ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

FOR THE PROPOSED NIGERIA ELECTRIFICATION PROJECT (DESERT TO POWER) PHASE II PROJECT.

AT ADMIRALTY UNIVERSITY OF NIGERIA (ADUN) DELTA STATE.

PREPARED FOR: RURAL ELECTRIFICATION AGENCY(REA)
(Nigeria Electrification Project – PMU)

DRAFT REPORT

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ABBREVIATIONS

ADUN	Admiralty University of Nigeria
AfDB	African Development Bank
APPI	Area of Potential Project Influence
ASTM	American Society for Testing and Materials
BOD	Biochemical Oxygen Demand
BOS	Balance of System
COPE	Care of the People
DRG	Debt Relief Gains
DtP	Desert to Power
ECN	Energy Commission of Nigeria
EEP	Energizing Education Programme
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
EPC	Engineering, Procurement and Construction
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FEPA	Federal Environmental Protection Agency
FGN	Federal Government of Nigeria
FMEnv	Federal Ministry of Environment
GPS	Global Positioning System
GRM	Grievance Redress Mechanism
HSE	Health Safety and Environment
HT	High Tension
ICREEE	Inter-ministerial Committee on Renewable Energy and Energy Efficiency
kVA	kilovolt-ampere
KW	Kilowatt
kWac	kilowatts alternating current
kWdc	kilowatts direct current
LGA	Local Government Area
LT	Low Tension
MW	Megawatt
NACOP	National Council on Power
NEEAP	National Energy Efficiency Action Plan

NEP	Nigeria Electrification Project
NEPP	National Electric Power Policy
NERC	Nigerian Electricity Regulatory Commission
NESREA	National Environmental Standards and Regulations Enforcement Agency
NIMET	Nigerian Meteorological Agency
NSIFT	National Social Insurance Trust Fund
NUC	National University Commission
OHS	Occupational Health and Safety
PAPs	Project Affected Persons
RAP	Resettlement Action Plan
REA	Rural Electrification Agency
RoW	Right of Way
SE4All	Sustainable Energy for All
STEL	Short Term Exposure Limit
TCN	Transmission Company of Nigeria
TWA	Time Weighted Average

EXECUTIVE SUMMARY

ES 1: Introduction

The Federal Government of Nigeria (FGN), through the Rural Electrification Agency (REA), is implementing the Nigeria Electrification Project Phase II (Desert-to-Power) with financial support from the African Development Bank (AfDB). The project's primary objective is to accelerate Nigeria's electrification efforts by deploying sustainable, off-grid and grid-connected solar-powered renewable energy solutions. As part of the Energizing Education Programme, the REA intends to electrify 24 Federal Universities and Teaching Hospitals, of which Admiralty University of Nigeria, Oshimili is among the beneficiaries.

This ESIA has been prepared for the proposed site in accordance with the African Development Bank's Integrated Safeguards System (ISS), the Environmental Impact Assessment (EIA) Act Cap E12 LFN 2004, and other applicable Nigerian environmental and sectoral regulations, and international good practice standards.

The relevant National and state environmental and social policies, laws, regulations, and the African Development Bank (AfDB) integrated safeguards as well as other international standards guided the preparation of this ESIA and will further guide the implementation of the project. A highlight of these policies / framework include:

Theme	Principal requirement	Project application
Environmental assessment and permitting	Environmental Impact Assessment Act, Cap E12 LFN 2004; applicable FMEnv EIA procedures and charges requirements	Obtain FMEnv approval and comply with approval conditions before works; retain the approval and compliance record.
Electricity and mini-grid regulation	Electricity Act 2023; NERC Mini-Grid Regulations 2026; applicable current NERC codes, including the NESI Health and Safety Code, Second Edition (March 2026)	Confirm isolated/ interconnected classification, capacity and authorisation route; obtain the applicable permit/ registration/ authorisation and comply with consumer, tariff and safety duties.
Electrical inspection and certification	Nigerian Electricity Management Services Agency Act and current NEMSA solar mini-grid inspection/ certification requirements	Use competent, certified contractors; submit final designs, test records and installation for required inspection and certification before energisation.
Pollution and waste	NESREA Act 2007, as amended; National Environmental (Sanitation and Wastes Control) Regulations, S.I. 28 of 2009; Construction Sector Regulations, S.I. 19 of 2011; Permitting and Licensing System Regulations, S.I. 29 of 2009	Secure applicable permits, segregate waste, use licensed carriers/facilities, retain manifests and prevent open burning/dumping.
Air, noise, water, erosion and energy	Air Quality Control Regulations, S.I. 88 of 2021 (amended); Noise Standards and Control Regulations, S.I. 35 of 2009; Surface and Groundwater Quality Control Regulations, S.I. 22 of 2011; Soil	Apply receptor-appropriate standards, drainage/erosion controls, monitoring and corrective action; do not substitute occupational noise limits for community criteria.

	Erosion and Flood Control Regulations, S.I. 12 of 2011; Energy Sector Regulations, S.I. 63 of 2014	
Electrical/ electronic equipment, batteries and plastics	Electrical/Electronic Sector Regulations, S.I. 79 of 2022; National Environmental (Battery Control) Regulations 2024; National Environmental (Plastic Waste Control) Regulations 2026	Use producer responsibility/EPR and documented take-back routes for batteries, PV modules, electronics and packaging; maintain inventory and end-of-life records.
Climate	Climate Change Act 2021; National Climate Change Policy 2021–2030	Integrate climate-risk screening, resilient drainage, wind/ lightning/ heat design and defensible operational GHG accounting.
Labour, OHS and compensation	Labour Act, Cap L1 LFN 2004; Employees' Compensation Act 2010; Factories Act, Cap F1 LFN 2004; applicable OHS policy and electricity-sector safety code	Provide lawful terms, hours, wages, insurance/compensation, competent supervision, risk assessment, PPE, welfare, permits-to-work and incident reporting.
Child protection, violence and inclusion	Child Rights Act 2003; Violence Against Persons (Prohibition) Act 2015 and applicable Delta State law; Discrimination Against Persons with Disabilities (Prohibition) Act 2018; National Gender Policy 2021–2026	Prohibit child labour and exploitation, implement Codes of Conduct and survivor-centred SEA/SH referral, and ensure accessible engagement and facilities.
Land and planning	Land Use Act, Cap L5 LFN 2004; Nigerian Urban and Regional Planning Act, Cap N138 LFN 2004; applicable Delta State land, planning, building and environmental requirements	Verify university control, registered survey, absence of claims/uses, planning/building approvals and a displacement-free final footprint before possession.
Biodiversity and heritage	Endangered Species Act, Cap E9 LFN 2004; applicable wildlife/forestry requirements; National Commission for Museums and Monuments Act and chance-find obligations	Screen protected/sensitive biodiversity, minimize clearance, protect fauna and apply formal chance-find escalation.

The principal international safeguards and good-practice instruments relevant to the Project include:

a) African Development Bank Group Integrated Safeguards System (ISS), 2023, including Operational Safeguards OS1–OS10 as applicable;
b) African Development Bank Borrower Guidance Notes, used as implementation guidance and not as a substitute for the mandatory ISS requirements; World Bank Group/International Finance Corporation General Environmental, Health and Safety Guidelines, including the relevant occupational and community health and safety provisions;
c) Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973;
d) Convention Concerning the Protection of the World Cultural and Natural Heritage, 1972; Convention on the Conservation of Migratory Species of Wild Animals, 1979;

e) United Nations Framework Convention on Climate Change, 1992, and the Paris Agreement, 2015

ES 2: Project Justification

Public tertiary institutions in Nigeria continue to experience inadequate and unreliable electricity supply from the national grid, which constrains effective teaching, research activities, and institutional operations. The proposed intervention at the Admiralty University of Nigeria, Oshimili forms part of the Energizing Education Programme under the DtP initiative, aimed at providing dedicated, clean, and reliable electricity to federal universities. The project is intended to address existing power supply limitations at the University, support academic and research activities, reduce dependence on fossil fuel-based generation, and enhance overall institutional efficiency.

Technical sustainability of the proposed solar hybrid mini grid project will be ensured through implementation by qualified Engineering, Procurement and Construction contractors selected by the Rural Electrification Agency through a competitive process in accordance with established technical standards and procedures. Project design, installation, and commissioning activities will be supervised by competent technical personnel from the Rural Electrification Agency in collaboration with the Admiralty University of Nigeria, Oshimili.

Environmental sustainability of the proposed project is supported by the adoption of solar energy as a renewable power source, thereby reducing reliance on fossil fuel-based electricity generation and associated greenhouse gas emissions. The project is designed to promote clean energy utilization while minimizing adverse environmental impacts throughout its lifecycle.

Economic sustainability of the proposed solar hybrid mini grid project will be achieved through reduction in energy expenditure associated with diesel fuel consumption, generator maintenance, and reliance on conventional grid electricity supply. The provision of dedicated renewable power is expected to significantly lower operational energy costs within the Admiralty University of Nigeria, Oshimili, thereby improving overall institutional financial efficiency.

Social sustainability of the proposed project is supported through inclusive stakeholder engagement conducted as part of the ESIA process, ensuring that relevant stakeholders are informed and provided opportunities to contribute to project planning at an early stage. This process has facilitated transparency and strengthened relationships between the project implementing agency, the University, and surrounding communities.

ES 3: Project Description

The Desert-to-Power (DtP) intervention at the Admiralty University of Nigeria, Oshimili in Delta state will involve the development of a solar photovoltaic (PV) power plant designed to meet a projected campus power demand of approximately 1 MW, which will convert solar radiation into usable electrical power for distribution within the University campus and will be supported by appropriate operation and maintenance arrangements to ensure long-term performance and sustainability.

The assessed Project comprises the following controlled design envelope. The final engineering design shall be checked against this envelope before procurement or mobilisation; any material change shall undergo E&S change review and, where required, supplementary assessment and disclosure:

- Ground-mounted solar photovoltaic arrays within the verified Project footprint;

- A battery energy storage system sized through the final load and autonomy study, with chemistry, capacity, enclosure, separation distances and fire protection confirmed through a documented hazard assessment;
- Inverters, transformers, switchgear, protection, metering, earthing, lightning protection, supervisory control and associated balance-of-system equipment;
- Underground internal distribution cabling within the controlled campus corridor, except where an approved final design demonstrates that another arrangement is safer and subject to E&S change review;
- Interconnection to the University's internal distribution system. Connection or export to an external distribution or national grid is not part of the assessed scope and would require separate technical, regulatory and E&S review;
- Supervisory control, monitoring, communications and security systems;
- Only the control, operations and maintenance facilities confirmed by the final design; and
- Standby generation only if retained in the approved final design, with fuel storage, emissions, noise, spill prevention and emergency controls assessed before installation.

Project site and controlled footprint

The Project is proposed within the permanent campus of Admiralty University of Nigeria at Ibusa, Oshimili North Local Government Area, Delta State. The approximately 10 ha university allocation and the coordinate information presented in this report are indicative for ESIA planning. Before site possession, a licensed survey shall establish the final cadastral boundary, area, access and cable corridor in WGS84/UTM Zone 32N and reconcile all coordinates, maps and receptor distances.

The allocated land is within the University's institutional holding. At the time of the site assessment, the proposed footprint was unused, unoccupied and free of buildings, crops and livelihood activity. This statement applies to the Project footprint and does not alter the description of farming as a livelihood in surrounding communities. The footprint shall be jointly re-inspected immediately before possession and mobilisation. If any occupation, cultivation, structure, access restriction, claim, tenancy or livelihood use is identified, the affected area shall be excluded from works until the requirements of AfDB OS5 and applicable Nigerian law have been assessed, and the required instrument has been approved and implemented.

Subject to the survey, land-status hold point and final engineering checks described in this ESIA, the location is suitable for assessment of the proposed solar hybrid mini-grid because it is within the intended campus load centre and can accommodate the principal components within a controlled institutional site.

ES 4: Description of the Environmental and Social Baseline Conditions

The baseline assessment describes the existing environmental and socio-economic conditions within the project area at the Admiralty University of Nigeria, Ibusa (ADUN) permanent campus and its area of influence. The purpose is to establish current conditions against which potential project impacts can be assessed and to ensure that project activities do not degrade the existing environmental quality but maintain or improve prevailing conditions.

Physical Environment

- The Project area has a humid tropical climate with distinct wet and dry seasons and rainfall conditions characteristic of southern Nigeria.
- The observed terrain is generally flat to gently undulating. Final suitability, grading, drainage, flood levels, geotechnical bearing capacity and erosion protection shall be confirmed through the final surveys and design.
- The open landscape enhances solar exposure and ease of installation.

Soil Characteristics

The existing soil condition is relatively stable under natural conditions but may degrade if disturbed without proper control measures.

- The soils within the project area are predominantly sandy-silty, loose, and moderately cohesive.
- The analysed soil parameters are reported in Chapter Four and Annex Eight. Conclusions are limited to the parameters, locations, dates and analytical methods represented by the signed laboratory evidence.
- However, low organic content and weak structural stability make the soil susceptible to erosion, particularly when disturbed.
- Field observations also identified early signs of surface erosion within parts of the site.

Water Quality (Groundwater and Surface Water)

- The available groundwater and surface-water results provide a screening baseline for the analysed parameters. They do not constitute a complete drinking-water certification.
- No exceedance was identified for the reported parameters where a valid, directly comparable criterion was available. Confirmatory testing shall be undertaken where water is proposed for drinking or another decision-critical use.
- Groundwater is an important domestic water source within the broader area.
- Surface water bodies in the area show generally acceptable quality, although some parameters indicate slight variability, likely due to natural runoff and seasonal influences.
- No major pollution sources were identified within the immediate project footprint.

Air Quality and Noise

- The air-quality and noise survey provides a short-duration reconnaissance baseline for the monitoring locations and conditions sampled.
- The reported spot measurements are interpreted against criteria with compatible units and averaging periods. They do not, by themselves, demonstrate long-term compliance or the absence of episodic conditions.
- No major stationary emission source was observed within the proposed footprint during the survey. Construction and operational controls shall protect nearby academic, welfare and other sensitive receptors.
- The recorded noise values represent the survey period only. Preconstruction and compliance monitoring shall use documented duration, instrument calibration and receptor-specific day/night criteria.

Biodiversity

Vegetation within the project footprint is characteristic of the derived rainforest ecological zone of southern Nigeria. Owing to prolonged agricultural activities, settlement expansion, and other anthropogenic disturbances, the site is dominated by secondary vegetation comprising grasses, herbs, shrubs, cultivated farmland, and scattered trees. Common plant species observed include *Azadirachta indica* (Neem), *Elaeis guineensis* (Oil Palm), *Mangifera indica* (Mango), *Psidium*

guajava (Guava), *Chromolaena odorata* (Siam weed), *Panicum maximum* (Guinea grass), and other secondary vegetation species typical of southern Nigeria. No endangered, protected, or conservation-significant plant species were recorded within the project footprint during the field survey.

Faunal species observed or expected within the project area are those commonly associated with disturbed agricultural landscapes and peri-urban environments. These include small mammals such as rodents and squirrels, reptiles such as lizards and snakes, birds including weavers, doves, bulbuls, and cattle egrets, as well as numerous insects and other invertebrates. The level of faunal diversity is relatively low due to ongoing human activities, habitat modification, and farming within and around the project site. No endangered or globally threatened wildlife species were observed during the field assessment.

Socio-Economic Environment

- The project site is located within the permanent campus of ADUN, which is currently under development.
- There are no existing structures or active academic activities at the site.
- The nearest community, Ibusa (~400 m away), represents the primary external receptor.
- Livelihoods in surrounding communities include small-scale trading, farming and informal activities. These surrounding-community activities are not located within the proposed Project footprint based on the site assessment and remain subject to the pre-possession verification protocol.
- Basic infrastructure such as roads and access routes exist but is still developing within the campus The university operates under a structured administrative system, with governance provided by the University Council and management.
- At present, students and staff operate from a temporary campus located approximately 10 km away, meaning the project site has limited current human activity.

ES 5: Potential and Associated Impacts

The assessment of potential environmental and social impacts associated with the proposed project was carried out across the pre-construction, construction, operation, and decommissioning phases. Most impacts are site-specific, short-term, and reversible. Moderate impacts are primarily associated with construction activities. Major impacts are limited to occupational health and community safety risks if unmanaged. No significant impacts on sensitive ecological receptors or protected areas were identified

Key Potential Adverse Impacts

These impacts are expected to be temporary, localized, and manageable through proper coordination and mitigation measures.

Pre-Construction Phase

Impacts at this phase are expected to be minimal and short-term, arising mainly from site preparation and mobilization activities:

- Minor removal of vegetation (grasses and shrubs)
- Localized disturbance of sandy-silty soils, with potential to trigger surface erosion in already vulnerable areas
- Temporary dust emissions from initial site preparation and vehicle movement
- Slight increase in traffic and movement within the campus
- Minor community safety risks associated with mobilization activities
- Potential for low-level stakeholder expectations and grievances if not properly managed

Construction Phase

This phase presents the highest level of environmental and social interaction, due to intensive civil and electrical works, including trenching for distribution lines:

- Increased risk of soil erosion and land disturbance due to excavation, trenching, and grading activities
- Generation of dust and particulate matter affecting local air quality
- Elevated noise levels from construction machinery and installation activities
- Potential for surface runoff and sediment transport during rainfall events
- Generation of construction waste, including debris and packaging materials
- Minor disturbance to sparse vegetation and local fauna
- Temporary disturbance within the developing university environment due to noise and movement of personnel and equipment
- Increased traffic and access disruptions within campus routes
- Potential for unmet employment expectations and minor grievances among nearby communities (e.g., Ibusa)
- Interaction between workers and local population, with associated social risks if unmanaged
- Increased risk of workplace accidents, including injuries from equipment handling and excavation activities
- Potential for electrical hazards during installation works
- Risk of traffic-related incidents due to movement of construction vehicles
- Safety risks to nearby receptors from open trenches and active construction zones

Operation Phase

Operational impacts are generally low in intensity but long-term in nature:

- Minimal environmental emissions, as solar PV systems generate clean energy
- Potential risks of soil and water contamination from improper handling or leakage of battery systems
- Generation of electronic waste (e-waste) from damaged or obsolete components
- Low-level noise emissions from inverters and associated equipment
- Minor visual impacts from installed infrastructure
- Restricted access to operational areas for safety purposes
- Risk of electrical hazards, fire incidents, and unauthorized access to energized components
- Limited but ongoing occupational health and safety risks for operational staff

Cumulative Impacts

The presence of ongoing construction activities within the ADUN permanent campus may result in cumulative impacts, including:

- Increased dust levels and noise from simultaneous construction activities
- Higher traffic volumes and safety risks within campus roads
- Increased pressure on soil stability, particularly in erosion-prone areas
- Elevated safety risks due to multiple construction fronts

ES 6: Mitigation Measures

Mitigation measures have been developed to address the identified environmental and social impacts of the proposed Solar Hybrid Mini-Grid Project at the Admiralty University of Nigeria, Ibusa (ADUN). These measures follow the mitigation hierarchy of avoidance, minimization, and control, and are tailored to site-specific conditions.

Pre-Construction Phase

- Use of well-maintained vehicles to minimize exhaust emissions
- Restriction of movement to designated access routes within the campus
- Implementation of basic traffic management measures during mobilization
- Early and continuous stakeholder engagement to manage expectations
- Clear communication with university management and nearby communities

Construction Phase

- Regular water sprinkling to control dust from exposed sandy-silty soils
- Controlled vegetation clearing limited strictly to the project footprint
- Prompt backfilling of trenches to reduce soil exposure
- Installation of temporary drainage channels to manage runoff
- Stabilization of erosion-prone areas observed on site
- Proper storage and handling of fuels and lubricants to prevent contamination
- Availability and use of spill kits for emergency response
- Segregation and proper disposal of construction waste
- Prioritization of local labour where feasible
- Continuous stakeholder engagement with ADUN and host community
- Establishment and operation of a Grievance Redress Mechanism (GRM)
- Implementation of a Labour Management Plan (LMP)
- Enforcement of a Code of Conduct for all workers
- Awareness and prevention measures for GBV, SEA, and SH risks
- Provision and mandatory use of appropriate Personal Protective Equipment (PPE)
- Regular toolbox talks and safety training for workers
- Installation of safety signage and barricades around work areas
- Restriction of unauthorized access to active construction zones
- Safe handling and installation of electrical components
- Implementation of safety measures for trenching and excavation works
- Availability of first aid kits and emergency response procedures

Operational Phase

- Routine inspection and maintenance of solar panels and equipment
- Regular cleaning of panels to maintain efficiency (dust control)
- Proper housing and ventilation of battery storage systems
- Safe handling, storage, and disposal of e-waste through licensed handlers
- Maintenance of site drainage to prevent erosion and waterlogging
- Continued operation of the Grievance Redress Mechanism (GRM)
- Controlled access to the facility to prevent unauthorized entry
- Ongoing engagement with ADUN management and users
- Clear safety signage around energized equipment
- Use of qualified personnel for system operation and maintenance
- Enforcement of electrical safety procedures (e.g., lockout/tagout)
- Regular inspection of equipment to prevent faults and hazards
- Continuous safety training for operational staff

ES 7: Environmental and Social Management Plan (ESMP)

The Environmental and Social Management Plan (ESMP) outlines the measures required to avoid, minimize, and manage the potential adverse impacts identified for the proposed Solar Hybrid Mini-Grid

Project at the Admiralty University of Nigeria, Ibusa (ADUN). It also defines the roles, responsibilities, and monitoring framework necessary to ensure effective implementation throughout the project lifecycle. Implementation of mitigation measures will be primarily the responsibility of the Engineering, Procurement, and Construction (EPC) Contractor, particularly during the pre-construction and construction phases**,** where most impacts are anticipated. The Contractor will be required to comply with all environmental and social requirements, including site-specific management plans, health and safety procedures, and good international industry practices.

The Nigeria Electrification Project Management Unit (NEP-PMU**)** will provide oversight and supervisory functions**,** ensuring that mitigation measures are properly implemented and that the project remains compliant with applicable environmental and social standards. This will include routine monitoring, reporting, and auditing of Contractor performance. The ESMP also includes environmental and social monitoring, to ensure that impacts are effectively managed and that project implementation aligns with national regulations and AfDB requirements.

The total costs of the ESMP implementation including costs for mitigation, monitoring and capacity building is estimated as: **₦41,470,000.00** (Forty-One Million, Four Hundred and Seventy Thousand Naira, only.*)* the table below:

ITEM	RESPONSIBILITY	COST ESTIMATE	
		NAIRA (₦)	USD ($)
Cost of Mitigation	Contractor	21,100,000.00	15,312.05
Cost of Monitoring	NEP-PMU, MDAs	6,600,000.00	4,789.55
Capacity Building	NEP- PMU/Contractor	10,000,000.00	7,256.89
Sub-total		37,700,000.00	27,358.49
Contingency (10% of sub-total)		3,770,000.00	2,735.85
TOTAL		**41,470,000.00**	**30,094.34**

Exchange Rate $1.00(USD) = ₦1,378 (NGN) – CBN rate as at July, 2026

ES 8: Remediation Plan After Decommissioning and Closure

The proposed solar project is expected to have a life span of 25 years. It is envisaged that technology and environmental policies could have changed so drastically by then, hence a definite decommissioning plan cannot be put in place for now. However, it is of importance that abandonment activities be planned in advance in accordance with the Nigerian regulatory requirements.

In the event of decommissioning, NEP, in conjunction with the leadership of Admiralty University of Nigeria, Oshimili (ADUN), shall ensure that the Project site is left in a safe and environmentally acceptable condition. A standard decommissioning, abandonment and closure programme shall be invoked. The tasks will include, amongst others:

- Evacuation of the dismantled PV panels and other related items (such as inverters, and control devices) to the manufacturers for recycling.
- Transportation of spent batteries to recycling facilities;
- Monitoring the abandoned project environment as necessary.

Decommissioning activities will only begin after due consultation with the relevant stakeholders including the regulatory authorities. The decommissioning activities shall be carried out in line with the relevant provisions of the National Guidelines for Decommissioning of Facilities in Nigeria (2017) issued by the FMEnv.

The key personnel and institutions with major roles in the implementation and monitoring of environmental and social measures for the Project decommissioning/closure are as follows:

- Contractor(s) Engaged for Decommissioning Activities
- NEP-PMU
- ADUN University Site Manager
- Director of Works and Physical Planning Department in ADUN
- FMEnv/Delta State Ministry of Environment Representatives

ES 9: Stakeholder Engagement and Grievance Redress Mechanism

Stakeholder analysis was undertaken to identify relevant stakeholders, understand their roles, and assess their level of influence and interest in relation to the proposed project. Stakeholder consultations were conducted at various levels to ensure that the views, concerns, and expectations of relevant stakeholders were incorporated into the ESIA process for the Solar Hybrid Mini-Grid Project at ADUN.

Key Stakeholders Consulted

- University Management (Vice Chancellor and administration)
- Traditional leadership
- Host community (men, women, youths, elderly, and persons with disabilities)
- Local Government Authority (Oshimili North)
- State Ministries (Education and Environment)

Key Concerns Raised

- Demand for transparent and fair employment opportunities, especially for local youths
- Importance of inclusive participation, including women and persons with disabilities
- Need for continuous communication and stakeholder engagement throughout project implementation
- Concern for maintaining peaceful coexistence between workers and host community

Expectations and Requests

- Priority consideration for local labour recruitment
- Provision of skill acquisition opportunities for youths
- Inclusion of women in project-related economic opportunities
- Maintenance of open communication channels during all project phases
- Proper consultation and involvement of community representatives

The Project grievance mechanism enables communities and other stakeholders to raise concerns and obtain a timely response throughout the Project lifecycle. The mechanism shall be widely communicated, accessible and free to use. Individual grievance records shall remain confidential; only anonymized aggregate performance information may be publicly disclosed.

ES 10: Conclusion and Recommendation

The proposed project is designed to provide a reliable and sustainable electricity supply to the university campus, thereby enhancing academic activities, improving living and learning conditions, and reducing dependence on fossil fuel-based energy sources. In this regard, the project aligns with national energy development objectives and international commitments to sustainable development. Potential adverse impacts identified during the ESIA are largely site-specific, temporary, and manageable. During the

construction phase, key impacts include dust generation, noise, soil disturbance, vegetation clearing, occupational health and safety risks, and minor social disturbances associated with labour influx and construction activities. During the operational phase, potential impacts are minimal and relate primarily to equipment maintenance, waste management (including e-waste), and occupational safety. Appropriate mitigation measures have been developed to address these impacts. The anticipated benefits of the project significantly outweigh the potential adverse impacts, all of which can be effectively mitigated through the implementation of the recommended measures.

CHAPTER ONE: INTRODUCTION

1.1 Background Information

The Federal Government of Nigeria (FGN), through the Rural Electrification Agency (REA), is implementing the Nigeria Electrification Project Phase II (Desert-to-Power) with financial support from the African Development Bank (AfDB). The project's primary objective is to accelerate Nigeria's electrification efforts by deploying sustainable, off-grid and grid-connected solar-powered renewable energy solutions. By leveraging Nigeria's vast solar energy resources, the initiative aims to provide clean, reliable, and long-lasting electricity to Federal Universities and their affiliated teaching hospitals. The broader goal is to enhance academic performance, support research initiatives, and improve healthcare service delivery.

As part of the Energizing Education Programme, the REA intends to electrify 24 Federal Universities and Teaching Hospitals, of which Admiralty University of Nigeria, Oshimili is among the beneficiaries. The proposed project involves the installation of a solar-hybrid power system with a generation capacity exceeding 1 MW to provide reliable and sustainable electricity supply to the University.

This ESIA has been prepared for the proposed site in accordance with the African Development Bank's Integrated Safeguards System (ISS), the Environmental Impact Assessment (EIA) Act Cap E12 LFN 2004, and other applicable Nigerian environmental and sectoral regulations, and international good practice standards.

1.2 Rationale for the ESIA

The project is rated as Category 2 (Medium Risk) in line with the Bank's Integrated Safeguards System (ISS) and Nigeria's Environmental Impact Assessment (EIA) Act, CAP E.12 LFN 2004 and the Environmental Impact Assessment Procedures and Charges Regulations (2021). The justification for the E&S categorization has been based on the nature, scale, sensitivity, and location of the proposed projects, with the likelihood to generate limited, site-specific (within existing university campuses, and in exceptional cases when there is land-related dispute in adjoining areas), and reversible E&S impacts such as: limited changes in environmental baseline due to pre-construction and construction activities (e.g., excavation, waste generation, etc.,); unsustainable waste management practices including management of solar e-wastes (spent batteries, broken panels and faulty electrical components); economic displacement of farm owners on the allocated parcel of lands within the universities' premises; exposure of workers to occupational hazards and risks to health during construction activities, etc.

1.3 Objectives of the Assignment

The objective of this consultancy is to conduct site specific ESIA for the proposed power systems and associated infrastructure in Admiralty University of Nigeria, Oshimili, to:

- Establish environmental and socio-economic baselines for each site;
- Identify, predict, and evaluate environmental, social, health, and safety impacts (positive and negative);
- Recommend mitigation and enhancement measures;
- Ensure compliance with AfDB and Nigerian E&S standards;
- Develop site-specific Environmental and Social Management Plans (ESMPs); and
- Facilitate environmental approvals, and stakeholder acceptance.
- Support REA in securing FMEnv ESIA certification and AfDB no-objection;
- Conduct inclusive stakeholder engagement (including women, youth, and persons with disabilities); and
- Build local institutional capacity for ESMP implementation.

This shall be in line with the requirements of the Federal Government of Nigeria and the African Development Bank's Integrated Safeguards System to ensure that any adverse effects on the environment and wellbeing of people are properly identified and mitigated.

1.4 Scope of Works

The scope of work for this assignment is to conduct an Environmental and Social Impact Assessment (ESIA) for the proposed Desert-to-Power (DtP) solar-hybrid power systems at the Admiralty University of Nigeria, Oshimili Delta State. The assignment will include the preparation of a site-specific Environmental and Social Management Plan (ESMP) detailing mitigation measures, monitoring requirements, implementation responsibilities, and indicative costs, in line with applicable national regulations and the African Development Bank's Integrated Safeguards System.

To ensure a robust ESIA study, the following tasks were conducted:

Review of Project Information and Regulatory Requirements

- Review available NEP documentation, feasibility information, conceptual design, layout and mapping relevant to the Admiralty University of Nigeria site;
- Identify applicable national regulations, FMEnv procedures, and AfDB safeguard requirements.
- Prepare ESIA registration documentation and liaise with FMEnv for project registration.

Scoping and Work Planning

- Conduct preliminary scoping and environmental and social risk screening.
- Identify key stakeholders and sensitive receptors within the project areas.
- Prepare detailed and site-specific ESIA work plans and schedules.

Baseline Data Collection (within defined area of influence)

- Undertake biophysical studies covering air quality, noise, water, soil, hydrology, flora, and fauna.
- Conduct socio-economic surveys addressing demography, livelihoods, gender issues, land use/tenure, cultural heritage, and traffic/transport conditions.
- Utilize GIS and remote sensing tools for spatial analysis and sensitivity mapping.
- Ensure laboratory analyses are performed by FMEnv-accredited laboratories.

Impact Identification and Evaluation

- Identify and assess direct, indirect, induced, and cumulative impacts.
- Evaluate pollution pathways, waste streams, and greenhouse gas emissions.
- Apply FMEnv and AfDB risk-rating methodologies (high, moderate, low).
- Develop mitigation hierarchy measures (avoid, minimize, mitigate, offset).

Stakeholder Engagement and Social Inclusion

- Undertake meaningful, accessible and culturally appropriate consultation with the University, host communities, relevant authorities, women, youth, persons with disabilities and other interested or potentially affected groups.
- Ensure inclusive participation of women, youth, and persons with disabilities.
- Maintain consultation records including attendance sheets, photographs, and feedback logs.
- Establish and operationalize a multi-tier Grievance Redress Mechanism (GRM).
- Prepare a costed Stakeholder Engagement Plan.

Development of Environmental and Social Management Plans (ESMPs)

- Define mitigation measures with clear performance indicators.
- Establish monitoring frameworks and reporting schedules.

- Specify roles, responsibilities, and institutional arrangements.
- Develop capacity-building plans for implementing entities.
- Provide cost estimates and financing considerations.
- Integrate ESMP provisions into EPC and operational contracts.

Reporting, Disclosure, and Approvals

- Prepare and submit inception, draft, and final ESIA reports in required formats.
- Facilitate statutory disclosure processes (public notices, hearings, gazette publications).
- Support disclosure through AfDB channels via the PMU.
- Facilitate issuance of ESIA approval letters and certificates.
- Cover statutory obligations including payment of access charges and IMM fees as required.

1.5 Study Approach/ Methodology in Details

The ESIA of the proposed Project of the Admiralty University of Nigeria, Oshimili, DeltaState has been carried out in line with the Federal Ministry of Environment (FMEnv) approved EIA process for mini-grid / off-grid projects being implemented under the Nigeria Electrification Project (NEP) Desert to Power (DtP) project. It also considers the requirements of relevant and applicable international standards and best practices such as the AfDB Integrated Safeguard system. The approach and methodology applied for undertaking the environmental and social impact assessment is as provided in the flowchart below.

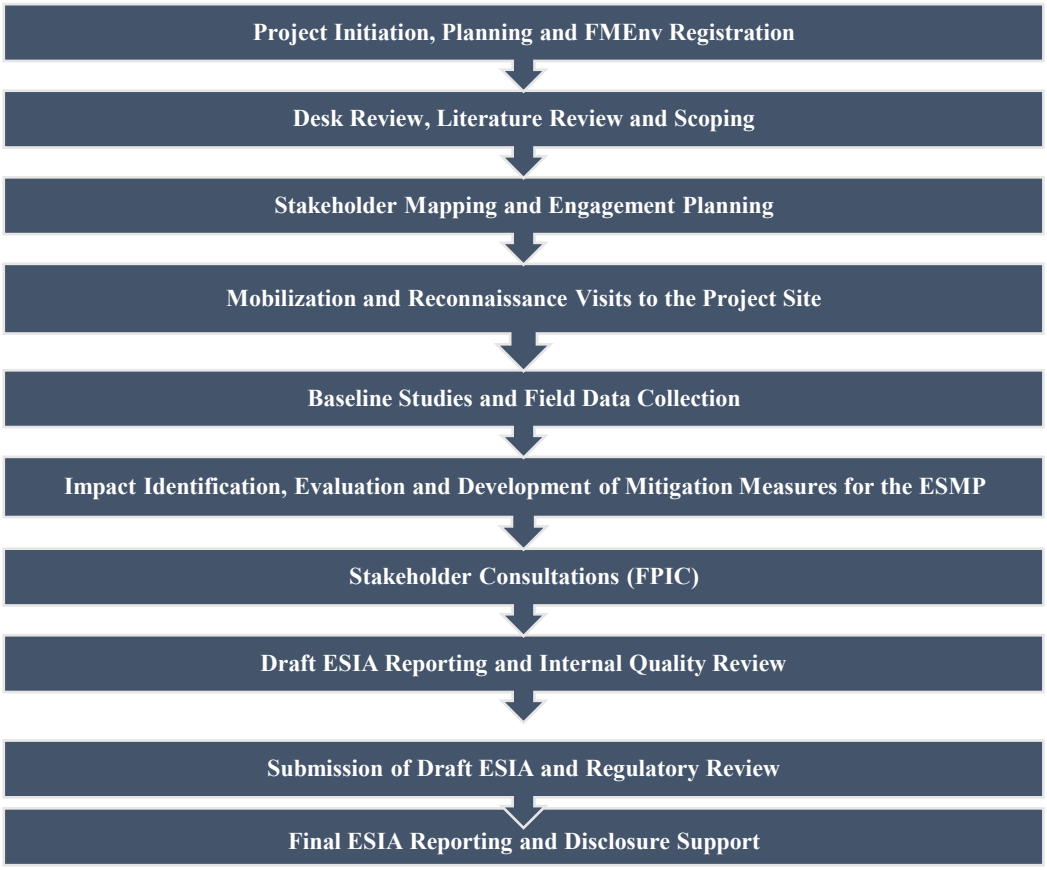


Figure 1: ESIA Methodology Flowchart

1.6 Policy, Legal and Administrative Framework

The proposed Project forms part of the Federal Government of Nigeria's Energizing Education Programme under the Nigeria Electrification Project, with the Desert-to-Power initiative representing the current scale-up phase. Several national laws and sectoral regulations govern the power and

environmental sectors in Nigeria, alongside policies and guidelines that direct environmental and social assessment processes.

This section therefore outlines the relevant statutory, regulatory, and policy framework applicable to the proposed Project, noting that the ESIA will be conducted in compliance with applicable national and international standards throughout the project lifecycle.

1.6.1 Policy Framework

1.6.1.1 National Environmental Policy/ National Policy on the Environment (Revised 2016)

The national environmental policy launched by Government in November 1989 revised in 2016, prescribed guidelines for achieving sustainable development in fourteen vital sectors of the nation's economy, namely: Human Population; Land Use and Soil Conservation; Water Resources Management; Forestry, Wildlife and Protected Natural Areas; Marine and Coastal Area Resources; Sanitation and Waste Management; Toxic and Hazardous Substances; Mining and Mineral Resources; Agricultural Chemicals; Energy Production; Air Pollution; Noise in the Working Environment; Settlements; Recreational Spaces, Green Belts, Monuments, and Cultural Property.

It also contains Nigeria's commitment to ensure that the country's natural and built environment is safeguarded for the use of present and future generations. This commitment demands that efficient resource management and minimization of environmental impacts be the core requirements of all development activities. Accordingly, this Policy seeks to promote good environmental practices through environmental awareness and education.

The goal of the National Policy on the Environment is to ensure environmental protection and the conservation of natural resources for sustainable development.

1.6.1.2 National Policy on Climate Change/ National Climate Change Policy for Nigeria 2021-2030

The National Climate Change Policy for Nigeria 2021-2030 was established to promote a low carbon, climate-resilient and gender-responsive sustainable socio-economic development. The revised National Policy on Climate Change was to define a new holistic framework to guide the country's response to the development challenge of climate change.

Achieving the goal of low carbon, high growth and resilient socio-economic system for equitable and sustainable socio-economic and environmental development faces some challenges which include stability and sustainability of the enabling environment, adequate institutional and human resource capacity and availability of adequate resources to address mitigation and adaptation initiatives to address climate change. Thus, the Government needs to ensure that economic growth, resource management and climate change mitigation and adaptation can all happen simultaneously if this will be done effectively (Department of Climate Change 2017).

1.6.1.3 The National Electric Power Policy (NEPP), 2001

In order to ensure a safe, steady, reliable and progressively improved electric power sector in Nigeria, the Electric Power Reform Implementation Committee (EPIC) was inaugurated by the BPE and resulted in Federal Executive Council (FEC) of Nigeria approving the National Electric Power Policy in September 2001, which recommended, amongst others: establishment of the electric power sector regulator and the privatisation of the electric power sector. The National Electric Power Policy (NEPP), 2001 outlines the realization of an adequate and reliable supply of electricity in three phases - the privatization of the state-own utility NEPA and the introduction of the Independent Power Producers (IPPs); increasing the competition between market participants, partial removal of subsidies, and sale of excess power to distribution companies (DISCOs); and the freedom to select suppliers by large consumers and the creation of a fully liberalized and competitive market.

In 2004, the National Integrated Power Project (NIPP) was initiated to boost power supply by the launch of gas-powered stations. The National Electric Power Policy (NEPP) of 2001 resulted in the Electric Power Sector Reform (EPSRA) Act of 2005 establishing the Nigerian Electricity Regulatory Commission (NERC). The EPSRA provided the statutory basis for the privatisation of the power sector.

1.6.1.4 The National Energy Policy (NEP) 2013

The National Energy Policy (NEP) 2013 is a revised version of the NEP 2003, emphasizes the effective and efficient use of energy and proposes major areas to be considered for energy efficiency and conservation including amongst others: transportation, services/commercial sector, and energy efficient building designs.

1.6.1.5 The National Energy Efficiency Action Plans of Nigeria

The first version of the National Energy Efficiency Action Plans (NEEAP) for Nigeria (2015 - 2030) was approved on July 14, 2016, by the National Council on Power (NACOP). It has been formulated within the framework of United Nations' Sustainable Energy for All (SE4All) and adopted by the Inter-Ministerial Committee on Renewable Energy and Energy Efficiency (ICREEE). The NEEAP includes baseline data and information on energy efficiency activities and programmes in Nigeria, barriers to the development and promotion of energy efficiency in the country and suggested achievable energy efficiency targets, including gender disaggregated indicators, based on national potentials and socio-economic assessments. The implementation of the NEEAP is being monitored by the Federal Ministry of Power.

1.6.1.6 National Occupational Health and Safety Policy 2020

The National Occupational Health and Safety Policy 2020 provides the overarching framework for the protection of workers and the working environment in Nigeria. The Policy establishes principles for the prevention of occupational accidents, diseases, and hazardous exposures, and places obligations on employers to maintain safe working conditions. Its provisions are directly relevant to this project during the construction phase, where workers will be exposed to excavation hazards, working at height, electrical installation risks, and heavy equipment operation.

1.6.1.7 National Gender Policy 2021 to 2026

The National Gender Policy 2021 to 2026 provides the strategic framework for mainstreaming gender equality and women's empowerment across all sectors of national development in Nigeria. The Policy promotes equal participation of women in economic, social, and political life and seeks to eliminate gender-based discrimination. Its provisions are relevant to this project in respect of gender-responsive stakeholder engagement, equitable local employment practices during construction, and the prevention of gender-based violence and sexual exploitation and abuse associated with labour influx.

1.6.1.8 National Policy on Solid Waste Management 2020

The National Policy on Solid Waste Management 2020 establishes the framework for environmentally sound management of solid waste generated from domestic, commercial, industrial, and construction activities in Nigeria. The Policy promotes waste minimization, segregation at source, recycling, and the polluter pays principle. Its provisions are relevant to this project in respect of construction waste, general operational waste streams, and the management of spent materials arising from the solar hybrid mini-grid system.

1.6.1.9 National Policy on Plastic Waste Management 2020

The National Policy on Plastic Waste Management 2020 addresses the growing challenge of plastic pollution in Nigeria and establishes principles for the reduction, reuse, recycling, and responsible disposal of plastic waste. The Policy is relevant to this project given the plastic components associated with solar PV module packaging, cable insulation, and ancillary construction materials, all of which must be managed in accordance with the Policy's waste minimization and responsible disposal requirements.

1.6.2 National Legal Framework

1.6.2.1 Environmental Impact Assessment Act Cap E12 LFN 2004 and EIA Procedures and Charges Regulations 2021

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

The programme is considered to be a minor development, which is expected to have minimum impact on the environment. Hence, the programme is categorised as a Category II (B) EIA. The EIA guidelines (procedural and sectoral) issued by the FMEnv derives from this Act and the programme proponents shall conduct their activities in conformance with these guidelines.

The Environmental Impact Assessment Procedures and Charges Regulations 2021, made pursuant to the EIA Act, prescribe procedural and administrative requirements for registration, scoping, review, public participation, approval and applicable charges. The Project shall comply with the current procedures and project-specific directions issued by the Federal Ministry of Environment.

1.6.2.2 The Electricity Act 2023.

The Electricity Act 2023 is the principal legislation governing the Nigerian electricity sector, enacted to modernise the regulatory framework and consolidate all electricity sector laws in Nigeria. The Act devolves significant regulatory powers to states, establishes a liberalised electricity market, and provides for the licensing, regulation, and operation of electricity generation, transmission, distribution, and retail activities including off-grid and embedded generation systems such as solar hybrid mini-grids. The provisions of the Electricity Act 2023 are directly applicable to this project as the primary sector legislation governing its development, operation, and regulatory compliance

1.6.2.3 Energy Commission of Nigeria Act CAP 109 LFN 1990

The Act was promulgated to create the Energy Commission of Nigeria (ECN) with responsibility for coordinating and general surveillance over the systematic development of the various energy resources of Nigeria. Subject to this Act, the ECN is charged with the responsibility for the strategic planning and co-ordination of national policies in the field of energy in all its ramifications. The mandates of ECN include statistical analysis of Electricity Generation, Transmission and Distribution.

1.6.2.4 Land Use Act Cap 5 LFN 2004

The Land Use Act, Cap L5, Laws of the Federation of Nigeria (LFN) 2004**, vests** all land within each State of the Federation in the Governor, who holds and administers such land in trust for the use and common benefit of all Nigerians. The Act empowers the Governor to grant statutory rights of occupancy in urban areas, while Local Governments administer customary rights of occupancy in rural areas for agricultural and residential purposes. It also provides for the revocation of land rights for overriding public interest, including public infrastructure and development projects, subject to payment of compensation for unexhausted improvements such as buildings, crops, and economic trees. Furthermore,

the Act requires the Governor's consent for land transfers or assignments and serves as the principal legal framework guiding land acquisition, compensation, and resettlement processes in Nigeria.

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

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

- **Section 30 (3)** requires a building plan to be drawn by a registered architect or town planner.
- **Section 39 (7)** establishes that an application for land development would be rejected if such development would harm the environment or constitute a nuisance to the community.
- **Section 59** makes it an offence to disobey a stop-work order. The punishment under this section, is a fine not exceeding ₦10,000 (Ten thousand naira) and in the case of a company, a fine not exceeding ₦50,000.
- **Section 72** provides for the preservation and planting of trees for environmental conservation.

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

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

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

1.6.2.7 The Endangered Species Act, CAP E9, LFN 2004

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

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

Most of the proposed programme locations are on virgin land that serve as wildlife habitats which will be impacted by the programme. Hence, the programme activities shall be carried out to comply with the relevant provisions.

1.6.2.8 The Factories Act, Cap F1, Laws of the Federation of Nigeria 2004

The Factories Act, as contained in the Laws of the Federation of Nigeria 1990, seeks to legislate and regulate the conduct of health and safety in the Nigerian work environment. It was enacted in June 1987 with the objective to protect the workers and other professionals against exposure to occupational hazards. The Director of Factories at the Federal Ministry of Employment, Labour and Productivity is responsible for the administration of the provisions or requirements of this Act. Section 13 allows an inspector to take emergency measures or request that emergency measures be taken by a person qualified to do so, in cases of pollution or nuisances.

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

1.6.2.9 Labour Act CAP L1 LFN, 2004

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

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

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

- **Section 7** provides authority to ensure compliance with environmental laws, local and international, on environmental sanitation and pollution prevention and control through monitory and regulatory measures.
- **Section 8 (1)(K)** empowers the Agency to make and review regulations on air and water quality, effluent limitations, control of harmful substances and other forms of environmental pollution and sanitation.
- **Section 27** prohibits, without lawful authority, the discharge of hazardous substances into the environment. This offence is punishable under this section, with a fine not exceeding, ₦1,000,000 (One Million Naira) and an imprisonment term of 5 years. In the case of a company, there is an additional fine of ₦50,000, for every day the offence persists.

1.6.2.11 Employee Compensation Act 2010

The Employees' Compensation Act 2010 establishes the framework for compensation in respect of occupational injury, disease or death arising in the course of employment and is administered through the Nigeria Social Insurance Trust Fund. The EPC Contractor and other employers shall maintain the registrations, contributions, insurance and records required by law for all eligible Project workers.

1.6.2.12 Violence Against Persons (Prohibition) Act 2015

The Violence Against Persons (Prohibition) Act 2015 prohibits all forms of violence against persons in private and public life and provides for the protection of victims and punishment of offenders in Nigeria. The Act criminalises physical, sexual, psychological, and socio-economic violence including sexual harassment, exploitation, and abuse. Its provisions are relevant to this project in the context of labour influx during construction, which carries an inherent risk of gender-based violence and sexual exploitation and abuse affecting the host community, and imposes obligations on the project to implement preventive measures and reporting mechanisms.

1.6.2.13 Child Rights Act 2003

The Child Rights Act 2003 domesticates the provisions of the United Nations Convention on the Rights of the Child in Nigeria and establishes a comprehensive legal framework for the protection of children from all forms of exploitation, abuse, and hazardous labour. The Act prohibits the engagement of children in any form of work that is harmful to their health, education, or development. This legislation is directly applicable to the project given the risk of child labour associated with labour influx during

project implementation. Compliance with the Act requires that the EPC Contractor implement a robust labour screening mechanism to verify the age of all workers prior to engagement and maintain records confirming that no person under the age of 18 is employed on the project site.

National Environmental Regulations:

Section 34 of the NESREA Act, 2007 empowers the Minister of Environment to make regulations for safe and sustainable environment. In exercise of this power, the minster issued the national environmental regulations covering various environmental components and sectors of development. The regulations relevant to the programme are as follows:

- National Environmental (Energy Sector) Regulations, 2014. S.I. 63.
- National Environmental (Battery Control) Regulations, 2024.
- National Environmental (Permitting and Licensing System) Regulations, S. I. No. 29, 2009.
- National Environmental (Control of Vehicular Emissions from Petrol and Diesel Engines) Regulations, S. I. No. 20, 2011.
- National Environmental (Plastic Waste Control) Regulations, 2026
- National Environmental (Electrical/Electronic Sector) Regulations, 2011, S.I. No. 23
- National Environmental (Wetlands, River Banks and Lake Shores) Regulations, 2009. S. I. No. 26.
- National Environmental (Sanitation and Wastes Control) Regulations, 2009. S. I. No. 28.
- National Environmental (Watershed, Mountainous, Hilly and Catchments Areas) Regulations, 2009. S. I. No. 27.
- National Environmental (Sanitation and Wastes Control) Regulations, 2009. S. I. No. 28.
- National Environmental (Noise Standards and Control) Regulations, 2009. S. I. No. 35.
- National Environmental (Air Quality Control) Regulations, 2013, S. I. No. 64,
- National Environmental (Soil Erosion and Flood Control) Regulations, 2010. S. I. No. 12.
- National Environmental (Surface and Groundwater Quality Control) Regulations, 2010. S. I. No. 22.
- National Environmental (Control of Vehicular Emissions from Petrol and Diesel Engines) Regulations, 2010. S. I. No. 20.

1.6.3 EIA Procedural Guidelines:

This procedure prescribes the steps to be followed in the EIA process from project conception to commissioning and post commissioning impact mitigation, in order to ensure that the programme is implemented with maximum consideration of environmental factors. This ESIA study will be conducted in compliance with this guideline.

FMEnv ESMP Guidelines for Solar Mini-Grid Projects in Nigeria

The ESMP Guidelines for Solar Mini-Grid Projects in Nigeria was developed as an abridged form of the EIA Procedures Guidelines with the aim of simplifying the method of preparing ESMPs for proposed solar mini-grid projects. The simplified method is to also optimise the mini-grid projects EIA timeline and the cost of development.

1.6.4 Other Relevant Guidelines, Regulations and Policies

- Nigerian Electricity Supply and Installation Standards Regulations, 2015.
- The Renewable Energy Master Plan (REMP) - Policy
- National Renewable Energy and Energy Efficiency Policy, 2015
- National Renewable Energy Action Plans(NREAP), (2015-2030)
- Sustainable Energy for All Action Agenda (SE4ALL-AA)

- Nigerian Nationally Determined Contributions (Revised), 2021
- The Penal Code
- Public Health Law Cap 103 LFN 1990
- Fire and Rescue Service Act 2004;
- Employees' Compensation Act, 2010;
- Abandonment Guidelines 1995;
- National Guidelines on Environmental Management System 1999
- REA's HSE Policy.

1.6.5 International Legislations

The International Conventions, to which Nigeria is a signatory, relevant to this programme are as follows:

- **African Convention on the Conservation of Nature and Natural Resources (Revised Convention, 2003)**: relevant to the avoidance and management of biodiversity and land-disturbance impacts within modified institutional land.
- **Convention on Biological Diversity (1992):** This Convention is relevant given that project activities, including site clearing and soil disturbance, have the potential to affect local flora and fauna within the project footprint, necessitating measures to avoid biodiversity loss and protect ecosystem integrity.
- **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973**: relevant to preventing unauthorized collection, trade or procurement involving listed species.
- **Convention on the Conservation of Migratory Species of Wild Animals, 1979**: relevant as a precautionary biodiversity instrument. No ecological-zone or migratory-corridor conclusion is made without a current, documented spatial screen and species evidence.
- **UN Framework Convention on Climate Change 1992**: This Convention is directly relevant as the project involves the deployment of solar photovoltaic technology as a clean energy alternative to fossil fuel-based generation, contributing to Nigeria's nationally determined contributions and global greenhouse gas reduction commitments.
- **United Nations Convention to Combat Desertification, 1994:** relevant at national policy level to sustainable land management and erosion prevention. The Project site is not described as being within the Sahel.
- **Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) (1979):** This Convention is relevant as the project involves labour engagement and community interactions, requiring that gender equality principles are upheld throughout recruitment, occupational health and safety, and stakeholder engagement processes.
- **Human and Peoples' Rights on the Rights of Women in Africa 2005**: This instrument is applicable as it reinforces CEDAW obligations within an African context, requiring that the project avoids and mitigates risks of gender-based violence, sexual exploitation and abuse, and unequal access to project benefits by women in the host community.
- **Civil and Political Rights Covenant (1966):** This Covenant is relevant as it underpins the right of affected communities and workers to information, participation, and redress, which are operationalized through the project's stakeholder engagement and grievance redress mechanisms.
- **Economic, Social and Cultural Rights Covenant (1966):** This Covenant is applicable as the project has implications for the right to safe working conditions, adequate living standards, and access to energy as a socioeconomic enabler for the university community and surrounding population.
- **Convention on the Rights of the Child (1989):** This Convention is relevant as the project involves labour influx into a community that includes children, requiring that child labour is strictly

prohibited and that construction activities do not expose children within or near the university campus to safety risks.

1.6.6 Institutional Framework

This section highlights the relevant institutions through which the planning and implementation of the programme will be effected. A number of institutions have been identified and will be involved in the overall implementation of this programme. These include:

1.6.6.1 Federal Ministry of Environment

The Federal Ministry of Environment is responsible for the overall environmental policy of the country. It has the responsibility for EIA implementation, approval and issuance of certificates. It has developed certain guidelines and regulations to protect the environment and promote sustainable development. It will monitor the implementation of mitigation measures when the project commences. They can also issue directives to the project on specific actions related to the environment in the project area. The Ministry normally involves the states and sometimes local governments in this responsibility depending on the specific activity.

1.6.6.2 National Environment Standards and Regulations Enforcement Agency (NESREA)

ensures the embodiment of laws and regulations focused on the protection and sustainable development of the environment and its natural resources are monitored and complied with. NESREA ensures that the operational phase of the solar power system mini-grid project complies with national environmental standards and regulations.

1.6.6.3 The National Universities Commission

The National Universities Commission (the Commission) was established in 1974 by the National Universities Commission Act CAP N81 to advise the Federal and state governments of all aspects of university education and the general development of universities in Nigeria. It is the dynamic regulatory agency acting as a catalyst for positive change and innovation for the delivery of quality university education in Nigeria. It is also the agency for channeling all external aid to the universities in Nigeria; To receive block grants from the Federal Government and allocate them as appropriate

1.6.6.4 The Federal Ministry of Power

The Federal Ministry of Power provides federal policy leadership for the electricity sector under the Electricity Act 2023. Electricity-sector approvals, inspection and safety responsibilities shall be obtained from the institution holding the relevant statutory mandate at the time of design, construction and commissioning.

The Project shall maintain an approvals register covering, as applicable, NERC authorization, NEMSA inspection and certification, electricity-sector safety requirements, construction approvals and the University's internal authorizations.

- The final design and procurement documents shall demonstrate compliance with applicable electricity-sector legislation, codes, licence or permit conditions and manufacturer requirements.
- Electrical materials and installations shall be inspected, tested and certified by the competent authorities before energisation.
- The EPC Contractor shall retain material certificates, test records, protection studies, commissioning results and statutory inspection evidence in the Project file.
- Renewable-energy implementation shall be coordinated with REA/NEP and other authorities whose mandates apply to the approved design.
- Accidents and dangerous occurrences shall be reported and investigated in accordance with applicable law and the serious-incident procedure in the ESMP.

- Only qualified and authorized persons may design, install, test, operate or maintain electrical systems.
- The approvals register shall be reviewed at each design gate and before mobilisation, commissioning and energisation.

1.6.6.5 Nigerian Electricity Regulatory Commission (NERC)

The Nigerian Electricity Regulatory Commission regulates electricity activities within its statutory jurisdiction. The Project shall apply the current NERC mini-grid regulations and other applicable codes in force when authorization is sought.

The Project shall confirm its final installed and export capacity, operating configuration and interconnection status, and obtain the applicable NERC permit, registration, exemption or other authorization before construction or operation. The approved authorization and conditions shall be included in the compliance register.

i. Monitor and regulate the activities of the electricity industry in Nigeria;
ii. Issue licenses to market participants; and
iii. Ensure compliance with market rules and operating guidelines.

The current NERC Mini-Grid Regulations shall be used for permitting and operational compliance. Regulatory thresholds and procedures shall be verified at the time of application rather than relying on superseded regulations.

1.6.6.6 Transmission Company of Nigeria (TCN)

TCN emerged from the defunct National Electric Power Authority (NEPA) as a product of the merger of the Transmission and Operations sectors on April 1, 2004. TCN was incorporated in November 2005. Being one of the 18 unbundled Business Units under the Power Holding Company of Nigeria (PHCN), TCN was issued a transmission License on 1st July 2006. It was subsequently issued two licenses on June 10, 2013, for electricity transmission and system operations.

1.6.6.7 Rural Electrification Agency

The Rural Electrification Agency is the implementing agency for the Project. REA/NEP is responsible for ensuring that the Project is designed, procured, implemented and supervised in accordance with the financing agreement, applicable law, the AfDB ISS and the commitments in this ESIA and ESMP.

1.6.6.8 Federal Ministry of Women Affairs and Social Development

Promote actions to achieve the National Gender Policies, and a gender budget among policymakers. The goals of the gender policy among others include among others:

- Eliminate cultural/ religions gender-based biases and harmful cultural and religious practices which rise to inequalities in gender-role relations in the Nigerian society. A culture which is amendable to development must be dynamic.
- Tap the potential of women for development;
- Eliminate all forms of gender-based violence.
- Ensure equal access to women, boys and girls to both formal and informal education.

Women education is a priority because it is the key to gender equity, justice and poverty reduction, improved skills and technological knowledge, as well as the general socioeconomic development of the nation.

1.6.6.9 Nigerian Electricity Management Services Authority

The Nigerian Electricity Management Services Authority (NEMSA), established by the NEMSA Act 2015, is the technical regulatory agency responsible for the enforcement of technical standards, metering regulations, and safety requirements for electrical installations and equipment in Nigeria. NEMSA is mandated to inspect, test, and certify all categories of electrical equipment and installations, including renewable energy systems, prior to commissioning and operation. The Authority's technical oversight is directly applicable to this project, as all electrical components of the solar hybrid mini-grid including the PV array, inverters, battery energy storage system, transformers, switchgear, and the 11 kV campus distribution network will be subject to NEMSA inspection and certification before energization.

1.6.7 State Institutions

1.6.7.1 Delta State Ministry of Environment

The Ministry of Environment is currently responsible for environmental service matter and resources in the state. Other objectives include initiating formulation, execution and monitoring of all issues relating to all environmental matters, solid waste management, and mineral resources. A recent law passed established the Delta State Environmental Law 2006.

1.6.7.2 Delta State Ministry of Women Affairs and Social Development

The ministry seeks to empower women and youth, promote the participation of women in governance, pay attention to women in rural areas, enhance economic self-reliance of women, create awareness and campaign against gender-based violence etc.

1.6.7.3 Delta State Lands, Housing and Urban Development

This Ministry was created for the purpose of overseeing the Lands resources in the state. They are also charged with the responsibility to plan, devise and implement the state policies on lands and its resources.

1.6.8 Funding Agency Requirements

This programme is funded by the African Development Bank (AfDB). Therefore, the AfDB safeguard systems will be integrated in the project cycle as well as other national and international environmental and social protection requirements, in order to comply with international best practices. Both main environmental and social requirements that the project needs to comply with are described in the following sections.

1.6.8.1 The African Development Bank's Operational Safeguard

The proposed project has been classified as a Category 2 project under the African Development Bank's Integrated Safeguards System (ISS, effective May 2024). Category 2 projects are those with site-specific environmental and social risks and impacts that are generally reversible and can be effectively mitigated through appropriate management measures.

Under the ISS framework, the Operational Safeguards (OS1–OS10) have been considered during preliminary screening of the project. Given the nature of the proposed solar-hybrid mini-grid development, including civil works, electrical installations, labour engagement, community interface, climate considerations, and stakeholder interactions, all Operational Safeguards are considered applicable at this stage, with the exception of OS9 (Financial Institutions).

Applicability of the AfDB Operational Safeguards is determined by the Project's activities, risks and area of influence. OS1, OS2, OS3, OS4 and OS10 apply. OS5 is managed through a mandatory land-status verification and change trigger; OS6 applies to biodiversity screening and vegetation management; OS7 applies if the defined vulnerable-group circumstances are identified; OS8 applies through chance-finds

and cultural-heritage controls; and OS9 applies to assessment and management of financial-intermediary involvement, if any.

OS	Applicability	Project relevance	Required response
OS1	Applicable	Construction and operation of a ground-mounted PV array, BESS, transformers, 11 kV internal distribution and ancillary facilities create multi-phase E&S risks.	ESIA, ESMP, C-ESMP, design verification, supervision, monitoring and six pre-construction hold-points.
OS2	Applicable	Direct, contracted and primary-supply workers face OHS, labour-influx, discrimination, child/forced-labour and supply-chain risks.	Labour Management Plan, lawful terms, age verification, OHS systems, worker GRM, Code of Conduct, SEA/SH controls and risk-based supplier due diligence.
OS3	Applicable	Water use, dust, noise, fuels, oils, sewage, damaged PV modules, batteries and e-waste require resource-efficiency and pollution controls.	Water balance, spill prevention, licensed waste routes, NESREA-compliant EPR/take-back, hazardous storage, monitoring and lifecycle inventories.
OS4	Applicable	Active campus/community interfaces, traffic, open trenches, electrocution, arc flash, fire, BESS thermal runaway and security interactions create community risks.	Fencing, traffic and trench controls, electrical protection, BESS fire/life-safety design, emergency response, responder coordination and proportionate security controls.
OS5	Not triggered only if avoidance conditions are met	The source reports the site as fallow, unoccupied and under university control.	Complete land-status due diligence and a registered survey before site possession. Exclude any occupied, cultivated, livelihood-used or contested area. Changed conditions trigger avoidance/redesign or an appropriate OS5 instrument before works.
OS6	Applicable	Clearance of secondary/fallow vegetation may affect modified habitat, nesting fauna and ecosystem services; critical-habitat screening in the draft is not documented.	Current database screening, pre-clearance ecologist walkover, footprint minimization, seasonal/nest controls, native restoration and invasive-species management.
OS7	Applicable	Women, persons with disabilities, low-literacy persons, poorer households, youth and other groups may experience differentiated access, safety and engagement barriers.	Accessible and differentiated consultation, communications, grievance access, universal design and disaggregated monitoring without assuming homogeneous effects.
OS8	Applicable on a precautionary basis	No known heritage resource is documented within the planning envelope, but earthworks create a chance-find risk.	Implement the binding Chance Finds Procedure: stop, secure, notify, assess, authorize and resume.
OS9	Not applicable	No financial intermediary or FI-managed subproject structure is	No OS9 instrument is required unless financing arrangements

		identified for this site-specific investment.	change; REA/PMU must re-screen any such change.
OS10	Applicable	University, students, workers, host communities, authorities and vulnerable groups require continuing engagement and disclosure.	Implement the SEP, public and worker GRMs, accessible channels, documented response, privacy protection and survivor-centred SEA/SH referral.

In addition to the Operational Safeguards, the African Development Bank has published Borrowers' Guidance Notes corresponding to each Operational Safeguard. These Guidance Notes provide detailed technical and procedural guidance to borrowers on the practical implementation of the safeguard requirements and have been consulted in the preparation of this ESIA alongside the Operational Safeguards themselves. The Guidance Notes are publicly available on the AfDB website and constitute an integral reference within the AfDB Integrated Safeguards System[1].

The Borrower Guidance Notes are used to support implementation of the ISS but do not replace the requirements of the ISS, applicable Nigerian law or project-specific Bank conditions.

In addition to these, the ESIA also considers other good international Industry Practices as follows:

Topic	Reference	Application
General EHS	World Bank Group/IFC General EHS Guidelines	Air emissions, noise, wastewater, waste, OHS, traffic, community safety and emergency response.
PV design and commissioning	IEC 62548-1; IEC 62446-1; IEC 61215 series; IEC 61730 series; IEC 62109 series	Array design, documentation, testing, commissioning, module qualification/safety and inverter safety; apply current editions accepted by the Engineer/NEMSA.
BESS	IEC 62933 series, including lifecycle and electrochemical ESS safety; NFPA 855 and UL 9540A, or demonstrably equivalent accepted standards	System hazard analysis, test evidence, separation, ventilation, gas/heat/smoke detection, propagation/explosion control, suppression, emergency isolation and responder access.
Aviation	ICAO/NCAA/NAMA/airport-operator requirements and recognized solar glint-and-glare methodology	Model final panel geometry against runway, approach/departure paths and tower receptors; obtain design acceptance where required.
Biodiversity	Current IUCN Red List, Protected Planet/WDPA and Key Biodiversity Areas data	Desktop screening must be date-stamped and supported by a pre-clearance walkover.

1.7 Report Structure

In line with the FMEnv guidelines and requirements of the Terms of Reference, this report is structured as follows:

- Preliminary Sections
- Chapter One: Introduction containing an overview of the proposed Project, the ESIA objectives and study approach and applicable legal and administrative framework.
- Chapter Two: Project Justification containing a rationale for the proposed Project as well as the Technical, Environmental, Social and Economical sustainability of the project

[1] African Development Bank Group (AfDB), Borrowers' Guidance Notes for the Integrated Safeguards System (ISS), available at:*https://www.afdb.org/en/documents/borrower-guidance-note*

- Chapter Three: Project Description containing the technical elements of the Project. It concisely describes the proposed Project and its geographic and temporal context, including the Project's associated infrastructure. Chapter three also discusses Project Alternatives.
- Chapter Four: Description of the Environment. It details the baseline data that is relevant to decisions about the Project location, design, development and operation.
- Chapter Five: Potential and Associated Impacts. This considers all relevant environmental and social risks and impacts of the proposed Project, including cumulative impacts.
- Chapter Six: Mitigation measures for the identified negative environmental and social impacts, as well as the enhancement measures for the identified positive impacts.
- Chapter Seven: is the ESMP. It summarizes the key environmental and social measures and actions and the timeframe including responsibility for the implementation of the recommended measures.
- Chapter Eight: describes the stakeholder engagement activities carried out during the ESIA and an overview of the grievance redress mechanism for the Project.
- Chapter Nine: Presents an overview of remediation / decommissioning plan after Project closure.
- Chapter Ten: Conclusion and Recommendations

The report also includes references and Annexes.

CHAPTER TWO: PROJECT JUSTIFICATION

2.1 Need for the Project

Public tertiary institutions in Nigeria continue to experience inadequate and unreliable electricity supply from the national grid, which constrains effective teaching, research activities, and institutional operations. Federal universities, in particular, depend largely on diesel powered generators to supplement electricity needs, resulting in high operational costs, frequent power interruptions, and associated environmental impacts.

In response to these challenges, the Federal Government of Nigeria initiated the Nigeria Electrification Project (NEP) to improve electricity access through deployment of sustainable and renewable energy solutions. Building on lessons from NEP, the Desert to Power (DtP) initiative is being implemented by the Rural Electrification Agency with support from the African Development Bank to expand reliable electricity supply to public institutions and underserved areas using solar based hybrid systems.

The proposed intervention at the Admiralty University of Nigeria (ADUN), Oshimili forms part of the Energizing Education Programme under the DtP initiative, aimed at providing dedicated, clean, and reliable electricity to federal universities. The project is intended to address existing power supply limitations at the University, support academic and research activities, reduce dependence on fossil fuel-based generation, and enhance overall institutional efficiency. ADUN's need arises from the institutional consequences of unreliable and/or costly electricity supply for teaching, research, ICT, administration, security, welfare and campus development. The no-project option would retain those reliability constraints and dependence on existing supply arrangements; it is not an entirely off-grid scenario.

The intervention also contributes to Nigeria's commitment to climate change mitigation and sustainable energy transition in line with national development objectives and international obligations. Renewable energy generation is expected to reduce fossil-fuel use and emissions, but annual benefits shall be quantified only after a verified pre-operation baseline establishes grid imports, generator fuel use and operating hours, delivered solar energy, losses and an approved emission factor.

2.2 Project Benefits

The proposed solar hybrid mini grid project at the Admiralty University of Nigeria, Oshimili is expected to deliver significant environmental, institutional, and socioeconomic benefits. Key anticipated benefits include:

- Provision of reliable and sustainable electricity supply to support academic, research, administrative, and residential activities within the University.
- Enhancement of teaching, laboratory operations, ICT services, and research productivity through improved power reliability.
- Reduction in dependence on diesel powered generators, resulting in lower operational costs, decreased fuel consumption, and reduced greenhouse gas emissions.
- Improvement in campus safety and security through enhanced outdoor lighting and increased nighttime visibility.
- Promotion of renewable energy knowledge and technical capacity development through exposure to solar power technology and associated training opportunities.
- Creation of direct and indirect employment opportunities during construction and operational phases, with associated skills transfer and local economic stimulation.
- Support for institutional expansion and improved living and learning conditions for students and staff within the permanent campus.

- ❖ Contribution to national renewable energy deployment and climate change mitigation objectives consistent with Nigeria's Nationally Determined Contributions under the Paris Agreement.

Overall, the project is expected to strengthen energy reliability, improve institutional efficiency, and promote environmentally sustainable development within the University and its surrounding community.

2.3 Envisaged Sustainability

2.3.1 Technical Sustainability

Technical sustainability of the proposed solar hybrid mini grid project will be ensured through implementation by qualified Engineering, Procurement and Construction contractors selected by the Rural Electrification Agency through a competitive process in accordance with established technical standards and procedures. Project design, installation, and commissioning activities will be supervised by competent technical personnel from the Rural Electrification Agency in collaboration with the Admiralty University of Nigeria, Oshimili.

Standard operating procedures and operation and maintenance manuals will be developed to guide system management throughout the project lifecycle. Prior to commissioning, relevant University personnel will receive technical training to support effective system operation and routine maintenance.

Following completion of construction, an Operations and Maintenance contractor will be engaged to manage system performance and ensure continued functionality of the installation. Capacity building and knowledge transfer programmes will be implemented to enable designated University staff to progressively support day-to-day system operations. In addition, practical training opportunities will be provided for selected students in relevant science and engineering disciplines to enhance technical skills in renewable energy systems.

2.3.2 Environmental Sustainability

Environmental sustainability of the proposed project is supported by the adoption of solar energy as a renewable power source, thereby reducing reliance on fossil fuel-based electricity generation and associated greenhouse gas emissions. The project is designed to promote clean energy utilization while minimizing adverse environmental impacts throughout its lifecycle.

Oversight of environmental and social performance will be undertaken by the Rural Electrification Agency through its Project Management Unit, which includes qualified Environmental and Social Safeguards Specialists responsible for monitoring compliance with applicable standards and safeguards requirements. Furthermore, the conduct of this Environmental and Social Impact Assessment at the early stage of project development enables identification of potential impacts and incorporation of appropriate mitigation measures through the Environmental and Social Management Plan to ensure environmentally responsible project implementation.

2.4.3 Economic Sustainability

Economic sustainability of the proposed solar hybrid mini grid project will be achieved through reduced dependence on diesel-powered generation and conventional grid electricity, thereby lowering recurring expenditure on fuel procurement, generator operation and maintenance, and grid electricity supply. The provision of dedicated renewable energy is expected to improve the University's energy reliability while reducing long-term operating costs and enhancing institutional financial efficiency.

The project will be implemented under Engineering, Procurement and Construction and Operations and Maintenance arrangements to ensure reliable system performance and cost-effective operation over time. Savings realized from reduced expenditure on fuel and electricity supply are expected to support routine maintenance and long-term upkeep of project facilities. To ensure continued financial sustainability, appropriate energy service arrangements may be adopted within the University, including metered electricity supply to campus facilities and commercial establishments. Revenue generated through such mechanisms will contribute to operational costs, system maintenance, and periodic replacement of major components such as batteries and electrical equipment. The project is therefore expected to strengthen the University's internally generated revenue while reducing dependence on conventional energy sources and recurrent government funding for electricity supply. Detailed quantification of these savings will be undertaken during project implementation using actual operational and financial records.

2.3.4 Social Sustainability

Social sustainability of the proposed project is supported through inclusive stakeholder engagement conducted as part of the ESIA process, ensuring that relevant stakeholders are informed and provided opportunities to contribute to project planning at an early stage. This process has facilitated transparency and strengthened relationships between the project implementing agency, the University, and surrounding communities.

A Stakeholder Engagement Plan has been developed to guide continuous consultation and information disclosure throughout the project lifecycle. In addition, a Grievance Redress Mechanism established by the Rural Electrification Agency will provide accessible channels for stakeholders, affected persons, and community members to submit concerns or complaints related to project activities. The mechanism ensures timely review, documentation, and resolution of grievances, thereby promoting accountability and minimizing potential social conflicts during project implementation and operation.

CHAPTER THREE: PROJECT DESCRIPTION

3.1 Project Overview

The Desert-to-Power (DtP) intervention at the Admiralty University of Nigeria, Oshimili in Delta State forms part of the Energizing Education Programme component, which aims to provide reliable and sustainable electricity supply to federal universities through the deployment of solar-hybrid mini-grid systems with generation capacities exceeding 1 MW per site.

The assessed Project is a ground-mounted solar PV and battery energy storage system serving the University's internal distribution network. The final design shall remain within the controlled design envelope and hold points established in this ESIA.

The key project components will include:

- Ground-mounted solar PV modules installed within the verified Project footprint;
- Battery energy storage sized through the approved load and autonomy study, with chemistry, capacity and fire-safety basis documented;
- Inverters, transformers, switchgear, protection, metering, earthing, lightning protection and associated balance-of-system equipment;
- Underground internal cabling and approved campus distribution works;
- Interconnection to the University's internal distribution network only, unless a future external-grid connection undergoes separate regulatory and E&S change review;
- Supervisory control, monitoring, communications and security systems;
- Only the control and operations/maintenance facilities confirmed by final design; and
- Standby generation only if it remains in the final design and its fuel, emissions, noise and spill risks are specifically assessed.

Power will be converted, transformed and distributed at the voltages established by the approved campus electrical studies. Protection coordination, earthing, arc-flash, lightning, power-quality and commissioning studies shall be completed before energisation.

3.2 Proposed Project Site and Location

3.2.1 Overview of the Admiralty University of Nigeria, Oshimili

The Admiralty University of Nigeria (ADUN) is a federal tertiary institution located in Ibusa, Oshimili North Local Government Area of Delta State, within the South-South geopolitical zone of Nigeria. The University was established by the Federal Government of Nigeria as a specialized institution to provide quality education, research, innovation, and human capacity development in science, technology, management, social sciences, and related disciplines. ADUN operates from its permanent campus situated in Ibusa, approximately 15 km from Asaba, the Delta State capital, and is strategically positioned to serve students from across Nigeria and beyond.

The University is located within a rural to peri-urban setting containing residential settlements, community agricultural land and educational infrastructure. The Project footprint is within the permanent campus. Its final geographic position, area, access and cable corridor shall be established by the licensed survey required under the land hold point.

ADUN's permanent campus contains developing academic, administrative and welfare facilities. The final site plan shall identify every occupied, planned and under-construction receptor relevant to construction and operational safety; no receptor distance in this ESIA shall be treated as survey-certified until the licensed survey is accepted.

Electricity supply to the University is currently obtained primarily from the national grid through the public electricity distribution network. However, like many institutions in Nigeria, the University experiences frequent power outages, voltage fluctuations, and prolonged interruptions in electricity supply, which adversely affect academic activities, laboratory operations, information and communication technology (ICT) services, administrative functions, and overall campus productivity. To mitigate these challenges, the University relies on diesel-powered generators to supplement grid electricity, resulting in high operating costs, greenhouse gas emissions, noise pollution, and increased maintenance requirements.

To address these energy challenges and improve the reliability, affordability, and sustainability of electricity supply, the University has proposed the installation of a solar photovoltaic (PV) hybrid mini-grid system under the Desert-to-Power Initiative. The proposed renewable energy system will provide a clean and dependable source of electricity to support academic and administrative operations while reducing dependence on fossil fuels and enhancing the University's environmental sustainability objectives. The project is expected to improve energy security, lower operational costs, reduce greenhouse gas emissions, and contribute to the Federal Government of Nigeria's renewable energy and climate change mitigation goals.

The proposed solar hybrid mini-grid will therefore serve as a strategic investment in strengthening the University's infrastructure, promoting sustainable campus development, improving the quality of teaching and research, and ensuring uninterrupted electricity supply to critical facilities necessary for the University's long-term growth and development.

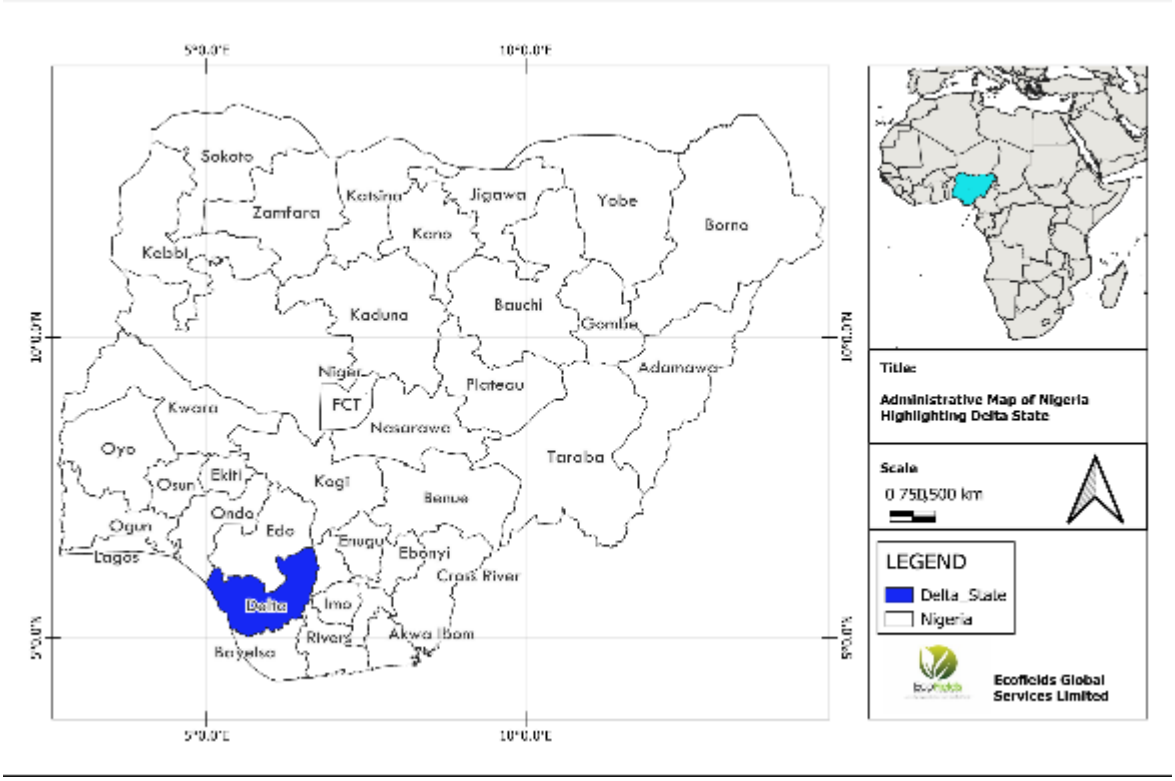


Figure 2: Map of Nigeria showing the project State, Delta State.

The proposed approximately 1 MW solar hybrid mini-grid is planned within an allocation of up to approximately 10 ha inside the permanent campus of Admiralty University of Nigeria at Ibusa, Oshimili North LGA, Delta State. The final footprint, access and cable corridor shall be defined by a licensed, signed cadastral survey before possession and reflected consistently in the approved layout and maps.

Boundary Point	Latitude	Longitude
Point 1	N6.166610	E6.579320
Point 2	N6.166196	E6.579158
Point 3	N6.166758	E6.586268
Point 4	N6.169208	E6.582321

The university is strategically located along the Asaba–Benin Expressway (Benin–Asaba Road) at Ibusa, providing easy access to Asaba, the Delta State capital, and neighbouring communities. Admiralty University of Nigeria was originally established in 2017 as a private university by the Nigerian Navy through Nigerian Navy Holdings Limited in collaboration with Hellenic Education Nigeria Limited. Subsequently, following the assent to the Admiralty University of Nigeria Act by the Federal Government on 8 February 2023, the institution was converted into a Federal University.

The proposed footprint was observed as unused, undeveloped fallow land with low-growing shrubs, grasses and scattered secondary vegetation. No structure, crop, occupation or livelihood activity was observed within the footprint at the time of assessment. This status shall be reverified immediately before site possession in accordance with the land protocol.

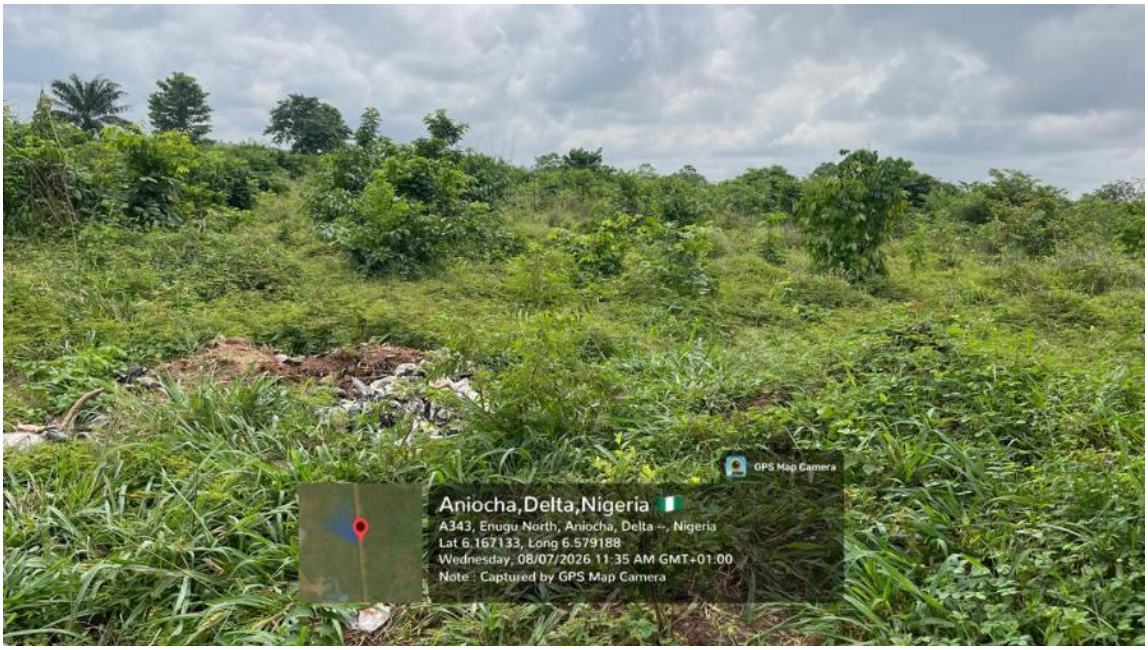
The closest reported university receptors include the cafeteria and an under-construction Career Centre. The reported distances are indicative and shall be remeasured from the verified Project boundary and equipment locations. The final layout, hazard assessment, noise study, fire strategy, emergency access and manufacturer requirements shall determine safe separation distances; a generic minimum setback does not replace this assessment.

The allocated university land was observed to be unused, unoccupied and free of buildings, crops and livelihood activity within the proposed footprint. Its suitability remains conditional on licensed boundary verification, confirmation of title and institutional authority, the pre-possession land-status inspection, receptor and access controls, geotechnical and drainage studies, and compliance with the hold points in this ESIA.

Land Status and Pre-possession Control

The land-status finding is time-bound. REA/NEP and ADUN shall complete and sign the following verification immediately before the Contractor is given access. Records shall be retained in the controlled Project file.

Step	Minimum evidence	Release authority
Boundary and title	Licensed survey; title/authority record; area and coordinate reconciliation	REA/NEP Project Manager and ADUN authorized representative
Current land status	Joint dated inspection; geotagged photographs; consultation; no occupation, crops, structures, claims or livelihood use	REA/NEP PMU
Access and receptors	Verified road/cable access and surveyed receptor distances	Engineering Specialist and PMU E&S Unit
Change trigger	Any contrary finding or delayed mobilisation	Stop; avoid the affected area; assess OS5; approve and implement required instrument before entry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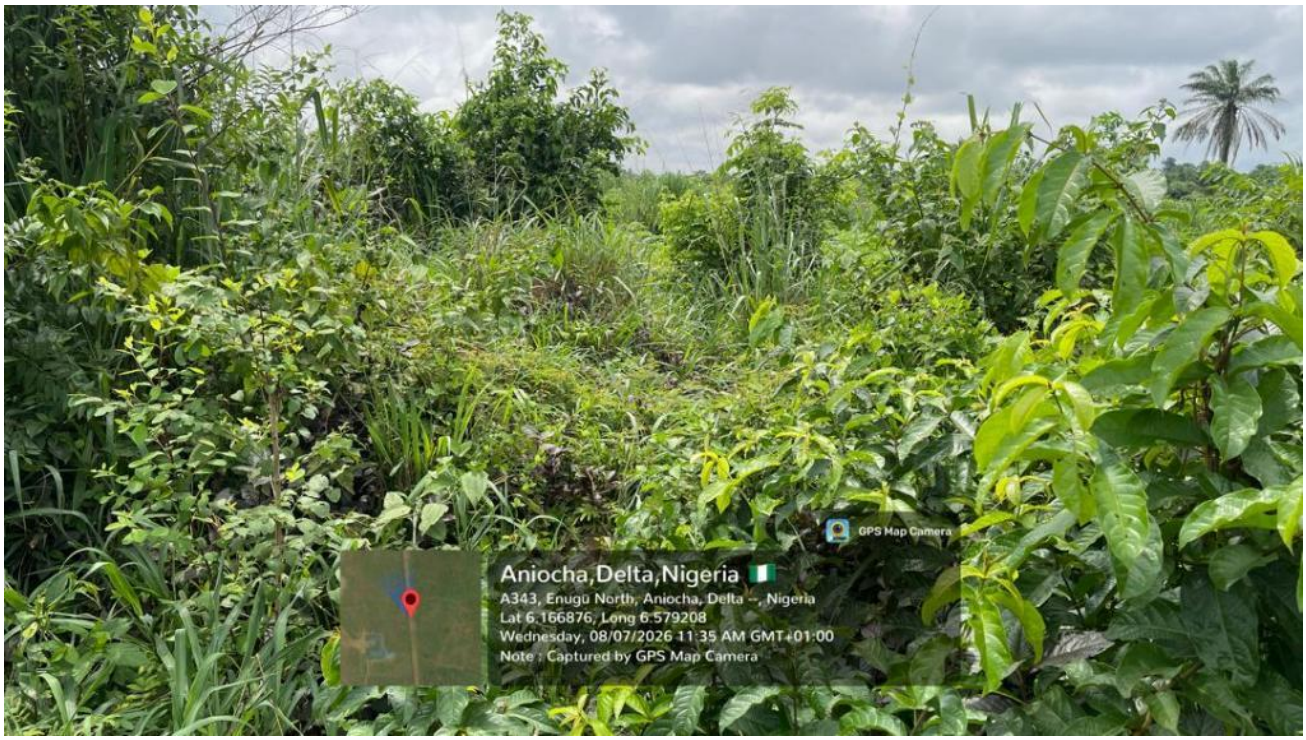
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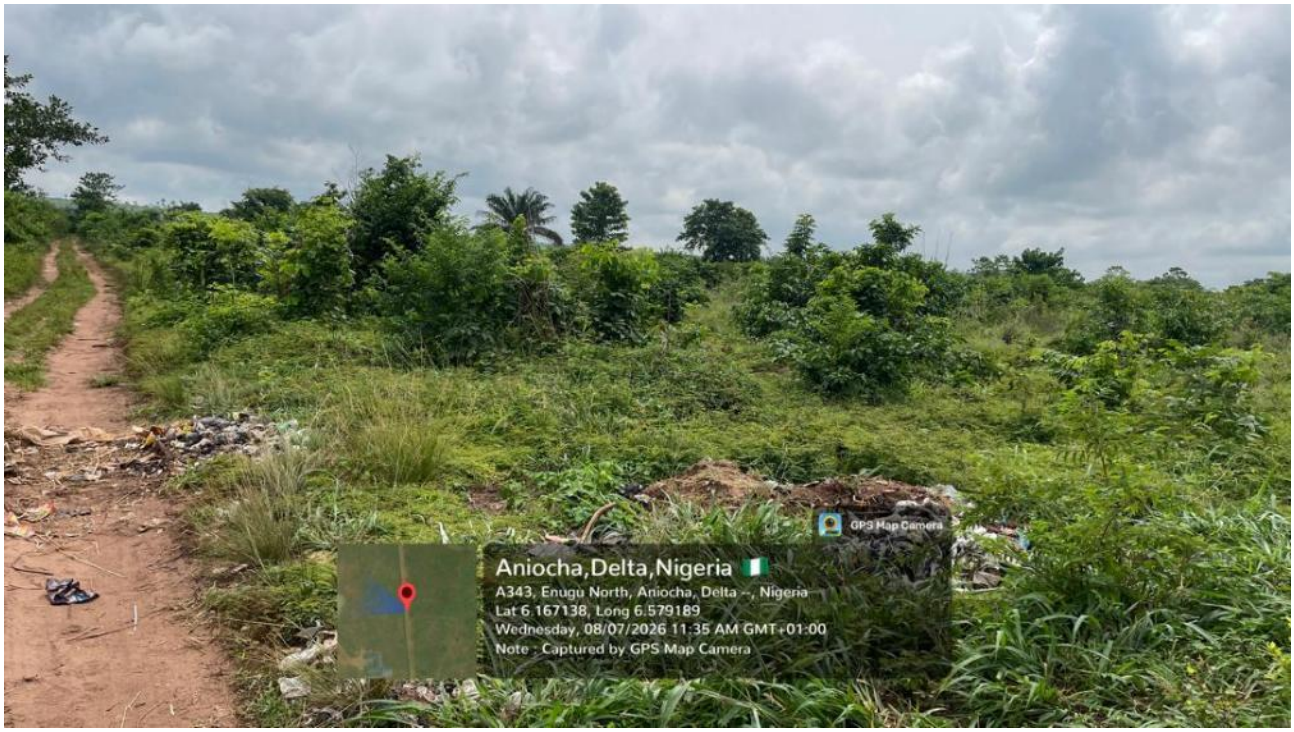


3.2.2 Survey Assessment of the Proposed Site

The proposed project is to be located within the permanent campus of the University in Ibusa community, Oshimili North LGA of Delta State, South-south Nigeria. The specific project footprint falls within the coordinate range of at approximately Lat. 6.164739 to 6.16132 and Long. 6.576139 to 6.576049

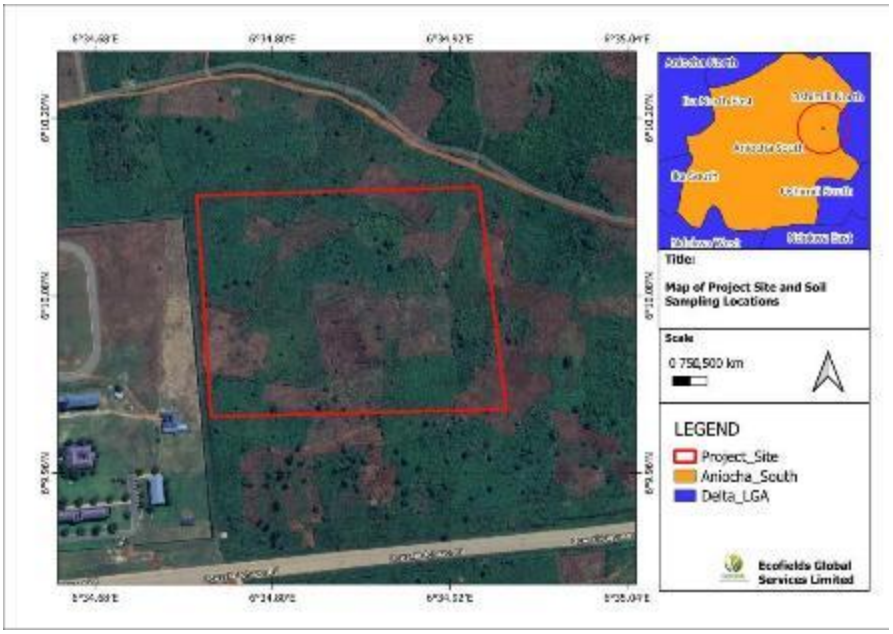


Figure 3: Location Map Showing the Proposed Site at the University

3.2.3 Site Suitability for the Proposed Project

The proposed site within the permanent campus of the Admiralty University of Nigeria, Oshimili is technically suitable for the development of the planned solar hybrid mini-grid system. The allocated land is sufficient to accommodate the photovoltaic arrays, battery storage, and associated infrastructure

without affecting existing buildings or institutional activities. The generally flat terrain with gentle undulations minimizes the need for major earthworks and supports efficient installation.

The site lies entirely within university-designated land, eliminating risks of land acquisition, displacement, or land use conflict. No farming, grazing, residential occupation, or economic activities were observed within the footprint. Environmental conditions indicate low sensitivity, as the area is sparsely vegetated and does not contain protected habitats, surface water bodies, or flood-prone zones. Potential impacts are therefore expected to be localized and manageable through standard mitigation measures.

The site is accessible through the existing road network connecting Oshimili town to Ibusa and the University. Although portions of the access road are untarred, the route remains motorable and suitable for construction logistics with proper planning. While electricity distribution infrastructure exists within the wider Oshimili area, the proposed solar hybrid mini-grid is designed to primarily provide dedicated power supply to the university, independent of the existing grid network

3.3 Project Requirements

Land

The university has identified an approximately 100,000 m² allocation for the solar facilities. The final approved area and boundary shall be established by licensed survey. At the time of assessment the footprint was unused, undeveloped and free of structures or competing livelihood use; site possession remains conditional on the pre-possession verification and OS5 change protocol.

Water Use and Supply

Water demand for the proposed solar hybrid mini grid project is expected to be minimal. During construction, limited quantities of water may be required for minor civil works, equipment installation activities, and domestic use by construction personnel, as cement intensive construction activities are anticipated to be limited. Based on standard construction water consumption rates, total construction phase water demand is estimated at approximately 8,250 litres per day.

During operation, water will be required mainly for periodic PV-panel cleaning. The cleaning frequency, number of modules, consumption rate and annual demand shall be derived from the final design, soiling study and manufacturer's instructions. Dry or low-water methods shall be used where effective, and water use shall be metered and recorded.

Water shall be obtained only from an approved supply shown by the final water-balance assessment not to adversely affect other users or environmental receptors. Panel washing shall avoid harmful detergents. Clean washwater shall be managed by controlled infiltration or drainage without erosion or nuisance; contaminated washwater shall be contained, characterized and managed through an authorized waste route.

Health and Safety

Occupational health and safety (OHS) is an issue that needs to be properly managed during all project phases in order to minimize the risk of preventable accidents leading to injuries and/or fatalities. Proper OHS risk identification and management measures should be incorporated in every project’s management plan and standard EPC contractual clauses.

The contractor shall engage dedicated personnel competent on the basis of appropriate education, training, and experience to manage and oversee the Health, Safety and Environment (HSE) aspects of the Project.

The HSE personnel shall ensure that the Project and subcontractors operate in accordance with the applicable regulatory HSE requirements and plans; and also monitor implementation of environmental

and social protection measures. Occupational health and safety (OHS) plans shall be developed and maintained by all contractors involved in the implementation of the proposed Project particularly in the following aspects:

Occupational Health and Safety:

- General Facility design and operation.
- Communication and Training.
- Physical Hazards.
- Chemical Hazards.
- Biological Hazards.
- Personal Protective Equipment (PPE).
- Special Hazard Environments.
- Monitoring.

Community Health and Safety:

- Water Quality and Availability.
- Structural Safety of Project Infrastructure.
- Life and Fire Safety (L&FS).
- Traffic Safety.
- Transport of Hazardous Materials.
- Disease Prevention.

Waste Management

Waste generation associated with the proposed solar hybrid mini grid project is expected to be limited and will occur mainly during construction, operation, and eventual decommissioning phases. Construction activities may generate typical solid wastes such as packaging materials, scrap metals, cable offcuts, and minor construction debris, while operational waste streams are expected to be minimal and largely associated with routine maintenance activities. Based on the proposed project scale, waste generation during the construction phase is expected to be estimated at approximately 1–3 tonnes over the construction period

The Project shall maintain a component and waste inventory based on procured quantities, expected service lives and measured waste records. No planning tonnage shall be used unless it is supported by a documented bill of quantities, waste factor and replacement profile.

During the operation and maintenance phase, waste generation is expected to be minimal, consisting primarily of packaging materials, spent consumables, and occasional electrical or electronic components, with quantities estimated at less than 0.2 tonnes per year. At the decommissioning stage, higher waste volumes are anticipated from the dismantling of solar panels, mounting structures, electrical systems, energy storage units, and associated infrastructure. Total waste generation is estimated at approximately 15–25 tonnes, a substantial proportion of which is expected to be reusable or recyclable through licensed recovery and waste management facilities.

Non-hazardous wastes may use an approved local system where capacity and final destination are verified. Batteries, PV modules, electronic equipment, oils, contaminated absorbents and other regulated wastes shall be segregated, labelled, securely stored and transferred only through authorized take-back schemes or licensed handlers, with manifests and final-destination evidence retained.

Table 1: Typical waste Streams across Project Phases

Waste Stream	Sources	Waste Generation Phase		
		Construction (C)	Operation (O)	Decommissioning (D)
General rubbish, refuse, and putrescible wastes (Food wastes)	Wood splinter, domestic waste, food packs, used bottles	X	X	X
Cleared vegetation	During site clearing and preparation	X	X	X
Scrap metals	Used tubular and casings, used iron rods	X	X	X
Excavated materials	Foundation works	X		X
Damaged/expired PV panels	PV modules	X	X	X
Expired inverters	Electrical installation		X	X
Damaged/expired Batteries	Power generation		X	X
Sanitary waste	Training centre	X	X	X

Solar Photovoltaic Installation Standards

Design, installation, and operation of the proposed solar photovoltaic hybrid system will comply with applicable national and international standards governing electrical safety, construction practices, and renewable energy installations. The project will adhere to relevant International Electro-Technical Commission standards for photovoltaic systems and mini grid development, including IEC 62257 guidelines covering system design, installation, operation, and maintenance.

Implementation will also conform to recognized engineering and construction codes relating to building safety, fire prevention, and electrical system protection. Compliance with these standards will ensure safe installation, reliable system performance, and long-term operational integrity of the solar power infrastructure throughout the project lifecycle.

3.4 Project Components

The proposed project consists of integrated infrastructure designed for electricity generation, storage, control, and distribution within the permanent campus of the Admiralty University of Nigeria, Oshimili. This section provides a description of the major system components and their functions within the overall project configuration.

Solar Power Generation System

The solar power generation system constitutes the primary energy producing component of the proposed project. Electricity will be generated through ground mounted photovoltaic (PV) arrays installed in organized rows within the designated project footprint. The PV modules will be mounted on engineered support structures designed to ensure structural stability, optimal panel orientation, and resistance to prevailing environmental conditions such as wind and rainfall.

The photovoltaic modules will be configured in interconnected strings and arrays to maximize solar energy capture and overall system efficiency. Through the photovoltaic effect, solar radiation incident on the modules will be converted directly into direct current electricity, which will subsequently be transmitted to inverters for conversion into usable alternating current for distribution within the University's electrical network.

The system will utilize polycrystalline silicon photovoltaic technology with an expected operational lifespan of approximately 25 to 30 years under normal operating conditions, providing a reliable and renewable source of energy throughout the project lifecycle.

Figure 4: Example of a Monofacial Si-poly photovoltaic module

Table 2: Photovoltaic module characteristics

Main characteristics	
Technology	Si-poly
Type of module	Monofacial
Maximum voltage	1500 V
Standard test conditions (STC)	
Peak power	415.0 W
Efficiency	18.79 %
MPP voltage	39.3 V
MPP current	10.55 A
Open circuit voltage	47.8 V
Short circuit current	11.14 A
Temperature coefficients	
Power coefficient	-0.370 %/°C
Voltage coefficient	-0.291 %/°C
Current coefficient	0.050 %/°C
Mechanical characteristics	
Length	2108.0 mm
Width	1048.0 mm
Thickness	0.04 mm
Weight	24.9 kg

Energy Storage System

The project will incorporate a Battery Energy Storage System to enhance reliability and stability of electricity supply within the campus. The storage system will retain excess energy generated by the

photovoltaic arrays during periods of peak solar production for use when solar generation is reduced or unavailable.

The Battery Energy Storage System will support load balancing and energy stabilization by regulating fluctuations in power output and maintaining consistent voltage supply. Stored energy will primarily be utilized during nighttime operations, low solar irradiation periods, or temporary demand surges, thereby ensuring continuous electricity availability to critical university facilities.

Power Conversion and Control System

The power conversion and control system will regulate and manage electricity generated from the solar photovoltaic arrays to ensure safe, efficient, and reliable utilization within the University's electrical network. Direct current electricity produced by the PV modules will be converted into alternating current through grid compliant inverters designed for institutional power applications. The inverters will incorporate Maximum Power Point Tracking technology to optimize energy extraction from photovoltaic strings under varying solar irradiation conditions.

Table 3: Inverter characteristics

Inverter characteristics	
Main characteristics	
Inverter type	STRING
Maximum DC to AC conversion efficiency	98.79 %
Input side (DC)	
MPPT search range	880- 1300 V
Maximum input voltage	1500 V
Output side (AC)	
Rated power	110.0 kVA
Power at 30 C (datasheet)	110.0 kVA
Power at 50 C (datasheet)	100.0 kVA
Output voltage	800 V
Output frequency	50 Hz

Converted power will be transmitted through step up transformers to increase voltage levels suitable for integration into the campus medium voltage distribution system. Power evacuation and system integration will be supported through dedicated transformer or power stations configured as enclosed or containerized units housing transformers and associated medium voltage equipment.

Medium voltage switchgear assemblies and protection systems will be installed to provide system isolation, fault detection, operational safety, and controlled power flow. Power conditioning equipment will further stabilize voltage and frequency to maintain consistent power quality and safeguard connected electrical installations. Collectively, these components ensure efficient energy conversion, secure transmission, and stable operation of the solar hybrid system under varying load and generation conditions.

Figure 5: Example of string photovoltaic inverter

Figure 6: A transformer

Figure 7: Example of a Power Station

Electrical Distribution and Interconnection Infrastructure

The electrical distribution and interconnection infrastructure will facilitate transmission of electricity from the solar hybrid generation facility to designated load centres within the University's permanent campus. Power evacuation will be achieved primarily through medium voltage distribution lines operating at approximately 11 kV, with underground cabling installed along designated utility corridors and campus road alignments to minimize surface disturbance and ensure maintenance accessibility.

The distribution network will integrate with the University's internal electrical system to enable efficient and controlled supply to academic buildings, residential facilities, research centres, and essential service infrastructure. Provision will also be incorporated for coordinated operation with existing or future grid infrastructure where applicable, allowing system flexibility and reliable interface between the solar hybrid installation and external electricity supply sources.

Monitoring and Supervisory Control System

The project will incorporate an integrated monitoring and supervisory control system to ensure efficient operation and management of the solar hybrid power installation. The system will utilize Supervisory Control and Data Acquisition technology to enable real time monitoring of energy generation, battery storage performance, and electricity distribution across the facility.

The platform will support remote supervision, system diagnostics, performance analysis, and early fault detection, enabling timely corrective actions and optimized power flow regulation. These functions will enhance operational reliability, system safety, and overall efficiency of the installation.

As part of the monitoring framework, a solar weather station will be installed to capture real time meteorological and performance data. The station will include sensors for solar irradiation, ambient

temperature, relative humidity, wind speed, wind direction, and photovoltaic module temperature. Data collected will inform system performance evaluation, preventive maintenance planning, and operational optimization.

Supporting Infrastructure

Supporting infrastructure will be provided to facilitate effective operation, maintenance, and security of the proposed solar hybrid power facility. This will include construction of a site office and maintenance building to accommodate operational personnel, equipment storage, and routine system management activities.

Internal access tracks will be developed within the project area to enable movement of personnel and maintenance equipment during installation and operational phases. Security installations, including perimeter fencing and controlled access points, will be provided to safeguard project infrastructure against unauthorized access, vandalism, and theft, thereby ensuring safe and sustained operation of the facility.

Internal access tracks will be developed within the solar facility to provide connectivity between major project components and facilitate movement of personnel, equipment, and maintenance vehicles during construction and operational phases. These access routes will support routine inspection, operation, and maintenance activities within the project area and will connect the various installation units to existing campus circulation routes.

The access tracks will be designed with appropriate surface finishing and basic drainage provisions to manage stormwater runoff and minimize localized erosion within the facility. These internal roads are distinct from the external access routes to the University previously described under the site accessibility section.

To ensure operational safety and infrastructure protection, the project area will be secured through installation of perimeter fencing with controlled access points. Additional security measures, including perimeter lighting and surveillance systems, will be provided to prevent unauthorized access and safeguard installed equipment.

Backup Power System

The proposed solar hybrid mini grid will incorporate limited backup generation facilities to enhance reliability and continuity of electricity supply within the University campus. The backup system, typically comprising diesel powered generators, will operate as a supplementary power source during periods of prolonged low solar generation, battery depletion, system maintenance, or emergency conditions.

The backup generators will be integrated into the hybrid control system to enable automatic synchronization and controlled operation alongside the solar photovoltaic and battery storage systems. This arrangement ensures uninterrupted power supply to critical facilities while maintaining overall system stability and operational flexibility.

3.5 Operation and Maintenance

Operation and maintenance of the system would be expected to occur on a limited basis at certain points during the system's estimated 25-year life cycle. To enhance the performance and reliability of the plant, the following types of maintenance will be carried out:

Preventive Maintenance: which involves routine inspection and servicing of plant equipment to prevent breakdowns. This includes panel cleaning, vegetation management, wildlife prevention, water drainage, monitoring of electrical components. It also involves retro- commissioning to improve the efficiency of the PV plant by detecting and solving problems in the system.

Corrective Maintenance: which involves repair of broken-down equipment. This includes on- site monitoring and mitigation, and critical and non-critical repairs of plant components.

Condition-based maintenance: which involves monitoring equipment and plant operations real- time and addressing potential problems early on in order to prevent plant downtime. This includes continuous monitoring via remote and on-site methods, warranty enforcement, and planned and unplanned equipment replacement.
Maintenance activities will be carried out by skilled manpower with backgrounds in electrical/electronic engineering and unskilled local labour where applicable. Specific maintenance activities include the following:

PV Modules

PV modules need to be cleaned weekly in the dry season manually using water and monthly in the wet season to prevent accumulation of dust. Also, the cabling around the modules need to be checked regularly for damages. Panels need to be checked regularly for cracks and breaks. Panel testing needs to be conducted annually to ensure they live up to the manufacturer's warranty.

Electrical System

- Inverter components need to be checked to prevent breakdown which can occur during very hot weather conditions.
- Electrical wiring and earthing protection need to be checked for wear and tear. Also, the underground cabling needs to be monitored regularly for damages from pests.
- Infrared technology may be employed to identify spots where there are electricity leaks.

Civil Structures

- Mounting structures need to be checked regularly for bending damage which can affect the PV modules
- Access roads, drainage works, plant foundation and array structures need to be checked by visual inspection for water damage during the rainy season

Vegetation

- Growth of shrubs and other vegetation needs to be curtailed to prevent shadowing effect on the solar panels leading to a decrease in the output from the plant. Weeds also need to be eliminated as they present a fire hazard.
- Vegetation around the transmission line RoW needs to be cleared quarterly to maintain a vegetation height at less than 2 ft (0.61 m).

A stockpile of spare parts will be kept on-site to facilitate replacement of broken-down or out- dated solar panels and inverters. On-site security and inventory management will be implemented to prevent theft of spare parts and installed plant components.

Monitoring of the PV system components needs to be conducted to ensure increased system output and to reduce down-time. Traditional monitoring methods that compare actual energy generation against predicted energy generation will help to track the system's relative health.

3.6 Project Implementation Phase Activities

3.6.1 Preconstruction

Preconstruction works is proposed to last for 1-2 months. The works at this stage will entail activities such as site selection and preparation, completion of engineering design for the Project and receipt of relevant approvals, mobilization of personnel, equipment and materials to site, site preparation and installation of temporary structures for material storage.

3.6.2 Construction

Construction activities would last about 12-18 months. The major facilities to be constructed will include:

- Towers;
- Transformers;
- Control building;
- Weather station; and
- Transmission lines;

The proposed construction programme would be as follows:

- Construct the site access roads with gates and temporary fencing;
- Erect weather station;
- Excavate the foundations
- Construct the panel foundations;
- Erect and connect the panels;
- Lay power and instrumentation cables;
- Construct the control station;
- Construct the transformer and install the grid connection;
- Commission the panels and transmission lines; and
- Carry out land reinstatement, remove temporary compounds and clear the site

The construction will normally be completed during daytime hours; however, there will be requirements for extended hours during major concrete pours or other installations that cannot be interrupted.

3.6.3 Commissioning and Operation

Following the completion of all works at the construction phase, the power plant will be commissioned for operations. The commission phase will involve testing and checking individual equipment /system, as well as the associated infrastructure to ensure they have been installed correctly and can be handed over for use. Standard operating procedures (SOPs) shall be developed by the EPS Contractor for the operation and maintenance of the solar panels, inverters, batteries, and other associated components of the Project.

Upon completion of the commissioning of the power plant and other ancillary infrastructures, the EPC contractor will hand over the power plant to the Operation and Maintenance (O&M) Consultant who will be charged with the responsibility of operating and maintaining the plant for a period of 1 year. At this period, the O&M Consultant will also train the technical unit staff of university for ease of handover at the end of the O&M period. Activities under this phase will include:

- Power generation and distribution to various sections of the University
- The preventative, corrective and predictive maintenance of the power plant and associated facilities.

Also, the training centre will be utilized in enhancing learning in renewable energy.

3.6.4 Decommissioning

Upon completion of the power plant, the project site area will be cleared out for proper housekeeping. This is different from the decommission of the site which will be undertaken at the end of life of the power plant. The plant has a life cycle of at least 25years, which is expected to be extended with proper and timely maintenance of the plant. Upon the end-of-life of the power plant, the decommissioning activities will include:

- Dismantling and removal of PV panels and associated infrastructure (mounting structure, power evacuation cable, inverters, transformers, batteries, etc.).
- Removal of any sub-surface installations (e.g. underground cables).
- Removal of PV panels and equipment, demolition of structures and evacuation as well as site remediation.
- Waste management – recycling, disposal of unusable parts etc.
- Restoring the environment to allowable baseline conditions and monitoring of the process.
- Assessing the residual impacts, if any, that the project has on the environment.

Table 4: Project Implementation Phase Activities and Staff Requirement.

Project Phases	Activities	Staff Requirement	Employment Type
Pre-construction Phase Activities	• Land identification and confirmation of project site • Completion of detailed engineering design • Obtaining regulatory approvals and permits • Mobilization of personnel, equipment and materials to site • Site preparation and demarcation • Installation of temporary facilities for material storage and site operations	• Manual workers (20) • Skilled labour / professionals / managers (15) • Security personnel (5)	Temporary
Construction Phase Activities	• Construction of internal access roads, gates and temporary fencing. • Excavation and preparation of foundations • Installation of panel mounting structures and PV arrays • Installation of transformers and grid connection • Infrastructure. • Laying of power and instrumentation cables • Construction of control station and supporting facilities • Installation of weather monitoring station • Erection and electrical connection of solar panels • Testing and commissioning of solar panels and transmission lines • Site reinstatement and removal of temporary structures after construction	• Manual workers (40) • Skilled labour / professionals / managers (20) • Security personnel (8)	Temporary
Commissioning and Operation Phase Activities	• Testing and verification of installed equipment and systems • Commissioning of solar power plant and associated infrastructure • Development and implementation of standard operating procedures (SOPs) • Electricity generation and distribution across the university campus • Preventive, corrective and predictive maintenance of plant components • System monitoring and performance management • Training of university technical personnel for system operation and maintenance	• Cleaners (5) • Security personnel (10) • Heavy maintenance technicians (15) • Light electrical maintenance staff (10) • Infrastructure maintenance staff (10)	Permanent (Contract)

		• Parts and inventory management staff (5)	
Decommissioning	• Dismantling and removal of photovoltaic panels and mounting structures • Removal of electrical components including inverters, transformers, batteries and cables • Removal of underground installations • Demolition of supporting structures and evacuation of materials • Waste management including recycling and disposal of unusable components • Site remediation and restoration to baseline conditions • Post-decommissioning environmental monitoring and impact assessment	• Manual workers (15) • Skilled labour / professionals / managers (10) • Security personnel (5)	Temporary

3.7 Analysis of Project Alternatives

The proposed solar hybrid mini grid system for the Admiralty University of Nigeria, Oshimili has been designed to provide a reliable and sustainable electricity supply to support the development of the University's permanent campus. In line with good environmental and social assessment practice, consideration was given to feasible alternatives during project planning in order to identify an option that meets the project objectives while minimizing potential environmental and social impacts.

The alternatives analysis focused primarily on the suitability of the selected project site within the University premises, the availability of land, proximity to electricity demand centres, accessibility, environmental sensitivity of the surrounding area, and compatibility with the campus development master plan. Technology options were also considered, particularly the suitability of renewable energy based electricity generation compared to continued reliance on conventional fossil fuel based power supply.

Thus, this sub-section specifically focuses on the alternatives considered within the proposed solar-hybrid power plant.

3.7.1 Site Alternatives

Several potential locations within the permanent campus of the Admiralty University of Nigeria, Oshimili were reviewed during preliminary site assessments. The evaluation considered key criteria including land availability, accessibility, proximity to electricity demand centres, environmental sensitivity, and potential social impacts.
Field verification was undertaken through site walk through surveys, GPS mapping, and consultation with university management. Based on these assessments, the selected site was considered the most suitable option due to the following factors:

- ❖ The land is already designated for institutional development within the university master plan and is under the control of the University.
- ❖ The site is presently undeveloped and free from physical structures, agricultural use, or other encumbrances that could require relocation or displacement.
- ❖ The terrain is generally flat with stable sandy soil conditions, making it technically suitable for installation of ground mounted photovoltaic systems.
- ❖ The site is located close to the anticipated campus load centres, thereby minimizing transmission losses and reducing the need for extensive distribution infrastructure.
- ❖ The location is accessible through existing campus road networks, which will facilitate construction logistics and future maintenance activities.

- ❖ Vegetation within the proposed footprint is modified secondary/fallow vegetation in a humid tropical setting. The available evidence does not demonstrate a protected habitat or cultural-heritage feature within the footprint, but those findings remain subject to the current biodiversity screen, pre-clearance walkover and chance-finds procedure.

Alternative locations within the University were screened against land status, current and planned institutional use, access, terrain, drainage, sensitive receptors, cable route, biodiversity, safety and constructability. The selected location remains conditional on the design and land hold points in this ESIA.

3.7.2 Solar Power Technology Alternatives

The solar technologies options available for the proposed power plant in the University are:

- Concentrated Solar Power (CSP) Systems
- Photovoltaic (PV) Solar Panels

Concentrated Solar Power (CSP) Systems

Concentrated solar power (CSP) technologies harness thermal energy from the sun to drive a thermodynamic cycle. Thermal energy storage (TES) is realized through the addition of tanks, which allows CSP systems to generate electricity at times of little or no solar irradiance. This includes operating 24-h a day (baseline generation) or adjusting electricity generation during times of increased demand and high prices.
There are four different types of solar collector designs indicated in figure 6 parabolic troughs, heliostats (for power towers), linear Fresnel lenses, and dish receivers.

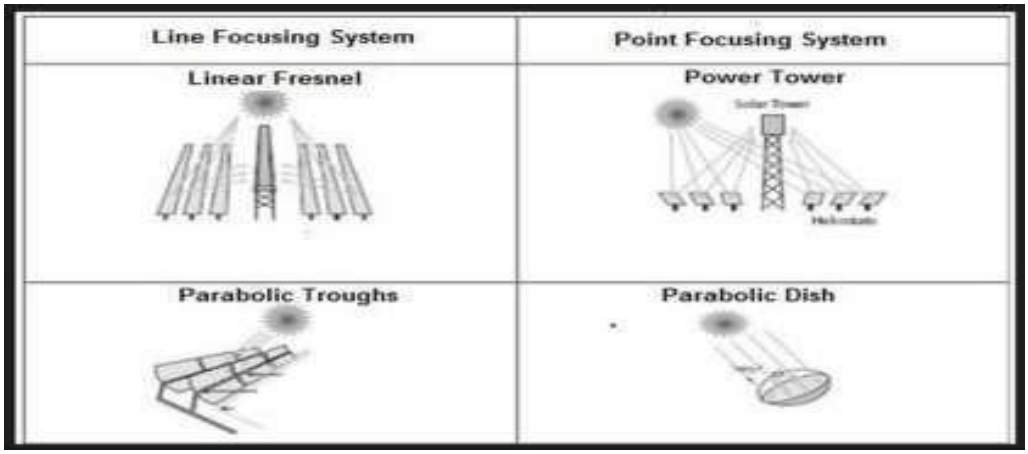


Figure 8: Four different types of solar collector designs

Solar Photovoltaic Power Systems

SPV systems utilize semiconductor-based materials (solar cells) which directly convert solar energy into electricity. SPV systems have many attractive features, including modularity, no fuel requirements, zero emissions, no noise and no need for grid connection. SPV systems can be classified according to three principal applications.

- Stand-alone solar devices purpose-built for a particular end use, such as solar HF radios, solar home lighting systems, or solar coolers. These dedicated SPV systems can either be configured to include some energy storage capacity or directly power electrical or mechanical loads, such as pumping or refrigeration;

- Stand-alone solar power plants, basically small power plants designed to provide electricity from a centralized SPV power plant to a small locality like village or a building; and
- Grid-connected SPV power plants, which are equivalent to any other generator supplying power to the electricity grid.

Comparison of solar power technologies

Parameter	Concentrated Solar Power (CSP)	Solar Photovoltaic (SPV)
Energy Conversion	Thermal (Heat to Steam to Electricity)	Direct (Semiconductor/Light to Electricity)
Mechanical Parts	High (Requires turbines, tracking mirrors)	Minimal (Solid-state, no moving parts)
Scalability	Best for large-scale utility projects	Highly scalable (from small devices to utility)
Operational Flexibility	Good (Thermal storage allows baseload)	Modular (Easy to expand/configure)
Maintenance	High (Complexity of thermal/mechanical systems)	Low (No fuel, no moving parts, simple upkeep)
Noise/Emissions	Low (Steam cycle may have some noise)	Zero (Silent, no emissions during operation)
Infrastructure Needs	Grid connection usually required	Can operate standalone or grid-tied

The final design preference is for Solar Photovoltaic Power Systems.

3.7.3 Solar Batteries Alternatives

Solar batteries are mainly categorized by manufacturing material. There are four main types of solar batteries available on the market:

Lead-Acid Batteries

Lead-acid batteries are the oldest form of battery with technology dating back more than a century. As a result, lead-acid batteries are a tried-and-true when it comes to storage. Lead acid batteries are categorized into two types: flooded lead-acid and sealed lead-acid batteries. The lead-acid variety are considerably more inexpensive than other solar batteries. These batteries come with some challenges: shorter lifespan and lower depth of discharge. Lead-acid battery capacity is also comparatively lower than other batteries. These limitations can complicate the installation process.

Figure 9: Illustrative Photo of a Lead Acid Battery

Lithium-Ion Batteries

Lithium-ion batteries are relatively new. Their advanced technology has updated features. Many portable devices, such as mobile phones and laptops, use lithium-ion batteries. They are efficient, compact and lightweight. If not properly installed, lithium-ion batteries could experience thermal runaway and catch fire.

Figure 10: Illustrative Photo of a Lithium-Ion Battery

Nickel Cadmium Batteries

Nickle Cadmium (Ni-Cd) batteries are not as common as lead-acid or lithium-ion batteries. These batteries are also a century old. They were popular in the aircraft industry. Because of their sturdiness, Ni-Cd batteries are useful for large-scale applications, such as utility solar energy storage.

Known for durability, Ni-Cd batteries can operate at higher temperatures. They also don't need complicated battery management systems and are almost maintenance-free. Ni-Cd batteries' biggest drawback is that they are toxic. Even when recycled, they can become a major environmental concern.

Figure 11: Illustrative Photo of a Nickel Cadmium Battery

Flow Batteries

Flow batteries are still in the development phase, and it may take some time before they are widely available in the market. Knowing about them now is worthwhile because this variety is expected to be a game changer in future solar panel storage methods. Within these batteries, water-based electrolyte liquid circulates between two different chambers. The chemical reaction of the charging process allows the battery to store and release electrical energy.

The biggest advantage of flow batteries is that they offer 100% depth-of-discharge capability. This means you can utilize all the energy stored in the battery without damaging it.

Table 5: Comparison of the Battery Technologies

Parameter	**Lead-Acid (VRLA/AGM)**	**Nickel-Cadmium (Ni-Cd)**	**Lithium Iron Phosphate (LiFePO4)**
Energy Density	Low	Low to Moderate	High
Cycle Life	Short (300–800 cycles)	Long (1,500–3,000+ cycles)	Very Long (3,000–6,000+ cycles)
Depth of Discharge	Shallow (50% recommended)	High (up to 80%)	Very High (up to 95%+)
Thermal Stability	Moderate	Very High	Excellent

Parameter	Lead-Acid (VRLA/AGM)	Nickel-Cadmium (Ni-Cd)	Lithium Iron Phosphate (LiFePO4)
Maintenance	Regular (depending on type)	Moderate	Low (Maintenance-free)
Environmental Risk	High (Lead/Acid)	Very High (Cadmium)	Low (No heavy metals)

N.B. The final design option is in preference of lithium battery. As illustrated in table 5 above, the Lithium-Ion Batteries technology is the preferred option. Its superior cycle life, high depth-of-discharge capability, and significantly lower environmental risk profile align with international best practices for modern, sustainable energy storage systems.

3.7.4 Climate Change Considerations

The following climate change considerations formed an explicit criterion in the evaluation of project alternatives.

Climate Risk: The selected site in South-south Delta State is exposed to climate risks including high temperatures, harmattan heat exposure, and seasonal wind loading. Among the site alternatives assessed, the selected location presents the lowest climate vulnerability due to its flat stable terrain and open aspect maximizing solar irradiance

Climate Impact on Project**:** The selected solar PV technology and lithium-ion battery storage system were evaluated against their susceptibility to climate-related impacts including heat stress on panels and batteries, dust accumulation on PV surfaces during harmattan conditions, and wind exposure. Lithium-ion batteries were preferred over lead-acid and nickel-cadmium alternatives in part due to superior thermal performance under the high ambient temperatures characteristic of the project environment. Panel cleaning provisions were incorporated to address dust-related efficiency losses.

Project GHG Contribution: Among the alternatives considered, solar photovoltaic technology generates negligible operational greenhouse gas emissions compared to continued diesel generation, which is estimated to contribute approximately 1,300 to 2,100 tonnes of CO2 equivalent per year. The preferred alternative therefore directly supports Nigeria's mitigation commitments under the National Climate Change Policy 2021 to 2030.

3.7.5 Project Options

No Project Option

The “No Project” option refers to the scenario in which the proposed solar hybrid mini grid project is not implemented at the Admiralty University of Nigeria, Oshimili. Under this scenario, the University would continue to rely largely on diesel powered generators and limited grid supply from surrounding distribution networks to meet its electricity needs. Existing electricity supply to the University and surrounding communities is characterized by severe limitations, as the transmission and distribution infrastructure serving the area was destroyed during insurgent activity and has not been rehabilitated or reconnected to the national grid. The community currently relies entirely on privately owned petrol and diesel generators and a small proportion of solar home systems, resulting in costly, unreliable, and environmentally burdensome energy supply conditions.

Continued reliance on these sources would result in higher operational costs, with ADUN estimated to expend approximately NGN 15 to 25 million annually on diesel procurement, increased greenhouse gas emissions, estimated at approximately 1,300 to 2,100 tonnes of CO2 equivalent per year, and persistent

energy reliability challenges, particularly as the University expands its permanent campus and academic activities.

Failure to implement the project would also prevent the realization of the expected benefits of the Energizing Education Programme under the Desert to Power initiative, including provision of clean and reliable electricity, reduction in fossil fuel dependence, improved learning and research conditions, and enhanced institutional development.

For these reasons, the No Project option is considered neither technically nor environmentally desirable and was therefore not selected as a viable alternative for meeting the long-term electricity demand of the Admiralty University of Nigeria, Oshimili.

Delayed Option

The delayed project option refers to a scenario where implementation of the proposed solar hybrid mini grid project is postponed to a later date. Under this option, the University would continue to experience inadequate and unreliable electricity supply while development of the permanent campus progresses.

Delaying the project would prolong dependence on diesel powered generators and limited grid supply, resulting in continued operational costs, energy insecurity, and associated environmental impacts from fossil fuel-based electricity generation. In addition, postponement of the project could lead to increased implementation costs due to inflationary pressures on equipment, materials, and construction services.

A delay would also slow the realization of the expected benefits of the Energizing Education Programme under the Desert to Power initiative, including improved electricity reliability for academic activities, enhanced research capacity, and reduced greenhouse gas emissions.

For these reasons, the delayed project option is considered undesirable and was not retained as a practical alternative for meeting the immediate and long-term energy needs of the Admiralty University of Nigeria, Oshimili.

Go Ahead Option

The “Go Ahead” option refers to the implementation of the proposed solar hybrid mini grid project at the Admiralty University of Nigeria, Oshimili as planned under the Energizing Education Programme of the Desert to Power initiative. Implementation of the project will provide reliable, sustainable, and cleaner electricity supply to support the development and operation of the University’s permanent campus.

The project is expected to enhance teaching, research, and innovation activities by providing stable electricity for academic buildings, laboratories, ICT facilities, and residential areas. In addition, improved lighting and power availability will contribute to better campus security and operational efficiency.

The project will also generate employment opportunities during construction and operational phases for skilled professionals, technicians, and local labour. Furthermore, the use of solar photovoltaic technology will reduce reliance on diesel powered generators, lower greenhouse gas emissions, and contribute to Nigeria’s renewable energy and climate commitments.

Considering the technical feasibility, environmental compatibility, and socio-economic benefits associated with the project, the option to proceed with implementation represents the most appropriate and sustainable alternative when compared with the “No Project” and “Delayed Project” options.

CHAPTER FOUR: DESCRIPTION OF THE ENVIRONMENTAL AND SOCIAL BASELINE CONDITIONS

4.1 Introduction

This chapter presents the baseline environmental and social conditions of the project area prior to the implementation of the proposed Project. The assessment provides an understanding of the existing physical, biological, and socio-economic characteristics of the project environment, which serves as a reference point for identifying and evaluating potential environmental and social impacts associated with the project.

4.2 Methodology for Baseline Data Collection

The baseline environmental and social conditions of the proposed Project at the University site were established through a combination of primary field investigations and secondary data review. The methodology adopted ensured that adequate information was obtained on the physical, biological, and socio-economic characteristics of the project site and its surrounding environment.

Baseline data collection activities were conducted between 6th – 17th July, 2026, and involved reconnaissance surveys, field observations, stakeholder consultations, environmental sampling, and socio-economic surveys. Baseline data collection was conducted during the rainy season period of July 2026, when the project area experiences maximum rainfall, reduced dust levels, and increased surface water flow.

These methods provided the basis for describing the existing environmental and social conditions within the project area prior to project implementation.

4.2.1 Study Area and Project Area of Influence

The assessment covered the proposed project site and its surrounding environment defined as the Project Area of Influence (AoI). For this study, the AoI encompasses the immediate project footprint and the surrounding environment within an approximate 2 km radius from the centre of the proposed solar hybrid mini-grid installation site located within the permanent campus of the Admiralty University of Nigeria, Ibusa (ADUN). This spatial boundary was considered appropriate for capturing environmental and social conditions that may potentially interact with the proposed project through construction activities, movement of personnel and equipment, drainage patterns, utility connections, and community interactions.

In delineating the AoI, consideration was given to the proximity of nearby receptors and facilities, including sections of the ADUN permanent campus, and the Ibusa community located about 400 m away. Access routes, water sources, and areas undergoing institutional development within the university environment were also taken into account.

Baseline environmental sampling, field observations, and socio-economic surveys were therefore conducted within the defined AoI to ensure that the existing environmental and social conditions of the project environment were adequately characterized.

4.2.2 Field Observations

Detailed field observations were carried out across the project site and its immediate surroundings during the baseline study period. The purpose of these observations was to document the prevailing physical and biological conditions of the area.

Field observations focused on key environmental parameters including:

- Topography and drainage characteristics
- Soil conditions and surface stability
- Existing vegetation cover and habitat conditions
- Presence or absence of wildlife and ecological sensitivity
- Current land use and human activities within the project vicinity

Observations were conducted within the proposed project footprint and along the surrounding area extending approximately 300 - 500 m from the site boundary**,** including sections of the ADUN campus and the direction of nearby settlements. Information obtained from field observations was recorded through field notes, geo-referenced photographs, and direct visual inspection.

4.2.3 Secondary Data Review

Secondary environmental and socio-economic data relevant to the project area were obtained through a review of existing literature and institutional sources. This review provided contextual information on the broader environmental and socio-economic conditions of Delta State and Oshimili North Local Government Area**.** The reviewed materials included:

- Project documentation provided by the Rural Electrification Agency, including the Terms of Reference (TOR) for the ESIA.
- Technical planning documents and infrastructure information provided by the Admiralty University of Nigeria, Oshimili, including the campus development framework and electrical planning information for the permanent campus.
- National and regional environmental datasets including climatic and meteorological information for Delta State.
- Relevant national environmental policies, legislation, and guidelines including the Environmental Impact Assessment Act (Cap E12 LFN 2004) and the Federal Ministry of Environment Environmental Impact Assessment Procedural Guidelines (2017).
- Applicable international environmental and social safeguard frameworks including the African Development Bank Integrated Safeguards System (ISS) and other international good practice guidance relevant to environmental and social assessment.

4.2.4 Environmental Sampling and Laboratory Analysis

Environmental sampling was conducted as part of the baseline study to establish the existing quality of key environmental media within the project area. Sampling focused on soil, air quality, and water resources within and around the project site.

Sampling activities were conducted on 6th – 17th July, 2026 at representative locations within the project footprint and along the surrounding environment at distances ranging between approximately 100 m and 500 m from the proposed site boundary.

Soil Sampling

The environmental assessment of soil in the project areas involved the collection and analysis of various soil samples within and around the project sites. Soil sampling involved the collection of samples from two depth intervals, namely topsoil (0–15 cm) and subsoil (15–30 cm), at each designated sampling location. The samples obtained from these depth intervals were composited at each sampling point to obtain a representative sample for laboratory analysis.

The samples were collected randomly using grab and composite techniques to achieve an even spread from the project site, and the sampling points were adequately captured by the use of a GPS and photo recognizable geographies on satellite imagery of the location. The dominant considerations in the

selection of sampling points included accessibility, ecological features and geographical location of settlement. All the soil samples collected were packed and preserved for onward transmission to the laboratory where they would be analyzed. Laboratory analyses were conducted to determine parameters such as soil pH, organic matter content, particle size distribution, and the presence of selected heavy metals where applicable as presented in Table 6.

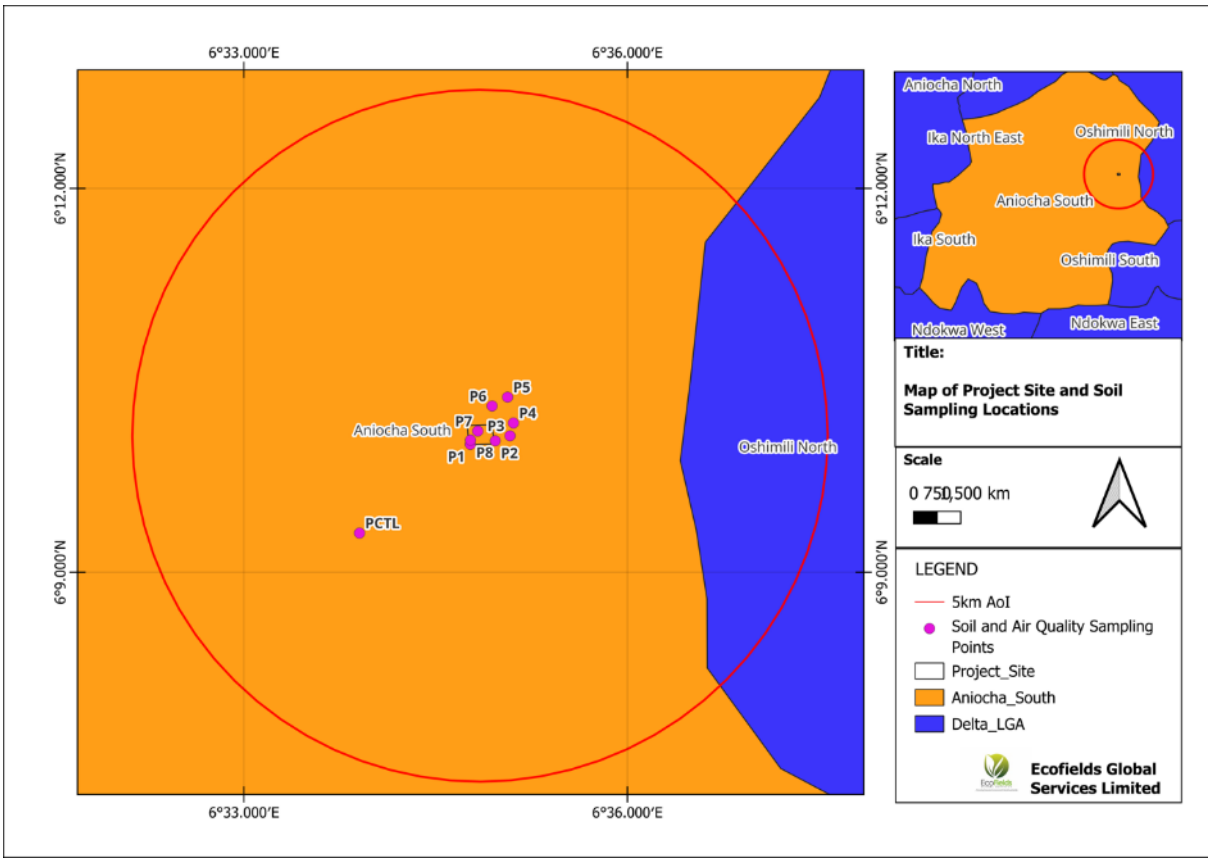


Figure 12: Map showing soil sampling points and Air / Noise quality sampling

Air Quality Monitoring and Noise measurement

Ambient air quality measurements were carried out at selected locations within the project area using pre-calibrated digital handheld Air Quality Monitoring Equipment such as pre-calibrated Crowcon [TETRA3] Pro Environmental Test Meter. Measurements focused on key parameters such as particulate matter (PM), carbon monoxide (CO), and other relevant indicators of air quality, carried out at Twelve (12) different points including control within and around the proposed project site. Air quality monitoring points were established within the project site and at nearby receptor locations to capture representative baseline conditions prior to project implementation.

Noise measurements were taken with a digital, battery-powered, sound pressure level meter (EXTEC Instruments, US Model 407735). The meter has both A and C weighting and 0.1 dB resolution with fast/slow responses. Its high- and low-metering ranges were 35 – 100 dB and 65 – 130 dB, respectively. The meter is also equipped with a building calibration check (94 dB), tripod mount, and analogue DC/AC conditioned outputs of 10mV/dB and utilized a 0.49 "(12.3 mm) condenser microphone.

Water Sampling

The baseline water dataset used in this ESIA comprises seven locations: five groundwater locations and two surface-water locations. A single signed register linking the map, field sheets, chain of custody and laboratory certificates shall be maintained in the controlled Project file.

Water samples were collected in pre-cleaned, analyte-appropriate containers and transported for analysis. The interpreted dataset comprises the locations and parameters documented in the field and laboratory records. It provides screening information only where chain-of-custody, preservation, holding time, analytical method, accreditation, detection limit and quality-control evidence are complete and traceable.

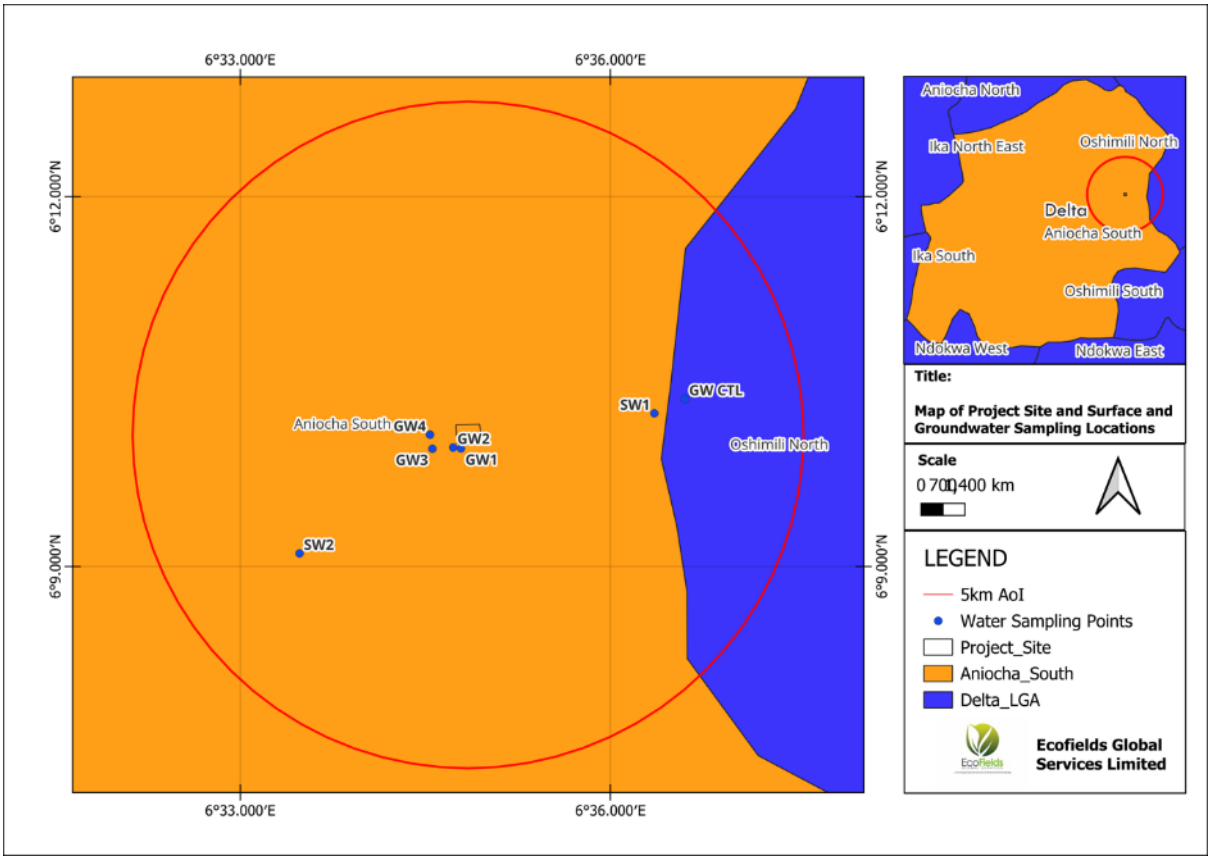


Figure 13: Water sampling Map

Quality Assurance and Control

Quality Assurance/ Quality Control (QA/QC) procedures covered all aspects of the study, including sample collection, handling, laboratory analyses, data coding and manipulation, statistical analyses, presentation and communication of results. The methods of analyses used in this study were those specified in Federal Ministry of Environment Guidelines, EGASPIN 2002 and other internationally accepted analytical procedures, in order to ensure the reliability and integrity of the data obtained.

Sample Collection, Handling and Data Quality

The interpreted baseline is confined to traceable locations and signed analytical results. Before decision-critical use, the Environmental Specialist shall issue a controlled sampling register and quality-assurance package covering date/time, coordinates, matrix, sampler, chain of custody, container/preservation, holding time, laboratory accreditation and method, detection/reporting limits, calibration, field and laboratory blanks, duplicates, spikes and data validation. Confirmatory sampling shall be undertaken where the required record is incomplete or where project design decisions require additional parameters.

Sample collection and handling procedures to maintain the integrity of samples and enhance the quality of the results, were in accordance with Federal Ministry of Environment. Following procurement, all samples were immediately labelled indelibly, giving details of sampling point, location of sampling, date and time of sampling, name of personnel sampling, etc. To reduce sampling error, measurements were

replicated and a number of spatially distributed samples were composited before sub sampling for analysis. The sample collection and handling procedures are summarized as follow:

- Standard field procedures and methods approved FMEnv were adopted.
- All sampling equipment was maintained in excellent condition, calibrated against international standards and adequate steps were taken to ensure that they function normally.
- Only new and thoroughly washed, rinsed and sterilized sampling containers were used.
- For heavy metal determination, sampling bottles were used and were rinsed with a solution of one-part nitric acid to four parts water, followed by copious amounts of distilled water. Water samples for BOD_5 determination were collected in black oxygen bottles and kept away from light source.
- All parameters without holding time were measured *in situ* on the field.
- Samples for other parameters were preserved as soon as they were collected.
- All samples were safely packed and transported to the laboratory base

Sample contamination and deterioration were avoided by pre-sterilizing sampling tools and containers, pre-treating and preserving samples in transit in ice-cooled chest (<4^{o}C) to the laboratory and storing samples at that temperature in refrigerators pending subsequent analysis especially for attributes having short-holding time such as total hydrocarbon, heavy metals and microbiology.

Sample Preservation

Sample contamination and deterioration were avoided by pre-sterilizing sampling tools and containers, pre-treating and preserving samples in transit in ice-cooled chests to the laboratory and stored at that temperature in refrigerators pending subsequent analysis. All parameters with short holding time such as pH and temperature were measured *in situ* on the field, while samples for delayed analyses were preserved by refrigeration (for general water chemistry), pH adjustment or chemical pre-treatment (for heavy metals, Total Hydrocarbon, Dissolved oxygen). Dissolved oxygen samples were acidified to a pH 2 with concentrated H_2SO_4 and NHO_3 respectively and samples for microbiology were stored immediately in ice cooled chest (at 4^{o}C) in transit to the laboratory base where they were stored in refrigerators.

4.2.5 Socio-Economic Survey Methods

Socio-economic baseline information was obtained through a combination of community consultations, key informant interviews, field observations, and questionnaire surveys conducted within the project area and surrounding communities. The study employed a sequential mixed-methods research design, integrating both quantitative and qualitative approaches for data collection, analysis, and reporting.

The socio-economic survey was conducted between 6th – 17th July, 2026 within the project area and the nearby Ibusa community. Quantitative data were collected using structured questionnaires administered to selected respondents, while qualitative information was obtained through Key Informant Interviews (KII), Focus Group Discussions (FGDs), and stakeholder consultations with university representatives, community leaders, and other relevant stakeholders.

The assessment focused on gathering information on key socio-economic indicators including population characteristics and settlement patterns, livelihood activities and sources of income, access to education, healthcare and other basic services, existing infrastructure and community facilities, as well as community perceptions regarding development projects.

Information obtained from the various survey methods was triangulated to ensure reliability and to distinguish community perceptions from verifiable conditions within the project area. The results of the

socio-economic assessment provided the basis for understanding the existing social conditions of the project environment and for evaluating potential project-related impacts on surrounding communities.

4.3 Physical Environment

4.3.1 Climate and Meteorology

Delta State lies within the humid tropical climatic zone of southern Nigeria and experiences two distinct seasons: the rainy season and the dry season. The climate is strongly influenced by the seasonal migration of the Inter-Tropical Discontinuity (ITD) (formerly referred to as the ITCZ), which separates the moist south-westerly maritime air mass from the dry north-easterly continental air mass. During the rainy season (approximately March to October), the moist south-westerly winds originating from the Atlantic Ocean dominate, resulting in abundant rainfall, high relative humidity, and extensive cloud cover. The dry season (typically November to February) is characterized by the influence of the dry north-easterly Harmattan winds from the Sahara Desert, although the Harmattan effect is generally weak and short-lived in Delta State due to its southern coastal location. The climate of Delta State is favourable for agricultural activities and renewable energy development. Despite relatively high cloud cover during the peak rainy months, the State receives sufficient annual solar radiation to support photovoltaic electricity generation throughout the year.

Air Temperature

Air temperatures in Delta State remain relatively uniform throughout the year because of its proximity to the Atlantic Ocean and its equatorial location. Mean monthly temperatures generally range from 24°C to 33°C, while average daily temperatures are approximately 27–29°C. The highest temperatures are usually experienced between February and April, immediately before the onset of the peak rainy season, whereas the coolest months occur between July and September due to increased cloud cover and rainfall. Annual temperature variations are relatively small compared with northern Nigeria.

Typical Monthly Mean Temperature Pattern

Figure 4.3.1: Typical Monthly Mean Temperature Pattern for Delta State (Adapted from NiMet Climate Normals, 1991–2020)

Month	Mean Temperature (°C)
January	27.5
February	29.0
March	29.5
April	28.8
May	28.0
June	27.2
July	26.5
August	26.3
September	26.7
October	27.3
November	28.0
December	27.2

Source: Adapted from Nigerian Meteorological Agency (NiMet) Climate Normals

Rainfall

Delta State is among the highest rainfall regions in Nigeria, receiving an annual rainfall of approximately 2,000–2,800 mm, depending on location. The rainy season extends from March to October, with peak rainfall commonly occurring between June and September.

Rainfall is characterized by a double maxima regime, typical of southern Nigeria, with major peaks occurring around July and September, separated by a brief reduction in rainfall during the August Break. The dry season extends from November to February, during which rainfall is considerably reduced. During the field survey period, rainfall conditions should be described according to the actual season in which fieldwork was undertaken.

Typical Monthly Rainfall Pattern

Figure 4.3.2: Typical Monthly Rainfall Distribution in Delta State (Adapted from NiMet Climate Normals)

Month	Rainfall (mm)
January	28
February	55
March	135
April	195
May	280
June	360
July	410
August	250
September	430
October	250
November	75
December	25

Source: Adapted from Nigerian Meteorological Agency (NiMet).

Sunshine Duration

Delta State receives an average daily sunshine duration ranging from approximately 3.5 to 6.5 hours per day. Sunshine hours are generally highest during the dry season (November to February) when skies are clearer, and lowest during the peak rainy months (June to September) because of increased cloud cover. Despite seasonal reductions in sunshine duration, solar radiation levels remain adequate to support solar photovoltaic systems throughout the year.

Typical Sunshine Duration

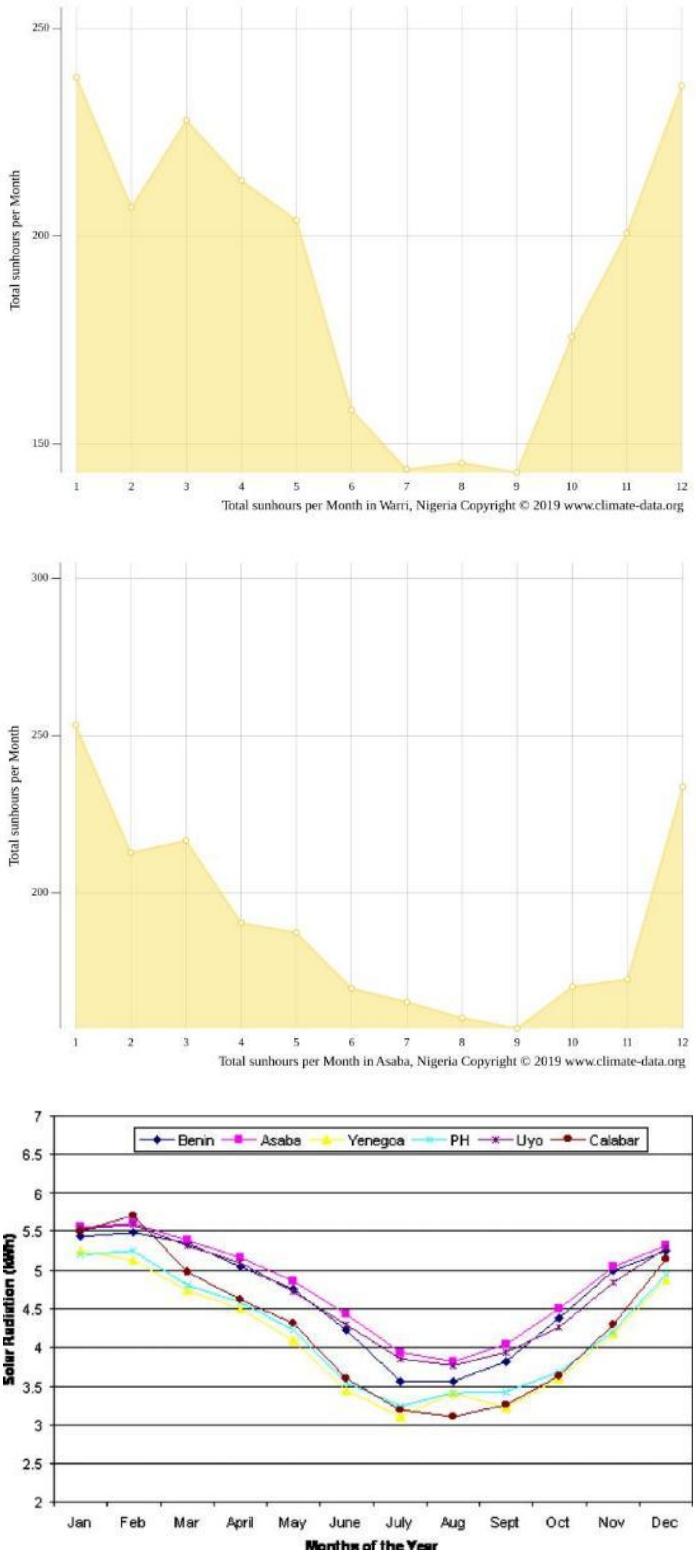


Figure 4.3.3: Mean Monthly Sunshine Hours for Delta State (Adapted from NiMet Climate Normals)

Month	Sunshine (hours/day)
January	6.4
February	6.5
March	6.2
April	5.8
May	5.1
June	4.2

July	3.8
August	3.6
September	4.0
October	5.0
November	6.0
December	6.3

Source: Adapted from NiMet Climate Normals.

Geology of the Project Area

The proposed project site at Ibusa, Oshimili North Local Government Area of Delta State, lies within the Niger Delta Basin, one of the world's largest sedimentary basins. The basin developed during the Tertiary Period through the accumulation of thick sequences of deltaic sediments deposited by the River Niger and its distributaries. The regional geology is composed predominantly of the Benin Formation, which consists mainly of unconsolidated to poorly consolidated coarse sands, gravels, sandstone, and localized clay lenses. The formation is highly permeable and serves as one of Nigeria's principal groundwater aquifers. The project area is underlain by relatively young Quaternary sediments, with soils generally consisting of sandy loam to loamy sand overlying unconsolidated sand deposits. These geological characteristics provide favourable conditions for shallow foundations typically required for solar photovoltaic installations.

Topography and Land Use

The project site is situated within the gently undulating lowland terrain characteristic of the Niger Delta hinterland. Ground elevations generally range between 60 and 120 metres above mean sea level, with slopes typically less than 5%. The relatively flat terrain provides favourable conditions for the installation of ground-mounted solar photovoltaic infrastructure with minimal earthworks.

Field observations indicate that the site is largely undeveloped and consists predominantly of secondary vegetation comprising grasses, shrubs, scattered trees, and fallow land. Minor localized erosion features were observed in isolated areas; however, no extensive gully erosion or unstable slopes were identified within the project footprint.

Current land use within and around the project site is characterized by:

- Secondary vegetation
- Fallow land
- Educational land reserved for university expansion
- Scattered residential development outside the project boundary
- Access roads and utility corridors

No evidence of industrial activities, waste disposal sites, mining operations, or environmentally sensitive land uses was observed within the proposed project footprint. The overall level of anthropogenic disturbance is low to moderate and is primarily associated with occasional vegetation clearing, pedestrian movement, and nearby educational development activities.

4.3.2 Soil Physico-Chemical Characteristics

The soil profile is predominantly sand-dominated with varying proportions of clay and silt, indicating a texture ranging from sand, loamy sand, to sandy loam. Surface conditions show bulk density values ranging from 1.18 g/cm³ to 1.43 g/cm³ and permeability ranging from 0.80 to 5.00 K-4 cm/hr. The higher sand content across several sampling points makes exposed surface layers susceptible to erosion during high seasonal runoff.

Analysis of Soil Sample Results

Physical Parameters

The physical characteristics of the soil were evaluated to establish baseline conditions for structural stability and chemical environment. Parameters analyzed include pH, electrical conductivity (EC), temperature, oxidation–reduction potential (ORP), total organic carbon (TOC), and porosity. The soil pH across the sampling locations ranges from 5.76 to 7.05 (control: 6.66), indicating slightly acidic to near-neutral conditions. These values are favorable for soil stability and do not indicate aggressive chemical conditions that would affect foundation foundations or underground structures. Electrical conductivity (EC) values range from 29.0 µS/cm to 61.0 µS/cm (control: 39.0 µS/cm), indicating low overall ionic strength. Oxidation–reduction potential (ORP) ranges from 137 mV to 178 mV, reflecting well-aerated, oxidizing soil conditions. Recorded soil temperatures range between 26.6°C and 28.8°C (control: 29.0°C). Overall, the physical parameters indicate non-corrosive, stable soil conditions suitable for civil works.

Exchangeable anions and nutrients are reported as an environmental baseline. The results are not a substitute for geotechnical, earthing or materials-corrosion investigations.

Exchangeable Anions & Nutrients

The soil sample analytical results show sulphate (SO_4^{2-}) concentrations ranging between 1.54 mg/kg and 2.96 mg/kg(control: 2.49 mg/kg) and chloride (Cl^-) levels from 10.03 mg/kg to 13.80 mg/kg (control: 11.29 mg/kg). Nitrogen species concentrations show nitrate-nitrogen (NO_3^-–N) ranging from 0.139 mg/kg to 0.235 mg/kg, nitrite-nitrogen (NO_2^-–N) between 0.014 mg/kg and 0.054 mg/kg, and ammonia-nitrogen (NH_3–N) between 0.166 mg/kg and 0.319 mg/kg. Available phosphorus ranges from 6.35 mg/kg to 13.06 mg/kg (control: 9.03 mg/kg), while total nitrogen remains low across all points at 0.010% to 0.017%. These values demonstrate low nutrient levels and no evidence of agricultural or industrial chemical accumulation.

Organic Parameters

Total Organic Carbon (TOC) ranges from 0.76% to 1.01% (control: 0.92%), reflecting natural, low organic matter content. Carbonate (CO_3^{2-}) was below detection limits (<0.05%) across all sampling points. Phenol concentrations were consistently below the detection limit (<0.05 mg/kg), and Total Hydrocarbon Content (THC) was not detected (<0.2 mg/kg) in any sample. This confirms that the soil environment is entirely free from hydrocarbon or industrial organic contamination, presenting minimal environmental risk during earthworks and excavation.

Soil Texture Characteristics

Particle size analysis reveals that sand is the dominant fraction, ranging from 46.50% to 91.40%. Clay content ranges from 1.50% to 40.40%, while silt content is minimal, ranging between 2.30% and 20.30%. Soil textures are classified as Loamy Sand (SS1), Sandy Loam (SS2, SS3, SS4, SS5, SS7), and Sand (SS6, SS8, Control). Coarse-textured soils with high sand percentages exhibit high porosity (36% to 50%) and moderate-to-high permeability. While structurally stable, these loose sandy surface soils can be prone to wind and water erosion when cleared of vegetation. Soil stabilization and standard erosion control measures (e.g., sediment traps, controlled grading) should be integrated during site development.

4.3.3 Water Quality Assessment

Water quality assessment was conducted to establish baseline conditions for surface water and groundwater resources within the study area.

Analysis of Water Sample Results - Surface Water Quality Characteristics

Physicochemical analysis of surface water samples (SW1 and SW2) shows slightly acidic to near-neutral pH values of 6.62 and 6.86. Electrical conductivity is low (11.0 to 17.0 µS/cm), and Total

Dissolved Solids (TDS) range from 5.8 mg/L to 9.7 mg/L.Turbidity varies from 6.3 NTU (SW1) to 28.5 NTU (SW2), with corresponding Total Suspended Solids (TSS) ranging from 2.0 mg/L to 24.0 mg/L and color ranging from 11 to 34 Pt.Co units. Dissolved Oxygen (DO) levels are healthy at 4.80 mg/L to 5.00 mg/L, with low Biochemical Oxygen Demand (BOD5) of 1.10 to 1.30 mg/L and Chemical Oxygen Demand (COD) of 3.76 to 4.90 mg/L. Nutrients and ions show low concentrations: nitrate (0.055 to 0.099 mg/L), sulphate (1.86 to 2.54 mg/L), total phosphorus (0.007 to 0.017 mg/L), ammonium-nitrogen (0.225 to 0.317 mg/L), and total hardness (6.0 to 8.0 mg/L). Salinity as Cl^- is low at 1.54 to 2.96 mg/L (salinity 0.00% to 0.01%). Oil & Grease and Total Hydrocarbons (THC) were below detection limits (<0.1 mg/L).

Overall, surface waters reflect good, natural baseline conditions, though the higher turbidity at SW2 requires basic sediment management to prevent surface runoff from construction activities degrading local streams.

Groundwater Hydrocarbon Parameters

Groundwater samples (GW1 to GW4 and GWC) were tested for hydrocarbon contamination:

- Total Aliphatic Hydrocarbons (nC8−nC44): Not detected (<0.001 mg/L).
- Polycyclic Aromatic Hydrocarbons (PAHs): All 16 targeted PAHs (including Naphthalene, Phenanthrene, Benzo(a)pyrene, etc.) were 0.000 mg/L (Total <0.001 mg/L).
- Total Petroleum Hydrocarbons (TPH): <0.001 mg/L.
- BTEX (Benzene, Toluene, Ethylbenzene, Xylenes): 0.000 mg/L (Total <0.005 mg/L).

The reported petroleum-hydrocarbon and selected aromatic-hydrocarbon results were below the stated reporting limits in the analysed groundwater samples.

The dataset is adequate for reconnaissance screening of the reported parameters. Decision-critical use requires reconciliation of sampling IDs and counts, complete quality-assurance records and, where necessary, confirmatory sampling.

The reported organic-parameter results provide a limited screening baseline for the sampled locations and analytes. They do not establish pristine or complete water quality. Fuel containment, spill response, controlled drainage and confirmatory fit-for-purpose testing shall prevent degradation of groundwater and surface-water receptors.

4.3.4 Air Quality and Noise Measurement

Baseline air quality and ambient noise monitoring across eight stations (AQ1 to AQ8) and one control point (AQC) indicate clean ambient environmental conditions.

- Gaseous Pollutants: Sulphur (IV) Oxide (SO2), Nitrogen (IV) Oxide (NO2), Carbon Monoxide (CO), Ammonia (NH3), Hydrogen Sulphide (H2S), and Ozone (O3) were all below detection limits (<0.01 ppm) across all sampling points. Carbon Dioxide (CO2) ranged from 400 ppm to 419 ppm (control: 400 ppm), consistent with typical rural atmospheric background levels.
- Volatile Organic Compounds (VOCs): Low concentrations ranging between 0.010 mg/m³ and 0.025 mg/m³(control: 0.009 mg/m³).
- Particulate Matter: Suspended Particulate Matter (SPM2.5) ranged from 9.0 µg/m³ to 25.0 µg/m³ (control: 11.2 µg/m³), while SPM10 ranged from 15.0 µg/m³ to 31.1 µg/m³ (control: 19.10 µg/m³). These concentrations are well within typical ambient air quality thresholds.
- Microclimatic Conditions: Temperatures ranged from 30.8°C to 31.8°C (control: 32.6°C), relative humidity from 55.3% to 68.0%, wind speeds between 0.3 and 1.0 mph (predominantly North-Easterly), and atmospheric pressure from 1003.0 to 1004.0 hPa.
- Noise Levels: Ambient noise levels ranged between 46.3 dB and 61.0 dB (control: 48.3 dB), representing typical low-noise conditions for semi-rural/undeveloped environments.

SURFACE WATER RESULTS

S/N	PARAMETER	MU	Methods	UNIT	ADM/EIA/IBU/SW1	ADM/EIA/IBU/SW2
1	pH	± 0.33	APHA 4500-H^+ B		6.86	6.62
2	Electrical Conductivity		APHA 2510 B.	µS/cm	11.0	17.0
3	Turbidity		APHA 2130 B.	NTU	6.3	28.5
4	TSS		APHA 2540 C	mg/L	2.0	24.0
5	Temperature		APHA 2550 B	°C	26.2	26.1
6	TDS		APHA 2520 B.	mg/L	5.8	9.7
7	THC		API-RP 45	mg/L	<0.1	<0.1
8	COD		APHA 5220B & D	mg/L	3.76	4.90
9	DO		APHA 4500-O C.	mg/L	5.00	4.80
10	BOD_5		APHA 5210 A	mg/L	1.10	1.30
11	Salinity as Cl		APHA 4500-Cl^- B.	mg/L	2.96	1.54
12	O & G		APHA 5520B	mg/L	<0.1	<0.1
13	Nitrate		EPA 352.1	mg/L	0.055	0.099
14	Sulphate		APHA 4500 SO_4^{2-} E.	mg/L	1.86	2.54
15	CO_3^{2-}		APHA 2320 B.	mg/L	<0.05	<0.05
16	Total Hardness		ASTM D1126-02	mg/L	6.0	8.0
19	Colour		APHA 2120C	Pt. Co	11	34
20	Alkalinity		APHA 2320 B.	mg/L	14.0	15.0
21	Total Phosphorous		APHA 4500-P E.	mg/L	0.007	0.017
22	NH_4 - N		ASTM D1426- 08A	mg/L	0.225	0.317
23	Salinity		APHA 2520 B.	%	0.01	0.00
24	Nitrite		APHA 4500-NO_2 B	mg/L	<0.001	<0.001
25	Reactive Silica			mg/L	0.023	0.024
26	Redox Potential		APHA 4500-H^+ B	mV	101	145

***MU measurement uncertainity** ***NS not stated**

GROUND WATER RESULTS

Table1: Total Aliphatic Hydrocarbon Content (mg/L)

COMPONENT	MU	Method	ADM/EIA/IBU/GW1	ADM/EIA/IBU/GW2	ADM/EIA/IBU/GW3	ADM/EIA/IBU/GW4	ADM/EIA/IBU/GWC
nC8 - nC44		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
Total (mg/L)			**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**

Table2: Total Polycyclic aromatic Hydrocarbon Content (mg/L)

COMPONENT	MU	Method	ADM/EIA/IBU/GW1	ADM/EIA/IBU/GW2	ADM/EIA/IBU/GW3	ADM/EIA/IBU/GW4	ADM/EIA/IBU/GWC
Naphthalene		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
Acenaphthalene		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
Acenaphthene		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
Florene		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
Phenathrene		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
Anthracene		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
Fluoranthene		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
Pyrene		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
Benzo(a)anthracene		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
Crysene		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
Benzo(b)fluoranthrene		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
Benzo(a)pyrene		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000

Benzo(k)fluoranthrene		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
Indeno(1,2,3) perylene		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
Dibenzo(a,h)anthracene		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
Benzo(g,h,i) perylene		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
Total (mg/L)			**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**

FINAL GROUND WATER RESULTS

COMPONENT	MU	Method	ADM/EIA/IBU/GW1	ADM/EIA/IBU/GW2	ADM/EIA/IBU/GW3	ADM/EIA/IBU/GW4	ADM/EIA/IBU/GWC
Aliphatics		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
PAH		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
Total TPH (mg/L)			**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**

FINAL GROUND WATER BTEX RESULTS

COMPONENT	MU	Method	ADM/EIA/IBU/GW1	ADM/EIA/IBU/GW2	ADM/EIA/IBU/GW3	ADM/EIA/IBU/GW4	ADM/EIA/IBU/GWC
Benzene		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
Toluene		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
Ethylbenzene		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
m, o xylene		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
p - xylene		ASTM D3921 & USEPA 8270B	0.000	0.000	0.000	0.000	0.000
Total (mg/L)			**<0.005**	**<0.005**	**<0.005**	**<0.005**	**<0.005**

MU measurement uncertainity

NS not stated

AIR QUALITY

PARAMETERS	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8	AQC
SO_2 (ppm) - daily mean	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NO_2 (ppm) - 1 hour mean	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
VOC (mg/m^3)	0.021	0.01	0.016	0.011	0.014	0.019	0.021	0.025	0.009
CO_2 (ppm)	401	400	400	401	403	401	408	419	400.00
NH3 (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
H2S(ppm)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CO (ppm) - 8 hours mean	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ozone (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Noise Level dB	55.40	50.10	48.30	46.3	52.0	57.00	58.00	61.00	48.3
SPM @ 2.5 ($\mu g/m^3$)	13.0	11.0	15.0	17.0	9.0	22.0	19.0	25.0	11.2
SPM @ 10 ($\mu g/m^3$)	18.3	15.2	20.1	23.0	15.0	29.1	24.1	31.1	19.10
Wind speed (mph)	0.3	0.50	0.50	0.30	0.70	0.70	0.6	1.00	0.4
Wind direction (mph)	NE	NE	NE	NE	NE	NE	NE	NE	NW
Relative humudity(%)	65.1	68.0	63.8	66.0	58.0	55.3	63.5	56.7	52.3
Ambient air temperature (ºc)	31.6	31.3	31.0	30.8	31.4	31.8	31.8	31.8	32.6
Air pressure (hpa)	1004.0	1004.0	1004.0	1004.0	1004.0	1003.0	1004.0	1004.0	1005.0

SOIL SAMPLE RESULTS

FIELD CODE	pH	Electrical Conductivity (µS/cm)	TEMP (°C)	CO_3^{2-} (%)	Available Phosphorous (mg/kg)	Total Nitrogen (%)	Redox Potential (mV)	THC (mg/kg)	TOC (%)	Porosity (% pore space)
ADM/EIA/IBU/SS1	6.47	31.0	26.9	<0.05	6.59	0.017	162	<0.2	0.90	50
ADM/EIA/IBU/SS2	5.99	46.0	27.4	<0.05	6.35	0.016	168	<0.2	1.01	47
ADM/EIA/IBU/SS3	5.76	37.0	28.5	<0.05	12.53	0.011	178	<0.2	0.86	40
ADM/EIA/IBU/SS4	6.11	29.0	26.6	<0.05	13.06	0.010	160	<0.2	0.84	47
ADM/EIA/IBU/SS5	6.65	56.0	27.4	<0.05	11.70	0.013	144	<0.2	0.88	38
ADM/EIA/IBU/SS6	7.04	61.0	28.1	<0.05	7.66	0.016	175	<0.2	0.94	38
ADM/EIA/IBU/SS7	7.05	44.0	27.8	<0.05	8.97	0.015	177	<0.2	0.82	50
ADM/EIA/IBU/SS8	6.96	57.0	28.8	<0.05	9.92	0.014	137	<0.2	0.76	40
ADM/EIA/IBU/SSC	6.66	39.0	29.0	<0.05	9.03	0.015	156	<0.2	0.92	36

FIELD CODE	Permeability (K-4 cm/hr)	Bulk Density (g/cm)	SO_4^{2-} (mg/kg)	Cl- (mg/kg)	NO_3 - N (mg/kg)	NO_2 - N (mg/kg)	NH_3 - N (mg/kg)	Phenols (mg/kg)	% Total Sand	% Total Silt	% Total Clay	Texture
ADM/EIA/IBU/SS1	0.80	1.35	2.02	13.80	0.183	0.054	0.319	<0.05	71.80	10.30	17.90	Loamy Sand
ADM/EIA/IBU/SS2	2.50	1.18	2.49	12.86	0.148	0.042	0.256	<0.05	46.50	20.30	33.20	Sandy Loam
ADM/EIA/IBU/SS3	2.50	1.18	2.49	12.23	0.152	0.020	0.207	<0.05	69.30	11.90	18.80	Sandy Loam
ADM/EIA/IBU/SS4	2.50	1.18	2.02	10.66	0.139	0.014	0.166	<0.05	54.10	5.50	40.40	Sandy Loam
ADM/EIA/IBU/SS5	2.50	1.25	1.54	12.07	0.165	0.031	0.265	<0.05	66.70	13.90	19.40	Sandy Loam
ADM/EIA/IBU/SS6	5.00	1.25	2.49	10.03	0.227	0.026	0.184	<0.05	90.30	4.50	5.20	Sand
ADM/EIA/IBU/SS7	2.50	1.25	2.96	13.80	0.187	0.037	0.207	<0.05	49.00	14.20	36.80	Sandy Loam
ADM/EIA/IBU/SS8	5.00	1.33	1.54	12.39	0.235	0.054	0.171	<0.05	91.40	2.30	6.30	Sand
ADM/EIA/IBU/SSC	5.00	1.43	2.49	11.29	0.156	0.042	0.234	<0.05	90.70	7.80	1.50	Sand

4.4 Biological Environment

The biological environment assessment was undertaken through systematic reconnaissance surveys and transect walks conducted within the proposed project footprint and its immediate Area of Influence (AoI). Field observations were complemented by habitat assessment, photographic documentation, and consultation with local residents and university staff familiar with the site. Flora species were identified based on observable morphological characteristics using standard botanical identification guides applicable to southern Nigeria, while fauna was identified through direct sightings, vocalizations, tracks, burrows, droppings, and other field evidence. The conservation significance of recorded species and habitats was evaluated using the IUCN Red List of Threatened Species, the IUCN Habitat Classification Scheme, the Nigerian Endangered Species (Control of International Trade and Traffic) Act, and the African Development Bank (AfDB) Integrated Safeguards System (ISS, 2023) criteria for critical habitat screening.

Field investigations indicate that the proposed project site comprises previously disturbed secondary vegetation within land designated for institutional development. No legally protected forests, Ramsar wetlands, Key Biodiversity Areas (KBAs), Important Bird Areas (IBAs), wildlife corridors, or habitats supporting threatened or endemic species were identified within the project footprint or its immediate Area of Influence. Consequently, the site does not qualify as Critical Habitat under the AfDB ISS or IFC Performance Standard 6 criteria.

4.4.1 Vegetation

The vegetation within the project footprint is characteristic of the Lowland Rainforest/Freshwater Swamp Forest transition zone of southern Nigeria but has been substantially modified by previous land clearing and institutional development activities. The project site is dominated by secondary vegetation consisting primarily of grasses, herbs, shrubs, scattered trees and regenerating woody species. Ground vegetation is relatively dense during the rainy season but becomes sparse during the dry season due to routine clearing and maintenance activities.

Common plant species recorded during the survey include:

- Elephant grass (Pennisetum purpureum)
- Spear grass (Imperata cylindrica)
- Siam weed (Chromolaena odorata)
- Goat weed (Ageratum conyzoides)
- Tridax (Tridax procumbens)
- Oil Palm (Elaeis guineensis)
- Coconut (Cocos nucifera)
- Mango (Mangifera indica)
- Neem (Azadirachta indica)
- African Star Apple (Chrysophyllum albidum)
- Bush Mango (Irvingia gabonensis)
- African Pear (Dacryodes edulis)
- Bamboo (Bambusa vulgaris)

Vegetation surrounding the project site consists of secondary forest regrowth, cultivated farmlands, ornamental vegetation within the university environment, and scattered economic trees maintained by surrounding communities. No rare, endemic, endangered or protected plant species were encountered during the survey. Similarly, no natural forest reserve, sacred grove, or ecologically sensitive vegetation community occurs within the project footprint.

The vegetation within the Area of Influence provides ecosystem services including:

- Carbon sequestration
- Soil stabilization
- Microclimate regulation

- Pollinator habitat
- Food and medicinal resources
- Fuelwood
- Fruit production
- Aesthetic landscaping

4.4.2 Fauna

Faunal occurrence within the project area reflects the highly modified nature of the landscape and continued human activities associated with the university and surrounding communities. Faunal diversity is generally low to moderate, comprising mainly adaptable species commonly associated with secondary vegetation, farmlands and peri-urban environments. No endangered mammals, migratory wildlife corridors, breeding colonies or critical habitats were observed during the field survey. Construction activities are therefore unlikely to result in significant impacts on wildlife populations provided vegetation clearing is minimized and unnecessary disturbance is avoided.

Mammals - Small mammals are the most commonly occurring terrestrial vertebrates within the Area of Influence.

Species observed:

- Greater Cane Rat (Thryonomys swinderianus)
- African Giant Rat (Cricetomys gambianus)
- House Rat (Rattus rattus)
- House Mouse (Mus musculus)
- Palm Squirrel (Heliosciurus gambianus)
- Maxwell's Duiker (Philantomba maxwellii) (occasionally reported in nearby secondary forest)
- Domestic Goat (Capra hircus)
- Sheep (Ovis aries)
- Cattle (Bos taurus)
- Domestic Dog (Canis familiaris)

Reptiles - Reptiles commonly associated with disturbed rainforest habitats include:

- Common Agama (Agama agama)
- Nile Monitor (Varanus niloticus)
- African Rock Python (Python sebae)
- Green Bush Snake (Philothamnus irregularis)
- Black-necked Spitting Cobra (Naja nigricollis)
- House Gecko (Hemidactylus mabouia)
- Skinks (Trachylepis spp.)

These species utilize shrubs, grasslands, tree bases and abandoned burrows as shelter.

Insects - The study area supports abundant insect populations typical of southern Nigeria.

Common insect groups include:

- Honey Bees (Apis mellifera adansonii)
- Carpenter Bees (Xylocopa spp.)
- Butterflies (Papilio spp.)
- Dragonflies (Anisoptera)
- Grasshoppers (Caelifera)
- Ants (Formicidae)
- Termites (Macrotermes spp.)
- Mosquitoes (Anopheles spp., Culex spp.)

- Beetles (Coleoptera)
- Orb-weaver spiders (Araneidae)

These species contribute significantly to pollination, decomposition and nutrient recycling.

Amphibians - Amphibians are relatively abundant due to the humid climate and seasonal pools occurring during the rainy season.

Common species include:

- African Common Toad (Sclerophrys regularis)
- Grass Frogs (Ptychadena spp.)
- Reed Frogs (Hyperolius spp.)
- African Bull Frog (Pyxicephalus edulis) (occasionally)

These organisms serve as important ecological indicators because of their sensitivity to environmental changes.

Birds**:** Birds constitute the most diverse vertebrate group within the Area of Influence.

Species observed:

- Village Weaver (Ploceus cucullatus)
- Pied Crow (Corvus albus)
- Cattle Egret (Bubulcus ibis)
- Black Kite (Milvus migrans)
- Laughing Dove (Spilopelia senegalensis)
- Red-eyed Dove (Streptopelia semitorquata)
- African Palm Swift (Cypsiurus parvus)
- Yellow-billed Kite (Milvus aegyptius)
- Little Weaver (Ploceus luteolus)
- Bronze Mannikin (Spermestes cucullata)

None of these species is globally threatened, and no Important Bird Area occurs within the project site.

Critical Habitat Assessment

Screening of the project site against internationally recognized biodiversity criteria indicates that:

- No IUCN Red List threatened species were recorded within the project footprint.
- No endemic plant or animal species were identified.
- No legally protected forest, National Park, Game Reserve or Ramsar Site occurs within or adjacent to the project area.
- No migratory bird congregation site or breeding habitat was observed.
- No wildlife movement corridor intersects the proposed development site.
- The habitat has been substantially modified through previous anthropogenic activities and institutional land development.

Accordingly, the project area does not constitute Critical Habitat under the AfDB Integrated Safeguards System (2023) or IFC Performance Standard 6.

Table 4.9: Identified Flora and Fauna Species, Economic Uses and IUCN Conservation Status

Group	Common Name	Scientific Name	Economic/Ecological Use	IUCN Status

Flora	Elephant Grass	Pennisetum purpureum	Livestock fodder	Least Concern
	Spear Grass	Imperata cylindrica	Soil stabilization	Least Concern
	Siam Weed	Chromolaena odorata	Traditional medicine	Least Concern
	Oil Palm	Elaeis guineensis	Palm oil production	Least Concern
	Coconut	Cocos nucifera	Food and income	Least Concern
	Mango	Mangifera indica	Fruit production	Least Concern
	Neem	Azadirachta indica	Medicinal, shade tree	Least Concern
	African Star Apple	Chrysophyllum albidum	Fruit production	Least Concern
	Bush Mango	Irvingia gabonensis	Food, medicine	Least Concern
	African Pear	Dacryodes edulis	Food, income	Least Concern
Mammals	Greater Cane Rat	Thryonomys swinderianus	Bushmeat	Least Concern
	African Giant Rat	Cricetomys gambianus	Bushmeat	Least Concern
	Palm Squirrel	Heliosciurus gambianus	Ecological role	Least Concern
	House Rat	Rattus rattus	None	Least Concern
	Domestic Goat	Capra hircus	Livestock	Not Evaluated
	Cattle	Bos taurus	Livestock	Not Evaluated
Reptiles	Nile Monitor	Varanus niloticus	Traditional use	Least Concern
	Common Agama	Agama agama	Ecological role	Least Concern
	African Rock Python	Python sebae	Ecological role	Near Threatened
	Green Bush Snake	Philothamnus irregularis	Ecological role	Least Concern
Insects	Honey Bee	Apis mellifera adansonii	Pollination	Not Evaluated
	Termites	Macrotermes spp.	Soil aeration	Not Evaluated
	Grasshopper	Caelifera spp.	Food chain	Not Evaluated
Amphibians	African Common Toad	Sclerophrys regularis	Pest control	Least Concern
	Grass Frog	Ptychadena spp.	Ecological indicator	Least Concern
Birds	Village Weaver	Ploceus cucullatus	Ecological indicator	Least Concern
	Cattle Egret	Bubulcus ibis	Pest control	Least Concern
	Pied Crow	Corvus albus	Scavenger	Least Concern
	Black Kite	Milvus migrans	Predator/scavenger	Least Concern
	Red-eyed Dove	Streptopelia semitorquata	Ecological value	Least Concern

4.5 Socio-Economic Assessment

This section covers the socio-economic and health assessment of the identified community within the project's area of influence. The assessment provides a description of existing conditions which is essential to the identification of the potential impacts of the proposed project. The socioeconomic environment around the project area is shaped by the presence of the Admiralty University of Nigeria, Oshimili and the adjoining Ibusa community. Other key community facilities within the broader environment include schools, a local market, and a police station.

Target Population for the Study and Sample Size

The target populations and stakeholders for this study are Ibusa community members above the age of 18 years, community leaders, healthcare practitioners, youths, and women. The study employed a sequential mixed methods research design, combining structured questionnaires for quantitative data gathering with Focus Group Discussions, Key Informant Interviews, and stakeholder consultations for qualitative data gathering. A total of three (3) FGDs were conducted comprising 2 male groups covering elderly men and youths, and 1 female group, with each FGD including a minimum of 15 and a maximum of 52 participants. Different categories of respondents including youths, adults, males, females, people living with disabilities, and educated and non-educated persons were included in each session.

Specific population figures for the Ibusa community are not available in recent official publications. However, Oshimili North LGA, within which Ibusa is located, had an estimated population of about 150,000 and 500,000 residents. Given the size of the Ibusa community, a sample size of 100 respondents was determined using the Cochran Formula at a 95% confidence level and a 5% margin of error, with a 10% non-response rate adjustment. Respondents were selected using a systematic sampling technique to ensure fair representation across gender, age, and community categories.

Consequently, students and most academic staff were physically present within the immediate project environment during the survey period. The socio-economic survey therefore focused primarily on the host community, academic staff, students and other stakeholders within the project's immediate area of influence, while consultations with university management provided institutional perspectives regarding the anticipated benefits and implications of the proposed solar hybrid mini-grid project.

Ethical Considerations

All interviews were undertaken with the informed written consent of participants. Confidentiality and anonymity were maintained through secure storage of data in password protected computers and under lock and key. Participation was voluntary and respondents were allowed to withdraw at any point they feel uncomfortable to continue with the study.

Socio-Economic Characteristics of Respondents

Gender Distribution

During the questionnaire administration, 72% of the respondents were males while 28 % were females. It was observed that there is a smooth relationship between the genders and no socio-cultural belief affecting their interaction and relationship.

Age Distribution

Analysis of the baseline data shows the age distribution among the gender; 70% of respondents within the age group of 18-50 years, while 30% of the respondents are from age 50-70 years.

Marital Status

Findings from the survey indicate that:

- 57% of respondents are single
- 41% are married
- 2% are divorced

The relatively high proportion of single respondents may reflect the youthful demographic structure of the community. However, marriage remains an important social institution in the area, consistent with broader socio-cultural practices in Delta State, particularly within rural communities of Oshimili North LGA.

Educational Profile

Educational Attainment

The educational profile of respondents indicates a relatively high level of literacy within Ibusa Community, reflecting its proximity to Asaba, the Delta State capital, and the availability of numerous educational institutions within the community and surrounding areas. The presence of Admiralty University of Nigeria, public and private secondary schools, and several primary schools has contributed to improved access to formal education.

Results of the socio-economic survey indicate that approximately **10%** of respondents attained primary education as their highest level of education, while about **35%** completed secondary education. Approximately **18%** possess a National Certificate in Education (NCE), National Diploma (ND), or Higher National Diploma (HND), whereas **30%** have obtained university degrees or postgraduate qualifications. Only about **7%** of respondents reported having no formal education.

The relatively high educational attainment reflects the growing importance of education in the community and enhances the availability of skilled and semi-skilled labour that could benefit from employment opportunities associated with the proposed project.

The educational profile is attributable to several factors, including:

- Availability of public and private primary and secondary schools within Ibusa and neighbouring communities.
- Proximity to tertiary institutions, including Admiralty University of Nigeria and several universities and polytechnics in Asaba and surrounding towns.
- Improved awareness of the socio-economic benefits of formal education.
- Better transportation and accessibility to educational facilities.
- Government investment in educational infrastructure and literacy programmes.

The relatively high literacy level is expected to facilitate effective stakeholder engagement during project implementation, as most community members can readily understand project information, participate in consultations, and engage in capacity-building programmes. It also increases the likelihood of recruiting qualified local personnel for skilled and administrative positions during both the construction and operational phases of the proposed solar hybrid mini-grid project.

Economic Engagement / Occupation

Economic activities in Ibusa community are predominantly informal and self-driven. The survey revealed that:

i. 52.5% of respondents are self-employed, primarily engaged in petty trading, small-scale retail businesses, artisanship (such as tailoring, carpentry, and welding), motorcycle transport services (commercial bike riding), barbing salons, and small household-based enterprises.
ii. 6% of respondents are farmers, mostly subsistence farmers cultivating crops such as maize, beans, sorghum, and groundnuts.
iii. 22.5% are students, many of whom combine schooling with minor economic activities.
iv. 5% are unemployed but actively seeking employment opportunities.

The dominance of self-employment reflects limited access to formal sector jobs and highlights the community's dependence on small-scale commerce and informal economic activities for survival.

Income Levels

The survey data reveals the income differences in the study area. Respondents were allowed to provide an estimate of their income per month in their respective livelihood activities. Respondents who earn below N10, 000 per month are 15%; 45% earn between N10, 000 – N50, 000 and 40% earn between N50, 000 – N100, 000. The survey data was further analyzed to show the distribution of income among the gender. It was evident that men earn more than women in the community. There are 65% of men in

the community who earn between N50, 000 – N100, 000 while only 35% of women earn such income. There are 75% of men who earn between N10, 000 – N50, 000 per month while only 25% of women earn such income.

Table 6: Income Levels of Respondents

Monthly Income Range (₦)	**Percentage of Respondents (%)**
Below 10,000	15
10,000 – 50,000	45
50,000 – 100,000	40
Total	**100**

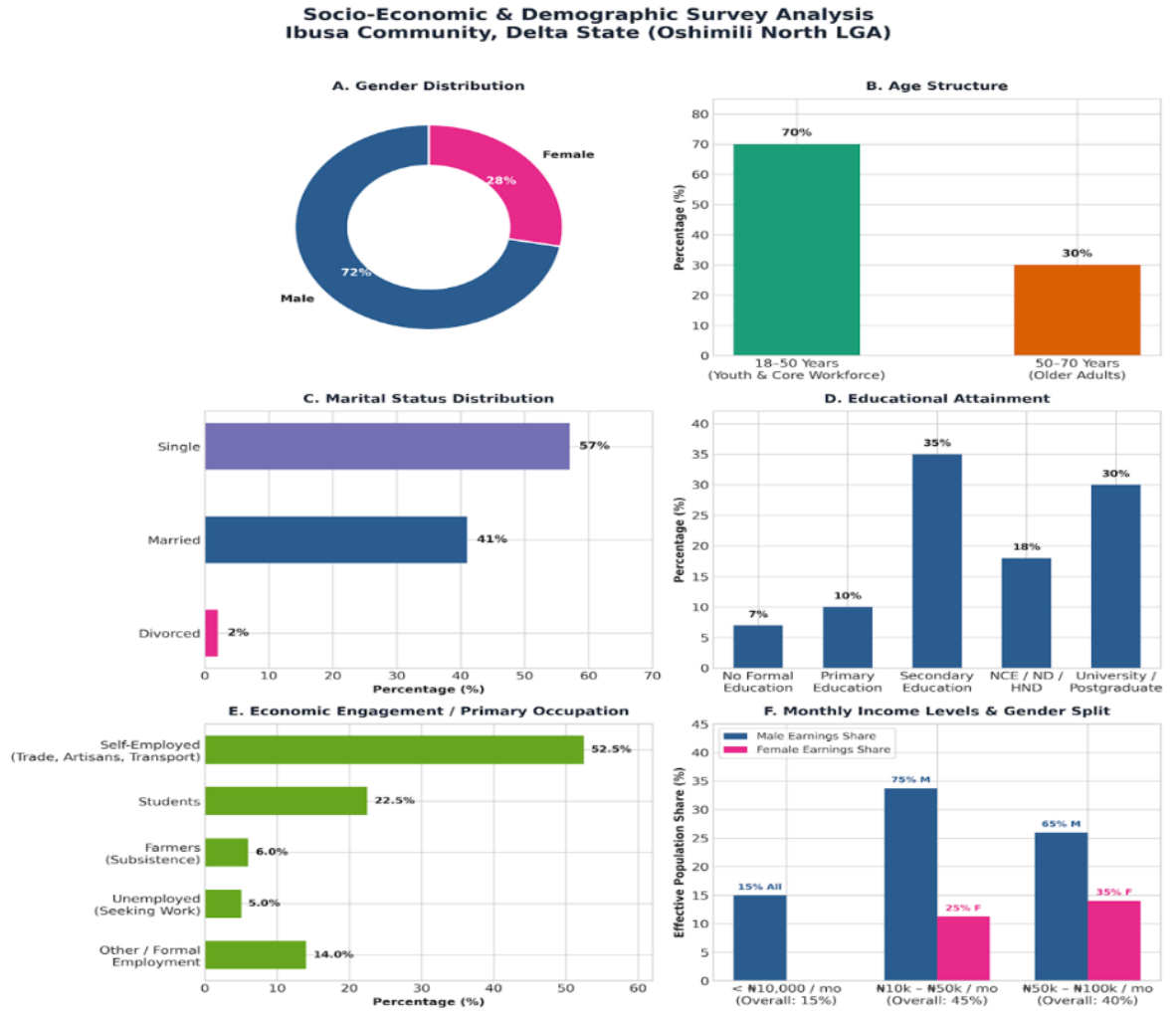


Figure 4: Graphical Representation of various socio-economics

Waste management

The Ibusa project community is rural in nature and lack access to the services of waste management system in the state. Hence, waste management practice is characterized by open dumping (25%) in their neighborhood, burning and application to farmlands as manure (68%). Others dump their waste indiscriminately (7%) in open unauthorized places. Although the nature of wastes is largely domestic and biodegradable, these practices cannot be adopted during project implementation. Therefore, contractors should liaise with the waste management authority in the state for proper management of all construction wastes.

Access to Water:

The primary source of domestic water supply in Ibusa community is hand-pump boreholes, which serve as the main and relatively reliable source of potable water. However, a proportion of households still depend

on alternative sources such as rivers and hand-dug wells, particularly during periods of high demand or when boreholes are non-functional. This pattern indicates partial access to improved water infrastructure, with continued reliance on unimproved surface water sources in some cases.

Healthcare Facilities and Access to Healthcare Services

Findings from the field survey confirm that only one functional healthcare facility exists within Ibusa community, a Primary Healthcare Centre (PHC) constructed by the State Government. This facility serves the entire population of the community. No additional public or private hospitals were identified within the community at the time of the survey.

Baseline survey data indicate that 71% of respondents reported having access to medical services, primarily through the existing Primary Healthcare Centre and pharmaceutical outlets located outside the immediate community. However, 29% reported limited or no access to formal healthcare services, which may be attributed to distance, affordability, or preference for traditional medicine.

In terms of healthcare utilization patterns:

- 63.38% of respondents patronize the public Primary Healthcare Centre.
- 31.69% obtain medications or medical advice from pharmaceutical outlets (largely outside the community).

4.93% seek care from private hospitals or clinics located in neighboring areas.

Energy Source

Ibusa Community in Oshimili North Local Government Area of Delta State is currently connected to the national electricity grid, with electricity supplied through the distribution network serving the community and its surrounding areas. Despite this grid connection, electricity supply is characterized by frequent outages, voltage fluctuations, and prolonged periods of interruption. These challenges have resulted in an unreliable power supply that is insufficient to meet the growing residential, commercial, institutional, and educational energy demands within the community.

To bridge the gap created by the unreliable public electricity supply, many households, businesses, and institutions depend on privately owned petrol and diesel generators as alternative sources of electricity. In recent years, the use of standalone solar photovoltaic (PV) systems and inverter-based backup systems has also increased among some residents and commercial establishments seeking more reliable and cost-effective energy solutions.

Admiralty University of Nigeria (ADUN), located within Ibusa Community, is similarly connected to the national grid. However, the university experiences the same challenges associated with the epileptic public power supply, which affects academic activities, administrative operations, research, information and communication technology (ICT) services, laboratory operations, security systems, and the overall efficiency of campus facilities. The institution therefore supplements grid electricity with alternative power sources to ensure continuity of essential services.

Given the increasing energy demand of the university and the limitations of the existing grid supply, the proposed Solar Hybrid Mini-Grid Project will provide a reliable, cleaner, and more sustainable source of electricity for Admiralty University of Nigeria. The hybrid system will complement—not replace—the existing national grid by improving power reliability, reducing dependence on fossil fuel-powered generators, lowering greenhouse gas emissions, decreasing operational energy costs, and enhancing the resilience of the university's electricity supply.

The proposed project is therefore expected to significantly improve energy security, support uninterrupted teaching, research, healthcare, and administrative functions, promote sustainable campus operations, and contribute to Nigeria's renewable energy and climate change mitigation objectives.

Socio-Cultural and Institutional Characteristics

Ethnicity, Language and Culture

Ibusa Community is located within Oshimili North Local Government Area of Delta State and is predominantly inhabited by the Anioma people, an Igbo-speaking ethnic subgroup indigenous to the northern part of Delta State. The people of Ibusa share strong historical, cultural, and linguistic ties with neighbouring Anioma communities such as Asaba, Okpanam, Issele-Uku, Ogwashi-Uku, and Okwe.

The predominant language spoken in the community is the Ibusa dialect of the Igbo language (Anioma dialect), while English serves as the official language for education, government administration, and formal communication. Nigerian Pidgin English is also widely spoken, particularly among traders, artisans, youths, and visitors, facilitating communication with people from diverse ethnic backgrounds.

Although Ibusa is predominantly occupied by the Anioma ethnic group, the community also accommodates residents from other parts of Delta State and Nigeria who engage in commerce, public service, education, and other economic activities. The peaceful coexistence among different ethnic groups has contributed to social harmony and economic development within the community.

The cultural heritage of Ibusa is deeply rooted in traditional customs, kinship systems, age-grade institutions, and respect for traditional authority. Festivals, traditional marriage ceremonies, title-taking, burial rites, and cultural dances remain important aspects of community life and continue to promote social cohesion and preserve the community's rich cultural identity. Farming seasons, traditional festivals, and community development activities also influence the social and economic calendar of the community.

Religion

Christianity is the predominant religion in Ibusa Community, with the majority of residents belonging to various Christian denominations, including the Roman Catholic Church, Anglican Communion, Pentecostal churches, and other Protestant congregations. Places of worship are widely distributed throughout the community and play important roles in spiritual development, education, and community welfare.

A small proportion of residents practice Islam and traditional African religion. These religious groups coexist peacefully, and the community is generally characterized by a high level of religious tolerance and mutual respect.

Religious festivals and ceremonies constitute important social events within the community. Major Christian celebrations, including Christmas, Easter, and other denominational events, are widely observed and often attract indigenes residing outside the community back to their ancestral home. These celebrations strengthen family ties, promote communal unity, and stimulate local economic activities through increased commercial transactions. Muslim residents also observe Eid-el-Fitr and Eid-el-Kabir, while adherents of traditional religion continue to participate in customary festivals and cultural ceremonies that form part of the community's cultural heritage.

Overall, the peaceful coexistence of different religious groups contributes positively to social stability, community development, and stakeholder cooperation, which are important considerations for the successful implementation of development projects within Ibusa Community.

Traditional Leadership Patterns and Representations

Traditional Leadership Structure

The traditional leadership institution in **Ibusa Community**, Oshimili North Local Government Area of Delta State, remains a fundamental component of local governance, cultural preservation, conflict resolution, and community development. The traditional institution commands considerable respect and serves as an important link between the people and government agencies, particularly during the planning and implementation of development projects.

Ibusa is predominantly inhabited by the **Anioma (Igbo-speaking)** people of Delta State and has a well-established traditional governance system that operates alongside the formal local government administration. The traditional institution plays a vital role in maintaining peace, preserving cultural heritage, administering customary laws, mobilizing community participation, and facilitating stakeholder engagement for public and private development initiatives.

The principal traditional governance structure in Ibusa comprises:

- **The Obuzor of Ibusa** – The paramount traditional ruler and custodian of the customs, traditions, and cultural heritage of the Ibusa Kingdom. The Obuzor provides overall leadership on customary matters, promotes peace and unity, and represents the community in engagements with government agencies, development partners, and private investors.
- **The Obi-in-Council (Council of Chiefs)** – Comprising titled chiefs and traditional advisers who assist the Obuzor in community administration, dispute resolution, cultural affairs, and decision-making on matters affecting the kingdom.
- **Village and Quarter Heads (Diokpa and Community Leaders)** – Ibusa is made up of several villages and quarters, each headed by a **Diokpa** (the oldest male in the family or lineage) or designated community leader. They coordinate local affairs, mobilize residents, resolve minor disputes, and represent their respective communities before the traditional council.
- **Community Development Committees (CDCs)** and **Youth and Women's Associations** – These organizations complement the traditional leadership by facilitating community development programmes, promoting social cohesion, and representing the interests of various stakeholder groups during project planning and implementation.

The **Obuzor of Ibusa** is widely respected as the traditional authority and custodian of the customs and traditions of the Ibusa Kingdom. The office of the Obuzor is hereditary and is occupied in accordance with the customary succession practices of the Ibusa people. The Obuzor is supported by the Obi-in-Council, village heads, elders, and other recognized traditional title holders in the administration of the community.

Traditional leadership in Ibusa emphasizes integrity, wisdom, fairness, and commitment to community development. Community decisions are generally reached through consultation and consensus involving the traditional council, village representatives, youth groups, women associations, and other relevant stakeholders. This participatory approach promotes transparency and strengthens community ownership of development initiatives.

Although the Council of Chiefs is traditionally composed mainly of male title holders in accordance with customary practices, women actively participate in community governance through recognized women's organizations and socio-cultural associations. These groups elect their own leaders, contribute to community development initiatives, and are regularly consulted on matters affecting the welfare of women, children, and the wider community.

Overall, the traditional institution in Ibusa works **collaboratively with the** Oshimili North Local Government Council**,** relevant government agencies, and development partners to promote sustainable development while ensuring that proposed projects respect local customs, cultural values, and community aspirations.

Land Tenure and Ownership

Land tenure is the legal regime in which a land is possessed or occupied. In other words, the principal methods on land acquisition in Nigeria are inheritance, purchase, lease, pledge, exchange, and gift. Rights to land can only be exercised over when it must have been acquired in one way or another.

The proposed Project site has been acquired by the state government for the establishment of the university. The University management has the authority to use the land for development projects to the

benefit of the University. The site was allocated for the Project by the management and physical planning department of the University.

Conflict Resolution

During interactions with the survey team, the community leader emphasized that Ibusa has had no recent record of significant conflicts. Minor disputes within households are typically resolved internally. For disputes that extend beyond the household, the Diokpa (community leaders) —as the recognized traditional authority which serves as the primary mediator and intervenes to resolve conflicts amicably.

When a conflict exceeds the mediation capacity of the traditional leadership, the Nigeria Police Force is involved to ensure resolution and prevent recurrence. The community maintains a positive working relationship with the Ibusa Police Command, reflecting mutual trust and cooperation. This dual system of traditional mediation and police support has contributed to the overall peace and social cohesion in Ibusa, reinforcing both customary norms and statutory law in conflict management.

Gender Relations and Involvement

Findings from the field assessment indicate that Ibusa community operates largely under a patriarchal social structure, where men predominantly make major decisions at both household and community levels. Although a community-based Women's Association exists within the community, women's decision-making authority is generally limited to matters concerning their immediate household, such as childcare, food management, and minor domestic issues. When decisions extend beyond the household particularly those relating to land, community development, dispute resolution, or public affairs, the involvement and approval of male household heads and, in some cases, the community leadership, are required.

With respect to property rights, it is culturally acceptable for women to inherit property in Ibusa. However, inheritance practices are gender-differentiated, with men typically receiving a larger share of family property. Nonetheless, women who possess the financial capacity to acquire land independently are permitted to do so without significant social resistance or institutional barriers.

Overall, while women participate in social and economic activities, decision-making power remains predominantly male-controlled, reflecting entrenched cultural norms within the community.

University Community Administrative Structure

The Admiralty University of Nigeria, Oshimili operates under a structured administrative system consistent with federal universities in Nigeria. The university is headed by a Vice-Chancellor who oversees academic, administrative, and development activities within the institution. Supporting the Vice-Chancellor are principal officers including the Deputy Vice-Chancellor(s), Registrar, Bursar, and Librarian, as well as Deans and Heads of Departments responsible for academic units. This administrative structure provides the institutional framework through which infrastructure development projects, including the proposed solar hybrid mini-grid, are coordinated and managed within the university environment.

Governing Council

The Governing Council is the highest decision-making body of the Admiralty University of Nigeria, Oshimili. The Council is headed by a Chairman (Pro-Chancellor) appointed by the Federal Government of Nigeria through the Federal Ministry of Education. Other members of the Council include the Vice-Chancellor, representatives of the University Senate, external members, and a representative of the Federal Ministry of Education, in accordance with the provisions guiding federal universities in Nigeria.

The Governing Council is responsible for the overall governance, policy formulation, and strategic direction of the University. Key decisions relating to institutional development, including approval of major

infrastructure projects, budgetary allocations, and the appointment of principal officers, are taken at this level.

The Council operates on a tenure basis, with members serving for a specified term as stipulated by relevant regulations. Decisions of the Council provide the institutional framework within which projects such as the proposed solar hybrid mini-grid are implemented within the University.

CHAPTER FIVE: POTENTIAL AND ASSOCIATED IMPACTS

5.1 Introduction

This chapter presents the assessment of the potential environmental and social impacts associated with the proposed Project at the permanent campus of the Admiralty University of Nigeria, Ibusa (ADUN), Delta State. The assessment identifies and evaluates the likely impacts that may arise from project activities across the different phases of implementation, namely pre-construction, construction, operation, and decommissioning.

The impact assessment is based on the interaction between project activities described in Chapter Three and the baseline environmental and social conditions established in Chapter Four. It considers both adverse and beneficial impacts, with particular emphasis on identifying potential risks to environmental components such as soil, water, air quality, and biological resources, as well as social aspects including community health and safety, livelihoods, and institutional dynamics.

In line with the requirements of the African Development Bank (AfDB), the assessment evaluates impacts in terms of their magnitude, spatial extent, duration, reversibility, and overall significance. The chapter also highlights potential cumulative impacts that may arise from the interaction of the proposed project with other activities within the area of influence.

The outcome of this assessment provides the basis for the development of appropriate mitigation and enhancement measures, which are presented in subsequent chapters to ensure that the project is implemented in an environmentally and socially sustainable manner.

5.2 Impact Assessment Methodology

The assessment of potential environmental and social impacts associated with the proposed Solar Hybrid Mini-Grid Project was carried out through a systematic evaluation of the interactions between project activities and environmental and social receptors within the defined Area of Influence.
Potential impacts were identified by linking specific project activities (e.g., site clearing, civil works, equipment installation, operation and maintenance) with environmental and social components such as soil, water, air quality, biological resources, and community / socio-economic receptors**.**

5.2.1 Impact Characterization Criteria

Each identified impact was characterized using defined criteria to ensure a consistent and objective evaluation. The criteria applied in this assessment are presented in Table 11.

Table 7: Impact Characterization Criteria

Criteria	Description	Classification
Nature	Type of impact	Positive / Negative
Extent	Spatial coverage of impact	Site-specific / Local / Regional
Duration	Time scale of impact	Short-term (less than 1 year) / Medium-term (1 to 5 years) / Long-term (greater than 5 years)
Reversibility	Ability of environment to recover	Reversible / Irreversible
Likelihood	Probability of occurrence	Unlikely / Likely / Highly Likely

5.2.2 Magnitude of Impact

The magnitude (or intensity) of each identified impact was assessed based on the degree of change it is likely to cause to the baseline environmental or social conditions within the project area. This considers the scale, intensity, and extent of the impact on the affected receptor. The criteria used for determining impact magnitude are presented in Table 12.

Table 8: Criteria for Determining Impact Magnitude

Magnitude	Description
Negligible	No measurable change to baseline conditions; impact is insignificant and does not affect the function or value of the receptor
Low	Minimal change to baseline conditions; impact is localized and of low intensity with no significant alteration to receptor function
Moderate	Noticeable change to baseline conditions; impact may alter the function or quality of the receptor but remains manageable with mitigation
High	Significant change to baseline conditions; impact substantially alters the function, integrity, or value of the receptor

5.2.3 Receptor Sensitivity

Receptor sensitivity refers to the degree to which an environmental or social component may be affected by project-related activities. It reflects the importance, vulnerability, and capacity of the receptor to withstand or recover from impacts**.** The classification of receptor sensitivity used in this assessment is presented in Table 13.

Table 9: Receptor Sensitivity Classification

Sensitivity	Description
Low	Receptors with low environmental or social value and high resilience (e.g., already disturbed land or modified environments)
Medium	Receptors of moderate value or sensitivity (e.g., vegetation, local infrastructure, institutional facilities)
High	Receptors of high importance or vulnerability (e.g., groundwater resources, human population, sensitive ecosystems)

5.2.3 Impact Significance Evaluation

Impact significance is determined from the nature, extent, duration, reversibility, likelihood, and magnitude of change together with receptor sensitivity and stakeholder concern. The assessment distinguishes initial significance from residual significance after specific mitigation. High-consequence events, including battery fire, electrocution and serious worker or community injury, are retained in the risk register even where likelihood is low.

The combination of these parameters provides a structured basis for evaluating the overall significance of each impact. A matrix approach was adopted to ensure a systematic and consistent assessment, as presented in Table 14.

Table 10: Impact Significance Matrix

Impact Magnitude ↓	Receptor Sensitivity →		
	Low	**Medium**	**High**
High	**Minor**	**Moderate**	**Major**
Medium	**Minor**	**Moderate**	**Major**
Low	**Negligible**	**Minor**	**Moderate**

Negligible	**Negligible**	**Negligible**	**Minor**

The resulting impact significance levels were classified as follows:

Table 11: Impact Significance Classification

Significance Level	Description
Negligible	No measurable change to baseline conditions
Minor	Low-level impact requiring minimal mitigation
Moderate	Noticeable impact requiring mitigation measures
Major	Significant impact requiring detailed mitigation and management

5.2.4 Quantitative Expression of Impact Significance

As part of the impact evaluation process, each identified impact has been assigned a quantitative significance value expressed as a percentage. This percentage represents the estimated proportion of the receptor affected by the identified impact, taking into account the magnitude of the impact and the sensitivity of the affected receptor as assessed in this chapter (*see tables 18 – 20)*).
The percentage ranges adopted correspond directly to the qualitative significance ratings applied throughout the impact evaluation, as presented in Table 16 below.

Table 12: Significance Rating and Corresponding Percentage Range

Significance Rating	Percentage Range	Representative Value
Negligible	0 - 10%	5%
Minor	11 - 30%	20%
Moderate	31 - 60%	45%
Major	61 - 100%	75%

5.2.5 Assessment of Cumulative Impacts

Cumulative impacts were assessed by considering the combined effects of the proposed project and other existing or planned activities within the project's area of influence. This includes ongoing and future developments within the university and surrounding communities. The assessment focused on determining whether the project could contribute to incremental environmental or social changes when considered alongside other activities, particularly in relation to land use, air quality, water resources, and community wellbeing**.**

5.2.6 Risk Assessment Approach

In addition to the impact assessment, a risk-based approach was adopted to evaluate potential environmental, health, and safety risks associated with the proposed project. Risk assessment was conducted using a Risk Assessment Matrix (RAM)**,** which evaluates risks based on the likelihood of occurrence and the severity of potential consequences.

The RAM provides a structured framework for identifying, analyzing, and prioritizing risks associated with project activities, particularly those related to occupational health and safety, accidental events, and environmental hazards. The likelihood of occurrence was categorized as rare, unlikely, possible, likely, or almost certain**,** while consequence severity was classified as insignificant, minor, moderate, major, or severe**,** as presented in Table 17.

Table 13: Risk Assessment Matrix (RAM)

Consequence ↓	Likelihood →				
	Rare	**Unlikely**	**Possible**	**Likely**	**Almost Certain**
Insignificant	Low	Low	Low	Low	Low
Minor	Low	Low	Medium	Medium	Medium
Moderate	Low	Medium	Medium	High	High
Major	Medium	Medium	High	High	Extreme
Severe	Medium	High	High	Extreme	Extreme

5.3 Positive Impacts of the Proposed Project

The anticipated positive impacts include:

- Improved reliability and stability of electricity supply for academic buildings, laboratories, ICT centres, student hostels, and administrative facilities.
- Enhanced research capacity, particularly for laboratory-based and technology-driven programmes that depend on uninterrupted power supply.
- Improved learning conditions and academic performance through access to lighting, digital resources, and extended study hours.
- Strengthening of agricultural research, innovation, and agro-technology development, thereby supporting regional food security and knowledge dissemination.
- Reduction in dependence on diesel generators, leading to lower greenhouse gas emissions, reduced noise pollution, and improved campus air quality.
- Decrease in operational and energy costs over time, allowing the University to redirect resources to core academic and developmental priorities.
- Creation of temporary employment opportunities during construction and installation phases for skilled and unskilled labour, including technicians, electricians, and support workers.
- Indirect economic opportunities for local suppliers, service providers, transport operators, and small-scale businesses supporting project implementation.
- Strengthening of local technical capacity in renewable energy installation and maintenance through skills transfer and training opportunities.
- Contribution to national renewable energy targets and improved energy resilience in the South-south region.

5.4 Potential Negative Impacts

The potential adverse environmental and social impacts associated with the proposed Solar Hybrid Mini-Grid Project were identified based on the interaction between project activities and environmental and social receptors within the project's area of influence. These impacts are assessed across the different phases of project implementation, namely pre-construction, construction, operation, and decommissioning. The identified impacts are grouped according to key environmental and social components, including: Land use and soil conditions; Air quality; Noise and vibration; Water resources; Biological environment (flora and fauna); Waste generation and management; Traffic and access; Socio-economic conditions; Community health and safety; and Occupational health and safety.
The impacts under each of these components are discussed with emphasis on their nature, magnitude, sensitivity of affected receptors, and overall significance.

Preconstruction Phase

The pre-construction phase of the proposed Project will involve activities such as site preparation, limited vegetation clearing, and mobilization of personnel, equipment, and materials to the project site. Although

these activities are relatively low in intensity, they may result in localized environmental and social interactions within the project area.

Site preparation activities will lead to the minor removal of vegetation, consisting mainly of grasses and shrubs within the project footprint. Given the absence of protected or economically important plant species, the impact on terrestrial flora is expected to be minimal. Faunal species within the area are largely common and mobile and are therefore likely to relocate temporarily during site disturbance.

Disturbance of the sandy-silty soil profile, coupled with existing signs of developing surface erosion within parts of the project site, may increase susceptibility to erosion, particularly during rainfall events. However, such impacts are expected to remain localized and of low intensity.

Mobilization of personnel, equipment, and materials may result in minor air quality impacts due to dust generation along campus access routes, as well as a temporary increase in traffic movement within the university environment. Increased human and vehicular activity may also pose minor safety risks to road users and nearby receptors within the site.

Overall, impacts associated with the pre-construction phase are expected to be short-term, site-specific, and of low significance. The identified adverse impacts arising from pre-construction activities, together with their corresponding magnitude, receptor sensitivity, and significance ratings, are presented in Table 18.

Construction Phase

The construction phase of the proposed Project will involve activities such as excavation for mounting structures, foundation works, installation of solar panels and associated infrastructure, trenching and laying of distribution cables within the university campus, movement of construction machinery, and handling of materials. These activities represent the most intensive stage of project implementation and will result in a range of interactions with environmental and social receptors within the project area.

The construction activities will interact with soil, air quality, water resources, and the biological environment. Given the sandy-silty soil conditions and existing signs of developing surface erosion within the project site, there is potential for increased susceptibility to erosion, particularly during earthworks and trenching activities. In addition, dust generation from excavation and vehicle movement may affect ambient air quality within the site and along campus access routes. However, considering the sparse vegetation and absence of ecologically sensitive habitats, impacts on flora and fauna are expected to be minimal and localized. Also, the construction phase will involve the presence of construction workers and increased movement of equipment and materials, which may interact with nearby Ibusa communities, located approximately 400 m from the project site. These interactions may result in temporary disruptions to movement and access within the campus, as well as minor community-related impacts such as expectations regarding employment opportunities and potential grievances. Nevertheless, given that the project is located within the permanent university campus with no displacement or land use conflicts, social impacts are expected to be localized and manageable.

In addition, construction activities present potential occupational health and safety (OHS) and community safety risks, particularly in relation to excavation works, operation of machinery, electrical installations, and movement of vehicles within the project environment. These risks may affect both construction workers and nearby community if not adequately controlled.

The impacts associated with the construction phase are expected to be site-specific, requiring effective management to minimize potential adverse effects. The identified adverse impacts arising from construction activities, together with their corresponding magnitude, receptor sensitivity, and significance ratings, are presented in Table 19.

Operation Phase

During the operation phase, activities will primarily involve the generation of electricity through the solar PV system, operation of inverters and battery storage systems, routine monitoring, inspection, and periodic maintenance of project infrastructure. These activities are less intensive and do not involve significant physical disturbance of the project site.

Identified Impacts during the operational impacts are expected to be minimal, as solar PV systems do not generate emissions during normal operation. However, certain risks may arise from the operation and maintenance of battery storage systems and handling of electrical components, particularly in relation to potential leakage, improper disposal of damaged components, and generation of e-waste. In addition, minor impacts may be associated with low-level noise from inverters and periodic maintenance activities, as well as the presence of installed infrastructure within the project area. there are also occupational health and safety (OHS) and community safety considerations, particularly in relation to electrical hazards, battery-related risks, fire hazards, and unauthorized access to energized components. These risks require appropriate control measures to ensure the safety of both facility operators and nearby users within the ADUN campus. Overall, impacts associated with the operation phase are expected to be long-term but of low to moderate significance, and largely manageable with standard operational and safety procedures.
The identified adverse impacts arising from operation activities, together with their corresponding magnitude, receptor sensitivity, and significance ratings, are presented in Table 20.

5.4.1 Negative Impacts: Pre-Construction Phase

Table 14: Preconstruction Phase Negative Impacts

Activity	Receptor	Potential Impact	Magnitude	Sensitivity	Significance	Impact Quantification (%)
Environmental Component						
Mobilization of construction materials and equipment to proposed university site	Air quality and Noise	Generation of dust along the university's access roads and within the project site due to movement of delivery trucks	Low	Medium	Minor	15%
		Exhaust fumes from vehicles resulting to environmental pollution and respiratory discomfort to project community	Low	Medium	Minor	15%
		Increase in ambient noise levels	Low	Medium	Minor	15%
Site clearing	Soil	Localized soil compaction and disturbance within areas designated for temporary material storage	Low	Medium	Minor	20%
		Minor disturbance of the sandy-silty topsoil within the designated project area may increase susceptibility to surface erosion and could potentially accelerate existing erosion processes, particularly during early rainfall events.	Low	Medium	Minor	25%
	Biological (Flora & Fauna)	Removal of sparse vegetation and temporary disturbance to local fauna within the project footprint	Low	Low	Negligible	5%
Social Component						
Movement of vehicles and equipment	Traffic / Access	Temporary increase in vehicular movement within the university access routes, with minor disruption to movement	Low	Medium	Minor	15%
		Minor disturbance to nearby university users and surrounding areas due to increased human activity	Low	Medium	Minor	1 5%
Handling and movement of equipment	OHS	Risk of minor accidents or injuries to workers during loading, unloading, and movement of equipment on site	Low	Medium	Minor	20%

		Influx of people (migrant workers, sub-contractors and suppliers) and increased pressure on existing social infrastructure	Low	Medium	Minor	20%
Project mobilization and initial engagement	Community	Minor safety risks to pedestrians and road users within campus access routes	Low	Medium	Minor	15%
	Security	Risk of unauthorized access to project site leading to potential theft of equipment and accidents	Low	Medium	Minor	20%

5.4.2 Negative Impacts: Construction Phase

Table 15: Construction Phase Negative Impacts

Activity	Receptor	Potential Impact	Magnitude	Sensitivity	Significance	Impact Quantification (%)
Environmental Component						
Excavation and foundation works for mounting structures	Soil	Disturbance of soil leading to increased susceptibility to erosion and potential acceleration of existing erosion features within the project footprint.	Moderate	Medium	Moderate	45%
Movement of construction vehicles and equipment within site	Soil	Soil compaction reducing permeability and affecting soil structure within frequently trafficked areas	Low	Medium	Minor	20%
Site grading and leveling for panel installation	Soil / Drainage	Alteration of natural surface runoff patterns, leading to localized water concentration and erosion	Moderate	Medium	Moderate	45%
Trenching for underground distribution cables	Soil	Creation of exposed and loosely compacted soil zones along cable routes, increasing erosion potential, especially during rainfall	Moderate	Medium	Moderate	45%
Trenching and cable laying across site	Soil / Drainage	Temporary disruption of natural drainage paths and potential formation of preferential runoff channels	Moderate	Medium	Moderate	40%
Movement of vehicles and earthworks	Air quality	Generation of dust (TSP) due to disturbance of dry sandy soil and vehicle movement within site and access roads	Moderate	Medium	Moderate	45%

Movement of construction equipment	Air quality	Emission of exhaust gases (NOx, CO, SO_2) from diesel-powered machinery	Low	Medium	Minor	20%
Operation of machinery and installation activities	Noise	Increased noise levels within the project area affecting nearby communities	Moderate	Medium	Moderate	40%
Installation of mounting structures and cable works	Flora	Removal of sparse grasses and shrubs within footprint and along cable routes	Low	Low	Negligible	5%
Construction activities and human presence	Fauna	Temporary disturbance and displacement of small terrestrial fauna species	Low	Low	Negligible	5%
Storage and handling of fuel, oil, and materials	Soil / Water	Risk of localized contamination from accidental spills affecting soil and potentially infiltrating groundwater located around the project footprint Potential pollution of the irrigation stream and ponds identified 450 m away from the project site	Low	High	Moderate	35%
Construction activities and material storage	Waste	Generation of construction waste (scrap materials, packaging, excavated soil) with potential for improper disposal and consequent environmental pollution.	Low	Medium	Minor	20%
Installation of mounting structures and foundations	Visual aesthetics	Temporary visual disturbance due to presence of equipment, materials, and exposed surfaces	Low	Medium	Minor	15%
Social Component						
Mobilization and presence of construction workers	University / premises	Temporary disruption to ongoing activities within the university environment due to increased human presence	Low	Medium	Minor	15%
Engagement of labour	Community	Potential for unmet expectations regarding employment opportunities among local residents, causing grievances	Low	Medium	Minor	15%
Movement of construction vehicles and materials	Access / Mobility	Temporary restriction or disruption of movement along campus roads and access routes	Moderate	Medium	Moderate	40%

Trenching and cable laying across campus	Access / Infrastructure	Temporary obstruction of walkways and internal access routes within the university.	Moderate	Medium	Moderate	40%
Presence of workforce	Public Health	Increased risk of communicable diseases and social vices due to interaction between workers and host community	Low	Medium	Minor	20%
Labour dynamics	Social (Gender)	Potential for unequal access to employment opportunities, particularly for women as well as risks of sexual exploitation, abuse and harassment (SEAH) and gender-based violence (GBV) associated with labour influx during the construction phase.	Low	Medium	Minor	20%
Influx of workers	Local Services	Minor pressure on existing social amenities and services within the university and surrounding areas	Low	Medium	Minor	15%
Project activities and expectations	Community Grievance	Potential for complaints arising from perceived impacts or unmet expectations	Low	Medium	Minor	15%
OHS and Community Safety						
Excavation and trenching works	OHS (Workers)	Risk of injuries from trench collapse, slips, trips, and falls within excavation areas	Moderate	High	Major	75%
Installation of mounting structures and panels	OHS (Workers)	Risk of falls, cuts, and musculoskeletal injuries during installation activities	Moderate	High	Major	75%
Handling of construction materials and equipment	OHS (Workers)	Risk of injuries from improper lifting, falling objects, or equipment misuse	Moderate	High	Major	70%
Electrical installation works (cabling, connections)	OHS (Workers)	Risk of electric shock, burns, or electrocution during installation of electrical components	Moderate	High	Major	75%
Operation of machinery and equipment	OHS (Workers)	Exposure to noise, vibration, and mechanical hazards	Moderate	Medium	Moderate	45%
Movement of construction vehicles	Community Safety	Risk of accidents involving pedestrians, workers, or other road users within the campus	Moderate	High	Major	75%

within site and access roads						
Open trenches and excavation areas	Community Safety	Risk of unauthorized access leading to falls or injuries	Moderate	High	Major	75%
Storage of fuel and hazardous materials	OHS / Community Safety	Risk of fire outbreak, explosion, or exposure to hazardous substances	Low	High	Moderate	35%
Dust and emissions from activities	OHS (Workers)	Respiratory discomfort or health effects due to prolonged exposure to dust	Moderate	Medium	Moderate	40%
Presence of construction workforce	Community Safety	Risk of unsafe interactions, including minor conflicts or security concerns	Low	Medium	Minor	20%

5.4.3 Negative Impacts: Operation Phase

Table 16: Operation Phase Negative Impacts

Activity	Receptor	Potential Impact	Magnitude	Sensitivity	Significance	Impact Quantification (%)
Battery storage and operation	Soil / Water	Risk of contamination from battery leakage or improper handling of electrolyte materials	Low	High	Moderate	35%
Operation of equipment (inverters, transformers)	Noise	Low-level noise generation from operational equipment	Low	Medium	Minor	15%
Surface structures and installations	Soil / Hydrology	Reduced infiltration due to presence of mounting structures and associated infrastructure	Low	Medium	Minor	20%
Cleaning of solar panels	Water resources	Use of water for panel cleaning leading to minimal water demand	Negligible	Medium	Negligible	5%
Maintenance activities	Waste generation	Generation of minor waste such as damaged components, packaging, and maintenance residues	Low	Medium	Minor	20%

End-of-life components (batteries, panels)	Soil / Environment	Potential environmental risk from improper disposal of hazardous components (e-waste)	Low	High	Moderate	40%
Operation of electrical systems (inverters, cables, connections)	OHS (Workers)	Risk of electric shock, burns, or electrocution during operation and maintenance	Moderate	High	Major	75%
Battery storage and management	OHS (Workers)	Risk of chemical exposure, fire, or explosion in case of battery failure or improper handling	Moderate	High	Major	75%
Operation of facility within campus	Community Safety	Risk of unauthorized access to energized equipment or restricted areas leading to injury	Moderate	High	Major	70%

5.5 Cumulative Impacts

Cumulative impacts refer to the combined effects of the proposed project together with other existing or reasonably foreseeable activities within the project's area of influence. These impacts may result from the incremental addition of project-related activities over time and space**,** even where individual impacts may be minor. The cumulative impacts identified are primarily associated with the simultaneous construction of the proposed mini-grid project and ongoing development within the ADUN campus. The most notable combined effects relate to dust generation, noise levels, traffic increase, and soil disturbance, all of which are influenced by the overlapping nature of construction activities.

Given the soil conditions and existing signs of developing erosion within the project area, the combined disturbance of multiple construction sites may increase the potential for localized erosion and sediment movement, particularly during rainfall events. In addition, the presence of multiple construction teams and equipment within the campus environment may lead to increased pressure on access routes, waste management systems, and overall safety conditions. However, these impacts are expected to be temporary, localized, and manageable through coordinated planning and implementation of mitigation measures. Table 21 below highlights identified cumulative impact associated with the proposed project.

Table 17: Identified cumulative Impacts

Component	Source of Cumulative Interaction	Potential Cumulative Impact	Significance
Air Quality	Simultaneous construction activities (mini-grid + building project)	Increased dust (TSP) levels due to combined earthworks and vehicle movement	Moderate
Noise	Concurrent operation of construction equipment	Elevated ambient noise levels within campus environment	Moderate
Traffic & Access	Combined movement of construction vehicles	Increased traffic volume, congestion, and accident risk within campus roads	Moderate
Soil / Erosion	Multiple disturbed surfaces across project areas	Increased risk of soil erosion and runoff, especially due to sandy soil conditions	Moderate
Waste Management	Waste generation from both projects	Increased pressure on campus waste handling and disposal systems	Minor–Moderate
Institutional Environment	Multiple construction activities within campus	Prolonged disturbance to academic and administrative activities	Moderate
Community & Occupational Safety	Increased number of workers, equipment, and vehicles.	Elevated risk of accidents and safety incidents within campus.	Moderate

5.6 Risk and Hazard Assessment

Risk assessment refers to the determination of the quantitative or qualitative estimate of *risk(s)* associated with recognized threats/hazards posed by the project's activities. The assessment of the risks and hazards associated with the proposed project involves:

- Identification of hazards/risks
- Assessing their likelihood of occurrence
- Estimating the consequence/severity of the hazards

Project Specific Risks and Hazards

The potential risks and hazards associated with the proposed project are:

Fire and Explosion

The major risk associated with the operation of the plant is fire and explosion because PV systems are subject to electrical faults like other electrical installations such as short circuits, ground faults and reverse currents. Failures within the plant system could cause hotspots that can ignite nearby combustible materials. Faulty installations or failure with DC/AC inverters can also cause photovoltaic fires. Overcharging, high temperatures and physical stress to Lithium-ion battery cells can cause thermal escape, which commonly leads to the destruction of the battery, fire and even explosions. In addition, deep discharging can also cause battery fires. Any outbreak of uncontrolled fire in the area can escalate to dangerous dimensions which could be critical. Thus, this hazard is classified as Severe.

Electrocution

Electrocution from direct contact with high-voltage electricity or tools, vehicles, ladders, and other devices that are in contact with high-voltage electricity could occur during the plant operation. This hazard is hardly likely to occur and it is of minimally severe consequence and is thus classified as Moderate.

Occupational Hazards

During construction, workers carrying out activities at heights could be exposed to occupational hazards. Electrical accidents may also result in shocks and/or burns, muscle contractions, and traumatic injuries associated with falls after the shock. This hazard is fairly probable although its severity is considered minimal and is thus classified as Moderate.

Gender-Based Violence, Harassment and Sexual Exploitation and Abuse (GBVH/SEAH)

The influx of construction workers into the Ibusa host community during the construction phase creates an elevated risk of gender-based violence, harassment, and sexual exploitation and abuse. Women and girls in the host community are particularly vulnerable to these risks given the patriarchal social structure of the community and its limited access to formal justice and support mechanisms. This risk is classified as Major.

Child Labor

The construction phase carries a risk of child labor, particularly given the low formal educational attainment and income levels within the Ibusa community, where economic pressure may drive households to present underage members for employment opportunities. The absence of a robust contractor labor screening mechanism increases this risk. This risk is classified as Moderate.

Security Risks

The project is located in Delta State within the South-south geopolitical zone, which has experienced insurgent activity in recent years. The destruction of community infrastructure including electricity distribution networks in Ibusa is directly attributable to this history. During the construction and operational phases, the project infrastructure and personnel may be exposed to security threats including theft, vandalism, and broader insecurity in the region. This risk is classified as Major.

Contamination from Improper Management of Solar E-Waste

The operational and decommissioning phases of the project will generate electronic waste including spent lithium-ion battery modules, photovoltaic panels, inverters, cables, and associated electrical components. Improper handling, storage, or disposal of these materials poses a risk of soil and groundwater contamination from hazardous substances including heavy metals and chemical electrolytes. Given the 25-year operational lifecycle and the volume of end-of-life components anticipated, this risk is classified as Major.

CHAPTER SIX: MITIGATION MEASURES

6.1 Introduction

This chapter outlines the measures proposed to prevent, reduce, and manage the environmental and social impacts associated with the Solar Hybrid Mini-Grid Project at the Admiralty University of Nigeria, Ibusa (ADUN), Delta State. The measures are based on the significance of impacts identified in Chapter Five and are designed to ensure that potential adverse effects are effectively controlled throughout the project lifecycle.

The development of mitigation measures follows the principles of the mitigation hierarchy as recommended by the African Development Bank, ensuring a systematic approach to impact management. These measures are tailored to the specific conditions of the project site, including its soil characteristics, vegetation cover, ongoing construction activities, and proximity to nearby communities.

In addition to addressing environmental concerns, the mitigation measures also incorporate occupational health and safety considerations, community safety, and resource efficiency. The measures have been developed in line with applicable national regulations, including those of the Federal Ministry of Environment, as well as international best practices.

6.2 Strategy and Principles

The selection of mitigation measures for the proposed project is guided by a structured approach aimed at managing risks in a practical and effective manner. This approach is based on the following principles:

- **Impact Avoidance:** Integration of environmental and social considerations into project design and planning to prevent adverse impacts where feasible;
- **Impact Reduction:** Application of appropriate construction methods and operational controls to limit the extent and intensity of unavoidable impacts;
- **Impact Control:** Implementation of site-specific measures to manage residual impacts during project execution;
- **Remediation and Compensation:** Restoration or compensation for significant residual impacts, where necessary and feasible.

Mitigation measures have also been designed with consideration for:

- the nature and scale of project activities;
- site-specific environmental sensitivities, including erosion-prone soils;
- interactions with ongoing construction within the university campus; and
- potential concerns of nearby communities.

This approach ensures that all identified risks are managed to acceptable levels while maintaining compliance with regulatory and institutional requirements.

6.3 Mitigation Measures by Project Phase

Pre-Construction Phase

Activity	Receptor	Potential Impact	Mitigation Measures	Significance
Environmental Component				
Mobilization of construction materials and equipment to proposed university site	Air quality and Noise	Generation of dust along the university's access roads and within the project site due to movement of delivery trucks	• All access roads and active work areas shall be regularly watered, particularly during dry and windy conditions, to suppress dust generation. • Delivery trucks transporting fine materials (e.g., sand, laterite) should be covered with tarpaulin to prevent dust dispersion. • Vehicle movement within the site shall be restricted to designated routes to minimize surface disturbance. - Speed limits (e.g., ≤ 30 km/h) shall be enforced for all construction vehicles within campus roads.	Minor
		Exhaust fumes from vehicles resulting to environmental pollution and respiratory discomfort to project community	• All vehicles and machinery should undergo routine maintenance and servicing to ensure efficient fuel combustion and reduced emissions. • switch off engines when not in use	Minor
		Increase in ambient noise levels	• Vehicles and equipment shall be fitted with functional silencers/mufflers • Mobilization activities shall be restricted to daytime hours (e.g., 8:00 am – 6:00 pm) to avoid nuisance	Minor
Site clearing	Soil	Localized soil compaction and disturbance within areas designated for temporary material storage	• Movement of heavy equipment shall be limited to designated areas to prevent widespread soil compaction • Where compaction occurs, affected soils shall be loosened/ripped after use to restore permeability	Minor
		Minor disturbance of the sandy-silty topsoil within the designated project area may increase susceptibility to surface erosion and could potentially accelerate existing erosion processes, particularly during early rainfall events.	• Vegetation clearing shall be restricted strictly to the project footprint to preserve natural ground cover. • Topsoil shall be carefully stripped, stockpiled, and protected for later reinstatement. • Land clearing shall be scheduled, where possible, to avoid peak rainfall periods. • Exposed surfaces shall be stabilized promptly after clearing activities.	Minor
	Biological (Flora & Fauna)	Removal of sparse vegetation and temporary disturbance to local fauna within the project footprint	• Clearing shall be limited to only required areas - avoiding unnecessary vegetation removal	Negligible

			• Post-construction, disturbed areas shall be rehabilitated/re-vegetated using native species.	
Social Component				
Movement of vehicles and equipment	Traffic / Access	Temporary increase in vehicular movement within the university access routes, with minor disruption to movement	• Movement of delivery vehicles should be scheduled during off-peak hours to minimize interference with campus traffic and nearby community movement. • Temporary traffic control measures (signage, flagmen) should be deployed at critical points along access roads. • Coordination should be maintained with university management to align with ongoing construction activities within the campus.	Minor
		Minor disturbance to nearby university users and surrounding areas due to increased human activity	• Mobilization activities should be properly planned and coordinated to reduce unnecessary movement and congestion	Minor
Handling and movement of equipment	OHS	Risk of minor accidents or injuries to workers during loading, unloading, and movement of equipment on site	• Conduct a Job Hazard Analysis (JHA) or Job Safety Analysis (JSA) before commencement of work activities. • Establish and enforce administrative controls including safe work method statements and worker induction training • Workers involved should be provided with appropriate Personal Protective Equipment (PPE) such as gloves, helmets, and safety boots. • Equipment handling procedures should be clearly communicated and enforced.	Minor
		Influx of people (migrant workers, sub-contractors and suppliers) and increased pressure on existing social infrastructure	• Preference should be given to local labour recruitment from Oshimili and surrounding communities where skills are available. • Engagement with community leaders should be carried out to manage expectations regarding employment opportunities. • Workers should be provided with basic on-site facilities (e.g., sanitation, water) to reduce pressure on local infrastructure.	Minor
Project mobilization and initial engagement	Community	Minor safety risks to pedestrians and road users within campus access routes	• Warning signs and temporary safety signage should be installed along access routes to the site. • Traffic marshals/flagmen should be positioned at key crossing points during peak movement periods	Minor
Project mobilization and initial engagement		Grievances from poor recruitment of local labour for semi- and unskilled jobs	• A transparent and documented recruitment process should be adopted. • Job opportunities for unskilled roles should be publicly communicated within nearby communities.	Minor

			• Selection criteria should be clearly defined and consistently applied. • A simple grievance redress mechanism (GRM) should be established to address complaints related to employment.	
Project mobilization and initial engagement		Increase in sexual activities and potential spread of STDs/STIs due to labour influx	• Awareness programs on HIV/AIDS and STDs/STIs prevention should be conducted for workers. • Information materials (posters, briefings) should be provided at site and worker gathering points	Minor
Project mobilization and initial engagement		Induced SEA/SH and other GBV risks due to labour influx	• A strict Code of Conduct addressing SEA/SH and GBV should be developed and enforced for all workers. • Workers should undergo mandatory induction and sensitization on acceptable behavior and consequences of violations • A confidential reporting mechanism should be established for GBV-related complaints • Sanctions for violations should be clearly defined and enforced.	Minor
Project mobilization and initial engagement	Security	Risk of unauthorized access to project site leading to potential theft of equipment and accidents	• The project site should be properly secured using temporary fencing or barriers. • Security personnel should be engaged to control access to the site • Warning signs such as *"No Unauthorized Access"* should be installed at visible locations.	Minor

Construction Phase

Activity	Receptor	Potential Impact	Mitigation Measures	Significance
Environmental Component				
Excavation and foundation works for mounting structures	Soil	Disturbance of soil leading to increased susceptibility to erosion and potential acceleration of existing erosion features within the project footprint.	• Excavation activities should be limited strictly to designated foundation areas to minimize unnecessary soil exposure. • Excavated areas should be backfilled and compacted promptly after installation works to reduce exposure duration. • Temporary erosion control measures such as sandbags, silt fences, or berms should be installed around disturbed areas • Excavation works should, where feasible, be scheduled outside peak rainfall periods to reduce erosion risk	Moderate
Movement of construction vehicles and	Soil	Soil compaction reducing permeability and affecting soil structure within frequently trafficked areas	• Movement of heavy-duty vehicles should be restricted to clearly defined access routes within the site	Minor

equipment within site			• Areas not required for construction activities should be cordoned off to prevent unnecessary movement. • Compacted areas should be ripped/loosened after construction to restore soil permeability.	
Site grading and leveling for panel installation	Soil / Drainage	Alteration of natural surface runoff patterns, leading to localized water concentration and erosion	• Gentle slopes and proper leveling techniques should be adopted to prevent water accumulation • Regular inspection of graded areas should be conducted, especially after rainfall events	Moderate
Trenching for underground distribution cables	Soil	Creation of exposed and loosely compacted soil zones along cable routes, increasing erosion potential, especially during rainfall	• Trenching activities should be planned in sections (progressive trenching) to limit the length of open trenches at any time. • Excavated materials should be placed on one side of the trench and protected from runoff. • Trenches should be backfilled and compacted immediately after cable laying • Temporary barriers or coverings (e.g., tarpaulin) should be used to protect open trenches during rainfall .	Moderate
Movement of vehicles and earthworks	Air quality	Generation of dust (TSP) due to disturbance of dry sandy soil and vehicle movement within site and access roads	• Active work areas and access roads should be regularly watered, especially during dry and windy conditions. • Vehicle speeds within the site should be strictly controlled (≤ 30 km/h) to reduce dust generation • Loading and unloading activities should be conducted in a manner that minimizes dust generation • Workers in high-dust areas should be provided with dust masks	Moderate
Movement of construction equipment	Air quality	Emission of exhaust gases (NOx, CO, SO_2) from diesel-powered machinery	• All construction equipment should undergo regular maintenance and servicing to ensure efficient combustion • Equipment emitting excessive smoke should be withdrawn from use and repaired immediately • Idling of machinery should be minimized; engines should be switched off when not in use	Minor
Operation of machinery and installation activities	Noise	Increased noise levels within the project area affecting nearby communities	• Construction activities should be restricted to daytime hours to minimize disturbance • Equipment should be fitted with functional silencers/mufflers	Moderate
Installation of mounting structures and cable works	Flora / Fauna	Removal of sparse grasses and shrubs within footprint and along cable routes	• Vegetation clearing should be restricted strictly to the required project footprint and cable routes to avoid unnecessary loss • Disturbed areas should be progressively rehabilitated after installation works using native grass species	Negligible

			• Awareness briefings on biodiversity protection should be conducted during worker induction	
Storage and handling of fuel, oil, and materials	Soil / Water	Risk of localized contamination from accidental spills affecting soil and potentially infiltrating groundwater located around the project footprint Potential pollution of the irrigation stream and ponds identified 450 m away from the project site	• Storage areas should be equipped with impermeable flooring and secondary containment (bund walls) to prevent seepage. • Refueling and maintenance activities should be conducted in controlled areas with spill containment measures • Spill kits (absorbent materials, sand, etc.) should be available on site at all times. • Any spills should be immediately contained, cleaned up, and contaminated soil properly disposed. • Regular inspection of storage areas should be conducted to detect leaks early	Moderate
Construction activities and material storage	Waste	Generation of construction waste (scrap materials, packaging, excavated soil) with potential for improper disposal and consequent environmental pollution.	• A waste management plan should be implemented for proper segregation, storage, and disposal of waste. • Waste should be stored in designated areas with appropriate containment to prevent scattering • Disposal should be carried out through approved waste handlers or designated disposal sites. • Open dumping and burning of waste should be strictly prohibited	Minor
Installation of mounting structures and foundations	Visual aesthetics	Temporary visual disturbance due to presence of equipment, materials, and exposed surfaces	• Construction materials and equipment should be neatly arranged and stored in designated areas. • Progressive site cleanup should be carried out as work advances • Disturbed areas should be restored promptly after completion of installation works	Minor
Social Component				
Mobilization and presence of construction workers	University / premises	Temporary disruption to ongoing activities within the university environment due to increased human presence	• Workers should be restricted to designated work zones and not allowed to roam freely within university premises. • Engagement should be maintained with university authorities to coordinate activities with ongoing campus developments	Minor
Engagement of labour	Community	Potential for unmet expectations regarding employment opportunities among local residents, causing grievances	• A grievance redress mechanism (GRM) should be established to handle employment-related complaints • A transparent and well-documented recruitment process should be implemented • Priority should be given to qualified local labour from Oshimili and surrounding communities	Minor

			• Selection criteria should be clearly defined and consistently applied	
Trenching and cable laying across campus	Access / Infrastructure	Temporary obstruction of walkways and internal access routes within the university	• Trenching activities should be carried out in phases to limit the extent of open excavations at any time • Work schedules should be coordinated to minimize disruption to key access routes	Moderate
Presence of workforce	Public Health	Increased risk of communicable diseases and social vices due to interaction between workers and host community	• Workers should undergo health and safety induction, including awareness on communicable diseases • A code of conduct addressing worker-community interactions should be strictly enforced	Minor
Labour dynamics	Social (Gender)	Potential for unequal access to employment opportunities, particularly for women, as well as risks of sexual exploitation, abuse and harassment (SEAH) and gender-based violence (GBV) associated with labour influx during the construction phase.	• Equal opportunity principles should be integrated into recruitment processes • Women should be encouraged to apply for suitable roles, especially in unskilled and semi-skilled categories • Recruitment processes should be free from discrimination based on gender or social status • Awareness should be created among contractors on the importance of gender inclusion in the workforce	Minor
Influx of workers	Local Services	Minor pressure on existing social amenities and services within the university and surrounding areas	• Basic facilities (water, sanitation) should be provided on-site for workers • Workers should be discouraged from using community's amenities without proper consent	Minor
Project activities and expectations	Community Grievance	Potential for complaints arising from perceived impacts or unmet expectations	• A functional grievance redress mechanism (GRM) should be established and communicated to stakeholders • Complaints should be promptly recorded, assessed, and resolved within defined timelines • Regular engagement should be maintained with university authorities and nearby communities • Clear communication should be provided on project scope, timelines, and limitations to manage expectations • Records of grievances and resolutions should be maintained for accountability	Minor
OHS and Community Safety				
Excavation and trenching works	OHS /Workers)	Risk of injuries from trench collapse, slips, trips, and falls within excavation areas	• Excavations should be properly designed with stable side slopes or shoring systems to prevent collapse	Major

			• Open trenches should be clearly barricaded and fitted with warning signage • Excavation areas should be kept free of loose materials and obstructions • Workers should be provided with appropriate PPE (helmets, safety boots, reflective vests) • Daily inspection of trenches should be conducted, especially after rainfall	
Installation of mounting structures and panels	OHS (Workers)	Risk of falls, cuts, and musculoskeletal injuries during installation activities	• Workers should be trained on safe installation techniques and manual handling practice • Use of appropriate lifting equipment and tools should be ensured • Work at height should be supported with fall protection systems (harnesses, guardrails) • PPE such as gloves and helmets should be mandatory at all times	Major
Electrical installation works (cabling, connections)	OHS (Workers)	Risk of electric shock, burns, or electrocution during installation of electrical components	• Electrical works should be carried out only by qualified and certified personnel • All electrical systems should be properly isolated and de-energized before work begins • Use of insulated tools and equipment should be enforced • Workers should wear appropriate PPE (insulated gloves, boots) • Warning signs should be installed around live or high-risk electrical areas.	Major
Operation of machinery and equipment	OHS (Workers)	Exposure to noise, vibration, and mechanical hazards	• Workers should be provided with hearing protection (earplugs/earmuffs) • Only trained personnel should operate machinery • Safe working distances should be maintained around operating equipment. • Work schedules should include rest breaks to reduce exposure to vibration and noise.	Moderate
Movement of construction vehicles within site and access roads	Community Safety	Risk of accidents involving pedestrians, workers, or other road users within the campus	• Clearly defined vehicle routes and pedestrian walkways should be established • Speed limits should be strictly enforced within the project site • Traffic marshals/flagmen should be deployed at high-risk crossing points. • Drivers should be trained on defensive driving and campus safety requirements	Major

Open trenches and excavation areas	Community Safety	Risk of unauthorized access leading to falls or injuries	• Open excavations should be securely barricaded and signposted at all times • Temporary fencing or covers should be installed where necessary • Access to excavation areas should be restricted to authorized personnel only • Night-time visibility should be enhanced using warning lights or reflective markers	Major
Storage of fuel and hazardous materials	OHS / Community Safety	Risk of fire outbreak, explosion, or exposure to hazardous substances	• Fuel and hazardous materials should be stored in designated, well-ventilated areas with proper containment systems • Fire extinguishers should be provided and strategically located • Workers should be trained on fire safety and emergency response procedures • Smoking should be strictly prohibited near fuel storage areas • Emergency response plans should be developed and communicated.	Moderate
Presence of construction workforce	Community Safety	Risk of unsafe interactions, including minor conflicts or security concerns	• A worker code of conduct should be enforced to guide behavior • Workers should undergo induction on community relations and acceptable conduct • Security personnel should be engaged to monitor site access and activities • Grievance mechanisms should be available to report and address conflicts promptly • Workers should be restricted from unauthorized interaction in sensitive areas	Minor

Operation Phase

Activity	Receptor	Potential Impact	Mitigation Measures	Significance
Battery storage and operation.	Soil / Water	Risk of contamination from battery leakage or improper handling of electrolyte materials	• Battery procurement specifications should include OEM safety, storage, and handling requirements as contractual obligations • Suppliers should demonstrate compliance with Extended Producer Responsibility (EPR) obligations for end-of-life battery collection, recycling, and disposal • Batteries should be stored in a secure, well-ventilated, and impermeable containment area to prevent leakage into soil • Secondary containment systems (e.g., bunds) should be provided to capture any accidental spills	Moderate

			• Routine inspection of battery units should be conducted to detect leaks or damage early • Handling of batteries should follow manufacturer guidelines and safety procedures • Spill response materials should be readily available at battery storage locations	
Operation of equipment (inverters, transformers)	Noise	Low-level noise generation from operational equipment	• Equipment should be properly installed and maintained to minimize noise emissions • Noise-generating equipment should be housed or shielded where necessary • Routine maintenance should be conducted to prevent abnormal noise levels • Monitoring should be carried out periodically to ensure noise remains within acceptable limits	Minor
Cleaning of solar panels	Water resources	Use of water for panel cleaning leading to minimal water demand	• Water use for cleaning should be optimized through efficient cleaning methods (e.g., controlled spraying) • Cleaning activities should be scheduled to avoid unnecessary frequency. • Where feasible, non-potable water sources should be utilized • Water use should be monitored to ensure efficiency	Negligible
Maintenance activities	Waste generation	Generation of minor waste such as damaged components, packaging, and maintenance residues	• Waste should be segregated and stored in designated areas • Recyclable materials (e.g., metals, packaging) should be recovered and reused where possible • Waste should be disposed through approved waste management facilities. • Open dumping or burning of waste should be strictly prohibited • Maintenance records should include waste tracking and disposal logs.	Minor
End-of-life components (batteries, panels)	Soil / Environment	Potential environmental risk from improper disposal of hazardous components (e-waste)	• A formal e-waste management plan should be implemented for end-of-life components • Used batteries and panels should be returned to manufacturers or certified recyclers • Temporary storage of decommissioned components should be in secure and controlled conditions • Handling of hazardous waste should comply with national environmental regulations	Moderate

			• Records of disposal and recycling should be maintained for accountability.	
Operation of electrical systems (inverters, cables, connections)	OHS (Workers)	Risk of electric shock, burns, or electrocution during operation and maintenance	• Electrical systems should be regularly inspected and maintained by qualified personnel • Access to electrical installations should be restricted to authorized personnel only • Warning signage should be installed in high-risk electrical areas • Lockout/tag-out procedures should be implemented during maintenance • Workers should use appropriate PPE (insulated gloves, boots) during maintenance	Major
Battery storage and management	OHS (Workers)	Risk of chemical exposure, fire, or explosion in case of battery failure or improper handling	• Battery storage areas should be equipped with fire detection and suppression systems • Adequate ventilation should be maintained to prevent accumulation of hazardous gases • Emergency response procedures should be developed and regularly tested. • Staff should be trained on battery handling and emergency response • Storage conditions should comply with manufacturer specifications	Major
Operation of facility within campus	Community Safety	Risk of unauthorized access to energized equipment or restricted areas leading to injury	• The facility should be properly fenced and secured to prevent unauthorized access • Security personnel should be engaged to monitor and control site access. • Warning signs such as *"Danger: High Voltage"* should be installed at visible locations • Access control measures (e.g., locked gates, ID systems) should be implemented • Regular inspection of security systems should be conducted	Major

CHAPTER SEVEN: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

7.1 Overview

The Environmental and Social Management Plan (ESMP) provides a structured framework for implementing, monitoring, and managing the mitigation measures identified in this ESIA. It is designed to ensure that potential environmental and social impacts associated with the Solar Hybrid Mini-Grid Project at the Admiralty University of Nigeria, Ibusa (ADUN) are effectively controlled throughout the project lifecycle.

The ESMP also provides for periodic reporting, supervision, and adaptive management. Monitoring results will be documented and used to inform corrective actions where necessary, ensuring continuous improvement in environmental and social performance throughout the project lifecycle.

7.2 Objectives of the ESMP

The key objectives of the ESMP are to:

- Ensure the effective implementation of all mitigation measures identified in this ESIA;
- Promote compliance with applicable national environmental regulations and relevant international standards, including those of the Federal Ministry of Environment and the African Development Bank;
- Establish a monitoring framework to track environmental and social performance using clearly defined and measurable indicators;
- Promote community health and safety through effective management of project-related risks;
- Ensure transparent stakeholder engagement and provide mechanisms for addressing grievances;
- Promote fair and inclusive employment practices, including equal opportunity for qualified individuals;
- Facilitate capacity building through training, awareness, and continuous supervision of project personnel; and
- Provide a basis for corrective actions and continuous improvement in project implementation.

7.3 Scope and Content of the ESMP

The ESMP outlines the specific measures required to manage identified environmental and social impacts across the pre-construction, construction, and operation phases of the project. For each identified impact, the ESMP specifies:

- the proposed mitigation measures;
- monitoring indicators for assessing performance;
- frequency of monitoring and reporting;
- institutional responsibilities for implementation and supervision; and
- estimated costs associated with mitigation and monitoring measures.

The mitigation and monitoring measures are presented in a structured matrix format, covering environmental, social, occupational health, and community safety aspects of the project. These matrices provide a practical tool for guiding day-to-day implementation and ensuring accountability throughout the project lifecycle.

7.4 ESMP Matrix: Pre-Construction Phase

Table 18: ESMP Matrix for Pre-construction Phase

Project Activity	Receptor	Potential Negative Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Costs (In Naira)	
								Mitigation	Monitoring
Environmental Component									
Mobilization of construction materials and equipment to proposed university site	Air quality and Noise	Generation of dust along the university's access roads and within the project site due to movement of delivery trucks	Minor	• All access roads and active work areas shall be regularly watered, particularly during dry and windy conditions, to suppress dust generation. • Delivery trucks transporting fine materials (e.g., sand, laterite) should be covered with tarpaulin to prevent dust dispersion. • Vehicle movement within the site should be restricted to designated routes to minimize surface disturbance.- Speed limits (e.g., ≤ 30 km/h) shall be enforced for all construction vehicles within campus roads.	Regular watering observed; low visible dust; covered trucks; compliance with routes/speed limits	Daily	**Mitigation** Contractor **Monitoring** NEP (PMU). Site Engineer.	500,000.000	200,000.00
		Exhaust fumes from vehicles resulting to environmental pollution and respiratory discomfort to project community	Minor	• All vehicles and machinery should undergo routine maintenance and servicing to ensure efficient fuel combustion and reduced emissions. • switch off engines when not in use.	Maintenance logs; no excessive smoke; engines off when idle	Weekly / Continuous	**Mitigation** Contractor **Monitoring** NEP (PMU) . Site Engineer.	500,000.00	100,000.00
		Increase in ambient noise levels	Minor	• Vehicles and equipment should be fitted with functional silencers/mufflers. • Mobilization activities should be restricted to daytime hours (e.g., 8:00 am – 6:00 pm) to avoid nuisance	Silencers installed; compliance with work hours; complaints record	Weekly			

Project Activity	Receptor	Potential Negative Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Costs (In Naira)	
								Mitigation	Monitoring
Site clearing	Soil	Localized soil compaction and disturbance within areas designated for temporary material storage	Minor	• Movement of heavy equipment should be limited to designated areas to prevent widespread soil compaction • Where compaction occurs, affected soils should be loosened/ripped after use to restore permeability	Designated routes used; compacted areas restored	weekly			
		Minor disturbance of the sandy-silty topsoil within the designated project area may increase susceptibility to surface erosion and could potentially accelerate existing erosion processes, particularly during early rainfall events.	Minor	• Vegetation clearing should be restricted strictly to the project footprint to preserve natural ground cover. • Topsoil should be carefully stripped, stockpiled, and protected for later reinstatement. • Land clearing should be scheduled, where possible, to avoid peak rainfall periods. • Exposed surfaces should be stabilized promptly after clearing activities.	Topsoil stockpiled; erosion signs monitored; stabilization applied	Weekly / After rainfall	**Mitigation** Contractor **Monitoring** NEP (PMU). Site Engineer.	700,000.00	200,000.00
	Biological (Flora & Fauna)	Removal of sparse vegetation and temporary disturbance to local fauna within the project footprint	Negligible	• Clearing should be limited to only required areas - avoiding unnecessary vegetation removal • Post-construction, disturbed areas should be rehabilitated/re-vegetated using native species.	Clearing within footprint; no unnecessary removal; evidence of rehabilitation	Weekly	**Mitigation** Contractor **Monitoring** NEP (PMU) . Site Engineer.	1,000,000.00	100,000.00
Social Component									
Movement of vehicles and equipment	Traffic / Access	Temporary increase in vehicular movement within the university access routes, with minor disruption to movement	Minor	• Movement of delivery vehicles should be scheduled during off-peak hours to minimize interference with campus traffic and nearby community movement. • Temporary traffic control measures (signage, flagmen)	Traffic signs/flagmen present; complaints record	Weekly	**Mitigation** Contractor **Monitoring** NEP (PMU) . Site Engineer.	500,000.00	100,000.00

Project Activity	Receptor	Potential Negative Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Costs (In Naira)	
								Mitigation	Monitoring
				should be deployed at critical points along access roads. • Coordination should be maintained with university management to align with ongoing construction activities within the campus.					
		Minor disturbance to nearby university users and surrounding areas due to increased human activity	Minor	Mobilization activities should be properly planned and coordinated to reduce unnecessary movement and congestion	Complaints record; coordination evidence	Daily / Weekly	**Mitigation** Contractor **Monitoring** NEP (PMU) . Site Engineer.	N/A	N/A
Handling and movement of equipment	OHS	Risk of minor accidents or injuries to workers during loading, unloading, and movement of equipment on site	Minor	• Workers involved should be provided with appropriate Personal Protective Equipment (PPE) such as gloves, helmets, and safety boots. • Equipment handling procedures should be clearly communicated and enforced.	PPE usage rate; safety briefings; incident records	Monthly	**Mitigation** Contractor **Monitoring** NEP (PMU). Site Engineer.	500,000.00	200,000.00
		Influx of people (migrant workers, sub-contractors and suppliers) and increased pressure on existing social infrastructure	Minor	• Preference should be given to local labour recruitment from Oshimili and surrounding communities where skills are available. • Engagement with community leaders should be carried out to manage expectations regarding employment opportunities. • Workers should be provided with basic on-site facilities (e.g., sanitation, water) to reduce pressure on local infrastructure.	Local labou percentage; facilities available; complaints recorded	Monthly	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer.	1,000,000.00	200,000.00

Project Activity	Receptor	Potential Negative Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Costs (In Naira)	
								Mitigation	Monitoring
Project mobilization and initial engagement	Community	Minor safety risks to pedestrians and road users within campus access routes	Minor	• Warning signs and temporary safety signage should be installed along access routes to the site. • Traffic marshals/flagmen should be positioned at key crossing points during peak movement periods	Signage present; marshals deployed; incident records	Daily	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer		
Project mobilization and initial engagement		Grievances from poor recruitment of local labour for semi- and unskilled jobs	Minor	• A transparent and documented recruitment process should be adopted. • Job opportunities for unskilled roles should be publicly communicated within nearby communities. • Selection criteria should be clearly defined and consistently applied. • Grievance redress mechanism (GRM) should be established to address complaints related to employment.	GRM records; complaints resolved	Daily	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	500,000.00	100,000.00
Project mobilization and initial engagement		Increase in sexual activities and potential spread of STDs/STIs due to labour influx	Minor	• Awareness programs on HIV/AIDS and STDs/STIs prevention should be conducted for workers. • Information materials (posters, briefings) should be provided at site and worker gathering points	Awareness sessions; materials available; attendance	Monthly	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	500,000.00	100,000.00
Project mobilization and initial engagement		Induced SEA/SH and other GBV risks due to labour influx	Minor	• A strict Code of Conduct addressing SEA/SH and GBV should be developed and enforced for all workers. • Workers should undergo mandatory induction and sensitization on acceptable behavior and consequences of violations	Code of conduct; trainings; reporting cases.	Continuous	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	500,000.00	100,000.00

Project Activity	Receptor	Potential Negative Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Costs (In Naira)	
								Mitigation	Monitoring
				• A confidential reporting mechanism should be established for GBV-related complaints • Sanctions for violations should be clearly defined and enforced.					
Project mobilization and initial engagement	Security	Risk of unauthorized access to project site leading to potential theft of equipment and accidents	Minor	• The project site should be properly secured using temporary fencing or barriers. • Security personnel should be engaged to control access to the site • Warning signs such as *"No Unauthorized Access"* should be installed at visible locations.	Fencing; security staff; access logs.	Daily	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	800,000.00	100,000.00
						Total Costs		**7,000,000.00**	**1,500,000.00**

ESMP: Construction Phase

Project Activities	Receptors	Potential Negative Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Costs (Naira)	
								Mitigation	Monitoring
Environmental Component									
Excavation and foundation works for mounting structures	Soil	Disturbance of soil leading to increased susceptibility to erosion and potential acceleration of existing erosion features within the project footprint.	Moderate	• Excavation activities should be limited strictly to designated foundation areas to minimize unnecessary soil exposure. • Excavated areas should be backfilled and compacted promptly after installation works to reduce exposure duration.	Presence of erosion control measures; exposed soil areas minimized; backfilled areas	Weekly / After rain	**Mitigation** Contractor **Monitoring** REA (PMU) Site Engineer	1,500,000.00	300,000.00

Project Activities	Receptors	Potential Negative Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Costs (Naira)	
								Mitigation	Monitoring
				• Temporary erosion control measures such as sandbags, silt fences, or berms should be installed around disturbed areas • Excavation works should, where feasible, be scheduled outside peak rainfall periods to reduce erosion risk					
Movement of construction vehicles and equipment within site	Soil	Soil compaction reducing permeability and affecting soil structure within frequently trafficked areas	Minor	• Movement of heavy-duty vehicles should be restricted to clearly defined access routes within the site • Areas not required for construction activities should be cordoned off to prevent unnecessary movement. • Compacted areas should be ripped/loosened after construction to restore soil permeability.	Use of designated routes; evidence of soil restoration	Weekly	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	N/A	200,000.00
Site grading and leveling for panel installation	Soil / Drainage	Alteration of natural surface runoff patterns, leading to localized water concentration and erosion	Moderate	• Gentle slopes and proper leveling techniques should be adopted to prevent water accumulation • Regular inspection of graded areas should be conducted, especially after rainfall events	Absence of water pooling	Weekly / After rain	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	N/A	100,000.00
Trenching for underground distribution cables	Soil	Creation of exposed and loosely compacted soil zones along cable routes, increasing erosion potential, especially during rainfall	Moderate	• Trenching activities should be planned in sections (progressive trenching) to limit the length of open trenches at any time. • Excavated materials should be placed on one side of the trench and protected from runoff.	Length of open trenches; backfilling compliance	Daily	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	1,000,000.00	300,000.00

Project Activities	Receptors	Potential Negative Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Costs (Naira)	
								Mitigation	Monitoring
				• Trenches should be backfilled and compacted immediately after cable laying • Temporary barriers or coverings (e.g., tarpaulin) should be used to protect open trenches during rainfall .					
Movement of vehicles and earthworks	Air quality	Generation of dust (TSP) due to disturbance of dry sandy soil and vehicle movement within site and access roads	Moderate	• Active work areas and access roads should be regularly watered, especially during dry and windy conditions. • Vehicle speeds within the site should be strictly controlled (≤ 30 km/h) to reduce dust generation • Loading and unloading activities should be conducted in a manner that minimizes dust generation • Workers in high-dust areas should be provided with dust masks	Watering records; visible dust levels; PPE use	Daily	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	500,000.00	200,000.00
Movement of construction equipment	Air quality	Emission of exhaust gases (NO_x, CO, SO_2) from diesel-powered machinery	Minor	• All construction equipment should undergo regular maintenance and servicing to ensure efficient combustion • Equipment emitting excessive smoke should be withdrawn from use and repaired immediately • Idling of machinery should be minimized; engines should be switched off when not in use	Maintenance logs; absence of excessive smoke	Weekly	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	N/A *Activities costed under pre-construction*	100,000.00

Project Activities	Receptors	Potential Negative Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Costs (Naira)	
								Mitigation	Monitoring
Operation of machinery and installation activities	Noise	Increased noise levels within the project area affecting nearby communities	Moderate	• Construction activities should be restricted to daytime hours to minimize disturbance • Equipment should be fitted with functional silencers/mufflers	Work hours compliance; complaints record	Weekly	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer		
Installation of mounting structures and cable works	Flora / Fauna	Removal of sparse grasses and shrubs within footprint and along cable routes	Negligible	• Vegetation clearing should be restricted strictly to the required project footprint and cable routes to avoid unnecessary loss • Disturbed areas should be progressively rehabilitated after installation works using native grass species • Awareness briefings on biodiversity protection should be conducted during worker induction	Clearing within footprint; rehabilitation evidence	Weekly	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	500,000.00	200,000.00
Storage and handling of fuel, oil, and materials	Soil / Water	Risk of localized contamination from accidental spills affecting soil and potentially infiltrating groundwater located around the project footprint Potential pollution of the irrigation stream and ponds identified 450 m away from the project site	Moderate	• Storage areas should be equipped with impermeable flooring and secondary containment (bund walls) to prevent seepage. • Refueling and maintenance activities should be conducted in controlled areas with spill containment measures • Spill kits (absorbent materials, sand, etc.) should be available on site at all times. • Any spills should be immediately contained, cleaned up, and contaminated soil properly disposed.	Bunds present; spill kits available; no contamination signs	Weekly	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	1,000,000.00	200,000.00

Project Activities	Receptors	Potential Negative Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Costs (Naira)	
								Mitigation	Monitoring
				• Regular inspection of storage areas should be conducted to detect leaks early					
Construction activities and material storage	Waste	Generation of construction waste (scrap materials, packaging, excavated soil) with potential for improper disposal and consequent environmental pollution.	Minor	• A waste management plan should be implemented for proper segregation, storage, and disposal of waste. • Waste should be stored in designated areas with appropriate containment to prevent scattering • Disposal should be carried out through approved waste handlers or designated disposal sites. • Open dumping and burning of waste should be strictly prohibited.	Waste segregation; disposal records	Weekly	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	1,500,000.00	300,000.00
Installation of mounting structures and foundations	Visual aesthetics	Temporary visual. disturbance due to presence of equipment, materials, and exposed surfaces	Minor	• Construction materials and equipment should be neatly arranged and stored in designated areas. • Progressive site cleanup should be carried out as work advances • Disturbed areas should be restored promptly after completion of installation works	Site tidiness; organized work materials	Weekly	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	300,000.00	100,000.00
Mobilization and presence of construction workers	University / premises	Temporary disruption to ongoing activities within the university environment due to increased human presence	Minor	• Workers should be restricted to designated work zones and not allowed to roam freely within university premises. • Engagement should be maintained with university authorities to coordinate activities with ongoing campus developments	Complaints record; coordination evidence	Weekly	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	N/A	200,000.00

Project Activities	Receptors	Potential Negative Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Costs (Naira)	
								Mitigation	Monitoring
Engagement of labour	Community	Potential for unmet expectations regarding employment opportunities among local residents, causing grievances	Minor	• A grievance redress mechanism (GRM) should be implemented to handle employment-related complaints • A transparent and well-documented recruitment process should be implemented • Priority should be given to qualified local labour from Oshimili and surrounding communities • Selection criteria should be clearly defined and consistently applied	GRM records; resolved complaints	Monthly	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	N/A	200,000.00
Trenching and cable laying across campus	Access / Infrastructure	Temporary obstruction of walkways and internal access routes within the university	Moderate	• Trenching activities should be carried out in phases to limit the extent of open excavations at any time • Work schedules should be coordinated to minimize disruption to key access routes	Barricades / signage; alternative routes	Daily	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	N/A	200,000.00
Presence of workforce	Public Health	Increased risk of communicable diseases and social vices due to interaction between workers and host community	Minor	• Workers should undergo health and safety induction, including awareness on communicable diseases • A code of conduct addressing worker-community interactions should be strictly enforced	Awareness records; sanitation availability	Monthly	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	500,000.00	200,000.00
Labour dynamics	Social (Gender)	Potential for unequal access to employment opportunities, particularly for women	Minor	• Equal opportunity principles should be integrated into recruitment processes • Women should be encouraged to apply for suitable roles, especially in unskilled and semi-skilled categories	Female participation; recruitment records	Monthly	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	N/A	200,000.00

Project Activities	Receptors	Potential Negative Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Costs (Naira)	
								Mitigation	Monitoring
				• Recruitment processes should be free from discrimination based on gender or social status • Awareness should be created among contractors on the importance of gender inclusion in the workforce.					
Influx of workers	Local Services	Minor pressure on existing social amenities and services within the university and surrounding areas	Minor	• Basic facilities (water, sanitation) should be provided on-site for workers • Workers should be discouraged from using community's amenities without proper consent	Facilities availability; complaints recorded	Monthly	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	N/A	N/A
Project activities and expectations	Community Grievance	Potential for complaints arising from perceived impacts or unmet expectations	Minor	• A functional grievance redress mechanism (GRM) should be established and communicated to stakeholders • Complaints should be promptly recorded, assessed, and resolved within defined timelines • Regular engagement should be maintained with university authorities and nearby communities • Records of grievances and resolutions should be maintained for accountability	GRM logs; resolution time	Monthly	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	N/A	N/A
OHS and Community Safety									
Excavation and trenching works	OHS /Workers)	Risk of injuries from trench collapse, slips, trips, and falls within excavation areas	Major	• Excavations should be properly designed with stable side slopes or shoring systems to prevent collapse • Open trenches should be clearly barricaded and fitted with warning signage	PPE use; barricades; inspection logs	Daily	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	800,000.00	200,000.00

Project Activities	Receptors	Potential Negative Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Costs (Naira)	
								Mitigation	Monitoring
				• Excavation areas should be kept free of loose materials and obstructions • Workers should be provided with appropriate PPE (helmets, safety boots, reflective vests) • Daily inspection of trenches should be conducted, especially after rainfall					
Installation of mounting structures and panels	OHS (Workers)	Risk of falls, cuts, and musculoskeletal injuries during installation activities	Major	• Workers should be trained on safe installation techniques and manual handling practice • Use of appropriate lifting equipment and tools should be ensured • Work at height should be supported with fall protection systems (harnesses, guardrails) • PPE such as gloves and helmets should be mandatory at all times	Training records; PPE compliance	Daily	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	500,000.00	100,000.00
Electrical installation works (cabling, connections)	OHS (Workers)	Risk of electric shock, burns, or electrocution during installation of electrical components	Major	• Electrical works should be carried out only by qualified and certified personnel • All electrical systems should be properly isolated and de-energized before work begins • Use of insulated tools and equipment should be enforced • Workers should wear appropriate PPE (insulated gloves, boots) • Warning signs should be installed around live or high-risk electrical areas.	Presence of qualified staff; lockout use; signage	Daily	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	500,000.00	200,000.00

Project Activities	Receptors	Potential Negative Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Costs (Naira)	
								Mitigation	Monitoring
Operation of machinery and equipment	OHS (Workers)	Exposure to noise, vibration, and mechanical hazards	Moderate	• Workers should be provided with hearing protection (earplugs/earmuffs) • Only trained personnel should operate machinery • Safe working distances should be maintained around operating equipment. • Work schedules should include rest breaks to reduce exposure to vibration and noise.	PPE use; operator certification	Weekly	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	N/A	N/A
Movement of construction vehicles within site and access roads	Community Safety	Risk of accidents involving pedestrians, workers, or other road users within the campus	Major	• Clearly defined vehicle routes and pedestrian walkways should be established • Speed limits should be strictly enforced within the project site • Traffic marshals/flagmen should be deployed at high-risk crossing points. • Drivers should be trained on defensive driving and campus safety requirements	Speed compliance; marshals present	Daily	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	N/A	200,000.00
Open trenches and excavation areas	Community Safety	Risk of unauthorized access leading to falls or injuries	Major	• Open excavations should be securely barricaded and signposted at all times • Temporary fencing or covers should be installed where necessary • Access to excavation areas should be restricted to authorized personnel only • Night-time visibility should be enhanced using warning lights or reflective markers	Presence of barricades; warning lights	Daily	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	N/A	N/A

Project Activities	Receptors	Potential Negative Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Costs (Naira)	
								Mitigation	Monitoring
Storage of fuel and hazardous materials	OHS / Community Safety	Risk of fire outbreak, explosion, or exposure to hazardous substances	Moderate	• Fuel and hazardous materials should be stored in designated, well-ventilated areas with proper containment systems • Fire extinguishers should be provided and strategically located • Workers should be trained on fire safety and emergency response procedures • Smoking should be strictly prohibited near fuel storage areas • Emergency response plans should be developed and communicated.	Presence of fire Extinguishers; training records	Weekly	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	500,000.00	100,000.00
Presence of construction workforce	Community Safety	Risk of unsafe interactions, including minor conflicts or security concerns	Minor	• A worker code of conduct should be enforced to guide behavior • Workers should undergo induction on community relations and acceptable conduct • Security personnel should be engaged to monitor site access and activities • Grievance mechanisms should be available to report and address conflicts promptly • Workers should be restricted from unauthorized interaction in sensitive areas.	Incident records; code of conduct enforcement	Weekly	**Mitigation** Contractor **Monitoring** NEP (PMU) Site Engineer	500,000.00	100,000.00
TOTAL CONSTRUCTION COST								**9,100,000.00**	**3,900,000.00**

ESMP: Operation Phase

Project Activity	Receptors	Potential Negative Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsivity	Cost (Naira)	
								Mitigation	Monitoring
Battery storage and operation.	Soil / Water	Risk of contamination from battery leakage or improper handling of electrolyte materials	Moderate	• Batteries should be stored in a secure, well-ventilated, and impermeable containment area to prevent leakage into soil • Secondary containment systems (e.g., bunds) should be provided to capture any accidental spills • Routine inspection of battery units should be conducted to detect leaks or damage early • Handling of batteries should follow manufacturer guidelines and safety procedures • Spill response materials should be readily available at battery storage locations	No leakage observed; bunds intact; spill kits available; inspection records	Weekly	**Mitigation** Facility Operator **Monitoring** NEP (PMU) Site Engineer	1,500,000.00	200,000.00
Operation of equipment (inverters, transformers)	Noise	Low-level noise generation from operational equipment	Minor	• Equipment should be properly installed and maintained to minimize noise emissions • Noise-generating equipment should be housed or shielded where necessary • Routine maintenance should be conducted to prevent abnormal noise levels • Monitoring should be carried out periodically to ensure noise remains within acceptable limits	No abnormal noise; maintenance records; no complaints	Quarterly	**Mitigation** Operator **Monitoring** NEP (PMU) Site Engineer	500,000.00	100,000.00
Cleaning of solar panels	Water resources	Use of water for panel cleaning leading to minimal water demand	Negligible	• Water use for cleaning should be optimized through efficient cleaning methods (e.g., controlled spraying) • Cleaning activities should be scheduled to avoid unnecessary frequency. • Where feasible, non-potable water sources should be utilized • Water use should be monitored to ensure efficiency	Water use records; efficient methods used; no excessive use	Monthly	**Mitigation** Operator **Monitoring** NEP (PMU) Site Engineer	N/A	100,000.00
Maintenance activities	Waste generation	Generation of minor waste such as damaged components, packaging, and	Minor	• Waste should be segregated and stored in designated areas • Recyclable materials (e.g., metals, packaging) should be recovered and reused where possible	Waste segregated; disposal records; no dumping	Monthly	**Mitigation** Operator **Monitoring**	1,000,000.00	200,000.00

Project Activity	Receptors	Potential Negative Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsivity	Cost (Naira)	
								Mitigation	Monitoring
		maintenance residues		• Waste should be disposed through approved waste management facilities in Deltastate • Open dumping or burning of waste should be strictly prohibited • Maintenance records should include waste tracking and disposal logs.			NEP (PMU) Site Engineer		
End-of-life components (batteries, panels)	Soil / Environment	Potential environmental risk from improper disposal of hazardous components (e-waste)	Moderate	• A formal e-waste management plan should be implemented for end-of-life components • Used batteries and panels should be returned to manufacturers or certified recyclers • Temporary storage of decommissioned components should be in secure and controlled conditions • Handling of hazardous waste should comply with national environmental regulations • Records of disposal and recycling should be maintained for accountability.	E-waste records; recycler receipts; secure storage	Annually	**Mitigation** Operator **Monitoring** NEP (PMU) Site Engineer	1,000,000.00	200,000.00
Operation of electrical systems (inverters, cables, connections)	OHS (Workers)	Risk of electric shock, burns, or electrocution during operation and maintenance	Major	• Electrical systems should be regularly inspected and maintained by qualified personnel • Access to electrical installations should be restricted to authorized personnel only • Warning signage should be installed in high-risk electrical areas • Lockout/tag-out procedures should be implemented during maintenance • Workers should use appropriate PPE (insulated gloves, boots) during maintenance	Qualified personnel; PPE use; lockout applied; signage present	Monthly	**Mitigation** Operator **Monitoring** NEP (PMU) Site Engineer	500,000.00	100,000.00
Battery storage and management	OHS (Workers)	Risk of chemical exposure, fire, or explosion in case of battery failure or improper handling	Major	• Battery storage areas should be equipped with fire detection and suppression systems • Adequate ventilation should be maintained to prevent accumulation of hazardous gases • Emergency response procedures should be developed and regularly tested. • Staff should be trained on battery handling and emergency response	Fire systems functional; ventilation adequate; training records.	Monthly	**Mitigation** Operator **Monitoring** NEP (PMU) Site Engineer	500,000.00	100,000.00

Project Activity	Receptors	Potential Negative Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsivity	Cost (Naira)	
								Mitigation	Monitoring
				• Storage conditions should comply with manufacturer specifications					
Operation of facility within campus	Community Safety	Risk of unauthorized access to energized equipment or restricted areas leading to injury	Major	• The facility should be properly fenced and secured to prevent unauthorized access • Security personnel should be engaged to monitor and control site access. • Warning signs such as *"Danger: High Voltage"* should be installed at visible locations • Access control measures (e.g., locked gates, ID systems) should be implemented • Regular inspection of security systems should be conducted.	Fencing intact; security present; access logs maintained	Weekly	**Mitigation** Operator **Monitoring** NEP (PMU) Site Engineer, Security.	N/A	200,000.00
						TOTAL OPERATION COST		**5,000,000.00**	**1,200,000.00**

7.5 Roles, Responsibilities and Accountabilities

The Rural Electrification Agency Project Management Unit (NEP-PMU) supervises the implementation of the ESMP throughout the project life span while conformance with the mitigation measures will be ensured by the Engineering, Procurement and Construction (EPC) contractor during the construction phase and by the operations and maintenance (O&M) contractor during the operational phase of the project. Table 23 indicates the Roles and Responsibilities of the Stakeholders in the Implementation, Monitoring and Review of the ESMP.

Table 19: Institutional Roles & Responsibilities for ESMP Implementation

S/N	Stakeholder	Roles and Responsibilities
1.	ADUN Director Physical Planning:	**Pre-Construction Phase** • Earmark the areas for the project development from the survey land • Appoint a Site Engineer • Arrange and ensure adequate training is carried out for the Site Engineer • Review the ESMP from the consultant • Ensure the University's commitment to the ESMP implementation • Implement the restoration of livelihood to affected persons before mobilization to site **Operational Phase** • Supervise the activities of the Site Engineer by reviewing reports on ESMP issues • Suggest ESMP improvements to O&M Contractor and PMU to address noncompliance and upcoming issues
2.	NEP-PMU	**Pre-Construction Phase** • Provide technical support to the University in the final selection of sufficient and suitable land for construction of power plant and training centre • Appoint an EPC contractor • Supervise the activities of the EPC contractor • Review the ESMP from the consultant • Ensure REA's commitment to the ESMP implementation **Construction phase** • Supervise the activities of the EPC contractor by reviewing reports on ESMP issues • Discuss ESMP improvements with ADUN Director of Physical Planning to address non-compliance and upcoming issues • Monitor the implementation of the ESMP • Supervise the activities of the EPC contractor and ensure compliance ESMP with mitigation measures • Report to ADUN Director of Physical Planning on ESMP compliance and noncompliance issues **Operational** • Appoint an O&M Contractor • Supervise the activities of the O&M Contractor by reviewing reports on ESMP issues • Discuss ESMP improvements with ADUN Director of Physical Planning to address non-compliance and upcoming issues
3.	Site Engineer	**Pre-Construction Phase** • Attend adequate training on ESMP implementation • Supervise the activities of the EPC contractor and ensure compliance ESMP with mitigation measures • Report to ADUN Director of Physical Planning on ESMP compliance and noncompliance issues

		Operational phase • Appoint a O&M Contractor • Supervise the activities of the O&M Contractor by reviewing reports on ESMP issues • Discuss ESMP improvements with ADUN Director of Physical Planning to address non-compliance and upcoming issues
4. 4	EPC Contractor	• Familiarize with ESMP requirements • Ensure that all personnel are made aware of the management measures/plans that are to be implemented • Report to the NEP-PMU, POE and ADUN Site Engineer on ESMP compliance and noncompliance issues • Implement ESMP requirements relevant to work being undertaken **Construction phase** • Implement ESMP requirements relevant to work being undertaken • Hire a Gender/GBV officer • Report to the REA-PMU, POE and ADUN Site Engineer on ESMP compliance and noncompliance issue
5.	O&M Contractor	• Implement ESMP requirements relevant to work being undertaken • Hire a Gender/ GBV officer • Report to the NEP-PMU, POE and ADUN Site Engineer on ESMP compliance and non-compliance issue
6.	FMEnv Representatives	• Monitor the implementation of ESMP requirements (impact mitigation monitoring) relevant to work being undertaken • Discuss ESMP improvements with ADUN Director of Physical Planning and NEP-PMU to address non-compliance and upcoming issues **Operational phase** • Monitor the implementation of ESMP requirements (environmental compliance monitoring) relevant to work being undertaken • Discuss ESMP improvements with O&M Contractor, ADUN Director of Physical Planning, and NEP-PMU to address non-compliance and upcoming issues
7.	NESREA Representatives	• Monitor the implementation of ESMP requirements (environmental compliance monitoring) relevant to work being undertaken • Discuss ESMP improvements with O&M Contractor, ADUN Director of Physical Planning, and NEP-PMU to address non-compliance and upcoming issues
8.	Delta State Ministry of Women Affairs and Social Development (GBV/SEA service provider)	• Monitor the implementation of Gender mitigation measures relevant to work being undertaken • Discuss ESMP improvements with the Gender/GBV officer, ADUN Director of Physical Planning, and NEP-PMU to address non-compliance and upcoming issues **Operational** • Monitor the implementation of Gender mitigation measures relevant to work being undertaken • Discuss ESMP improvements with the Gender/GBV officer, ADUN Director of Physical Planning, and NEP-PMU to address non-compliance and upcoming issues
9.	Delta State Ministry of Environment Representatives	• Monitor the implementation of ESMP requirements (impact-mitigation monitoring) relevant to work being undertaken • Discuss ESMP improvements with ADUN Director of Physical Planning and NEP-PMU to address non-compliance and upcoming issue
10.	Delta State Ministry of Environment Representatives	• Monitor the implementation of ESMP requirements (impact-mitigation monitoring) relevant to work being undertaken • Discuss ESMP improvements with ADUN • Director of Physical Planning and NEP-PMU to address non-compliance and upcoming issues

		Operational • Monitor the implementation of ESMP requirements (environmental compliance monitoring) relevant to work being undertaken • Discuss ESMP improvements with O&M Contractor, ADUN Director of Physical Planning, and NEP-PMU to address non-compliance and upcoming issues
11.	Safeguards Unit	**Environmental Aspects** • Analyze potential community/individual sub-projects and their environmental impacts; • Ensure that project activities are implemented in accordance to best practices and guidelines set out in the site specifics; • Identify and liaise with all stakeholders involved in environment related issues in the project; and • Be responsible for the overall monitoring of mitigation measures and the impacts of the project during implementation. **Social Aspects** • Develop, coordinate and ensures the implementation of the social aspects of the ESMP; • Implement the grievance mechanism on the project • Identify and liaise with all stakeholders involved in social related issues in the project; • Conduct impact evaluation and beneficiaries' assessment; and • Establish partnerships and liaise with organizations, Community Based Organizations (CBOs) and Civil Society Organizations (CSOs).
12.	EPC and Works Contractor	• After receiving and committing to the environmental procedures and Management Plans, • Contractors must fully carry out the measures of the environmental protection, health and safety procedure as indicated; • Any changes related to Environment, health and safety procedure must be referred to PMU for approval • In case of any violations on arising works either detected by Environmental consultant, Safeguard Specialists, or new arising works proposed by contractors, they must be reported to PMU for further actions. • If contractors decided to not follow instruction from PMU, construction activities will be halted until necessary actions are taken. • Contractors must assign at site, personnel in charge of Environment, health and safety procedure. • Compliance to BOQ specification in procurement of material and construction Provide oversight function during construction and decommissioning

7.6 Additional Management Plans

During the progression of the project, management plans will be expanded to include specific procedures to guide implementation by the relevant project personnel and institutions including contractors and subcontractors. Such documents will be prepared strictly in line with the requirements set out in the relevant international standards and guidelines and other applicable national and local regulations and guidelines. The Contractor's plans shall be approved before the relevant activity begins and shall be contractually binding. At a minimum, it shall cover construction E&S management, occupational health and safety, emergency response, BESS/electrical safety, waste, hazardous materials and spill response, traffic, labour and worker accommodation where applicable, security, stakeholder engagement, community GRM, worker GRM, SEA/SH prevention and response, biodiversity/ vegetation, chance finds, erosion/drainage, commissioning and decommissioning.

These additional management plans include the following:

- ❖ Labour Management Plan (LMP) (Annex 6)

- Waste Management Plan (WMP) (Annex 4)
- Grievance Redress Mechanism (GRM) (chapter 9)
- Stakeholder Engagement Plan (SEP) (chapter 9)
- Health and Safety Plan (H&S Plan) (Annex 7)
- Climate Change Adaptation and Mitigation Plan (Annex 5)

Preconstruction Hold Points

A hold point is a mandatory stop in the Project process. Work may proceed only when the listed evidence has been reviewed and the responsible authority has recorded release. Schedule pressure does not authorize bypass.

Hold point	Release evidence	Release before
HP1 — final footprint and land	Licensed survey, title/authority, joint land-status record, receptor/access map	Site possession or clearance
HP2 — final design	Approved layout/SLD, load and BESS sizing, geotechnical/drainage, fire/electrical hazard studies, E&S change review	Procurement and civil works
HP3 — permits and plans	FMEnv/State/NERC/NEMSA and other applicable approvals; approved C-ESMP and sub-plans; competent staff	Mobilisation
HP4 — sensitive activities	Utility clearance, permits to work, task risk assessments, traffic/lifting/excavation controls	Each controlled activity
HP5 — commissioning	Inspection/certification, test dossier, emergency plan/drill, O&M competency, as-built drawings	Energisation
HP6 — operation/ closure	Asset/waste register, monitoring and incident system, replacement/closure funding and approved decommissioning update	Commercial operation and major replacement/closure

7.7 Monitoring and Evaluation Plan

The monitoring plan (Internal and External Monitoring) for the ESMP is presented in Table 24 below. Monitoring results shall be documented with preventive/corrective actions to be implemented.

Table 20: Monitoring Plan for the ESMP

Monitoring	Action	Responsibility	Period	Performance Indicator
Internal Monitoring	Regular site visit to ensure that the mitigation measures and actions specified in the ESMP are implemented and as bound by the contract are satisfactorily implemented.	E&S team of the NEP PMU	During Preconstruction, Construction and Operation Phases	Monitoring Reports and documentation as described below
	Daily monitoring of the contractor's performance and adherence to GBV/SEA/SH obligations	Supervision Consultant, GBV Specialist	During Preconstruction and Construction phases	Monitoring Reports presented to the PMU.
	Site visits for supervision and inspection to ensure contractors adhere strictly to the E&S requirements of the project	Supervising Consultant Environmental, Social, GBV specialists	During Preconstruction and Construction phases	Observations and Monitoring Reports presented to the PMU.

External Monitoring	Periodic site visit to ensure project is implemented in an environmentally & socially sustainable manner using the monitoring indicators specified in the ESMP Matrix and other national and international environmental & social requirements	FMEnv, NESREA, Delta State Ministry of Environment, Representatives of the project community, Oshimili, and other relevant MDAs.	During Preconstruction, Construction and Operation Phases	Inspect monitoring reports from the PMU Provide feedback on observations. Enforce corrective actions where necessary.
	Periodic monitoring of timely, mandatory and confidential reporting for E&S activities	Third Party Monitors	During Preconstruction, Construction and Operation Phases	Monitoring Reports presented to the AfDB

7.8 Training, Awareness and Capacity Building for Zonal Offices

REA shall identify, plan, monitor, and record training needs for personnel whose work may have a significant adverse impact upon the environmental or social conditions. It is important that employees at each relevant phase of the project are aware of the potential environmental impacts of their activities and the occupational hazards associated with the work; as well as their roles and responsibilities in achieving conformance with the management documented in this report. Thus, a formal training process will be organized for employees on environmental management programs, plans and procedures associated with the project.

All staff employed will be trained in the following:

- General operation of the plant;
- Environmental management;
- Specific job roles and procedures;
- Occupational health and safety; and
- Contingency plans and emergency procedures.

Training will include:

- Induction training on appointment;
- Specialist training (as required for specific job role); and
- Refresher training as required.

Training for local community on general environmental awareness and ESMP mitigation measures pertaining to community health, safety and security shall also be provided.

7.8.1 ESMP Capacity Building Plan

The various actors involved in the ESMP implementation will need capacity enhancement to ensure adequate understanding of ESMP/ OHS/ Waste Management/ Code of Conduct requirements amongst other areas identified. Proposed topics and target audience is outlined in Table 25.

Table 21: Proposed Capacity Building Plan

	Training Content	Participants	Delivery	Cost (Naira)

1.	Specific training on Environmental & Social Safeguards	Environmental & Social Safeguard Officer	PMU Consultant	2,000,000.00
2.	Training on ESMP Implementation: mitigation, roles & responsibilities	Project Team	PMU Consultant	1,000,000.00
3.	Training for contractors on ESMP mitigation measures, Code of Conduct, OHS requirements	Contractors' management and workers	PMU Consultant	1,000,000.00
4.	Training of Contractor Drivers, fleet management, traffic control within ADUN etc.	Contractor, contractor drivers, HSE officer, ESO	School of Transport, ADUN / Security Management	2,000,000.00
5.	GBV/SEA/SH Prevention and Response Mechanisms	Project team Environmental & Safeguard Officer, Contractors	PMU Consultant	2,000,000.00
6.	Grievance Redress Mechanism	Grievance Redress Committees: project level and management level GRCs , Contractors	PMU Consultant	2,000,000.00
			Total	**10,000,000.00**

7.9 Implementation Schedule and Reporting

The project has an estimated completion period of 12-18months as outlined in activities related to the ESMP Matrix as seen above should to be integrated into the overall construction schedule.

Implementation will be in line with the finalized overall project schedule, as all activities are integrated into the project design. This will take place from the planning stages to ensure quality equipment and support services are sourced, through construction, commissioning, operation to decommissioning phases. Once monitoring begins, any observation of an environmental problem, such as non-compliance or adverse impacts will be reported immediately by the officers responsible to respective authorities in REA and corrective/ remedial actions will be taken without delay to ensure optimal performance of the project while promoting environmental sustainability. An activity shall stop where an imminent danger, unapproved design change, unmet hold point or serious non-compliance is identified.

Also, REA shall keep the regulatory authorities (FMEnv, NESREA, Delta State Ministry of Environment) informed of the project performance through reports that will be made available to the regulators when required. REA will provide appropriate documentation of HSE related activities, including internal inspection records, training records, and reports to the relevant authorities. These periodic HSE reports summarizing the status of the environment in the plant will be submitted to FMEnv. Any values exceeding regulatory limits will be specifically identified, together with an explanation of the circumstances involved and corrective measures to ensure compliance in the future.

Fatalities, life-threatening injuries, major fire or battery event, electrocution, significant pollution, violence, security incidents involving force, child or forced labour allegations and SEA/SH allegations shall be made safe and notified promptly through the agreed REA/DtP & AfDB protocol and applicable statutory channels. Initial notification shall protect identities and shall be followed by investigation, root-cause analysis, corrective action and lessons learned. SEA/SH handling shall remain survivor-centred and confidential.

Table 22: ESMP Implementation Schedule

S/No	Activity	Responsibility	Months											
			1	2	3	4	5	6	7	8	9	10	11	12 – 18
1	ESMP Disclosure	Project Team												
2	Develop Environmental/Social Requirements in Bid Documents	Project Team												
3	Finalization and Approval of Engineering Designs	Design Consultant/ Project Team												
4	Allocate budget for ESMP Monitoring	Project Team												
5	Appoint Support Staff for ESMP	Project Team												
6	Review and Approval of Contractor's HSE, WMP, TMP etc	ESO/SSO												
7	Capacity building	Project Team												
8	Implementation of Environmental and Social Mitigation Measures	Contractor												
9	Supervision of pre-Construction and Construction activities	Project Team												
10	Supervision of ESMP Implementation	ESO/SSO and Engineering Consultant												
11	Environmental and Social Monitoring and Auditing	FMEnv, SMEnv												
12	Reporting on ESMP Implementation	ESO/SSO												

7.10 ESMP Disclosure

Following the ESMP clearance by the Bank, the PIU shall disclose the ESIA in line with the Nigerian EIA laws. This will include a formal registration of the ESIA with the FMEnv and receipt of guidelines for the disclosure from the EA department including the locations to disclose the documents. At a minimum, this will include the following:

Table 23: ESMP Disclosure

s/n	Entity	Disclosure Requirements
1	Federal Ministry of Environment (FMEnv). Disclosure according to Country System in line with Nigeria EIA Act Cap E12 LFN, 2004	The PMU will disclose the ESIA for 21 days as required by the Nigeria EIA public notice and review procedures in the following offices: - FMEnv Office, - Delta State Ministry of Environment - Oshimili North LGAs - NEP-PMU Office Disclosure will also include adverts in 2 newspapers: one national and one local (state) newspapers and Radio Jingles. The purpose will be to inform stakeholders about the project activities; environmental and social impacts anticipated and proposed environmental and social mitigation measures.
2	AfDB	Disclosure timing shall follow the confirmed AfDB risk categorization, the applicable ISS disclosure requirements and Federal Ministry of Environment direction.

7.11 ESMP Budget

The total costs of the ESMP implementation including costs for mitigation, monitoring and capacity building is estimated as: **₦41,470,000.00** (Forty-One Million, Four Hundred and Seventy Thousand Naira, only.*)* which converts to **$30,094.34** (Thirty Thousand, and Ninety-Four Dollars, Thirty-Four Cents), as detailed in Table 28 below:

Table 24: ESMP Budget

ITEM	RESPONSIBILITY	COST ESTIMATE	
		NAIRA (₦)	USD ($)
Cost of Mitigation	Contractor	21,100,000.00	15,312.05
Cost of Monitoring	NEP-PMU, MDAs	6,600,000.00	4,789.55
Capacity Building	NEP- PMU/Contractor	10,000,000.00	7,256.89
Sub-total		37,700,000.00	27,358.49
Contingency (10% of sub-total)		3,770,000.00	2,735.85
TOTAL		**41,470,000.00**	**30,094.34**

Exchange Rate $1.00(USD) = ₦1,378 (NGN) – CBN rate as at July, 2026

CHAPTER EIGHT: REMEDIATION PLAN AFTER DECOMMISIONING/ CLOSURE

8.1 Introduction

Decommissioning is planned from the design stage because component replacement and end-of-life obligations arise throughout the Project lifecycle.

Upon the completion of useful life cycle of the project, there is a need to abandon and/or decommission such project if it no longer becomes economically viable either as a result of depleted feed stock or competing technology. The proposed solar project is expected to have a life span of 25 years. It is envisaged that technology and environmental policies could have changed so drastically by then, hence a definite decommissioning plan cannot be put in place for now. However, it is of importance that abandonment activities be planned in advance in accordance with the Nigerian regulatory requirements.

This chapter establishes the minimum framework; a detailed, costed closure plan shall be updated periodically and before any major replacement, repowering or closure decision.

8.2 Decommissioning Activities

Decommissioning refers to the process of removing all the operating assets of a project after completion of its life cycle. PV modules, batteries, inverters, transformers and civil/electrical infrastructure have different service lives. Replacement and decommissioning assumptions shall be based on the final asset register, manufacturer information, condition monitoring and applicable law rather than a single undifferentiated project life.

REA/NEP and ADUN shall ensure that decommissioning leaves the site safe, stable, non-polluting and suitable for the agreed institutional end use. Activities include:

- Dismantling and removal of PV panels and associated infrastructure (mounting structure, power evacuation cable, inverters, transformers, batteries, etc.);
- Removal of any sub-surface installations (e.g. underground cables);
- Waste generation and management;
- Restore the environment to allowable baseline conditions and monitor the process in line with legislative and regulatory requirements and best industry standards; and

8.3 Management of Decommissioning Activities

In the event of decommissioning, NEP, in conjunction with the leadership of the ADUN, shall ensure that the Project site is left in a safe and environmentally acceptable condition. A standard decommissioning, abandonment and closure programme shall be invoked. The tasks will include, amongst others:

- Evacuation of the dismantled PV panels and other related items (such as inverters, and control devices) to the manufacturers for recycling.
- Transportation of spent batteries to recycling facilities;
- Monitoring the abandoned project environment as necessary.

Decommissioning shall begin only after an options assessment, stakeholder engagement and all applicable regulatory approvals. The plan shall apply the waste hierarchy, producer/take-back arrangements and licensed transport and recovery/disposal routes.

Typically, the following actions shall be undertaken for decommissioning:

- An updated plan which takes into account the most cost-effective and best practicable methods, legal requirements and industry practices at that time for the facility decommissioning shall be developed and submitted to the FMEnv and other relevant regulatory authorities for approval. The plan shall include, but not limited to the following:
  - Description of the site and components to be decommissioned.
  - Description of the decommissioning scope, objectives, end state and strategy;
  - Activities to be performed during the decommissioning;
  - Schedule of decommissioning activities
  - Estimate of the decommissioning cost;
  - Estimated inventory of waste streams to be generated during the decommissioning and handling techniques;
  - Decommissioning team (qualifications, roles and responsibilities)

  The options assessment shall compare continued operation, repair, repowering, partial closure and full closure, including safety, land-use, environmental, social, technical and lifecycle-cost implications.
- A risk assessment shall be conducted to ensure that nothing, which could be constituted as a hazard for other users of the site or for the environment in general, will be left at the site. The Project site shall be left in a safe and environmentally acceptable condition.
- Hazard identification and analysis shall be conducted to determine special safety concerns to be addressed.
- An appropriate Health, Safety and Environment (HSE) plan shall be implemented to ensure that the decommissioning activities are carried out in an environmentally sound manner and in conformity with relevant laws and regulations guiding such operations
- Third party notifications shall be carried out before any demolition and shall be conducted in a phased sequence.
- Socio-economic considerations of facility decommissioning shall be carried out. These will include assessment of potential effects associated with termination of employment (at the end of operational phase) and the measures to minimize the effects by:
- An effective waste management plan shall be developed for the decommissioning activities. The decommissioning options for redundant structures and equipment will include: the complete dismantling of structures and equipment and the return of all components to the equipment manufacturer for recycling. A detailed record of all suitable recycling materials shall be maintained.

Closure Performance Requirements

The updated closure plan shall define the agreed end state, asset ownership, dismantling method, residual contamination criteria, soil/drainage restoration, worker and community safety, waste take-back and licensed destinations, cost estimate and financial provision, schedule, consultation, regulator approvals and post-closure monitoring. Closure is complete only after documentation of waste destinations, removal of hazards, stabilization of the site and acceptance by the responsible owner and authorities.

8.4 Abandonment Plan

Prior to site abandonment, NEP shall establish a standard procedure for incorporating the following practices:

- Identification of the components of the power plant that will be abandoned and/or removed;
- The proposed methods for abandonment or re-use of the plant equipment/material applicable;

- Processes put in place to mitigate potential environmental impacts associated with the abandonment process; and
- Appropriate site rehabilitation programs (including re-vegetation of the site with native plant species) to return the Project site to its original status (as much as possible).

In the event of the project being abandoned, this shall be done in accordance with strict compliance with legislative requirements and international best practices. The decommissioning, abandonment and/or closure programme shall generally be managed by a team of competent personnel from NEP-Project Management Unit, the Department of Works and Physical Planning in ADUN, the Federal Ministry of Environment and the Delta State Ministry of Environment. The abandonment process shall be carried out as follows:

- Relevant stakeholders shall be duly informed;
- Physical Asset Verification (PAV) of the facilities shall be carried out;
- National Sectoral Regulations, as they affect the abandonment of the project, shall be strictly complied with to ensure:
- Restoration and rehabilitation of the environment;
- Management of residual impacts of the project in strict compliance with extant National/FMEnv sectoral regulations.
- In addition, a site close-out permit shall be obtained as appropriate and a close out report shall be prepared and archived for future reference.

8.5 Roles, Responsibilities and Accountabilities

The key personnel and institutions with major roles in the implementation and monitoring of environmental and social measures for the Project decommissioning/closure are as follows:

A. Contractor(s) Engaged for Decommissioning Activities

- Implement environmental and social measures and management actions put in place for the decommissioning activities.

B. NEP-PMU

- Supervise the activities of the contractor(s) engaged for decommissioning purpose by ensuring that the recommended environmental and social and management actions are implemented.
- Discuss environmental and social management plan improvements with the Director of Works and Physical Planning Department in ADUN to address noncompliance and upcoming issues.

C. ADUN University Site Manager

- Directly monitor the activities of the contractor(s) engaged for decommissioning and ensure compliance to the implementation of environmental and social measures and management actions put in place to address potential impacts and risks associated with the decommissioning activities.
- Report to the Director of Works and Physical Planning Department in ADUN on contractor's performance regarding the implementation of environmental and social measures.

D. Director of Works and Physical Planning Department in ADUN

- Jointly supervise the activities of the contractor(s) engaged for decommissioning
- Suggest environmental and social management plan improvements to NEP-PMU to address non-compliance issues and upcoming issues.

E. FMEnv/Delta State Ministry of Environment Representatives

- ❖ Approve the decommissioning plan for the Project
- ❖ Monitor the implementation of environmental and social measures and management actions documented in the decommissioning plan.
- ❖ Discuss environmental and social management plan improvements to NEP-PMU to address non-compliance issues and upcoming issues.

CHAPTER NINE: STAKEHOLDER ENGAGEMENT AND GRIEVANCE REDRESS MECHANISM

9.1 Stakeholder Engagement

Stakeholders are defined as individuals, groups, or institutions that may be directly or indirectly affected by the proposed Solar Hybrid Mini-Grid Project at the Admiralty University of Nigeria, Ibusa (ADUN), or that have an interest in its planning and implementation. These stakeholders play an important role in providing relevant information, local knowledge, and feedback that can influence project design and decision-making. In line with national ESIA requirements and international best practices, including those of the African Development Bank, stakeholder engagement was carried out as an integral part of the ESIA process. The engagement process commenced at the early stage of project planning and continued throughout the assessment phase.

Consultations were conducted using a combination of approaches, including stakeholder meetings, site visits, key informant interviews, and administration of questionnaires. These engagements provided an opportunity to inform stakeholders about the project, obtain their views and concerns, and incorporate relevant inputs into the assessment and project design.

9.1.1 Objectives of Stakeholder Engagement

The objectives of public participation in an ESIA are to provide sufficient and accessible information to potentially interested and affected parties/stakeholders in an objective manner to assist them identify issues of concern, and provide suggestions for enhanced benefits and alternatives. The stakeholder engagement process was designed to conform to the Nigerian EIA Act and international standards. For this Project, the key objectives for stakeholder engagement are:

- Identify key stakeholders that can influence the Project and its activities;
- Inform and educate stakeholders about the proposed Project;
- Gather local knowledge to improve the understanding of the environmental and social context;
- Better understand the locally-important issues;
- Identify the most effective methods and structures through which to disseminate project information, and to ensure regular, accessible, transparent and appropriate consultation;
- Provide a means for stakeholders to have input into the Project planning Process;
- Take into account the views of stakeholders in the development of effective Mitigation measures and management plans; and
- Lay the foundation for future stakeholder engagement.

9.1.2 Stakeholder Analysis and Identification

Stakeholder analysis was undertaken to identify relevant stakeholders, understand their roles, and assess their level of influence and interest in relation to the proposed project. This process is important for determining stakeholder capacities, concerns, and potential contributions to project planning, decision-making, and implementation.

The analysis recognizes that different stakeholders exert varying degrees of influence on project outcomes. While some institutions and regulatory bodies may have significant authority in policy formulation and approvals, other groups such as local communities and end-users may have limited formal influence but play a critical role in day-to-day interactions that can affect project implementation and sustainability. To better understand these dynamics, stakeholders were assessed based on their level of influence and interest in the project. This approach provides useful insight into how different

stakeholder groups should be engaged, ensuring that appropriate strategies are adopted to enhance participation, address concerns, and support effective project implementation.

Table 25: Stakeholder Identification and Categorization

Stakeholder Category	Stakeholders
Primary Stakeholders (Directly Affected / Beneficiaries)	• Admiralty University of Nigeria, Ibusa (ADUN) Management • University Staff and Students (End Users) • On-campus Facilities and Departments • Host Community (Residents within ~400 m radius) • Traditional Rulers and Community Leaders • Youth and Women Groups within Host Community • Local Labour (Skilled and Unskilled Workers) • Contractors and Sub-contractors
Implementing Agency	National Electrification Project (NEP)
Regulatory Institutions	• Federal Ministry of Power • Federal Ministry of Environment • DeltaState Ministry of Environment • Nigerian Electricity Regulatory Commission (NERC) • Oshimili North Local Government Authority • Rural Electrification Agency (REA)
Financing / Oversight Institution	African Development Bank

9.1.3 Stakeholder Engagement Plan

Stakeholder engagement is a continuous and essential process for the successful and sustainable implementation of the proposed Solar Hybrid Mini-Grid Project at the Admiralty University of Nigeria, Ibusa (ADUN). In this regard, a Stakeholder Engagement Plan (SEP) has been developed to guide interactions with all relevant stakeholders throughout the project lifecycle. The SEP provides a structured approach for ensuring that stakeholders are adequately informed, consulted, and involved at appropriate stages of project planning, construction, and operation. It outlines mechanisms for effective communication, stakeholder consultation, and grievance redress, with the aim of promoting transparency, inclusiveness, and accountability.

The plan also ensures that stakeholder concerns, expectations, and feedback are systematically identified, documented, and integrated into project decision-making processes. This approach is consistent with national regulatory requirements and international best practices, including those of the African Development Bank.

Table 26: Proposed Stakeholder Engagement Plan

Project Phase	Key Activities	Target Stakeholders	Method of Engagement
Design / Preparation Phase	• Disclosure of ESIA findings- • Stakeholder identification and consultation • Integration of stakeholder inputs into project design	• Admiralty University of Nigeria, Ibusa (ADUN) Management- • University Staff and Students • Rural Electrification Agency (REA) • Federal Ministry of Environment- • Delta State Ministry of Environment-	• Formal stakeholder meetings- • Key informant interviews- • Site visits- • ESIA disclosure sessions-

		• Oshimili North Local Government Authority- • Host Community (nearby residents) • Traditional Leaders and Community Representatives	• Emails and official correspondence- • Public notices (where applicable)
Construction Phase	• Implementation of ESMP and mitigation measures • Environmental and social monitoring- • Labour management and community relations- • OHS supervision and compliance- • Ongoing stakeholder engagement and grievance management	• Host Community (residents within project area) • Youth and Women Groups • Local Labour and Workers • Contractors and Sub-contractors • ADUN Management • DtP-PMU • Delta State Ministry of Environment • Project Owner's Engineer (POE) / Supervising Engineer	• Community meetings and sensitization sessions- • Toolbox meetings (for workers)- • Grievance Redress Mechanism (GRM)- • Site inspections and monitoring visits- • Posters, signage, and notices on site- • Regular progress meetings
Operation Phase	• Operation and maintenance of the mini grid system • Monitoring of environmental and social performance- • Continued stakeholder engagement- • Management of grievances and feedback- • Periodic audits and reporting	• ADUN Management and Facility Operators- • University Staff and Students (users)- • Host Community • DtP PMU • Federal Ministry of Environment (as applicable)- • Delta State Ministry of Environment	• Periodic stakeholder meetings- • Feedback and complaint channels (GRM)- • Routine inspections and audits- • Reports and official communication- • Continuous engagement through university channels

9.2 Grievance Redress Mechanism

The Project shall operate accessible grievance mechanisms for communities and other external stakeholders, and a separate worker grievance mechanism. A dedicated, confidential, survivor-centred pathway shall receive SEA/SH allegations without requiring disclosure through the ordinary grievance process.

The community GRM enables concerns to be raised, acknowledged, assessed, resolved and appealed without retaliation or cost. Case records are confidential. Public reporting shall use anonymized aggregate information only and shall never disclose names, contact details, allegations or documents that could identify a complainant or survivor.

GRM Operating Principles

The GRM shall be accessible, predictable, transparent about process, confidential, non-retaliatory and free to use. It shall accept anonymous grievances, provide reasonable accommodation and language support, and avoid collecting personal data that are not necessary. The Project shall publish channels and anonymized performance information, not individual case records.

Worker GRM and SEA/SH Pathway

Workers shall have a separate mechanism independent of direct supervisors, without prejudice to statutory rights. SEA/SH allegations shall be received through trained focal points, limited to the minimum information needed for safe referral, and managed with informed consent, confidentiality and

referral to appropriate survivor services. The ordinary grievance committee shall not investigate credibility or seek details from a survivor.

9.2.1 Grievance Redress Mechanism: Reporting Channels and Process

The Grievance Redress Mechanism process as presented in figure 21 below, has been adopted to provide a structured and transparent process for receiving, addressing, and resolving complaints or concerns from stakeholders. This process is designed to ensure that all grievances are handled in a timely, fair, and consistent manner, thereby enhancing trust, accountability, and effective stakeholder engagement throughout the project lifecycle.

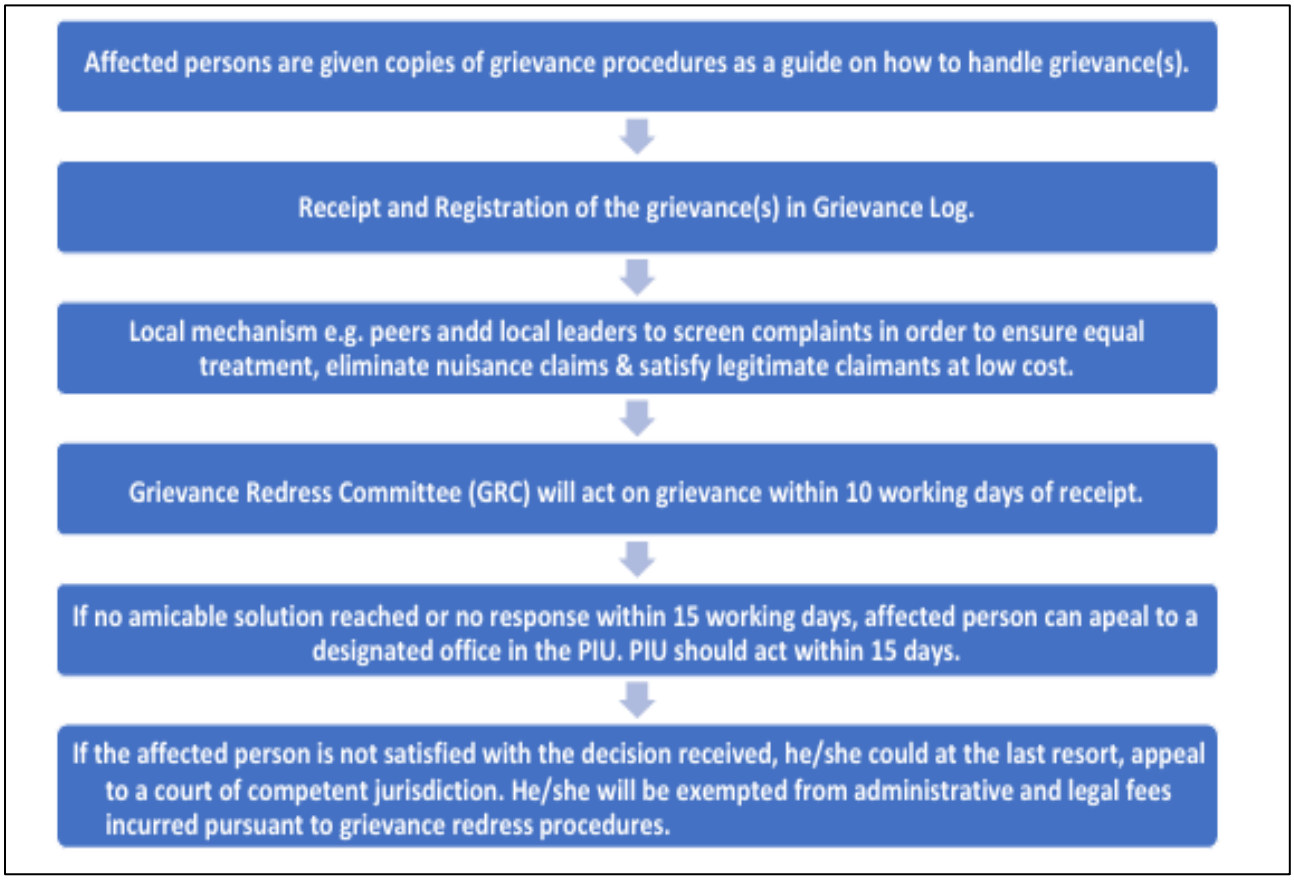


Figure 14: GRM process

9.2.2 Publicizing and Disclosure of the GRM

The GRM shall be publicized through accessible written and verbal channels, including campus and community meetings, notices, accessible formats and channels suitable for people with disabilities or low literacy. Contact details shall be confirmed before disclosure and kept current.

9.2.3 Receiving and Recording Grievances

A grievance may be submitted verbally, in writing, anonymously or through a representative using the published channels. Staff shall promptly refer it to the designated grievance officer and protect confidentiality. The form is optional and only the minimum information necessary for resolution shall be collected. A sample grievance form is presented in the table below:

Table 27: Grievance Recording Form

Grievance Registration	
Case No.:	Date:
Name:	
Office Location: Unit:	
Phone no:	
Details of grievance:	
Name of person recording grievances:	
Designation of recording person:	
Proposed date of response to grievance:	
Signature of recording person	Signature of complainant
Grievance Redressal Response	
Decision of GO (give full details):	
Claimant accepts the outcome:	
Accepted	Not accepted
Signature of claimant:	
Signature of GO:	

All project staff will be informed that they must pass all grievances, communications to the Grievance Officer (discussed in the following section) on site as soon as possible after they are received. Details of the person lodging the grievance shall be noted and passed along with the grievance. The Grievance Officer in turn will communicate all grievances to the Social Standard Officer/Manager for the project. For assisting the communication of grievances, a Register will be maintained at the project office and site camp, at which any individual/group can come have their complaint registered.

9.2.4 Maintaining a Grievance Register

Each grievance shall receive a unique code and be entered in a controlled register with restricted access. The register shall record dates, category, actions, outcome and complainant feedback without unnecessary personal or sensitive information. SEA/SH case information shall not be entered in the ordinary register.

9.2.5 Acknowledgment of Grievance

Receipt shall normally be acknowledged within two working days through the complainant's preferred safe channel. Anonymous grievances shall be acknowledged through the channel by which they were received where possible.

This receipt is acknowledgement of grievance registration by_____, resident of -community/staff of -------- department _____ on date _____. His/her case number is _____ and the date for response is _____.

Full name & signature of recording person

9.2.6 Site Inspection and Resolution

For the purpose of verifying and resolving the grievances received, site inspection may not be required in all the cases. Depending upon the sensitivity of the issue, requirement of a site inspection will be identified.

A site inspection will be undertaken by the site level community liaison officers or the project member assigned by the Social Safeguard Officer/ Manager. The purpose of the site inspection will be to check the validity and severity of the grievance. For this purpose, the personnel may also undertake discussions with the concerned external stakeholder. The inspection will be undertaken within ten days of receiving the grievance. The assigned individual will then work with other relevant members of the Project team to investigate the problem and identify measures to resolve the grievance as appropriate. The personnel to be involved in the grievance resolution shall be dependent upon the nature of the grievance, as discussed in the table 32.

Table 28: Classification and Categorization of External Grievances

S/N	Nature of Grievance	Categorization
1	Environment, nuisance, access or community health and safety	Project E&S/Community Liaison Officer
2	Employment, procurement or contractor conduct	Contractor and Social Safeguards Officer
3	Land use, access or damage allegation	Project Manager and Social Safeguards Officer; OS5 screening before any remedy
4	SEA/SH or other sensitive allegation	Confidential specialist pathway; not the ordinary GRM register
5	Other	Grievance Officer routes to the competent function

9.2.7 Resolution, Escalation, and Closure

The grievance officer shall agree a proportionate resolution with the responsible team and the complainant where appropriate, record acceptance or reasons for non-acceptance, and verify implementation before closure. Ordinary grievances should be resolved as soon as practicable, with ten working days used as the target for uncomplicated cases.

Matters beyond the site team's authority shall be escalated promptly to the Head of the NEP PMU, and the complainant shall receive a safe status update. Complex cases shall have a documented action plan and revised timeframe rather than being closed solely because the target period has elapsed.

If, however, the grievance remains unsettled, and the Head PMU of NEP is not able to identify an adequate resolution for the grievance, then an adequate response shall be given to the grievant along with a suggested alternative resolution to the grievance including to take the matter to the citizens' rights mediation-centre for the settlement before a law court is considered.

A complainant may request review or use another lawful remedy at any time. No person shall suffer retaliation for raising a concern. Allegations of SEA/SH, child abuse, criminal conduct or imminent danger shall be referred only through the applicable safe and lawful protocol.

9.2.8 Update of Records

The grievance register shall be reviewed weekly while cases remain open and reported through anonymized performance metrics. Closure requires evidence that the agreed action was implemented and, where contact is possible, that the complainant was informed.

9.3 Summary of Public Consultations.

The proposed Solar Hybrid Mini-Grid Project at the Admiralty University of Nigeria, Ibusa (ADUN) is expected to generate both positive and adverse environmental and socio-economic impacts during its construction and operation phases. These impacts may affect various stakeholders directly or indirectly, including the university community and nearby residents. As such, stakeholder consultations were undertaken to ensure that the views, concerns, and expectations of relevant stakeholders were adequately captured and considered in the ESIA process.

The consultation process focused on providing information about the project scope, planned activities, and implementation approach, as well as clarifying the roles of key stakeholders. It also provided an opportunity to obtain feedback, identify potential concerns, and incorporate stakeholder inputs into project planning and impact assessment. Engagement methods included stakeholder meetings, key informant interviews, site visits, and interactive discussions with community representatives and relevant institutions.

The specific objectives of the public consultations were to:

- Inform stakeholders about the proposed project and its components;
- Raise awareness within the university environment and surrounding communities;
- Obtain stakeholder views, concerns, and expectations regarding the project; and
- Ensure that the concerns of potentially affected groups are identified and addressed.

As part of the preparation of the Environmental and Social Impact Assessment (ESIA) for the proposed Nigeria Electrification Project (Desert to Power initiative) at Admiralty University, a structured stakeholder engagement process was undertaken to promote broad participation, inclusiveness, and transparency in project planning and anticipated implementation. The consultations were conducted in accordance with the requirements of the African Development Bank (AfDB) Environmental and Social Framework (ESF) and applicable national regulatory guidelines, which emphasize early, inclusive, and culturally appropriate engagement with host communities and other relevant stakeholders.

9.3.1 The stakeholder engagement process covered a diverse range of groups, including:

- Delta State Ministry of Environment
- University Management
- Department of works/Physical Planning
- Security Department
- Student Union Representatives
- Host community leaders
- Staff Representatives

9.3.2 Choice and Right

Stakeholders were provided with detailed information on the project design, proposed implementation timeline, and opportunities for their input during both the planning and execution phases. Discussions also covered the anticipated benefits of the project to the university and surrounding host communities. University management and community representatives were encouraged to express concerns, expectations, and recommendations, with assurances that their feedback would be considered in finalizing the project design and implementation approach. The value proposition of the proposed solar installation was comprehensively presented, highlighting improved reliability of electricity supply, strengthened access to sustainable energy, and the generation of short-term employment opportunities during the construction and installation phases.

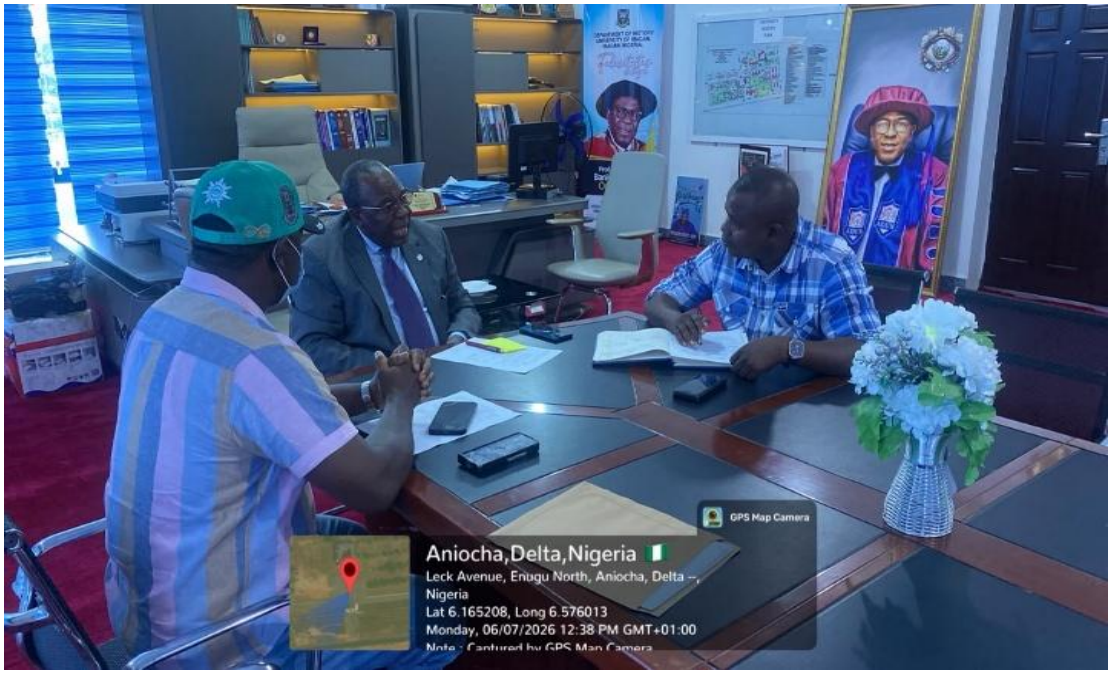
9.4 Concerns and Resolutions

A comprehensive overview of the stakeholder consultations undertaken during the preparation of this ESIA. The engagements were conducted at ADUN and within its host communities to promote inclusiveness, transparency, and active participation in the project planning process. The tables summarize the key discussion points, stakeholder concerns and expectations, and the responses or clarifications offered by the project team. This approach was designed to ensure that stakeholder inputs were systematically captured, considered in the assessment, and reflected in the ESIA documentation

Summary of Consultation at Admiralty University and Host Communities

Summary of Consultation at the University (ADUN) and Host Communities			
General Introduction	Consultations were held at Admiralty University Ibusa, its host communities (Ogwashi-Uku and Ibuzo), for the Nigeria Electrification Project Phase II under the AfDB Desert to Power initiative. Stakeholders including Admiralty University management, community leaders, village heads, women, youth, and other groups were engaged to identify concerns and provide input on project planning. Key issues raised included safety considerations due to the proximity of certain existing structures within the school to the proposed solar panel installation, potential environmental impacts, and opportunities for temporary employment. The ESIA team committed to addressing these concerns through targeted mitigation measures, gender and social inclusion strategies, and continuous stakeholder engagement throughout the project lifecycle.		
Attendees	Vice Chancellor Admiralty University and the University Managements, community leaders and traditional heads.		
Language of Communication	Igbo & English		
Date/Time	**Admiralty University**	**Ibuzo**	**Ogwashi-Uku**
06-07-2026/ 9:00am	Courtesy visit and project briefing with university management/contact person	Consultation with the Traditional head of the communities	Consultation with the Palace Secretary
07-07-2026 / 10:30am	Meetings with key stakeholders (University Management, physical planning/works department, security, student representative, Host Community representatives, and distribution of questionnaires	-	-
08-07-2026 / 10:30am	Site mapping, soil, air and water sampling	Administration of questionnaires	Administration of questionnaires
09-07-2026/ 10:30am	Meeting with a staff of Delta state Ministry of Environment	-	-
Stakeholder Concerns, Observations, and Inputs during Consultations			

Concern/Need Category	Host Communities	Concerns/Needs	How Concerns Were Addressed
Admiralty University Managements	Across all corridors	safety considerations due to the proximity of certain existing structures within the school to the proposed solar panel, considering heat generation and radiation during the installation.	The project will be situated at least 10 metres from existing infrastructure, with existing trees providing natural heat regulation.
Ibuzo and Ogwashi-Uku Community	All project corridors	Youth expressed a strong interest in employment opportunities during construction, requesting priority in unskilled and semi-skilled work. They also expressed concerns about the availability of permanent roles, such as maintenance positions, beyond the project implementation phase.	The project will prioritize the engagement of qualified local community members, particularly youths, during the construction and installation phases. Contractors will be encouraged to adopt a local-first employment approach, especially for non-specialized roles. In addition, basic training and capacity-building opportunities related to site safety, equipment handling, and facility maintenance will be provided to enhance local participation and long-term benefits.
Traditional Leaders	All project corridors	The district heads expressed concern that local youths and community members should have access to employment opportunities generated by the project. He also requested that the electricity from the solar panels benefit the surrounding communities, ensuring that local schools, institutions, and residents can access reliable power.	The ESIA team noted the traditional heads concern and confirmed that local youths and community members will be prioritized for employment opportunities during the construction and operational phases. Options for enabling surrounding communities, including local schools and institutions, to benefit from the electricity generated by the solar panels will be explored during project design and implementation.
Student Union Representatives	All communities	Students expressed concern and wanted to know if the solar installation is going to be free, and if it is going to go round to all parts of the school property including the undeveloped parts.	The installation is free with no cost added to them. The Solar Installation is large enough to cover the whole school property.



Meeting with the ADUN Management

Group photograph with the VC, ADUN

Consultation with HRH, Traditional Head of Ibuzo.

Public Consultation with Staffs and Students representative, ADUN

Group Photograph with Student Representatives, ADUN

Consultation with the Physical Planning/Works Department

Consultation with the director, physical Planning

CHAPTER TEN: CONCLUSION AND RECOMMENDATIONS

10.1 Conclusion

The Environmental and Social Impact Assessment (ESIA) conducted for the proposed Solar Hybrid Mini-Grid Project at the Permanent site of Admiralty University of Nigeria, Ibusa (ADUN), Delta State, has evaluated the potential environmental, social, and occupational health and safety implications associated with the project across its pre-construction, construction, and operational phases.

The proposed project is designed to provide a reliable and sustainable electricity supply to the university campus, thereby enhancing academic activities, improving living and learning conditions, and reducing dependence on fossil fuel-based energy sources. In this regard, the project aligns with national energy development objectives and international commitments to sustainable development.

The baseline assessment indicates that the project site is located within the university's permanent campus, characterized by relatively flat terrain, sandy-silty soils with signs of surface erosion, and sparse Sudan savannah vegetation. The site is currently not under active academic use, and no significant ecological or culturally sensitive resources were identified within the project footprint. The nearest community is located approximately 400 metres from the site, suggesting limited direct social disruption.

Potential adverse impacts identified during the ESIA are largely site-specific, temporary, and manageable. During the construction phase, key impacts include dust generation, noise, soil disturbance, vegetation clearing, occupational health and safety risks, and minor social disturbances associated with labour influx and construction activities. During the operational phase, potential impacts are minimal and relate primarily to equipment maintenance, waste management (including e-waste), and occupational safety.

Appropriate mitigation measures have been developed to address these impacts and have been presented in Chapter Six, while a comprehensive Environmental and Social Management Plan (ESMP) has been provided in Chapter Seven to guide implementation, monitoring, and reporting. The ESMP outlines clear responsibilities, monitoring indicators, and institutional arrangements to ensure effective environmental and social management throughout the project lifecycle.

Stakeholder consultations conducted as part of the ESIA process indicate general support for the project, particularly due to its expected benefits in improving electricity supply and supporting academic activities. Concerns raised such as safety, environmental management, and community interaction have been duly considered and incorporated into the project design and mitigation measures.

Based on the findings of this ESIA, the proposed project is considered environmentally and socially viable. The anticipated benefits of the project significantly outweigh the potential adverse impacts, all of which can be effectively mitigated through the implementation of the recommended measures.

10.2 Recommendations

To ensure the successful and sustainable implementation of the project, the following recommendations are provided:

Environmental Management

- All mitigation measures identified in Chapter Six should be fully implemented.
- Site-specific measures should be adopted to control dust, soil erosion, and surface runoff during construction activities.
- Vegetation clearing should be limited strictly to the project footprint, and disturbed areas should be rehabilitated where necessary.
- Proper waste management practices, including segregation and disposal of solid waste and e-waste, should be strictly enforced.

Occupational Health and Safety (OHS)

- A comprehensive Health, Safety, and Environment (HSE) plan should be implemented by the contractor.
- All workers should be provided with appropriate Personal Protective Equipment (PPE) and trained on its proper use.
- Regular safety training, toolbox talks, and site inspections should be conducted.
- Adequate safety signage and restricted access controls should be maintained at all times.

Social Management

- The project should prioritize the engagement of local labour where feasible to enhance socio-economic benefits.
- A functional Grievance Redress Mechanism (GRM) should be established and maintained throughout the project lifecycle.
- Continuous stakeholder engagement should be ensured, particularly with ADUN management, campus users, and nearby communities.
- Measures should be implemented to prevent and address risks related to gender-based violence (GBV), sexual exploitation and abuse (SEA), and sexual harassment (SH).

Institutional and Regulatory Compliance

- The project should comply with all applicable national environmental regulations and standards, including those of the Federal Ministry of Environment.
- Implementation of the ESMP should be supervised by the Rural Electrification Agency (REA) and relevant regulatory authorities.
- The project should adhere to the environmental and social safeguard requirements of the African Development Bank.

Monitoring and Reporting

- Environmental and social monitoring should be carried out in accordance with the ESMP, using the defined indicators and frequency.
- Regular monitoring reports should be prepared and submitted to relevant authorities.
- Corrective actions should be taken promptly where non-compliance or unforeseen impacts are identified.

Operation and Maintenance

- Routine inspection and maintenance of the mini-grid system should be conducted to ensure optimal performance.
- Battery storage systems should be properly managed to prevent leakage, fire risks, and environmental contamination.
- End-of-life management plans should be established for solar panels, batteries, and other components.

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ANNEX ONE: TERMS OF REFERENCE

1 INTRODUCTION/ BACKGROUND

The Federal Government of Nigeria (FGN), through the Rural Electrification Agency (REA), is implementing the Nigeria Electrification Project Phase II (Desert-to-Power) with financial support from the African Development Bank (AfDB). The project's primary objective is to accelerate Nigeria's electrification efforts by deploying sustainable, off-grid and grid-connected solar-powered renewable energy solutions. By leveraging Nigeria's vast solar energy resources, the initiative aims to provide clean, reliable, and long-lasting electricity to Federal Universities and their affiliated teaching hospitals. The broader goal is to enhance academic performance, support research initiatives, and improve healthcare service delivery.

As part of the Energizing Education Programme, the REA intends to electrify 24 Federal Universities and Teaching Hospitals through solar-hybrid mini-grid systems exceeding 1 MW per site. The Government intends to apply part of the proceeds toward engaging a qualified Environmental and Social Consulting Firm to prepare Environmental and Social Impact Assessments (ESIAs) for 13 universities proposed under the AfDB-financed component.

The ESIAs shall be prepared in accordance with the African Development Bank's Integrated Safeguards System (ISS, effective 31 May 2024), the Environmental Impact Assessment (EIA) Act Cap E12 LFN 2004, relevant FMEnv Procedural Guidelines (2017), Nigerian Climate Change Act (2021), other relevant and associated Nigerian regulations, and international good practice (IFC Performance Standards, ISO 14001, ISO 45001).

Table 1: List of Federal Universities Under the AfDB Desert-to-Power Programme for ESIA Study

S/N	NAME OF INSTITUTION	STATE	GEO-POLITICAL ZONE	CATEGORIZATION INTO LOT
1	Federal University, Birnin-Kebbi	Kebbi	North West	LOT 1
2	Federal University of Education, Kano	Kano	North West	
3	Federal University of Education, Zaria	Kaduna	North West	
4	Federal University of Health Sciences, Azare	Bauchi	North East	LOT 2
5	Admiralty University of Nigeria, Oshimili	Delta	South South	
6	Federal University of Technology, Minna	Niger	North Central	
7	University of Jos	Plataeu	North Central	
8	Adeyemi Federal University of Education	Ondo	South West	LOT 3
9	Federal University of Health Sciences, Ila Orangun	Osun	South West	
10	Admiralty University of Nigeria and Technology, Okeho	Oyo	South West	
11	Federal University Otuoke	Bayelsa	South-South	LOT 4
12	Federal University of Technology, Ikot Abasi	Akwa-Ibom	South-South	
13	Federal University of Health Sciences Kwale	Delta	South-South	

2 DESCRIPTION OF THE PROJECT

The Desert-to-Power (DtP) project builds on lessons from NEP-I, focusing on three main components:

1. Energizing Education Programme: Electrification of 24 Federal Universities and Teaching Hospitals with solar-hybrid mini-grids exceeding 1 MW capacity per site.

2. Energizing Healthcare Facilities: Deployment of reliable energy to health centres in underserved regions.

3. Interconnected Mini-Grids for Cooperatives: Supporting local electricity cooperatives via Minimum Subsidy Tenders and Performance-Based Grants.

Each university system will include solar PV arrays, battery energy storage systems, control systems, distribution infrastructure, and backup generation, with appropriate operation and maintenance plans.
The ESIA will consider the full lifecycle — design, construction, operation, and decommissioning — including waste management (solar panels, batteries, oils, packaging, etc.), community safety, and resilience to climate risks.

3 STATUTORY LEGAL AND ADMINISTRATIVE FRAMEWORK

The statutory (legal and administrative) frameworks within which the consultancy activities shall be executed are provided in the following regulations, guidelines and standards (Note: these regulations are not exhaustive):

- African Development Bank's Integrated Safeguards System (2024)
- The regulations, guidelines and standards of the Federal Ministry of Power as it concerns high voltage power transmission in Nigeria.
- Environmental Impact Assessment Act Cap E12 LFN 2004
- FMEnv EIA Procedural Guidelines (2017)
- The regulations, guidelines and standards of the Federal Ministry of Environment concerning power generation and transmission activities in Nigeria.
- National Environmental (Solar Energy) Regulations (2017)
- NESREA Act (2007) and sectoral guidelines
- Labour Act (2004) and Employee Compensation Act (2010)
- Land Use Act (1978) and Urban and Regional Planning Act
- Climate Change Act (2021);
- Occupational Safety and Health (Factories) Regulations (2010)
- National Gender Policy (2006) and Discrimination Against Persons with Disabilities Act (2018)
- All International Conventions/Treaties on Environmental Protection/Social Welfare to which Nigeria is a party: Paris Agreement (2015), Convention on Biological Diversity, ILO Conventions, and the UN Guiding Principles on Business and Human Rights
- The regulations, guidelines and standards of the various State Ministries of Environment and Social Welfare.

The Consultant shall ensure all studies align with FMEnv, relevant State Environmental Protection Agencies, and Local Government Authorities.

4 OBJECTIVES OF THE ASSIGNMENT

The objective of this consultancy is to conduct site specific ESIAs for the proposed power systems and associated infrastructure to:

- Establish environmental and socio-economic baselines for each site;
- Identify, predict, and evaluate environmental, social, health, and safety impacts (positive and negative);
- Recommend mitigation and enhancement measures;
- Ensure compliance with AfDB and Nigerian E&S standards;
- Develop site-specific Environmental and Social Management Plans (ESMPs); and
- Facilitate environmental approvals, and stakeholder acceptance.
- Support REA in securing FMEnv ESIA certification and AfDB no-objection;
- Conduct inclusive stakeholder engagement (including women, youth, and persons with disabilities); and

- Build local institutional capacity for ESMP implementation.

Special attention shall be given to vulnerable groups, gender equality, disability inclusion, resettlement risks, occupational health and safety, and climate resilience.

This must be in line with the requirements of the Federal Government of Nigeria and the African Development Bank's Integrated Safeguards System to ensure that any adverse effects on the environment and wellbeing of people are properly identified and mitigated.

Each university represents a unique ecological, social, and institutional context — from arid North-West terrains to humid South-South coastal areas. Therefore, individual (modular) ESIA studies are required to capture site-specific risks, localized stakeholder concerns, and regulatory obligations under Nigeria's Environmental Impact Assessment Act (Cap E12 LFN 2004).

This modular approach ensures:

- Tailored mitigation and management measures suitable for each region and site;
- Independent FMEnv certification and public disclosure;
- Alignment with AfDB Category 2 project requirements under the Integrated Safeguards System (ISS);
- Easier monitoring and adaptive management during implementation.

5 SCOPE OF THE ASSIGNMENT – METHODOLOGY AND GENERAL APPROACH

The Consultant, who shall be duly registered with the Federal Ministry of Environment, towards achieving the objectives noted under section 4 above, shall carry out the following activities:

Phase 1 – Desk Review and Scoping

- Review prior NEP documentation, feasibility studies, conceptual project design and maps.
- Conduct preliminary stakeholder identification and risk screening.
- Prepare forms and register the project with the FMEnv.
- Prepare and submit detailed work plans

Phase 2 – Baseline Studies (within at least 5km radius)

- Biophysical: Air, water, soil, noise, flora, fauna, hydrology.
- Socio-economic: Demography, livelihoods, gender, land tenure, cultural heritage, transport/traffic studies.
- Laboratory analysis shall be performed by FMEnv-accredited laboratories.
- GIS and remote sensing tools shall be used for mapping and sensitivity analysis.

Phase 3 – Impact Assessment

- Identify and evaluate direct, indirect, and cumulative impacts.
- Assess greenhouse gas emissions and pollution pathways.
- Use AfDB's and FMEnv's risk rating methodology (high, moderate, low).
- Develop mitigation hierarchy (avoid, minimize, mitigate, offset).

Phase 4 – Stakeholder Engagement

- Conduct Free, Prior, and Informed Consultations (FPIC) with communities, institutions, and Federal/ state agencies.
- Ensure inclusive participation of women, youth, and persons with disabilities.

- Maintain engagement logbooks with signatures, photos, and feedback.
- Establish and operationalize a multi-tier costed Grievance Redress Mechanism (GRM).
- Develop a costed stakeholder engagement plan.

Phase 5 – ESMP Development: Each ESMP shall include:

- Mitigation measures and performance indicators;
- Roles, responsibilities, and institutional arrangements;
- Monitoring framework and schedule;
- Capacity-building plan;
- Estimated costs and financing sources;
- Integration strategy into EPC contracts.

Phase 6 – Reporting and Disclosure

- Submit inception, draft, and final ESIA reports all in soft and hard copies
- Facilitate public disclosure in line with FMEnv procedures (public notice, hearing, gazette publication).
- Ensure AfDB disclosure on its website and InfoShop portal via the PMU E&S Unit.
- Payment of Final access charge and IMM fees.
- Issuance of ESIA Approval Letters and certificates by the FMEnv

NOTE: The successful consultant for this assignment is responsible for the payment of Federal Ministry of Environment's regulatory fees. Hence, all costs related to this should be factored as part of reimbursable expense in its financial submission.

6 DELIVERABLES AND PAYMENT SCHEDULE

The successful consultant shall work closely and report to the Head, Project Management Unit (HPMU) of the Nigeria Electrification Project through the Environmental & Social (E&S) team of the NEP Project Management Unit (PMU). The Consultant is expected to work closely with the E&S unit of the PMU towards successfully executing the assignment.

Schedule: The following reports shall be submitted by the Consultant to the Rural Electrification Agency and FMEnv:

#	Deliverables	Timeline *(After contract signing in weeks)*
1.	**A. Inception Report:** - This should include methodology and work plan with clearly defined strategy for carrying out the assignment with timelines for the various outputs. The report should include: • Detailed Project including plan for the on-site activities • Complete Work plan document • Draft Survey Tools • Evidence of registration of project sites (by state) with the Federal Ministry of Environment. The Consultant must submit (3) hard copies and a soft copy of the inception report. **B. Progress Report:** An update on the progress of the Baseline survey and plans for completion of the survey and next activities. The consultant must submit electronic copies of this progress report	2 weeks

2.	**Draft ESIA Report:** - A draft report containing detailed assessment and survey information in line with the approved reporting outline of the FMEnv to be reviewed by the AfDB and PMU. The consultant shall submit electronic copies of the draft ESIA report to the PMU and Bank for internal reviews.	Week 2-14
3	**Resubmission of Draft ESIA Report:** Upon completion of review by the PMU and incorporation/finalization of recommended changes, the revised Draft Report shall be resubmitted to the REA, Bank and FMEnv for review and disclosure	Week 14-16
4.	**A. In house Panel Review:** - Presentation of the ESIA at a Panel to be held by the Federal Ministry of Environment (as required) **B. Review of the draft report** in line with the comments from the FMEnv. **C. Draft Final ESIA report** as approved by the FMEnv will be produced for each of the institutions as covered in the TOR. The consultant shall submit the required number of copies to the FMEnv, and one hard copy and one soft copy (in a flash drive) of each final ESIA reports D. ESIA approval letters and certification from the FMEnv for each of the project sites shall be obtained by the Consultant	Week 16-20

Note: Each site must be registered separately, and standalone reports must be prepared for each of the sites.

Report Structure: The Environmental and Social Impact Assessment (ESIA) report for the project will be structured in line with FMEnv and AfDB guidelines, including all necessary management plans and supplementary documentation. The report must include detailed analysis, mitigation measures, and management strategies for addressing environmental and social impacts. Below is a sample structure for the ESIA report, to be considered, and improved on as necessary.

1. Executive Summary

- Purpose of the Project: A concise overview of the project, its objectives, scope, and alignment with sustainable development goals.
- Key Findings: Summary of the significant environmental and social impacts identified, including proposed mitigation measures.
- Recommendations: A summary of the recommended actions for project implementation and ongoing compliance with environmental and social safeguards. In addition, the consultant shall provide summary of cost of the measures and the institutional arrangements for implementation.

2. Introduction

- Project Background: Description of the project's goals, location, and key stakeholders.
- ESIA Purpose and Scope: The specific objectives of the ESIA, focusing on identifying, assessing, and mitigating the environmental and social impacts of the project.
- Regulatory Framework: Reference to the relevant Nigerian regulations (e.g., EIA Act Cap E12 LFN 2004), AfDB's Integrated Safeguards System (ISS), Nigerian Climate Change Act (2021), and international standards (e.g., IFC Performance Standards, ISO 14001, ISO 45001).

3.1 Project Description

- Project Components: A detailed description of the project components, including all infrastructure and technologies (e.g., solar-hybrid mini-grid systems, energy storage, etc.). Also, the consultant shall describe the proposed project and its geographic, environmental, social, and temporal context, including associated facilities, third parties, and any offsite investments that may be required.
- Project Phases: Explanation of all phases of the project lifecycle, including planning, construction, operation, and decommissioning.

- Project Activities: A breakdown of project activities and their potential environmental and social implications.
- Includes a map of sufficient detail showing the project site and the area that may be affected by the project's direct, indirect, and cumulative impacts.
- Presents the basis for selecting the project design proposed, including for applying the mitigation hierarchy.

3.2 Analysis of Project Alternatives

- Evaluates a reasonable range of feasible project alternatives to meet the project's purpose and needs (e.g. location, technology options, or timing) and their E&S implications, including a no project alternative.
- During the project scoping process, Borrowers shall consult stakeholders and the public and allow for their participation in the identification of feasible project alternatives through public consultation meetings and the opportunity to comment.
- Assesses the alternatives' feasibility of mitigating the E&S impacts, the capital and recurrent costs of alternative mitigation measures, and their suitability under local conditions, and the institutional, training, and monitoring requirements for the alternative mitigation measures.
- Evaluates a reasonable range of feasible project alternatives to meet the project's purpose and needs (e.g. location, technology options, or timing) and their E&S implications, including a no project alternative.
- During the project scoping process, Borrowers shall consult stakeholders and the public and allow for their participation in the identification of feasible project alternatives through public consultation meetings and the opportunity to comment.
- Assesses the alternatives' feasibility of mitigating the E&S impacts, the capital and recurrent costs of alternative mitigation measures, and their suitability under local conditions, and the institutional, training, and monitoring requirements for the alternative mitigation measures.

4. Legal and Institutional Framework

- National Legislation: Overview of Nigerian laws, including the EIA Act, Nigerian Climate Change Act (2021), and other FMEnv regulations. In addition, the E&S institutional and regulatory framework is comprehensively analyzed, not focusing only on environmental and land laws but including social protection policies/strategies, and the project's sector relevant standards/norms related to E&S health and safety.
- AfDB Safeguard Policies: Summary of the AfDB's Integrated Safeguards System (ISS), including the environmental and social safeguard policies that must be adhered to.
- International Standards: Reference to IFC Performance Standards, ISO 14001, and ISO 45001, which guide the ESIA process.
- Permits and Approvals: A list of the necessary permits and clearances required by local authorities and the relevant ministries for the project.
- Analyses the legal and institutional framework for the project within which the ESA is carried out, consisting of:
    - the host country's applicable policy framework, national and local laws and regulations, and the respective institutional capabilities (including implementation) concerning E&S issues;
    - national environmental or social action plans or strategies, and obligations of the country directly applicable to the project under relevant international and regional treaties and agreements;

- applicable requirements under the OSs and the African Development Bank's Integrated Safeguards System (ISS) Guidance Notes;
- the identification of differences between the Borrower's existing Environmental and Social Framework, and requirements relating to the project that may affect how the project is carried out in a manner consistent with the OSs;
- a description of how any deficiencies in the host framework can be addressed through administrative, legislative or regulatory change, institutional strengthening, and capacity building.

5. Baseline Environmental and Social Conditions

- Environmental Baseline: The environmental baseline should:
  - Describe how climate change is affecting or likely to be affecting the project area and how this may influence the nature of project risks and impacts.
  - Describe how the project may be affecting or contributing to climate change and its associated risks and impacts.
  - Overview of climate, topography, hydrology, land use, and vegetation.
  - Assessment of biodiversity, water quality, and air quality.
  - Identification of sensitive environmental receptors (e.g., protected areas, species of concern).
- Social Baseline:
  - Overview of local communities, demographics, socio-economic conditions, and existing infrastructure.
  - Description of land tenure, livelihoods, cultural heritage, and public health.

6. Stakeholder Engagement

The consultant shall identify and characterize individuals and groups that are, due to circumstances, vulnerable, discriminated against, and underserved in, or excluded from, mainstream society. Disaggregated data on all such social groups should be provided to the extent that personal and group safety and data confidentiality and privacy are not compromised.

In addition, the consultant shall describe contextual risks (e.g. the political economy) that may affect the ability of the project to be carried out in a manner consistent with the AfDB OSs and other requirements such as international human rights obligations.

Other aspect to consider include:

- Stakeholder Identification: A comprehensive list of key stakeholders, including local communities, governmental bodies, NGOs, and other interested parties.
- Stakeholder Consultation Process: Description of consultation methods (e.g., meetings, surveys, public hearings), frequency, and topics discussed.
- Stakeholder Concerns: Summary of key concerns raised by stakeholders and how these concerns have been addressed in the ESIA process.

7. Impact Assessment

To the extent demonstrable, characterize residual impacts in terms of their magnitude, extent, duration, reversibility, and significance. The levels of impacts will be assessed using the following key tools:

- Methodology: A thorough impact analysis (***quantitative NOT generic***) and identification of feasible measures addressing each significant and moderate impact and risk.
- Environmental Impacts: Analysis of potential environmental impacts (e.g., land degradation, water and air quality, noise, waste generation, etc.).

- Social Impacts: Evaluation of potential social impacts, including displacement, changes to local livelihoods, public health, and community wellbeing.
- Cumulative Impacts: Assessment of how the project may interact with other projects or activities in the region, and the cumulative impacts on the environment and society.

8. Environmental and Social Risks and Opportunities

- Risk Assessment: Identification of key risks to the environment and local communities, including legal, environmental, social, and economic risks.
    - Potential environmental risks (e.g., habitat destruction, resource depletion)
    - Social risks (e.g., community resistance, displacement, health impacts)
    - Legal and regulatory non-compliance risks
    - Economic risks, including project delays or cost overruns
- Opportunities: Identification of potential benefits arising from the project, such as:
    - Job creation and local employment
    - Community development (e.g., infrastructure, healthcare, education)
    - Improved energy access and sustainability
    - Contribution to local and national economic growth

9. Mitigation and Management Plans

- **Mitigation Measures:** Identify avoidance, minimization and mitigation measures and significant residual impacts that cannot be mitigated and, to the extent possible, assesses the acceptability of these residual impacts. This should also include specific actions to mitigate the identified environmental and social impacts, including design modifications, operational best practices, and technological solutions. Other measures to note are thus:

  • Identify measures to enhance positive impacts and opportunities.
  • Identify differentiated measures so that adverse impacts do not fall disproportionately on the vulnerable.
  • Assess the feasibility of mitigating the E&S impacts, the capital and recurrent costs of proposed mitigation measures, and their suitability under local conditions, and the institutional, training, and monitoring requirements for the proposed mitigation measures.
  Specify issues that do not require further attention, providing the basis for this determination.

- Environmental and Social Management Plan (ESMP): A detailed plan to monitor and manage the implementation of mitigation measures, including roles and responsibilities, timelines, and resources.
- Climate Change Mitigation and Adaptation: Address the project's approach to mitigating climate change impacts and adapting to potential climate risks.

10. Monitoring and Evaluation

- Monitoring Plan: Framework for monitoring the implementation of the mitigation measures and ESMP, including frequency, parameters, and responsible entities.
- Performance Indicators: Identification of key performance indicators (KPIs) to track the effectiveness of the mitigation measures and the overall environmental and social performance of the project.
- Adaptive Management: Plans for adjusting project activities based on monitoring results and feedback from stakeholders.

11. Conclusions and Recommendations

- Summary of Findings: A concise summary of the key environmental and social impacts, along with the proposed mitigation measures.
- Project Justification: Justification for the project's viability and positive outcomes relative to its

environmental and social risks.

- Further Actions: Recommendations for additional studies, monitoring, or mitigation measures that may be necessary.

Appendix: Detailed Management Plans and Supporting Documentation

The following plans and documents must be included as part of the ESIA report to ensure comprehensive environmental and social management throughout the project lifecycle:

- **Labour Management Plan (LMP)**: A detailed plan for managing labor-related impacts, including workforce accommodation, health and safety, working conditions, and grievance mechanisms for workers.
- **Waste Management Plan (WMP)**: A strategy to manage waste generated by the project, detailing waste minimization, segregation, storage, transportation, and disposal procedures.
- **Grievance Redress Mechanism (GRM)**: A clear culturally appropriate and accessible process for receiving, addressing, and resolving grievances from local communities and other stakeholders throughout the project.
- **Stakeholder Engagement Plan (SEP)**: A plan outlining how stakeholder engagement will be carried out throughout the project lifecycle, including consultation methods and feedback loops.
- **Biodiversity Management Plan (BMP)**: A strategy for managing impacts on biodiversity, including mitigation measures for habitat loss, species protection, and ecosystem restoration.
- **Health and Safety Plan (H&S Plan)**: A plan to ensure the health and safety of workers, local communities, and other stakeholders, covering site safety procedures, emergency response protocols, and health monitoring.
- **Climate Change Adaptation and Mitigation Plan**: A plan for assessing and addressing climate risks, reducing the project's carbon footprint, and enhancing resilience to climate change.

In addition, the following supporting documentation shall be included in the report:

- A list of the individuals or organizations that prepared or contributed to the ESA.
- References listing the written materials, both published and unpublished, that have been used.
- A record of meetings, consultations, and surveys with stakeholders, including those with affected people and other interested parties. The record specifies the means of stakeholder engagement that were used to obtain the views of affected people and other interested parties.
- Tables presenting the relevant data referred to or summarized in the main text.
- A list of associated reports or plans.

7 DURATION OF THE ASSIGNMENT

The Consultant shall prepare time schedules to be submitted to the E&S unit of the PMU in accordance to this TOR. The time frame for the entire consultancy services is within four (4) months of contract signing.

ANNEX TWO: ENVIRONMENTAL AND SOCIAL ASSESSMENT CHECKLIST

Project Alternatives – On-Site Checklist

Item	What to Verify on Site	Method / Evidence	Daily Check (✓)	Remarks
Alternative Location	Other feasible locations within FUAM identified	Walk-through, GPS points, maps		
Land Availability	Alternative sites free of encumbrance	Physical inspection, interviews		
Proximity to Sensitive Receptors	Distance to hostels, labs, water bodies	GPS, mapping		
Technology Options	Other renewable/energy options considered	Engineer input, design notes		
Battery Technology	Alternative battery types assessed	Vendor info, safety review		
Timing Option	Construction timing alternatives assessed	Academic calendar review		
E&S Implications	Environmental & social pros/cons documented	Field notes		

2. BASELINE ENVIRONMENTAL CONDITIONS – DAILY FIELD CHECKLIST

2.1 Climate Change Considerations

Item	What to Check	Method	Daily check ✓	Remarks
Climate Risk	Flooding, heat, wind exposure	Community interview, observation		
Climate Impact on Project	Effect on PV, batteries, access roads	Engineer + climate expert		
Project GHG Contribution	Diesel backup, logistics emissions	Inventory checklist		
Climate Adaptation Measures	Drainage, elevation. ventilation.	Design review		

2.2 Physical Environment

Parameter	What to Verify	Method	Daily Check	Remarks
Climate	Rainfall pattern, temperature	Local data, observation		
Topography	Slope, elevation, flood risk	GPS, visual survey		
Land Use	Academic, residential, open land	Mapping, inspection		

Vegetation	Type and density	Transect walk		

2.3 Environmental Quality

Parameter	What to Verify	Method	Daily Check	Remarks
Biodiversity	Flora/fauna presence	Ecological survey		
Water Quality	Surface & groundwater condition	Sampling + visual inspection		
Air Quality	Dust, emissions	Instrument + observation		
Noise	Ambient noise levels	Sound meter		

2.4 Sensitive Environmental Receptors

Item	What to verify	Method	Daily check	Remarks
Protected Areas	Nearby protected sites	GIS, authority consultation/GPS Cordinates		
Flora of Concern	Threatened species	Ecologist input		
Fauna of Concern	Wildlife presence/movement	Observation, interviews		

3. SOCIAL BASELINE – DAILY CHECKLIST

Item	What to verify	Method	Daily check	Remarks
Local Communities around the project sites	Host & adjacent communities	Mapping, interviews		
Demographics	Population structure	Surveys, records		
Socio-Economic Conditions	Livelihoods, income sources	FGDs, questionnaires		
Existing Infrastructure	Roads, power, water, health	Physical inspection		

4. STAKEHOLDER ENGAGEMENT

4.1 Vulnerable Groups & Context

Item	What to verify	Method	Daily check	Remarks
Vulnerable Groups	Widows, elderly, PWDs identified	Community mapping		
Inclusion Measures	Separate or assisted sessions	Observation		
Political Economy	Power dynamics, conflicts	Key informant interviews		

4.2 Stakeholder Identification & Engagement

Item	What to verify	Method	Daily check	Remarks
Stakeholder List	Communities, NGOs, institutions	Stakeholder register		
Consultation Technique	Meeting, survey, hearing	Engagement log		
Frequency	Adequate & documented	Attendance sheets		

5. STAKEHOLDER CONCERNS – ISSUE-BASED CHECKLIST

Concern area	What to check	Evidence	Daily Check	Remarks
Water Quality	Boreholes, streams condition	Physical inspection		
Air Quality	Dust, fumes	Observation, monitoring		
Noise	Disturbance risk	Measurement		
Waste Generation	Type & volume of waste	Site inspection		

6. DAILY SUMMARY OF FINDINGS

Items	Summary
Key Environmental Issues	
Key Social Issues	
Stakeholder Concerns Raised	
Immediate Mitigation Actions	
Issues for ESMP	

ANNEX THREE: STAKEHOLDERS CONSULTATION ATTENDANCE SHEET

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSEMENT (ESIA) FOR THE INSTALLATION OF SOLAR-HYBRID INTERCONNECTED MINIGRID IN ADMIRALTYNUNIVERSITY, IBUSA, OSHIMILI NORTH LGA, DELTA STATE

ATTENDANCE

LOCATION: Meeting with the Student Rep Council (SRC) DATE: 07/07/26

S/N	Name	Phone No	Email	Organization/Community	Position	Signature
1.	Obeten Klinford A.	09105256377	[illegible]	Admiralty University	Auditor	[signature]
2.	Kachikwu, Triumph Chinyere	07037963356	gamilestar@gmail.com	Admiralty University	FEMALE HOSTEL GOVERNOR	[signature]
3.	Haruna Mustapha Yahaya	09118381181	Harunaprince@gmail.com	Admiralty University	[illegible]	[signature]
4.	Chinaka Chidiwa Wisdom Obim	07062401459	chidewachinaka06@gmail.com	Admiralty University	Secretary General	[signature]
5.	Bangs Nenrit Luka	09041149902	nenritbangs122@gmail.com	Admiralty university	Male Hostel Governor	[signature]
6.	Anetoh Cyril Ikenna	08131122097	ikennaanetoh@gmail.com	Admiralty University	SRC President	[signature]
7.	Okolie Helen Chidera	09131752271	helenokolie790@gmail.com	Admiralty University	Financial Secretary	[signature]
8.	Philips Clever Chima	08146048999	CleverPhilips123@gmail.com	Admiralty University	DIRECTOR OF WELFARE	[signature]
9.	Manwoo Precious	09168869457	pmanwoo@gmail.com	Admiralty University	Female hostel Representative	[signature]
10.	Desmond Opara	08138551890	desmondopara@gmail.com	E&S Consultant	Lead	[signature]
11.	Ogili Oluchi F	07013790259	francesoly19@gmail.com	Ecofield	field assistant	[signature]
12.						
13.						
14.						

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSEMENT (ESIA) FOR THE INSTALLATION OF SOLAR-HYBRID INTERCONNECTED MINIGRID IN ADMIRALTYNUNIVERSITY, IBUSA, OSHIMILI NORTH LGA, DELTA STATE

ATTENDANCE

LOCATION: Meeting with Physical Planning DATE: 07/07/26

S/N	Name	Phone No	Email	Organization/Community	Position	Signature
1.	Commander Y Usman	07030693568	usmanynkulu83@gmail	ADUN	Dr. of works	[signature]
2.	Desmond Opara	08138551890	desmondopara@gmail.com	E&S Consultant	Lead	[signature]
3.	Ogili Oluchi F	07013790259	francesoly19@gmail.com	Ecofield	field assistant	[signature]
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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSEMENT (ESIA) FOR THE INSTALLATION OF SOLAR-HYBRID INTERCONNECTED MINIGRID IN ADMIRALTYNUNIVERSITY, IBUSA, OSHIMILI NORTH LGA, DELTA STATE

ATTENDANCE

LOCATION: Ibuzo Consultation DATE: 06/07/26

S/N	Name	Phone No	Email	Organization/Community	Position	Signature
1.	PRINCE JUDE EMERDI	07039034428		DELSHI-UKWU	PALACE SECRETARY	
2.	HRM Obi Prof. L. C Nwoboshi	08057453127	Louisnwoboshi@yahoo.com	Ibusa	Traditional Ruler	
3.	Desmond Opara	08138551890	desmondopara@gmail.com	Ecofield	Lead EPS	
4.	Ogili Oluchi F	07013790259	francesoly19@gmail.com	Ecofield	field assistant	
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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSEMENT (ESIA) FOR THE INSTALLATION OF SOLAR-HYBRID INTERCONNECTED MINIGRID IN ADMIRALTYNUNIVERSITY, IBUSA, OSHIMILI NORTH LGA, DELTA STATE

ATTENDANCE

LOCATION: ADUN MGT. DATE: 6th July 2026

S/N	Name	Phone No	Email	Organization/Community	Position	Signature
1.	Prof. Christopher N. Ogbogbo	08141500091	VC@adun.edu.ng	Admin	Vice Chancellor	
2.						
3.	Commander T Roman	08030693568	ysmanyaku6683@gmail.com	ADUN	Dir of Works	
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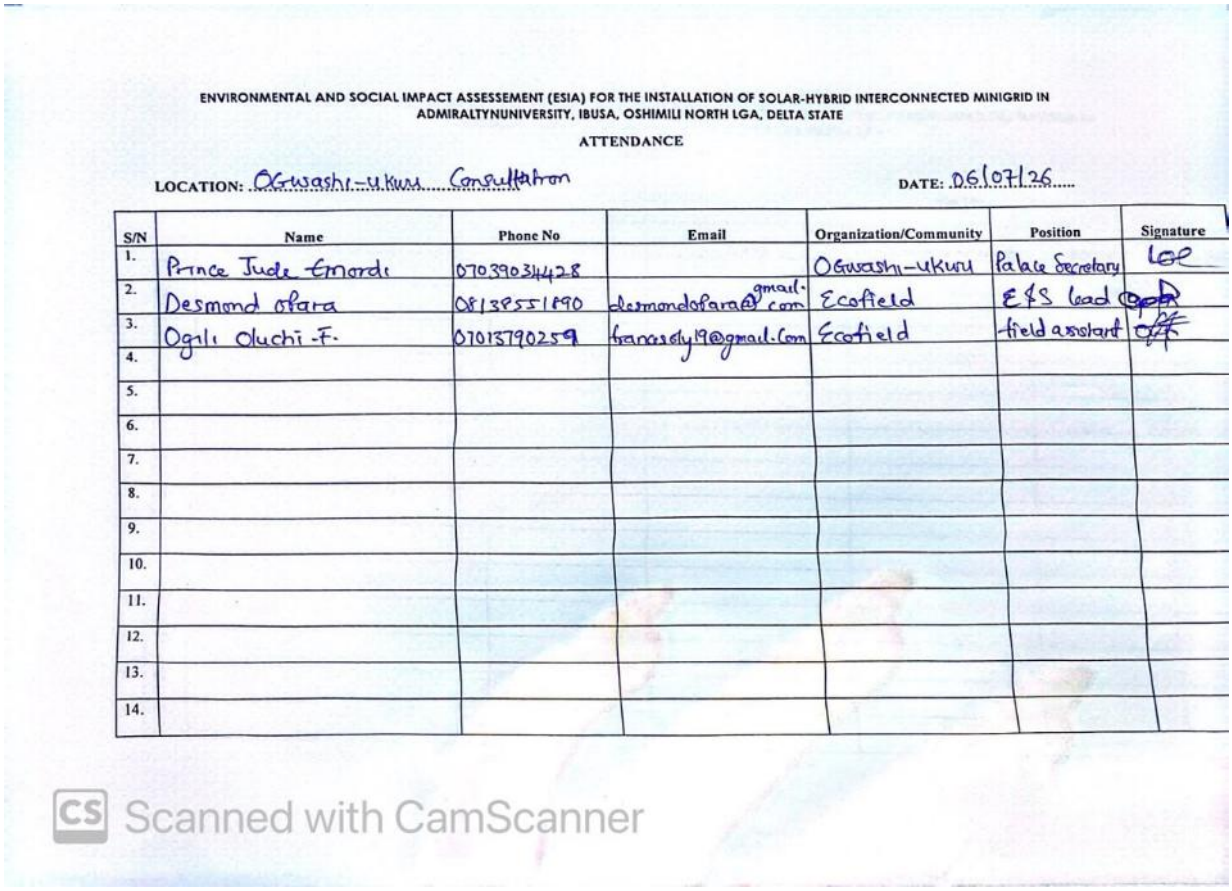

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSEMENT (ESIA) FOR THE INSTALLATION OF SOLAR-HYBRID INTERCONNECTED MINIGRID IN ADMIRALTYNUNIVERSITY, IBUSA, OSHIMILI NORTH LGA, DELTA STATE

ATTENDANCE

LOCATION: Ogwashi-Ukwu Consultation DATE: 06/07/26

S/N	Name	Phone No	Email	Organization/Community	Position	Signature
1.	Prince Jude Emordi	07039034428		Ogwashi-Ukwu	Palace Secretary	
2.	Desmond ofara	08138551890	desmondofara@gmail.com	Ecofield	EFS lead	
3.	Ogili Oluchi F.	07013790259	franosdy19@gmail.com	Ecofield	field assistant	
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ANNEX FOUR: WASTE MANAGEMENT PLAN

BACKGROUND

This Waste Management Plan (WMP) has been developed as part of the Environmental and Social Impact Assessment (ESIA) for the proposed solar hybrid mini-grid at the Admiralty University of Nigeria, Ibusa (ADUN), Delta State, under the Energizing Education Programme III of the Nigeria Electrification Project Phase II (Desert-to-Power), financed by the African Development Bank (AfDB).

The purpose of this plan is to ensure that effective procedures are implemented for the generation, handling, storage, transportation, and disposal of all waste streams arising from project activities across all phases. The plan prescribes measures for waste collection, temporary storage, safe management, and disposal, and includes provisions for recovery, reuse, and recycling in accordance with the waste management hierarchy.

This WMP has been prepared with due cognizance of the AfDB Integrated Safeguards System 2023, the World Bank Environmental, Health and Safety (EHS) Guidelines on Waste Management, the NESREA Act 2018 and applicable subsidiary regulations, and the National Environmental (Sanitation and Wastes Control) Regulations 2009. It shall be reviewed and updated as further detail on waste quantities and categorization becomes available during construction and operational stages.

2.0 Regulatory and Policy Framework

The preparation and implementation of this Waste Management Plan is guided by the following regulatory instruments:

- AfDB Integrated Safeguards System 2023, Operational Safeguard 3 on Pollution Prevention and Control
- World Bank Environmental, Health and Safety General Guidelines on Waste Management
- National Environmental Standards and Regulations Enforcement Agency (NESREA) Act 2018
- National Environmental (Sanitation and Wastes Control) Regulations 2009
- NESREA National Environmental Regulations on the Electrical and Electronic Sector 2011
- Federal Ministry of Environment (FMEnv) Guidelines on Hazardous Waste Management
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, to which Nigeria is a signatory
- Delta State Environmental Law 2021

3.0 General Waste Management Strategy

An integrated approach to waste management is required across all phases of this project. Waste management is premised on the principle of a management hierarchy, ranging from the most desirable to the least desirable option, as follows:

- Reduce: Avoid waste generation by minimizing the quantity of materials used. This is the most preferred and cost-effective option.
- Reuse: Use products or materials again for the same or similar purpose without reprocessing, thereby reducing waste generation and energy consumption.
- Recycle: Process waste into a usable non-waste product, conserving energy and reducing landfill pressure.
- Dispose: Where reduction, reuse, and recycling are not feasible, waste shall be removed and disposed of at a licensed landfill or appropriately approved facility.

The following overarching good management practices shall apply across all project phases:

- Waste generation shall be limited to the lowest practicable level at all times.
- Non-hazardous wastes shall be segregated from hazardous wastes at source.
- Wastes destined for recycling shall be segregated by type.
- Hazardous materials use shall be minimized; personnel handling hazardous waste shall be trained accordingly.
- Spills of hazardous materials shall be prevented through sensible materials management and regular equipment inspections.
- Waste storage areas shall have secondary containment or spill trays.
- Under no circumstances shall waste be burnt or disposed of on site.

4.0 Classification of Wastes

Project activities will generate both non-hazardous and hazardous waste streams, as described below.

Non-Hazardous Wastes

Non-hazardous wastes expected from project activities include domestic waste, recyclable materials such as paper, glass, metals, wooden waste, and tin cans, packaging waste, waste tyres, and excavation and concrete waste generated from civil works and foundations.

Hazardous Wastes

Hazardous wastes expected from project activities include electrical wastes such as damaged or expired batteries, accumulators, inverters, and PV panels, waste oil from equipment and vehicle maintenance, waste paint and chemical residues, and other hazardous waste related to operation, maintenance, and decommissioning activities. These wastes require dedicated management given their potential to cause significant environmental and human health harm if improperly handled.

5.0 Waste Streams by Project Phase and Management Method

The tables below present the expected waste streams for each project phase, their classification, and the prescribed management method.

5.1 Pre-Construction Phase

Project Phase	Activity / Waste Aspect	Waste Type	Classification	Management Method
Pre-Construction	Vegetation clearing	Vegetation, logs, mulched timber, weeds	General Solid (Non-putrescible)	Reuse as compost, soil conditioner, or woodchip mulch on site
	Site clearing and preparation	Excavated materials and topsoil	General Waste	Beneficial reuse on site; balance cut and fill earthworks to optimize reuse
	Site clearing and preparation	Potentially contaminated soils	Hazardous Waste	Off-site disposal at an approved FMEnv or NESREA-licensed facility
	Site clearing and preparation	Scrap metal from site preparation	General Solid (Non-putrescible)	Off-site recycling
	Mobilization of equipment	Packaging materials (wood, plastic, cardboard)	General Solid (Non-putrescible)	Off-site disposal at an approved facility
	Mobilization of equipment	Domestic waste from workers (food packs, cans, bottles)	General Solid (Putrescible)	Off-site disposal at an approved facility

5.2 Construction Phase

Project Phase	Activity / Waste Aspect	Waste Type	Classification	Management Method
Construction	Civil works and foundations	Concrete, brick, asphalt and gravel	General Solid (Non-putrescible)	Crushed and used as backfill or road base
	Civil works and foundations	Steel reinforcing and scrap metal	General Solid (Non-putrescible)	Off-site recycling
	Civil works and foundations	Timber formwork	General Solid (Non-putrescible)	Reuse on site where possible; off-site recycling otherwise
	Civil works and foundations	Sediment from earthworks and excavations	General Solid (Non-putrescible)	Beneficial reuse on site as fill material

Project Phase	Activity / Waste Aspect	Waste Type	Classification	Management Method
	Electrical and cabling works	Conduits, pipes and bulk electrical cabling	General Solid (Non-putrescible)	Off-site recycling
	Electrical and cabling works	Packaging materials (wood, plastic, cardboard, metals)	General Solid (Non-putrescible)	Off-site disposal at an approved facility
	Electrical and cabling works	Empty oil and chemical drums	General Solid (Non-putrescible)	Off-site recycling by licensed contractor
	Electrical and cabling works	Spill clean-ups, waste paint and chemicals	Hazardous Waste	Off-site disposal at an approved FMEnv or NESREA-licensed facility
	Equipment maintenance	Waste oil, grease, fuel and other fluids	Liquid Hazardous Waste	Off-site disposal at an approved facility; no discharge to ground or water
	Equipment maintenance	Used air and oil filters, worn components and rags	General Solid (Non-putrescible)	Off-site disposal at an approved facility
	General site operations	Domestic waste from workers (food packs, cans, bottles)	General Solid (Putrescible)	Off-site disposal at an approved facility
	General site operations	Sanitary waste and sewage	General Solid (Putrescible)	Off-site disposal at approved facility or on-site sewer system
	General site operations	Wastewater and stormwater	Liquid	Off-site disposal or on-site sewer system; no uncontrolled discharge
	Office operations	Paper, cardboard and plastic	General Solid (Non-putrescible)	Off-site recycling
	Office operations	Glass bottles and aluminium cans	General Solid (Non-putrescible)	Off-site recycling
	Office operations	Ink cartridges and toner	General Solid (Non-putrescible)	Off-site recycling by licensed contractor

5.3 Operation and Maintenance Phase

Project Phase	Activity / Waste Aspect	Waste Type	Classification	Management Method
Operation and Maintenance	Routine O&M activities	Waste oil and lubricants from equipment servicing	Liquid Hazardous Waste	Off-site disposal at an approved facility; no discharge to ground or water
	Routine O&M activities	Used filters, worn mechanical components and rags	General Solid (Non-putrescible)	Off-site disposal at an approved facility
	Routine O&M activities	General site waste (cardboard, paper, plastic, tins)	General Solid (Non-putrescible)	Off-site recycling or disposal at approved facility
	Battery and e-waste	Damaged or expired batteries and battery accumulators	Hazardous Waste (E-waste)	Stored in dedicated bonded containment; handed to NESREA-licensed e-waste handler or returned to supplier under EPR arrangement
	Battery and e-waste	End-of-life or damaged inverters	Hazardous Waste (E-waste)	Managed under EPR plan; handed to NESREA-licensed e-waste handler

Project Phase	Activity / Waste Aspect	Waste Type	Classification	Management Method
	Battery and e-waste	Damaged or degraded PV panels	Hazardous Waste (E-waste)	Managed under EPR plan in accordance with NESREA Electrical and Electronic Sector Regulations 2011
	Battery and e-waste	Waste electrical and electronic components	Hazardous Waste (E-waste)	Off-site disposal through certified e-waste management facility in compliance with Basel Convention
	General site operations	Domestic waste from operational staff	General Solid (Putrescible)	Off-site disposal at an approved facility
	General site operations	Sanitary waste and sewage	General Solid (Putrescible)	Off-site disposal at approved facility or on-site sewer system

5.4 Decommissioning Phase

Project Phase	Activity / Waste Aspect	Waste Type	Classification	Management Method
Decommissioning	Dismantling of solar arrays	PV panels and mounting structures	Hazardous Waste (E-waste)	Inventoried; reusable components redirected for refurbishment; remainder disposed through certified e-waste facility in compliance with Basel Convention
	Dismantling of electrical systems	Battery banks, inverters and transformers	Hazardous Waste (E-waste)	Inventoried; managed under EPR and NESREA Electrical and Electronic Sector Regulations 2011
	Dismantling of electrical systems	Electrical cabling and conduits	General Solid (Non-putrescible)	Off-site recycling by licensed contractor
	Demolition of structures	Concrete, brick and rubble	General Solid (Non-putrescible)	Crushed for reuse as fill or road base; remainder to licensed landfill
	Demolition of structures	Scrap metal from structural components	General Solid (Non-putrescible)	Off-site recycling
	Site remediation	Contaminated soils (if any)	Hazardous Waste	Off-site disposal at approved FMEnv or NESREA-licensed facility
	Site remediation	General demolition waste and debris	General Waste	Off-site disposal at a licensed landfill by certified contractor

6.0 Phase-Specific Waste Management Requirements

6. Pre-Construction and Construction Phase

6.1.1 Waste Assessment and Inventory

The Environmental Officer shall develop, implement, and maintain a waste inventory reflecting all waste generated during pre-construction and construction, covering both general and hazardous waste streams. Construction methods and materials shall be carefully considered to maximize opportunities for waste reduction, reuse, and recycling. Targets for waste recovery shall be established once the inventory is in place.

6.1.2 Waste Collection, Handling, and Storage

Each contractor and subcontractor shall implement a waste segregation system using separate bins for food waste, plastics, paper, wood, glass, cardboard, and metals. Waste collection bins and hazardous waste containers shall be provided by the principal contractor and placed at designated locations across the site. A dedicated waste storage area shall be established on site for the temporary storage of all waste streams prior to removal.

Colour coding and signage shall be used to differentiate disposal bins by waste stream type. Hazardous waste shall be stored within a bonded containment area constructed in accordance with FMEnv requirements, and the volume of waste stored shall not exceed 110 percent of the bund capacity. Waste storage areas shall be positioned away from water courses and covered with tarpaulins or roofing to prevent water ingress. Portable sanitation facilities shall be monitored and maintained daily. Under no circumstances shall waste be burnt on site.

6.1.3 Disposal

Waste shall be removed from site on a regular basis as determined by the Environmental Officer, taking into account the volumes generated at different stages of construction. All waste removal shall be undertaken by a registered and licensed contractor, who shall provide waste manifests for all removals at least once a month and supply proof of appropriate disposal at a licensed landfill or approved facility.

6.1.4 Record Keeping

Documentation including waste manifests and certificates of safe disposal shall be maintained, detailing the quantity, nature, and fate of all regulated waste for audit purposes. Waste management shall form part of monthly reporting requirements, covering volumes generated, waste types, storage arrangements, and final disposal.

6.1.5 Training

Training and awareness on waste management shall be provided to all employees and contractors as part of on-site induction and periodic awareness sessions.

6.2 Operation and Maintenance Phase

During the operational phase, waste generation is expected to be limited, consisting primarily of general waste such as cardboard, paper, plastic, tins, metals, and vegetation materials. Limited hazardous waste from end-of-life electrical and electronic equipment may also arise during maintenance activities.

The O&M Contractor and Site Manager shall develop and maintain a waste inventory covering all general and hazardous waste streams generated during operations. Separate bins shall be provided for general and hazardous waste, and recyclable materials shall be removed from the waste stream and stored separately. All waste shall be removed regularly by a licensed contractor and disposed of at an appropriately licensed landfill, with proof of disposal retained.

6.3 Battery and Electronic Waste (E-Waste) Management

The solar hybrid mini-grid involves the installation and long-term operation of battery energy storage systems, inverters, PV panels, and associated electrical and electronic equipment. These components are a significant source of hazardous e-waste over the project lifecycle, particularly at end of life or upon damage during operation. Their management requires dedicated attention given the toxic constituents they may contain, including lead, cadmium, lithium, and other heavy metals.

Battery waste and e-waste generated across all project phases shall be managed in accordance with the NESREA National Environmental Regulations on the Electrical and Electronic Sector 2011, the FMEnv guidelines on hazardous waste management, and the Extended Producer Responsibility (EPR) framework. At the point of procurement, the EPC Contractor shall confirm and document the EPR obligations of all equipment suppliers, including take-back and end-of-life management arrangements for batteries, inverters, and PV modules.

During the operational phase, damaged, expired, or end-of-life batteries and inverters shall be classified as hazardous waste and stored separately in a dedicated, covered, and bonded containment area prior to collection and disposal. No battery or electronic component shall be dismantled, buried, or disposed of on site under any circumstances. All such waste shall be handed over to a NESREA-licensed e-waste handler or returned to the equipment supplier under the applicable EPR arrangement, with waste transfer documentation retained for audit purposes.

During the decommissioning phase, all PV panels, battery banks, inverters, transformers, and electrical cabling removed from the site shall be inventoried and categorised by waste type prior to disposal. Reusable components shall be identified and redirected for reuse or refurbishment where feasible. All remaining e-waste shall be disposed of through certified and licensed e-waste management facilities in compliance with the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.
The Environmental Officer shall maintain a dedicated e-waste register recording the type, quantity, storage location, collection date, and final disposal destination of all battery and electronic waste generated throughout the project.

6.4 Decommissioning Phase
The project is expected to operate for a minimum of 25 years and potentially up to 40 years with proper maintenance. Waste management during decommissioning shall include notifying the appropriate ministries including FMEnv and NESREA prior to commencement of decommissioning activities, applying best practices in demolition and dismantling to prevent pollution or contamination from improper waste handling, managing all associated e-wastes under the EPR framework and NESREA Electrical and Electronic Sector Regulations 2011, and disposing of all other waste types through certified waste managers at appropriately licensed landfills.

7.0 Monitoring of Waste Management Activities
Records shall be kept of the volumes and mass of the different waste streams collected from the site throughout the project lifecycle. The appointed waste contractor shall provide monthly reports to the operator containing the following information:
- Monthly volumes and mass of the different waste streams collected
- Monthly volumes and mass of waste disposed of at a landfill site
- Monthly volumes and mass of waste recycled
- Data illustrating progress compared to previous months

These reports will aid in monitoring the effectiveness of the waste management procedures in place and identify any need for revision or corrective action.

8.0 Waste Management Cost
Finances have been allocated for proper waste management across all project phases. The cost of mitigation and monitoring for waste management from pre-construction through to operations and maintenance has been factored into the respective phase budgets in the ESMP, covering training, personal protective equipment, receptacles, containment areas, and disposal costs. The cost of waste management during the decommissioning phase shall be developed at that stage, reflecting the specific quantities and types of waste to be managed at that time.

9.0 Conclusion
This Waste Management Plan has been prepared to ensure that all wastes generated from the proposed solar hybrid mini-grid project at ADUN are effectively managed, minimised, and disposed of in an environmentally responsible manner consistent with applicable Nigerian regulations and AfDB safeguard requirements. The effectiveness of the plan depends on prompt and systematic waste management practices, the use of appropriately licensed contractors, and adequate supervision by the REA-PMU and relevant regulatory authorities throughout the project lifecycle.

ANNEX FIVE: CLIMATE CHANGE ADAPTATION AND MITIGATION PLAN

Introduction

This Climate Change Adaptation and Mitigation Plan has been developed for the proposed Solar Hybrid Mini-Grid Project at the Admiralty University of Nigeria, Ibusa (ADUN), DeltaState. The plan outlines measures to enhance the project's resilience to climate variability and change, while also contributing to climate change mitigation through reduced greenhouse gas (GHG) emissions.

The plan is prepared in line with national climate policies and international best practices, including the requirements of the African Development Bank.

Climate Context of the Project Area

Oshimili, located in DeltaState, lies within the Sudan Savannah ecological zone and is characterized by:

- High temperatures, particularly during the dry season
- Seasonal rainfall with increasing variability
- Occasional intense rainfall events leading to localized erosion and flooding
- Increasing risk of prolonged dry periods

These conditions present potential risks to infrastructure performance and environmental sustainability.

Climate Change Risks to the Project

Climate Risk	Potential Impact on Project
Increased temperature	Reduced efficiency of solar panels and battery systems
Intense rainfall events	Soil erosion, flooding of trenches, damage to infrastructure
Strong winds	Damage to solar panel mounting structures
Prolonged dry periods	Increased dust generation affecting panel efficiency
Extreme weather events	Disruption of construction and operation activities

Climate Change Mitigation Measures

The project inherently contributes to climate change mitigation through the use of renewable energy. Additional measures include:

Reduction of Greenhouse Gas Emissions

- Deployment of solar photovoltaic (PV) systems to reduce reliance on diesel generators
- Optimization of hybrid system design to minimize fossil fuel backup usage
- Promotion of energy efficiency within the university facilities

Sustainable Construction Practices

- Use of well-maintained equipment to reduce emissions
- Minimization of material wastage during construction
- Efficient logistics planning to reduce fuel consumption

Waste Management

- Proper handling and disposal of construction waste
- Safe management of hazardous materials (e.g., batteries)
- Promotion of recycling where feasible

Climate Change Adaptation Measures

Infrastructure Design and Siting

- Elevation of critical equipment (e.g., inverters, batteries) to prevent flood damage
- Design of adequate drainage systems to manage stormwater runoff
- Use of corrosion-resistant and heat-tolerant materials

Erosion and Soil Management

- Stabilization of exposed soils through compaction and vegetation where applicable
- Installation of erosion control measures (e.g., sandbags, drainage channels)

Solar Panel Efficiency Management

- Regular cleaning of solar panels to reduce dust accumulation
- Proper spacing and orientation to optimize airflow and reduce overheating

Structural Stability

- Design and installation of mounting structures to withstand local wind conditions
- Regular inspection and maintenance of structural components

Operational Resilience

- Development of maintenance schedules to ensure system reliability
- Training of personnel on climate-related risks and response measures

Institutional Responsibilities

Activity	Responsible Party
Implementation of mitigation measures	Contractor / Operator
Monitoring of climate risks	REA- NEP / Supervising Engineer
Compliance with standards	Federal Ministry of Environment
Oversight and reporting	African Development Bank / REA

Monitoring Indicators

Aspect	Indicator	Frequency
Solar efficiency	Energy output vs expected performance	Monthly
Erosion control	Presence of erosion features	After rainfall
Drainage performance	Absence of flooding or waterlogging	During rainy season
Structural integrity	Condition of mounting structures	Quarterly
Waste management	Proper disposal records	Monthly

Capacity Building and Awareness

- Training of workers on climate-resilient construction practices
- Awareness programs for facility operators on system maintenance under varying climatic conditions
- Integration of climate considerations into routine operational procedures
- reducing greenhouse gas emissions while ensuring reliable and climate-resilient energy supply.

ANNEX SIX: LABOUR MANAGEMENT PLAN

1.0 Introduction

This Labour Management Plan (LMP) has been developed for the proposed Solar Hybrid Mini-Grid Project at the Admiralty University of Nigeria, Ibusa (ADUN), Delta State. The LMP outlines the approach to managing labour and working conditions in a manner that promotes fair treatment, non-discrimination, and safe working environments throughout the project lifecycle.

The plan is prepared in line with national labour laws and international best practices, including the requirements of the African Development Bank.

2.0 Types of Project Workers

The project is expected to engage the following categories of workers:

Direct Workers

- Personnel engaged by the Rural Electrification Agency (REA) and project consultants
- Supervising engineers (including Project Owner's Engineer – POE)

Contracted Workers

- Workers employed by contractors and sub-contractors for construction and installation activities
- Skilled and unskilled labour for civil, electrical, and mechanical works

Community Workers (Where Applicable)

- Local labour engaged for minor site activities (e.g., clearing, logistics support)

3.0 Key Labour Risks

Risk Category	Potential Issues
Occupational Health and Safety (OHS)	Injuries from equipment, electrical hazards, falls, trenching risks
Labour influx	Pressure on local resources, potential community tension
Worker misconduct	Conflict with host community, inappropriate behaviour
Child labour	Engagement of underage workers
Forced labour	Unfair or coercive employment practices
Gender-based risks	Sexual Exploitation and Abuse (SEA), Sexual Harassment (SH)
Poor working conditions	Lack of PPE, inadequate welfare facilities

4.0 Labour Management Measures

- **Employment Principles**
  - Equal opportunity employment based on qualifications and competence
  - No discrimination based on gender, religion, ethnicity, or social status
  - Preference for local labour where feasible

- **Working Conditions**
  - Clear terms of employment (contracts, wages, working hours)
  - Compliance with national labour regulations
  - Provision of adequate welfare facilities (water, sanitation, rest areas)

- **Occupational Health and Safety (OHS)**
  - Development and implementation of a site-specific Health, Safety and Environment (HSE) Plan
  - Mandatory use of appropriate Personal Protective Equipment (PPE)
  - Regular toolbox talks and safety briefings
  - Provision of first aid kits and emergency response procedures
  - Safe handling of equipment and electrical systems

- **Code of Conduct**

All workers shall sign and adhere to a Code of Conduct that includes:

- Respect for local communities and cultural norms
- Prohibition of SEA/SH and gender-based violence (GBV)
- Prohibition of child labour and forced labour
- Compliance with safety rules and regulations

- **Prevention of Child and Forced Labour**
  - Minimum employment age of 18 years for hazardous work
  - Verification of worker age through valid identification
  - Voluntary employment without coercion

- **Gender and Social Inclusion**
  - Promotion of women participation where feasible
  - Awareness programs on GBV, SEA, and SH
  - Safe and inclusive working environment for all workers

5.0 Worker Grievance Redress Mechanism (GRM)

A dedicated grievance mechanism shall be established for workers to raise concerns related to:

- Working conditions
- Wages and benefits
- Harassment or discrimination
- Safety concerns
- **GRM Features:**
- Accessible and confidential
- Timely response and resolution
- Proper documentation of grievances
- No retaliation against complainants

6.0 Roles and Responsibilities

Entity	Responsibilities
Contractor	Implementation of LMP, worker management, OHS compliance
Supervising Engineer / POE	Monitoring compliance with labour and safety requirements
Rural Electrification Agency (REA)	Oversight and enforcement of labour standards
African Development Bank	Monitoring compliance with safeguard requirements

7.0 Monitoring Indicators

Aspect	Indicator	Frequency
PPE usage	% of workers using PPE correctly	Daily
Safety training	Number of toolbox talks conducted	Weekly
Incidents	Number of accidents/incidents recorded	Monthly
Labour conditions	Availability of contracts and welfare facilities	Monthly
GRM	Number of grievances received and resolved	Monthly
Gender inclusion	% of female workers (where applicable)	Monthly

ANNEX SEVEN: HSE PLAN

1.0 INTRODUCTION

All projects present inherent health, safety, and environmental (HSE) risks that must be effectively managed to prevent accidents, injuries, and environmental harm. This HSE Plan has been developed for the proposed Solar Hybrid Mini-Grid Project at the Admiralty University of Nigeria, Ibusa (ADUN), Delta State, to ensure compliance with applicable Occupational Health and Safety (OHS) standards and best practices.

The plan provides a structured framework for identifying, assessing, and managing HSE risks associated with the project. The project team shall ensure high performance standards and full compliance with contractual and regulatory requirements by implementing HSE measures in a systematic, proactive, and continuous manner throughout the project lifecycle.

2.0 PROJECT DESCRIPTION

The proposed project involves the installation and operation of a Solar Hybrid Mini-Grid system within the permanent campus of the Admiralty University of Nigeria, Ibusa (ADUN). The project components include site preparation, installation of solar photovoltaic (PV) panels, battery energy storage systems, inverters, and associated electrical infrastructure, as well as trenching and cabling for power distribution within the campus.

Construction activities will include site clearing, civil works, equipment installation, and electrical connections, while the operational phase will involve routine maintenance, system monitoring, and facility management.

2.1 Purpose

The purpose of this HSE Plan is to outline the occupational health, safety, and environmental management requirements for the project, and to define the procedures, control measures, and responsibilities necessary to prevent incidents and ensure a safe working environment.

Specifically, this plan aims to:

- Identify potential HSE risks associated with project activities;
- Establish appropriate risk control and mitigation measures;
- Ensure compliance with applicable national OHS laws and international best practices, including those of the African Development Bank;
- Promote a strong safety culture among all project personnel; and
- Provide guidelines for safe work practices throughout the project lifecycle.

2.2 HSE Objectives

The Objectives for this plan are to:

- Adopt a positive Health & Safety Culture.
- Adopt the principles of prevention to avoid risk.

- Complete the project without incident (Zero fatalities, Zero Lost Time Injury (LTI) or occupational illness).

2.3 Scope of Work

The Project Occupational Health and Safety (OHS) plan covers the scope of works defined in the contract. This includes Preconstruction, Construction, Operation & Maintenance and decommissioning phases.

2.4 Policy Statement

In addition to the existing HSE policy, other policies shall be developed which includes:

- Substance Abuse Policy – Prohibiting the consumption or possession of narcotics, drugs, alcohol and other banned substances
- Emergency Response Policy – Stating commitment to ensure adequate resources and arrangement are in place in the case an emergency.
- Community Affairs Policy – Stating commitment to foster healthy relationships with communities through observance of the highest standard of conduct.
- Road Safety Policy–Stating commitment to complying with Road Traffic regulations and continuously improving its road safety performance by implementing a Road Safety Management Plan (RSMP)

3.0 KEY RESPONSIBILITIES

Involvement of all in implementing, maintaining and continually improving OHS processes is the key to successful completion and achievement of quality objectives set by the management. All project personnel shall therefore be required to be familiar with the content of this OHS plan and shall participate in implementing, maintaining and improving the management system.

It is the responsibility of the project manager and all key personnel to ensure that the requirements for quality are fulfilled for works under their responsibility.

All new staff and staff who are given new responsibilities are to be inducted into the requirements set out in this plan in general and into their function and responsibilities in particular.

3.1 Project Manager Responsibilities

- Set good example in HSE issues.
- Ensure the availability of resources essential to establish, implement, maintain and improve the OHS Management System.
- Define, document and communicate roles, allocate responsibilities and accountabilities, delegating authorities, to facilitate effective OHS management.
- Ensure that all of the activities undertaken in the Project conform to Nigerian legislation, client requirements or international standards when applicable.
- Review objectives achievements throughout the year.

3.2 Project Supervisors Responsibilities

- Enforcing all phases of the established HSE plan.
- Set good example in HSE issues.
- Preparing Job Hazard Analysis when required.
- Ensuring the safety of all workers associated with the site.
- Conducting HSE inspections.
- Ensuring workers are competent for their allocated tasks.
- Attending and participating in HSE meetings.

- Participating in accident investigations.

3.3 HSE Manager/Supervisor Responsibilities

- Prepare relevant OHS documentation and procedures.
- Monitor the efficient implementation of OHS requirements.
- Participate and organize the OHS risk assessments.
- Advise management of compliance and of conditions requiring attention.
- Conduct regular HSE inspections.
- Make thorough analysis of statistical data and inspections; delineates problem areas; and makes recommendation for solutions.
- Take part in the review of all OHS incidents and assist in investigating incident.
- Monitor the efficient implementation of the Project's OHS requirements.
- Organize the Project's OHS risk assessment exercises.
- Check on the use of all types of personal protective equipment specifies the use of appropriate PPE for the various work activities. Evaluates their effectiveness and suggests improvements where indicated.

3.4 HSE Advisor Responsibilities

- Check on the use of all types of personal protective equipment specifies the use of appropriate PPE for the various work activities. Evaluates their effectiveness and suggests improvements.
- Conduct independent inspections to observe conformance with established OHS Plan and determines the effectiveness of individual elements of the plan (pre-task briefing, weekly toolbox talk, etc)
- Establish contact with Subcontractors with the objective of maintaining good relations and coordination of accident prevention activities and compliance with the established OHS plan.
- Correct unsafe acts and unsafe conditions.
- Deliver HSE induction/orientation course to all employees, including subcontractors.
- Deliver HSE awareness course and toolbox talk.
- Advise employees on OHS matters.

3.5 All employees Responsibilities

- Take all reasonable and practical steps to care for their own health and safety and avoid affecting the health and safety of co-workers and the general public.
- Follow all instructions and use the equipment properly
- Not interfere with any safety arrangements.
- Report any circumstances which may not comply with the project's OHS management system.

4.0 Competency

All personnel required to operate or work with any equipment or machine must be competent, be tested for each equipment that he/she shall be operating. All personnel who as part of their profession require licensing or certification must obtain the necessary certification before he/she shall be allowed to work on the site.

5.0 Fitness

All personnel working on site shall be required to be certified medically fit to do so by an approved medical facility or Medical Doctor (pre-employment medical examination)

6.0 HSE Training

6.1 Induction/Orientation

Every new or rehired employee and Subcontractors employees must undergo mandatory OHS orientation / induction. The purpose of the Induction is to educate workers and make them aware of the major potential hazards he or she shall come into contact with while working on the site; also, it is one more opportunity to stress the importance of HSE being the first priority in the operations.

The content of the HSE orientation / induction shall cover the following subjects:

- Site safety rules.
- Personnel protective equipment requirements (PPE).
- Environmental sensitivity and protection.
- Preparation and planning of the job (Daily Pre-task talk).
- Emergency plan and muster points.

6.2 Project Specific HSE Training

In addition to the HSE orientation /induction, there shall be specific site HSE trainings which shall cover the following topics:

- Manual handling.
- Electrical Safety
- Emergency Prevention, Preparedness and Response
- Work at height training
- First Aid training (for site First Aiders)
- Lifting and Rigging
- Safe Driving techniques (for drivers)

7.0 Hazard identification & HSE risk assessment

7.1 Project HSE Risk Assessment

The project HSE risk assessment shall be developed and recorded. The Project's HSE risk assessment shall be conducted by a team consisting of HSE Manager/ Supervisor and technical managers/supervisors. It must be approved by the Project manager.

7.2 Fire Risk Assessment

A fire risk assessment shall be developed and recorded. A fire safety plan shall be in place in the site.

7.3 Job Hazard Analysis

Job hazard analysis is required when the hazards and risks associated with a specific task is to be identified so as to implement control measures. The HSE department together with the technical managers/supervisors shall develop a job hazard analysis when applicable.

8.0 EMERGENCY PREPAREDNESS AND RESPONSE

Emergency procedures and evacuation plan shall be developed by the HSE Department and displayed on the notice board. These procedures shall be communicated to all staff. Also, each section/department shall have at least a trained first aider at all times.

9.0 HSE IMPLEMENTATION AND PERFORMANCE MONITORING

9.1 HSE Meetings

HSE management meetings shall be held once a month. The meeting is to help identify safety problems, develop solutions, review incident reports, provide training and evaluate the effectiveness of our safety program. Some of the meetings shall be:

- Project/Site Management HSE Meeting for management and supervision (Monthly).
- Tool box talk meetings for all workforce (Weekly).
- Pre-task briefing for all workforces (Daily).
- Special situation meeting (As required).

9.2 HSE Reporting

All incidents and illnesses must be reported to site supervisor after which investigation shall commence and recorded so that appropriate corrective actions shall be implemented to prevent any re-occurrence and report findings shall be forwarded to management for review. Reporting requirements shall include notification of incident, investigation report, and monthly report. Notification of Incident form shall be developed which shall be filled and submitted to HSE department for investigation.

9.3 HSE Inspection and Audits

For continual improvement of HSE management system, HSE inspection and audit shall be conducted. An inspection checklist shall be developed. This is to ensure that the HSE management system is being adhered to. The inspection shall be conducted by the HSE department together with site management.

9.4 Corrective and Preventive Actions and Non-Conformities

During the cause of inspections, concerns raised shall be addressed and closed out. It is expected that in a period of two weeks, a close out inspection shall take place to verify that the corrective actions have been closed.

10.0 PROJECT HSE RULES

The project HSE rules shall be developed and supervision shall develop specific rules and procedures when necessary.

The following site rules shall be implemented at all times. The Site Manager shall draw these rules to the attention of their own workmen or staff. All sub-contractors must ensure that these rules are drawn to the attention of their workmen and staff.

The Principal Contractor may implement additional site rules during the contract programme. Any such additional rules shall be notified to all personnel engaged on the project prior to their implementation. The HSE rules shall include but not limited to:

1. Personal Protective Equipment must be worn at all times.
2. All instructions issued by the Site Manager regarding the storage, handling or cleaning of materials, plant and equipment must be followed.
3. All vehicles must be parked in the designated areas.
4. Any workman suffering from a medical condition that might affect his work and/or that could require specific medical treatment must inform the supervisor before commencing work.
5. All site tools shall either be battery operated or 110 volts.
6. No one shall be permitted on site if it is believed that they are under the influence of alcohol or drugs.
7. Vehicles must not reverse without a banksman in attendance.
8. All visitors to site must undergo a site-specific induction and operative Identity badges must be worn at all times.
9. All excavations must be secured.
10. Smoking and eating shall only be permitted in the designated area. This area shall be identified during induction.

11. No hot works operations are permitted without a hot work permit in place.
12. There shall be no radios or other music playing devices on site.
13. Good housekeeping practices to be adopted.
14. Compliance with all Ethical Power Permit to Work systems
15. The site keyed access procedure must be strictly adhered to.
16. All Contractors must comply with Site Health & Safety Guidelines / Site Safety Method Statement
17. No untrained worker shall be permitted to operate heavy machineries.

11.0 SAFE WORK PRACTICES

Implementing safe work practices is one of the keys to achieving our HSE objectives and some of these safe work practices include:

11.1 Personal Protective Equipment (PPE)

The basic PPE required for the project shall be Safety Glasses, Safety Boots, Hand Gloves, Hard Hat and Coverall. Any other PPE shall be used as applicable. Management is responsible for the provision of PPE and usage shall be enforced at all time. PPE shall be provided in circumstances where exposure to hazards cannot be avoided by other means or to supplement existing control measures identified by a risk assessment. An assessment shall be made to ensure that the PPE is suitable for purpose and is appropriate to the risk involved. Information, instruction & training shall be given to all employees on safe use, maintenance and storage of PPE. Employees shall, in accordance with instructions given, make full use of all PPE provided and maintain it in a serviceable condition and report its loss or defect immediately to the maintenance department where it shall be replaced. PPE shall be replaced when it is no longer serviceable and returned on a new for old basis. Employees shall sign to state that they have received PPE when issued.

12.0 WELFARE FACILITIES

The provision of welfare facilities on the site shall be communicated to all operatives at site induction.

A cleaning regime shall be implemented and maintained for the duration of the construction phase to ensure the site welfare facilities remain in a clean and tidy condition.

If mains drinking water becomes unavailable during the construction phase bottled water shall be brought to site for all operatives for the necessary period.

13.0 SIGNAGE

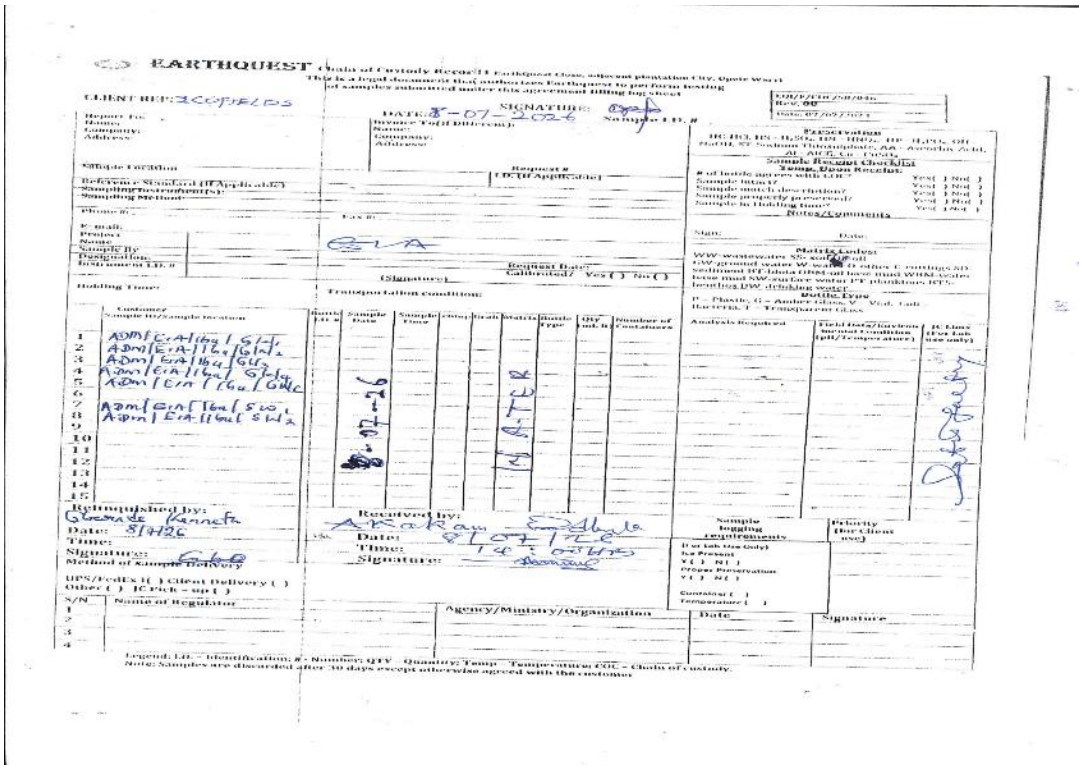
Adequate provision for warning and directional signs shall be made.

14.0 PROJECT HSE PROCEDURES

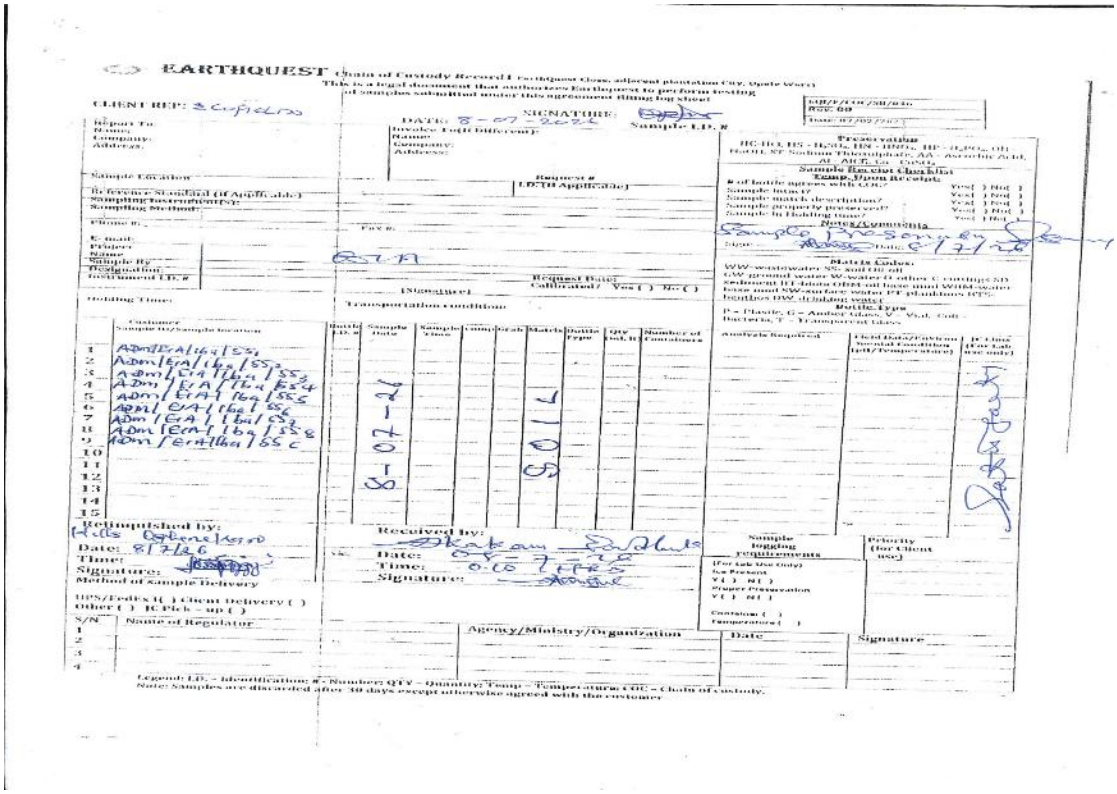
OHS procedures shall be developed. Project activities shall generally be controlled in accordance with OHS Procedures. These procedures shall include:

- Lifting and Rigging Procedure
- HSE Reporting Procedure
- Working at Height Procedure.
- Emergency Procedure.

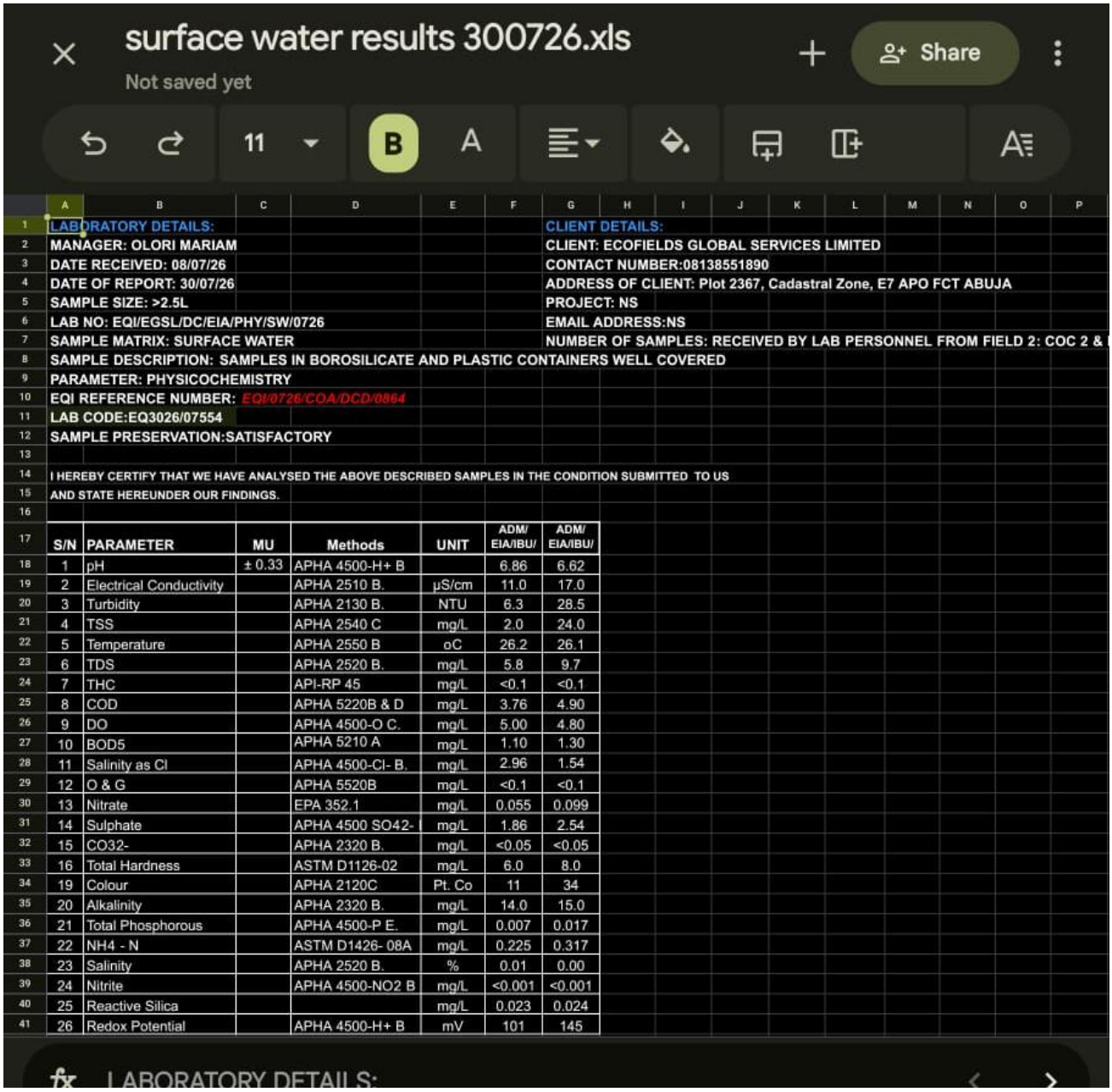
ANNEX EIGHT: LAB DOCUMENTATION



EARTHQUEST Chain of Custody Record

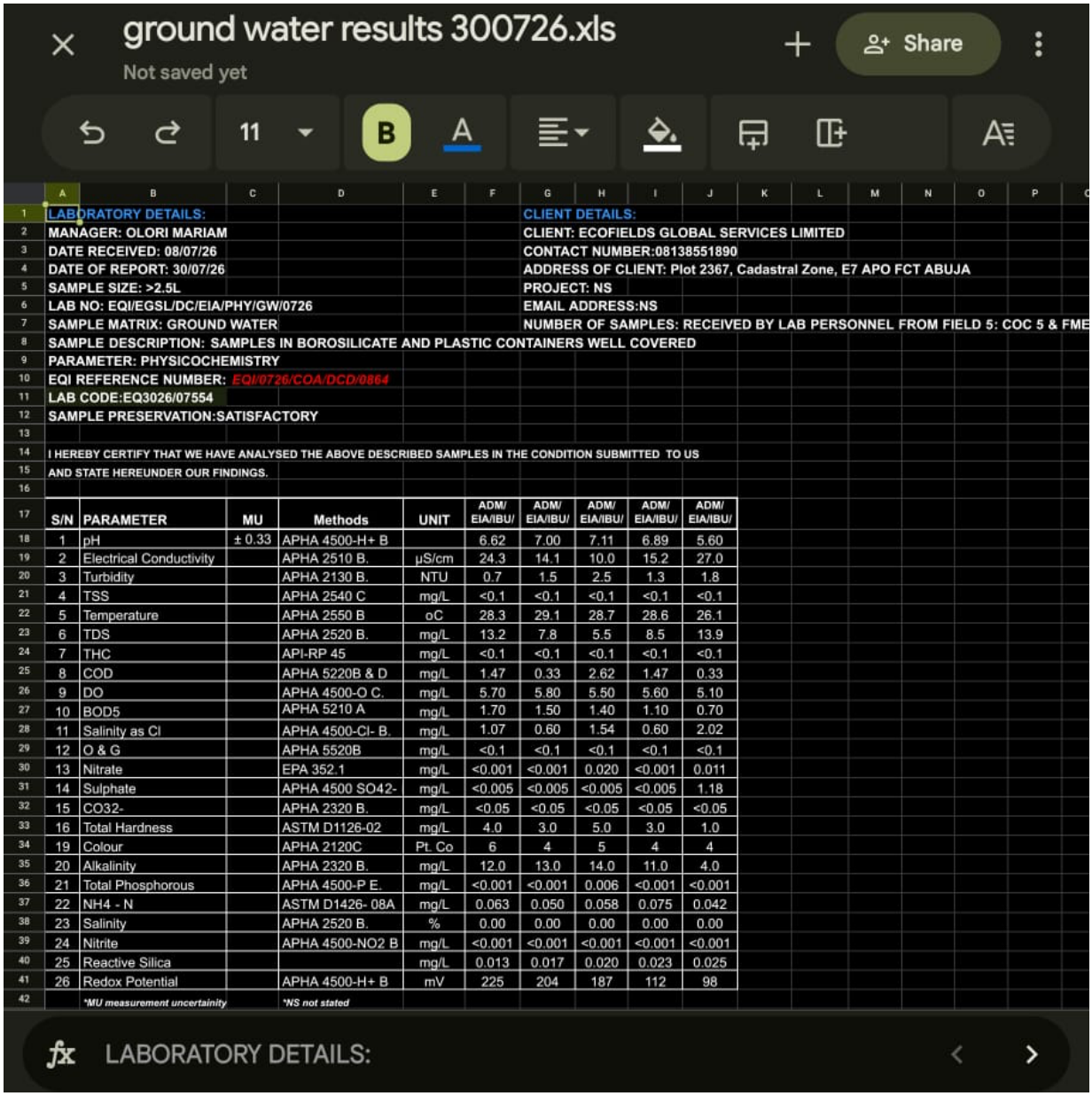


EARTHQUEST Chain of Custody Record



1	LABORATORY DETAILS:					CLIENT DETAILS:										
2	MANAGER: OLORI MARIAM					CLIENT: ECOFIELDS GLOBAL SERVICES LIMITED										
3	DATE RECEIVED: 08/07/26					CONTACT NUMBER:08138551890										
4	DATE OF REPORT: 30/07/26					ADDRESS OF CLIENT: Plot 2367, Cadastral Zone, E7 APO FCT ABUJA										
5	SAMPLE SIZE: >2.5L					PROJECT: NS										
6	LAB NO: EQI/EGSL/DC/EIA/PHY/SW/0726					EMAIL ADDRESS:NS										
7	SAMPLE MATRIX: SURFACE WATER					NUMBER OF SAMPLES: RECEIVED BY LAB PERSONNEL FROM FIELD 2: COC 2 &										
8	SAMPLE DESCRIPTION: SAMPLES IN BOROSILICATE AND PLASTIC CONTAINERS WELL COVERED															
9	PARAMETER: PHYSICOCHEMISTRY															
10	EQI REFERENCE NUMBER: EQI/0726/COA/DCD/0864															
11	LAB CODE:EQ3026/07554															
12	SAMPLE PRESERVATION:SATISFACTORY															
13																
14	I HEREBY CERTIFY THAT WE HAVE ANALYSED THE ABOVE DESCRIBED SAMPLES IN THE CONDITION SUBMITTED TO US															
15	AND STATE HEREUNDER OUR FINDINGS.															
16																

17	S/N	PARAMETER	MU	Methods	UNIT	ADM/ EIA/IBU/	ADM/ EIA/IBU/
18	1	pH	± 0.33	APHA 4500-H+ B		6.86	6.62
19	2	Electrical Conductivity		APHA 2510 B.	µS/cm	11.0	17.0
20	3	Turbidity		APHA 2130 B.	NTU	6.3	28.5
21	4	TSS		APHA 2540 C	mg/L	2.0	24.0
22	5	Temperature		APHA 2550 B	oC	26.2	26.1
23	6	TDS		APHA 2520 B.	mg/L	5.8	9.7
24	7	THC		API-RP 45	mg/L	<0.1	<0.1
25	8	COD		APHA 5220B & D	mg/L	3.76	4.90
26	9	DO		APHA 4500-O C.	mg/L	5.00	4.80
27	10	BOD5		APHA 5210 A	mg/L	1.10	1.30
28	11	Salinity as Cl		APHA 4500-Cl- B.	mg/L	2.96	1.54
29	12	O & G		APHA 5520B	mg/L	<0.1	<0.1
30	13	Nitrate		EPA 352.1	mg/L	0.055	0.099
31	14	Sulphate		APHA 4500 SO42-	mg/L	1.86	2.54
32	15	CO32-		APHA 2320 B.	mg/L	<0.05	<0.05
33	16	Total Hardness		ASTM D1126-02	mg/L	6.0	8.0
34	19	Colour		APHA 2120C	Pt. Co	11	34
35	20	Alkalinity		APHA 2320 B.	mg/L	14.0	15.0
36	21	Total Phosphorous		APHA 4500-P E.	mg/L	0.007	0.017
37	22	NH4 - N		ASTM D1426- 08A	mg/L	0.225	0.317
38	23	Salinity		APHA 2520 B.	%	0.01	0.00
39	24	Nitrite		APHA 4500-NO2 B	mg/L	<0.001	<0.001
40	25	Reactive Silica			mg/L	0.023	0.024
41	26	Redox Potential		APHA 4500-H+ B	mV	101	145



1	LABORATORY DETAILS:					CLIENT DETAILS:										
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5	SAMPLE SIZE: >2.5L					PROJECT: NS										
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9	PARAMETER: PHYSICOCHEMISTRY															
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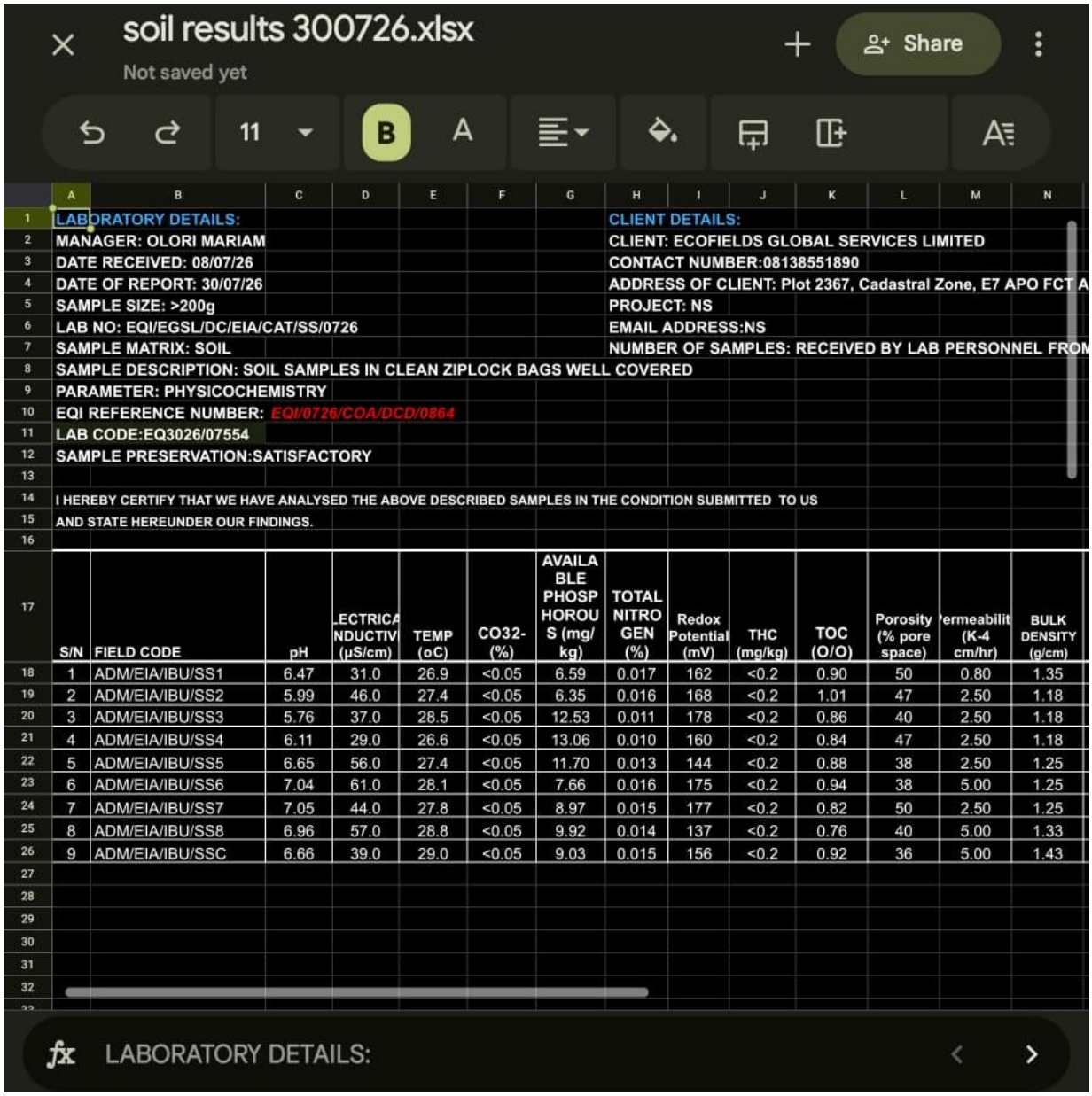
11	LAB CODE:EQ3026/07554															
12	SAMPLE PRESERVATION:SATISFACTORY															
13																
14	I HEREBY CERTIFY THAT WE HAVE ANALYSED THE ABOVE DESCRIBED SAMPLES IN THE CONDITION SUBMITTED TO US															
15	AND STATE HEREUNDER OUR FINDINGS.															
16																

17	S/N	PARAMETER	MU	Methods	UNIT	ADM/ EIA/IBU/	ADM/ EIA/IBU/	ADM/ EIA/IBU/	ADM/ EIA/IBU/	ADM/ EIA/IBU/
18	1	pH	± 0.33	APHA 4500-H+ B		6.62	7.00	7.11	6.89	5.60
19	2	Electrical Conductivity		APHA 2510 B.	µS/cm	24.3	14.1	10.0	15.2	27.0
20	3	Turbidity		APHA 2130 B.	NTU	0.7	1.5	2.5	1.3	1.8
21	4	TSS		APHA 2540 C	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
22	5	Temperature		APHA 2550 B	oC	28.3	29.1	28.7	28.6	26.1
23	6	TDS		APHA 2520 B.	mg/L	13.2	7.8	5.5	8.5	13.9
24	7	THC		API-RP 45	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
25	8	COD		APHA 5220B & D	mg/L	1.47	0.33	2.62	1.47	0.33
26	9	DO		APHA 4500-O C.	mg/L	5.70	5.80	5.50	5.60	5.10
27	10	BOD5		APHA 5210 A	mg/L	1.70	1.50	1.40	1.10	0.70
28	11	Salinity as Cl		APHA 4500-Cl- B.	mg/L	1.07	0.60	1.54	0.60	2.02
29	12	O & G		APHA 5520B	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
30	13	Nitrate		EPA 352.1	mg/L	<0.001	<0.001	0.020	<0.001	0.011
31	14	Sulphate		APHA 4500 SO42-	mg/L	<0.005	<0.005	<0.005	<0.005	1.18
32	15	CO32-		APHA 2320 B.	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
33	16	Total Hardness		ASTM D1126-02	mg/L	4.0	3.0	5.0	3.0	1.0
34	19	Colour		APHA 2120C	Pt. Co	6	4	5	4	4
35	20	Alkalinity		APHA 2320 B.	mg/L	12.0	13.0	14.0	11.0	4.0
36	21	Total Phosphorous		APHA 4500-P E.	mg/L	<0.001	<0.001	0.006	<0.001	<0.001
37	22	NH4 - N		ASTM D1426- 08A	mg/L	0.063	0.050	0.058	0.075	0.042
38	23	Salinity		APHA 2520 B.	%	0.00	0.00	0.00	0.00	0.00
39	24	Nitrite		APHA 4500-NO2 B	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
40	25	Reactive Silica			mg/L	0.013	0.017	0.020	0.023	0.025
41	26	Redox Potential		APHA 4500-H+ B	mV	225	204	187	112	98
42		*MU measurement uncertainity		*NS not stated						



soil results 300726.xlsx

Not saved yet

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1	LABORATORY DETAILS:						CLIENT DETAILS:						
2	MANAGER: OLORI MARIAM						CLIENT: ECOFIELDS GLOBAL SERVICES LIMITED						
3	DATE RECEIVED: 08/07/26						CONTACT NUMBER:08138551890						
4	DATE OF REPORT: 30/07/26						ADDRESS OF CLIENT: Plot 2367, Cadastral Zone, E7 APO FCT A						
5	SAMPLE SIZE: >200g						PROJECT: NS						
6	LAB NO: EQI/EGSL/DC/EIA/CAT/SS/0726						EMAIL ADDRESS:NS						
7	SAMPLE MATRIX: SOIL						NUMBER OF SAMPLES: RECEIVED BY LAB PERSONNEL FROM						
8	SAMPLE DESCRIPTION: SOIL SAMPLES IN CLEAN ZIPLOCK BAGS WELL COVERED												
9	PARAMETER: PHYSICOCHEMISTRY												
10	EQI REFERENCE NUMBER: EQI/0726/COA/DCD/0864												
11	LAB CODE:EQ3026/07554												
12	SAMPLE PRESERVATION:SATISFACTORY												
13													
14	I HEREBY CERTIFY THAT WE HAVE ANALYSED THE ABOVE DESCRIBED SAMPLES IN THE CONDITION SUBMITTED TO US												
15	AND STATE HEREUNDER OUR FINDINGS.												
16													

17	S/N	FIELD CODE	pH	LECTRICA NDUCTIV (µS/cm)	TEMP (oC)	CO32- (%)	AVAILA BLE PHOSP HOROU S (mg/ kg)	TOTAL NITRO GEN (%)	Redox Potential (mV)	THC (mg/kg)	TOC (O/O)	Porosity (% pore space)	ermeabilit (K-4 cm/hr)	BULK DENSITY (g/cm)
18	1	ADM/EIA/IBU/SS1	6.47	31.0	26.9	<0.05	6.59	0.017	162	<0.2	0.90	50	0.80	1.35
19	2	ADM/EIA/IBU/SS2	5.99	46.0	27.4	<0.05	6.35	0.016	168	<0.2	1.01	47	2.50	1.18
20	3	ADM/EIA/IBU/SS3	5.76	37.0	28.5	<0.05	12.53	0.011	178	<0.2	0.86	40	2.50	1.18
21	4	ADM/EIA/IBU/SS4	6.11	29.0	26.6	<0.05	13.06	0.010	160	<0.2	0.84	47	2.50	1.18
22	5	ADM/EIA/IBU/SS5	6.65	56.0	27.4	<0.05	11.70	0.013	144	<0.2	0.88	38	2.50	1.25
23	6	ADM/EIA/IBU/SS6	7.04	61.0	28.1	<0.05	7.66	0.016	175	<0.2	0.94	38	5.00	1.25
24	7	ADM/EIA/IBU/SS7	7.05	44.0	27.8	<0.05	8.97	0.015	177	<0.2	0.82	50	2.50	1.25
25	8	ADM/EIA/IBU/SS8	6.96	57.0	28.8	<0.05	9.92	0.014	137	<0.2	0.76	40	5.00	1.33
26	9	ADM/EIA/IBU/SSC	6.66	39.0	29.0	<0.05	9.03	0.015	156	<0.2	0.92	36	5.00	1.43
27														
28														
29														
30														
31														
32														

fx LABORATORY DETAILS:

PARAMETERS		Q2	AQ3	AQ4	AQ5	AQ6	AQ7	AQ8	AQC
SO2 (ppm) - daily mean	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NO2 (ppm) - 1 hour mean	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
VOC (mg/m3)	0.021	0.01	0.016	0.011	0.014	0.019	0.021	0.025	0.009
CO2 (ppm)	401	400	400	401	403	401	408	419	400.00
NH_3 (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
H_2S(ppm)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CO (ppm) - 8 hours mean	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ozone (ppm)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Noise Level dB	55.40	50.10	48.30	46.3	52.0	57.00	58.00	61.00	48.3
SPM @ 2.5 (µg/m3)	13.0	11.0	15.0	17.0	9.0	22.0	19.0	25.0	11.2
SPM @ 10 (µg/m3)	18.3	15.2	20.1	23.0	15.0	29.1	24.1	31.1	19.10
wind speed (mph)	0.3	0.50	0.50	0.30	0.70	0.70	0.6	1.00	0.4
wind direction (mph)	NE	NE	NE	NE	NE	NE	NE	NE	NW
relative humudity(%)	65.1	68.0	63.8	66.0	58.0	55.3	63.5	56.7	52.3
ambient air temperature (°c)	31.6	31.3	31.0	30.8	31.4	31.8	31.8	31.8	32.6
Air pressure (hpa)	1004.0	1004.0	1004.0	1004.0	1004.0	1003.0	1004.0	1004.0	1005.0

ANNEX NINE: LAND STATUS VERIFICATION AND OS5 CHANGE PROTOCOL

Purpose: to confirm the time-bound finding that the Project footprint is unused, unoccupied and free of structures, crops and livelihood use before possession, and to prevent unassessed physical or economic displacement.

Step	Required action and record
1	Confirm institutional authority/title and licensed boundary/area; reconcile all coordinates and maps.
2	Conduct joint dated inspection with REA/NEP, ADUN and relevant representatives; record geotagged photographs and access.
3	Verify no person, crop, structure, claim, tenancy, seasonal use, route or livelihood activity occurs within the footprint/corridor.
4	If unchanged, sign the land-release record. If changed, avoid/stop, screen OS5 and complete the required instrument before possession.
5	Repeat verification if mobilisation is delayed, the footprint changes or a grievance/claim is received.

Required sign-off: REA/NEP Project Manager; REA/NEP Social Safeguards Specialist; ADUN authorized representative; licensed surveyor for the boundary record; and Contractor acknowledgement after release. Blank records are not evidence of completion.

ANNEX TEN: DESIGN, PERMIT AND E&S HOLD-POINT REGISTER

The hold points in Chapter Seven form part of the Project commitments. The controlled register shall record evidence reference, reviewer, decision, date, conditions, responsible person and closure status. A material change shall be logged, screened for legal and AfDB consequences, and approved before implementation.

Change requiring review	Minimum E&S question
Footprint, cable route or access	Does land use, displacement, biodiversity, drainage, receptor exposure or consultation change?
Capacity, module count or layout	Do land take, glare, drainage, waste, fire access or receptor distances change?
BESS chemistry, capacity or enclosure	Does thermal-event behaviour, separation, ventilation, detection, firefighting, waste or emergency response change?
Generator or fuel storage	Do air, noise, spill, fire, traffic and hazardous-material risks change?
External grid/community connection	Are new routes, permits, customers, land, safety and cumulative impacts introduced?
Water source or cleaning chemical	Are abstraction, competition, discharge, soil/water quality or waste risks introduced?

ANNEX ELEVEN: BESS AND ELECTRICAL SAFETY/EMERGENCY REQUIREMENTS

Before procurement, the Project shall document the BESS chemistry, cell/module/rack configuration, energy and power, enclosure, operating temperature, safety certification and relevant propagation/fire-test evidence. A competent fire and electrical engineer shall translate the evidence into site-specific separation, ventilation, gas/smoke/heat detection, automatic isolation, explosion/deflagration protection where relevant, firefighting strategy, drainage/firewater containment, emergency access and post-event handling.

The emergency plan shall define alarm and shutdown logic, evacuation distances and assembly points, incident command, University/security interface, emergency contacts, responder information on chemistry and hazards, water/runoff controls, medical response, notification, damaged-unit quarantine, re-entry criteria and recovery. Commissioning shall include functional tests and a witnessed drill before energisation.

Electrical safety shall include approved single-line diagrams, short-circuit and protection coordination, earthing/lightning studies, arc-flash risk assessment, labelled isolation points, LOTO, permits to work, restricted access, competent persons, inspection/testing and statutory certification.

ANNEX TWELVE: CHANCE-FINDS, WORKER GRM AND SEA/SH PROTOCOLS

Chance finds: stop work; secure the area without handling or removing the find; notify the supervising engineer and E&S specialist; record location without public disclosure of sensitive coordinates; notify the competent cultural-heritage authority; resume only after written clearance and required measures.

Worker GRM: explain at induction; permit confidential and anonymous submission; provide a channel outside line management; acknowledge and resolve within defined timeframes; prohibit retaliation; allow representation/appeal; retain data securely; and report anonymized trends.

SEA/SH: use trained focal points and safe referral channels; obtain informed consent; collect no unnecessary details; never mediate between survivor and alleged perpetrator; protect confidentiality and data; provide information on available medical, psychosocial, legal and protection services; apply employment/contract sanctions through due process; and report only non-identifying information as required.

Public-disclosure privacy: signatures, telephone numbers, addresses, identity documents and sensitive case information are retained only in the controlled Project file. The public ESIA presents aggregate consultation evidence and the substantive issues and responses.