure
Implement robust sediment and erosion control measures, such as silt curtains or sediment traps, to minimize the release of suspended solids during the piling activities.	WHO World Bank Environmental, Health, And Safety Guidelines
Conduct thorough characterization of the sediments and develop a sediment management plan to ensure proper handling and disposal of contaminated materials.	IMO, 1973/1978 World Bank Environmental, Health, And Safety Guidelines
Monitor the water quality in the project basin and adjacent surface waters to detect any changes in turbidity, suspended solids, and associated contaminants. These should limit turbidity of discharge water to ≤ 5 NTU	WHO World Bank Environmental, Health, And Safety Guidelines
Develop and implement a response plan to address any significant increases in turbidity or sedimentation that could adversely affect the aquatic environment.	

Residual Impacts

Increased turbidity and suspended solids are expected to have minor, manageable impacts on surface water, while groundwater residuals are expected to be negligible due to their primary effects.

2. Mitigation Measures to Saline Water Intrusion into the Freshwater Aquifer System: Due to Dewatering Activities

Measure	Source of Measure
Careful planning and execution of site grading, drainage, and landscaping to maintain natural groundwater flow patterns and hydraulic gradients.	
Proper management and disposal of dewatering effluent, ensuring it does not directly or indirectly recharge the freshwater aquifer.	Dewatering and Groundwater Control by the American Society of Civil Engineers (ASCE), ASCE Manual of Practice No. 110, ISBN: 978-0-7844-0750-8.
Comprehensive site restoration and stabilization to minimize the potential for surface water infiltration and saline water intrusion.	
Groundwater monitoring, including regular testing for salinity levels, to detect any changes in water quality.	
Implementation of groundwater recharge measures, such as infiltration basins or permeable surfaces, to maintain freshwater aquifer levels and prevent saline water intrusion.	

Residual Impacts

Residual impact is expected to minimal, localized, temporary and not significant

3. Mitigation Measures to Increased surface runoff and pollutant mobilization

Measure	Source of Measure
Implement effective sediment and erosion control methods, such as silt fences, sediment traps, and temporary soil stabilization, to reduce sediment and pollutant transmission in surface runoff.	International Erosion Control Association (IECA) Best Management Practices (BMP) Handbook, ISBN: 978-0-9853220-0-2.

Measure	Source of Measure
Ensure that construction debris, garbage, and hazardous materials created during demobilization are thoroughly cleaned up and disposed of properly.	
Create and implement strict conventions for the dealing with, capacity, and transfer of powers, oils, and other unsafe materials utilized amid the operation and up keep of the offices to avoid coincidental spills or spills.	
Conduct routine monitoring and maintenance of waste frameworks and stormwater treatment facilities to ensure their continued effectiveness in managing water quality.	
Provide specific spaces for equipment maintenance and fluid storage complete with suitable containment and spill control measures.	
Monitor surface water quality and take remedial measures if pollution levels increases.	

Residual Impact

With the implementation of the proposed mitigation measures, the residual impacts on surface water and groundwater are considered not to be Significant.

- **Social**

1. Mitigation Measures to Potential impact on Socio-economics

Measure	Source of Measure
• **Traffic Management**: Develop site-specific traffic management plans to minimize disruptions. • **Notification**: Notify neighbours and stakeholders about equipment removal schedules. • **Fenced Construction Area**: Install fences around the area to reduce wind-blown dust dispersion and dust clouds. • **Control Material Drop Heights**: Reduce material drop heights to control fugitive dust emissions during material handling	General EHS Guidelines.
Businesses and food vendors near the project sites may rely on the project activities. During equipment removal, their operations could be disrupted. Reduced business activity can lead to financial losses and affect employment.	

The Human Resources Management Plan should consider the following: • **Communication and Engagement:** Establishing clear communication channels with employees and stakeholders to provide information about potential job impacts, timelines, and support services available. • **Training and Development:** Providing training opportunities for employees to acquire new skills that align with the project's needs and future job opportunities. • **Redeployment and Retraining:** Offering redeployment options within the organization or retraining programs to help employees transition to new roles or industries.	

Residual Impact

Positive

2. Mitigation Measures to Potential impact on occupational health and safety at post construction phase

Measure	Source of Measure
• Proper training, personal protective equipment (PPE), and clear signage are essential. • Strict handling protocols, proper disposal, and air quality monitoring are crucial. • Adequate ventilation, rescue plans, and continuous monitoring are necessary. • Respiratory protection, dust control, and regular health checks for workers. • Ear protection, noise reduction strategies, and awareness campaigns.	• General EHS Guidelines. • International Labour Organization (ILO) Code of Practice for Safety and Health • General Conference of the International ILO Convention concerning Occupational Safety and Health.

Residual Impact

Not significant if impacts are adequately implemented

Additional Measures Common to Construction - Related Impacts

6.5 Environmental and Social Management System (ESMS)

An effective ESMS integrates environmental considerations into day-to-day operations, promotes continual improvement, and goes beyond regulatory compliance. Thus for minimising environmental hazards during both the construction and operation phases of the project, the following components are necessary**:**

a. Risk Identification and Ranking:

The hazard risk analysis conducted during the Environmental and Social Impact Assessment (ESIA) identifies potential risks. Build on this and manage effectively based on the mitigation measures suggested. Others come rear their heads, provide measures for them. Risks are assessed based on their likelihood of occurrence and the magnitude of consequences. This ranking informs decision-making and risk mitigation strategies. Follow the patten set in Chapter 5, in risk assessment**.**

b. Standard Operating Procedures (SOPs):

1. SOPs provide clear guidelines for safe and environmentally responsible operations.
2. They cover aspects such as cargo handling, waste management, and emergency procedures.
3. Continue to implement the existing one and develop detailed SOPs for all project activities.

c. Emergency Preparedness and Response Plans:

1. Comprehensive plans are established to address accidents or incidents.
2. These plans consider various scenarios (e.g., spills, fires, structural failures).
3. Protocols for worker safety, community protection, and environmental containment should continue to be implemented.

d. Health and Safety Focus:

1. The ESMS prioritizes the health and safety of workers, nearby residents, and the environment.
2. Training programs ensure that personnel understand emergency protocols.
3. Regular drills and exercises test the effectiveness of response plans.

6.6 Specific Measures to Address Air and Water Pollution

- **Air Pollution:**
    - Trucks and Machinery: Regular maintenance and emission standards for project vehicles and equipment.
  - Health Monitoring:
    - Respiratory Health: Regular health check-ups for project workers and nearby residents.
    - Air Quality Sensors: Install monitoring stations to track pollutant levels.
- **Water Pollution:**

  - Fuel Spills Mitigation:
    - Spill Response Plans: Train personnel to handle fuel spills promptly.
    - Containment Booms: Deploy barriers to prevent spilled fuel from spreading.
  - Wastewater Treatment:
    - Runoff: Treat runoff water before it enters rivers or oceans.
    - Oil-Water Separators: Install systems to remove oil and contaminants.
- **Noise and Vibrations:**
  - Noise Reduction:
    - Quieter Equipment: Invest in quieter machinery and engines.
    - Noise Barriers: Erect soundproof walls around noisy areas.
  - Community Engagement:
    - Communication: Inform nearby residents about construction schedules and noise levels.
    - Nighttime Restrictions: Limit noisy activities during nighttime hours.
- **Traffic Congestion:**
  - Traffic Management:
    - Alternate Routes: Divert cargo traffic away from residential areas.
    - Peak Hours: Schedule cargo movements during off-peak hours.
    - Public Transport: Encourage use of public transportation for project workers.
- **Health Risks:**
  - Worker Safety:
    - Protective Gear: Provide proper gear for handling hazardous materials.
    - Training: Train workers on safe practices.
  - Community Awareness:
    - Health Education: Educate nearby residents about risks and precautions.
    - Emergency Response: Ensure quick medical assistance in case of accidents.

- **Stakeholder Involvement and Continuous Monitoring**
  - Ensure a wholistic approach that ensures stakeholder involvement, and continuous monitoring are caused for sustainable operations.

6.7 Measures for Handling Hazardous Materials

A proactive approach, continuous training, and adherence to safety protocols are critical for handling hazardous materials effectively. To ensure safety and environmental protection, the following key guidelines must be followed:

- **Proper Labelling and Storage:**
  - Ensure all hazardous materials are properly marked.
  - Adequately label hazmat containers.
  - Store chemicals in appropriate containers.
  - Keep hazardous materials in dry, cool, and ventilated areas.
  - Separate incompatible materials to prevent reactions.

- **Emergency Preparedness:**
    - Develop emergency response plans specific to hazardous materials.
    - Train personnel on proper handling procedures.
    - Use personal protective clothing and equipment to prevent exposure.
    - Be familiar with emergency contact information and procedures.
- **Safe Handling Techniques:**
    - Use mechanical handling equipment (e.g., hydraulic hoists) to minimize manual lifting.
    - Encourage workers to adopt safe lifting techniques.
    - Avoid manual handling of heavy or hazardous loads whenever possible.
- **Spill Prevention and Response:**
    - Implement spill prevention measures:
        - Properly secure containers.
        - Regularly inspect storage areas.
    - Have spill kits readily available for immediate response.
    - Train personnel on spill containment and cleanup procedures.
- **Chemical Compatibility:**
    - Understand the compatibility of different chemicals.
    - Avoid storing incompatible substances together.
    - Refer to Material Safety Data Sheets (MSDS) for guidance.
- **Worker Training and Awareness:**
    - Regularly train personnel on hazardous material handling.
    - Raise awareness about risks and safe practices.
    - Encourage reporting of any incidents or near misses.

CHAPTER SEVEN
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

- **7.0. Introduction**

The Environmental and Social Management Plan (ESMP) is a critical component of infrastructure projects designed to integrate mitigation measures and environmental and social management objectives. This Chapter thus outlines the ESMP for the proposed project with several critical aspects designed to contribute to the successful implementation. The ESMP adheres to international and national standards for environmental and social (E&S) performance. It covers the entire project life cycle, from planning to implementation and operation.

Upfront, it should be noted that the ESMP ensures that mitigation measures are incorporated into project planning and design. It outlines specific impacts identified and corresponding mitigation measures. It establishes institutional arrangements for implementing and monitoring these measures with focus on Lagos – Calabar Coastal Highway (Section 2)

7.1 Purpose and Benefits of ESMP:

The Environmental and Social Management Plan (ESMP) plays a crucial role in ensuring that a project achieves its objectives while minimizing adverse environmental, social, and health impacts. The ESMP) for the Lagos - Calabar Coastal Highway is a comprehensive framework designed to ensure responsible project implementation while minimizing environmental impact. The ESMP serves as a roadmap for responsible project management, emphasizing environmental protection, social well-being, and compliance with statutory instruments and applicable laws.

With regard to benefits, the ESMP:

- Monitors the effectiveness of mitigation measures
- Ensures compliance with environmental standards.
- Minimizes negative impacts on the environment, social aspects, and health.
- Enhances safety policies.

7.2 Objectives of ESMP.

The core objectives of the ESMP for the proposed project are outlined below:

- Demonstrate that environmental aspects and potential impacts of the proposed project activities have been thoroughly identified and evaluated.
- Implement measures to mitigate significant adverse impacts.
- Present the management system that ensures compliance with relevant environmental regulations, standards, guidelines, and codes of practice throughout all project phases.

- Monitor adherence to all mitigation measures and commitments outlined in the Environmental and Social Impact Assessment (ESIA) report during project implementation.
- Commit to continuous improvement in environmental performance by adopting best management practices.
- Monitor compliance with legal standards and limits for waste discharges.
- Provide early warning signals regarding potential environmental degradation, enabling timely actions to prevent or minimize adverse consequences.

7.3 Environmental and Social Management System

The ESMP for this project serves as a comprehensive framework which emphasizes responsible project management, environmental protection, and social well-being. The key aspects of the Environmental and Social Management System (ESMS) are outlined below:

1. **Legislative Framework**:

The legislative framework encompasses the legal context, laws, regulations, and policies at various levels (international, local and company/organisation). As they relate to the project were well espoused in Chapter 1.

Thus, FMW and its contractor, HITECH are committed to abiding to all the relevant instruments in the course of the project implementation, using this ESMP. Adhering to these regulations ensures responsible environmental and social practices and minimizes negative impacts.

2. Corporate Environmental Responsibility**:**

The Contractor working with FMW recognizes that an environment, health and safety friendly workplace along with environment, safety and health conscious personnel are core values of driving the business sustainability. The contractor is committed to ensuring environmentally sustainable and responsible operations to achieve the highest standards of excellence.

As part of the corporate environmental responsibility the contractor and FMW are committed to sustainable practices and minimizing the project's ecological footprint. To this end, initiatives like reducing waste, conserving energy, promoting biodiversity, and supporting community environmental and social projects shall be key in the implementation.

3. Organizational Structure and Responsibility**:**

The Federal Ministry of Works (FMW) and contractors commit to implementing the outlined mitigation measures through this ESMP. Responsibilities include operation, supervision, enforcement, monitoring, remedial action, financing, reporting, and staff training.

To achieve the success of this ESMP and indeed the overall project outcome, the **FMW** has the core mandate to co-ordinate the project programmes and actions; plan, coordinate, manage and develop the various project activities; prepare plans for project management and development. To achieve this, the FMW shall liaise with the various levels of government and other stakeholders identified with their institutional roles and responsibilities below:

The Contractor will have ultimate responsibility for implementing the provisions of the ESMP. This role will include the management of environmental impacts, monitoring of subcontractors performance as well as development of mechanisms for dealing with environmental and social problems.

The contractors will also ensure that the activities of its subcontractors during establishment, construction and decommissioning phases are conducted in accordance with 'good practice' measures and the project ESMS, implementation of which will be required through contractual documentation. In order to facilitate this and to demonstrate commitment to the ESMP, the contractor will conduct regular internal site inspections and audits, the results of which will be documented.

The organisation structure of the project EHS Team is presented in the Figure 7.1. This structure might be subject to changes based on project needs during implementation.

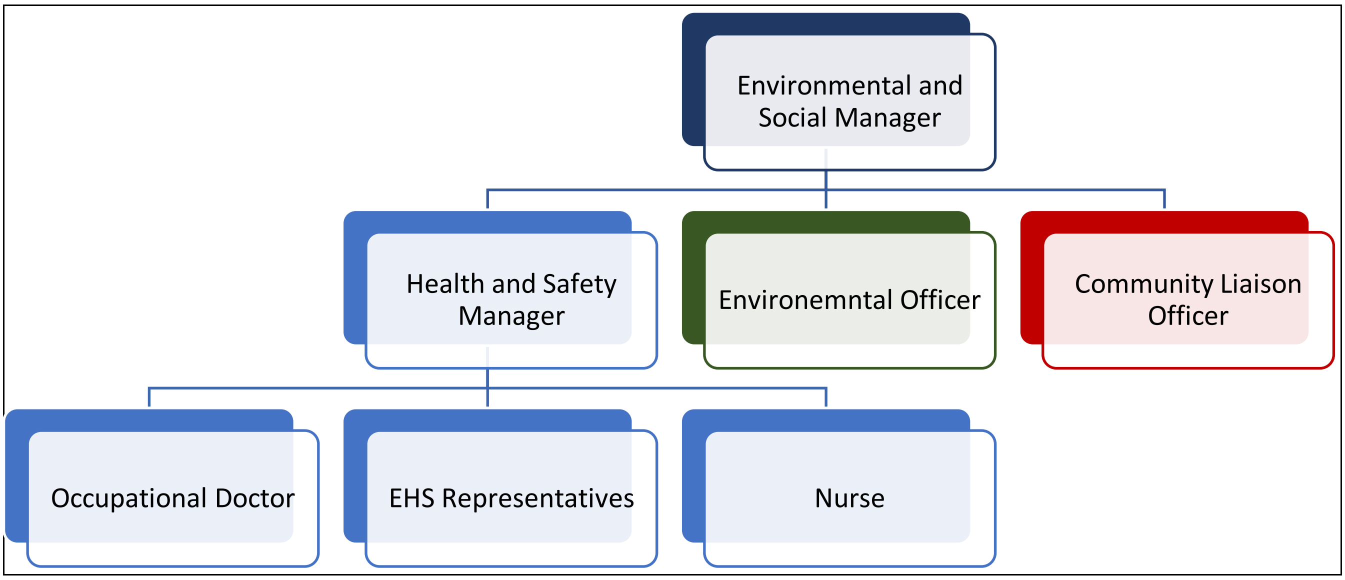

Figure 7.3: Organizational Structure of the EHS Team

Table 7.5: Roles and Responsibilities of Institutions

Role	Responsibility
FMW and Contractor EHS Team	
FMW	• Implementing authority • Co-ordinate all policies, programmes, and actions relating to the project • Ensure that the project is carried out in a sustainable manner. • 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
E&S Manager	• Responsible for developing, implementing, and overseeing the ESMP the project. • Ensure project activities comply with legal and regulatory environmental and social requirements. • Facilitate the participation and consultation of stakeholders, including local communities, in the planning and implementation of environmental and social measures. • Evaluate and report on the E&S performance of the project on ongoing basis.
Health and Safety Manager	• Responsible for establishing, supervising, and evaluating health and safety management measures at the project site. • Ensure all activities are conducted in safe and healthy working conditions. • Ensure workers are trained and equipped to minimize the risks of accidents and occupational illnesses.
Environmental Officer	• Responsible for ensuring appropriate measures are taken to mitigate environmental impacts and monitoring their effectiveness. • Prepare environmental performance and monitoring reports for review and approval by the Environmental and Social Manager.
Community Liaison Officer	• Responsible for communication and coordination between the project and local communities. • Ensure that the concerns and needs of communities are considered in the planning and implementation of the project. • Facilitate the participation and consultation of communities in the implementation of environmental and social measures.
EHS Representatives	• Support the Health and Safety Manager in implementing health and safety measures. • Ensure compliance with health and safety regulations and standards.

Role	Responsibility
	• Participate in the investigation of accidents and incidents.
Occupational Doctor	• Responsible for the medical surveillance of personnel. • Prevent occupational risks and manage health issues within the project. • Coordinate with internal and external stakeholders as necessary.
Nurse	• Responsible for providing first aid in emergencies and incidents, as well as managing the clinic. • Operate under the coordination of the Occupational Doctor to ensure responsiveness and effective management of health situations within the project.
• **Subcontractors**	• Inclusion of environmental and social mitigation measures in construction activities and budgets as specified in the project ESMP. • Responsible for ensuring the project adheres to national law and the policy of the lender, including social and environmental safeguards. • Comply with the project ESMS and Contractor E&S policies and procedures. • Day-to-day project management and coordination: project administration; technical oversight (engineering and environmental); review, supervise and approval of the work of the employees. • Environmental and social supervision to ensure that all mitigation is provided as specified in the project ESMP by their own staff. • Monitor the environmental and social compliance of the project according to the ESMP.
ESIA Consultant	• Provide support in the relevant fields of concern to ensure robust implementation. • Support in monitoring activities • Support in ESMP update
	Authorities and Other Stakeholders
Federal Ministry of Environment (FMEnv)	• Provide lead role with advice on screening, scoping, review of draft ESIA report (in liaison with State Ministry of Environment and Water Resources), receiving comments from stakeholders, public hearing of the project proposals and social liability investigations, monitoring and evaluation process and criteria.
National Environmental Standards and Regulations Enforcement Agency (NESREA)	• Ensures compliance with a range of environmental laws, guidelines, policies, and standards related to the Lagos Ports. This includes monitoring and enforcing regulations on air quality, water quality, and pollution abatement
State Ministry of Environment/EPA	• Review of draft ESIA report (in liaison with Federal Ministry of Environment) • Site assessment and monitoring of ESIA implementation.

Role	Responsibility
	• Environmental monitoring and compliance overseer at the State level
• **LGAs**	• Provision of oversight function across project within its jurisdiction for ESIA compliance. • Monitoring of activities related to public health, sanitation, waste management amongst others.
Affected • **Community**	• Promote environmental awareness. • Review environmental and social performance report made available by SPIU. • Provide comments, advice and/or complaints on issues of nonconformity. • Attend public meetings organized by the SPIU to disseminate information and feedback.
• **NGOs/CSOs**	• Assisting in their respective ways to ensure effective response action, conducting scientific research alongside government groups to evolve and devise sustainable environmental strategies and techniques.
• **Funders**	• Overall supervision and provision of technical support and guidance. • Recommend additional measures for strengthening management framework implementation performance; • Supervising the application and recommendations of sub project ESMPs.
• **General Public**	• Identify issues that could derail the project and support project impacts and mitigation measures, awareness campaigns.

7.4 Implementation

7.4.1 Management Control

Prior to start of proposed project activities, equipment and procedures will be designed to achieve the levels of EHS and social performance by all personnel and subcontractors. Implementation of the ESMP will involve the Contractor staff and its subcontractors. This will involve the implementation of the commitments contained in the ESMP, including relevant mitigation and control measures, working practices and overall management procedures as appropriate.

7.4.2 EHS Awareness and Training

Environmental and social awareness training will be developed by the EHS Team, the objective of which will be to provide all personnel working on the Project with:

- A broad understanding of the local environment and the potential impacts of the project, in particular information about environmentally or socially-sensitive areas;
- An understanding of what each Contractors responsibilities are, as outlined in the ESMP;

- A means of developing a culture of compliance with the Project environmental requirements; and
- A means to improve the environmental awareness of the workforce through the education of Project field personnel;
- The HSE team will arrange to provide the required training during project initiation.

The EHS Training Programme will be provided on Monthly basis for internal documentation as per

1. 7.4.3 Project Induction

A site-specific EHS induction training module will be developed by the Contractor Project EHS Team. Induction records will be kept and used to verify that all personnel working onsite have duly completed the process of EHS induction.

- The content of the site induction training is to include, at a minimum:
- Roles and responsibilities of all personnel in achieving EHS performance;
- Management of EHS incidents and operation of accidental spill control equipment;
- Management of waste; and
- Response to EHS incidents.

2. 7.4.4 EHS Toolbox Talks and Training

A toolbox talk involves the dissemination of information to project personnel at the field level. Generally, toolbox talks focus on EHS aspects with reference to certain Project jobs or tasks. They can, however, also be used to disseminate environmental and social management information. Toolbox talks are to be held regularly and will cover aspects, such as:

- Explanation of any new project requirements (if any);
- Explanation of the key EHS risks associated with an activity or specific procedure(s) which could have potential environmental and social impacts;
- Explanation of mitigation strategies with reference to an activity or specific procedure(s), which could have potential environmental and social impacts;
- Reinforcing the importance of specific or generic environmental commitments;
- Obtaining feedback related to EHS issues; and
- Any other relevant purpose related to the implementation or review of the ESMP.

Toolbox talks will allow relevant information to be communicated to the workforce and will also provide a forum for providing feedback on issues of interest or concern. Toolbox talks will generally be organized by the Contractor Project EHS Team but may also be delivered by the Project Management team. Possible Toolbox Talk topics will include:

- Management of works in port premises;
- Air emission suppression measures during project activities;
- Noise and vibration reduction;
- Waste management, reduction and recycling;
- Waste-water management, treatment facility operation and monitoring
- Fire safety at site;
- Spill management;

- Unloading and lifting of heavy machineries and equipment;
- Occupational health and safety, especially COVID-19 protocols.

Table 7.2: Training modules on environment and social management for the stakeholders

Table 7.2: Training Modules on Environment and Social Management						
Programme	**Description**	**Participants**	**Form of Training**	**Duration/ Location**	**Training Conducting Agency**	**Budget $**
Sensitization Workshop	Introduction to Environmental and Social Management	Engineers and EHS Team of FMW and contractor	Workshop	½ Working Day	Environmental & Social Specialists of Design Consultant/External Agency engaged for capacity building	1,500
Module I	Introduction to Environment: Basic Concept of Environment, Environmental Regulations and Statutory requirements as per Government	Engineers and EHS Team of FMW and contractor	Lecture	¼ Working Day	Environmental & Social Specialists of Design Consultant/External Agency engaged for capacity building	2,000
-Module II	Environmental Considerations in projects Management: Environmental components affected by project, Environmental Management Good Practices, Stakeholder and Community	Engineers and EHS Team of FMW and contractor	Workshop	1 Working Day	Environmental & Social Specialists of Design Consultant/External Agency engaged for capacity building	4,200

Table 7.2: Training Modules on Environment and Social Management

Programme	Description	Participants	Form of Training	Duration/ Location	Training Conducting Agency	Budget $
	project Participation					
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.	Engineers and EHS Team of FMW and contractor	Lecture and Field Visit	½ Working Day	Environmental & Social Specialists of Design Consultant/External Agency engaged for capacity building	5,000
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	Engineers and EHS Team of FMW and contractor	Workshop	½ day	Environmental & Social Specialists of Design Consultant/External Agency engaged for capacity building	3,200
Module VII	Gender and GBV Awareness raising/mainstreaming in project, GBV prevention,	Engineers and EHS Team of FMW and contractor	Workshop	1 day	Environmental & Social Management Consultant/External Agency	4,500

Table 7.2: Training Modules on Environment and Social Management

Programme	Description	Participants	Form of Training	Duration/ Location	Training Conducting Agency	Budget $
	mitigation and response				engaged for capacity building	
Module VIII	Training on Code of Conduct, OHS, HSE, C-ESMP, GRM including field visit for Case Studies.	Engineers and EHS Team of FMW and contractor	Workshop	2 days spread across the project Planning & Construction Phase	Environmental & Social Management Consultants	5,000
Total						**25,400**

7.5 Grievance Redress Mechanism

The Workers and Community Grievance Redress Mechanism (GRM) provides a systematic means to capture and resolve to all valid grievances that are related to both base business and development projects. The steps used in the GRM are:

- Record
- Investigate
- Communicate
- Resolve
- Close

Grievances are regularly discussed at the periodic Grievance Resolution Committee (GRC) meeting which is chaired by EHS Team and Project Team, as required to promote uniform awareness and to properly investigate and resolve grievances with the overview of the EHS Team.

1. 7.5.1 Introduction

A Grievance Redress Mechanism (GRM) that helps record, assess, and resolve grievances and complaints during the implementation of a project in as efficient, effective, and transparent manner as possible is essential to the success of the project. It also informs the Government and donors/financiers of design and implementation changes that can be used to improve the systems. The GRM aims to record and address any complaints that may arise during the Project's implementation phase. It is designed to address concerns and complaints promptly and transparently with no impacts (cost, discrimination) for project-affected people or those submitting the grievance. It works in compliance with the IFC Performance Standard 1 and 2 as well as legal and cultural frameworks, providing an additional opportunity to resolve grievances.

The GRM procedures to be followed will be presented to the community representatives as needed so that they are easily accessible to all stakeholders. Information on the steps to be followed in handling grievances will be incorporated into the consultation process with local community by the CLO. A Grievance Log will be used in this project to guarantee that the project is conducted in compliance with relevant environmental and social principles. The GCLS will be used to collect and store grievances and complaints in a single database, as well as track their progress until they are resolved. The figure below shows the flow process of the GRM.

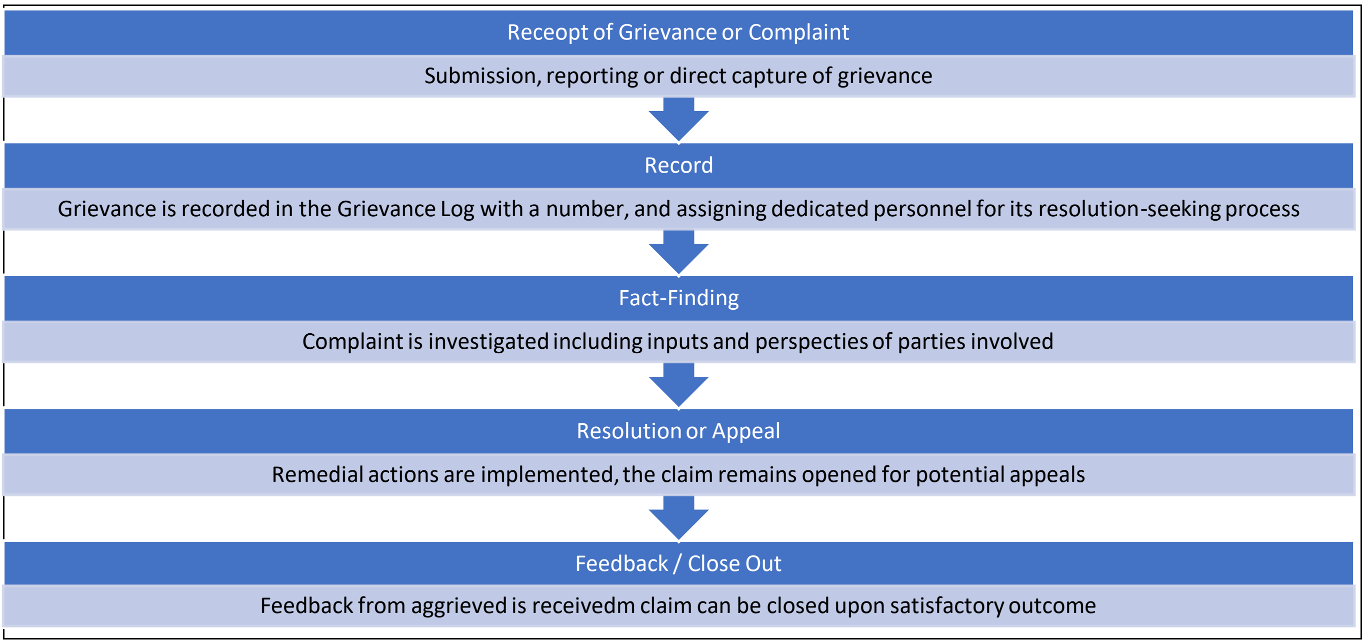

FIGURE 7.4: GRM PROCESS

2. 7.5.2 GRM Process

The process operates as follows:

- A Grievance Redress Committee (GRC) will be established. The CLO will be responsible to monitor and facilitate resolution of complaints.
- The affected peoples (AP) (or his/her representative) may submit his/her complaint in a number of ways e.g. by filling the **Error! Reference source not found.** in the Project site, calling on t he provided phone number, SMS messages and email to the GRC, or, alternatively, raise his/her voice in a public or individual meeting with project staff. Anonymous grievances will be accepted in case that the AP prefer to not disclose his/her identity. However, it is important to include an address that can be used for the Community Liaison Officer to send a reply.
- Contact details for complains are below.

    - Address:
    - Telephone:

- Email:

Depending on their nature, grievances will be addressed at the site level, terminal levels for related issues, host community level, State, and national levels. A complainant also retains the right to bypass this procedure and can address a grievance directly to the HITECH Office or FMW. The complaint could make a recourse to the law court where the various levels of grievance redress fail the Office of the National and Provincial Assembly, as provided for by law in the Togolese Republic. At each level, grievance details, discussions, and outcomes will be recorded in a grievance log, and the data will be provided to the GRC for recording. The status of grievances submitted and the grievance redress will be reported to the FMW management through the monthly reporting generated by the grievance committee to be set up by FMW GCLS.

The GRM will ensure the following:

- To provide a means for raising concerns. The process will be understandable and transparent, and provide timely feedback to those concerned, without retribution.
- To communicate the use of the mechanism to local communities through the Project's stakeholder engagement process. (on-going)
- To manage any complaints from surrounding community members, including those related to noise, vibrations, emissions, discharges, human rights violations, etc.
- To allow for the issues potentially associated with the loss of trade to be tracked and managed. (on-going)

All incoming grievances will be reflected in a Grievance Log to assign an individual reference number and inform the complainant about the reference number assigned to his/her complaint, either on the date of filing (if a complaint is delivered personally or over the telephone) or within seven days of receipt (if a complaint is sent by ordinary or electronic mail). The Grievance Log will also be used to track the status of a grievance, analyses the frequency of complaints arising, typical sources and causes of complaints, as well as to identify prevailing topics and any recurrent trends. the registration of the grievance to the log, significance of the grievance will be assessed within five to seven days.

The GRC will meet to try and resolve the matter at community level and make a recommendation within 7 working days from receipt of complaint. Each complaint and grievance will be analyzed and monitored according to type, accessibility and degree of priority. The status of grievances submitted, and grievance redress will be reported by the CLO. If a complainant is not satisfied with the proposed resolution, further negotiations can take place until the matter of the complaint is resolved and the case is closed. If negotiations between the Project parties and the complainant do not achieve a satisfactory result leading to the closure of the complaint, then the grievance is escalated to higher levels to be defined in the course of the Project’s procedures setting.

A Worker Grievance Mechanism will be established by the Project prior to construction within the scope of the Human Resources Management Plan to manage the complaints from all Project employees. This mechanism will be structured with an intention of it being an effective approach for early identification, assessment and resolution of grievances throughout the Project's phases.

7.5.3 Record Keeping

A record keeping system will be developed and implemented to support accurate and timely maintenance of Project records. Systems to be established, which are directly relevant to the environmental and social management aspects of the Project, include:

- Trainings Log
- Incidents, non-conformances, and grievance records;
- Inspection reports, checklists, and observation logs;
- EHS Dashboard including Environmental monitoring results and EHS KPIs on monthly basis
- Minutes of Meetings (MOM)s;
- Stakeholder Consultations Register

7.5.4 Inspections, Verification and Validation

The EHS Team will undertake and document regular site inspections for the purpose of verifying compliance with the ESMP, licenses, permits and approvals, and other environmental and social requirements. Where inspections determine that environmental and social management measures are not effective, corrective and preventative measures will be implemented. The weekly observations log will include positive observations and areas of improvement recorded by the EHS representatives.

7.5.5 Monitoring

The inspections will be further supported by monitoring i.e. documenting practical achievement of implementation of required actions. Sampling and analysis as per the identified monitoring plan will be implemented to check level of compliance of discharges, emissions and required environmental conditions. The environmental and social monitoring program has been provided in Section 7. 6

7.5.6 Preventive and Corrective Actions

The E&S Manager will be responsible for directing monitoring of the following aspects, to determine trends and recommend actions to be taken to reduce the potential for EHS incidents:

- Project, activity, or area-specific EHS risks;
- Any exceedance of environmental and social standards;
- Legislative changes; and
- Inspection outcomes.

Deficiencies identified on the Project will, if possible, be rectified immediately by the person identifying the deficiency, and reported to the EHS Team. This includes submission of a corrective action request at the earliest on any of the following:

- A major deviation from agreed upon or approved procedure, approval conditions or Project Environmental and Social management objectives;
- A major non-compliance with the ESMP performance criteria; and/or
- Any perceived breach of the legislative requirements.

The corrective action request will include details of the environmental impact, action taken to correct the problem and proposed measures to prevent the occurrence of a similar incident. The identification, reporting and rectification of environmental deficiencies should be encouraged at

Project induction and in toolbox discussions.

7.5.7 Reporting

The Contractor Project EHS Team will prepare a quarterly Environmental and Social report summarizing monitoring and inspection outcomes, EHS Performance as well as details of any non-compliances and actions taken/recommended. The reporting procedures presented in Table 7.3 have been developed in order to ensure that the FMW and contractors 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. 3: Reporting Procedures

Phase	Responsibility	Deliverables	Frequency	Accountability
Preconstruction	Contractor	Report of monitoring activities including any specific events	Once	HITECH reports to FMW
Construction	Contractor	Two (2) monitoring Reports. First to be prepared mid-way into the civil works and the other upon completion of all construction activities.	Twice	HITECH reports to FMW
	Contractor	Additional Reports according to specific conditions e.g. Accidents, serious	Once	HITECH reports to FMW

Phase	Responsibility	Deliverables	Frequency	Accountability
		environmental/social impacts		
Completion of Construction and demobilization of contractor from site	Contractor	Final Monitoring Report including all monitoring activities Throughout project implementation	Once	HITECH reports to FMW

- **7.5.8 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 EHS team 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 are to be kept by the HITECH and be made available to relevant regulators upon request. In addition, all significant communications with FMEnv, 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.

- **7.5.9 Management Review**

The contractor management will review the performance against the required actions of the proposed Project

7.6 Environmental and Social Management 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. 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 major indicators to be measured will include:

- The state of biological conditions

- The state of physical environment
- The state of key social concerns e.g. 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 plan is presented in Table 7.4. It should be noted that all relevant aspects of the identified impacts and mitigations measures have been reframed with indicators listed in in the Table 7.4

The method of implementation of the ESMP monitoring programme shall be carried at two layers

Layer 1 Monitoring (Control) FMW and FMENv and funders.

- Focuses on validating claims, assessing mitigation measures, and evaluating effectiveness.
- Collaborates with FMEnv and receives support from NESREA.
- Roles include reviewing contractor's worksite ESMP, appraising adverse effects, monitoring mitigation implementation, assessing effectiveness, and proposing remedies.
- Environmental compliance and assessment occur at the project's end.
- Recommended frequency: every six months.

2. **Layer 2 Site Activity Monitoring:**
    - Contractor conducted regularly by the Monitoring Team (HITECH).
    - Guided by national and international environmental standards.
    - Ensures compliance with relevant Nigerian laws.

Table 7.4: Environmental and Social Management and Monitoring Plan – Pre-Construction Phase.

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**PRE-CONSTRUCTION PHASE**										
	Site Clearing and Mobilization										
Environmental Impacts											
1.	Increase in amounts of fugitive dust, exhaust fumes and GHGs from	Sprinkling of water via spraying devices to limit dusts.	Contractor	4000	Fugitive dust	Visual Observation	Minimal dust on project site & surroundings	Project site & surroundings	Daily	Supervision Consultant/ FMEnv FMW	1000

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**PRE-CONSTRUCTION PHASE**										
	movement of heavy-duty vehicles and equipment into work area.	Ensure that vehicles are serviced; undergo vehicle emission testing (VET) and vehicle exhaust screening (VES) as laid down in the NESREA guidelines.	Contractor	1000	Greenhouse gases Vehicle emission	In-situ Air Quality. Measurement Vehicle emission testing (VET) and vehicle exhaust screening (VES Report	FMEnv air pollutants permissible limit	On-site and surroundings	Monthly	Supervision Consultant/ FMEnv FMW	
2	Loss of top soil and soil compaction due to	Limit zone of vehicle and equipment weight	Contractor	500	Visible demarcation of vehicles and	Visual observation	Visual observation	Project camp site and equipment	Monthly	Supervision Consultant/ FMEnv	500

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**PRE-CONSTRUCTION PHASE**										
	movement of vehicles to site and stacking of heavy-duty equipment	impacts (designate an area for parking and stacking equipment)			equipment limit zone	Soil Compaction test	Soil Compaction test	packing zone.		FMW	
	Leakages from stacked equipment and subsequent intrusion of oil and chemical substances into soil.	Ensure fastening of loose parts (bolts, nuts); Install impermeable surface at the limit zone to contain potential leakages	Contractor	1000	Installation of impermeable platform at limit zone.	Project camp site and equipment packing zone.	Soil quality test	Project camp site and equipment packing zone	Monthly	Supervision Consultant/ FMEnv FMW	

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**PRE-CONSTRUCTION PHASE**										
3	Increase in noise level above permissible noise level, (90dB) during equipment movement	Equipment should be transported early hours (6 - 7.00am) when it will cause least disturbance Retrofit machines with sound proof	Contractor	-	Number and frequency of complaints in project area	In-situ measurement of noise level	Noise level test (Not to exceed 90dB(A) for 8 hours working period	Project site	As required	Supervision Consultant/ FMEnv FMW	500
4	Displacement of soil fauna and damage to flora.	Limit vegetation clearing to minimum area required to	Contractor	-	Radius of cleared path	Visual Observation	Evidence of re-vegetation	Non Access pathway in Project site	One-off	Supervision Consultant/ FMEnv FMW	

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**PRE-CONSTRUCTION PHASE**										
		create access path									
5	Occupational accidents and injuries from the use of machineries and equipment	• Provision of PPE to workers; • Worker Education • Incident/accident reporting; • Provision of First Aid onsite • Ensure that staging areas for contractor equipment are adequately delineated and	Contractor	2,000	Contractors Compliance .	Routine inspection	Use of PPEs by Workers Training Records	Construction site	Daily	FMEnv FMW LSMEnv LASEPA	FMEnv – 500 LASEPA – 500 LSMEnv – 500

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**PRE-CONSTRUCTION PHASE**										
		cordoned off with reflective tapes and barriers • Workers should get a daily induction/tool box before going on the site and a refresher of what happened on site a day before • appropriate security measures in place to									

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**PRE-CONSTRUCTION PHASE**										
		prevent harassment or kidnapping of workers									
6	Accidents involving vehicles or pedestrians during vehicle and equipment movement to the site.	Training of drivers on safe driving practices Install safety signage	Contractor	500	Accident Report	Site Inspection Consultations	Training Report Accident/ Incident Report	Routes to the Project site	Every 2 weeks	Supervision Consultant/ FMEnv FMW	500
Social Impacts											

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**PRE-CONSTRUCTION PHASE**										
7	Nuisance to nearby Hospital and School Blocks	Retrofit with suitable cost effective vehicle sound proofing materials/ technologies.	Contractor	-	Number and frequency of complaints in project area	In-situ measurement of noise level	Noise level test (Not to exceed 90dB(A) for 8 hours working period	Routes to project site	Weekly	Supervision Consultant/ FMEnv FMW	500
8	Labour Influx which could lead to Increase in sexual activities leading to possible spread of STDs/STIs in the project	Awareness campaign against sexual diseases, and distribution of male and female condoms.	Contractor	200	Level of Awareness and Education No of new STI Cases.	Rapid health survey	Level of awareness and knowledge of preventive measures.	Nearby communities Health care facilities	Twice during Construction	FMEnv FMW	100

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**PRE-CONSTRUCTION PHASE**										
	host communities						% of reported STI/ STD cases among workforce				
9	Potential risk of Sexual Exploitation and Abuse (SEA)/ Gender Based Violence (GBV) Influx of workers (non-locals)	All contractor's workers to sign Code of Conduct (CoC) (see Annex for sample CoC) and be sensitized on zero tolerance	PIU GBV Specialist Contractor Management	400	Stakeholders concerns on risk of GBV	Consultations GBV Incident Report	Signed CoCs with the PIU Conduct of sensitization campaigns	Host communities	Twice during Construction	FMEnv FMW Supervision Consultant	3000

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**PRE-CONSTRUCTION PHASE**										
	to project location	for sexual integration with host community . CLOs to sensitize the community on appropriate conduct with contractors Appoint NGO at the state level to manage social risks associated									

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**PRE-CONSTRUCTION PHASE**										
		with GBV/SEA in the project area Provide Referral Centres for survivors of GBV/SEA.									
10	Child labour and school drop out	• Ensure that children and minors are not employed directly or indirectly on the project.	Contractor Supervision Consultant	500	Visual observation	Routine inspection	No. of cases observed & recorded	Project site	Daily	FMEnv FMW Project Engineer	300

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**PRE-CONSTRUCTION PHASE**										
		• Communication on hiring criteria, minimum age, and applicable laws should be ensured.									
Sub Total				**10,100=**							**7,300 =**

Table 7.5: Environmental and Social Management and Monitoring Plan - Construction Phase.

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**CONSTRUCTION PHASE**										
	Construction activities and installation works										
Environmental Impacts											
1	Fugitive dust	Sprinkling of water during activities	Contractor	See A1	Fugitive dust	Visual Observation	Minimal dust	On-site	Daily	LSMEnv LASEPA FMEnv FMW Supervision Consultant	500
	Release of exhaust fumes, hazardous gases (NOx, CO, SOx, SPM,), Oxides	Fuel switching-Fuel switching from high- to low-carbon content fuels (where available) can be a relatively cost effective means to mitigate GHG emissions during this phase.	Contractor	See A1	Gaseous pollutants: SO_2, NO_2, CO_2, CO,VOCs, H_2S, PM	In-situ Air Quality Measurement Vehicle emission testing (VET) and vehicle exhaust	FMEnv air pollutants permissible limit	Project area	Every two months		

Activity	**Potential Impact**	**Mitigation Measures**	**Responsibility for Mitigation**	**Mitigation Cost (USD)**	**Parameters to be measured**	**Method of measurement**	**Performance indicator**	**Sampling Location**	**Monitoring Frequency**	**Institutional Responsibility (Monitoring)**	**Costs (USD)**
B	**CONSTRUCTION PHASE**										
	from machinery GHG Emissions	Energy efficiency- Machines e.g. generator plants could be turned off when not in use, in order to reduce carbon emissions.				screening (VES Report					
2	Pollution of the environment from open defecation by contractors workers	Contractor to provide mobile toilets for workers or rehabilitate existed toilet facilities at the Project Site. Sensitize workers against open defecation	Contractor	500	Evidence of feacal waste within the project site & surroundings	Site inspection	Absence of feacal waste on-site & surroundings	Camp site and working zone	Weekly	Supervision Consultant FMEnv FMW	500

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**CONSTRUCTION PHASE**										
3	Surface soil compaction from Movement of heavy vehicles/Stationary vehicles and equipment	Creation of limit zone Minimize compaction during stockpiling by working in the dry state Rip compacted areas to reduce runoff and re-vegetate where necessary	Contractor	200	Visible demarcation of vehicles and equipment limit zone	Visual observation Soil Compaction test	Visual observation Soil Compaction test	Project camp site and equipment packing zone	Monthly	Supervision Consultant FMEnv FMW Project Engineer	200
4	Pollution of soil and groundwater contaminat	All oil and lubricants should be sited on an impervious base	Contractor	1000	Soil quality parameters (especially hydrocarbon	In situ/ Laboratory Analysis	FMEnv Soil polluants permissible	Project area	Twice during construction	FMEnv LSMEnv LASEPA FMEnv	300

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**CONSTRUCTION PHASE**										
	ion by oil spills, lubricants and other chemicals	and should have drip pans The storage area should be far from boreholes, all containers should be clearly labeled			contaminants) Compliance with fuel storage procedures	Visual Observation	limit			FMW	
5	Presence of constructio n waste on-site which can pollute the environme nt leading to community	Implement site-specific waste management plan in Annex Liaise with State Waste Management Authority and affected LG Environmental	Contractor	200	Presence of construction waste on-site & surroundings	Site inspection	Compliance with the site waste managemen t plan Good house keeping	Project site & surroundi ngs	Weekly	LAWMA FMEnv FMW Project Engineer	200

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**CONSTRUCTION PHASE**										
	and public health issues.	Unit for effective waste management and safe handling/disposal of waste.									
6	Air quality deterioration	Suppress dust emission by sprinkling water	Contractor	500	Fugitive dust	Visual Observation	Emission of noxious gases	Location of work on project site	Daily	Supervision Consultant FMEnv FMW	200
7	Increase in noise level above permissible noise level, (90dB)	Adequate maintenance of equipment and machineries to reduce noise	Contractor	-	Number and frequency of complaints in project site & surroundings	In-situ measurement of noise level	Noise level test (Not to exceed 90dB(A) for 8 hours	Location of work on project site	Weekly	Supervision Consultant FMEnv FMW	200

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**CONSTRUCTION PHASE**										
	during construction activities and OHS issues	Retrofit machines with sound proof Implement OHS Plan in Annex					working period				
8	Risk of occupational accidents (OHS), Injuries and diseases	Implement project OHS Plan in Annex Provide and enforce usage of appropriate PPE. Demarcate/cordon off construction areas and , lit up adequately at night, Fence out danger zones and keep out of reach.	Contractor	See A5	HSE Plan Developed Compliance with HSE Plan	Consultations Accident Report	increase/decrease in Lost Time Injuries	Project area	Monthly	FMEnv FMW	200

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**CONSTRUCTION PHASE**										
		Restricted access to be placed at construction site using caution signs and manned personnel Use caution tapes. Develop and implement visitors management protocol Ensure that staging areas for contractor equipment are adequately delineated and cordoned off with reflective tapes and barriers									

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**CONSTRUCTION PHASE**										
		Workers should get a daily induction/toolbox before going on the site and a refresher of what happened on site a day before Appropriate security measures in place to prevent harassment or kidnapping of workers									
Social Impacts											
9	Grievances and negative perception	Conduct consultation at every phase of the project	Contractor PIU	2,000	No of complaints by affected persons	Consultations	Minimal number of reported cases	Host Communities	Every 2 months	Grievance Committees	300

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**CONSTRUCTION PHASE**										
	by job seekers, Community Members and CBOs					Review grievance log				FMEnv FMW	
10	Increase in sexual activities leading to possible spread of STDs/STIs from influx of workers (non locals) to project location	Awareness on sexual diseases, and distribution of male and female condoms.	Contractor	See A 8	Level of Awareness and Education No of new STI cases	Rapid health survey	Level of awareness and knowledge of preventive measures. % of reported STI/ STD	Host Community	Twice during Construction	FMEnv FMW Supervision Consultant	See A 8

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost (USD)	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
B	**CONSTRUCTION PHASE**										
							cases among workforce.				
11	Potential risk of Sexual Exploitation and Abuse (SEA)/ Gender Based Violence (GBV) Influx of workers (non locals) to	All contractors workers to sign Code of Conduct (CoC) see Annex for sample CoC) and be sensitized on zero tolerance for sexual integration with job seekers, CDA and CBOs to sensitize the community on appropriate conduct with contractors	PIU GBV Specialist	See A 9	Stakeholders concerns on risk of GBV	Consultations GBV Incident Report	Signed CoCs with the FMWR Conduct of sensitization campaigns	Project community	Twice during Construction	FMEnv FMW Supervision Consultant	See A 9

Activity	**Potential Impact**	**Mitigation Measures**	**Responsibility for Mitigation**	**Mitigation Cost (USD)**	**Parameters to be measured**	**Method of measurement**	**Performance indicator**	**Sampling Location**	**Monitoring Frequency**	**Institutional Responsibility (Monitoring)**	**Costs (USD)**
B	**CONSTRUCTION PHASE**										
	project location										
12	Conflicts between contractor and host community members over labour intake	Good work enforcement program Grievance Redress Mechanism Regular consultations	Contractor Grievance Redress Committee (GRC)	500	No of complaints received	Consultation Review Grievance redress Log	No of cases handled by the GRC	Project area of influence	Continuous	Grievance Redress Committee	500
13	Increase demand on existing Hospital sanitation infrastructure due to influx of	Provide basic amenities (water, sanitation etc to workers)	Contractor	3000	No of amenities in worker's camp & project site	Visual observation	Availability of all essential amenities in workers' camp & project site	Workers camp & project site	Monthly	FMEnv FMW Supervision Consultant	300

Activity	**Potential Impact**	**Mitigation Measures**	**Responsibility for Mitigation**	**Mitigation Cost (USD)**	**Parameters to be measured**	**Method of measurement**	**Performance indicator**	**Sampling Location**	**Monitoring Frequency**	**Institutional Responsibility (Monitoring)**	**Costs (USD)**
B	**CONSTRUCTION PHASE**										
	temporary workers										
14	Child labour and school drop out	• Ensure that children and minors are not employed directly or indirectly on the project. • Communication on hiring criteria, minimum age, and applicable laws should be ensured.	Contractor	See A 10	Visual observation	Routine inspection	No. of cases observed & recorded	Project site	Daily	FMEnv FMW Supervision Consultant	A 10
Sub Total				**7,900=**							**3,400 =**

Table 7.6: Environmental and Social Management and Monitoring Plan –Operation Phase

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
C	**OPERATION PHASE**										
	Demobilization of equipment and construction materials from site.										
Environmental Impacts											
1	Potential oil contamination of soil and water	Cart away all spoils through the relevant authorities Clean out impact areas	Contractor	2000	Oil Spillages, Littered construction waste and spoilt equipment/parts	Site inspection	Good house keeping	Workers Camp site	Quarterly for one year	FMEnv FMW Project Engineer Supervision Consultant	300

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
C	**OPERATION PHASE**										
2	Increase in vehicular movements will lead to increase in air pollution from exhaust fumes	In collaboration with the State Government, implement regular sensitization via mass media on the allowable vehicular emission limit and the need for regular vehicle maintenance and the effect of excessive emissions into the atmosphere	Contractor FRSC; VIO	1000	Gaseous Pollutants such as SO_2, NO_2, CO_2, CO, VOCs, H_2S, TSP, PM 10 and PM 2.5	In-situ measurement of air quality	General compliance	Project site	Quarterly	LSMENV LASEPA FMEnv FMW	300

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
C	**OPERATION PHASE**										
		Routine inspection of motorists' compliance									
3	The drainages may become conveyors for surface debris and improperly disposed wastes during a heavy rain, leading to drainage blockage	Routine maintenance of drainages Proper waste management system in the communities	Contractor FMW	1500	Flow rate of water through the drainage systems Adequate waste treatment in the communities	Visual observation	Implementation of proffered mitigation	Project site and community	Quarterly	LSMENV FMEnv FMW Project Engineer	500

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
C	**OPERATION PHASE**										
	and disruption of free flow. This may result in stagnated water, and water contamination downstream.										
4	Possibility of culvert collapse, flooding, or erosion from post construction which may	To follow proper design and best available practices to rural road construction	Contractor	300	Structural and performance integrity of hydraulic features		Efficient Durability of roads and hydraulic structures	Project Sites	Quarterly	FMEnv FMW LSMENV LASEPA	200

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
C	**OPERATION PHASE**										
	result from poor designs, non-compliance to designs, sub-standard materials, poor maintenance	Strict adherence to terms of reference and specifications of engineering design for bridge and road construction Adequate and regular maintenance	Project Engineer FMW								
	Demobilization of equipment and construction materials from Site										

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
C	**OPERATION PHASE**										
	Operation and use of Highway										
Social Impacts											
1	The project area & Hostl communities will become more accessible and thus there will be improvement in security, business & commerce etc	Vigilance & surveillance to sustain and enhance business and commerce	NPF Lagos State Command; Community executives and Traditional Leaders	1,500	Incidence of security breach	Routine interview	Absence of security threat	Communities along project path	Quarterly for 2 years	Lagos State Police Force	300

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
C	**OPERATION PHASE**										
2	Accidents involving vehicles or pedestrians are likely to occur as a result of increased vehicle density, operation and increased speed, as community roads	Adequate road signs for motorists and pedestrians Routine maintenance of roads. Routine inspection of motor-able roads and road users. Training of road users on interpretation of road signs	FRSC	1,000	Road accidents/animal crushing	Routine interview	No complaints from the community	Communities	Quarterly	Road Marshals	300

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
C	**OPERATION PHASE**										
3	Discrimination against gender and vulnerable group Gender Based violence Grievance and conflicts amongst members	Continues sensitization and awareness program and ensure that community level programs allow for gender inclusiveness Reporting GBV, SEA VAC cases properly and timely Implement requirements of GRM that	project monitoring committee	500	Reports and awareness	Number of cases indicated	General compliance	communities	Quarterly	NGO Women Affairs GBV/SEA Referral Units	200

Activity	Potential Impact	Mitigation Measures	Responsibility for Mitigation	Mitigation Cost	Parameters to be measured	Method of measurement	Performance indicator	Sampling Location	Monitoring Frequency	Institutional Responsibility (Monitoring)	Costs (USD)
C	**OPERATION PHASE**										
		addresses such issues									
Sub Total				**7,800=**							**2,100=**
TOTAL A+B+C				**25,800.00**							**12,800**

NB: FMEnv – Federal Ministry of Environment; LSMEnv – Lagos State Ministry of Environment, LASEPA – Lagos State Environmental Protection Authority; LAWMA – Lagos State Waste Management Authority; EHS Team – Environmental , Health & Safety Team (Contractor), GRM – Grievance Redress Mechanism; VAC – Violence Against Children

- **7.7 ESMP and relevant Plans**

The Environmental and Social Management Plans have been prepared based on the outcome of the project Environmental and Social Impact Assessment study. The commitments made in these plans are applicable to the Contractor personnel and subcontractors. The principal purpose of formulating this ESMP is to mitigate all the impacts identified in the ESIA study. The overview of the ESMP is presented for both phases as shown in Tables 7.7 – 7.8

Table 7.7: Overview of ESMP during establishment and construction phase

Site Development and Construction Phase	
Key Activities	• List of activities • Establish temporary access to work areas and create clearance zones while controlling access. • Construct temporary diversions for roads that need upgrading to manage existing traffic. • Clear and level the corridor and perform major earthworks such as cuttings and embankments. • Locate and develop borrow pits and quarries, and import materials like gravel, clay, and • bitumen as needed. • Source and establish a water supply from surface and/or groundwater. - Improve existing drainage and introduce new road drainage, including culverts if necessary. • Surface and seal the carriageway, including using bitumen mixing plants where applicable. • Build water crossings such as bridges and culverts, including concrete batching for structures. • Establish or improve safety arrangements such as modifying camber, barriers, and sight lines. • Perform landscaping as needed.
Objective	• To manage the activities undertaken during site development and construction phase of the Project in a manner which reduces potential negative impacts on both the local environmental and the local community • To comply with all statutory and approvals requirements pertinent to site development and construction phase of the Project
Performance Criteria	• Worksites prepared in accordance with designs providing for the management and mitigation of potential project impacts

	• All site development and construction works are managed to avoid, mitigate, and/or manage potential impacts on the social and environmental conditions within the AOI. • All community complaints are recorded and investigated and, if appropriate, actioned
Target	• Zero accidental releases • Compliance with relevant regulatory requirements • All appropriate project related community concerns are appropriately actioned and recorded
Monitoring	• Review the ESMP and relevant Management Plans if any significant changes are made to the Project scope or methodology • Verify and validate the implementation of the ESMP on an ongoing basis
Reporting	• EHS to report as required by statutory authorities with respect to environmental and social management performance. • Community complaints register should be filed for each complaint

TABLE 7.8: OVERVIEW OF ESMP DURING DECOMMISSIONING PHASE

Decommissioning	
Key Activities	• List of activities Activities include site Clean-Up and Equipment Removal After Construction. The Stages of Construction Clean-Up: Rough Cleaning: • It occurs once the structural elements are in place and heavy installation work is largely completed. • Address potential hazards, such as unstable structures or hidden debris. • Thoroughly sweep and clean the site to remove dust, dirt, and loose debris. • Implement proper signage to enhance the safety and order Final Touches: • Remove temporary construction site signs and message boards directing traffic. • Deploying reliable traffic safety equipment (such as delineators, attenuators, and signs) to enhance safety during clean-up. • Prioritize safety and efficiency in your work zone
Objective	• The goal of post-construction clean-up goes beyond mere aesthetics. It involves removing all construction debris, hazardous materials, and dust that remain after a project is finished. • Ensure proper clean-up of work areas and facility and site that is presentable, safe, and ready for occupation, signaling completion and readiness.

	• Comply with all statutory and approvals requirements pertinent to site development and construction phase of the Project
Performance Criteria	• Worksites free of debris, hazardous materials, and dust • Worksite free of hazardous substances and objects, safe and clean • No complains from stakeholders and all community complaints are recorded and investigated and, if appropriate, actioned
Target	• Zero accidental releases • Compliance with relevant regulatory requirements • All appropriate project related community concerns are appropriately actioned and recorded
Monitoring	• Review the ESMP and relevant Management Plans if any significant changes are made to the Project scope or methodology • Verify and validate the implementation of the ESMP on an ongoing basis
Reporting	• EHS to report as required by statutory authorities with respect to environmental and social management performance. • Community complaints register should be filed for each complaint

7.7.1 Monitoring Management

The Environmental and Social Management and Monitoring Programme (ESMMP) has been developed with the following objectives:

- To evaluate the effectiveness of the proposed mitigation measures and the protection of the ambient environment, workers and the community as per prescribed/ applicable standards for the Project;
- To identify the need for improvements in the management plans;
- To verify compliance with regulations and community obligations; and
- To allow comparison against baseline conditions and assess the changes in environmental quality in the Project AOI.

7.7.2 Performance Indicators

Management of components linked with physical, biological and socioeconomic environment of particular significance have been identified as performance indicators. A comprehensive monitoring plan for each performance indicator has been prepared for all phases of the Project and is presented below. This includes parameters to be measured, methods to be used, sampling locations, frequency of measurements, and responsibilities.

7.7.3 Reporting

A reporting system will provide the Project with the necessary feedback mechanisms to verify quality and timely implementation of the works. The reporting system will provide a mechanism to verify that the measures proposed in the Project's ESMP are implemented.

7.7.4 Relevant Management Plans

Relevant additional management plans are necessary to ensure full implementation of the ESMP. These plans outline specific activities for each environmental and social aspect of the project, aligning with both international and local regulations.

Table 7.9 provides an overview of these management plans. These plans are crucial for ensuring the project's sustainability and addressing potential environmental, social, and economic impacts.
By implementing these management plans, the Lagos-Calabar Highway Section 2 project can be executed in a responsible manner, minimizing negative impacts and promoting positive outcomes.

Table 7.9 Management Plans[3]

S/No	Management Plan	Description	Mitigation Measures
20.	Resettlement Action Plan (RAP)	Addresses the social impacts of the project on affected communities.	• Provides compensation, relocation assistance, and livelihood restoration programs.
21.	Livelihood Restoration Plan (LRP)	Restores livelihoods of affected communities.	• Develops sustainable livelihood options and provides training and support alongside the RAP
22.	Biodiversity Management Plan	Conserves, restores, and enhances biodiversity.	• Develops a Biodiversity Action Plan to identify threats and protection measures.
23.	Heritage/Cultural Management Plan	Manages affected cultural heritage throughout the project's lifecycle.	• Incorporates design features to avoid or mitigate negative effects on cultural heritage.
24.	Shoreline and Coastal Erosion Management Plan	Supports localized responses to shoreline erosion.	• Uses barriers and vegetation to prevent erosion.
25.	Gender Management Plan	Mainstreams gender dimensions throughout the project.	• Tackles gender stereotypes, promotes paternity leave, and empowers women and girls.
26.	Dust Management Plan	Controls dust emissions to protect air quality.	• Uses automatic dust suppression systems like misting cannons.
27.	Environmental Construction Method Statement	Describes environmentally friendly construction methods.	• Grades fine materials from haul roads and keeps them compacted.
28.	Emergency Management Plan	Outlines procedures for responding to emergencies.	• Includes structural and non-structural mitigation measures.

[3] Some of the Management Plans are further briefly described in this document and others as standalone

Table 7.9 Management Plans[3]

S/No	Management Plan	Description	Mitigation Measures
29.	Human Resources Management Plan	Manages human resources to ensure a safe and healthy work environment.	• Focuses on recruitment, training, and welfare.
30.	Waste Management Plan	Manages construction and hazardous waste.	• Prioritizes prevention, minimization, recycling, and reuse.
31.	Wastewater Management Plan	Manages wastewater generated during construction.	• Employs physical, biological, chemical, and sludge water treatment.
32.	Construction Contaminated Land Management Plan	Manages contaminated land during construction.	• Uses remediation methods like soil removal and replacement.
33.	Soil and Water Management Plan	Protects soil and water resources.	• Implements agronomic measures like mulching and crop management.
34.	Occupational Health and Safety Management Plan	Ensures worker health and safety.	• Communicates health and safety policies, deals with hazards promptly, and equips employees with necessary tools.
35.	Community Health and Safety Management Plan	Addresses health and safety concerns of local communities.	• Considers health outcomes and determinants, and mitigates risks from construction activities.
36.	Contractor and Supplier Management Plan	Manages contractors and suppliers.	• Employs strategies like supply chain mapping, weighted ranking, and diversification.
37.	Stakeholder Engagement Plan	Engages with stakeholders.	• Defines stakeholders, analyzes their interests, and plans effective communication and engagement.
38.	Security Management Plan	Addresses security risks, particularly during construction.	• Implements measures to ensure security throughout construction and operation.

7.7.41 Biodiversity Action Plan (BAP)

Proactive measures must be taken to address biodiversity impacts associated with the Lagos-Calabar Coastal Highway project. Conservation parks along the route stand ready to contribute their expertise, facilities, and services for biodiversity protection and rescue. It is crucial to consider the proximity to protected areas, riverine ecosystems, and wetlands in project planning, with the establishment of a trust fund to ensure sustainable funding for conservation initiatives.

1. **Current Biodiversity Impacts:**

The project's proximity to protected areas, conservation project sites, rivers,/rivulets, streams, wetland and the shoreline of the Atlantic Ocean underscores the need for careful consideration of environmental impacts. Potential impact to note in this BAP

- Potential habitat fragmentation and disturbance to wildlife populations.
- Disruption of ecological processes, especially in riverine and wetland ecosystems.
- Increased risk of wildlife mortality due to road traffic and infrastructure development.
- Importance of maintaining connectivity between habitats and protected areas for species survival and genetic diversity.
- Habitat Fragmentation: Ongoing construction is causing habitat fragmentation, disrupting ecosystems and wildlife habitats.
- Wildlife Disturbance: Construction activities are disturbing wildlife populations, leading to stress and displacement.
- Road Mortality: Increased traffic is resulting in road mortality for various species.

2. **Conservation Centres & Nature Park**

Table 7.10 provides a glimpse into three remarkable conservation centers and nature parks located in Lagos, Nigeria. Each plays a vital role in protecting biodiversity, raising environmental awareness, and offering opportunities to connect with nature. Whether you're a local resident or a visitor, these sanctuaries offer a chance to observe fascinating wildlife, learn about conservation efforts, and appreciate the beauty of the natural world.

The Table7.10 delves into details about each center, including its name, location, size, governing body, and the incredible species it protects. From the Lekki Conservation Centre, established by the Nigerian Conservation Foundation, to LUFASI, a haven for rescued animals, and the Eco-Park Mangrove Sanctuary & Research Centre, dedicated to coastal ecosystem conservation, each center offers unique experiences.

Table 7.10: Conservation Centres & Nature Park

S/No	Name of Sanctuary	Brief Description
1	Lekki Conservation Centre - Location Lekki, Lagos State, Nigeria Coordinates 6°26′11″N 3°32′8″E	The Nigerian Conservation Foundation is a non-governmental organisation dedicated to sustainable development and nature conservation. It also serve as an area of biodiversity conservation and environmental awareness center. The foundation aims to preserve Nigeria's species and ecosystems, promote sustainability when using

Table 7.10: Conservation Centres & Nature Park		
S/No	**Name of Sanctuary**	**Brief Description**
	Area 0.78 square kilometres (78 ha) Established 1990 Governing body Nigerian Conservation Foundation Website www.ncfnigeria.org Species: Monkeys, Crocodiles, Snakes, and various Birds	natural resources and advocates actions that minimise the impact on the environment and prevent resource wastage. NCF has worked tirelessly to raise environmental awareness and promote responsibility. The center is located along the Lekki-Epe Expressway in the Lekki Peninsula, opposite Chevron. The reserve area which covers a land area of 78 hectares (192.74 acres) is located on Lekki Peninsula, next to the Lekki Lagoon, and near the Lagos Lagoon. It protects the wetlands of the Lekki peninsula which consists of swamp and savannah habitats. Approaching the reserve, there's a boulevard of coconut trees that leads to a well-laid-out car and Visitors Park. It is endowed with an abundance of plant and animal life. Its huge tract of wetlands is set aside for wildlife viewing. Raised walkways enable the viewing of animals like monkeys, crocodiles, snakes, and various birds. There is also a conservation center and a library.
2	LUFASI - Lekki Urban Forestry and Animal Shelter Initiative Cordinates: 6.46581/ 3.65447 Size: 40 hectares Location: Awoyaya, Lekki Express way	LUFASI is an acronym for Lekki Urban Forestry and Animal Shelter Initiative: a non-governmental organisation established in 2013 and dedicated to the preservation of natural habitats in urban areas for use as a field laboratory to interact with and learn from nature. LUFASI attempts to address the issue of limited green spaces in urban areas like Lagos Nigeria, which can provide recreation and aesthetic satisfaction, and likewise enlighten the populace to clear the ambiguity of climate change through practical learning. The shelter for rescued animals (wild and domestic) serves to educate on conservation with an extra aesthetic and recreational incentive for the centre. To conserve LUFASI's forest by bridging the knowledge gap and safeguarding the biodiversity, while exploring possibilities for expanding forest cover in Lagos State and across the nation. To promote awareness among students / the public and develop relevant capacity on biodiversity conservation and climate change issues needed to trigger a behavioral change. Whilst highlighting the health benefits of Urban forests. Our Animal Sanctuary serves as a refuge for distressed and persecuted animals. These animals are rescued, rehabilitated before reintegration into the wild, where possible. We also lend a voice to the global cause against wildlife persecution and sensitize the public on the

Table 7.10: Conservation Centres & Nature Park		
S/No	**Name of Sanctuary**	**Brief Description**
		need to appreciate and understand the link between man, animals and the natural environment. Species: ungulates, avifauna, primates and small mammals. Some of these include the: African Wild Donkey (Equus africanus), West African Barb Horse (Equus ferus callabus), Mona Monkey (Cercopithecus mona) and Helmeted Guinea fowls (Numida meleagris).
3	Eco-Park Mangrove Sanctuary & Research Centre Location: Akodo Ise Community, Ibeju-Lekki Size 74 hectares Coordinates: 6.39071, 4.21882 Governing body: Eco-Restoration Foundation (ERF) website: www.erf.ng	The Eco-Park Mangrove Sanctuary & Research Centre is nestled in a stunning 74-hectare mangrove-filled site, we are dedicated to the protection, restoration, and conservation of coastal ecosystems. Our park features vibrant animal and bird sanctuaries, scenic walkways, cozy chalets, and thrilling kayaking adventures through the mangrove creeks. As a premier tourist attraction and research hub, we focus on environmental studies and mangrove product research. It is sanctuary is home to and rehabilitates a diverse range of wildlife, including snakes, pangolins, manatees, sea turtles, monkeys, and alligators. Currently, our park is undergoing audits to certify as a carbon sink, aiming to trade carbon credits and promote sustainable practices. Explore nature, research, and relaxation all in one unique destination. Species: Snakes, Pangolins, Manatees, Sea Turtles, Monkeys, Euguana's, Alligators, Birds

Current Assessment of Conservation Parks Readiness:

- **Facilities:**

Conservation parks have the space, advantage of professional personnel and location advantages. Infrastructure such as access roads, water sources, and waste management facilities support conservation activities exist within the centers.

- **Infrastructure:**

They are currently not fully equipped with facilities for wildlife rescue and rehabilitation, including veterinary care, enclosures, and rehabilitation areas.

- **Expertise and Personnel:**

Trained personnel, including veterinarians, wildlife biologists, and animal care specialists, are available to manage rescue and rehabilitation operations effectively.

Conservation parks have experience in handling diverse species and possess valuable knowledge of local biodiversity.

- **Collaborative Networks**:

Collaborative networks with wildlife authorities, NGOs, and stakeholders facilitate coordination of rescue efforts and resource sharing.

Regular communication channels have been established for reporting stranded or injured animals and coordinating response actions.

Proposed Biodiversity Protection:

a. Wildlife crossings

Incorporating wildlife crossings into road design is a win-win: it benefits both ecosystems and human safety Wildlife crossings are essential structures that allow animals to safely cross human-made barriers such as roads and highways. These crossings serve two critical purposes: habitat connectivity and reducing wildlife-vehicle collisions. Let's explore how road design can incorporate wildlife crossings:

1. **Types of Wildlife Crossings**:

- Underpass Tunnels: These tunnels run beneath roadways, allowing animals to move freely without encountering traffic.
- Overpasses or Green Bridges: Elevated structures that span over roads, providing safe passage for large or herd-type animals.
- Amphibian Tunnels: Specifically designed for amphibians (e.g., frogs, salamanders) to avoid road mortality.
- Fish Ladders: Assist fish in navigating around dams or other barriers.
- Canopy Bridges: Especially useful for monkeys and squirrels, these bridges connect tree canopies.
- Tunnels and Culverts: Designed for small mammals like otters, hedgehogs, and badgers.
- Green Roofs: Benefit butterflies and birds by creating vegetated pathways.

2. **Benefits of Wildlife Crossings**:

- Habitat Connectivity: Crossings allow animals to move between fragmented habitats, promoting genetic diversity and species survival.
- Reduced Roadkill: By providing safe routes, crossings minimize wildlife-vehicle collisions.
- Human Safety: Prevents accidents caused by animals on roads, protecting both humans and property.

3. Design Considerations**:**

- Natural Appearance: Wildlife crossings should blend seamlessly into the landscape, resembling natural features.
- Fencing: Install fencing along roads to funnel wildlife toward crossings.
- Location: Place crossings where animals naturally move (based on their behavior and habitat preferences).
- Size and Height: Ensure crossings accommodate various species, from small mammals to large ungulates.

b. Wildlife Rescue and Rehabilitation:

- Conservation parks will actively participate in rescuing stranded or injured animals, providing immediate care and stabilization.
- Animals will undergo rehabilitation processes, receiving medical treatment, rehabilitation exercises, and behavioral conditioning.

c. **Establishment of Rescue Centers**

- Set up temporary and permanent rescue centers for affected wildlife.
- Equip centers with necessary medical and rehabilitation facilities.

d. Rescue and Rehabilitation Operations

- Train and deploy rescue teams to capture and transport impacted organisms.
- Provide medical care, feeding, and rehabilitation for injured and displaced wildlife.

e. Release and Monitoring:

- Upon recovery, animals will be released into suitable habitats, and monitoring programs will track their post-release survival and adaptation.

- Identification, Geo-Tagging & Protecting such critical ecosystem hotpots and the various Conservation Sites across the length of the project and the adjoining biodiversity **migratory pathways.**

f. Appointment of a Biodiversity or ESG Manager

Federal Government Involvement: The Ministry of Works should appoint a Biodiversity or ESG Manager or a Special Assistant to the Honourable Minister on ESG. This role should not be a political appointment but rather a selection from existing conservation practitioners or operators along the impacted areas. This will help with smoother inter-organizational cooperation and provide an army of existing volunteers and networks to add credibility to the project.

- Contractor Involvement: Hi-Tech Construction should also appoint an ESG Manager to ensure the contractor's adherence to high environmental standards. This role will coordinate with the government-appointed manager to implement the plan effectively.

g. Documentation and Reporting

- Ensure all activities, progress, and outcomes are thoroughly documented.
- Prepare detailed reports highlighting the ESG values of the project proponent and the contractor. This documentation is crucial for international funding and climate-friendly financing.

h. Real Commitment, Not Green-washing

- Emphasize the genuine commitment of both the government and the contractor to biodiversity protection, ensuring that this initiative is not perceived as green-washing or a government-sponsored PR exercise.

i. . Leveraging Local Expertise and Networks

- Engage local conservation experts and community volunteers to enhance the credibility and effectiveness of the plan.
- Use existing networks to foster community support and involvement, ensuring a sustainable impact.

j. Community Engagement and Education

- Conduct awareness campaigns to involve local communities in conservation efforts.
- Train local volunteers to assist in rescue and rehabilitation operations.

Plate 7.1: ESIA Team & Conservation Stakeholders

k. Monitoring and Evaluation

- Regularly monitor biodiversity indicators to assess the effectiveness of the action plan.
- Adjust strategies based on monitoring data and feedback.

1. Responsibility

Emphasis is placed on the need for Hi-tech Construction Company and the Federal Government to be committed to & provide resources for effective action during the construction & operational phases, to mitigate biodiversity losses effectively. This is urgent and immediately required, considering the impacts already being seen while the ESIA is still going on.

Regular stakeholders meeting will kick-start collaboration and coordination efforts among stakeholders, project authorities, and conservation parks.

Proposed Trust Fund for Conservation:

- To ensure continuous availability of funding for conservation efforts, we propose the establishment of a trust fund supported by a fraction of toll revenues during the project's operational phase. This trust fund would:
  - Provide financial support for ongoing wildlife rescue, rehabilitation, and release programs.
  - Fund research and monitoring initiatives to assess the effectiveness of conservation

measures.

- Support community outreach and education programs on biodiversity conservation and environmental stewardship.
- Enable adaptive management strategies based on scientific data and feedback from conservation partners.

7.7.4.2 Smart Emergency Response System for Lagos Coastal Road

This Smart Emergency Response System (SERS) is part of the management plan for the Lagos Coastal Road. By incorporating this Smart Emergency Response System into the Lagos Coastal Road management plan, we can enhance safety, minimize response time, and protect lives and infrastructure. This system will enhance emergency preparedness, search and rescue operations, and risk mitigation

1. System Overview

The Smart Emergency Response System (SERS) integrates cutting-edge technology, real-time data, and efficient resource allocation to ensure rapid and effective emergency response along the Lagos Coastal Road. Its components include:

1. **Real-Time Sensors and Data Collection**:
   - Deploy sensors for gas levels, temperature, humidity, and structural integrity.
   - Cameras capture live video feeds.
   - Environmental monitoring (e.g., flooding, landslides).
2. **Communication Infrastructure**:
   - Establish a robust communication network:
     - Broadband WiFi Networks: Deploy commodity drones with directional antennas for extended coverage (up to 5 km range).
     - Ad-Hoc Wireless Networks: Utilize cellphones for citizen communication.
     - Satellite Communication: Backup for remote areas.

3. **Mission Command and Control Center**:
   - Located centrally, this center coordinates emergency responses.
   - Real-time visualization using Google Earth or GIS software.
   - Dynamic resource allocation based on real-time data.

2. Emergency Response Phases

1. **Preparedness Phase**:
   - Conduct regular drills and training for first responders.
   - Educate citizens about emergency procedures.
   - Ensure all SERS components are functional.
2. **Detection and Alert Phase**:
   - Real-time sensors detect anomalies (e.g., gas leaks, structural damage).
   - Citizens can report emergencies via a dedicated app.
   - Alerts sent to the command center.
3. **Response Phase**:
   - Command center dispatches:

- **Human First Responders**: Equipped with real-time data.
- **Autonomous Vehicles (Drones)**: Aerial surveillance and delivery of supplies.
- **Tele Robots**: Remote-controlled robots for hazardous areas.
- **Search and Rescue Dogs**: Trained to locate survivors.

4. **Recovery Phase**:
   - Assess damage and prioritize recovery efforts.
   - Coordinate with other agencies (firefighters, medical teams).
   - Use SERS data for informed decision-making.

3. Risk Mitigation Strategies

- Climate Resilience:
  - Design infrastructure to withstand extreme weather events (storms, sea-level rise).
  - Elevate critical road sections.
  - Implement natural buffers (mangroves, dunes) to reduce erosion.
- Early Warning Systems:
  - Integrate weather forecasting and early warning alerts.
  - Notify residents and travelers in advance of potential hazards.
- Community Engagement:
  - Educate communities about evacuation routes and safe zones.
  - Encourage citizen participation in emergency drills.
  - Continuous Improvement
- Data Analytics:
  - Analyze historical data to identify patterns and improve response strategies.
  - Machine learning algorithms for predictive modeling.
- Feedback Loop:
  - Gather feedback from first responders and citizens.
  - Regularly update and enhance SERS based on lessons learned.

7.7.4.3 Cultural Heritage Preservation Management Plan

Cultural Heritage Preservation Management Plan for the Lagos Coastal Road (Section 2) involves integrating cultural heritage considerations into the infrastructure planning process.Cultural heritage preservation is not only about protecting the past but also enhancing the quality of life for present and future generations. By integrating heritage considerations into infrastructure planning, we create more resilient and culturally rich communities. key steps and components to include in the plan:

- **Introduction**:
  - Provide an overview of the project, including its purpose, scope, and objectives.
  - Explain the significance of cultural heritage preservation within the context of the road development.
- **Legislative Requirements and International Frameworks**:
  - Describe relevant international treaties, conventions, and standards related to cultural heritage preservation.
  - Highlight the importance of complying with legal obligations.

- **Roles and Responsibilities**:
  - Identify key stakeholders responsible for cultural heritage management.
  - Define their roles and responsibilities in preserving and promoting heritage.
- **Inventory and Assessment**:
  - Conduct a comprehensive inventory of cultural heritage sites along the road corridor.
  - Assess the significance, condition, and vulnerability of each site.
- **Mitigation Measures**:
  - Develop strategies to minimize adverse impacts on cultural heritage during construction and operation.
  - Consider alternative alignments or designs to avoid significant heritage sites.
- **Community Engagement**:
  - Involve local communities, experts, and heritage organizations.
  - Seek their input on preservation priorities and strategies.
- **Monitoring and Adaptive Management**:
  - Establish a monitoring system to track the impact of the road on cultural heritage.
  - Be prepared to adjust plans based on monitoring results.
- **Education and Awareness**:
  - Raise awareness among project teams, contractors, and the public about the importance of cultural heritage.
  - Educate them on best practices for preservation.
- **Emergency Preparedness**:
  - Develop contingency plans for emergencies (e.g., natural disasters, accidents) that may affect heritage sites.
  - Ensure rapid response and recovery measures.
- **Integration with Urban Planning**:
  - Coordinate with urban planners to ensure that cultural heritage preservation aligns with broader city development goals.
  - Explore opportunities for heritage-led regeneration and sustainable tourism.

Also, the socio-economic impacts of proposed infrastructure projects, such as the Lagos Coastal Road section, are multifaceted and interconnected. understanding local dynamics, involving communities, and considering multidimensional impacts are essential for effective infrastructure development.

Some key aspects:

- **Improved Accessibility**:
  - Enhancing accessibility through infrastructure development positively influences people's lifestyles.
  - Better road connectivity allows for faster travel, efficient transportation of goods, and improved market access.
  - Accessibility also attracts investment and economic activities to previously underserved areas.
- **Economic Opportunities**:

    - Infrastructure projects create economic opportunities by stimulating trade, supporting industries, and generating employment.
    - Improved transportation networks facilitate the movement of goods and services, benefiting local businesses and entrepreneurs.
- **Community Participation**:
    - Engaging local communities in the planning and implementation of infrastructure projects is crucial.
    - Community participation ensures that projects align with local needs, aspirations, and cultural context.
    - It fosters ownership, transparency, and accountability.
- **Local Context Matters**:
    - Infrastructure impacts vary based on the specific location and community characteristics.
    - Consider factors such as demographics, existing services, environmental conditions, and social dynamics.
    - Tailor infrastructure solutions to address local challenges and opportunities.
- **Positive and Negative Impacts**:
    - While infrastructure development brings benefits, it can also have adverse effects.
    - Positive impacts include economic growth, improved services, and enhanced quality of life.
    - Negative impacts may involve displacement, environmental changes, or social disruptions.
- **Policy Formulation**:
    - Policymakers should consider local contextual factors when designing infrastructure projects.
    - Holistic planning involves balancing economic gains with social and environmental considerations.
    - Sustainable decision-making ensures long-term benefits for communities.

7.7.4.4 Carbon footprint Management Plan

A holistic approach that considers materials, energy, and long-term impact will help minimize the carbon footprint of the Lagos-Calabar Coastal Highway. Thus Minimizing the **carbon footprint** of the **Lagos-Calabar Coastal Highway** project involves adopting sustainable practices and considering environmental impact throughout its lifecycle. The strategies are outlined below:

1. Materials Selection:
    - Use Recycled Materials: Opt for construction materials with a lower carbon footprint, such as recycled concrete or asphalt.
    - Locally Sourced Materials: Choose materials sourced locally to reduce transportation emissions.
2. Energy Efficiency:
    - Construction Phase: Use energy-efficient machinery and equipment during construction.
    - Lighting and Facilities: Implement energy-saving lighting and HVAC systems in highway facilities.
3. Green Infrastructure:

- Vegetation: Incorporate green spaces, trees, and vegetation along the highway. Trees absorb carbon dioxide and improve air quality.
- Permeable Surfaces: Use permeable pavements to allow rainwater infiltration and reduce runoff.

4. Transport Logistics:
   - Construction Materials: Optimize transportation routes for delivering construction materials to minimize fuel consumption.
   - Maintenance Vehicles: Use fuel-efficient vehicles for maintenance and repairs.
5. Carbon Offsetting:
   - Afforestation and Reforestation: Plant trees in nearby areas to offset emissions from construction and operation.
   - Renewable Energy Projects: Invest in renewable energy projects (solar, wind) to balance emissions.
6. Lifecycle Assessment:
   - Conduct a life cycle assessment (LCA) to evaluate the environmental impact from cradle to grave.
   - Consider emissions during construction, operation, and eventual decommissioning.
7. Public Transportation Integration:
   - Design the highway to accommodate public transportation (buses, commuter trains).
   - Encourage people to use mass transit, reducing individual car emissions.
8. Maintenance Practices:
   - Regularly maintain the highway to prevent deterioration and ensure optimal performance.
   - Well-maintained roads reduce fuel consumption and emissions.
9. Education and Awareness:
   - Educate workers, contractors, and the public about environmental responsibility.
   - Promote eco-friendly practices during and after construction.
10. Monitoring and Reporting:
    - Continuously monitor emissions, energy usage, and environmental impact.
    - Report progress and improvements transparently.

Roles and Responsibilities for Managing the Carbon Management Plan

By incorporating these nature-based practices, the Lagos-Calabar Coastal Highway can serve as a model for sustainable infrastructure development, benefiting both people and the environment. Integrating **nature-based management** practices can enhance its sustainability and minimize environmental impact through the following nature-based approach:

1. **Ecosystem Restoration**:
   - Identify and restore **ecologically sensitive areas** along the highway route.
   - Implement **afforestation** and **revegetation** programs to enhance biodiversity and stabilize soil.
   - Create **green corridors** with native plants and trees to support wildlife habitats.
2. **Wetland Conservation**:
   - Protect and restore **coastal wetlands**, mangroves, and estuaries.

   - These ecosystems act as natural buffers against storms, absorb carbon, and provide habitat for aquatic species.
3. **Natural Drainage Systems**:
   - Design the highway to work with natural drainage patterns.
   - Avoid disrupting existing watercourses and wetlands.
   - Use **permeable surfaces** to allow rainwater infiltration.
4. **Climate-Resilient Infrastructure**:
   - Construct bridges and culverts that accommodate **sea-level rise** and extreme weather events.
   - Consider **natural shoreline protection** (e.g., mangrove belts) to prevent erosion.
5. **Biodiversity Corridors**:
   - Create wildlife corridors by preserving or restoring natural habitats.
   - These corridors allow animals to move freely, reducing roadkill incidents.
6. **Green Spaces and Buffer Zones**:
   - Integrate **green spaces** (parks, rest areas) along the highway.
   - Buffer zones between the road and sensitive ecosystems can mitigate noise, pollution, and visual impact.
7. **Community Engagement**:
   - Involve local communities in planning and decision-making.
   - Educate residents about the importance of nature-based management.
8. **Monitoring and Adaptive Management**:
   - Regularly assess the effectiveness of nature-based interventions.
   - Adjust strategies based on monitoring results and changing environmental conditions.

7 **Constructing roads near** sensitive ecosystems

When constructing roads near **sensitive ecosystems**, it's crucial to adopt practices that minimize environmental impact as outlined below:

1. **Build the Roadbed Formation Once and Be Done**:
   - Construct the roadbed with care to minimize disturbance. Avoid repeated excavation or grading, which can harm ecosystems.
   - Properly compact the soil to prevent erosion and maintain stability.
2. **Build to the Minimum Width Necessary**:
   - Design roads with the **minimum necessary width** to accommodate traffic flow.
   - Narrower roads reduce the area of disturbance and minimize habitat fragmentation.
3. **Limit Lateral Road Access**:
   - Restrict lateral access points (side roads, trails) near sensitive areas.
   - Unauthorized access can lead to habitat destruction, soil compaction, and disturbance to wildlife.
4. **Focus Infrastructure Investment Where Land Tenure and Access Is Secure**:
   - Prioritize road construction in areas where land ownership and access rights are well-defined.
   - Secure land tenure ensures long-term management and reduces the risk of illegal activities.

7.7.4.5 Physical Climate Risk Assessment and InfraTech (Infrastructure Technology)

The Lagos-Calabar Coastal Road faces significant climate risks due to its coastal location. These risks include increased rainfall, flooding, coastal erosion, extreme weather events, and temperature extremes. A detailed analysis of the physical climate risks and impacts on the Lagos-Calabar Coastal Road, as well as a summary of the impact assessment has been created as a stanadlone but aligned with this ESIA report. It is important to note that adapting the coastal road to climate change impacts is crucial for its functionality and safety. The key strategies identified based on the risk assessment include:

Elevating Roadways:	Raising road levels to protect from flooding and sea level rise.
Improving Drainage Systems:	Enhancing drainage infrastructure to manage increased rainfall.
Using Resilient Materials:	Employing materials resistant to water damage.
Constructing Sea Walls:	Building barriers to protect roads from storm surges and erosion.
Vegetation and Natural Buffers:	Planting vegetation to stabilize soil and reduce erosion.
Regular Maintenance and Monitoring:	Conducting inspections and monitoring to identify vulnerabilities.
Relocating Vulnerable Sections:	Moving road sections to safer areas if necessary.
Implementing Climate-Resilient Design Standards:	Incorporating climate resilience into new road projects.

In other words, too address the challenges idneitfied, the project must incorporate climate resilience measures, such as:

- Elevated Road Sections
- Improved Drainage Systems
- Coastal Protection Structures
- Nature-Based Solutions

- Early Warning Systems
- Resilient Road Materials
- Stormwater Management Systems
- Emergency Response Plans
- Community Engagement

By implementing these strategies and conducting regular monitoring, the Lagos-Calabar Coastal Road can be made more resilient to climate change and ensure its long-term sustainability. Below is summary of climate risks and mitigation strategies for the lagos-calabar coastal road:

Climate Risk	Impact	Adaptation Strategies
21. Flooding and Sea Level Rise	Increased flooding, road submersion, traffic disruption, structural damage	Elevate road sections, improve drainage systems, construct sea walls, use resilient materials, relocate vulnerable sections.
22. Increased Rainfall	Overwhelmed drainage systems, water accumulation, road damage	Improve drainage systems, use resilient materials, implement stormwater management systems.
23. Coastal Erosion	Undermined road foundations, collapses, increased maintenance costs	Construct sea walls and barriers, plant vegetation, relocate vulnerable sections.
24. Habitat Destruction	Increased vulnerability to erosion and flooding	Plant vegetation, implement coastal protection measures.
25. Vulnerability of Coastal Communities	Disruption of local economies and livelihoods	Relocate vulnerable communities, provide economic support.
26. Morphological Change in Terrain and Landforms	Increased vulnerability to erosion and flooding	Implement coastal protection measures, use resilient materials.
27. Extreme Weather Events	Overwhelmed drainage systems, water accumulation, road damage	Improve drainage systems, use resilient materials, implement emergency response plans.
28. Temperature Extremes	Increased vulnerability to stress	Use resilient materials, implement cooling systems, conduct regular maintenance.

Involving Local Communities and Monitoring

Engaging local communities in the assessment process is crucial for addressing their concerns and ensuring effective adaptation. Below is monitoring programs as part of dealing with the challenges od climate risk for the Lagos-Calabar Coastal Road:

Monitoring Program	Description	Activities

29. Nigerian Meteorological Agency (NIMET)	Continuous monitoring of weather patterns and early warning systems.	Weather monitoring (rainfall, temperature, wind speed). Early warning systems for extreme weather events.
30. Federal Ministry of Works and Housing	Regular inspections and erosion monitoring.	Infrastructure inspections. Monitoring coastal erosion rates. Implementing erosion mitigation measures.
31. Academic Institutions and Research Organizations	Ongoing research on climate impacts and collaborative projects.	Climate impact studies. Collaborative projects with universities, government agencies, and international organizations.
32. Community-Based Monitoring	Local community involvement in monitoring and reporting climate impacts.	Local involvement in monitoring. Training and education programs for local communities.
33. International Partnerships	Participation in global climate monitoring networks.	Access to advanced monitoring tools and data through networks like WMO and IPCC.

Leveraging InfraTech (Infrastructure Technology) Towards Climate-Resilience

The Lagos-Calabar Coastal Highway Project Provides a compelling case study for the application of InfraTech solutions. This vital transportation corridor is vulnerable to climate change impacts, including coastal erosion, flooding, saltwater intrusion, etc. To help mitigate these risks, ensuring safer, more reliable transportation networks, the project shall leverage various infratech solutions as outlined below:

Key Area	**InfraTech Solutions**
Coastal Protection	• Nature-Based Solutions: Mangrove forests, seagrass meadows, • Innovative Materials: Geotextiles, composite materials for seawalls and breakwate • Early Warning Systems: Real-time monitoring
Flood Management	• Sustainable Drainage Systems: Rain gardens, bioswales, permeable pavements • Flood Modeling: Advanced modeling techniques • Early Warning Systems: Flood alerts for timely evacuation and response
Climate-Proofing Transportation	• Elevated Roadways: Construct elevated roadways in flood-prone areas • Resilient Materials: Use weather-resistant materials • Adaptive Design: Flexible and adaptable infrastructure design
Energy Infrastructure Resilience	• Renewable Energy Integration: Solar, wind energy • Microgrids: Ensure energy supply during disruptions

	• Smart Grid Technologies: Optimize energy distribution and improve resilience
Urban Planning and Development	• Climate-Sensitive Urban Planning: Integrate climate change considerations • Green Infrastructure: Parks, green roofs, urban forests
Climate Information Services	• Data Collection and Analysis: Monitor climate change impacts • Early Warning Systems: Alerts for extreme weather events • Climate Modeling: Predict future climate scenarios

CHAPTER EIGHT
DECOMMISSIONING AND RESTORATION PLAN

8.0 Introduction

Decommissioning covers the project cessation of operations and the removal of inventory to obtain a state of passive safety. Though this phase is unlikely for a Project like the Lagos - Calabar Highway Road, such a possibility should be discussed for the completeness of this ESIA report as required by procedural guidelines and best practice.

In planning the commissioning and restoration plan for Lagos – Calabar Coastal Highway (Section 2), it is vital to devise plans for recovering and restoring the site to its original state after the project is lost or decommissioned. This necessitates a thorough understanding of all the effects of the project's environmental components on the ecosystem during its lifespan. Considering this component during the planning stage demonstrates the project's environmental commitment and contributes to a sustainable future, motivating us to do better.

8.1 Decommissioning Activities and Anticipated Impacts

During the decommissioning phase of the **Lagos-Calabar Coastal Highway** project, several activities will take place to ensure a proper transition and site restoration.

The anticipated activities and/or impacts are presented in Table 8.1

Table 8.1: Project Anticipated Activities and/or Impacts

No	Focus	Activity:	Impact:
1	Decommissioning, Mantling, and Removal of Road Infrastructure and Ancillary Equipment:	Disassemble and remove road components such as asphalt, barriers, signs, and lighting.	Restoration of the landscape but potential disruption during dismantling.
2	Excavation, Dismantling, and Removal of Underground Cables, Water Pipes, and Power Transmission Facilities:	Unearthing and removing buried utilities (cables, pipes, etc.).	Soil disturbance, potential damage to existing infrastructure, and safety risks.
3	Removal of All Structures (Plant Houses, Administrative Buildings, Equipment Removal Techniques etc.):	Demolishing and clearing all buildings and structures associated with the project. Dismantling and removing equipment can disrupt the landscape.	Altered landscape, waste generation, and potential soil contamination. Soil compaction, ground disturbance, and altered topography may occur.
4	Reinstatement of Excavated Portions and Buried Structures:	Reinstatement of Excavated Portions and Buried Structures	If excavated soil is not properly reinstated, erosion can occur. Unstable slopes, sediment runoff, and loss of topsoil may impact nearby ecosystems. Increased Particulate Emission (Dust): During decommissioning, dust emissions can increase, especially in dry conditions.

			Dust pollution affects air quality and can have health implications. Hazards and Accidents Associated with Decommissioning: Workers involved in dismantling and removal face occupational risks.

8.2 Rehabilitation and Restoration Activities

The restoration programme at the end of the Lagos-Calabar Coastal Highway project's economic life is crucial for environmental sustainability. The statutory regulations emphasize the importance of rehabilitating areas to be relinquished after a project. In this context, the biological objective of rehabilitation programs is to establish an ecologically functional system that supports satisfactory flora growth, such as outlined below:

1. **Rehabilitation Purpose**:
   - When a project concludes, the site must be restored to its original or improved state.
   - Rehabilitation ensures that disturbed ecosystems recover and regain functionality.
2. **Ecologically Functional System**:
   - The goal is to create an ecosystem that functions naturally and supports life.
   - This involves restoring soil health, water cycles, and nutrient cycling.
3. **Satisfactory Flora Growth**:
   - Flora (plants) play a crucial role in ecosystem stability.
   - Successful rehabilitation ensures that native plants thrive, enhancing biodiversity.

8.3 Specific Activities for the Restoration

In this subsection, the specific activities for the restoration are outlined. Also shown in Table 8.1 is an ESMP designed for the decommissioning phase.

1. **Site Restoration Upon Completion (Suspension or Abandonment)**:
   - When the project concludes, the site must be restored to its original state or improved.
   - Removal of equipment, dismantling structures, and reclamation of disturbed areas are essential.
2. **Backfilling Excavations**:
   - All excavated areas should be properly backfilled.
   - Ensuring soil stability and preventing erosion are key goals.
3. **Integrated Study for Cleared Areas Restoration**:
   - Ecological and hydrological specialists will assess the site.
   - Strategies for site restoration, including vegetation, soil, and hydrological aspects, will be determined.
4. **Detailed Field-Specific Restoration Plan**:
   - Ensure the study results in a comprehensive plan for each specific area.
   - Ensure restoration goals include achieving vegetation similarity to the surroundings.

5. **Soil Compaction/Cementing**:
    - Compacted or cemented soil inhibits re-vegetation, so put mechanisms in place for regrowth, such as ripping apart these areas for successful restoration.
6. **Intensive Management Over Several Years**:
    - Restoration efforts require ongoing monitoring, maintenance, and adaptive management.
    - Ensuring long-term success involves active stewardship.
7. **Site Remediation Measures Based on Environmental Characterization**:
    - Assess potential impacts and characterizing the environment guide remediation.
    - Tailor measures to specific conditions to ensure effective restoration.
8. **Hazards and Accidents Associated with Decommissioning**:
    - Ensure proper safety protocols and training to prevent accidents.
9. **Management Challenges**:
    - Coordinate decommissioning activities, waste disposal, and site restoration with effective management and relevant stakeholders involvement.
    - Ensure compliance with safety standards to minimise disruptions
10. **Removal of Equipment and Infrastructure**:
    - All project-related equipment, structures, and materials should be removed from the environment.
    - Proper disposal or recycling methods must be followed.
11. **Reinstatement of Excavated Portions**:
    - Backfill and restore excavated areas to their original state to help minimize environmental impact.
    - Ensure soil stability and prevent erosion.
12. **Grading and Erosion Prevention**:
    - Grade the site back to its original landscape to help prevent erosion.
    - Ensure proper soil management and vegetation restoration.
13. **Waste Management Plan**:
    - A robust waste management plan ensures proper disposal of construction debris and materials.
    - Recycling, reusing, or safely disposing of waste is critical.
14. **Pension Schemes for Workers**:
    - Providing appropriate pension schemes ensures financial security for project workers after decommissioning.
    - Addressing their well-being during project closure is essential.

Table 8.2: Environmental and Social Management Plan (ESMP) of the proposed Lagos Coastal Highway Road for Decommissioning

Proj	Decommissionings cription of Impacts	Rating before Mitigat ion	Mitigation/Control Measures	Rating after Mitiga tion
Demolition and Evacuation	Interference with road transportation	M	• The proponent (FMW) shall monitor the number of trucks daily to determine whether there is a need to create other access roads. • FMW shall develop a transport management plan specifying routes, speeds, times of travel, and key roads/waterways regarding local services. • Consideration shall be given to avoid reliance on public transport, and contractors must use private vehicles.	L
	Noise and vibration nuisance	M	FMW shall ensure that: • Electric power generators are fitted with effective silencers. • Vehicles and generators shall be regularly maintained. • Generators and cars are switched off when not in use. • Soundproof electric power generators are engaged. • PPEs are used	L
	Impairment of air quality	H	FMW shall ensure the following: • Engine to comply with international standards for exhaust gases; Maintenance of engines and exhaust gas check; Adoption of engine-off policy at the construction site. • Site workers wear nose masks and earmuffs during excavation. • That water shall be sprayed on construction sites to reduce dust levels, especially during the dry season.	L
	Contamination of surface and	M	FMW shall ensure:	L

	Groundwater & soil by oil spill from decommissioning equipment		• Soil disturbance shall be kept to the minimum required for operation and safety. • Oil spill containment shall be provided to reduce oil spills. • From getting to the soil and surface/ groundwater. • Follow all regulatory- FMENv and State FMEnv guidelines on waste management. • Cleanup in compliance with relevant national and • International guidelines involving the removal of the • waste, etc. • Restore the condition in no way inferior to before the commencement of work.	
	Poor disposal of wastes generated during this phase	H	• FMW shall treat and dispose of all wastes using approved contractors following regulatory requirements and best practices. • FMW shall ensure that none of these wastes are disposed of into any water body or on land. • Follow safety measures while disposing of waste. • FMW shall keep all waste consignment, treatment, and disposal records for regulatory verification. • Proper disposal of solid waste from labour camps. • Storage of lubricants, fuels, and other hydrocarbons in self-contained enclosures. • Sanitation arrangements at worksites/facilities to avoid the release of wastewater to the environment. • All other wastes generated, including environmentally deleterious materials generated by construction activities, will	M

			be disposed of offsite appropriately, legally, and safely. • There is a minimum generation of waste. • Unsuitable excavated materials shall be systematically carried away from areas prone to erosion. • Reuse waste materials wherever possible. • An accredited state waste collector shall segregate, store, and dispose of waste.	
	The threat of Naturally Occurring Radioactive Material (NORM) to the environment	H	FMW shall ensure: • Regular maintenance or servicing of all infrastructure and production equipment as and when due. • Regular NORM monitoring programs to detect materials and equipment with NORM. • carrying out personal dosimetry for external radiation exposures to confirm that exposures fall into the range expected from external radiation surveillance monitoring. • measuring airborne radioactive dust during maintenance activities to check that the assumptions upon which respirator selections were made are accurate – or if respirators are needed at all. • a surface contamination survey in a workshop to confirm that NORM contamination controls are working. • sampling and analysis of waste streams to verify that they remain within regulatory limits. • materials used in NORM control procedures, such as gloves, plastic sheeting, disposable coveralls, etc., if an area, materials, or equipment is affected by NORM. • Equipment with NORM shall be recycled or incinerated at an approved recycling or incineration center.	M

	Tripping/falling from heights because of Climbing and working on electric poles	H	The proponent – • shall ensure and require that contractors implement the following fall prevention and protection measures for all workers exposed to the hazard of falling while working on power projects: • Test structures for integrity before undertaking work. • Implement a fall protection program that includes training in climbing techniques and the use of fall protection measures, inspection, maintenance, and replacement of fall protection equipment, and rescue of fall-arrested workers, among other things. • Establish criteria for using 100 percent fall protection (typically when working over 2 meters above the working surface. The fall protection system shall be appropriate for the tower structure and necessary movements, including ascent, descent, and moving from point to point. • Install fixtures on tower components to facilitate the use of fall protection systems. • Provide adequate work-positioning device system for workers. • Ensure proper rating for hoisting equipment. • Ensure proper maintenance of hoisting equipment and properly train hoist operators. • Use Safety belts that are at least 16 millimeters (mm) (5/8 inch) of two-in-one nylon or a material of equivalent strength. • When operating power tools at height, require that workers use a second (backup) safety strap.	L

			• An approved tool bag should be used to raise or lower tools or materials for workers on structures.	
	The kidnapping of workers and visitors on-site	H	The proponent • shall ensure that the contractor and FMW personnel develop a high-security consciousness within and outside the work area. • The FMW Project Manager shall review daily security reports. • A special security force shall be established and deployed for the project. This shall include deploying some of the FMW police to strengthen security in the area. • FMW shall ensure that a liaison is established and sustained to foster a partnership with the community and guarantee security for the project. • To beef up security for the project, FMW shall support FMW authorities by assisting with equipment, such as patrol vehicles. • FMW shall ensure that safety workshops to identify, evaluate, and recommend contingency plans for all security risks are regularly organized.	M

CHAPTER NINE
CONCLUSION AND RECOMMENDATIONS

9.1 Background Information

According to the ESIA (Environmental and Social Impact Assessment) study of the construction and operation of the Lagos Coastal Highway Section 2 would have minimal negative effects on the environment, provided that the recommendations outlined in the environmental and social management plan developed during the study, along with other additional provisions, are strictly adhered to.

9.2 Conclusion

The Lagos-Calabar Coastal Highway Project Section 2 Environmental and Social Impact Assessment (ESIA) initial draft was prepared *with a strong commitment to comply with the Environmental Impact Assessment (EIA) Act CAP E12, LFN 2004.* The report results from a rigorous scoping of the proposed alignment, areas of influence, and the existing baseline environmental and social impact based on previous studies. The report presents compelling and inspiring findings demonstrating the importance of responsible and sustainable development practices.

The ultimate objective of the ESIA process was to ensure that the Project has no major residual impacts on the environment, be it in the long term or over a vast area. Consequently, after implementing the delineated mitigation measures, the residual impacts of the Project were significantly reduced to mostly short-term, localized, and reversible. Alongside this, we provided recommendations to optimize the beneficial effects of the Project and sustain them for the long term.

An Environmental and Social Management Plan (ESMP) was developed to ensure that the Project meets its operational requirements and delivers its stated business objective in an environmentally responsible manner. The ESMP outlines the mitigation/enhancement measures to action points and recommends performance indicators monitoring and audit programmes. This helps maintain all impact indicators for the various environmental components within statutory limits throughout the Project's life.

9.3 Recommendations

9.3.1 Management Action Plan

The Federal Government of Nigeria, through the Federal Ministry of Works (FMW) is committed to adhering to the following management recommendations to ensure sustainability and continual environmental performance of the Project. Therefore, the Government (FMW) shall:

- Always support green initiatives in all phases of the proposed Project to reduce the effect of greenhouse gas emissions
- Implement the Environmental and Social Management Plan (ESMP) designed for the Lagos - Calabar Coastal Highway project through its phases of development, covering construction, operation, and decommissioning. The ESMP shall also be reviewed as the need arises;
- Develop and implement a standard Environmental Management System (EMS) for the Project, such as ISO 14001:2015 EMS and ISO 14064-1:2006 on *Greenhouse gases*.
- Develop and implement a standard Safety Management System (SMS) in line with FMEnv and best practice standards,

- Implement the Project's waste management plan (WMP)
- Implement the Project's performance indicator monitoring programme as recommended. Monitoring (inspection and measurements) shall be monitored at least three (3) times during the construction phase and operation quarterly.
- Carry out a 3-year post-ESIA environmental auditing. A competent third-party person shall carry out the audit to ensure objectivity.
- Develop and implement a public complaint and grievance redress system to handle stakeholders' concerns effectively.
- Provide adequate resources for managing the Project's environmental aspects (including noise, air emissions, water etc.)
- Obtain relevant regulatory permits and approvals before the commencement of the Project and as when due.

9.3.2 Operations Environmental Action Plan

The Project will implement a range of environmental management and pollution control action including scheduled inspection and maintenance of mobile and immobile equipment and noise and emissions mitigation measures as recommended.

.

The ESIA report confirms that these mitigation measures will prevent any significant negative impact**,** and FMW is now seeking approval from FMEnv for the report.

Therefore, in view of the fact that the stakeholder communities shall be carried along during the project construction and operation, and that there is no stern environmental, health, social or cultural issues that may warrant the cancellation of the proposed project**,** it is therefore advised that the project be embark upon as proposed.

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APPENDICES

Appendix 1: Survey Instrument

The Proposed Lagos-Calabar Coastal Road

Stakeholder Perception Survey Instrument

Introduction

Your input as a critical stakeholder is vital for the success of the proposed Lagos-Calabar Coastal Road project. This survey covers Section 2 of the road, which starts from Eleko,Ibeju Lekki to the boundary of Lagos and Ogun States (Ode-Omi). Your feedback is crucial for assessing and improving the project's outcomes in a sustainable manner.

Instructions:

Please contribute your honest and unbiased responses. Your participation is crucial in gaining a better understanding of the road's impact on the community. Rest assured that all responses will be kept confidential and combined with those of other stakeholders. Please provide your responses by typing or checking the relevant options:

Part A General Information (kindly fill)

1. Name/Organization (Optional):: ______________________________
2. Role/Position: ___________________________________
3. Contact Information (Optional):: ____________________________
4. Residential Address(Optional):::
5. Name of your Community: ....
6. Local Government ………………………………………………..

Part B Demographics and Social Fabric

1. **Demographic Information** (kindly tick)

a) **Age**:
   a. [ ] Under 18
   b. [ ] 18-24
   c. [ ] 25-34

d. [ ] 35-44
e. [ ] 45-54
f. [ ] 55 and above

b) **Gender**:
a. [ ] Male
b. [ ] Female
c. [ ] Prefer not to say

c) **Occupation**:

i. [ ] Student
ii. [ ] Professional (e.g., engineer, doctor, teacher)
iii. [ ] Self-employed
iv. [ ] Homemaker
v. [ ] Civil Servant
vi. Retired
vii. [ ] Other (please specify): ________________________

d) **Community and Livelihood**:
a. **How long have you lived in the vicinity of this Section of the Lagos-Calabar Coastal Road?**
i. [ ] Less than 1 year
ii. [ ] 1-5 years
iii. [ ] 6-10 years
iv. [ ] More than 10 years

e) **What economic activities are prevalent in your community?**

i. Business and Commerce:
ii. Hospitality and Tourism:
iii. Real Estate and Construction:
iv. Transport and Logistics:
v. Fishing and Aquaculture:
vi. Small-Scale Manufacturing:
vii. Services Sector:
viii. Education and Healthcare:
ix. Other (please specify): ________________________

f) Which of the following sectors provides your livelihood?"

i. Business and Commerce
ii. Hospitality and Tourism
iii. Real Estate and Construction
iv. Transport and Logistics

v. Fishing and Aquaculture
vi. Small-Scale Manufacturing
vii. Services Sector
viii. Education and Healthcare
ix. Other (please specify): ________________________

g) Please, what is your average monthly income from your primary employment source of income? (simply tick one below)
   a. N1-300,000
   b. N301,000-600,000.
   c. 601,000-900,000
   d. Above N901,000

h) What is the name of your community where you reside along the corridor and what is the estimated population of the community and each Household?

S/N	Communities	Location (coordinates)	Estimated Population 2023	Estimate of Number of Persons Per household	Remarks
1.					
2.					
3.					

Part C Stakeholders' Awareness and Attitudes toward the Road Project

1. Are you aware of the proposed Lagos-Calabar Coastal Road project that will pass your area?"
   - [ ] Yes
   - [ ] No
   - [ ] Not Sure
2. How informed do you feel about the project's timeline and milestones?"
   - Options: Not informed, Somewhat informed, Moderately informed, Very informed, Extremely informed
3. Do you believe the road project will positively impact your community?"
   - [ ] Yes
   - [ ] No
   - [ ] Not Sure

4. Are you part of any community groups or associations discussing the road project?"
   - [ ] Yes
   - [ ] No
5. **If yes to question 4, name the group/Association.................................**

Part D Stakeholders' Expectations, Fears, and Hopes

1. **Expectations:**
   1. To what extent do you expect economic benefits (e.g., increased trade, tourism) from the completion of this road?
      - [ ] Not at all
      - [ ] Slightly
      - [ ] Moderately
      - [ ] Significantly
      - [ ] Extremely
   2. How hopeful are you about improved connectivity and accessibility due to this road project?
      - [ ] Not hopeful
      - [ ] Slightly hopeful
      - [ ] Moderately hopeful
      - [ ] Very hopeful
      - [ ] Extremely hopeful
2. **Improvements Expected from the Lagos-Calabar Coastal Road/Transport Infrastructure:**
   - Reduced travel time
   - Better access to essential services
   - Increased safety
   - Economic opportunities
   - Other (please specify):
3. **Impact on Daily Commute:**
   - Positively
   - Negatively
   - No change
   - (Please explain if positively or negatively)
4. **Impact on Local Businesses:**
   - Yes
   - No
   - (Please explain if yes)
5. **Changes in Property Values Due to the Project:**
   - Increase
   - Decrease
   - No change

6. **Social Impact:**
   - Changes in social interactions within your community:
     - Increase
     - Decrease
     - No change
   - How the project will affect the safety of pedestrians and cyclists:
     - Improve
     - Worsen
     - No change
7. **Perceptions and Support:**
   - How positively do you perceive the Lagos-Calabar coastal road project?
     - [ ] Very negative
     - [ ] Negative
     - [ ] Neutral
     - [ ] Positive
     - [ ] Very positive
   - To what extent do you support the implementation of this road project?
     - [ ] Strongly oppose
     - [ ] Oppose
     - [ ] Neutral
     - [ ] Support
     - [ ] Strongly support
8. **Concerns and Expectations:**
   - Main concerns regarding the road project:
     - (Please specify)
   - Outcomes or benefits expected from the completion of this road:
     - (Please specify)
9. **Fears:**
   - Concern about potential disruptions during road construction:
     - [ ] Not concerned
     - [ ] Slightly concerned
     - [ ] Moderately concerned
     - [ ] Very concerned
     - [ ] Extremely concerned
   - Extent of fear regarding property loss or negative impacts on your community:
     - [ ] Not fearful
     - [ ] Slightly fearful
     - [ ] Moderately fearful
     - [ ] Very fearful
     - [ ] Extremely fearful

Part E Environmental and Social concerns

i. **Environmental Impact:**

a. To what extent are you concerned about habitat destruction due to the road project?" [ ] Not concerned, [ ] Slightly concerned, [ ] Moderately concerned, [ ] Very concerned, [ ] Extremely concerned.
b. How worried are you about potential disruptions to marine ecosystems?" [ ] Not worried, [ ] Slightly worried, [ ] Moderately worried, [ ] Very worried, [ ] Extremely worried
c. To what degree do you anticipate increased pollution as a result of the road construction?" [ ] Not at all, [ ] Slightly, [ ] Moderately, [ ] Significantly, [ ] Extremely

d. **Are there any specific plants or animals you are concerned about?**
   a. Yes
   b. No
   c. If yes, please specify:

e. **In this area, list five environmental resources that will be affected by the road construction project:**

   i, ii, iii, iv and v

f. **Do you think the project will contribute to environmental sustainability?**
   a. Yes
   b. No
   c. If yes, please explain how:

ii. **Social Implications:**

a. How concerned are you about property loss and displacement of residents and businesses?" [ ] Not concerned, [ ] Slightly concerned, [ ] Moderately concerned, [ ] Very concerned, [ ] Extremely concerned
b. To what extent do you fear disruptions to local communities during construction? [ ] Not at all, [ ] Slightly, [ ] Moderately, [ ] Significantly, [ ] Extremely

c. **Do you have any economic trees (e.g., cocoa, palm trees) that might be affected by the project?**
   a. Yes
   b. No
   c. If yes, please specify the type and number of trees:

d. **How do you expect the Lagos Calabar Coastal road project to impact these economic trees?**
   a. Positively

   b. Negatively
   c. No change
   d. If positively or negatively, please explain:

Part F Travel Habits, Transportation and Accessibility

e. **How often do you travel for work or personal reasons?**
   a. Daily
   b. Weekly
   c. Monthly
   d. Rarely
f. **What is the average distance of your daily commute?**
   a. Less than 5 km
   b. 5-10 km
   c. 10-20 km
   d. More than 20 km
g. **What is your primary mode of transportation?**
   a. Car
   b. Bus
   c. Motorcycle (Okada)
   d. Bicycle
   e. Walking
   f. Other (please specify):
h. **How much do you spend on transportation per month on average?**
   a. Less than ₦5,000
   b. ₦5,000 - ₦10,000
   c. ₦10,000 - ₦20,000
   d. More than ₦20,000
i. **How often do you travel out from your community?**
   a. Daily
   b. Weekly
   c. Monthly
   d. Rarely
j. **Does the existing road/transport infrastructure ease your access to essential services (e.g., healthcare, education, markets)?**
   a. Yes
   b. No
   c. If yes, please specify:
k. **Does the existing road/transport infrastructure affect your travel time?**
   a. Yes
   b. No

l. **How satisfied are you with the existing public transport services?**
   a. Very satisfied
   b. Satisfied
   c. Neutral
   d. Dissatisfied
   e. Very dissatisfied

m. **What means of transportation do you primarily use for receiving goods?**
   a. Truck
   b. Rail
   c. Air freight
   d. Maritime transport (ships)
   e. Other (please specify):
   f. Not applicable

n. **What means of transportation do you primarily use for transporting goods?**
   a. Truck
   b. Rail
   c. Air freight
   d. Maritime transport (ships)
   e. Other (please specify):
   f. Not applicable

1.

Part G Willingness-to-pay (WTP) and acceptability of users

a. Tick one of the following statements based on options for Strongly Disagree, Disagree, Neutral, Agree, or Strongly Agree that best meets your expectations.

S/No	Statement	Strongly Disagree	Disagree,	Neutral	Agree	Remarks
1	The Lagos-Calabar coastal road project is a valuable and worthwhile endeavor.					
2	“How acceptable do you find the idea of tolls on					

	the Lagos-Calabar coastal road?”					
3	To what extent do you agree that tolls are a fair way to fund road infrastructure?”					
4	I am willing to pay tolls for the road					
5	If the toll road significantly reduces travel time compared to alternatives, I am still inclined to pay.					
6	Transparent use of toll revenue and maintenance practices influence willingness to pay.					

Part H Gender and social inclusion with historical sites and cultural landmarks

1. **Gender Inclusion and Social Inclusion:**

   a. To what extent do you believe gender considerations have been integrated into the planning and design of this road project?
   [ ] Not at all, [ ] Slightly, [ ] Moderately, [ ] Significantly, [ ] Fully

   b. How well do you think this road project addresses the needs of marginalized or vulnerable groups in the community?
   [ ] Poorly, [ ] Fairly, [ ] Adequately, [ ] Well, [ ] Excellently

2. **Historical Sites and Cultural Landmarks**

    a. To what extent are you aware of specific historical sites or monuments along the proposed Lagos-Calabar Coastal Road?
    [ ] Not at all, [ ] Slightly, [ ] Moderately, [ ] Significantly, [ ] Fully
    b. How well-informed are you about the historical events or cultural significance associated with these sites?
    [ ] Not at all, [ ] Slightly, [ ] Moderately, [ ] Significantly, [ ] Fully
    c. Are there any cultural landmarks, traditional gathering places, or sacred sites within the project corridor?
    [ ] None, [ ] Few, [ ] Some, [ ] Many, [ ] Abundant
    d. How do these landmarks contribute to the local identity and heritage?
    [ ] Minimally, [ ] Somewhat, [ ] Moderately, [ ] Significantly, [ ] Profoundly

Part I Health Impact, Community well-being and health and safety

1. **Are you aware of any health impacts associated with road construction?**
    a. Yes
    b. No
    c. If yes, please specify:
2. **Have you experienced any of the following health issues in any prior road construction activities?**
    a. Respiratory problems (e.g., coughing, asthma exacerbation)
    b. Allergies
    c. Hearing problems (e.g., due to noise)
    d. Stress or anxiety
    e. Injuries (related to construction activities or accidents)
    f. None
3. **Do you believe prior road construction activities have contributed to any of these health issues?**
    a. Yes
    b. No
    c. If yes, please describe how:
4. **Do you expect the project to improve access to healthcare facilities?**
    a. Yes
    b. No
    c. If yes, please explain how:
5. **Community Well-Being and Social Inclusion:**

i. To what extent do you believe the Lagos-Calabar coastal road project will positively impact community well-being?
[ ] Not at all, [ ] Slightly, [ ] Moderately, [ ] Significantly, [ ] Fully

ii. How well do you think the project considers the needs and rights of local residents?"
[ ] Poorly, [ ] Fairly, [ ] Adequately, [ ] Well, [ ] Excellently

6. **Occupational Health and Safety:**

i. Please rate your perception of the current state of occupational health and safety in the proposed road project: [ ] Strongly Disagree (1) [ ] Disagree (2) [ ] Neutral (3) [ ] Agree (4) [ ] Strongly Agree (5)

ii. How confident are you that safety regulations will be strictly enforced during construction? [ ] Not confident (1) [ ] Slightly confident (2) [ ] Moderately confident (3) [ ] Very confident (4) [ ] Extremely confident (5)

7. **Community Health and Safety:**

i. How concerned are you about potential health risks to nearby communities during construction? [ ] Not Concerned (1) [ ] Somewhat Concerned (2) [ ] Neutral (3) —[ ] Concerned (4) — Very Concerned (5)

ii. Do you believe adequate measures are in place to protect community members from dust, noise, and other hazards?" [ ] No, Inadequate measures (1) —[ ] Somewhat inadequate (2) — [ ] Neutral (3) — [ ] Adequate (4) —[ ] Very Adequate (5)

8. **Emergency Preparedness and Healthcare Access**:

i. How well-prepared do you think the project is for handling emergencies during construction? [ ] Not prepared (1) — [ ] Slightly prepared (2) —[ ] Moderately prepared (3) — [ ] Very prepared (4) [ ] — Extremely prepared (5)

ii. How well-prepared do you think the project is for emergencies (e.g., accidents, natural disasters)? [ ] Not Prepared (1) —[ ] Somewhat Prepared (2) —[ ] Neutral (3) [ ] — Prepared (4) [ ] — Very Prepared (5)

iii. Are there clear emergency response plans in case of incidents?
....
....

iv. How accessible are healthcare facilities for workers and community members along the road? [ ] Very Inaccessible (1) [ ] — Inaccessible (2) [ ] — Neutral (3) [ ] — Accessible (4) [ ] — Very Accessible (5)

Part K Overall Satisfaction and Suggestions

1. **Overall, how satisfied will you be with the Lagos Calabar Coastal road transport project?**
   - Very satisfied
   - Satisfied
   - Neutral
   - Dissatisfied
   - Very dissatisfied
2. Is there anything else you would like to share regarding the proposed Lagos-Calabar Coastal Road

   ……………………………………………………………………………………………………

ESIA Team, Project Lead

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