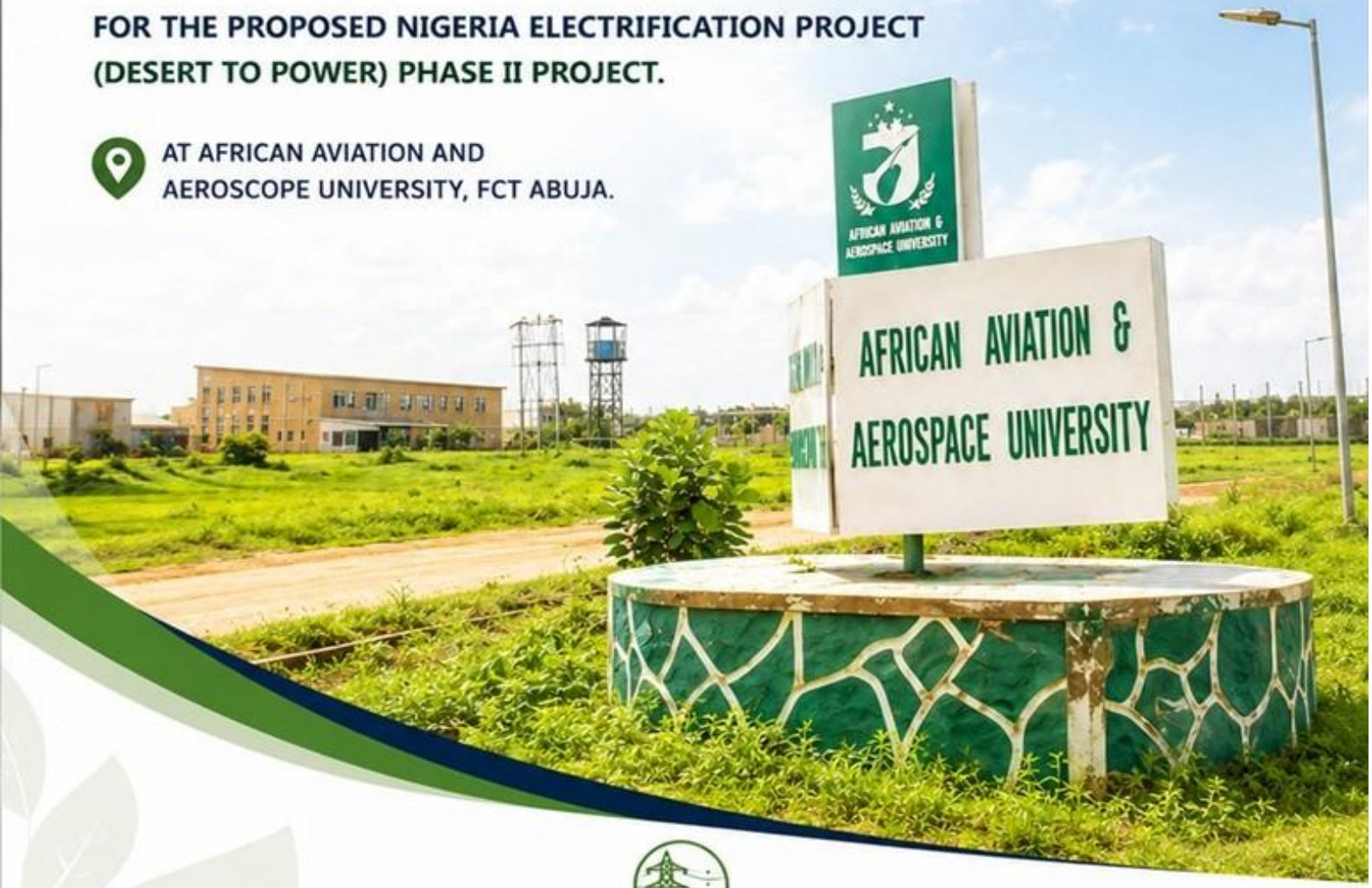
RURAL ELECTRIFICATION AGENCY
ENERGY • EMPOWERMENT • EFFICIENCY

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

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

AT AFRICAN AVIATION AND AEROSCOPE UNIVERSITY, FCT ABUJA.



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

DRAFT REPORT

AUGUST 2026

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ABBREVIATIONS

AAAU	African Aviation and Aerospace University
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 (EEP), REA intends to electrify 24 Federal Universities and Teaching Hospitals across Nigeria, of which the African Aviation and Aerospace University (AAAU), located along the Airport Road corridor in the Federal Capital Territory (FCT), Abuja, is among the designated beneficiary institutions.

This Environmental and Social Impact Assessment (ESIA) has been prepared for the proposed Solar Hybrid Mini-Grid installation at the African Aviation and Aerospace University (AAAU) permanent campus in accordance with the Environmental Impact Assessment (EIA) Act Cap E12 LFN 2004 and applicable Federal Ministry of Environment procedures, the African Development Bank (AfDB) Integrated Safeguards System (ISS) 2023, effective 31 May 2024, relevant Nigerian environmental, electricity, labour, land, waste, climate and data-protection requirements, and Good International Industry Practice (GIIP).

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 / frameworks include;

a) Environmental Impact Assessment (EIA) Act CAP E12 LFN 2004
b) EIA Sectoral Guidelines for Power Sector (2013)
c) National Policy on the Environment (Revised 2016)
d) Climate Change Act 2021
e) Natural Resources Conservation Act CAP 349 LFN 1990
f) Nigeria's Nationally Determined Contribution (NDC) under the Paris Agreement of the UNFCCC COP26
g) Guidelines on Environmental Audit 2010
h) National Environmental Standards & Regulations Enforcement Agency (NESREA) Act, 2018
i) Public Health Act CAP 103 LFN 1995
j) Electric Power Sector Reform Act, 2005
k) Roadmap for Power Sector Reform, 2010
l) National Energy Policy 2013
m) Nigerian Electricity Regulatory Commission (NERC) 2005
n) Energy Commission of Nigeria Act No. 19 of 1989
o) Land Use Act CAP L5 LFN 2004
p) Penal Code Act CAP 53 LFN 2008
q) The Nigerian Urban and Regional Planning Act CAP N138 LFN 2014
r) Employees Compensation Act 2010
s) Applicable FMEnv decommissioning/closure requirements and approved project conditions
    - National Environmental (Electrical/Electronic Sector) Regulations, S.I. No. 79, 2022
    - National Environmental (Battery Control) Regulations, 2024

- National Environmental (Air Quality Control) Regulations, S.I. No. 88, 2021 (as amended)
- National Environmental (Construction Sector) Regulations, S.I. No. 19, 2011
- National Environmental (Surface and Groundwater Quality Control) Regulations, S.I. No. 22, 2011
- National Environmental (Noise Standards and Control) Regulations, S.I. No. 35, 2009
- National Environmental (Soil Erosion and Flood Control) Regulations, S.I. No. 12, 2011
- Nigeria Data Protection Act, 2023

The applicable International laws are: -

a) The African Development Bank (AfDB) Integrated Safeguards 2023
b) International Union for the Conservation of Nature and Natural Resources (IUCN) Guidelines, 1996
c) Convention on International Trade in Endangered Species of Wild Fauna and Flora, CITES 1975.
d) Convention on the Protection of the World Cultural and Natural Heritage Sites (World Heritage Convention) 1972
e) United Nations Framework Convention on Climate Change (UNFCCC) 1992

ES 2: Project Justification

The African Aviation and Aerospace University (AAAU) permanent campus currently has no national grid connection and relies entirely on diesel-powered generating sets for all electricity supply, resulting in high operational costs, frequent power interruptions, generator noise disrupting academic activities, and inadequate power for air conditioning in classrooms. The proposed intervention at AAAU forms part of the Energizing Education Programme under the Desert-to-Power initiative, aimed at providing dedicated, clean and reliable electricity to federal universities. The project is intended to address these existing energy constraints, support academic and research activities, reduce dependence on fossil fuel-based generation, and enhance overall institutional efficiency and 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 REA through a competitive process in accordance with established technical standards. Project design, installation and commissioning activities will be supervised by competent technical personnel from REA in collaboration with AAAU.

Environmental sustainability is supported by the adoption of solar photovoltaic technology as the primary renewable energy source, significantly reducing reliance on diesel generation and associated greenhouse gas emissions, noise pollution and air quality impacts currently experienced on the AAAU campus. The project is designed to promote clean energy utilization while minimizing adverse environmental impacts throughout its lifecycle through the implementation of robust mitigation measures and an Environmental and Social Management Plan.

Economic sustainability will be achieved through reduction in recurrent energy expenditure associated with diesel fuel procurement, generator maintenance, lubricants and emergency repairs. Given that AAAU currently has no grid connection and bears the full cost of diesel generation for all campus operations, the solar hybrid system is expected to deliver significant long-term operational cost savings, improving overall institutional financial efficiency and freeing resources for academic and infrastructure investment.

Social sustainability is supported through inclusive stakeholder engagement undertaken with university management, academic and non-academic staff, students, the Iddo Sarki host community and relevant authorities. The engagement identified expectations regarding reliable electricity, construction scheduling, local opportunities, skills development, safety, long-term operation and maintenance, and community communication. Engagement will continue throughout implementation under the Stakeholder Engagement Plan and Grievance Redress Mechanism, with specific measures for women, young people, persons with disabilities and other stakeholders who may face barriers to participation.

ES 3: Project Description

The Desert-to-Power (DtP) intervention at the African Aviation and Aerospace University (AAAU) in the Federal Capital Territory, Abuja, will involve development of an approximately 1 MW-class solar hybrid mini-grid based on the available concept design. The design basis comprises approximately 2,500 ground-mounted 415 Wp photovoltaic modules (approximately 1.04 MWp DC), lithium iron phosphate (LiFePO4) battery energy storage, string inverters, step-up transformers, switchgear, supervisory control and data acquisition, limited diesel backup, and underground approximately 11 kV armoured cabling to the University's internal power distribution system. Final equipment make/models may vary provided the approved capacity, safety and environmental performance criteria in this ESIA are met.

The key project components will include:

- Ground-mounted photovoltaic (PV) modules installed in engineered arrays
- Battery energy storage systems for load balancing and energy reliability
- Inverters, step-up transformers, marshalling switchgear, and associated power conditioning and control systems
- Underground armoured electrical cabling for internal power evacuation and distribution
- Interconnection infrastructure linking the solar plant to AAAU’s internal approximately 11 kV distribution system
- A supervisory control and monitoring system
- Site office and maintenance building
- Limited backup generation facilities to enhance system reliability

The proposed project site

The proposed project is located within the permanent campus of the African Aviation and Aerospace University (AAAU), along the Airport Road corridor in Abuja Municipal Area Council (AMAC), Federal Capital Territory. Field geo-tagging identifies the project-site reference location at approximately 8.966396°N, 7.245487°E (WGS 84). The solar development footprint is approximately 4 hectares within the secured university property. The previously reported wider coordinate extents describe the broader study/sampling context and are not used as the cadastral limits of the 4-hectare construction footprint. Figure 3 presents the allocated project parcel and project reference location; all construction shall remain within the physically demarcated and approved footprint.

The designated project footprint contains no residential buildings, business premises or electrical/utility infrastructure requiring relocation. At the time of ESIA verification, the selected development footprint is treated as university-controlled institutional land that is unoccupied and not subject to active livelihood use requiring physical or economic displacement. This land-status condition is a project eligibility requirement and shall be re-verified immediately before site handover. If any occupation, standing crops, economic activity, third-party claim, access-dependent use or other displacement risk is identified at that verification, the affected area shall be excluded or the layout adjusted before works commence.

The proposed site is technically suitable for the development of the planned solar hybrid mini-grid system. The 4-hectare footprint is sufficient to accommodate the photovoltaic arrays, battery storage, control room and associated infrastructure without affecting existing campus buildings or ongoing institutional activities. The flat terrain minimizes the need for major earthworks and supports efficient panel installation and system layout.

ES 4: Description of the Environmental and Social Baseline Conditions

The baseline assessment describes the existing environmental and socioeconomic conditions within the project area at the African Aviation and Aerospace University (AAAU) permanent campus and its Area of Influence, extending approximately 3km from the proposed project footprint. The purpose is to establish current conditions against which potential project impacts can be assessed and to ensure that project activities do not degrade existing environmental quality but maintain or improve prevailing conditions. Baseline data collection was conducted between 8th and 17th July 2026, covering reconnaissance surveys, field observations, stakeholder consultations, environmental sampling and socioeconomic surveys during the wet season period.

Physical Environment

- The project area is characterized by a tropical savannah climate with distinct wet and dry seasons, with the wet season extending from April to October and the dry harmattan season from November to March.
- The terrain across the proposed 4-hectare project footprint is generally flat, providing favourable conditions for solar infrastructure development and minimizing the need for major earthworks.

Soil Characteristics

- Soil samples were collected from ten locations across the project footprint and surrounding Area of Influence, with samples taken separately from the topsoil horizon at 0 to 15cm and the subsoil horizon at 15 to 30cm.
- The soils are predominantly sandy in character, with sandy content ranging from 21% to 65% and loam content ranging from 19% to 43% across sampling locations.
- The available soil dataset does not indicate elevated heavy-metal contamination. Mercury and lead are reported as 0.000 at the sampled locations and are interpreted as not detected or below the laboratory reporting resolution rather than proof of absolute absence.
- The dominantly sandy character and existing surface disturbance indicate susceptibility to localized erosion where vegetation/ground cover is removed, reinforcing the need for topsoil protection, drainage and erosion/sediment control during construction.

Water Quality

- Five analytical water records are presented in the laboratory results: two campus boreholes, two stream sampling points and one supplemental pond sample within the wider Area of Influence. The field in-situ sheet documents the two boreholes and two stream points; the pond is retained as a supplemental surface-water baseline location.
- Groundwater from campus boreholes shows generally good physicochemical quality with most parameters within acceptable limits.
- Iron exceeded the table comparator at the two boreholes, two stream points and the pond. Chromium and other metal exceedances were also recorded in some surface-water samples, particularly the pond. These results are treated as pre-existing baseline conditions; their origin may be geogenic and/or influenced by upstream/local activities and is not attributed to the project.

- Chromium exceeded the FMEnv limit at both stream sampling points and nickel exceeded the limit at Stream I Midstream, both representing pre-existing baseline conditions.
- E. coli was not detected in the two borehole samples collected during the survey. This is a baseline observation only and does not constitute comprehensive certification of the boreholes as potable-water sources.

Air Quality and Noise

- Ambient air quality and noise measurements were conducted at ten monitoring locations across the project site and surrounding Area of Influence.
- The site is located approximately 400 metres from the Airport Road expressway serving the Nnamdi Azikiwe International Airport, and is subject to periodic aircraft movements, both of which contribute to the prevailing ambient air quality and noise environment.
- Sulphur dioxide concentrations exceeded the comparator presented in Table 8 at nine of ten monitoring locations, while chlorine gas was recorded as 0.0 ppm at all ten locations. PM2.5 values were at or above 25 µg/m³ at four locations (AQ4, AQ6, AQ9 and AQ10). Potential contributing background sources include diesel generation, campus construction, Airport Road traffic and wider urban/aviation activity; the one-day baseline survey does not provide source apportionment.
- PM2.5 values were at or above the 25 µg/m³ table comparator at four locations. Potential contributing background sources include road traffic, ongoing campus construction and diesel generation; the monitoring event does not establish source attribution.
- The Air Quality Index was classified as Excellent at eight locations and Good at two locations, confirming generally satisfactory overall ambient air quality across the site.

Biodiversity

Vegetation within and around the project area is characteristic of a modified Southern Guinea Savannah/institutional environment with grasses, shrubs and scattered planted or naturally occurring trees. The available flora list contains mostly common species. The record of Terminalia neotaliala is treated cautiously because the species is native to Madagascar and is introduced outside its native range; it is therefore not used as evidence of a Nigerian natural-habitat conservation trigger. No confirmed critical habitat or threatened native species occurrence was identified within the approximately 4-hectare development footprint from the available survey evidence. Clearance shall nevertheless be restricted to the minimum footprint, and boundary trees shall be retained where compatible with safety/design.

Socio-Economic Environment

The socioeconomic survey conducted during the baseline assessment as presented in Section 4.5, covered university management, academic and non-academic staff, students and the Iddo Sarki community. Livelihoods within the surrounding community are based primarily on small-scale trading, farming and informal economic activities. The university operates under a structured administrative system headed by an Acting Vice Chancellor, with governance provided by the Governing Council. Campus infrastructure including roads, water supply and drainage channels is still developing as part of the ongoing permanent campus development programme. The university currently has no national grid connection and relies entirely on diesel-powered generating sets for all electricity supply

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:

- Limited removal of grasses, herbs and other low-value modified vegetation within the approved development footprint, with avoidance of unnecessary tree removal outside the footprint.
- Localized disturbance of the disturbed brownish topsoil, with moderate susceptibility to surface erosion during wet season rainfall events given the flat, open and sandy character of the site.
- Temporary dust emissions from initial site clearing and vehicle movement along the Airport Road expressway access route and internal campus roads, noting the existing marginal PM2.5 baseline from expressway traffic.
- Slight increase in traffic and vehicular movement within the campus environment during equipment mobilization.
- Minor safety risks to students, staff, visitors and pedestrians associated with increased vehicle and equipment movement within the active campus.
- Potential supply chain risks related to the procurement of solar equipment from manufacturers associated with forced labour or child labour if due diligence is not undertaken.
- Potential for low-level stakeholder expectations and grievances if employment commitments and communication obligations are not properly managed.

Construction Phase

This phase presents the highest level of environmental and social interaction due to intensive civil and electrical works including excavation, cable trenching across the campus and panel installation activities:

Environmental Impacts

- Increased risk of soil erosion and land disturbance arising from excavation, cable trench works along the underground cable corridor, grading and foundation works within the project footprint.
- Generation of dust and particulate matter affecting ambient air quality within the campus and along the Airport Road expressway access route, noting the existing marginal PM2.5 baseline.
- Elevated noise levels from construction machinery and installation activities within the active academic campus environment, with potential disruption to lectures and academic sessions.
- Potential for surface runoff and sediment transport into drainage channels under construction in the vicinity during wet season rainfall events.
- Generation of construction waste including excavated soil, scrap materials, packaging and debris requiring proper segregation and licensed disposal.
- Minor disturbance to modified low-value vegetation and common fauna species within and around the project footprint.

Social Impacts

- Temporary disturbance to ongoing academic, administrative and campus development activities due to noise, dust and movement of personnel and equipment within the active permanent campus.
- Increased traffic and access disruptions along campus internal roads and the Airport Road expressway corridor during delivery of equipment and materials.
- Potential for unmet employment expectations and grievances if recruitment principles, eligibility criteria and project scope are not communicated transparently.
- Labour influx risks including gender-based violence, sexual exploitation and abuse, and social tensions arising from interaction between construction workers and students, staff and community members if the Code of Conduct is not enforced.

Occupational Health and Safety Impacts

- Increased risk of workplace accidents including injuries from excavation, trench collapse, equipment handling and materials movement.
- Potential for electrical hazards including electric shock or electrocution during cable installation, equipment connection, testing and commissioning activities.
- Risk of falls and musculoskeletal injuries during installation of mounting structures and solar panels.
- Risk of injuries from falling tools, equipment or photovoltaic modules during installation activities.
- Traffic-related accident risks due to movement of construction vehicles within the campus.
- Safety risks to students, staff and visitors from open trenches and active construction zones within the developing campus environment.

Operation Phase

- Minimal environmental emissions as the solar PV system generates clean renewable energy, directly displacing diesel generation and associated greenhouse gas emissions, noise and air quality impacts currently experienced on campus.
- Potential risk of soil and groundwater contamination from improper handling or leakage of battery electrolyte materials from the battery energy storage system.
- Generation of hazardous electronic waste from damaged or end-of-life components including batteries, inverters and PV panels, requiring management in accordance with NESREA Electrical/Electronic Sector Regulations S.I. No. 79, 2022 and Battery Control Regulations 2024.
- Low-level noise emissions from operational inverters and transformers, negligible relative to the existing ambient noise baseline from the Airport Road expressway.
- Minor reduction in surface water infiltration within the area covered by mounting structures and associated infrastructure.
- Restricted access to operational areas for safety purposes, with potential risk of unauthorized access by students, staff or visitors to energized solar arrays and battery storage areas within the campus.
- Risk of electrical hazards including electric shock or electrocution during routine operation and maintenance activities.
- Risk of battery failure, fire incidents or chemical exposure from improper battery handling or management.
- Risk of equipment damage or power interruption from lightning strikes or electrical surges, noting the need for adequate lightning protection systems given the frequency of convective thunderstorms in the FCT during the wet season.

- Low-frequency/high-consequence risk of lithium-ion BESS thermal runaway, fire, smoke/toxic-gas release and re-ignition if battery faults are not detected, isolated and managed through an engineered fire/life-safety design and emergency response system.
- Potential solar glint and glare interaction with aviation receptors because the project is located in the Airport Road/Nnamdi Azikiwe International Airport environment. Final PV orientation and layout shall demonstrate an acceptable no-hazard outcome for relevant flight paths and air traffic control lines of sight.
- Potential operational waste and resource impacts from spent batteries, damaged PV modules, inverters and other electrical/electronic equipment, requiring producer take-back/EPR or licensed recycling and documented waste tracking.
- Potential climate-related operational risks from extreme heat, intense rainfall, stormwater, high winds, harmattan dust and lightning, requiring climate-resilient structural, drainage, thermal-management, earthing and maintenance provisions.

Cumulative Impacts

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

- Increased dust levels and elevated noise from simultaneous solar project and campus building construction activities operating concurrently.
- Higher traffic volumes and increased safety risks along the Airport Road expressway access route and within internal campus roads due to combined construction vehicle movement.
- Increased pressure on soil stability and erosion risk across multiple disturbed areas within the developing campus environment, particularly during wet season rainfall events.

- Elevated safety risks for students, staff and campus users due to multiple active construction fronts operating simultaneously within the campus.

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 African Aviation and Aerospace University (AAAU). These measures follow the mitigation hierarchy of avoidance, minimization, restoration and offsetting, and are tailored to the specific conditions of the AAAU permanent campus environment.

Pre-Construction Phase

- Restrict vegetation clearance strictly to the approved 4-hectare project footprint and avoid unnecessary disturbance of surrounding vegetation and economic trees outside the designated boundary.
- Strip and stockpile topsoil separately from subsoil during site clearing for reuse in reinstatement, and install silt fences and erosion control measures along the downslope perimeter before clearing commences.
- Apply water-based dust suppression on all access routes and within the project site during dry and windy periods, and cover all vehicles transporting materials with tarpaulins to prevent dust dispersion.
- Restrict vehicle and equipment movement to designated access routes and implement site traffic management measures during mobilization, coordinating delivery schedules to avoid peak academic activity periods.

- Implement appropriate safety measures including warning signs, barriers and controlled access to safeguard students, staff, authorized visitors during mobilization activities.
- Before site handover, REA/NEP-PMU and AAAU shall jointly verify and document that the approved footprint and temporary work areas remain free of occupation, structures, standing crops, livelihood/economic use, third-party claims and access restrictions. Any affected area failing this criterion shall not be handed over for works until avoidance is achieved through footprint/layout adjustment.
- Implement a supply chain due diligence policy requiring all equipment suppliers to provide written declarations confirming the absence of forced labour, modern slavery and child labour in their supply chains.
- Maintain effective stakeholder engagement and communication with AAAU management and the Iddo Sarki community, supported by an accessible grievance redress mechanism to address stakeholder concerns

Construction Phase

- Apply water-based dust suppression daily on all active earthworks areas, the underground cable trench corridor and haul routes, and cover all vehicles transporting excavated soil or fine materials with tarpaulins.
- Restrict vegetation clearance strictly to the approved project footprint, conducting clearing progressively to allow fauna to relocate naturally before disturbance.
- Promptly backfill and compact trenches after cable installation and reinstate surface cover immediately, installing silt fences and erosion control measures along the full length of the cable trench corridor.
- Install temporary drainage diversions and sediment traps to manage stormwater runoff and sediment transport during wet season construction activities.
- Schedule high-noise construction activities during agreed daytime periods, avoid examinations and other sensitive academic events, maintain equipment silencers/enclosures, and implement receptor-based noise monitoring and complaint response. At higher-learning receptors, apply the National Environmental (Noise Standards and Control) Regulations, 2009 construction-site guideline of 60 dBA daytime and 50 dBA night-time unless a stricter project/authority condition applies.
- Designate a bunded fuel and materials storage area with impermeable base and secondary containment, and maintain spill response kits on site at all times.
- Implement waste segregation at source into general, recyclable and hazardous categories, and contract a licensed waste collector for regular removal and disposal of all construction waste in compliance with AEPB requirements.
- Develop and implement a Traffic Management Plan covering all vehicle routes within the campus and along the Airport Road expressway access corridor, designating flagpersons at all vehicle-pedestrian conflict points.
- Enforce a strict speed limit of 10 km/h for all vehicles within the campus and schedule heavy vehicle deliveries during off-peak academic activity periods.
- Use transparent, non-discriminatory recruitment procedures and provide reasonable outreach to qualified persons in the Iddo Sarki community and AAAU community for suitable unskilled and semi-skilled opportunities, without guaranteeing employment to any individual or group.
- Maintain continuous stakeholder engagement with AAAU management and the Iddo Sarki community and operate an accessible Grievance Redress Mechanism throughout the construction phase (see Section 9.2).
- Implement the Labour Management Plan and enforce the Workers Code of Conduct, with zero tolerance for gender-based violence, sexual exploitation and abuse, and sexual harassment.

- Implement dedicated GBV, SEAH and sexual harassment prevention measures including worker awareness training, a confidential reporting mechanism and immediate removal of any violating worker from the project.
- Provide appropriate PPE to all workers, conduct pre-mobilization safety induction and deliver regular toolbox talks and occupational health and safety training throughout the construction period.
- Implement safe trenching and excavation procedures including installation of shoring for trenches deeper than 1.2 metres, safety signage, physical barriers and controlled access around all open trenches, with daily inspection before works commence.
- Install temporary bridging over open trenches at all major pedestrian crossing points and erect barriers along the full length of open trench sections to protect students, staff and campus users within the active campus.
- Ensure all electrical installation, testing and commissioning works are carried out exclusively by certified and licensed electricians, with lockout/tagout procedures enforced for all electrical works.
- Coordinate construction scheduling with the AAAU academic calendar to avoid examination periods and convocation seasons, consistent with commitments made during stakeholder consultations.
- Maintain first aid facilities on site at all times and implement emergency preparedness and response procedures throughout the construction phase.

Operational Phase

- Conduct routine inspection and maintenance of solar panels, battery storage systems, inverters, transformers and all associated electrical infrastructure in accordance with the Operations and Maintenance plan developed by the dedicated O&M contractor.
- Schedule regular panel cleaning, particularly during the harmattan period when dust accumulation on panel surfaces reduces generation efficiency, using minimum water volumes from the campus borehole supply.
- Ensure proper housing, ventilation and thermal management of battery storage systems to prevent overheating, electrolyte leakage and fire risk, with monthly inspection of battery banks for signs of swelling, corrosion or damage.
- Manage spent batteries, degraded PV panels, failed inverters and other end-of-life electrical/electronic equipment through manufacturer take-back/extended producer responsibility (EPR) arrangements or NESREA-licensed handlers, with manifests and records, in accordance with the National Environmental (Electrical/Electronic Sector) Regulations, S.I. No. 79, 2022, the National Environmental (Battery Control) Regulations, 2024 and other applicable requirements.
- Maintain site drainage around mounting structures and the installation footprint to prevent ponding, waterlogging and surface erosion, with post-wet season drainage inspection and clearance.
- Continue operation of the project Grievance Redress Mechanism, maintaining accessibility to AAAU management, staff, students and the Iddo Sarki community throughout the operational phase (see Section 9.2).
- Install and maintain perimeter fencing, lockable gates and clearly visible warning signs around the solar array, battery storage room and control room to prevent unauthorized access by students, staff or visitors.
- Maintain ongoing engagement with AAAU management on system performance, any operational issues and community safety matters arising during operation.

- Engage only certified and licensed electricians for all operation and maintenance electrical works, with lockout/tagout procedures and a Permit-to-Work system enforced for all high-risk activities including electrical maintenance, work at height, hot work and other hazardous tasks.
- Install, test and maintain appropriate lightning protection and surge protection systems to safeguard PV arrays, battery storage, inverters, transformers and associated electrical equipment, with routine inspection and testing of lightning protection and earthing arrangements.
- Conduct regular inspection and testing of fire protection equipment including smoke detectors and fire suppression systems within the battery storage room.
- The BESS shall use lithium iron phosphate (LiFePO4) chemistry or an equivalent demonstrably safe stationary-storage technology and shall be designed with a manufacturer battery-management system, independent protective functions, thermal/fault monitoring, emergency isolation, ventilation/thermal management, detection/alarm, controlled emergency access and a documented fire response strategy consistent with applicable Nigerian requirements and recognized GIIP such as IEC 62619:2022, IEC 62485-5:2020 and NFPA 855/UL 9540A or technically equivalent standards.
- Before PV installation, the final panel layout, azimuth and tilt shall be screened using an appropriate glint/glare assessment method for potential effects on aircraft approach/departure paths and air-traffic-control lines of sight. Where a potential hazard is identified, the layout/orientation, screening or module specification shall be modified before installation. Anti-reflective modules shall be preferred.
- Provide continuous safety training for all operational staff covering electrical safety, battery management, fire emergency response and evacuation procedures.

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 African Aviation and Aerospace University (AAAU). It also defines the roles, responsibilities and monitoring framework necessary to ensure effective implementation throughout the project lifecycle (Tables 22 and 23).

Implementation of mitigation measures will be primarily the responsibility of the Engineering, Procurement and Construction (EPC) Contractor during the pre-construction and construction phases, where most significant impacts are anticipated. The Contractor will be required to comply with all environmental and social requirements, including site-specific management plans, the Labour Management Plan, the Health Safety and Environment Plan, the Waste Management Plan, the Workers Code of Conduct, and applicable good international industry practice. During the operational phase, implementation responsibility transfers to the dedicated Operations and Maintenance contractor under the oversight of AAAU management.

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 including the AfDB ISS 2023. This will include routine monitoring, reporting and auditing of contractor performance. The Abuja Environmental Protection Board (AEPB), FMEnv and NESREA will provide regulatory oversight in accordance with their respective mandates within the FCT.

The total costs of the ESMP implementation including costs for mitigation, monitoring and capacity building is estimated as: **₦29,810,000.00** (Twenty-Nine Million, Eight Hundred and Ten Thousand Naira, only.*)* which converts to **$21,886.92** (Twenty-One Thousand, Eight Hundred and Eighty-Six Dollars, Ninety-Two Cents), as detailed in Table 29 below:

ITEM	RESPONSIBILITY	COST ESTIMATE	
		NAIRA (₦)	USD ($)
Cost of Mitigation	Contractor	12,800,000.00	9,397.94
Cost of Monitoring	NEP-PMU, MDAs	4,300,000.00	3,157.12
Capacity Building	NEP- PMU/Contractor	10,000,000.00	7,342.14
Sub-total		27,100,000.00	19,897.20
Contingency (10% of sub-total)		2,710,000.00	1,989.72
TOTAL		**29,810,000.00**	**21,886.92**

Exchange Rate $1.00(USD) = ₦1,362 (NGN) – CBN rate as at August, 2026

ES 8: Remediation Plan After Decommissioning and Closure

The solar hybrid facility has an expected design life of approximately 25 years, subject to component replacement and technically justified life extension. A lifecycle decommissioning framework is established at ESIA stage so that closure liabilities are managed from project inception. Before end-of-life dismantling, the asset owner shall convert this framework into a detailed Decommissioning and Restoration Plan consistent with the legal, technical and environmental requirements applicable at that time. The plan shall address safe de-energization, dismantling and lifting, battery/PV/electronic take-back or licensed recycling, hazardous-material management, waste tracking, contamination assessment, foundation/cable removal or agreed beneficial retention, drainage/erosion stability, site restoration, stakeholder communication, grievance management and post-closure monitoring.

In the event of decommissioning, REA, in conjunction with the leadership of African Aviation and Aerospace University, FCT Abuja, 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
- REA
- AAAU Site Manager
- Director of Works and Physical Planning Department in AAAU
- FMEnv 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 (see Table 30). Stakeholder consultations were conducted at various levels between 8th and 20th July 2026 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 AAAU (see Tables 34 and 35).

Key Stakeholders Consulted

- University management including the Director and Deputy Director of Works and Physical Planning, Director of Academic Planning and Quantity Surveyor
- Academic staff and students through focused group discussions
- AAAU Works/Physical Planning representatives responsible for site allocation and land-status confirmation
- Iddo Sarki community leadership, elders, men, women and youth representatives
- Relevant Ministries, Departments and Agencies including the Federal Ministry of Environment (FMEnv) and the Abuja Environmental Protection Board (AEPB)

Key Concerns Raised

- Potential noise impacts from the solar plant on the planned guest house adjacent to the project site, raised by university management
- Generator noise disrupting lectures and hot classrooms due to insufficient generator load for air conditioning, raised by students
- Demand for transparent and fair employment opportunities for local youth and community members, raised by the Iddo Sarki community
- Request for electricity benefits from the solar installation to be extended to surrounding communities including local schools
- Concern about the long-term sustainability and maintenance of the solar installation
- Need for continuous communication and stakeholder engagement throughout project implementation

Expectations and Requests

- Priority consideration for local labour recruitment from the Iddo Sarki community and AAAU campus community for unskilled and semi-skilled roles
- Provision of skills acquisition and training opportunities for youth in renewable energy systems
- Inclusion of women in project-related economic opportunities
- Maintenance of open communication channels and an accessible grievance mechanism throughout all project phases
- Construction scheduling to avoid examination periods and convocation seasons as confirmed during university management consultations

The GRM will be communicated to all stakeholders and maintained throughout the project lifecycle. Complaints may be submitted through accessible in-person, telephone/SMS/WhatsApp, email, written and secure complaint-box channels, including anonymously. Receipt shall normally be acknowledged within two business days and routine grievances targeted for resolution within 15 business days, with complex matters managed within up to 30 business days where practicable and with progress updates. SEA/SH cases shall follow a separate confidential, survivor-centred referral pathway. Public reporting shall present anonymized aggregate grievance information only; complainant identities, telephone numbers, signatures and sensitive case details shall not be disclosed.

ES 10: Conclusion and Recommendation

The proposed Solar Hybrid Mini-Grid Project at the African Aviation and Aerospace University (AAAU) is designed to provide reliable and sustainable electricity supply to a campus currently without national grid connection and dependent entirely on diesel generators. The project will enhance academic activities, eliminate generator noise disruption to lectures, provide sufficient power for air conditioning, and significantly reduce fossil fuel dependence, in alignment with national energy objectives and Nigeria's international sustainable development commitments.

Potential adverse impacts are largely site-specific, temporary and manageable (see Chapter Five). Key construction phase impacts include dust, noise within the active campus environment, soil disturbance, vegetation removal, OHS risks and minor social disturbances from labour influx. Operational phase impacts are minimal, relating primarily to e-waste management and electrical safety. All impacts can be effectively managed through the mitigation measures in Chapter Six and the ESMP in Chapter Seven.

Stakeholder consultations indicated broad support for the project while identifying expectations concerning construction scheduling, employment information, skills development, community communication, safety and long-term maintenance. The selected footprint is managed as displacement-free university land for purposes of project implementation, subject to mandatory land-status verification before handover; no work may commence in any area where occupation, livelihood use, crops, structures, claims or access restrictions are identified until avoidance is achieved.

Based on the findings of this ESIA, the project is considered environmentally and socially viable. The anticipated benefits significantly outweigh the potential adverse impacts, and it is recommended that the project proceed to implementation subject to full compliance with applicable regulatory requirements and the ESMP.

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.

Under the Energizing Education Programme (EEP), REA intends to expand reliable electricity supply to selected tertiary institutions. Among the designated beneficiary institutions under the present assignment is the African Aviation and Aerospace University (AAAU), Federal Capital Territory, Abuja. The available concept design for AAAU is an approximately 1 MW-class solar hybrid mini-grid, with an indicative PV design basis of about 2,500 modules rated at 415 Wp (approximately 1.04 MWp DC), battery storage, limited diesel backup and internal approximately 11 kV distribution infrastructure.

In compliance with applicable regulatory and safeguard requirements, this Environmental and Social Impact Assessment (ESIA) has been prepared in accordance with the African Development Bank's Integrated Safeguards System (ISS) 2023, the Environmental Impact Assessment (EIA) Act Cap E12 LFN 2004, and other relevant Nigerian environmental and sectoral regulations, as well as 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 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); 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 African Aviation and Aerospace University (AAAU) 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 African Aviation and Aerospace University, FCT Abuja. 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 NEP documentation, feasibility studies, conceptual designs, layouts, and maps for each of the four universities.
- ❖ 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

- ❖ Conduct Free, Prior, and Informed Consultations (FPIC) with host communities, institutions, and relevant authorities around each university.
- ❖ 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.

1.5 Study Approach/ Methodology in Details

The ESIA of the proposed Project of the African Aviation and Aerospace University 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.

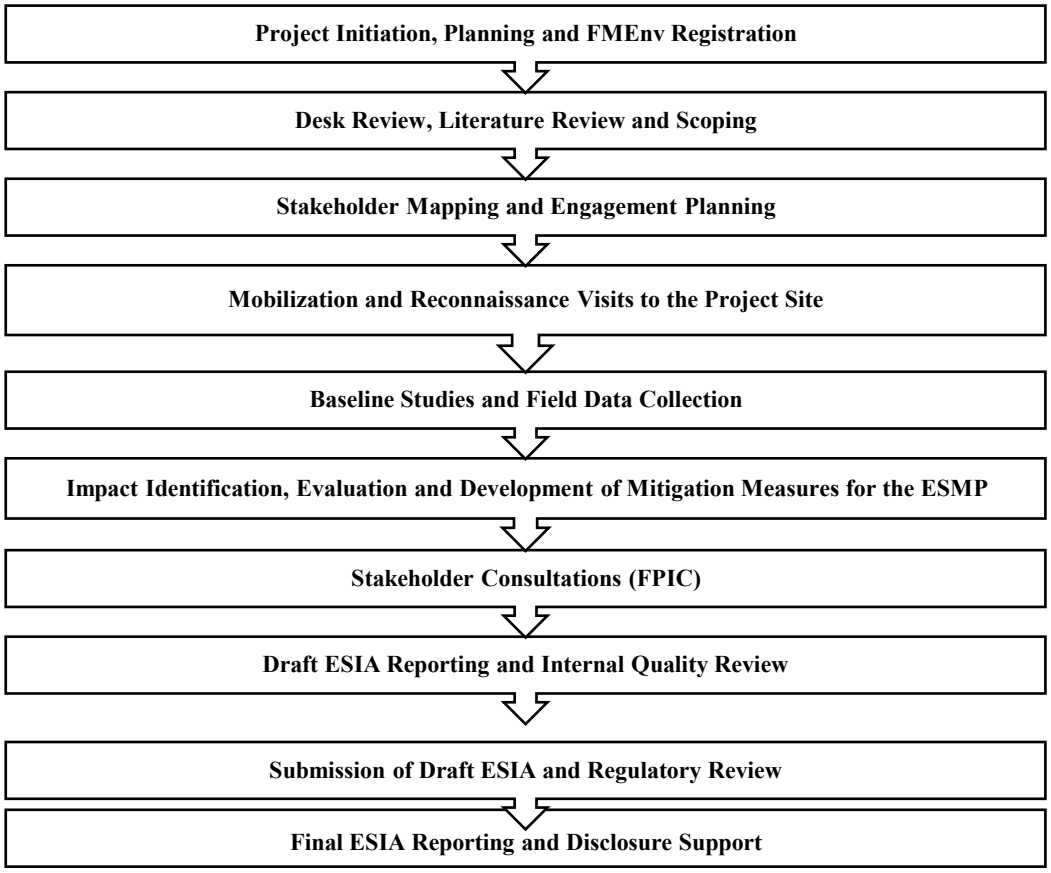

Figure 1: ESIA Methodology Flowchart

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 privatization 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 privatization 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 project is subject to the Federal environmental assessment process and has been prepared as a site-specific ESIA because of its civil works, electrical infrastructure, BESS, occupational/community safety, waste, stakeholder and lifecycle environmental and social risks. The applicable FMEnv classification and approval conditions shall be those formally determined through the statutory EIA registration and review process; the ESIA does not substitute for that regulatory determination.

The EIA Procedures and Charges Regulations 2021, made pursuant to the EIA Act Cap E12 LFN 2004, prescribe the procedural requirements and applicable fees governing the conduct and administration of environmental impact assessments in Nigeria. The Regulations establish the mandatory steps for EIA registration, scoping, review, public participation, and approval, and specify the access charges and Interim Management and Monitoring (IMM) fees payable at defined stages of the EIA clearance process. Compliance with these Regulations is required for the issuance of the EIA approval certificate and environmental compliance certificate for this project.

1.6.2.2 The Electricity Act 2023.

The Electricity Act 2023 is the principal legislation governing the Nigerian electricity sector, enacted to modernize the regulatory framework and consolidate all electricity sector laws in Nigeria. The Act devolves significant regulatory powers to states, establishes a liberalized 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.

The proposed project site is a modified/open institutional land within the university campus, representing a disturbed environment with limited wildlife habitat value. Notwithstanding, project activities shall be carried out in compliance with the relevant provisions of this Act to ensure no species of conservation concern is adversely affected during site clearing and construction.

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

The Factories Act (Cap F1, Laws of the Federation of Nigeria, 2004) provides the legal framework for safeguarding the health, safety, and welfare of workers in factories and other designated workplaces. The

Act prescribes requirements relating to workplace safety, the use and maintenance of machinery, fire prevention, welfare facilities, accident reporting, and the protection of workers from occupational hazards. The Act is relevant to the proposed project during the construction and operational phases, where contractors shall implement appropriate occupational health and safety measures to ensure a safe working environment and compliance with applicable statutory requirements.

This Act deals with working conditions at work sites, including construction sites, such as the type to be undertaken under this proposed project. 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 of the Act 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 Employee Compensation Act 2010 establishes a comprehensive framework for the payment of compensation to employees who suffer from occupational diseases, sustain injuries, or die in the course of employment in Nigeria. The Act replaces the Workmen's Compensation Act and provides for a contributory scheme administered by the Nigeria Social Insurance Trust Fund (NSITF). Its provisions are directly relevant to this project during the construction phase, where workers will be exposed to occupational hazards including excavation risks, working at height, electrical installation, and heavy equipment operation, and where the contractor bears statutory obligations to ensure compensation coverage for all site personnel.

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 criminalizes 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 (Construction Sector) Regulations, S.I. No. 19, 2011.
Nigeria Data Protection Act, 2023.

- National Environmental (Plastic Waste Control) Regulations, 2026
- National Environmental (Electrical/Electronic Sector) Regulations, S.I. No. 79, 2022
- 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, S.I. No. 88, 2021 (as amended).
- National Environmental (Soil Erosion and Flood Control) Regulations, 2011. S. I. No. 12.
- National Environmental (Surface and Groundwater Quality Control) Regulations, 2011. 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 optimize 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 (Northern States) Federal Provisions Act (Cap. P3, Laws of the Federation of Nigeria, 2004)
- Public Health Law Cap 103 LFN 1990
- Fire and Rescue Service Act 2004;
- 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 (2003):** This Convention is applicable as the project involves land clearing and vegetation removal within the Southern Guinea Savannah ecosystem of the Federal Capital Territory, requiring that natural resources are managed sustainably and in accordance with Africa-wide conservation commitments throughout all phases of project implementation.
- **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:** Although no CITES-listed species were identified within the project area, this Convention remains applicable as a precautionary reference to ensure that no project activities inadvertently affect protected species or facilitate illegal wildlife trade during construction.
- **Conservation of Migratory Species of Wild Animals 1973:** This Convention is applicable as the project site lies within the Southern Guinea Savannah ecological zone of the Federal Capital Territory, which provides habitat for migratory bird and animal species. The movement patterns and habitats of such species shall be considered during project implementation to ensure that construction activities do not disrupt known migratory routes or breeding grounds within the Area of Influence.
- **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.

- **Convention to Combat Desertification 1994:** This Convention is applicable given that the project involves ground disturbing activities including site clearing, excavation and cable trenching within the Federal Capital Territory, where land degradation and soil erosion pressures can arise if construction activities are not properly managed. Appropriate land management, topsoil conservation and erosion control measures shall be implemented during construction to ensure compliance with the spirit and provisions of this Convention.
- **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 university environment that includes young persons, requiring that child labour is strictly prohibited in accordance with the Child Rights Act 2003 and that construction activities do not expose children within or near the university campus to safety risks. All contractors shall be required to verify the age of workers prior to engagement and maintain records confirming compliance with minimum age requirements.

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 is the Federal Government ministry responsible for national power-sector policy. The current statutory framework is principally the Electricity Act 2023, together with applicable regulations, codes and standards. Sector institutions relevant to this project include the Rural Electrification Agency (REA), Nigerian Electricity Regulatory Commission (NERC), Nigerian Electricity Management Services Authority (NEMSA), Energy Commission of Nigeria and other entities according to their statutory mandates.
Regulatory Commission (NERC) Power Holding Company of Nigeria (PHCN) Rural Electrification Agency (REA). The responsibilities of the Federal Ministry of Power are as follows:

- Initiating and formulating broad policies and programmes on the development of the power sector Initiating concessions in the power sector Licensing of electrical contractors and electric generating sets of 1MW capacity and below
- Conducting investigation on electrical accidents and to ensure safety in the electricity industry in Nigeria
- Conducting statutory tests and certification of electric poles (concrete, wooden, steel etc.) and other major electrical materials before they are used on the grid and networks in Nigeria
- Implementing renewable energy programmes/ initiatives (solar, wind, biomass, small hydro etc.) Coordinating activities of the power sector
- Handling policy matters relating to research and development in the power sector
- Promoting the development of hydro power plants through public private partnership (PPP) Participating in bilateral and multilateral relations affecting the power sector
- Facilitating the overall coordination of the activities of the parastatals under its supervision

1.6.6.5 Nigerian Electricity Regulatory Commission (NERC)

The Nigerian Electricity Regulatory Commission (NERC) is an independent regulatory agency. NERC was established in 2005 as part of the economic reform agenda of the Obasanjo administration. The Electric Power Sector Reform Act, 2005 was the legislation that led to the establishment of NERC.
The Commission is mandated to carry out the following, amongst others:

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.

NERC currently regulates mini-grid development under the Mini-Grid Regulations 2026, issued pursuant to section 226 of the Electricity Act 2023. The project proponent shall determine and obtain any permit, registration or authorization applicable to the final generation/distribution configuration and capacity before operation, together with required electrical safety inspections and certifications.

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 (REA) is the Federal implementing institution for rural and off-grid electrification programmes. Under the current Electricity Act 2023 framework, REA continues to promote electricity access in unserved and underserved locations, support off-grid and mini-grid solutions, manage applicable rural electrification funding mechanisms and facilitate renewable/decentralized energy deployment.

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 Abuja Environmental Protection Board

The Abuja Environmental Protection Board (AEPB) was established in 1997 by the Federal Government of Nigeria through the promulgation of Abuja Environment Protection Board Decree No. 10 of 1997. The Board's functions shall cover, but not limited to:

- The control of removal and disposal of liquid wastes
- The control and disposal of solid wastes
- The control of vector pests, rodents, and reptiles; water and waste water effluent discharges; noise which constitute a nuisance; the use of septic tanks and sewage maintenance; bush burning, poaching and indiscriminate felling of trees; stray and wandering animals; public conveniences and cemeteries; the
  use of residential areas for prohibited purposes; walking or driving on prohibited areas.

1.6.7.2 Abuja Municipal Area Council

The proposed Project falls within the jurisdiction of Abuja Municipal Area Council. The Council has an Environmental Health Department which ensures compliance with environmental sanitation law.

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 Integrated Safeguards System

The proposed project is assessed as Category 2 (Medium Risk) under the African Development Bank Integrated Safeguards System (ISS) 2023, which became effective on 31 May 2024. The updated ISS and the associated Borrower Guidance Notes are used to guide identification, avoidance, mitigation, monitoring and disclosure of environmental and social risks and impacts.

All ten Operational Safeguards have been screened for relevance. OS1, OS2, OS3, OS4, OS6, OS7, OS8 and OS10 are relevant to assessment and management of project risks. OS5 is not triggered by the selected displacement-free project footprint provided the land-status eligibility condition is maintained; a mandatory pre-construction verification prevents works on any occupied, cultivated, livelihood-dependent, claimed or access-restricted area. OS9 is not applicable because the project is not financed through a financial intermediary. The substantive requirements of applicable safeguards are integrated throughout the ESIA, mitigation measures, ESMP and supporting management plans.

The Operational Safeguards considered include:

- OS 1 (OS1): Assessment and Management of Environmental and Social Risks and Impacts
- OS 2 (OS2): Labour and Working Conditions
- OS 3 (OS3): Resource Efficiency and Pollution Prevention and Management
- OS 4 (OS4): Community Health, Safety and Security
- OS 5 (OS5): Land Acquisition, Restrictions on Access to Land and Land use, and Involuntary Resettlement
- OS 6 (OS6): Habitat and Biodiversity Conservation and Sustainable Management of Living Natural Resources
- OS 7 (OS7): Vulnerable Groups
- OS 8 (OS8): Cultural Heritage
- OS 10 (OS10): Stakeholder Engagement and Information Disclosure.

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 ESIA report provides comprehensive evaluation of the relevance and level of applicability of each Operational Safeguard and outlines corresponding mitigation and management measures in compliance with AfDB ISS requirements.

Operational Safeguard	Applicability	Project Response
OS1 - E&S Risks and Impacts	Applicable	ESIA, mitigation hierarchy, ESMP, monitoring and incident/corrective-action management.

[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*

OS2 - Labour and Working Conditions	Applicable	LMP, OHS, worker GRM, fair employment, age/forced-labour controls and supplier due diligence.
OS3 - Resource Efficiency and Pollution Prevention	Applicable	Water efficiency, dust/noise, spill control, hazardous materials, battery/e-waste and waste hierarchy.
OS4 - Community Health, Safety and Security	Applicable	Traffic/pedestrian safety, electrical safety, BESS fire/life safety, emergency response and security.
OS5 - Land Acquisition / Restrictions / Resettlement	Not triggered by selected footprint	Displacement-free site eligibility plus mandatory pre-construction land-status verification; redesign/avoid any new use/occupation.
OS6 - Biodiversity	Applicable/relevant	Modified-habitat screening, minimum clearance, tree protection and biodiversity good practice.
OS7 - Vulnerable Groups	Applicable/relevant	Accessible engagement and differentiated measures for women, young persons, PWDs and other vulnerable stakeholders.
OS8 - Cultural Heritage	Applicable as precaution	Chance Finds Procedure for excavation/trenching.
OS9 - Financial Intermediaries	Not applicable	No financial intermediary structure.
OS10 - Stakeholder Engagement and Disclosure	Applicable	SEP, GRM, disclosure, privacy and ongoing engagement.

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
- 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 takes into account 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 significantly constrains effective teaching, research activities, and institutional operations. Federal universities, in particular, depend largely on diesel powered generators to supplement their electricity needs, resulting in high operational costs, frequent power interruptions, and associated environmental impacts including air pollution, noise nuisance and greenhouse gas emissions.

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

The proposed intervention at the African Aviation and Aerospace University (AAAU) forms part of the Energizing Education Programme (EEP) under the DtP initiative, aimed at providing dedicated, clean, and reliable electricity to federal universities across Nigeria. Specifically, the project is intended to address existing power supply limitations at AAAU, support academic and research activities, reduce the institution's dependence on fossil fuel based generation, and enhance overall institutional efficiency and sustainability. The intervention equally contributes to Nigeria's commitments to climate change mitigation and sustainable energy transition, in line with national development objectives and applicable international obligations.

2.2 Project Benefits

The proposed solar hybrid mini grid project at the African Aviation and Aerospace University 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 African Aviation and Aerospace University (AAAU).

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.

2.3.3 Economic Sustainability

Economic sustainability of the proposed solar hybrid mini-grid project will be achieved through reduced dependence on diesel powered generation, which currently constitutes the sole source of electricity at AAAU given that the permanent campus is still under development and has no national grid connection. The project will lower recurring expenditure on diesel procurement, generator servicing, lubricants, spare parts, emergency repairs, and productivity losses associated with power outages and generator downtime. Although the initial capital cost of solar hybrid infrastructure is higher than the short-term cost of operating existing diesel generators, the operational cost profile of renewable energy systems is generally more favourable over the project lifecycle because solar generation has no fuel cost, lower routine maintenance requirements, and reduced exposure to fuel price volatility.

Comparable university energy studies demonstrate that diesel-dependent institutional power systems can carry significant recurring fuel and maintenance costs. Such information is used only as contextual secondary evidence and is not treated as AAAU-specific baseline expenditure. For AAAU, economic performance will be assessed using the University's own recorded diesel consumption, generator runtime, maintenance expenditure, renewable generation and hours of reliable supply during implementation and operation.

For AAAU, the project is expected to reduce diesel generator runtime, diesel fuel consumption, generator maintenance frequency, expenditure on lubricants and spare parts, emergency generator repairs, and indirect economic losses associated with power interruptions including disruption of academic activities, ICT services, laboratory operations, administrative work, and security lighting across the developing permanent campus.

The economic sustainability of the project shall be tracked using measurable indicators including reduction in litres of diesel consumed per month, reduction in monthly diesel expenditure, reduction in generator maintenance cost, reduction in generator runtime, improvement in daily hours of reliable electricity supply, and reduction in electricity related operational disruptions. The results of this monitoring shall inform long-term operation and maintenance planning including budgeting for battery replacement, inverter replacement, preventive maintenance and lifecycle asset management.

The project is therefore expected to improve AAAU's energy reliability, reduce long-term operating costs, enhance institutional financial efficiency, and reduce dependence on recurrent government funding for electricity supply.

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

As part of the Energizing Education Programme (EEP) under the Nigeria Electrification Project Phase II (Desert-to-Power), the Rural Electrification Agency (REA) is facilitating deployment of an approximately 1 MW-class solar hybrid mini-grid at the African Aviation and Aerospace University (AAAU), Federal Capital Territory, Abuja. The system is intended to supply the University permanent campus, which presently relies substantially on diesel generation and does not have a reliable dedicated national-grid connection.

The available concept design supports an approximately 1.04 MWp DC photovoltaic array, based on approximately 2,500 ground-mounted 415 Wp modules, integrated with a lithium iron phosphate (LiFePO4) Battery Energy Storage System (BESS), string inverters, step-up transformation, protective switchgear, SCADA, limited diesel backup and underground approximately 11 kV armoured cabling to the University internal distribution system. The exact BESS energy capacity and final equipment makes/models are procurement/design parameters; however, any final design shall meet or improve the safety, environmental and performance criteria established by this ESIA and shall not increase the approved footprint or risk profile without environmental and social review.

The key project components will include:

- Ground-mounted monofacial silicon photovoltaic modules installed in engineered arrays
- Battery energy storage systems for load balancing and energy reliability
- Inverters, step-up transformers, marshalling switchgear, and associated power conditioning and control systems
- Underground armoured electrical cabling for internal power evacuation and distribution
- Interconnection infrastructure linking the solar plant to AAAU's internal approximately 11 kV distribution system
- A supervisory control and monitoring system
- Site office and maintenance building
- Limited backup generation facilities to enhance system reliability

Power produced by the PV array will be converted to AC by inverters and transformed to the voltage required for the University internal medium-voltage distribution system. The present ESIA does not assess export to the national grid; any future external grid interconnection would require the applicable technical/regulatory authorization and environmental and social review of associated works.

3.2 Proposed Project Site and Location

3.2.1 Overview of the African Aviation and Aerospace University

The African Aviation and Aerospace University (AAAU) is a federal tertiary institution located along the Airport Road corridor in the Federal Capital Territory (FCT), Abuja, within the North-Central geopolitical zone of Nigeria. The University is situated in close proximity to the Nnamdi Azikiwe International Airport, a location that is consistent with its specialized mandate in aviation, aerospace and related disciplines. The campus sits within the Southern Guinea Savannah ecological zone of the FCT, characterized by a mix of savannah vegetation, open grasslands and scattered trees.

Established by the Federal Government of Nigeria, AAAU is currently in its developmental phase, with academic and administrative activities being conducted at the permanent campus site which is still undergoing active construction and infrastructure development. The permanent campus currently

accommodates administrative blocks, classroom facilities and ongoing construction of additional academic and support structures. Student and staff population levels remain moderate at this stage but are expected to grow steadily as academic programmes expand and infrastructure development progresses.

The University currently has no national grid connection, as the permanent campus is still developing and grid extension plans are yet to be implemented. Electricity supply on campus is therefore provided entirely through diesel powered generating sets, resulting in high operational costs and constraints on academic and research activities. The proposed solar hybrid power intervention under the Desert-to-Power initiative is intended to address this energy gap, providing reliable and sustainable electricity to support the University's growing operational needs and long-term development objectives.

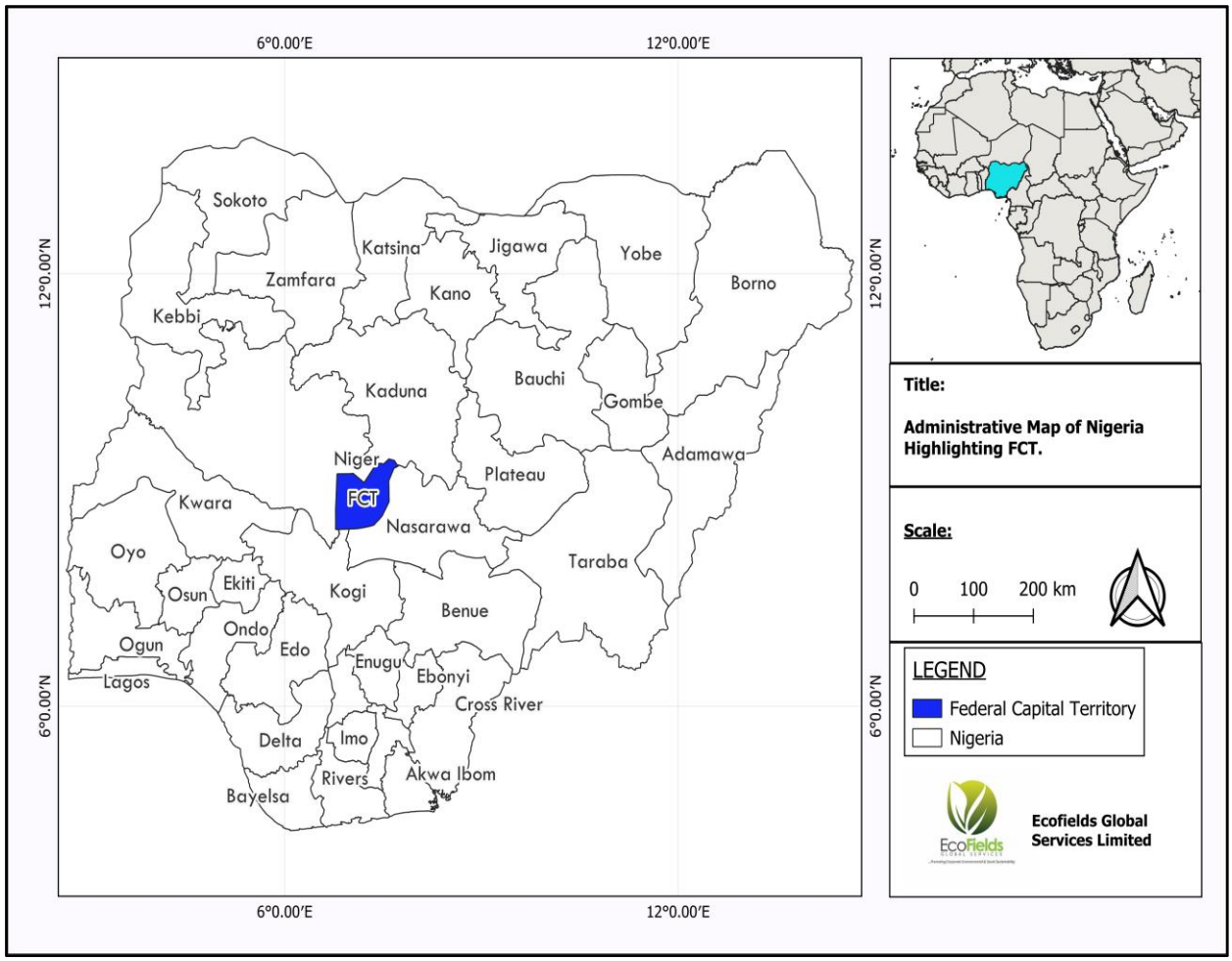

Figure 2: Map of Nigeria Showing the Project Site, FCT Abuja

3.2.2 Survey Assessment of the Proposed Site

The project is located within the permanent campus of the African Aviation and Aerospace University (AAAU), along the Airport Road corridor in Abuja Municipal Area Council (AMAC), FCT. The geo-tagged site photograph recorded during fieldwork provides a project reference coordinate of approximately 8.966396°N, 7.245487°E (WGS 84). The development footprint is approximately 4 hectares within the secured university property. The broad coordinate ranges used elsewhere in the field datasets represent the wider Area of Influence/sampling context and shall not be interpreted as the cadastral boundary of the 4-hectare solar footprint.

The proposed development footprint covers approximately 4 hectares of relatively flat institutional land within the AAAU perimeter, about 100 metres from the main entrance. The selected footprint is managed

as unoccupied and unutilized university-controlled land for project purposes and contains no residential or business structures requiring displacement. Land-status eligibility shall be re-confirmed and documented by AAAU and REA immediately before handover; any portion found to contain occupation, standing crops, livelihood/economic use, third-party claims or access-dependent use shall be excluded or redesigned before construction.

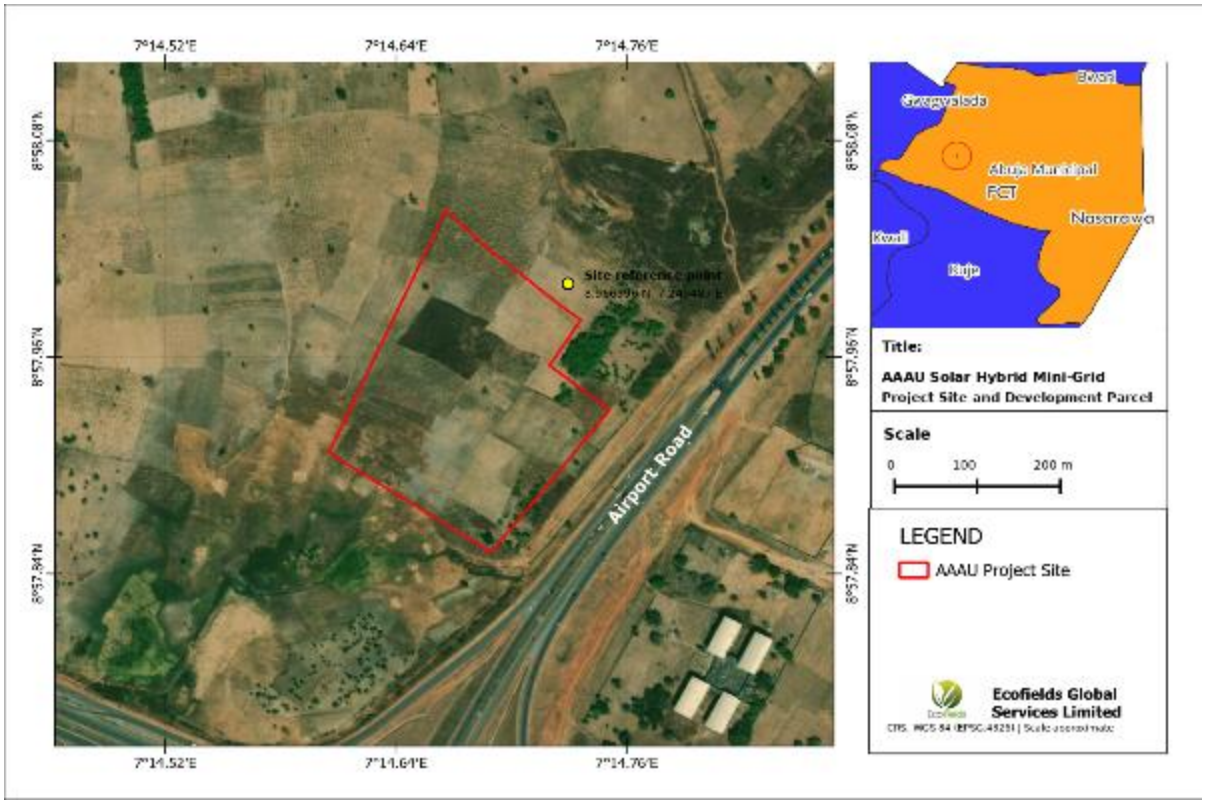

Figure 3: Map showing the Project footprint

Existing Infrastructure

The proposed project site does not contain any electrical or utility infrastructure within the designated project footprint. Field observations confirmed the absence of transmission lines, transformers, substations, or internal power distribution facilities within the footprint boundary. No underground utilities or overhead power connections were identified crossing the site, although electric poles were observed within the broader campus area, currently without active connections pending the provision of national grid supply.

The broader campus is characterized by ongoing infrastructure development, with administrative blocks, classroom facilities and other academic structures presently under construction as part of the University's permanent campus development programme. The campus is fully secured within a perimeter fence, with an established security post at the main entrance gate. Water supply is provided through functional borehole points distributed across the campus. Drainage channels have been mapped out and excavated within the campus but remain under active construction. Existing power supply to the campus is provided entirely through diesel powered generating sets, given the absence of a national grid connection at this stage of campus development.

3.2.3 Site Suitability for the Proposed Project

The proposed site is technically suitable for the development of the planned solar hybrid mini-grid system. The allocated 4-hectare footprint is sufficient to accommodate the photovoltaic arrays, battery

storage, control room, and associated infrastructure without affecting existing campus buildings or ongoing institutional activities. The flat terrain minimizes the need for major earthworks and supports efficient panel installation and system layout.

The footprint is an open, modified institutional site with low habitat complexity, situated away from hostels, health facilities and places of worship. Academic and administrative facilities are located at greater distances from the core solar footprint, although construction traffic and the underground cable route will interact with the wider active campus and therefore require specific community health and safety controls.

The site is readily accessible through the main campus entrance directly off the Airport Road expressway, which provides a high-quality paved access route suitable for heavy construction vehicles and equipment. A secondary entrance also provides additional access flexibility for logistics management during construction. The campus is fully secured within a perimeter fence with an operational security post, facilitating effective access control during the construction phase.

Given the absence of a national grid connection at the permanent campus, the proposed solar hybrid mini-grid is particularly well suited to this location, as it will provide a dedicated and self-sustaining electricity supply independent of grid availability and with diesel generator backup serving in the interim, directly addressing the University's current energy gap and supporting its long-term development objectives.

3.3 Project Requirements

Land

The allocated land is under the administrative control of AAAU and lies within the secured campus perimeter. The project footprint is selected to avoid involuntary land acquisition, physical displacement, economic displacement and restrictions on existing livelihood/access use. No external land acquisition is required. Before site handover, REA and AAAU shall complete and sign the Land Status Verification Protocol in Annex Nine; failure of any verification criterion is a construction hold-point requiring avoidance through footprint/layout adjustment before works proceed.

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 primarily be required for periodic cleaning of photovoltaic panels to remove dust accumulation, particularly during the dry season when airborne particles may reduce panel efficiency. Cleaning activities will be undertaken manually and regulated to minimize water consumption. Based on experience from similar solar power installations, each photovoltaic panel may require approximately 5 litres of water per cleaning cycle. giving a total estimated water consumption of approximately 12,500 litres per cleaning cycle for the full panel array. Where practicable, wash water will be collected and reused to minimize freshwater abstraction.

Routine panel cleaning will use clean water and non-abrasive methods, with detergents avoided unless specifically approved. Under normal conditions, clean-water panel washings may infiltrate or drain through the site without significant contamination; however, washing of damaged/contaminated equipment or use of chemicals shall be controlled and any contaminated wash water collected and

managed appropriately. Water use shall be optimized to avoid unnecessary abstraction from campus boreholes.

Health and Safety

Occupational health and safety (OHS) is an issue that needs to be properly managed during all project phases 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

At this design stage, construction waste is preliminarily estimated at approximately 1–3 tonnes, excluding excavated material suitable for beneficial reuse and major packaging streams returned to suppliers. Actual quantities shall be recorded by the EPC Contractor using waste registers, weighbridge/handler receipts and manifests rather than relying solely on these planning estimates.

Although solar photovoltaic systems generate negligible emissions during operation, some project components may require periodic replacement over their service life. These materials will be handled, stored, recycled, or disposed of in accordance with applicable environmental regulations, manufacturer recommendations, and approved waste management procedures.

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.

The University maintains an existing waste management system which will support collection and management of non-hazardous wastes generated during project implementation. Specialized wastes arising from electrical or electronic components will be managed through approved vendors and licensed waste handlers in the state, to ensure environmentally sound disposal practices. A summary of anticipated waste streams across project phases is presented in Table 1.

Table 1: Typical waste Streams across Project Phases

Waste Stream	Sources	Waste Generation Phase		
		Construction	Operation	Decommissioning
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	Site facilities / worker welfare facilities	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 AAAU. 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	40 mm (indicative module frame thickness; confirm manufacturer datasheet)
Weight	24.9 kg

Energy Storage System

The project will incorporate a stationary Battery Energy Storage System (BESS), with lithium iron phosphate (LiFePO4) chemistry preferred based on the alternatives assessment, to enhance reliability and system stability. The BESS will store excess PV generation and discharge during low solar availability or peak demand. The BESS shall be procured as an engineered system with manufacturer BMS, independent safety protections, appropriate enclosure/fire separation, thermal management, fault detection/alarm, emergency isolation and a project-specific emergency response arrangement. Safety evidence shall be appropriate for stationary industrial use, including IEC 62619:2022 and IEC 62485-5:2020 or equivalent, with thermal-runaway propagation/fire information consistent with UL 9540A/NFPA 855 or equivalent GIIP where applicable.

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 transformers 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 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.

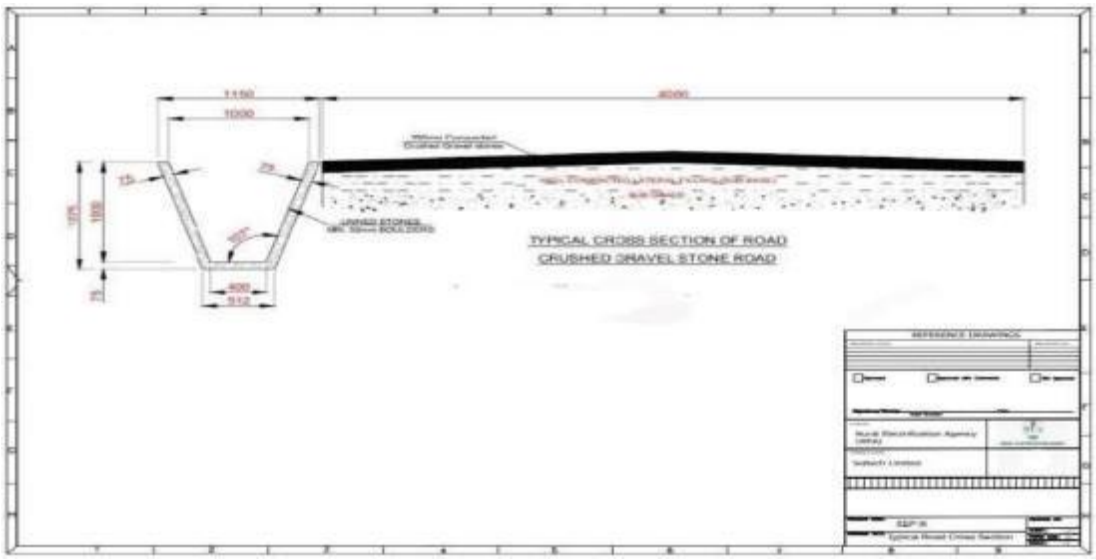

Figure 8: Typical Road Cross Section

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 breakdowns 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 within the solar facility and along the underground cable corridor shall be managed mechanically as needed to maintain safe access, fire separation, drainage and visibility. Herbicides and open burning shall not be used unless specifically authorized and environmentally justified.

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 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

The major facilities and works to be constructed/installed will include:

- ❖ PV mounting structures;
- ❖ Transformers;
- ❖ Control building;
- ❖ Weather station; and
- ❖ Underground medium-voltage cable infrastructure;

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 PV arrays, BESS, transformers, protection systems, SCADA and underground medium-voltage distribution infrastructure; 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 EPC 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.

Renewable-energy learning and knowledge transfer will be supported through structured training for designated AAAU operators and selected students and staff.

3.6.4 Decommissioning

Upon completion of the power plant, the project site area will be cleared up 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	15–25 persons: project engineer's / design specialists, E&S officers, surveyors, security personnel, and limited support workers	Temporary / short-term professional assignment
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	50–70 persons at peak construction: skilled technicians, electricians, civil workers, equipment operators, HSE/ safeguard personnel, supervisors, security personnel, and unskilled local labour	Temporary, mainly construction-period employment
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	10–15 persons: commissioning engineers, electrical specialists, HSE officer, REA/ AAAU representatives, EPC technical personnel O&M manager/ engineer, electrical technicians, BESS technician, HSE/support officer, security personnel, cleaner/ site attendants,	Temporary / short-term technical assignment for commissioning phase & Long-term O&M contract / permanent operational support for operation and maintenance phase
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	25–35 persons: decommissioning contractor, electricians, waste handlers, HSE officer, environmental officer, security and manual workers	Temporary / end-of-life decommissioning employment

3.7 Analysis of Project Alternatives

The proposed solar hybrid mini grid system for the African Aviation and Aerospace University, Abuja 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

Two potential locations within the permanent campus of the African Aviation and Aerospace University (AAAU) were reviewed and assessed during the field survey conducted on 9th July 2026. The evaluation considered key criteria including land availability, proximity to the planned electricity load centre and transformer connection point, environmental sensitivity, social impacts, topography, flood risk, accessibility, and security.

Selected Site

Field verification was undertaken through site walkthrough surveys, GPS mapping, and consultation with university management and the Directorate of Works. The assessments confirmed that the selected site within the campus perimeter, approximately 100 metres from the main entrance gate, is the most technically and environmentally suitable option, through the following factors:

- The site is located approximately 800 metres from the main campus load centre and approximately 100 metres from the proposed transformer connection point, minimising transmission losses and reducing the need for extensive distribution infrastructure.
- The terrain is flat, providing optimal conditions for ground mounted photovoltaic array installation and minimising the need for major earthworks or ground preparation.
- The site is situated within the secured campus perimeter, fully fenced with an operational security post, facilitating effective access control during construction and operation.
- The footprint is accessible directly from the main campus entrance off the Airport Road expressway, and a secondary entrance provides additional access flexibility for construction vehicles and logistics.
- No permanent third-party structures, underground utilities, overhead power connections or ecologically sensitive features were identified within the selected footprint. The preferred site is maintained as a displacement-free project footprint; this status is a binding site-eligibility criterion and shall be verified before handover. Any newly identified occupation, cultivation, livelihood use, claim or access restriction shall be avoided by adjusting the footprint/layout before works.
- The site is an open field with minimal shading from buildings or trees, ensuring maximum solar irradiance potential for the photovoltaic arrays.

- The footprint is located within the Southern Guinea Savannah ecological zone of the FCT, with sparse modified low-value vegetation of low ecological sensitivity and no evidence of protected plant species, critical habitats, or cultural heritage resources within or adjacent to the site.

Alternative Site

An alternative site was identified during the field assessment, located outside the University's perimeter fence on school land adjacent to the campus boundary. This alternative site was assessed against the same criteria and rejected on the following grounds:

- The alternative site is located approximately 1 kilometre from the proposed transformer connection point, compared to 100 metres for the selected site, resulting in significantly longer cabling requirements and higher infrastructure costs.
- The alternative site is located very close to a stream, presenting a higher flood and waterlogging risk compared to the selected site which has no flood risk.
- The terrain at the alternative site is undulating rather than flat, requiring more extensive earthworks and increasing installation complexity and cost.
- The alternative site is situated outside the campus security perimeter and is not fenced, presenting significant security and access control challenges during both construction and operation.
- The soil at the alternative site has a rocky texture compared to the more workable sandy/loamy soil at the selected site, increasing foundation costs.

On the basis of this comparative assessment, the selected site within the campus perimeter is confirmed as the preferred option, offering superior technical suitability, lower environmental sensitivity, better security, and more favourable access and infrastructure conditions relative to the alternative considered.

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 10 parabolic troughs, heliostats (for power towers), linear Fresnel lenses, and dish receivers.

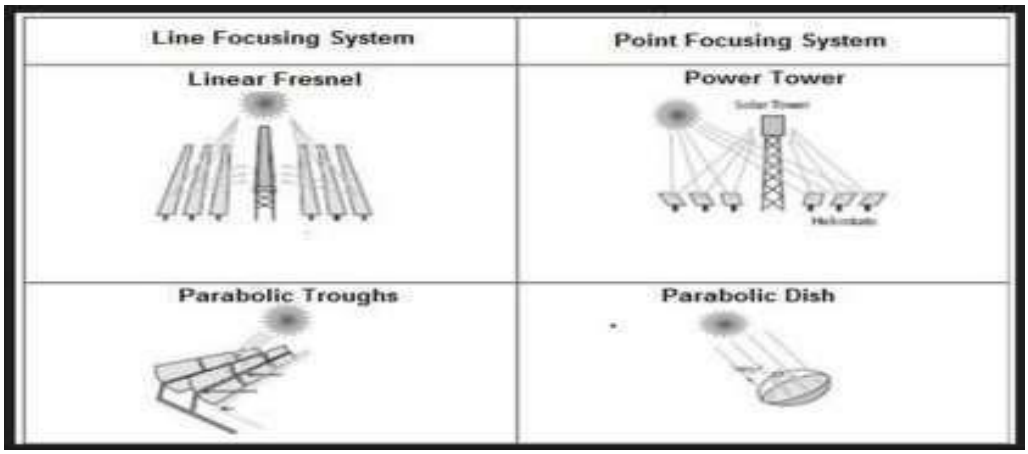

Figure 9: Four different types of solar collector designs

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 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 10: 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 11: 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 12: 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
Maintenance	Regular (depending on type)	Moderate	Low (Maintenance-free)
Environmental Risk	High (Lead/Acid)	Very High (Cadmium)	Low (No heavy metals)

The preferred storage technology is lithium iron phosphate (LiFePO4), a lithium-ion chemistry with a comparatively strong stationary-storage safety profile, long cycle life and high usable depth of discharge. Selection does not eliminate thermal-runaway risk; the final BESS shall therefore incorporate engineered prevention, detection, isolation, fire/life-safety and emergency-response controls.

3.7.4 Climate Change Considerations

Climate change considerations formed an explicit criterion in the evaluation of project alternatives, reflecting the requirements of the AfDB ISS 2023 and the need to ensure long-term project resilience and sustainability within the FCT Abuja environment.

Climate Risk: The proposed site experiences a tropical savannah climate characterized by a distinct wet season from April to October and a dry season from November to March. Climate related risks relevant to the project include high ambient temperatures during the dry season, intense rainfall events and associated stormwater runoff during the wet season, harmattan dust conditions from November to February, seasonal wind loading, and lightning associated with convective thunderstorms during the early wet season. Among the site options assessed, the selected location presents the lowest climate

vulnerability due to its flat terrain, open aspect maximizing solar irradiance, and position within the secured campus perimeter away from waterlogged areas. Appropriate climate resilience measures including lightning protection systems, surge protection, adequate earthing of all electrical installations, and panel orientation optimised for the FCT solar irradiance profile will be incorporated into the detailed project design.

Climate Impact on Project: The selected solar PV technology and battery energy 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 and rain exposure during the wet season. Lithium-ion battery storage was preferred over lead-acid alternatives in part due to superior thermal performance under the high ambient temperatures characteristic of the FCT environment, as well as longer cycle life and lower maintenance requirements. Panel cleaning and maintenance provisions will be incorporated into the Operations and Maintenance plan to address dust related efficiency losses during the harmattan period.

Project GHG Contribution: Among the alternatives considered, solar photovoltaic generation produces negligible operational greenhouse gas emissions compared to continued reliance on diesel powered generation, which currently constitutes the sole source of electricity at AAAU. Based on standard IPCC emission factors for diesel combustion, continued diesel generation at a university campus of this scale is estimated to contribute significantly to annual carbon dioxide equivalent emissions. The preferred solar hybrid alternative directly displaces this fossil fuel dependency and supports Nigeria's mitigation commitments under the National Climate Change Policy 2021 to 2030, the Nationally Determined Contributions under the Paris Agreement, and the Federal Government's Sustainable Energy for All Action Plan.

3.7.5 Project Options

No Project Option

The “No Project Option” refers to the scenario in which the proposed solar hybrid mini-grid is not implemented at the African Aviation and Aerospace University (AAAU). Under this scenario, the University would continue to rely entirely on diesel powered generating sets to meet its electricity needs, as the permanent campus currently has no national grid connection and grid extension plans remain at the proposal stage.

The existing electricity situation at AAAU is characterized by complete dependence on diesel generation, with all academic, administrative, security and operational activities powered by generator sets. This arrangement results in high and recurring operational costs covering diesel procurement, lubricants, spare parts, generator maintenance and emergency repairs. It also produces continuous greenhouse gas emissions, noise pollution and air quality impacts from generator exhaust within the campus environment and exposes the institution to the risk of fuel supply disruptions and price volatility.

Continued reliance on diesel generation would constrain the University's ability to expand its academic programmes, research activities, ICT services and laboratory operations as the permanent campus develops. Power interruptions and generator downtime would continue to disrupt teaching schedules, examination activities and administrative operations, undermining the University's academic performance and institutional efficiency at a critical stage of its development.

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 the provision of clean

and reliable electricity, reduction in fossil fuel dependence, improved learning and research conditions, creation of local employment opportunities, and enhanced institutional sustainability.

Because audited AAAU-specific fuel-consumption records were not included in the ESIA data package, this ESIA does not assign a numerical annual diesel expenditure or avoided-emissions value. The environmental case for the project is based on the established displacement of diesel-generator runtime by renewable generation; operational monitoring will record renewable generation, backup-generator runtime and diesel use as performance indicators without presenting unsupported baseline quantities.

For these reasons, the no project option is considered neither technically nor environmentally desirable and was not selected as a viable alternative for meeting the long-term electricity demand of the African Aviation and Aerospace University.

Delayed Option

The delayed project option refers to a scenario in which implementation of the proposed solar hybrid mini-grid at the African Aviation and Aerospace University (AAAU) is postponed to a later date. Under this option, the University would continue to experience complete dependence on diesel powered generation, with no reliable or sustainable electricity supply, while development of the permanent campus continues to progress.

Delaying the project would prolong the University's reliance on diesel generators, resulting in continued high operational costs, energy insecurity, recurring generator maintenance burdens, and ongoing environmental impacts from fossil fuel combustion including greenhouse gas emissions, noise pollution and air quality degradation within the campus environment. The absence of reliable electricity would continue to constrain academic activities, laboratory operations, ICT services, research productivity and administrative efficiency at a critical stage of the University's institutional development.

A delay would equally slow the realisation of the expected benefits of the Energizing Education Programme under the Desert-to-Power initiative, including improved electricity reliability for academic and research activities, reduction in fossil fuel dependence, creation of local employment opportunities during construction, and enhanced institutional sustainability during the University's formative development phase.

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 African Aviation and Aerospace University.

Go Ahead Option

The go-ahead option refers to the implementation of the proposed solar hybrid mini-grid project at the African Aviation and Aerospace University (AAAU) as planned under the Energizing Education Programme of the Desert-to-Power initiative. This option represents the most technically feasible, environmentally compatible, and socioeconomically beneficial alternative assessed, and is therefore the recommended and selected course of action.

Implementation of the project will provide reliable, sustainable, and clean electricity supply to the University's permanent campus, directly addressing the current total dependence on diesel powered generation and the associated operational, environmental and financial burdens.

The project will enhance teaching, research and innovation activities by providing stable electricity for academic buildings, laboratories, ICT facilities and administrative operations across the developing permanent campus. Improved power availability and outdoor lighting will contribute to better campus security, operational efficiency and a more conducive learning environment for students and staff.

The use of solar photovoltaic technology will significantly reduce reliance on diesel powered generators, lower greenhouse gas emissions, reduce noise and air pollution from generator exhaust on campus, and contribute to Nigeria's renewable energy commitments under the Nationally Determined Contributions and the National Climate Change Policy 2021 to 2030.

Considering the technical feasibility, environmental compatibility, economic sustainability, and broad socioeconomic benefits associated with the project, the go ahead option represents the most appropriate and sustainable alternative when compared with the no project and delayed project options, and is therefore selected as the preferred course of action for meeting the long-term electricity needs of the African Aviation and Aerospace University.

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 8th and 17th July 2026, and involved reconnaissance surveys, field observations, stakeholder consultations, environmental sampling, and socioeconomic surveys. Data collection was conducted during the wet season period of July 2026, when the Federal Capital Territory experiences moderate to heavy rainfall, elevated humidity, suppressed dust levels, and active surface water flow. Secondary data obtained from the Nigerian Meteorological Agency and other published sources were used to supplement field measurements and provide a more complete characterization of environmental conditions across both seasons.

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 3km radius from the centre of the proposed solar hybrid mini-grid installation site, located within the permanent campus of the African Aviation and Aerospace University (AAAU). This spatial boundary was considered appropriate for capturing the environmental and social conditions that may potentially interact with the proposed project through construction activities, movement of personnel and equipment, drainage patterns, underground cable routing, and community interactions.

In delineating the AoI, consideration was given to the proximity of nearby receptors and facilities, including the developing academic and administrative structures within the AAAU permanent campus located approximately 800 metres to 1 kilometre from the project footprint, and the Iddo Sarki community located approximately 1 kilometre from the project site. The Airport Road expressway, approximately 400 metres from the project footprint, was also considered given its potential interaction with construction traffic and logistics. Access routes, water sources, drainage channels under construction, and areas undergoing active institutional development within the university environment were likewise taken into account in defining the spatial scope of the assessment.

Baseline environmental sampling, field observations, and socioeconomic surveys were conducted within the defined AoI to ensure that the existing environmental and social conditions of the project environment were adequately characterized prior to project implementation.

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, biological and social conditions of the project environment prior to implementation.

Field observations focused on the following key environmental and social parameters:

- Topography and drainage characteristics including slope, terrain condition, drainage patterns and the status of drainage channels under construction within the campus.
- Soil conditions and surface stability including soil colour, texture, compaction and evidence of erosion or disturbance within and around the project footprint.
- Existing vegetation cover and habitat conditions including the type, density and ecological sensitivity of vegetation within the footprint and the broader Area of Influence.
- Presence or absence of wildlife and indicators of ecological sensitivity including fauna species observed or detected within the footprint and surrounding area.
- Current land use and human activities within the project vicinity, including the modified/open institutional character of the selected development footprint, ongoing campus construction and community activities within the wider Area of Influence.
- Existing infrastructure conditions including the status of roads, drainage channels, security arrangements, water supply and power generation facilities within the campus.
- Sensitive receptors including the location and distance of campus buildings.

Information obtained from field observations was recorded through field notes, geo-referenced photographs, GPS coordinate logging, and direct visual inspection by the ESIA team.

4.2.3 Secondary Data Review

Secondary environmental and socioeconomic 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 socioeconomic conditions of the Federal Capital Territory and the immediate project environment. The reviewed materials included:

- Project documentation provided by the Rural Electrification Agency, including the Terms of Reference for the ESIA.
- Technical planning documents and infrastructure information provided by the African Aviation and Aerospace University, including campus development information and electrical planning data for the permanent campus.
- Environmental and Social Impact Assessment for the Proposed 3.0 MW Solar-Hybrid Power Plant and Associated Infrastructure in University of Abuja (UNIABUJA), Federal Capital Territory. Final Report, December 2020.
- National and regional environmental datasets including climatic and meteorological information for the Federal Capital Territory obtained from the Nigerian Meteorological Agency (NiMet).
- 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 2023 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 9th July 2026 at representative locations within the project footprint and along the surrounding environment.

Soil Sampling

Soil sampling was undertaken at representative locations within the proposed project footprint and surrounding Area of Influence to establish the general baseline quality of the soil environment prior to project implementation. Samples were collected within the soil horizons likely to be affected by project activities, particularly site clearing, grading, excavation of the underground cable trench route, foundation works, vehicle movement and temporary stockpiling of construction materials.

The laboratory chain-of-custody record identifies ten soil samples, SS1–SS10, and Table 6 presents one analytical result set for each location. The soil dataset is therefore interpreted as ten representative field samples collected using grab/composite methods across the project area and Area of Influence. Sampling locations were geo-referenced and the laboratory analytical report and chain-of-custody documentation are retained in Annex Eight.

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. Laboratory analyses were conducted by the Pollution Control Laboratory, Ministry of Environment, Kano State, an FMEnv-accredited environmental laboratory, to determine parameters including soil pH, organic matter content, particle size distribution, and selected heavy metals. The laboratory applied established analytical procedures and quality assurance/quality control (QA/QC) protocols to ensure the reliability of the analytical results. Supporting laboratory documentation is provided in Annex Eight.

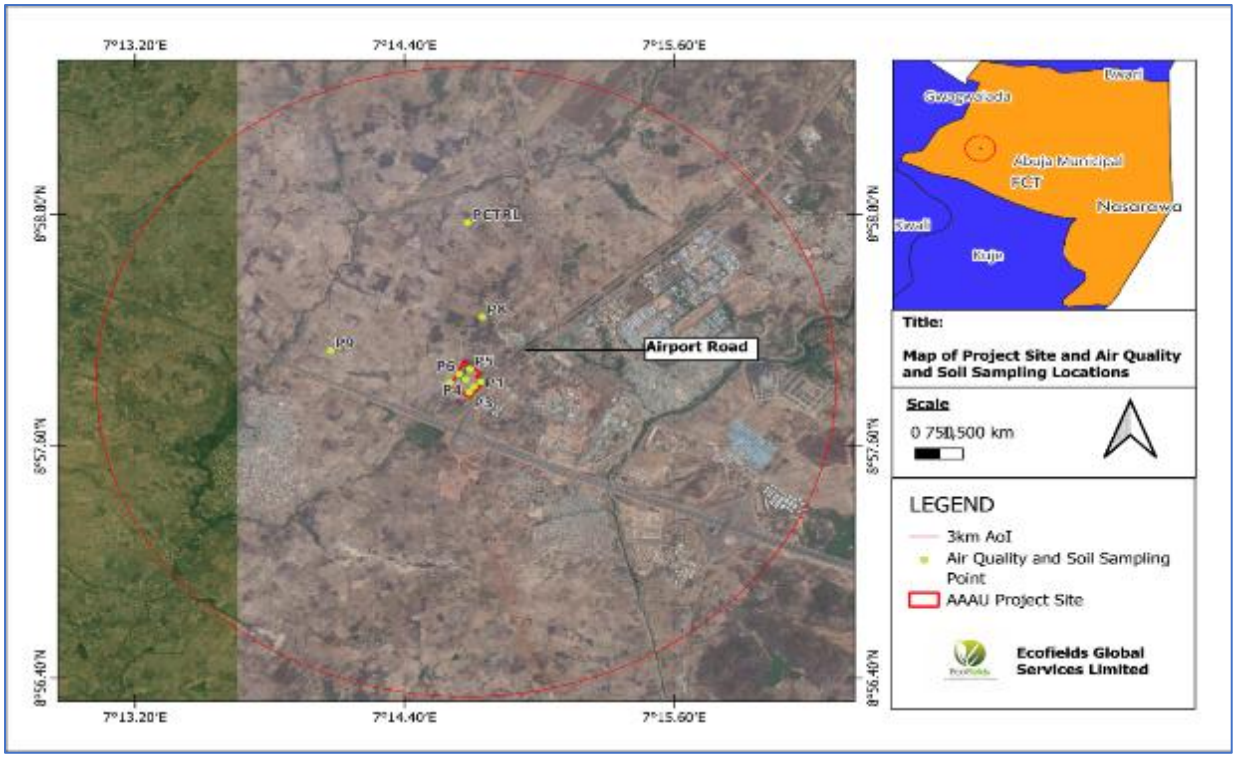

Figure 13: Map showing the soil sampling points in, and around the project footprint

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 ten (10) monitoring locations (AQ1–AQ10) within and around the project site 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 analytical results table contains five water records: two groundwater samples from campus boreholes (Borehole I and Borehole II), two stream samples (Stream I and Stream II) and one supplemental pond sample within the wider Area of Influence. The field in-situ record documents the four core borehole/stream locations; the pond result is retained as a supplemental surface-water baseline record. These locations collectively characterize campus water supply and nearby surface-water conditions.

Samples were collected using pre-cleaned and sterilized sampling bottles and preserved in accordance with standard sampling and preservation protocols prior to transportation for laboratory analysis. The collected samples were analyzed for selected physicochemical and microbiological parameters, including indicators of water quality such as pH, turbidity, total dissolved solids (TDS), electrical conductivity (EC), and other relevant parameters as discussed in subsection 4.3.3.

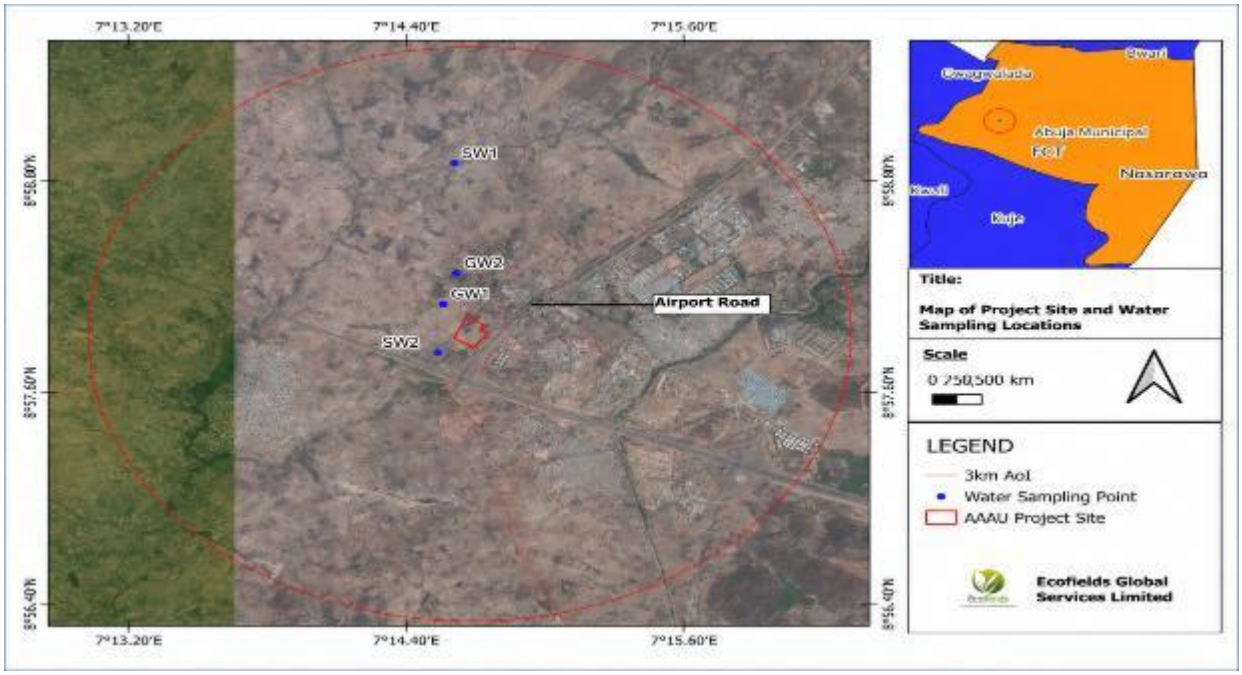

Figure 14: Water sampling points

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 relevant Federal Ministry of Environment/NESREA requirements and internationally recognized analytical procedures appropriate to each parameter (including APHA/ASTM/ISO methods where applicable), to ensure the reliability and integrity of the data obtained.

Sample Collection and Handling

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 preservation and holding-time requirements were applied according to the parameter being analysed and the laboratory method. Parameters requiring immediate field measurement, including temperature and pH, were measured in situ; samples for laboratory analysis were stored in appropriate containers, cooled where required and transported with chain-of-custody documentation. The analytical certificates in Annex Eight constitute the controlling record where any narrative description of preservation differs from the accredited laboratory method.

4.2.5 Socio-Economic Survey Methods

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

The socioeconomic survey was conducted on 9th and 10th July 2026 within the AAAU permanent campus and the Iddo Sarki community. Quantitative data were collected from a purposive/stratified descriptive sample of students, academic and non-academic staff and surrounding-community respondents. Qualitative information was obtained through Key Informant Interviews with university

management/Works and community leadership and through Focus Group Discussions. The survey results are used to describe stakeholder conditions and perceptions and are not treated as statistically representative estimates of the entire Area-of-Influence population.

The assessment focused on gathering information on key socioeconomic 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, energy access and expenditure, awareness of and attitude toward the proposed project, and community perceptions regarding potential project impacts and benefits.

Information obtained from the various survey methods was triangulated to ensure reliability and to distinguish community perceptions from verifiable conditions within the project environment. The results of the socioeconomic assessment provided the basis for understanding existing social conditions and for evaluating potential project related impacts on the university community, and the surrounding Iddo Sarki community.

4.3 Physical Environment

4.3.1 Climate and Meteorology

The study area proposed which is located within the Federal Capital Territory (FCT), Abuja, experiences a tropical wet-and-dry savannah climate classified as Aw under the Köppen–Geiger climate classification. The climate is characterized by a distinct wet season and dry season, associated with the seasonal movement of the Inter-Tropical Convergence Zone (ITCZ) and the corresponding alternation between moisture-bearing south-westerly winds and dry north-easterly continental air masses. The wet season generally extends from about April to October, while the dry season occurs predominantly from November to March.

The monthly climate profile is presented in Figure 15. The figure demonstrates the strong seasonal relationship between temperature and rainfall, with temperatures increasing toward the late dry season and rainfall increasing markedly from April, reaching a maximum during August–September, before declining rapidly toward November and December.

Air Temperature

Abuja has a warm tropical climate throughout the year. The late dry season, particularly February–April, is associated with the highest temperatures, while temperatures decrease during the peak wet season as cloud cover and rainfall increase. The long-term warming trend of approximately 0.19°C per decade indicates that climate variability and increasing heat exposure should be considered in project design and occupational health and safety planning. For the proposed project, this supports the need for adequate worker hydration, heat-stress management, appropriate work scheduling and protection of electrical and battery systems against elevated ambient temperatures.

The monthly climate normals show mean minimum temperatures ranging from approximately 18.6°C in December to 24.3°C in April, while mean maximum temperatures range from approximately 28.5°C in August to 36.0°C in March. These values represent climatological averages and should not be interpreted as absolute historical temperature extremes.

Rainfall

Annual rainfall averages approximately 1,365 mm, with pronounced seasonal variability. Rainfall increases from April and becomes substantial between May and October, with peak monthly totals of

approximately 280.3 mm in August and 279.5 mm in September. December and January are comparatively dry, with approximately 1.1 mm and 2.1 mm of average rainfall, respectively.

The seasonal rainfall pattern has direct implications for the project. Construction activities involving excavation, trenching and access roads may be affected by intense rainfall, runoff, temporary waterlogging and erosion. Accordingly, the ESMP shall provide for appropriate stormwater diversion, erosion and sediment control, protection of excavated areas, safe management of open trenches and timely reinstatement of disturbed surfaces.

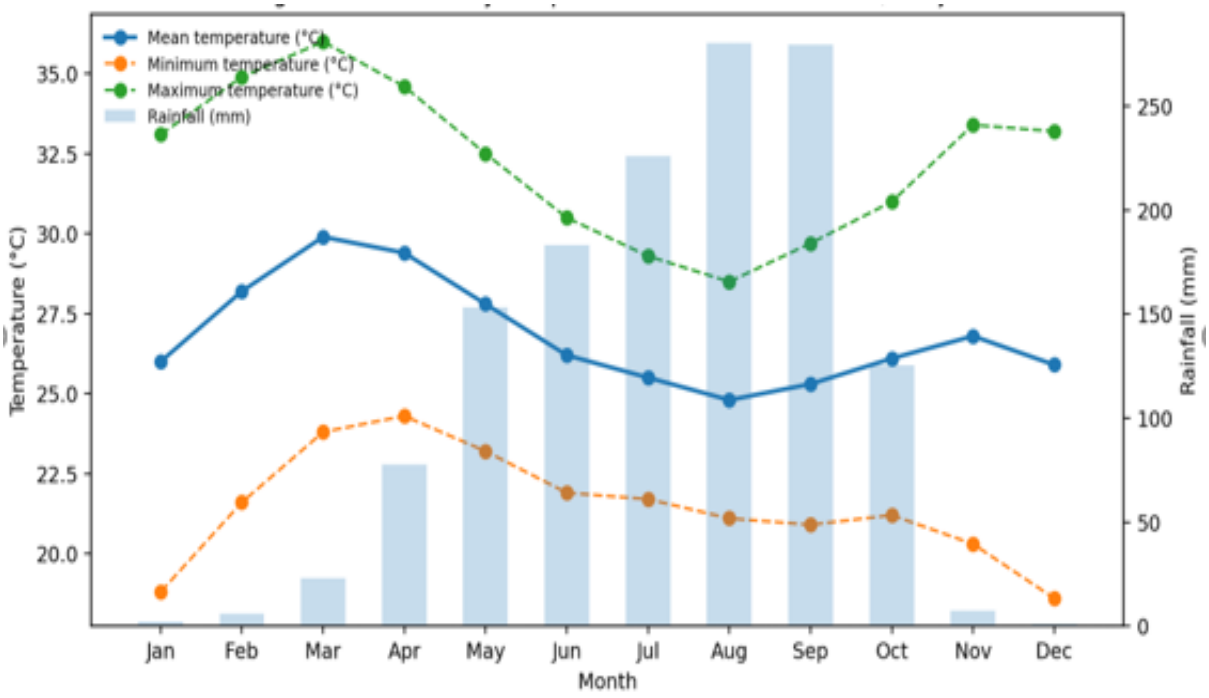

Figure 15:Climatic profile of the project area

Sunshine Hours and Solar Resource

Abuja has a favourable solar resource for photovoltaic electricity generation, with substantial sunshine during the dry season and reduced sunshine during the peak wet season due mainly to increased cloud cover. Available climate data indicate an average annual sunshine duration of approximately 2,694 hours, equivalent to about 224.5 hours per month. Average daily sunshine duration is highest during the dry-season months, reaching approximately 10.3 hours per day in January, February and December, and declining to about 3.9 hours per day in August.

The monthly sunshine pattern is presented in Figure 16. The seasonal profile supports the technical suitability of the FCT for solar PV generation. For environmental and operational management, the project shall also consider dust deposition during the dry season because accumulated dust on module surfaces can reduce solar conversion efficiency. Routine module cleaning shall therefore be incorporated into the Operations and Maintenance Plan, using methods that minimize water consumption and prevent uncontrolled wastewater discharge.

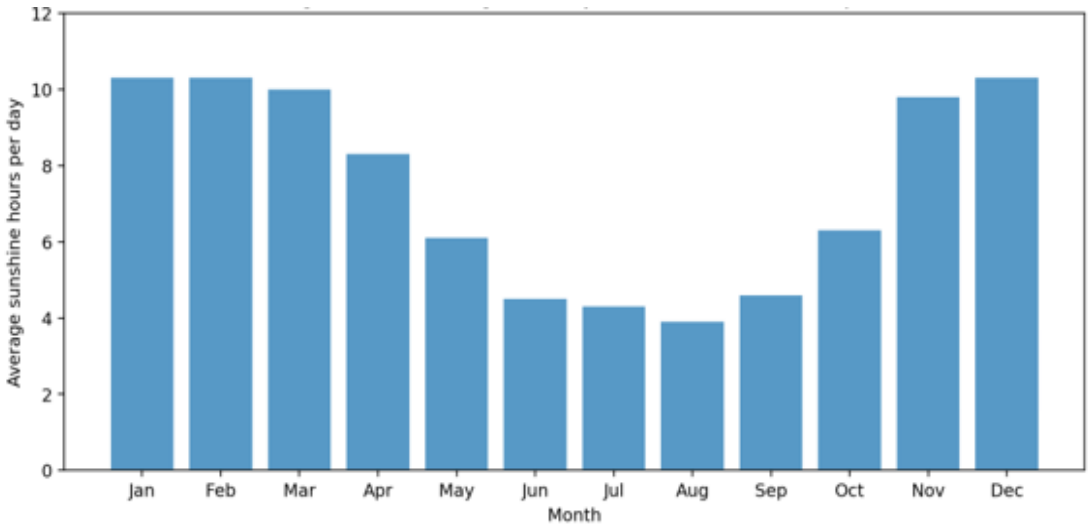

Figure 16: Monthly sunshine pattern

Geology of the Project Area

The study area is located within the Central Nigeria Precambrian Basement Complex. The geology of the area has been studied and discussed by previous publications like Oyawoye (1972), McCurry (1976) etc. They described the rocks as comprising mostly granite, gneisses, mica schists, hornblende and feldspathic schists and migmatites. The rocks are highly fractured and jointed showing essentially two fracture patterns, NE – SW and NW – SE. These fractures control the drainage and flow patterns of rivers in the area. However, minor Cretaceous deposits of Nupe sandstones occur in the southern part of FCT between Kwali and Abaji, extending to Rubochi and the border with Nassarawa State. Similarly, meta-sediments have also been mapped along a general NNE-SSW direction through the west of Kusaki (in the south) and east of Takushara (in the north) (USGS 1977). Mica schists and amphibolite schists occur around Kusaki and Buze villages outside the study area.

Topography and Land Use

The selected project footprint is an open, modified institutional site within the university property. No permanent or temporary third-party structures were recorded within the proposed construction footprint.

Figure 17: View of the proposed project footprint at AAAU

No permanent or temporary structures were identified within the project footprint. Economic trees were observed at the boundary of the footprint, approximately 20 metres from the site boundary, but none were identified within the footprint itself. Drainage channels are present in the vicinity of the site, currently under active construction as part of the broader campus infrastructure development programme. Pockets of stormwater were observed within the wider campus area, associated with the untarred internal campus roads and ongoing construction activities across the permanent campus.

4.3.2 Soil Physico-Chemical Characteristics

Ten representative soil samples designated SS1 to SS10 were collected across the proposed project area and surrounding Area of Influence. The laboratory chain-of-custody form records ten soil samples, and the analytical table provides one result set per location. These data provide a screening-level baseline of soil physicochemical, selected metal and microbiological characteristics for comparison during project monitoring.

Analysis of Soil Sample Results

Physical Parameters

Soil colour across all ten sampling locations is predominantly brown, with SS7 recording a dark brown colour, reflecting slightly higher organic matter content at that location. Soil pH ranges from 6.77 to 8.88 across the sampling locations, indicating a range from near neutral to moderately alkaline conditions. These pH values are within acceptable ranges for infrastructure development and do not indicate chemical constraints for civil works associated with the proposed solar installation.

The results indicate low reported salinity across the sampled locations. They are suitable for environmental baseline comparison; however, they do not by themselves constitute a geotechnical or materials-corrosion assessment. Foundation design and underground electrical infrastructure shall rely on appropriate engineering/geotechnical investigations and material-protection specifications.

Exchangeable Cations

Calcium concentrations range from 0.16 mg/kg at SS3 to 4.87 mg/kg at SS10. Magnesium ranges from 0.26 mg/kg at SS4 to 2.61 mg/kg at SS9. Sodium concentrations range from 3 mg/kg at SS4 to 41 mg/kg at SS10. These sodium levels are not excessively high and do not indicate sodic soil conditions that could lead to soil dispersion or structural instability during construction. Potassium levels range from 0.1 mg/kg at SS1 and SS4 to 1.4 mg/kg at SS10.

Exchangeable Anions

Sulphate concentrations range from 14 mg/kg at SS6 to 56 mg/kg at SS3. Nitrate concentrations range from 2.3 mg/kg at SS1 to 11.4 mg/kg at SS7. Phosphate concentrations range from 0.21 mg/kg at SS8 to 2.31 mg/kg at SS3. Chloride concentrations range from 0.5 mg/kg at SS10 to 7.6 mg/kg at SS5. All anion concentrations are within levels consistent with natural soil background conditions and do not indicate pollution or chemical accumulation within the project footprint.

Heavy Metals

Mercury and lead are reported as 0.000 at the sampled locations. These values are interpreted as non-detect or as below the laboratory reporting resolution. Taken together with the reported concentrations of the other analysed metals, the available dataset does not indicate elevated heavy-metal contamination within the sampled soil environment.

Mercury and lead are reported as 0.000 at the sampled locations and are interpreted as non-detect or below the laboratory reporting resolution. Together with the reported concentrations of the other analysed metals, the available dataset does not indicate elevated heavy-metal contamination at the sampled locations; it is not interpreted as proof of absolute absence or as a substitute for geotechnical/materials testing.

Soil Characteristics

Loam content across the sampling locations ranges from 19% at SS8 to 43% at SS1 and SS5. Sandy content ranges from 21% at SS5 to 65% at SS8, with the majority of locations recording sandy content above 40%, confirming the dominantly sandy character of the soil within the project area. Clay content ranges from 3% at SS1 to 25% at SS5, with generally low clay fractions across most locations. Variability in soil organic content, ranging from 0% at SS2 to 18% at SS7, is attributable to the uneven distribution of crop residues, tillage patterns and organic matter accumulation associated with heterogeneous surface cover and prior disturbance within the broader project area.

Microbiological Parameters

E. coli counts range from 1 cfu/100/kg at SS3 to 9 cfu/100/kg at SS5 and SS9. Fungal counts range from 31 cfu/100/kg at SS7 to 203 cfu/100/kg at SS9. These values reflect natural background microbial activity typical of disturbed surface soils and do not indicate any abnormal biological contamination within the project footprint. No public health or environmental risk is associated with these microbiological findings in the context of the proposed project.

4.3.3 Water Quality Assessment

Five analytical water records were assessed: Borehole I and Borehole II within AAAU, Stream I and Stream II within the Area of Influence, and a supplemental pond sample. The field in-situ sheet documents the two boreholes and two stream locations; the pond is retained as an additional surface-water analytical point. GPS coordinates are presented in Table 7.

Analysis of Water Sample Results

Physicochemical Characteristics

Both borehole samples present as clear and odourless with tasteless water, consistent with groundwater of acceptable aesthetic quality. The stream samples present as cloudy in colour, with Stream I Midstream recording a bad odour, indicating organic loading and biological activity typical of open surface water bodies.

pH values range from 6.12 in Borehole I to 7.14 in Stream I Midstream. Borehole I records a pH of 6.12, which is marginally below the FME recommended range of 6.5 to 8.5, indicating slightly acidic conditions. All other sampling locations fall within the acceptable pH range. Total Dissolved Solids (TDS) range from 48 mg/L in Stream I Upstream to 403 mg/L in Borehole II, all well below the FME limit of 500 mg/L, indicating low dissolved mineral content across all sources. Electrical conductivity ranges from 96 µS/cm in Stream I Upstream to 816 µS/cm in Borehole II, all below the FME limit of 1,000 µS/cm.

Total Suspended Solids (TSS) are very low, ranging from 0 mg/L in Borehole I to 3 mg/L in the stream samples, well within the FME limit of 20 mg/L. Dissolved oxygen ranges from 4.0 mg/L in Borehole II to 5.1 mg/L in Stream I Midstream, all within the FME range of 2 to 8 mg/L, indicating adequate oxygenation across all sampling points. BOD values range from 2.0 mg/L to 3.0 mg/L across all locations. Salinity is negligible at 0.02% and 0.04% in the boreholes and 0.00% in both stream locations.

The two boreholes and stream points show generally low TDS/TSS and conductivity in the reported dataset, while the pond has notably elevated TSS (109 mg/L) and visibly poor aesthetic quality. These measurements establish environmental baseline conditions only and should not be interpreted as certification of any source for potable use.

Chemical Characteristics

Calcium concentrations range from 0.7 mg/L in Stream I Midstream to 2.1 mg/L in Borehole I, well below the FME limit of 200 mg/L. Magnesium ranges from 0.3 mg/L to 1.9 mg/L, within the FME limit of 20 mg/L. Sodium concentrations in the boreholes are 3 mg/L and 6 mg/L respectively, with no sodium detected in either stream location, all within the FME limit of 20 mg/L.

Sulphate concentrations range from 47 mg/L in Borehole I to 84 mg/L in Stream I Midstream, all below the FME limit of 100 mg/L. Nitrate concentrations range from 1.0 mg/L to 3.4 mg/L, well within the FME limit of 50 mg/L. Chloride concentrations are very low, ranging from 0.3 mg/L to 2.0 mg/L, well within the FME limit of 150 mg/L. Phosphate was not detected in either borehole but was recorded at 2.2 mg/L in both stream locations. Ammonium concentrations range from 0.006 mg/L in Borehole II to 1.800 mg/L in Stream I Midstream, with higher values recorded in the surface water sources reflecting organic matter decomposition.

Overall, chemical concentrations across all sampling locations are within acceptable limits and indicate no significant anthropogenic chemical contamination within the project area.

Heavy Metals

Zinc concentrations range from 0.054 mg/L in Borehole I to 0.168 mg/L in Stream I Midstream, within the comparator presented in Table 7. Lead and mercury are reported as 0.000 µg/L at the sampled locations and are therefore treated as non-detect/below the laboratory reporting resolution for this baseline event; the results do not establish absolute absence from the wider water environment.

Iron concentrations range from 0.62 mg/L in Borehole I to 1.53 mg/L in the pond and exceed the 0.3 mg/L comparator at all five analytical locations. The surface-water dataset also contains elevated chromium, cobalt and/or nickel at several locations, particularly the pond. These are pre-existing baseline observations; potential sources may include natural geochemistry and/or upstream/local anthropogenic influences, but the available dataset does not establish source attribution.

Chromium concentrations were not detected in either borehole at 0.00 mg/L but were recorded at 0.47 mg/L in both Stream I Upstream and Stream I Midstream, significantly exceeding the FME limit of 0.05 mg/L. The consistent chromium detection in both stream sampling points but absence in boreholes suggests a possible geogenic or upstream anthropogenic source requiring further investigation.

Nickel concentrations were not detected in either borehole or in Stream I Upstream, but Stream I Midstream recorded 0.14 mg/L, exceeding the FME limit of 0.05 mg/L. This localised exceedance in the midstream location warrants monitoring during construction to ensure project activities do not contribute to further nickel loading in the stream. Copper concentrations range from 0.36 mg/L in Borehole II to 1.05 mg/L in Borehole I, below the FME limit of 1.5 mg/L across all locations.

Surface-water sources are not proposed as potable supply for the project and shall not be used for drinking without appropriate treatment and verification. Campus boreholes may be used for non-potable construction/panel-cleaning purposes subject to University authorization and resource-efficiency controls. Potable water for workers shall meet applicable drinking-water requirements. Water monitoring

during construction shall compare project-period results with this baseline and investigate any material deterioration attributable to project activities.

Microbiological Characteristics

E. coli was not detected in the two borehole samples at the time of sampling. Total coliform was nevertheless reported at 1 and 3 cfu/ml in Borehole I and II respectively. These results provide a point-in-time environmental baseline and do not constitute comprehensive certification of potable-water safety.

Total coliform counts range from 1 cfu/ml in Borehole I to 6 cfu/ml in Stream I Midstream, all within the FME limit of 10 cfu/ml. The borehole groundwater sources demonstrate acceptable microbiological quality at baseline, while the surface water sources show low but detectable microbial activity typical of open water bodies.

Environmental Safeguard Consideration

The water quality results establish the existing baseline condition of water resources within the project Area of Influence. The identified exceedances of iron in all sources, chromium and nickel in stream samples, and slightly acidic pH in Borehole I represent pre-existing conditions unrelated to the proposed project. These baseline conditions shall be maintained and not worsened during construction and operational phases.

Project activities including site clearing, earthworks, cable trenching, material storage and equipment maintenance shall be managed to prevent contamination of the campus borehole water supply and the stream within the Area of Influence. Specific measures including erosion and sediment controls along the cable trench route, spill prevention for fuels and lubricants, and prohibition of waste disposal near water sources shall be implemented and detailed in the ESMP. Periodic water quality monitoring of both borehole and stream sampling locations during construction is recommended to detect any project-related changes against this established baseline.

4.3.4 Air Quality and Noise Measurement

Ambient air quality and noise measurements were conducted at ten monitoring locations designated AQ1 to AQ10 across the proposed project site and surrounding Area of Influence. Parameters assessed include gaseous pollutants, particulate matter, total volatile organic compounds, formaldehyde and ambient noise levels.

Gaseous Parameters

Nitrogen dioxide (NO_2) concentrations range from 0.1 ppm to 0.2 ppm across all ten monitoring locations, well within the FMEnv limit of 0.4 ppm, indicating low combustion-related nitrogen oxide emissions within the project environment. Carbon monoxide (CO) was not detected at any monitoring location, recording 0 ppm across all ten points, confirming the absence of significant combustion activity within the immediate project area.

Nitrous oxides (NO_2) concentrations range from 0.0006 ppm at AQ5 to 0.020 ppm at AQ4, all well within the FMEnv limit of 0.4 ppm. Hydrogen sulphide, hydrogen cyanide, ammonia, phosphine and methane were not detected at any monitoring location, all recording 0.00 ppm, confirming the absence of industrial, agricultural or decomposition-related gaseous pollutants within the project environment.

Sulphur dioxide (SO_2) values in Table 8 are above the table comparator of 0.02 ppm at nine of ten stations, whereas chlorine gas is 0.0 ppm at all stations. Hydrogen chloride is reported at 0.16–1.43 ppm

but the table does not provide a regulatory comparator; it is therefore reported descriptively rather than classified as an exceedance. Potential background sources require caution because the single survey event cannot determine pollutant source attribution.

Particulate Matter

PM2.5 concentrations range from 19 µg/m³ at AQ3 to 29 µg/m³ at AQ6. Four locations are at or above the 25 µg/m³ comparator shown in Table 8: AQ4 (25), AQ6 (29), AQ9 (25) and AQ10 (26 µg/m³). The monitoring was undertaken during the wet season, and potential contributing sources include vehicle movement, campus construction, diesel generation and wider corridor activity. The survey does not provide source-apportionment evidence and therefore does not attribute the measurements to a single source.

PM10 concentrations range from 24 µg/m³ at AQ1 and AQ8 to 39 µg/m³ at AQ4, all below the indicative threshold. PM1.0 concentrations range from 13 µg/m³ at AQ5 to 20 µg/m³ at AQ4, all within acceptable ranges.

Other Organic Parameters

Total Volatile Organic Compounds (TVOC) range from 0.003 mg/m³ at AQ1 and AQ9 to 0.015 mg/m³ at AQ5, reflecting low organic compound concentrations consistent with a non-industrial environment. Formaldehyde (HCHO) concentrations range from 0.001 mg/m³ at AQ1 and AQ9 to 0.012 mg/m³ at AQ8, also at low levels consistent with background conditions.

Ambient Noise Levels

Ambient sound levels recorded across the ten monitoring locations range from 47.1 dBA at AQ10 to 69.7 dBA at AQ5. The 85 dBA occupational exposure value is not used to determine acceptability of community/institutional ambient noise. The National Environmental (Noise Standards and Control) Regulations, 2009 distinguish environmental/institutional and occupational criteria; for institutes of higher learning, the general environmental guideline is 45 dBA daytime/35 dBA night-time, while construction-site noise at schools/higher-learning institutions is guided by 60 dBA daytime/50 dBA night-time at the receptor. Because the baseline measurements are short-duration field observations rather than long-term day/night LAeq surveys, they are used to characterize existing conditions and identify the need for receptor-based construction noise management and complaint response, not to claim blanket compliance.

Table 6: Results of Soil Sampling

S/N	PARAMETERS	UNIT	AAAU SS1	AAAU SS2	AAAU SS3	AAAU SS4	AAAU SS5	AAAU SS6	AAAU SS7	AAAU SS8	AAAU SS9	AAAU SS10
(A)	**PHYSICAL TEST**											
1.	Colour	Tcu	Brown	Brown	Brown	Brown	Olive brown	Brown	Dark brown	Brown	Brown	Brown
2.	PH	-	8.84	6.89	8.51	8.88	6.77	7.05	7.86	8.41	8.56	8.09
3.	Electrical conductivity	us/cm	1146	1029	1256	1333	1493	941	929	1204	1751	1966
4.	ORP	mV	193	228	246	235	256	140	131	262	256	243
5.	Salinity	%	0.01	0.02	0.02	0.02	0.02	0.01	0.02	0.03	0.02	0.02
(B)	**EXCHANGEABLE CATION**											
6.	Calcium	mg/kg	0.37	0.52	0.16	0.56	0.57	0.34	0.18	0.53	0.92	4.87
7.	Magnesium	mg/kg	1.25	0.73	1.44	0.26	0.28	0.53	1.09	1.29	2.61	1.44
8.	Sodium	mg/kg	23	18	12	3	14	9	24	16	27	41
9.	Potassium	mg/kg	0.1	0.3	0.3	0.1	0.8	0.2	0.9	1.2	0.7	1.4
10.	Ammonium	mg/kg	0.099	1.052	0.227	0.7940	370	2.255	0.582	0.231	0.771	0.199
(C)	**EXCHANGEABLE ANION**											
11.	Sulphate	mg/kg	29	31	56	24	53	14	29	18	34	19
12.	Nitrate	mg/kg	2.3	2.9	7.1	4.6	3.8	5.7	11.4	3.9	4.4	2.7
13.	Chloride	mg/kg	4.2	2.5	0.9	5.0	7.6	0.8	2.3	2.8	1.3	0.5
14.	Phosphate	mg/kg	2.05	1.96	2.31	2.05	0.81	0.31	0.59	0.21	1.62	0.77
15.	Nitrate	mg/kg	0.026	0.022	0.017	0.031	0.025	0.023	0.011	0.007	0.003	0.002
(D)	**HEAVY METALS**											
16.	Chromium	mg/kg	0.06	0.04	0.03	0.02	0.02	0.01	0.02	0.03	0.00	0.03
17.	Zinc	mg/kg	1.009	1.056	2.871	1.037	0.960	0.341	0.525	1.881	0.274	0.119
18.	Iron	mg/kg	0.11	0.25	1.87	0.44	1.30	1.05	2.27	1.74	0.86	0.11
19.	Cupper	mg/kg	1.86	1.09	1.32	0.25	0.57	0.50	0.18	1.11	0.34	0.82
20.	Manganese	mg/kg	0.047	0.012	0.007	0.234	0.028	0.138	0.115	0.021	0.953	0.047
21.	Cobalt	mg/kg	0.02	0.01	0.01	0.02	0.00	0.01	0.27	0.18	0.02	0.02
22.	Mercury	ug.kg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23.	Lead	ug/kg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

(E)	**SOIL CHARACTERISTICS**											
24.	Loam	%	43	36	29	31	43	29	26	19	29	29
25.	Sandy	%	51	59	49	57	21	36	41	65	62	51
26.	Clay	%	3	5	12	8	25	20	15	10	6	19
27.	Soil	%	3	0	10	2	11	15	18	6	3	1
(G)	**MICROBIOLOGICAL TEST**											
28.	E. coli	cfu/100/kg	4	8	1	2	9	2	6	4	9	8
29.	Fungal	cfu/100/kg	74	164	55	60	106	63	31	76	203	192

Table 7: Results of Water Sampling

S/N	PARAMAMETERS	UNIT	BOREHOLE I	BOREHOLE II	STREAM I	STREAM II	POND	FMENT LIMIT
(A)	**COORDINATES**							
1.	Latitude	N	8.96137	8.970994	8.968415	8.962491	8.964813	-
2.	Longitude	E	7.2342	7.243506	7.242692	7.245228	7.24681	-
(B)	**PHYSICOCHEMICAL**							
3.	Colour	Tcu	Clear	Clear	Cloudy	Cloudy	Dirty cloudy	Clear
4.	Odour	-	Odourless	Odourless	Odourless	Bad odour	Bad odour	Unobjectionable
5.	Taste	-	Tasteless	Tasteless	ND	ND	ND	Unobjectionable
6.	PH	-	6.12	6.54	6.64	7.14	7.09	6.5.8.5
7.	Total dissolve solid	mg/l	276	403	48	169	27	500
8.	Electrical conductivity	us/cm	558	816	96	134	54	1000
9.	Temperature	O c	32.0	31.8	31.2	32.9	31.4	Ambient
10.	Salinity	%	0.02	0.04	0.00	0.00	0.00	⩽1000
11.	Total suspended solid	mg/l	0	1	3	3	109	20
12.	ORP	mV	33	25	87	145	95	200-600
13.	Dissolve oxygen	mg/l	4.3	4.0	4.6	5.1	4.6	2-8
14.	B.O.D	mg/l	2.0	2.3	2.9	3.0	3.1	NS
(C)	**CHEMICAL TEST**							
15.	Calcium	mg/l	2.1	1.8	0.9	0.7	8.4	200
16.	Magnesium	mg/l	0.3	0.6	1.5	1.9	2.3	20
17.	Ammonium	mg/l	0.109	0.006	1.306	1.800	3.862	NS
18.	Potassium	mg/l	0.0	0.1	2.3	1.8	2.6	20
19.	Sulphate	mg/l	47	51	69	84	88	100

20.	Nitrate	mg/l	1.0	2.3	2.9	3.4	6.5	50
21.	Sodium	mg/l	3	6	0	0	13	20
22.	Phosphate	mg/l	0.0	0.0	2.2	2.2	2.9	NS
23.	Chloride	mg/l	0.3	1.6	2.0	2.0	2.5	150
24.	Nitrate	mg/l	0.00	0.00	0.04	0.09	0.11	0.2
(D)	**HEAVY METAL**							
25.	Zinc	mg/l	0.054	0.086	0.113	0.168	0.003	3.0
26.	Iron	mg/l	0.62	0.69	1.34	1.12	1.53	0.3
27.	Cupper	mg/l	1.05	0.36	0.93	0.97	0.00	1.5
28.	Chromium	mg/l	0.00	0.00	0.47	0.47	3.81	0.05
29.	Lead	ug/l	0.000	0.000	0.000	0.000	0.003	0.001
30.	Cobalt	mg/l	0.01	0.00	0.36	0.34	0.89	0.2
31.	Mercury	ug/l	0.000	0.000	0.000	0.000	0.000	0.001
32.	Nickel	mg/l	0.00	0.00	0.03	0.14	0.86	0.05
(E)	**ORGANICS**							
33.	Phenols	mg/l	0.00	0.00	0.03	0.14	0.86	0.05
34.	Oil and grease	mg/l	0	0	0	0	3	10
35.	BTEX	mg/l	0	0	0	0	1	Nil
(F)	**MICROBIOLOGICAL TEST**							
36.	E.coli	cfu/ml	0	0	2	3	8	Nil
37.	Total coliform	cfu/ml	1	3	5	6	39	10

Table 8: Air Quality and Noise Measurements

S/N	PARAMETERS	UNIT	AAAU AQ1	AAAU AQ2	AAAU AQ3	AAAU AQ4	AAAU AQ5	AAAU AQ6	AAAU AQ7	AAAU AQ8	AAAU AQ9	AAAU AQ10	FMEnv Limit
1.	Latitude	N	8.966319	8.964896	8.96481	8.962491	8.966323	8.966323	8.962484	8.964218	8.962835	8.966413	-
2.	Longitude	E	7.245513	7.24862	7.244312	7.245228	7.245516	7.245516	7.245565	7.244553	7.245228	7.245394	-
3.	Hydrogen sulphide	ppm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
4.	Hydrogen cyanide	ppm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
5.	Hydrogen chloride	Ppm	0.32	0.16	1.43	1.05	0.86	1.00	1.32	0.89	0.61	0.74	
6.	Ammonia gas	ppm	0	0	0	0	0	0	0	0	0	0	0.02
7.	Nitrogen (iv) oxide	ppm	0.1	0.2	0.2	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.4

8.	TVOC	mg/m^3	0.003	0.012	0.012	0.004	0.015	0.009	0.014	0.012	0.003	0.006	-
9.	HCHO	mg/m^3	0.001	0.007	0.003	0.002	0.011	0.006	0.008	0.012	0.001	0.002	-
10.	PM2.5	ug/m^3	20	24	19	25	22	29	22	21	25	26	25
11.	PM10	ug/m^3	24	27	29	39	38	28	28	24	27	31	-
12.	Pm1.0	ug/m^3	16	17	16	20	13	14	16	17	18	19	-
13.	Chlorine gas	ppm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.02
14.	Carbon (ii) oxide	ppm	0	0	0	0	0	0	0	0	0	0	10
15.	Sulphur (iv) oxide	ppm	0.1	0.0	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.02
16.	Nitrous (NOx)	ppm	0.002	0.004	0.003	0.020	0.0006	0.011	0.013	0.013	0.012	0.006	0.4
17.	Ambient Sound level	dBA	48.1	50.4	51.2	49.3	69.7	58.4	58.1	51.1	49.6	47.1	85
18.	Phosphine	ppm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
19.	Methane	ppm	0	0	0	0	0	0	0	0	0	0	-
20.	AQI	-	Good	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Excellent	

4.4 Biological Environment

Terrestrial Flora

The project area features the classic Guinea savanna vegetation, characterized by a mix of lush grasslands and scattered woodland trees. The vegetation falls in the transitional zone between the tropical rainforest and the northern savanna. The specific area around the Nnamdi Azikwe International Airport is primarily Guinean forest savanna mosaic. It features broad leaved deciduous trees, tall grasses, and shrubs that stay green during the rainy season and become drier during the harmattan period.

Sampling Methodology and Data Acquisition

Vegetation Assessment

Sampling methods adopted for vegetation assessment were in accordance with the acceptable international standards. The "Belt Transects Method" (which allows for acquisition of information on density of flora composition of the area) was used for assessment of the vegetation at every sampling location. Both in-situ and ex-situ identification of plant specimens were conducted both in the field and herbarium respectively using appropriate Manuals and Monographs.

Representative samples of plant species in the study area were collected and prepared as standard herbarium specimens, using appropriate techniques. The preserved specimens would serve as permanent records of the vegetation and floristic composition of the study area. Each specimen would always be available for study or quick reference in connection with any future operations in any of the study locations referred to in the future.

Results

Vegetation assessment was carried out at the Project site. A transect size of 50 square meters was adopted for proper assessment of species. Assessment of vegetation at various sampling locations was based on the following:

- Vegetation types encountered
- Plant species distribution and richness
- Inventory of economic plants

The ecological status of recorded taxa was reviewed using current taxonomic/conservation references where identification was sufficiently reliable. Because some field-list entries are taxonomically uncertain and one non-native ornamental taxon was duplicated with conflicting status, the revised assessment uses species-level conservation conclusions only where the available evidence supports them. Unverified records are retained as field observations but are not used to infer critical habitat or threatened-species presence.

Table 9: Plant species, classification and IUCN status

S/N	BOT NAME	Common Name	Family	Habit	IUCN Status	Uses/ Importance
1.	*Anacardium occidentale* L	Cashew	Anacardiaceae	Tree	Least concern (IUCN 3.1)	Food/fruit; medicinal and economic use.
2.	*Magifera indica* L.	Mango	Anacardiaceae	Tree	Least Concern (IUCN 3.1)	Food and medicinal/ economical purposes
3.	*Chromolaena odorata* (L)	Jack in the bush	Asteraceae	Shrub	Secure (Nature Serve)	Common invasive/weed species; medicinal uses reported.

	R.M.King and H.Rob					
4.	*Vitex doniana Sweet*	Black plum	Lamiaceae	Tree	Least Concern (IUCN 3.1)	Food and medicinal/economic use.
5.	*Monoon longifolium* Sonn.BXue and R.M.K. Saunders	Masquerade plant. Indian Mast Tree	Annonaceae	Tree	Least Concern (IUCN 3.1)	Ornamental/landscaping; medicinal uses reported.
6.	*Azadirachta indica* A.Juss	Neem	Meliaceae	Tree	Least Concern (IUCN 3.1)	Shade, insecticidal and medicinal uses.
7.	*Parkia biglobosa (Jacq)* R.Br ex G.DonS	African locust bean	Fabaceae	Tree	Least Concern (IUCN 3.1)	Food, Animal feed and Medicinal uses.
8.	*Ficus* species (L)	Fig trees or Figs	Moraceae	Tree	Least Concern (IUCN 3.1)	Ecological/medicinal uses; identification to genus only.
9.	*Sida acuta* Burm.f.	Common wireweed	Malvaceae	Shrub and herb	Least concern and not threatened	Traditional Medicinal uses.
10.	*Gmelina arborea* (Roxb)	Beechwood	Lamiacea	Tree	Least concern	Durable wood, furniture, construction and paper pulp. Traditional medicine and food.
11.	*Bauhinia variegata* (L) Benth.	Orchid tree and mountain ebony	Fabaceae	Tree	Least Concern (IUCN 3.1)	Traditional uses, medicine, landscaping and nutrition.
12.	Piliostigma thonningii (Schum.) Milne.Redh	Carmel´s foot tree and monkey bread.	Fabaceae	Tree	Unassessed globally but in Nigeria of National priority.	Traditional medicine, Ecological uses and materials and craft.
13.	Ipomea asarifolia (Desr)Roem. And Schult.	Ginger leaf Morning glory.	Convolvulaceae	subShrub	Not assessed.	Folk medicine, agriculture and soil stabilization.
14.	*Daniella oliveri*(Rolfe) Hutch, and Dalziel	African coaida balsam tree	Fabaceae	Tree	Least Concern (IUCN 3.1)	Furniture, flooring, and plywood. Traditional medicine.
15.	*Senna siamea* (lam.) Irwin et Barneby	Cassia tree	Fabaceae	Tree	Least Concern (IUCN 3.1)	Shade, fuelwood and landscaping.
16.	*Terminalia neotaliala* Capuron	Madagascar almond	Combretaceae	Tree	Vulnerable (IUCN 3.1)	Ornamental plant and medicinal plant
17.	*Adansonia digitata* (L)	African baobab	Malvaceae	Tree	Least Concern (IUCN 3.1)	Food, cultural and ecological uses.
18.	*Roystonea oleraceae* Kunth O.F. Cook	Royal alm	Arecaceae	tree	Least concern	Landscaping/ornamental use.
19.	*Dichrostachys cinerea* Wight et Arin	Sicklebush or Kalahari Christmas tree	Fabaceae	Shrub and small tree	Least concern	Medicinal/ ecological plant

Crops recorded within the wider Area of Influence include Groundnut (Arachis hyogea), Bambara nut (Vigna subterranea), Maize (Zea mays L) and Hibiscus vitifolius.

Terrestrial Fauna

Field surveys were conducted to determine the types of wildlife present within the study area. Fauna species were taxonomically identified, and biodiversity statuses were verified.

Faunal observations were based on direct and indirect field evidence, supplemented by local ecological knowledge from people familiar with the Area of Influence. Because some original records were not supported by diagnostic photographs or specimen-level evidence, uncertain identifications are retained only at the taxonomic level supported by the available information and are not used to infer threatened-species presence or critical habitat.

Table 10: Fauna species within the study area

Fauna Species	Common name	Family	IUCN
Domestic animals within the study area			
Bos bovidae	Cow	Bovidae	LC
Ovis aries	Sheep	Bovidae	LC
Capra aegagrus hircus	Goat	Bovidae	LC
Canis lupus familiaris	Dog	Canidae	LC
Gallus gallus domesticus	Chicken	Phasianidae	LC
Numida meleagris	Guinea fowl	Numididae	LC
Wildlife in the study area			
Dilacodes lefebvrii.(Rambur)	Black percher	Libellulidae	LC
Phaon iridispennis	Glistening demoiselle	Calopterygidae	LC
Chilocorinae. mulsant	Lady bug	Coccinelloidae	LC
Papillio demodocus.Esper	Citrus swallow tail butterfly	Papilioidae	LC
Acheta domestics L	Noise making cricket	Gryllidae	LC
Spodoptera exempta.Walker	African army worm	Noctuidae	LC
Palpopleura lucia.Drury	Lucia widow	Libelloidea	LC
Danaus chrysippus L	Plain tiger butterfly	NymPhalidae	LC
*Agama agama.*L	Red headed rock agama	Agamidae	LC
Bufo bufo . L	Common toad	Bufonidae	LC
Rana temporaria L	Common frog	Ranidae	LC
Bird species in the study area			
Columbia guinea. LC	Speckled pigeon	Columbidae	LC
Columbia livia Gmelin J.J.F. LC	Rock dove	Columbidae	LC
***S**pilopelia senegalensis.L*	Laughing dove	Columbidae	LC
Streptopelia semitoquata Ruppell	Red Eyed dove	Columbidae	LC
Turtur afer L	Blue spotted wood dove	Columbidae	LC
Pycnonotus barbatus. Desfontaines	Common bulbul	Pycnonotidae	**LC**
Malvus migrans LC	Black Kite	Accipitriformes	**LC**
Corvus albus.L	Pied crow	Corvidae	**LC**
Lophoceros nastus L	African grey hornbill	Bucerotidae	**LC**
Uraeginthus bengalus. L	Red cheek cordon bleu	Estrrdidae	**LC**
Ploceus cucullata. LC	Village weaver	Ploceidae	**LC**
Euplectes franciscanus. Isert	Northern Red Bishop	Ploceidae	**LC**

A*pus barbatus.*Sclater, PL	Black swift	Apodidae	**LC**

Biodiversity / OS6 Screening Conclusion

The available field evidence characterizes the approximately 4-hectare solar footprint as modified/open institutional habitat with low habitat complexity. No protected area, critical habitat or confirmed threatened native species occurrence has been demonstrated within the development footprint by the available survey data.

Project controls shall nevertheless apply the mitigation hierarchy: restrict clearance to the approved footprint, retain trees outside required safety/engineering clearances, prohibit hunting/collection by workers, control invasive plants, reinstate disturbed temporary areas, and stop/seek specialist advice if an unexpected conservation-significant species or habitat feature is encountered.

4.5 Socio-Economic Assessment

This section covers the socioeconomic and health assessment of the identified communities and stakeholder groups within the project Area of Influence. The assessment provides a description of existing conditions which is essential to the identification of potential impacts of the proposed project on the human environment.
The socioeconomic environment around the project area is shaped by the presence of the African Aviation and Aerospace University (AAAU) permanent campus and its associated institutional population comprising students, academic staff, non-academic staff and campus/community stakeholders within the campus premises and the nearest external community; Iddo Sarki. The broader Area of Influence is further characterized by the Airport Road expressway corridor and the Nnamdi Azikiwe International Airport, which together define the economic and physical context of the surrounding environment.

Target Population for the Study and Sample Size

A descriptive sample of 100 respondents was used to capture views across key stakeholder categories. Respondents were selected to achieve coverage of students, staff and Iddo Sarki community members across gender, age and occupation categories. The dataset is used descriptively and is not claimed to provide a statistically representative estimate for the entire Area-of-Influence population.

Consultations with university management, the Directorate of Works and the Iddo Sarki community leadership provided additional institutional and community perspectives regarding the anticipated benefits and social implications of the proposed solar hybrid mini-grid project.

Ethical Considerations

Participation in the socioeconomic assessment was voluntary, and respondents were informed of the purpose of the survey and their right not to answer or to withdraw. Personal data are to be stored securely and disclosed only where lawful and necessary. Because the aggregate age profile includes respondents below 18 years, no personally identifiable information relating to minors is reproduced in the public-disclosure ESIA; minor responses are used only in aggregate social-baseline reporting and not for labour eligibility or land/livelihood conclusions.

Socio-Economic Characteristics of Respondents

Gender Distribution

The gender distribution of respondents indicates that 61% are male and 39% are female, reflecting a male majority within the Project Area of Influence. This distribution is broadly representative of the university and surrounding communities and underscores the importance of incorporating gender considerations

into project planning and implementation. The distinct roles, responsibilities, and needs of both men and women will help ensure equitable access to employment opportunities, stakeholder engagement processes, and other benefits associated with the proposed project

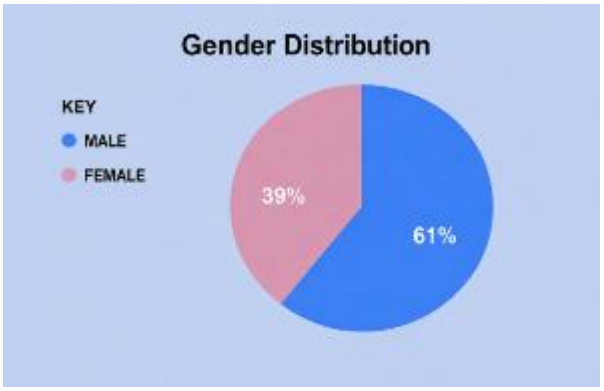

Figure 18: Gender Distribution

Age Distribution

Findings from the socio-economic survey conducted within the project's Area of Influence indicate that 15% of respondents are below 18 years of age, while 45% fall within the 18–30 age group. Additionally, 20% of respondents are aged 31–45 years and another 15% fall within the 46–60 age category. While 5% are aged 60 years and above. A total of 80% of respondents were between 18 and 60 years of age, indicating that the majority of the survey population falls within the working-age group.

This distribution indicates a predominantly youthful and productive population engaged in academic, administrative and small-scale economic activities within the university and adjoining host communities. The proposed approximately 1 MW-class solar installation is expected to provide reliable power to support teaching, research, healthcare services and other socio-economic activities, while also stimulating small businesses and improving livelihoods within the project area of influence.

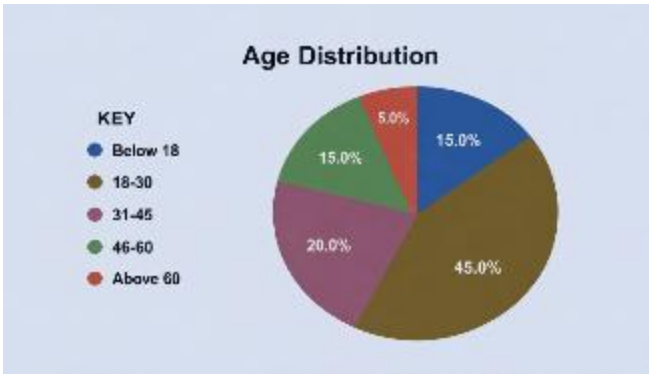

Figure 19: Age distribution

Educational Profile

Educational attainment within the Project Area of Influence (AOI) reflects its university setting. While 50% of respondents are either pursuing or have completed tertiary education and 5% are enrolled in postgraduate programmes, the host communities have comparatively lower educational attainment, with 5% having no formal education and 40% having completed primary education.

Overall, the presence of students, civil servants, and small-scale entrepreneurs indicates a relatively diverse and capable workforce that can contribute to the implementation and long-term sustainability of the proposed approximately 1 MW-class solar power project.

Economic Engagement / Occupation

The occupational profile of respondents reflects the university setting of the Project Area of Influence (PAI). Students constitute the largest group (53%), followed by staff (20%) and farmers (7%). Traders, civil servants, business owners, and respondents in other occupations each account for 5%, while no respondents identified as artisans. The occupational distribution indicates that the population is predominantly education-oriented, with additional engagement in agriculture, commerce, public service, and small-scale business activities. This diversity in occupations provides a broad human resource base that can support the construction and operation of the proposed approximately 1 MW-class solar power project while enhancing opportunities for employment and skills development.

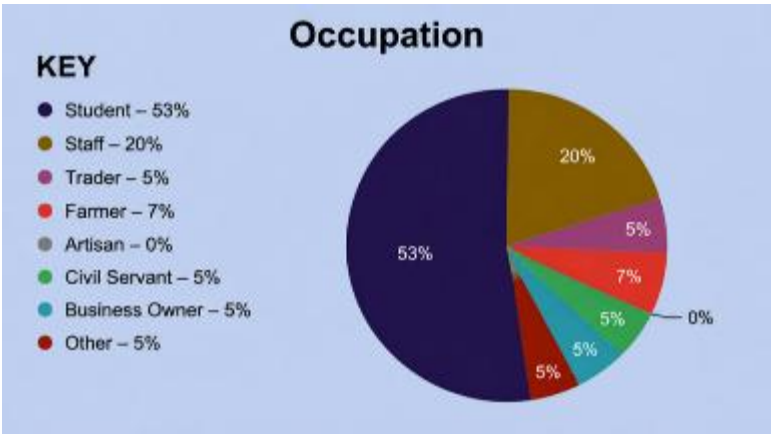

Figure 20: Occupation of respondents

Major Source of Electricity

Across the combined Area-of-Influence respondent sample, 55% identified public electricity as their primary household/community source, 40% identified generators, 5% reported no source, and none identified solar as their primary source. These percentages describe the combined respondent sample and shall not be interpreted as the AAAU campus electricity mix. AAAU itself does not presently have a reliable dedicated grid connection and relies substantially on diesel-powered generation and limited alternative sources.

Income Levels

The income profile of respondents indicates a mixed socioeconomic setting. About 10% earn less than ₦30,000 per month, while 25% earn between ₦30,000 and ₦100,000, and another 25% earn between ₦100,000 and ₦300,000. A further 40% preferred not to disclose their income. Although a substantial proportion of respondents chose not to state their earnings, the available data suggest varying income levels and underline the importance of affordable and reliable energy solutions. In line with the AfDB Integrated Safeguards System (ISS), the proposed solar power project is expected to enhance access to dependable electricity, reduce energy costs associated with generator use, and support improved institutional performance and local socioeconomic development.

Waste management

Waste management within the AAAU permanent campus is handled through an organized institutional arrangement whereby a private waste management company licensed within the FCT collects and evacuates solid waste from the campus on a regular basis. This represents a more structured waste management system than is typical of peri-urban communities in the FCT, and reflects the institutional character of the project environment.

Within the surrounding Iddo Sarki community, waste management practices are less formalized, with open burning being the predominant method of waste disposal. The EPC Contractor shall coordinate with

the Abuja Environmental Protection Board (AEPB) and engage a licensed waste contractor for the collection, transportation and disposal of all construction and operational waste generated during the project, in compliance with applicable FCT waste management regulations and the project Waste Management Plan.

Access to Water:

The African Aviation and Aerospace University (AAAU) relies primarily on boreholes and water storage facilities to support academic activities, administrative operations, sanitation needs, and residential facilities. However, as the institution expands, water demand is expected to increase, requiring effective management and maintenance of existing water infrastructure. Overall, water supply within the Project Area of Influence is functional but requires sustainable planning to support future institutional growth and avoid pressure on existing resources

Energy Source

Electricity supply at the African Aviation and Aerospace University AAAU and surrounding communities is currently inadequate and unreliable. The university is not presently connected to the national electricity grid through a dedicated transformer, resulting in limited access to a stable power supply for academic, administrative, and residential operations. Alternative electricity sources, such as generators and a mini solar plant, are used to supplement available power where necessary.
The unreliable electricity situation affects key university functions, including teaching and learning activities, ICT infrastructure, laboratory operations, administrative services, and future aviation and aerospace training facilities that require consistent power availability. In surrounding communities, inadequate electricity supply also limits productivity, affects small-scale businesses, and increases reliance on alternative energy sources.

Security and Conflict Situation

The security environment within the Project Area of Influence is characterized by a high level of stability, significantly reinforced by the proximity of the project site to the Nnamdi Azikiwe International Airport. The airport's presence brings with it a robust and continuously maintained security infrastructure including perimeter surveillance, security checkpoints, law enforcement presence, and restricted access protocols that extend their influence across the surrounding corridor including the AAAU campus environment. This security overlay represents a significant baseline security advantage for the proposed project.

The AAAU permanent campus itself operates within a fully enclosed and fenced perimeter with a manned security post at the main entrance gate, providing institutional access control that complements the broader airport security environment.

Field consultations and observations did not identify an active site-specific land, communal or institutional conflict affecting the proposed project footprint during the ESIA period. This finding does not constitute a prediction of the wider security situation in the FCT. The EPC and O&M arrangements shall therefore maintain proportionate access control, security communication, journey/traffic management and emergency procedures, while ensuring that security personnel act lawfully and respect community/stakeholder rights.

The overall security profile of the project environment is therefore considered low risk. The safety of construction workers and contractors will nonetheless be managed through site-specific occupational health and safety measures, access control arrangements consistent with the existing campus security protocols, pre-mobilization safety induction, and compliance with approved construction procedures. Community engagement, grievance management and social monitoring measures will be implemented

throughout the project lifecycle to sustain social stability and minimize any risks to workers and surrounding communities arising from labour influx or construction activities.

Socio-Cultural and Institutional Characteristics

Ethnicity, Language, Religion and Culture

The Federal Capital Territory (FCT), including the Iddo Sarki community and surrounding areas, is ethnically diverse. The wider FCT is home to indigenous groups as well as residents from different parts of Nigeria, with Gbagyi (Gwari) being among the major indigenous groups. Hausa and English are widely used for communication alongside other Nigerian languages spoken by residents.

Both Christianity and Islam are practiced by residents. The cultural setting of Iddo Sarki reflects the broader socio-cultural diversity of Abuja, with community life influenced by interactions among people from different ethnic, linguistic and religious backgrounds.

Traditional Leadership Patterns and Conflict Resolution

The Project Area of Influence, comprising the Iddo Sarki community operates under a combination of formal administrative structures and traditional community leadership systems. At the community level, traditional leaders, known as Sarkin, provide local leadership and play important roles in maintaining social order, resolving minor disputes, facilitating community mobilization, and supporting engagement with external institutions. Minor disputes within households are typically resolved internally. For disputes that extend beyond the household, the Sarkin serves as the recognized traditional authority who serves as the primary mediator that intervenes to resolve conflicts amicably.

These traditional structures complement formal governance systems and provide an important platform for community consultation, information sharing, grievance management, and social engagement during project implementation. Engagement with the Sarkin and other community representatives will support effective communication, promote local acceptance, and facilitate smooth implementation of the Project in line with ESIA good practice.

Land Tenure and Ownership

The proposed project site forms part of the land allocated for AAAU and is under the University's administrative control for institutional development. The approximately 4-hectare project footprint is selected on the basis that project implementation will not require involuntary acquisition, physical displacement, economic displacement or restriction of existing livelihood/access use. This condition shall be verified through the pre-construction Land Status Verification Protocol; any part of the proposed work area that fails the displacement-free criterion shall be avoided through layout/footprint adjustment before construction.

Gender Relations and Involvement within Iddo Sarki Community

Findings from the field assessment indicate that the Iddo Sarki community reflects a predominantly patriarchal social structure, with men playing a major role in decision-making at household and community levels. Women participate actively in household, social and economic activities, while their involvement in broader community decisions may be influenced by existing family and community leadership structures.

With respect to property rights, women may acquire and own property, subject to applicable legal provisions and prevailing customary practices. However, customary practices relating to inheritance and ownership may vary among households and ethnic groups within the community, particularly given the culturally diverse nature of the FCT.

Overall, women participate in the social and economic life of the community, although gender roles and decision-making responsibilities remain influenced by prevailing cultural and household norms. These considerations are relevant to stakeholder engagement for the project, particularly in ensuring that women are provided with appropriate opportunities to participate in consultation and access the project's grievance mechanism.

Vulnerability and Inclusion Screening (AfDB OS7)

The project does not identify a discrete indigenous or culturally distinct vulnerable group whose collective identity is dependent on the project footprint. Nevertheless, vulnerability can arise from age, disability, gender, low income, limited literacy, dependence on institutional access routes, or reduced ability to participate in formal consultation.

Stakeholder engagement and project communications shall therefore use accessible venues and formats, permit assisted/anonymous grievance submission, provide targeted opportunities for women, young people and persons with disabilities to participate, maintain safe pedestrian access around works, and monitor whether any group experiences disproportionate construction or benefit-access impacts.

University Community Administrative Structure

The African Aviation and Aerospace University (AAAU) operates under a structured administrative system consistent with federal universities in Nigeria, with a specific institutional mandate focused on aviation, aerospace and allied disciplines. The university is currently headed by an Acting Vice Chancellor, who oversees academic, administrative and development activities within the institution. Supporting the Acting Vice-Chancellor are principal officers including the Registrar, Bursar and Librarian, as well as Deans and Heads of Departments responsible for academic units. The Directorate of Works and Physical Planning oversees infrastructure development and facilities management and serves as the primary institutional interface for the implementation of the proposed solar hybrid mini-grid project. This administrative structure provides the institutional framework through which infrastructure development projects are coordinated and managed within the university environment.

Governing Council

The Governing Council is the highest decision-making body of the African Aviation and Aerospace University. The Council is headed by a Chairman, designated as Pro-Chancellor, appointed by the Federal Government of Nigeria through the Federal Ministry of Aviation and Aerospace Development, which is the supervising ministry for AAAU. Other members of the Council include the Vice-Chancellor, representatives of the University Senate, external members, and a representative of the supervising ministry, in accordance with the provisions governing federal universities in Nigeria.

The Governing Council is responsible for the overall governance, policy formulation and strategic direction of the University. In line with its community relations policy, the Governing Council has announced additional sponsorship for students from host communities, reflecting the institution's commitment to community engagement and social responsibility. 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 provides the institutional framework within which projects such as the proposed solar hybrid mini grid are approved and 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 African Aviation and Aerospace University (AAAU), 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) 2023, 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 11: 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 12: 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 13: 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 and surface resources, human population, sensitive ecosystems)

5.2.3 Impact Significance Evaluation

The significance of identified environmental and social impacts was determined as a function of impact magnitude and receptor sensitivity. Receptor sensitivity reflects the importance, vulnerability, and resilience of the affected environmental or social component within the project's area of influence.

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 14: 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 15: 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 Initial and Residual Impact Significance

Impact significance is expressed qualitatively using the magnitude–receptor sensitivity matrix. Each impact is assigned an initial significance before mitigation and a residual significance after application of the specified controls. Unsupported numerical percentage scores are not used because they imply a degree of precision that is not supported by the assessment data.

The qualitative significance ratings used throughout the assessment are linked to the management response and residual-risk principles presented in Table 16.

Table 16: Significance Rating and Required Management Response

Significance Rating	Percentage Range	Percentage Value	Required Management Response	Residual-Risk Principle
Negligible	0 - 10%	5%	Routine good practice and monitoring where relevant.	Normally remains Negligible.
Minor	11 - 30%	20%	Standard mitigation and routine monitoring.	Target Negligible or Minor.
Moderate	31 - 60%	45%	Specific mitigation, measurable monitoring and named responsibility required.	Target Minor or tolerable Moderate with justification.
Major	61 - 100%	75%	Avoidance/ design control, detailed management plan, senior oversight and verification before proceeding.	Must be reduced to an acceptable residual level before the relevant activity proceeds.

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 community. 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 17: 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 across the developing permanent campus.
- Enhanced research capacity, particularly for technology-driven and aviation-related programmes that depend on uninterrupted and stable power supply for simulation equipment, computing systems and laboratory instruments.
- Improved learning conditions and academic performance through consistent access to lighting, digital resources and extended study hours, directly benefiting the growing student population at AAAU.
- Reduction in dependence on diesel generators as the sole source of campus electricity, leading to lower greenhouse gas emissions, reduced noise pollution from generator operation, and improved ambient air quality within the campus environment.
- Decrease in recurrent operational and energy costs over time, enabling the University to redirect financial resources to core academic, research and institutional development priorities.
- Creation of temporary direct employment opportunities during the construction and installation phases for skilled and semi-skilled labour including electricians, civil works operatives, technicians and support workers, with priority for qualified members of the host community.
- Indirect economic opportunities for local suppliers, service providers, transport operators and small-scale businesses within the Iddo Sarki community and broader FCT Area of Influence during the construction period.
- Strengthening of local and institutional technical capacity in renewable energy installation, operation and maintenance through skills transfer and training opportunities for designated University staff and students in engineering and technology related disciplines.
- Support for AAAU's transition to a fully functional permanent campus by providing the foundational energy infrastructure necessary to sustain institutional expansion and attract academic and research investment.
- Contribution to Nigeria's national renewable energy targets and the Federal Government's commitments under the Nationally Determined Contributions and the Energizing Education Programme objectives under the Desert-to-Power initiative.

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 will involve survey confirmation, demarcation, limited clearing of grasses/herbs and other modified vegetation within the approved footprint, establishment of temporary facilities, and mobilization of personnel, equipment and materials. These activities may cause localized environmental and social interactions within the project area and along the Airport Road access corridor.

Site preparation will remove limited grasses, herbs and other modified vegetation within the approved development footprint. The available survey evidence does not demonstrate protected or conservation-significant habitat within the footprint; effects on common mobile fauna are expected to be localized and temporary provided clearance is restricted to the approved area and trees outside required engineering/safety clearances are retained.

Disturbance of the disturbed soil profile within the project footprint may increase susceptibility to surface erosion, particularly during wet season rainfall events given the flat, open nature of the site. However, such impacts are expected to remain localized, of low intensity and manageable through standard erosion control measures.

Mobilization of personnel, equipment and materials may result in minor air quality impacts due to dust generation along the Airport Road expressway access route and within internal campus roads, as well as a temporary increase in traffic movement within the university environment. The existing elevated baseline of pm2.5 attributable to Airport Road traffic makes dust management during this phase particularly important. Increased human and vehicular activity may also pose minor safety risks to students, staff, campus users and road users within the campus access routes.

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 19.

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 underground distribution cables, 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 and along the cable corridor.

Construction activities will interact with soil, air quality, water resources and the biological environment. Given the disturbed brownish soil conditions within the project footprint and the flat, open character of the site, there is potential for increased susceptibility to surface erosion particularly during earthworks and cable trench excavation activities, especially during wet season rainfall events.

Dust generation from excavation and vehicle movement along the Airport Road expressway access route and internal campus roads may affect ambient air quality within the site. Given the modified and disturbed character of the site and the absence of ecologically sensitive habitats or protected species, impacts on terrestrial flora and fauna are expected to be negligible and localized.

The construction phase will involve the presence of construction workers and increased movement of equipment and materials, which may interact with students, staff of the University. These interactions may result in temporary disruptions to movement along campus access routes and walkways, particularly during cable trench works, as well as minor community-related impacts including unmet expectations regarding employment opportunities and potential grievances. The Airport Road expressway corridor may also experience temporary disruption during delivery of heavy equipment and materials.

The eligible project footprint is within the secured AAAU campus and is required to remain free of occupation, structures, standing crops, livelihood/economic use, third-party claims and access-dependent uses. This condition will be re-verified immediately before site handover; any area that does not satisfy the displacement-free criterion shall be excluded or redesigned before works commence.

Construction activities present significant occupational health and safety and community safety risks, particularly in relation to excavation and trench works, operation of machinery, electrical installation works, and movement of heavy vehicles within the campus environment. Open trenches along the cable route pose a specific risk of unauthorized access and falls by students and campus users if not adequately secured. These risks require robust OHS management measures to protect both construction workers and campus users throughout the construction period.

The impacts associated with the construction phase are expected to be temporary and 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 20.

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 than the construction phase and do not involve significant physical disturbance of the project site. Identified impacts during the operational phase are expected to be minimal, as solar PV systems generate no air emissions, noise or physical disturbance during normal operation. However, certain risks may arise from the operation and maintenance of battery storage systems and electrical components, particularly in relation to potential battery leakage or failure, improper disposal of damaged components, and generation of hazardous e-waste over the project lifecycle.

In addition, minor impacts may be associated with low-level noise from inverters and transformers during operation, though these are negligible. There are significant occupational health and safety and community safety considerations during the operational phase, particularly in relation to electrical hazards from energized systems, battery-related chemical and fire risks, and the potential for unauthorized access to restricted electrical infrastructure by students, staff or visitors within the AAAU permanent

campus. These risks require appropriate operational control measures, access restriction, and safety signage to ensure the safety of both facility operators and campus users throughout the operational life of the installation. Overall, impacts associated with the operation phase are expected to be long-term but of low to moderate significance and largely manageable through standard operational safety procedures, routine maintenance protocols and the e-waste management provisions detailed in the ESMP. The identified adverse impacts arising from operation phase activities, together with their corresponding magnitude, receptor sensitivity and significance ratings, are presented in Table 21.

5.4.1 Negative Impacts: Pre-Construction Phase

Table 18: 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 cultivated topsoil within the project footprint may increase susceptibility to surface erosion, particularly during wet season rainfall events given the flat, open nature of the site.	Low	Medium	Minor	25%
	Biological (Flora & Fauna)	Removal of cultivated vegetation within the project footprint, with temporary disturbance to soil-dwelling and ground fauna.	Low	Low	Negligible	5%
Social Component						
Procurement of solar equipment	Workers within the supply chain / Project reputation	Potential procurement of equipment from OEMs or suppliers associated with forced labour, modern slavery, child labour or other human rights abuses within the supply chain.	Low	Medium	Minor	15%
Movement of vehicles and equipment	Traffic / Access	Temporary increase in vehicular movement along the Airport Road expressway access route and within the AAAU campus internal road network, with minor disruption to campus movement	Low	Medium	Minor	15%
		Minor disturbance to students, staff and farmers due to increased human activity and equipment movement within the developing permanent campus	Low	Medium	Minor	15%

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 students, staff, and pedestrians along the Airport Road expressway and internal 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%
Site handover / footprint confirmation	Land use / stakeholders	Risk that occupation, crops, livelihood use, claims or access-dependent use emerges between ESIA and mobilization if land status is not re-verified.	Low	High	Moderate	35%

5.4.2 Negative Impacts: Construction Phase

Table 19: 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 compaction reducing permeability and affecting soil structure within frequently trafficked areas	Low	Medium	Minor	20%
Trenching for underground distribution cables		Creation of exposed and loosely compacted soil zones along the underground cable trench route across the campus, increasing erosion potential especially during wet season rainfall events	Moderate	Medium	Moderate	45%
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 and cable laying across site		Temporary disruption of natural drainage paths along the underground cable trench route and potential formation of preferential runoff channels, given the presence of excavated drainage channels close to the footprint.	Moderate	Medium	Moderate	40%
Movement of vehicles and earthworks	Air quality	Generation of dust due to disturbance of cultivated brownish soil, earthworks along the underground cable trench route, and vehicle movement within the site.	Moderate	Medium	Moderate	45%
		Emission of exhaust gases from diesel-powered machinery	Low	Medium	Minor	20%
Operation of machinery and installation activities	Noise	Increased noise levels within the project environment, noting the existing elevated noise baseline from the Airport Road expressway	Moderate	Medium	Moderate	40%
Installation of mounting structures and cable works	Flora	Removal of cultivated vegetation within the project footprint	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 or the Potential pollution of the surface water stream located approximately 1km from the project footprint	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 academic, administrative and construction activities within the AAAU permanent campus due to increased human presence and construction activity	Low	Medium	Minor	15%

Engagement of labour	Community	Potential for unmet expectations regarding employment opportunities among Iddo Sarki community members and temporary farmers, causing grievances if local labour engagement commitments are not fulfilled	Low	Medium	Minor	15%
Trenching and cable laying across campus	Access / Infrastructure	Temporary obstruction of walkways and internal access routes within the AAAU permanent campus during cable trench excavation and installation works across the campus	Moderate	Medium	Moderate	40%
Presence of workforce (Labour Inlfux)	Public Health	Increased risk of communicable diseases and social vices due to interaction between construction workers and students, staff, temporary farmers and the Iddo Sarki community within and around the campus	Low	Medium	Minor	20%
	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%
	Local Services	Minor pressure on existing social amenities and services within the AAAU campus due to labour influx during the construction phase	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 within site and access roads	Community Safety	Risk of accidents involving pedestrians, workers, or other road users within the campus	Moderate	High	Major	75%
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%
Excavation and cable trenching	Cultural heritage	Unexpected archaeological, historical, sacred or cultural material may be encountered during excavation.	Low	High	Moderate	35%

5.4.3 Negative Impacts: Operation Phase

Table 20: 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 inverters and transformers, negligible relative to the existing ambient noise baseline from the Airport Road expressway	Low	Medium	Minor	15%
Cleaning of solar panels	Water resources	Use of water from campus borehole supply for panel cleaning, particularly during the harmattan period, leading to minimal additional water demand on existing campus water infrastructure	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 end-of-life components including spent lithium-ion batteries, degraded PV panels and failed inverters, if not managed under the Extended Producer Responsibility framework and in compliance with NESREA Electrical and Electronic Sector Regulations 2011	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 by students, staff or visitors to energized solar arrays, battery storage areas or electrical infrastructure within the AAAU permanent campus, leading to potential injury or electrocution	Moderate	High	Major	70%
PV array operation in airport corridor	Aviation safety	Solar glint/glare could adversely affect pilots or air-traffic-control lines of sight if final orientation/layout is not screened.	Moderate	High	Major	70%
Extreme weather and climate conditions	Plant / workers / community	Heat, intense rainfall, wind, lightning and harmattan dust may affect system safety, drainage and performance.	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 Area of Influence. These impacts may result from the incremental addition of project-related activities over time and space, even where individual impacts may appear minor in isolation.

Within the AAAU permanent campus, active construction of academic buildings, administrative structures and supporting infrastructure is ongoing as part of the University's broader campus development programme. The simultaneous implementation of the proposed solar hybrid mini-grid project alongside this ongoing campus development presents the potential for overlapping environmental and social interactions, particularly during the construction phase.

The cumulative impacts identified are primarily associated with the concurrent execution of the solar hybrid mini-grid project and the ongoing building construction activities within the AAAU permanent campus. The most notable combined effects relate to dust generation, ambient noise levels, increased traffic and vehicle movement, and soil disturbance, all of which are amplified by the overlapping nature of multiple construction activities within the same campus environment.

Given the disturbed soil conditions within the project footprint and the flat, open character of the site, the combined disturbance from multiple active construction zones may increase the potential for localized surface erosion and sediment movement, particularly during wet season rainfall events. In addition, the presence of multiple construction teams and equipment within the campus may lead to increased pressure on internal access routes, campus water supply from the borehole, waste management arrangements and overall safety conditions for students, staff and campus users within the developing permanent campus.

Beyond the campus boundary, the proximity of the project site to the Airport Road expressway means that cumulative traffic impacts from construction vehicles associated with both the solar project and the ongoing campus development, combined with the existing high traffic volumes on the Airport Road corridor, may result in a more pronounced but temporary increase in dust, noise and congestion along this access route during the construction period.

However, all cumulative impacts identified are expected to be temporary, localized and manageable through coordinated construction planning, scheduling of activities to avoid peak overlap where possible, and implementation of integrated mitigation measures across all concurrent construction activities within the campus. The cumulative impacts identified in association with the proposed project are presented in Table 21.

Table 21: 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 along the Airport Road expressway access route and within internal AAAU campus roads due to combined construction vehicle movement	Moderate

Soil / Erosion	Multiple disturbed surfaces across project areas	Increased risk of surface erosion and runoff from multiple disturbed areas across the AAAU campus, particularly during wet season rainfall events given the flat, open character of the project environment	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 ongoing academic, administrative and campus development activities within the AAAU permanent campus during the concurrent construction period	Moderate
Community & Occupational Safety	Increased number of workers, equipment, and vehicles.	Elevated risk of accidents and safety incidents for students, staff, temporary farmers and construction workers within the AAAU permanent campus due to increased equipment, vehicles and workforce.	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

Low-frequency/high-consequence accident scenarios are assessed separately from routine environmental impact significance because consequence severity can remain high even where likelihood is low. Priority scenarios for this project are electrical shock/electrocution and arc flash, BESS thermal runaway/fire/deflagration and re-ignition, major traffic collision, fall or lifting failure, lightning/surge damage, significant fuel/chemical spill, and fire. The Emergency Preparedness and Response Plan shall define prevention, detection, isolation, evacuation, emergency responder notification, incident classification/reporting, contaminated firewater/debris management, investigation, corrective actions and return-to-service criteria.

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. In addition, lightning strikes during extreme weather events may damage solar photovoltaic panels, inverters, transformers, and other electrical equipment, potentially resulting in electrical surges, equipment failure, fire, or service interruption if adequate protection systems are not provided. 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 runaway, which commonly leads to battery damage, fire, and, in severe cases, explosions. Deep discharging may also compromise battery integrity and increase fire risk. These risks will be minimized through the incorporation of appropriate lightning protection systems, surge protection devices, and adequate earthing of electrical installations as part of the project design. Any outbreak of uncontrolled fire within the facility could escalate to dangerous dimensions and is therefore 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 Moderat**e**.

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

The influx of construction workers into the AAAU permanent campus environment during the construction phase creates an elevated risk of gender-based violence, harassment, and sexual exploitation and abuse. Female students, female staff and women within the Iddo Sarki community are particularly vulnerable to these risks given the campus setting where workers will interact closely with a young student population. The presence of a large, predominantly male construction workforce within an active academic environment requires robust Code of Conduct enforcement, worker awareness training and accessible reporting mechanisms. This risk is classified as Major.

Child Labour

The construction phase carries a risk of child labour, particularly given the possibility that community members or campus users may present underage dependants for employment opportunities during worker recruitment. The Child Rights Act 2003 strictly prohibits the engagement of persons under 18 years in hazardous construction work. The EPC Contractor shall implement a robust age verification and labour screening mechanism prior to engagement of any worker on the project site to eliminate this risk. This risk is classified as Moderate.

Security Risks

The project is located within the AAAU permanent campus along the Airport Road corridor in the Federal Capital Territory, Abuja. The FCT benefits from a robust and well-maintained security infrastructure reinforced by the proximity of the Nnamdi Azikiwe International Airport, which brings continuous law enforcement presence, surveillance and emergency response capacity to the surrounding corridor. The campus itself is fully secured within a perimeter fence with a manned security post. Security risks associated with this project are therefore considerably lower than those typical of peri-urban or rural project environments. Residual risks during construction include potential theft of equipment and materials and unauthorised access to the project site, which shall be managed through enhanced access control, site security personnel and lighting. This risk is classified as Minor.

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 proposed Solar Hybrid Mini-Grid Project at the African Aviation and Aerospace University (AAAU), Federal Capital Territory, Abuja. 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, from pre-construction through to decommissioning.

The development of mitigation measures follows the principles of the mitigation hierarchy as recommended by the African Development Bank Integrated Safeguards System 2023, ensuring a systematic approach to impact management that prioritizes avoidance, followed by minimization, restoration and offsetting where residual impacts remain. These measures are tailored to the specific conditions of the AAAU project site.

In addition to addressing environmental concerns, the mitigation measures incorporate occupational health and safety considerations, community safety, gender-based violence prevention, child labour prohibition, e-waste management, and labour influx management specific to the campus institutional context. The measures have been developed in line with applicable national regulations including those of the Federal Ministry of Environment, the National Environmental Standards and Regulations Enforcement Agency, the Abuja Environmental Protection Board, and the Child Rights Act 2003, as well as international good practice standards and AfDB safeguard requirements.

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.

In addition to routine mitigation, five mandatory environmental and social hold-points apply:

- (HP-01) verified displacement-free land status before site handover;
- (HP-02) approved Contractor ESMP and supporting plans before mobilization;
- (HP-03) accepted PV glint/glare assessment before PV installation;
- (HP-04) accepted BESS fire/life-safety design before BESS procurement/installation; and
- (HP-05) electrical safety/commissioning readiness before energization.

Failure of a hold-point criterion prevents the related activity from proceeding until the deficiency is resolved.

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	Generation of dust along the university's access roads and within the project site due to movement of delivery trucks	• Apply water-based dust suppression on all access routes and within the project site during dry and windy periods. • All vehicles transporting materials shall be covered with tarpaulins to prevent dust dispersion. • Restrict vehicle speeds on unpaved sections of campus roads to below 15 km/h. • Schedule delivery vehicles during off-peak academic activity hours to minimize disruption.	Minor
		Exhaust fumes from vehicles resulting to environmental pollution and respiratory discomfort to project community	• All vehicles and machinery shall undergo routine maintenance and servicing to ensure efficient fuel combustion and reduced exhaust emissions. • Switch off engines when not in use. Avoid prolonged idling within the campus environment.	Minor
	Noise	Increase in ambient noise levels	• Schedule all noisy mobilization activities to avoid core academic hours. Where possible, maintain weekends and public holidays, in coordination with the university management and academic calendar. • Maintain construction equipment in good working order to reduce noise generation. • Notify university management in advance of activities likely to generate elevated noise levels.	Minor
Site clearing	Soil	Localized soil compaction and disturbance within areas designated for temporary material storage	• Restrict temporary material storage to designated areas only. • Install protective matting or boards in storage areas to minimize soil compaction. • Avoid stockpiling heavy materials on the same ground area for extended periods.	Minor

	Biological (Flora & Fauna)	Removal of cultivated vegetation within the project footprint, with temporary disturbance to soil-dwelling and ground fauna.	• Limit clearing strictly to the minimum necessary footprint. • Mark and protect all vegetation outside the designated clearing boundary. • Conduct clearing progressively to allow fauna to relocate naturally before disturbance.	Negligible
Social Component				
Procurement of solar equipment	Workers within the supply chain / Project reputation	Potential procurement of equipment from OEMs or suppliers associated with forced labour, modern slavery, child labour or other human rights abuses within the supply chain.	• Develop and implement a supply chain due diligence policy for all equipment suppliers and OEMs. • Require written declarations from all suppliers confirming absence of forced labour, modern slavery and child labour in their supply chains. • Include supplier compliance clauses in all procurement contracts. • Screen and audit key suppliers before contract award.	Minor
Movement of vehicles and equipment	Traffic / Access	Temporary increase in vehicular movement within the AAAU campus internal road network, with minor disruption to campus movement	• Develop and implement a site traffic management plan covering all vehicle routes within the campus and along the Airport Road access corridor. • Designate specific delivery time windows to avoid peak academic activity periods. • Install traffic management signage at all vehicle entry and movement points within the campus.	Minor
		Minor disturbance to students, staff and farmers due to increased human activity and equipment movement within the developing permanent campus	• Notify all students, staff and temporary farmers in advance of mobilization activities. • Maintain pedestrian access routes at all times during mobilization. • Designate a clear construction zone with barriers separating active work areas from pedestrian and academic areas. • Provide regular updates on construction schedules and any expected disruptions.	Minor
Handling and movement of equipment	OHS	Risk of minor accidents or injuries to workers during loading, unloading, and movement of equipment on site	• Develop and implement a site-specific OHS Management Plan prior to mobilization. • Conduct pre-mobilization safety induction for all workers before commencement. • Provide appropriate PPE including helmets, gloves, high-visibility vests and safety boots to all workers.	Minor

		Influx of people (migrant workers, sub-contractors and suppliers) and increased pressure on existing social infrastructure	• Develop and implement a Labour Influx Management Plan prior to worker mobilisation. • Brief all incoming workers on the campus Code of Conduct before commencement. • Maintain a worker register and verify identity and age of all workers before engagement. • Establish clear rules of engagement between workers and students, staff and community members.	Minor
Project mobilization and initial engagement	Community	Minor safety risks to students, staff, and pedestrians along the Airport Road expressway and internal campus access routes.	• Install clearly visible safety signage and barriers at all construction entry points. • Establish a project grievance mechanism and communicate access to all stakeholders. • Brief campus security personnel on construction activity schedules.	Minor
	Security	Risk of unauthorized access to project site leading to potential theft of equipment and accidents	• Erect temporary security fencing around the mobilization and material storage areas. • Engage dedicated site security personnel during mobilization activities. • Conduct daily inventory checks of all equipment and materials on site. • Report any theft or security incidents to campus security and relevant authorities immediately.	Minor
Site handover	Land / stakeholders	Risk of new occupation/use/claim before mobilization	• REA/NEP-PMU and AAAU shall verify and sign Annex 9 Land Status Verification; • Exclude/ redesign any area with occupation, crops, structures, livelihood use, claims or access restrictions before works.	Minor
Final PV/BESS design	Aviation / community safety	Potential glint/glare and BESS fire/life-safety risk	• Complete PV glint/glare screening and BESS safety design review. • Final PV orientation/layout shall demonstrate acceptable aviation outcome; • BESS shall meet applicable Nigerian requirements and recognized stationary-battery/fire GIIP.	Minor to Moderate

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.	• Strip and stockpile topsoil separately from subsoil and protect from erosion during works. • Install erosion control measures including silt fences along downslope perimeters of all excavation areas. • Reinstate excavated areas with compacted fill and ground cover immediately upon completion. • Conduct earthworks progressively and avoid leaving large areas of exposed soil overnight.	Moderate
Movement of construction vehicles and equipment within site		Soil compaction reducing permeability and affecting soil structure within frequently trafficked areas	• Restrict heavy vehicle movement to designated haul routes only. • Avoid repeated vehicle passes over the same unprotected ground areas. • Inspect and rip compacted areas after construction to restore soil permeability before reinstatement.	Minor
Trenching for underground distribution cables		Creation of exposed and loosely compacted soil zones along the underground cable trench route across the campus, increasing erosion potential especially during wet season rainfall events	• Bench and shore trench walls appropriately to prevent collapse and soil disturbance. • Stockpile excavated materials away from the trench edge to prevent slippage. • Backfill and compact trenches progressively and reinstate surface cover immediately upon cable laying. • Install erosion control measures along the full length of the cable trench corridor.	Moderate
Site grading and leveling for panel installation	Soil / Drainage	Alteration of natural surface runoff patterns, leading to localized water concentration and erosion	• Design site grading to maintain natural drainage patterns where possible. • Install temporary drainage diversions and sediment traps to intercept and manage runoff. • Reinstate natural drainage patterns upon completion of grading works.	Moderate

Trenching and cable laying across site		Temporary disruption of natural drainage paths along the underground cable trench route and potential formation of preferential runoff channels, given the presence of excavated drainage channels close to the footprint	• Install temporary culverts or bridging across existing drainage channels where the cable route crosses them. • Reinstate all disturbed drainage paths immediately after cable installation. • Monitor drainage channels under construction in the vicinity for any signs of blockage or diversion.	Moderate
Movement of vehicles and earthworks	Air quality	Generation of dust (TSP) due to disturbance of cultivated brownish soil, earthworks along the underground cable trench route, and vehicle movement within the site.	• Apply water-based dust suppression on all active earthworks areas and haul routes daily during dry periods. • Cover all vehicles transporting excavated soil or fine materials with tarpaulins. • Restrict vehicle speeds within the campus to below 15 km/h. • Coordinate with airport road authorities for any works near the expressway access.	Moderate
Movement of construction equipment		Emission of exhaust gases from diesel-powered machinery	• Ensure all construction vehicles and machinery are regularly serviced and maintained. • Switch off engines when not in use. Avoid prolonged idling within the campus. • Use low-emission equipment where available and practicable.	Minor
Operation of machinery and installation activities	Noise	Increased noise levels within the project environment, noting the existing elevated noise baseline from the Airport Road expressway	• Fit all construction machinery with functional silencers and mufflers. • Erect temporary noise barriers around high-noise work areas adjacent to academic buildings. • Notify university management and students in advance of activities likely to generate elevated noise.	Moderate
Installation of mounting structures and cable works	Flora	Removal of cultivated vegetation within the project footprint	• Mark and protect vegetation outside the designated clearing boundary. • Reinstate cleared areas with appropriate ground cover immediately upon completion of installation works.	Negligible
Storage and handling of fuel, oil, and materials	Soil / Water	Risk of localized contamination from accidental spills affecting soil and potentially infiltrating	• Designate a bunded fuel and materials storage area with impermeable base and secondary containment. • Store all fuels, oils and chemicals within the bunded area at all times.	Moderate

		groundwater or the Potential pollution of the surface water stream located approximately 1km from the project footprint	• Maintain spill response kits on site at all times. Train workers in spill response procedures. • Prohibit refuelling within 100m of the stream or campus borehole locations.	
Construction activities and material storage	Waste	Generation of construction waste (scrap materials, packaging, excavated soil) with potential for improper disposal and consequent environmental pollution.	• Implement waste segregation at source into general, recyclable and hazardous categories. • Contract a licensed waste collector for regular removal and disposal of all construction waste. • Prohibit open burning or unauthorized dumping of any construction waste within the campus. • Maintain a waste register tracking volumes generated, stored and disposed.	Minor
Installation of mounting structures and foundations	Visual aesthetics	Temporary visual disturbance due to presence of equipment, materials, and exposed surfaces	• Remove all construction materials, equipment and waste from site upon completion. • Reinstate disturbed surfaces and restore campus aesthetics upon completion of all works. • Maintain an orderly and clean construction site throughout the construction period.	Minor
Social Component				
Mobilization and presence of construction workers	University / premises	Temporary disruption to ongoing academic, administrative and construction activities within the AAAU permanent campus due to increased human presence and construction activity	• Designate clear construction zone boundaries with physical barriers separating works from academic areas. • Notify students, staff and university management in advance of all construction activities and schedules. • Coordinate construction scheduling with the university academic calendar to avoid examination periods. • Maintain safe pedestrian access routes around all active work areas at all times.	Minor
Engagement of labour	Community	Potential for unmet expectations regarding employment opportunities among Iddo Sarki community members and temporary farmers, causing grievances if	• Implement a grievance mechanism accessible to community members and temporary farmers. • Develop and communicate a transparent local employment policy prior to construction commencement. • Establish a community liaison officer to manage employment enquiries from Iddo Sarki and temporary farmers.	Minor

		local labour engagement commitments are not fulfilled	• Report local employment outcomes regularly to university management and community representatives.	
Trenching and cable laying across campus	Access / Infrastructure	Temporary obstruction of walkways and internal access routes within the AAAU permanent campus during cable trench excavation and installation works across the campus	• Install clearly marked pedestrian diversions and alternative walkway routes for all affected campus paths. • Erect safety barriers and warning signs along the full length of open trench sections. • Backfill and reinstate walkways and access routes immediately after cable installation in each section. • Provide temporary bridging over open trenches at all major pedestrian crossing points.	Moderate
Presence of workforce	Public Health	Increased risk of communicable diseases and social vices due to interaction between construction workers and students, staff, temporary farmers and the Iddo Sarki community within and around the campus	• Implement a Worker Code of Conduct covering hygiene, behaviour and interaction with campus users. • Provide health awareness briefings to all workers before commencement, covering communicable disease prevention. • Establish adequate sanitation facilities for construction workers separate from campus facilities. • Conduct HIV/AIDS and communicable disease awareness sessions for workers during induction.	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.	• Implement an equal opportunity employment policy requiring non-discriminatory recruitment practices. • Establish and enforce a zero-tolerance SEAH and GBV policy with clear reporting and response procedures. • Brief all workers on the Code of Conduct covering SEAH, GBV and respectful conduct toward female students and staff. • Ensure female workers and campus users have access to a confidential SEAH reporting mechanism.	Minor
Influx of workers	Local Services	Minor pressure on existing social amenities and services within the AAAU campus and Iddo Sarki community due to labour influx during the construction phase	• Limit worker numbers on site to the minimum required for each construction activity. • Prohibit workers from residing within the campus or the Iddo Sarki community unless formally arranged. • Coordinate with university management on any additional pressure on campus facilities from workers.	Minor

Project activities and expectations	Community Grievance	Potential for complaints arising from perceived impacts or unmet expectations	• Establish a project-level grievance mechanism accessible to all campus users and community members. • Designate a community liaison officer to receive and respond to all project-related complaints. • Log and respond to all grievances within 14 working days and report outcomes to complainants. • Conduct regular community update meetings with the Iddo Sarki community and campus representatives.	Minor
OHS and Community Safety				
Excavation and trenching works	OHS (Workers)	Risk of injuries from trench collapse, slips, trips, and falls within excavation areas	• Ensure all excavation and trench works comply with applicable OHS standards for confined spaces and excavations. • Install shoring or benching for all trenches deeper than 1.2 metres. • Prohibit entry into unsupported trenches deeper than 1.2 metres. • Conduct daily inspection of all excavation areas before workers commence activities.	Major
Installation of mounting structures and panels	OHS (Workers)	Risk of falls, cuts, and musculoskeletal injuries during installation activities	• Enforce use of full PPE including harnesses, helmets and non-slip footwear for all installation works. • Erect scaffolding or working platforms for all elevated installation activities. • Conduct toolbox talks on fall prevention and safe working at height before each shift. • Inspect all lifting equipment and tools daily before use.	Major
Handling of construction materials and equipment	OHS (Workers)	Risk of injuries from improper lifting, falling objects, or equipment misuse	• Train all workers in manual handling techniques and safe lifting practices before commencement. • Provide mechanical lifting aids for all loads exceeding 25kg. • Inspect all construction materials and equipment for defects before use. • Enforce hard hat and steel-toed boot requirements at all times on site.	Major
Electrical installation works (cabling, connections)	OHS (Workers)	Risk of electric shock, burns, or electrocution during installation of electrical components	• Engage only certified and licensed electricians for all electrical installation works. • Implement lockout/tag out procedures for all electrical works.	Major

			• Conduct pre-work electrical safety briefings before each shift involving electrical activities. • Test all electrical connections before energizing any component.	
Operation of machinery and equipment	OHS (Workers)	Exposure to noise, vibration, and mechanical hazards	• Provide hearing protection to all workers operating or working near noisy machinery. • Rotate workers away from high-noise and high-vibration tasks to limit exposure duration. • Conduct pre-employment and periodic medical screening for workers exposed to noise and vibration. • Maintain all machinery in good working order to minimize noise and vibration output.	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	• Implement a site traffic management plan with designated vehicle and pedestrian zones. • Enforce a strict speed limit of 10 km/h for all vehicles within the campus. • Station flag persons at all vehicle-pedestrian conflict points. • Install speed bumps and warning signage at all campus vehicle entry and movement points.	Major
Open trenches and excavation areas	Community Safety	Risk of unauthorized access leading to falls or injuries	• Install physical barriers, hoarding and warning signs along the full length of all open trenches. • Cover or bridge open trenches at all pedestrian crossing points before end of each working day. • Conduct daily inspections of all barriers and coverings before works commence. • Prohibit all unauthorized persons from entering the active construction zone.	Major
Storage of fuel and hazardous materials	OHS / Community Safety	Risk of fire outbreak, explosion, or exposure to hazardous substances	• Store all fuels and hazardous materials in a designated bunded area away from academic buildings. • Maintain fire extinguishers at all fuel storage and electrical works areas. • Prohibit smoking within 25 metres of any fuel storage or hazardous materials area. • Train workers in fire emergency response procedures during induction.	Moderate

Excavation / trenching	Cultural heritage	Chance discovery of archaeological/cultural material	• Apply Chance Finds Procedure: stop work, secure area, notify PMU/competent authority, obtain clearance before resumption.	Moderate

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	• Inspect battery storage systems and connections monthly for signs of leakage, corrosion or damage. • Install battery containment trays with secondary containment capacity under all battery banks. • Maintain spill response kits in the battery storage room at all times.	Moderate
Operation of equipment (inverters, transformers)	Noise	Low-level noise generation from operational inverters and transformers, negligible relative to the existing ambient noise baseline from the Airport Road expressway	• Ensure inverters and transformers are installed within enclosed housing to contain operational noise. • Conduct periodic noise monitoring at the nearest sensitive receptor to confirm compliance with noise limits. • Schedule any high-noise maintenance activities during daytime hours only.	Minor
Surface structures and installations	Soil / Hydrology	Reduced infiltration due to presence of mounting structures and associated infrastructure	• Design drainage around mounting structures to maintain natural surface water flow patterns. • Inspect and clear drainage paths around the installation area after each wet season. • Monitor for any ponding or waterlogging around the installation footprint during the wet season.	Minor
Cleaning of solar panels	Water resources	Use of water from campus borehole supply for panel cleaning, particularly during the harmattan period, leading to minimal additional water demand on existing campus water infrastructure	• Use minimum water volumes necessary for effective panel cleaning. • Schedule panel cleaning during early morning hours to minimise evaporative water loss. • Consider dry cleaning methods during the harmattan period to reduce water demand.	Negligible

Maintenance activities	Waste generation	Generation of minor waste such as damaged components, packaging, and maintenance residues	• Implement waste segregation at source separating general waste from hazardous maintenance residues. • Contract a licensed waste collector for regular removal of all maintenance waste from the campus. • Maintain a waste log recording types, quantities and disposal destinations of all waste generated. • Prohibit dumping of any maintenance waste within the campus or surrounding environment.	Minor
End-of-life components (batteries, panels)	Soil / Environment	Potential environmental risk from improper disposal of hazardous end-of-life components including spent lithium-ion batteries, degraded PV panels and failed inverters, if not managed under the Extended Producer Responsibility framework and in compliance with NESREA Electrical and Electronic Sector Regulations 2011	• Develop and implement an e-waste management plan in accordance with NESREA Electrical and Electronic Sector Regulations 2011. • Engage a NESREA-licensed e-waste handler for collection and disposal of all end-of-life batteries, panels and inverters. • Ensure all equipment suppliers confirm Extended Producer Responsibility obligations at the point of procurement. • Store all end-of-life components in a designated and labelled hazardous waste storage area pending collection. • Maintain records of all e-waste transfers including quantities, dates and licensed handler details.	Moderate
Operation of electrical systems (inverters, cables, connections)	OHS (Workers)	Risk of electric shock, burns, or electrocution during operation and maintenance	• Implement lockout/tagout procedures for all maintenance works on energised electrical systems. • Engage only certified and licensed electricians for all operation and maintenance electrical works. • Conduct quarterly electrical safety inspections of all inverters, cables and connections. • Provide appropriate PPE including insulated gloves and tools to all O&M electrical workers. • Train all O&M staff in electrical safety and emergency response procedures.	Major
Battery storage and management	OHS (Workers)	Risk of chemical exposure, fire, or explosion in case of battery failure or improper handling	• Install automated battery management systems with thermal monitoring and overcharge protection. • Conduct monthly inspections of battery banks for signs of swelling, overheating or electrolyte leakage.	Major

			• Install fire suppression systems and smoke detectors within the battery storage room. • Train O&M staff in battery fire emergency response and evacuation procedures. • Prohibit storage of flammable materials within 5 metres of the battery storage area.	
Operation of facility within campus	Community Safety	Risk of unauthorized access by students, staff or visitors to energized solar arrays, battery storage areas or electrical infrastructure within the AAAU permanent campus, leading to potential injury or electrocution	• Install perimeter fencing and lockable gates around the solar array, battery storage room and control room. • Install clearly visible warning signs on all energised equipment and restricted areas. • Brief campus security personnel on restricted access zones within the solar installation. • Conduct regular community awareness sessions with students and staff on electrical safety within the installation.	Major
BESS operation	Workers / community / environment	Thermal runaway, fire, smoke/toxic gas, re-ignition, contaminated runoff	• Maintain BMS and independent protective functions, thermal/fault alarms, emergency isolation, ventilation/thermal control, fire detection/response system, emergency access, drills, damaged-battery quarantine and controlled management of contaminated debris/runoff.	Moderate
PV operation near airport corridor	Aviation safety	Glint/glare effects on pilots/ATC if design changes	• Maintain approved PV orientation/layout. Any material change to module type, tilt, azimuth or footprint shall be screened for glare before implementation; investigate aviation complaints immediately.	Minor

CHAPTER SEVEN: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

7.1 Overview

The Environmental and Social Management Plan (ESMP) translates the ESIA commitments into binding implementation, monitoring and reporting requirements for REA, AAAU, the EPC Contractor, subcontractors, supervising/Owner's Engineer arrangements and the O&M Contractor. The EPC Contractor shall prepare a site-specific Contractor ESMP (C-ESMP) and supporting management plans consistent with this ESIA before mobilization. Subcontracting does not transfer responsibility for compliance, and the O&M Contractor shall maintain proportionate operational environmental, social, health, safety and emergency management arrangements throughout the facility life.

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.

7.3.1 Pre-Construction Environmental and Social Hold-Points

Hold-Point	**Evidence / Acceptance Criterion**
HP-01 Land Status	Signed Annex 9 verification by AAAU and REA/NEP-PMU; no occupation, crops, livelihood/economic use, claims or access restrictions in work area.
HP-02 C-ESMP	PMU-approved C-ESMP including OHS, traffic, erosion/stormwater, waste, labour, worker/community GRMs, SEA/SH, emergency/BESS, security and Chance Finds.
HP-03 PV Glint/Glare	Final PV layout/orientation screened and demonstrated acceptable for relevant aviation receptors; design modified where necessary.
HP-04 BESS Safety	Accepted BESS fire/life-safety design including enclosure/siting, separation, BMS/protection, alarms/detection, isolation, thermal management, emergency access and response.
HP-05 Energization Readiness	Electrical inspection/testing, earthing, protection, LOTO/PTW, signage, emergency arrangements and applicable NEMSA requirements completed.

7.4 ESMP Matrix

ESMP: Pre-Construction Phase

Activity	Receptor	Potential Impact	Impact Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Costs (Naira)	
								Mitigation	Mitigation
Environmental Component									
Mobilization of construction materials and equipment to proposed university site	Air quality	Generation of dust along the university's access roads and within the project site due to movement of delivery trucks	Minor	• Apply water-based dust suppression on all access routes and within the project site during dry and windy periods. • All vehicles transporting materials shall be covered with tarpaulins to prevent dust dispersion. • Restrict vehicle speeds on unpaved sections of campus roads to below 15 km/h. • Schedule delivery vehicles during off-peak academic activity hours to minimize disruption.	Dust levels on access routes and within site. Visual observation of vehicle tarpaulin compliance. Speed limit compliance.	Daily during mobilization	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	500,000	200,000
		Exhaust fumes from vehicles resulting to environmental pollution and respiratory discomfort to project community	Minor	• All vehicles and machinery shall undergo routine maintenance and servicing to ensure efficient fuel combustion and reduced exhaust emissions. • Switch off engines when not in use. Avoid prolonged idling within the campus environment.	Vehicle and equipment maintenance records. Observation of engine idling compliance. Worker PPE usage.	Weekly	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer		
	Noise	Increase in ambient noise levels	Minor	• Schedule noisy mobilization activities during daytime hours only, between 7:00am and 6:00pm. • Maintain construction equipment in good working	Noise levels within campus during mobilization activities. Compliance with daytime-only work	Weekly / as required	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	-	-

				order to reduce noise generation. • Notify university management in advance of activities likely to generate elevated noise levels.	schedule. University management notification records.				
Site clearing	Soil	Localized soil compaction and disturbance within areas designated for temporary material storage	Minor	• Restrict temporary material storage to designated areas only. • Install protective matting or boards in storage areas to minimize soil compaction. • Avoid stockpiling heavy materials on the same ground area for extended periods.	Visual inspection of material storage areas. Evidence of protective matting installation. Soil condition in storage zones.	Weekly	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	500,000	200,000
	Biological (Flora & Fauna)	Removal of cultivated vegetation within the project footprint, with temporary disturbance to soil-dwelling and ground fauna.	Negligible	• Limit clearing strictly to the minimum necessary footprint. • Mark and protect all vegetation outside the designated clearing boundary. • Conduct clearing progressively to allow fauna to relocate naturally before disturbance. • Reinstate cleared areas with appropriate ground cover upon completion of works.	Area of vegetation cleared versus designated footprint. Evidence of fauna relocation measures. Ground cover reinstatement status.	Once prior to and once post-clearing	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	500,000	100,000
Social Component									
Procurement of solar equipment	Workers within the supply chain / Project reputation	Potential procurement of equipment from OEMs or suppliers associated with forced labour, modern slavery, child labour or other human rights abuses	Minor	• Develop and implement a supply chain due diligence policy for all equipment suppliers and OEMs. • Require written declarations from all suppliers confirming absence of forced labour, modern slavery and child	Supplier declaration records on file. Procurement contract compliance clauses. Audit reports for key suppliers.	Prior to procurement and at contract award	**Mitigation:** Contractor / REA PMU **Monitoring:** NEP (PMU)	-	-

		within the supply chain.		labour in their supply chains. • Include supplier compliance clauses in all procurement contracts. • Screen and audit key suppliers before contract award.					
Movement of vehicles and equipment	Traffic / Access	Temporary increase in vehicular movement along the Airport Road expressway access route and within the AAAU campus internal road network, with minor disruption to campus movement	Minor	• Develop and implement a site traffic management plan covering all vehicle routes within the campus and along the Airport Road access corridor. • Designate specific delivery time windows to avoid peak academic activity periods. • Install traffic management signage at all vehicle entry and movement points within the campus.	Traffic management plan in place and implemented. Number of traffic incidents reported. Signage installation records.	Daily during vehicle movement activities	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	700,000	200,000
		Minor disturbance to students, staff and farmers due to increased human activity and equipment movement within the developing permanent campus	Minor	• Notify all students, staff and temporary farmers in advance of mobilization activities. • Maintain pedestrian access routes at all times during mobilization. • Designate a clear construction zone with barriers separating active work areas from pedestrian and academic areas. • Provide regular updates on construction schedules and any expected disruptions.	Advance notification records to students, staff and temporary farmers. Pedestrian access routes maintained. Number of disturbance complaints received.	Weekly / Continuous	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	500,000	100,000
Handling and movement of equipment	OHS	Risk of minor accidents or injuries to workers during loading,	Minor	• Develop and implement a site-specific OHS Management Plan prior to mobilization.	OHS Management Plan approved and on site. Worker	Prior to mobilization and weekly thereafter	**Mitigation:** Contractor	600,000	200,000

		unloading, and movement of equipment on site		• Conduct pre-mobilization safety induction for all workers before commencement. • Provide appropriate PPE including helmets, gloves, high-visibility vests and safety boots to all workers. • Designate a trained first aider and maintain a first aid kit on site at all times.	induction records. PPE provision and usage records. First aid kit availability.		**Monitoring:** NEP (PMU), Site Engineer		
		Influx of people (migrant workers, sub-contractors and suppliers) and increased pressure on existing social infrastructure	Minor	• Develop and implement a Labour Influx Management Plan prior to worker mobilisation. • Brief all incoming workers on the campus Code of Conduct before commencement. • Maintain a worker register and verify identity and age of all workers before engagement. • Establish clear rules of engagement between workers and students, staff and community members.	Labour Influx Management Plan approved. Worker register maintained. Code of Conduct briefing records. Worker age verification records.	Prior to mobilization and weekly thereafter	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	200,000	100,000
Project mobilization and initial engagement	Community	Minor safety risks to students, staff, and pedestrians along the Airport Road expressway and internal campus access routes.	Minor	• Install clearly visible safety signage and barriers at all construction entry points. • Conduct community notification meetings at the Iddo Sarki community and within the AAAU campus before activities commence. • Establish a project grievance mechanism and communicate access to all stakeholders. • Brief campus security personnel on construction activity schedules.	Safety signage installed at all entry points. Community notification meeting records. Grievance mechanism communicated and accessible. Number of safety incidents reported.	Prior to mobilisation and monthly thereafter	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer, AAAU Security	400,000	100,000

	Security	Risk of unauthorized access to project site leading to potential theft of equipment and accidents	Minor	• Erect temporary security fencing around the mobilization and material storage areas. • Engage dedicated site security personnel during mobilization activities. • Conduct daily inventory checks of all equipment and materials on site. • Report any theft or security incidents to campus security and relevant authorities immediately.	Security fencing installed and maintained. Security personnel deployment records. Daily equipment inventory records. Number of theft or security incidents reported.	Daily	**Mitigation:** Contractor **Monitoring:** NEP (PMU), AAAU Security	500,000	200,000
Site handover / footprint confirmation	Land / stakeholders	New occupation, crop, livelihood use, claim or access restriction could create displacement risk.	Moderate	• Implement Annex 9 Land Status Verification before handover. Do not commence works on any area failing the criteria; redesign/exclude affected area. Residual significance: Negligible/Minor once avoidance is confirmed.	Signed verification; zero occupied/used area in work footprint	Once before handover and after material delay/design change	Implementation: AAAU + REA/NEP-PMU E&S; Verification: PMU/Owner's Engineer	-	-
Final PV/BESS design acceptance	Aviation / community / worker safety	Glint/glare or inadequate BESS fire/life-safety design could create high-consequence operational risk.	Major	• Complete aviation glint/glare assessment and BESS fire/life-safety design review before procurement/installation. Residual significance: Minor–Moderate subject to accepted design.	Approved glare assessment; approved BESS safety review	Once before relevant procurement/installation; repeat on material change	Implementation: EPC Designer; Approval: REA/NEP-PMU/Owner's Engineer with aviation/regulatory interface as applicable	-	-
Total cost for Pre-construction Phase								**3,900,000.00**	**1,400,000.00**

ESMP: Construction Phase

Activity	Receptor	Potential Impact	Significance	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Costs (Naira)	
Environmental Component									
Excavation and foundation works for mounting structures	Soil	Disturbance of soil leading to increased susceptibility to erosion and potential acceleration of erosion from the existing excavated drainage line	Moderate	• Strip and stockpile topsoil separately from subsoil and protect from erosion during works. • Install erosion control measures including silt fences along downslope perimeters of all excavation areas. • Reinstate excavated areas with compacted fill and ground cover immediately upon completion. • Conduct earthworks progressively and avoid leaving large areas of exposed soil overnight.	Topsoil and subsoil stockpile records. Silt fence installation inspection. Visual evidence of progressive earthworks. Reinstatement status of excavated areas.	Daily during excavation works	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	700,000	200,000
Movement of construction vehicles and equipment within site		Soil compaction reducing permeability and affecting soil structure within frequently trafficked areas	Minor	• Restrict heavy vehicle movement to designated haul routes only. • Avoid repeated vehicle passes over the same unprotected ground areas. • Inspect and rip compacted areas after construction to restore soil permeability before reinstatement.	Vehicle movement records on designated haul routes. Visual inspection of trafficked soil areas. Post-construction soil permeability assessment.	Weekly	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	-	-
Trenching for underground distribution cables		Creation of exposed and loosely compacted soil zones along the underground cable trench route across the campus, increasing erosion potential especially	Moderate	• Bench and shore trench walls appropriately to prevent collapse and soil disturbance. • Stockpile excavated materials away from the trench edge to prevent slippage. • Backfill and compact trenches progressively and reinstate	Trench shoring installation records. Daily trench inspection records. Backfill and compaction records. Erosion control	Daily during trenching works	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	500,000	100,000

		during wet season rainfall events		surface cover immediately upon cable laying. • Install erosion control measures along the full length of the cable trench corridor.	installation along cable corridor.				
Site grading and leveling for panel installation	Soil / Drainage	Alteration of natural surface runoff patterns, leading to localized water concentration and erosion	Moderate	• Design site grading to maintain natural drainage patterns where possible. • Install temporary drainage diversions and sediment traps to intercept and manage runoff. • Reinstate natural drainage patterns upon completion of grading works.	Drainage pattern inspection before and after grading. Sediment trap installation records. Runoff observation during rainfall events.	Weekly during grading works	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	500,000	200,000
Trenching and cable laying across site		Temporary disruption of natural drainage paths along the underground cable trench route and potential formation of preferential runoff channels	Moderate	• Install temporary culverts or bridging across existing drainage channels where the cable route crosses them. • Reinstate all disturbed drainage paths immediately after cable installation. • Monitor drainage channels under construction for any signs of blockage or diversion.	Drainage reinstatement inspection records. Culvert installation records. Observation of drainage channels under construction in vicinity.	Daily during cable laying works	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	600,000	200,000
Movement of vehicles and earthworks	Air quality	Generation of dust due to disturbance of cultivated soil, earthworks along the underground cable trench route, and vehicle movement within the site.	Moderate	• Apply water-based dust suppression on all active earthworks areas and haul routes daily during dry periods. • Cover all vehicles transporting excavated soil or fine materials with tarpaulins. • Restrict vehicle speeds within the campus to below 15 km/h.	Dust levels on haul routes and at earthworks areas. Vehicle tarpaulin compliance records. Speed limit compliance observation.	Daily during earthworks	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	200,000	100,000
Movement of construction equipment		Emission of exhaust gases from diesel-powered machinery	Minor	• Ensure all construction vehicles and machinery are regularly serviced and maintained. • Switch off engines when not in use. Avoid prolonged idling within the campus.	Vehicle and machinery maintenance service records. Engine idling observation. Exhaust	Weekly	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	-	-

				• Use low-emission equipment where available and practicable.	emission visual inspection.				
Operation of machinery and installation activities	Noise	Increased noise levels within the project environment	Moderate	• Fit all construction machinery with functional silencers and mufflers. • Erect temporary noise barriers around high-noise work areas adjacent to academic buildings. • Notify university management and students in advance of activities likely to generate elevated noise.	Silencer and muffler installation records. Noise barrier installation records. Construction activity timing log.	Weekly / Continuous	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	-	-
Installation of mounting structures and cable works	Flora	Removal of cultivated vegetation within the project footprint	Negligible	• Mark and protect vegetation outside the designated clearing boundary. • Reinstate cleared areas with appropriate ground cover immediately upon completion of installation works.	Area of vegetation cleared versus designated footprint. Reinstatement status of cleared areas.	Once pre-clearing and once post-installation	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	500,000	100,000
Storage and handling of fuel, oil, and materials	Soil / Water	Risk of localized contamination from accidental spills affecting soil and potentially infiltrating groundwater or the Potential pollution of the surface water stream located approximately 1km from the project footprint	Moderate	• Designate a bunded fuel and materials storage area with impermeable base and secondary containment. • Store all fuels, oils and chemicals within the bunded area at all times. • Maintain spill response kits on site at all times. Train workers in spill response procedures. • Prohibit refuelling within 100m of the stream or campus borehole locations.	Bunded storage area inspection records. Spill kit availability and condition. Worker spill response training records. Refuelling location compliance.	Weekly	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer, AEPB	500,000	100,000
Construction activities and material storage	Waste	Generation of construction waste (scrap materials, packaging, excavated soil) with potential for improper disposal and consequent	Minor	• Implement waste segregation at source into general, recyclable and hazardous categories. • Contract a licensed waste collector for regular removal and disposal of all construction waste.	Waste segregation compliance observation. Licensed waste contractor removal records. Waste register	Weekly	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer, AEPB	500,000	100,000

		environmental pollution.		• Prohibit open burning or unauthorized dumping of any construction waste within the campus. • Maintain a waste register tracking volumes generated, stored and disposed.	log. Evidence of no open burning.				
Installation of mounting structures and foundations	Visual aesthetics	Temporary visual disturbance due to presence of equipment, materials, and exposed surfaces	Minor	• Remove all construction materials, equipment and waste from site upon completion. • Reinstate disturbed surfaces and restore campus aesthetics upon completion of all works. • Maintain an orderly and clean construction site throughout the construction period.	Site cleanliness observation. Materials and waste removal records upon completion. Campus aesthetics reinstatement inspection.	Upon completion of works	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	500,000	100,000
Social Component									
Mobilization and presence of construction workers	University / premises	Temporary disruption to ongoing academic, administrative and construction activities within the AAAU permanent campus due to increased human presence and construction activity	Minor	• Designate clear construction zone boundaries with physical barriers separating works from academic areas. • Notify students, staff and university management in advance of all construction activities and schedules. • Coordinate construction scheduling with the university academic calendar to avoid examination periods. • Maintain safe pedestrian access routes around all active work areas at all times.	Construction zone boundary inspection. Advance notification records. Pedestrian access route maintenance. Number of campus disturbance complaints.	Weekly / Continuous	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	-	200,000
Engagement of labour	Community	Potential for unmet expectations regarding employment opportunities among Iddo Sarki community members and temporary farmers,	Minor	• Develop and communicate a transparent local employment policy prior to construction commencement. • Establish a community liaison officer to manage employment enquiries from Iddo Sarki and temporary farmers.	Local employment policy communicated. Community liaison officer appointment records. Grievance	Monthly	**Mitigation:** Contractor **Monitoring:** NEP (PMU), AAAU Management	400,000	100,000

		causing grievances if local labour engagement commitments are not fulfilled		• Implement a grievance mechanism accessible to community members and temporary farmers. • Report local employment outcomes regularly to university management and community representatives.	register. Employment outcome reports.				
Trenching and cable laying across campus	Access / Infrastructure	Temporary obstruction of walkways and internal access routes within the AAAU permanent campus during cable trench excavation and installation works across the campus	Moderate	• Install clearly marked pedestrian diversions and alternative walkway routes for all affected campus paths. • Erect safety barriers and warning signs along the full length of open trench sections. • Backfill and reinstate walkways and access routes immediately after cable installation in each section. • Provide temporary bridging over open trenches at all major pedestrian crossing points.	Pedestrian diversion signage and barriers installed. Temporary bridging at crossing points. Walkway reinstatement records after each trench section.	Daily during trench works	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	500,000	100,000
Presence of workforce	Public Health	Increased risk of communicable diseases and social vices due to interaction between construction workers and students, staff, temporary farmers and the Iddo Sarki community within and around the campus	Minor	• Implement a Worker Code of Conduct covering hygiene, behaviour and interaction with campus users. • Provide health awareness briefings to all workers before commencement, covering communicable disease prevention. • Establish adequate sanitation facilities for construction workers separate from campus facilities. • Conduct HIV/AIDS and communicable disease awareness sessions for workers during induction.	Worker Code of Conduct briefing records. Sanitation facility provision and maintenance. Health awareness session attendance records. Disease incident reports.	Monthly	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	500,000	100,000
Labour dynamics	Social (Gender)	Potential for unequal access to employment	Minor	• Implement an equal opportunity employment policy requiring	Equal opportunity recruitment	Monthly	**Mitigation:** Contractor	-	200,000

		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.		non-discriminatory recruitment practices. • Establish and enforce a zero-tolerance SEAH and GBV policy with clear reporting and response procedures. • Brief all workers on the Code of Conduct covering SEAH, GBV and respectful conduct toward female students and staff. • Ensure female workers and campus users have access to a confidential SEAH reporting mechanism.	records. SEAH/GBV zero-tolerance policy communicated. SEAH reporting mechanism accessible and functioning. Number of SEAH incidents reported and resolved.		**Monitoring:** NEP (PMU), AAAU Management		
Influx of workers	Local Services	Minor pressure on existing social amenities and services within the AAAU campus and Iddo Sarki community due to labour influx during the construction phase	Minor	• Limit worker numbers on site to the minimum required for each construction activity. • Prohibit workers from residing within the campus or the Iddo Sarki community unless formally arranged. • Coordinate with university management on any additional pressure on campus facilities from workers.	Worker numbers on site versus approved complement. Worker residential arrangement records. Coordination meeting records with university management.	Weekly	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	-	-
Project activities and expectations	Community Grievance	Potential for complaints arising from perceived impacts or unmet expectations	Minor	• Establish a project-level grievance mechanism accessible to all campus users and community members. • Designate a community liaison officer to receive and respond to all project-related complaints. • Log and respond to all grievances within 14 working days and report outcomes to complainants. • Conduct regular community update meetings with the Iddo Sarki community and campus representatives.	Grievance mechanism established and accessible. Community liaison officer operational. Grievance register with response timelines. Community update meeting records.	Monthly	**Mitigation:** Contractor **Monitoring:** NEP (PMU), AAAU Management	300,000	100,000

Excavation and trenching works	OHS (Workers)	Risk of injuries from trench collapse, slips, trips, and falls within excavation areas	Major	• Ensure all excavation and trench works comply with applicable OHS standards for confined spaces and excavations. • Conduct daily inspection of all excavation areas before workers commence activities.	Trench shoring installation records. Daily excavation safety inspection records. Prohibited entry compliance. Injury incident reports.	Daily during excavation works	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	-	-
OHS / Community Safety									
Installation of mounting structures and panels	OHS (Workers)	Risk of falls, cuts, and musculoskeletal injuries during installation activities	Major	• Enforce use of full PPE including harnesses, helmets and non-slip footwear for all installation works. • Erect scaffolding or working platforms for all elevated installation activities. • Conduct toolbox talks on fall prevention and safe working at height before each shift. • Inspect all lifting equipment and tools daily before use.	PPE usage inspection. Scaffolding installation records. Toolbox talk attendance records. Fall incident reports.	Daily	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	-	-
Handling of construction materials and equipment	OHS (Workers)	Risk of injuries from improper lifting, falling objects, or equipment misuse	Major	• Train all workers in manual handling techniques and safe lifting practices before commencement. • Provide mechanical lifting aids for all loads exceeding 25kg. • Inspect all construction materials and equipment for defects before use. • Enforce hard hat and steel-toed boot requirements at all times on site.	Manual handling training records. Lifting aid availability. Equipment defect inspection records. OHS incident reports.	Daily	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	500,000	200,000
Electrical installation works (cabling, connections)	OHS (Workers)	Risk of electric shock, burns, or electrocution during installation of electrical components	Major	• Engage only certified and licensed electricians for all electrical installation works. • Implement lockout/tagout procedures for all electrical works.	Electrician certification records. Lockout/tagout procedure compliance. Pre-work electrical	Daily during electrical works	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	-	-

				• Conduct pre-work electrical safety briefings before each shift involving electrical activities. • Test all electrical connections before energizing any component.	safety briefing records. Electrical incident reports.				
Operation of machinery and equipment	OHS (Workers)	Exposure to noise, vibration, and mechanical hazards	Moderate	• Provide hearing protection to all workers operating or working near noisy machinery. • Rotate workers away from high-noise and high-vibration tasks to limit exposure duration. • Conduct pre-employment and periodic medical screening for workers exposed to noise and vibration. • Maintain all machinery in good working order to minimize noise and vibration output.	Hearing protection provision and usage records. Worker exposure duration rotation records. Medical screening records. Machinery maintenance logs.	Weekly	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	-	-
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	• Implement a site traffic management plan with designated vehicle and pedestrian zones. • Enforce a strict speed limit of 10 km/h for all vehicles within the campus. • Station flag persons at all vehicle-pedestrian conflict points.	Traffic management plan implementation. Speed limit compliance observation. Flag person deployment records. Vehicle accident incident reports.	Daily	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer, AAAU Security	-	-
Open trenches and excavation areas	Community Safety	Risk of unauthorized access leading to falls or injuries	Major	• Install physical barriers, hoarding and warning signs along the full length of all open trenches. • Cover or bridge open trenches at all pedestrian crossing points before end of each working day. • Conduct daily inspections of all barriers and coverings before works commence.	Physical barriers and warning signs installed along open trenches. Pedestrian crossing bridging in place before end of each working day. Daily barrier	Daily	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer, AAAU Security	-	-

				• Prohibit all unauthorized persons from entering the active construction zone.	inspection records. Unauthorized access incidents.				
Storage of fuel and hazardous materials	OHS / Community Safety	Risk of fire outbreak, explosion, or exposure to hazardous substances	Moderate	• Store all fuels and hazardous materials in a designated bunded area away from academic buildings. • Maintain fire extinguishers at all fuel storage and electrical works areas. • Prohibit smoking within 25 metres of any fuel storage or hazardous materials area. • Train workers in fire emergency response procedures during induction.	Bunded fuel storage area inspection. Fire extinguisher availability and condition. No-smoking zone compliance. Fire emergency drill records.	Weekly	**Mitigation:** Contractor **Monitoring:** NEP (PMU), Site Engineer	500,000	200,000
Excavation / trenching	Cultural heritage	Unexpected chance find	Moderate	• Apply Chance Finds Procedure.	Worker induction; stop-work records if any	Before excavation and continuous	Contractor; NEP-PMU E&S oversight	-	-
Total cost for Construction Phase								**6,200.000**	**2,100,000**

ESMP: Operation Phase

Activity	Receptor	Potential Impact	Significance	Mitigation measures	Monitoring Indicators	Monitoring Frequency	Institutional Responsibility	Cost	
								Mitigation	Monitoring
Battery storage and operation	Soil / Water	Risk of contamination from battery leakage or improper handling of electrolyte materials	Moderate	• Inspect battery storage systems and connections monthly for signs of leakage, corrosion or damage. • Install battery containment trays with secondary containment capacity under all battery banks.	Monthly battery inspection records. Secondary containment integrity checks. Spill kit availability and condition. Staff training records on spill response.	Monthly	**Mitigation:** Contractor / O&M Operator **Monitoring:** NEP (PMU), AAAU Management, AEPB	1,500,000	200,000

				• Prohibit storage of batteries directly on unprotected soil surfaces. • Train O&M staff in battery leak detection and emergency spill response procedures. • Maintain spill response kits in the battery storage room at all times.					
Operation of equipment (inverters, transformers)	Noise	Low-level noise generation from operational inverters and transformers, negligible relative to the existing ambient noise baseline from the Airport Road expressway	Minor	• Ensure inverters and transformers are installed within enclosed housing to contain operational noise. • Conduct periodic noise monitoring at the nearest sensitive receptor to confirm compliance with noise limits. • Schedule any high-noise maintenance activities during daytime hours only.	Periodic noise measurement at nearest sensitive receptor. Inverter and transformer housing inspection. High-noise maintenance activity scheduling records.	Quarterly	**Mitigation:** O&M Operator **Monitoring:** NEP (PMU), Site Engineer	200,000	100,000
Cleaning of solar panels	Water resources	Use of water from campus borehole supply for panel cleaning, particularly during the harmattan period, leading to minimal additional water demand on existing campus water infrastructure	Negligible	• Use minimum water volumes necessary for effective panel cleaning. • Schedule panel cleaning during early morning hours to minimize evaporative water loss. • Consider dry cleaning methods during the harmattan period to reduce water demand.	Volume of water used per panel cleaning session. Borehole water level monitoring. Evidence of dry cleaning methods during harmattan period.	Per cleaning event	**Mitigation:** O&M Operator **Monitoring:** NEP (PMU), AAAU Management	-	-
Maintenance activities	Waste generation	Generation of minor waste such as damaged components, packaging, and maintenance residues	Minor	• Implement waste segregation at source separating general waste from hazardous maintenance residues. • Contract a licensed waste collector for regular removal of all maintenance waste from the campus.	Waste segregation compliance observation. Licensed waste contractor removal records. Waste log maintained and up to date. Evidence	Monthly	**Mitigation:** O&M Operator **Monitoring:** NEP (PMU), AAAU Management, AEPB	300,000	100,000

				• Maintain a waste log recording types, quantities and disposal destinations of all waste generated. • Prohibit dumping of any maintenance waste within the campus or surrounding environment.	of no unauthorized dumping.				
End-of-life components (batteries, panels)	Soil / Environment	Potential environmental risk from improper disposal of hazardous end-of-life components including spent lithium-ion batteries, degraded PV panels and failed inverters, if not managed under the Extended Producer Responsibility framework and in compliance with NESREA Electrical and Electronic Sector Regulations 2011	Moderate	• Develop and implement an e-waste management plan in accordance with NESREA Electrical and Electronic Sector Regulations 2011. • Engage a NESREA-licensed e-waste handler for collection and disposal of all end-of-life batteries, panels and inverters. • Store all end-of-life components in a designated and labelled hazardous waste storage area pending collection. • Maintain records of all e-waste transfers including quantities, dates and licensed handler details.	E-waste management plan in place and implemented. Licensed e-waste handler engagement records. E-waste storage area inspection. E-waste transfer records.	Per end-of-life event / Annually	**Mitigation:** O&M Operator **Monitoring:** NEP (PMU), NESREA, AEPB	1,000,000	200,000
Operation of electrical systems (inverters, cables, connections)	OHS (Workers)	Risk of electric shock, burns, or electrocution during operation and maintenance	Major	• Implement lockout/tagout procedures for all maintenance works on energized electrical systems. • Engage only certified and licensed electricians for all operation and maintenance electrical works. • Conduct quarterly electrical safety inspections of all inverters, cables and connections.	Lockout/tagout procedure compliance records. Electrician certification records. Quarterly electrical safety inspection reports. PPE provision records. OHS training records.	Quarterly	**Mitigation:** O&M Operator **Monitoring:** NEP (PMU), Site Engineer	400,000	100,000

				• Provide appropriate PPE including insulated gloves and tools to all O&M electrical workers. • Train all O&M staff in electrical safety and emergency response procedures.					
Battery storage and management	OHS (Workers)	Risk of chemical exposure, fire, or explosion in case of battery failure or improper handling	Major	• Install automated battery management systems with thermal monitoring and overcharge protection. • Conduct monthly inspections of battery banks for signs of swelling, overheating or electrolyte leakage. • Install fire suppression systems and smoke detectors within the battery storage room. • Train O&M staff in battery fire emergency response and evacuation procedures. • Prohibit storage of flammable materials within 5 metres of the battery storage area.	Automated battery management system operational status. Monthly battery bank inspection records. Fire suppression system and smoke detector tests. Staff emergency response training records.	Monthly	**Mitigation:** O&M Operator **Monitoring:** NEP (PMU), Site Engineer	-	-
Operation of facility within campus	Community Safety	Risk of unauthorized access by students, staff or visitors to energized solar arrays, battery storage areas or electrical infrastructure within the AAAU permanent campus, leading to potential injury or electrocution	Major	• Install perimeter fencing and lockable gates around the solar array, battery storage room and control room. • Install clearly visible warning signs on all energized equipment and restricted areas. • Maintain adequate security lighting around the installation area throughout the night.	Perimeter fencing and lockable gates installed and maintained. Warning signs visible on all energized equipment. Security lighting operational. Security briefing records. Community awareness session records.	Monthly	**Mitigation:** O&M Operator **Monitoring:** NEP (PMU), AAAU Security, AAAU Management	200,000	100,000

				• Brief campus security personnel on restricted access zones within the solar installation. • Conduct regular community awareness sessions with students and staff on electrical safety within the installation.					
BESS operation	Workers / campus / environment	Thermal runaway/fire/smoke/re-ignition and emergency runoff	Major	• Maintain BMS/protection, alarms/detection, isolation, thermal management, fire response, emergency access, drills and controlled damaged-battery/fire-debris management.	Alarm/protection tests; drills; incidents; maintenance records	Monthly/quarterly as applicable; annual drill minimum	O&M Contractor; AAAU/REA	-	-
PV array operation	Aviation safety	Glint/glare if approved layout is altered or reflective conditions change	Major	• Maintain approved layout/orientation; • Screen material changes and investigate complaints.	No unapproved layout change; complaint close-out	Continuous; review on design change/complaint	O&M Contractor / AAAU / REA interface	-	-
Total Cost for Operation Phase								**2,700,000**	**800,000**

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 22 indicates the Roles and Responsibilities of the Stakeholders in the Implementation, Monitoring and Review of the ESMP.

Table 22: Institutional Roles & Responsibilities for ESMP Implementation

S/N	Stakeholder	Roles and Responsibilities
1.	AAAU 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 AAAU 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 AAAU 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 AAAU 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 AAAU 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 AAAU Director of Physical Planning to address non-compliance and upcoming issues
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 AAAU 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 AAAU 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 AAAU 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 AAAU Director of Physical Planning and NEP-PMU to address non-compliance and upcoming issues • Operational phase
7.	NESREA Representatives	• Monitor the implementation of ESMP requirements (environmental compliance monitoring) relevant to work being undertaken • Discuss ESMP improvements with O&M Contractor, AAAU Director of Physical Planning, and NEP-PMU to address non-compliance and upcoming issues
8.	AEPB Representatives	• Monitor the implementation of ESMP requirements (impact-mitigation monitoring) relevant to work being undertaken • Discuss ESMP improvements with AAAU Director of Physical Planning and NEP-PMU to address non-compliance and upcoming issue
9.	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).
10.	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. 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)

Nevertheless, before mobilization, the EPC Contractor shall submit project-specific plans proportionate to the final design: C-ESMP; Occupational Health and Safety Plan; Traffic Management Plan; Erosion/Stormwater Plan; Waste and Hazardous Materials Plan; Battery/E-Waste and EPR Plan; BESS Fire and Emergency Response Plan; Emergency Preparedness and Response Plan; Labour Management Procedures and Worker GRM; Worker Code of Conduct/SEA-SH procedures; Community Health and Safety Plan; Stakeholder Engagement/Community GRM arrangements; Chance Finds Procedure; and Security Management Procedure. These plans shall be reviewed/accepted by REA/NEP-PMU before the activities to which they relate.

7.7 Monitoring and Evaluation Plan

The monitoring plan (Internal and External Monitoring) for the ESMP is presented in the Table 23 below. Monitoring results shall be documented with preventive/corrective actions to be implemented.

Table 23: 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 is 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 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 contractor 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, Federal Ministry of Environment, AAAU Campus representatives, 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
Land-status verification	Complete Annex 9 and retain evidence before handover	AAAU + REA/PMU E&S	Before handover / material delay or footprint change	Signed PASS; no occupation/use/claims in work area
Serious E&S incident reporting	Notify/escalate serious incidents promptly under project/AfDB procedures; investigate and close corrective actions	Contractor/O&M; REA/PMU	Immediate notification per severity; monthly trend reporting	Timely notification; root-cause analysis; corrective actions closed

7.8 Training, Awareness and Capacity Building for Zonal Offices

REA - NEP 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 24.

Table 24: 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 AAAU etc.	Contractor, contractor drivers, HSE officer, ESO	School of Transport, AAAU / 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**

The capacity-building cost estimate is an all-inclusive budget. It covers facilitator/resource person fees, venue and logistics, participant transportation or local travel support, training materials and printing, audio-visual/technology support, refreshments, documentation, reporting, and post-training follow-up. The final cost breakdown shall be confirmed during implementation planning, but the estimate has been included to ensure that all key training-related expenditures required for ESMP implementation are budgeted.

7.9 Implementation Schedule and Reporting

The project has an estimated completion period of 12-18 months 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.

Also, REA shall keep the relevant regulatory authorities, including FMEnv, NESREA, the Abuja Environmental Protection Board (AEPB), 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.

Table 25: 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

The ESIA/ESMP will be disclosed in accordance with applicable FMEnv and AfDB requirements. The public-disclosure version shall protect personal and sensitive information in accordance with the Nigeria Data Protection Act 2023: telephone numbers, signatures, complainant identities and sensitive case details shall be removed/redacted. Grievance reporting shall be anonymized and aggregated.

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 26: 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, - Abuja Environmental Protection Agency - NEP-PMU Office Disclosure will also include advert 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	Following clearance by the AfDB, the ESIA/ESMP shall be disclosed in accordance with the disclosure requirements applicable to the project's environmental and social categorization under the AfDB Integrated Safeguards System.

7.11 ESMP Budget

The total costs of the ESMP implementation including costs for mitigation, monitoring and capacity building is estimated as: **₦29,810,000.00** (Twenty-Nine Million, Eight Hundred and Ten Thousand Naira, only.*)* which converts to **$21,886.92** (Twenty-One Thousand, Eight Hundred and Eighty-Six Dollars, Ninety-Two Cents), as detailed in Table 27 below:

Table 27: ESMP Budget

ITEM	RESPONSIBILITY	COST ESTIMATE	
		NAIRA (₦)	USD ($)
Cost of Mitigation	Contractor	12,800,000.00	9,397.94
Cost of Monitoring	NEP-PMU, MDAs	4,300,000.00	3,157.12
Capacity Building	NEP- PMU/Contractor	10,000,000.00	7,342.14
Sub-total		27,100,000.00	19,897.20
Contingency (10% of sub-total)		2,710,000.00	1,989.72
TOTAL		**29,810,000.00**	**21,886.92**

Exchange Rate $1.00(USD) = ₦1,362 (NGN) – CBN rate as at August, 2026

CHAPTER EIGHT: REMEDIATION PLAN AFTER DECOMMISIONING/ CLOSURE

8.1 Introduction

The proposed solar-hybrid mini-grid is expected to have an operational design life of approximately twenty-five (25) years, subject to proper operation, maintenance and replacement of major components such as batteries and inverters. At the end of the project's operational life, or where major components are permanently taken out of service, decommissioning shall be planned and implemented in accordance with applicable Nigerian regulatory requirements, the AfDB Integrated Safeguards System, the FMEnv National Guidelines for Decommissioning of Facilities in Nigeria, and good international industry practice.

8.2 Decommissioning Activities

A detailed decommissioning and closure plan shall be prepared before decommissioning activities commence and submitted to the relevant regulatory authorities for review and approval. The plan shall define the scope of decommissioning, the components to be removed, the method of dismantling, waste streams to be generated, handling and recycling arrangements, occupational and community health and safety measures, site rehabilitation requirements, implementation schedule, institutional responsibilities and estimated costs.

Decommissioning activities shall include:

i. Dismantling and removal of photovoltaic panels, mounting structures, inverters, transformers, batteries, switchgear, control equipment, cables and associated infrastructure;
ii. Removal or safe abandonment of underground cables and subsurface installations, where applicable;
iii. Segregation, inventory and management of decommissioned materials, including reusable components, scrap metal, electrical and electronic waste, batteries and general demolition waste;
iv. Transportation of spent batteries and e-waste through licensed handlers to approved recycling, take-back or disposal facilities in accordance with applicable NESREA regulations and Extended Producer Responsibility requirements;
v. Restoration and stabilization of disturbed areas, including erosion control, backfilling, grading and revegetation where required;
vi. Consultation with AAAU, Iddo Sarki community, regulatory authorities and other relevant stakeholders before commencement of decommissioning; and
vii. Post-decommissioning inspection and monitoring to confirm that the site has been left in a safe, environmentally sound and socially acceptable condition.

8.3 Management of Decommissioning Activities

In the event of decommissioning, REA, in conjunction with the leadership of the African Aviation and Aerospace University (AAAU), 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.
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)
- To ensure that due consideration is given to all options a detailed evaluation of facility decommissioning options shall be carried out. The options will include facility mothballing, partial facility decommissioning or complete site decommissioning. The evaluation will consider environmental issues in conjunction with technical, safety and cost implications to establish the best practicable environment friendly options for the Project decommissioning.
- 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.

8.4 Abandonment Plan

Closure performance criteria are: all electrical systems safely de-energized; no uncontrolled batteries/e-waste/hazardous materials remaining; no unsafe pits, exposed cables or unstable structures; no unacceptable project-attributable contamination; stable drainage and erosion conditions; lawful transfer/recycling/disposal records for dismantled materials; and the site restored to a condition suitable for the agreed future AAAU land use. Stakeholder communication and grievance channels shall remain available through the closure period.

Prior to site abandonment, REA 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 AAAU, and the Federal 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. DtP-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 AAAU to address noncompliance and upcoming issues.

C. AAAU 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 AAAU on contractor's performance regarding the implementation of environmental and social measures.

D. Director of Works and Physical Planning Department in AAAU

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

E. Federal 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 DtP-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 African Aviation and Aerospace University (AAAU), 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 Integrated Safeguards System 2023 particularly Operational Safeguard (OS) 10 on Stakeholder Engagement and Disclosure, 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, focus group discussions, and administration of socioeconomic questionnaires. Engagements were conducted in both English and Hausa to ensure effective communication across all stakeholder groups. These engagements provided an opportunity to inform stakeholders about the proposed project, obtain their views and concerns, and incorporate relevant inputs into the impact assessment and project design. The consultation process covered university management and staff, students, the Iddo Sarki host communities, traditional leadership, and relevant Ministries, Departments and Agencies.

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 28: Stakeholder Identification and Categorization

Stakeholder Category	Stakeholders
Primary Stakeholders (Directly Affected / Beneficiaries)	African Aviation and Aerospace University (AAAU) Management, University Academic and Non-Academic Staff, Students (End Users), On-campus Facilities and Departments, Iddo Sarki Community (Nearest Host Community), Traditional Rulers and Community Leaders, Contractors and Sub-contractors
Implementing Agency	Rural Electrification Agency (REA) through the Nigeria Electrification Project (NEP) Project Management Unit
Regulatory Institutions	Federal Ministry of Environment (FMEnv), National Environmental Standards and Regulations Enforcement Agency (NESREA), Abuja Environmental Protection Board (AEPB), FCT Environmental Planning and Protection Department (FCT EPPD), Federal Capital Development Authority (FCDA), National Universities Commission (NUC), Nigerian Electricity Regulatory Commission (NERC), Federal Ministry of Power, FCT Area Council (Abuja Municipal Area Council)
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 African Aviation and Aerospace University (AAAU), Abuja. 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 29: Proposed Stakeholder Engagement Plan

Project Phase	Key Activities	Target Stakeholders	Method of Engagement
Design / Preparation Phase	• Disclosure of ESIA findings • Stakeholder identification and consultation	• African Aviation and Aerospace University (AAAU) Management • University Staff and Students	• Formal stakeholder meetings • Key informant interviews • Site visits

	• Integration of stakeholder input into project design	• Rural Electrification Agency (REA) – PMU • Federal Ministry of Environment • Host Community (nearby residents) • Traditional Leaders and Community Representatives	• ESIA disclosure sessions- • 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 including youth and Women Groups • Local Labour and Workers • Contractors and Sub-contractors-AAAU Management • REA • Federal 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 environmental and social performance • Continued stakeholder engagement • Management of grievances and feedback • Periodic audits and reporting	• AAAU Management and Facility Operators • University Staff and Students (users) • Host Community • REA • Federal Ministry of Environment (as applicable)	• 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

This section shall describe the grievance redress mechanism for general grievances and GBV/SEA related grievances (including a GBV action Plan). The standard GRM of REA-NEP will support but not replace the site-specific grievance mechanisms established at subproject level.

Grievance redress mechanism (GRM) is a framework which enables local communities and relevant stakeholders of a project to raise issues (including logging, tracking, and grievances resolution) about the project which are addressed efficiently and effectively while issues as regards implementation are resolved. The GRM will be communicated to all stakeholders in the course of project development and implementation and will make publicly available a record documenting the responses to all grievances received. The GRM shall be maintained throughout the project life cycle.

9.2.1 Grievance Redress Mechanism: Reporting Channels and Process

The GRM shall include accessible in-person, telephone/SMS/WhatsApp, email, written and secure complaint-box channels, including anonymous reporting. SEA/SH allegations shall be handled through a separate confidential, survivor-centred referral pathway based on informed consent and shall not be investigated by the ordinary grievance committee. Only minimum necessary personal data shall be collected, and public disclosure shall contain anonymized aggregate grievance information.

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.

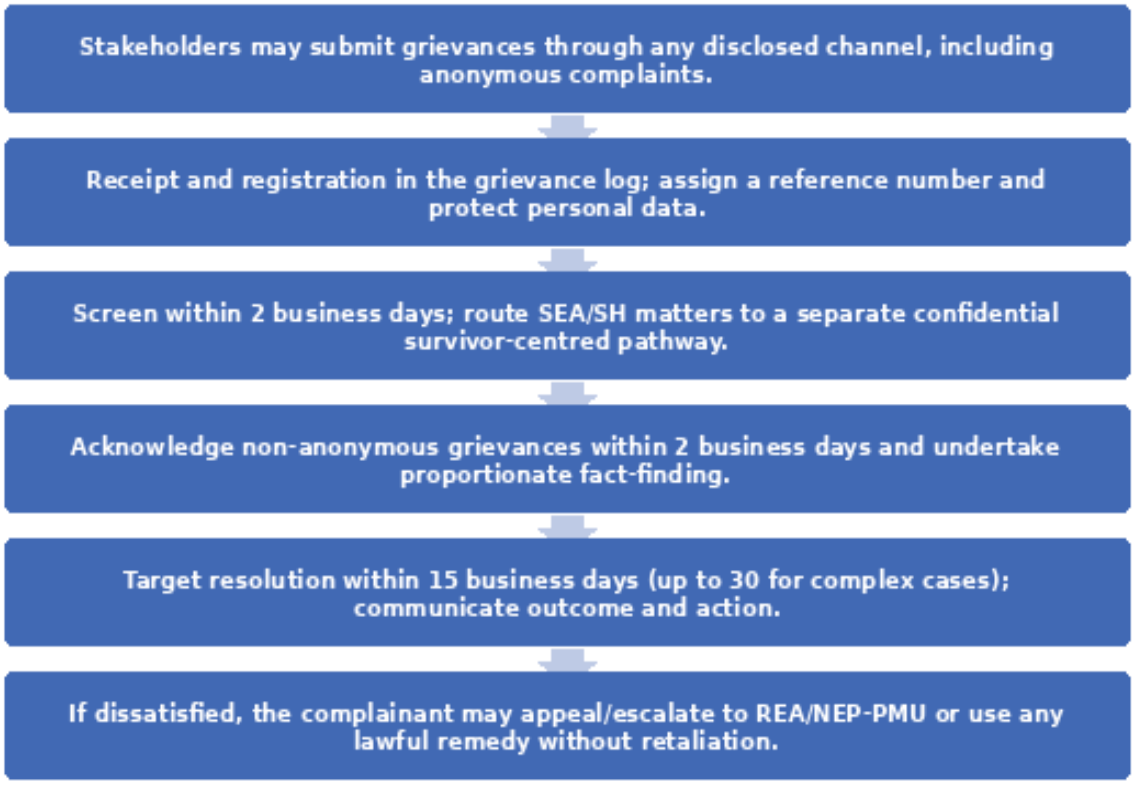

Figure 21: GRM process

9.2.2 Publicizing and Disclosure of the GRM

The GRM will be disclosed to the stakeholders through written and verbal communication. The mediums to be used for this purpose are public meetings, group discussions The GRM disclosure will be done along with the disclosure of other management plans.

9.2.3 Receiving and Recording Grievances

As part of the GRM, the grievances from the stakeholder or their representatives may be communicated verbally (in person or over a telephonic conversation) or in written form (in the format given in Table 30) to the project representatives or to the designated Grievance Officer (GO) directly. If the grievance is received directly by the GO or other project representatives, it will be recorded directly into the Grievance Form as soon as the personnel return to site. A sample grievance form is presented in the table below:

Table 30: 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
Anonymous / Contact Preference	Anonymous complaint permitted: Yes / No. Preferred safe contact method (if provided): _____. Signature is not required for anonymous complaints.
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 thus received, shall be recorded in a grievance register. This grievance register shall be updated at each stage of the grievance redressal. Once the grievance is recorded in the register, a preliminary analysis shall be undertaken by the social standard officer/ manager to ensure that the grievance is within the scope of the GRM.

9.2.5 Acknowledgment of Grievance

Upon the completion of the recording of the grievance, the stakeholder will be provided with an acknowledgment of the receipt, along with a summary of the grievance. In case the grievance is assessed to be out of the scope of the GRM, a communication towards the same shall be made to the grievant, and an alternative mode of redressal shall be suggested.

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 31.

Table 31: Classification and Categorization of External Grievances

S/N	Nature of Grievance	Categorization
1.	Land/site access or status	Social Safeguards / AAAU / Contractor as relevant
2.	Construction nuisance: dust, noise, traffic or access	Contractor / Environmental & Social Safeguards
3.	Damage to property or infrastructure	Contractor / Social & Environmental Safeguards
4.	Labour/recruitment or worker conduct	Contractor HR / Social Safeguards
5.	Environmental pollution, waste or water issue	Environmental Safeguards / Contractor
6.	Community/ OHS safety or security	HSE / Social Safeguards / Security as relevant
7.	SEA/SH or other sensitive complaint	Confidential survivor-centred referral pathway; not ordinary GRM investigation

9.2.7 Resolution, Escalation, and Closure

Based on the understanding thus developed, the social safeguard officer/ manager, in consultation with the concerned departments, shall identify a suitable resolution to the issue. This could involve provision of information to clarify the situation, undertaking measures to remedy actual problems or compensate for any damage that has been caused either by financial compensation or compensation in-kind, and introduction of mitigation measures to prevent recurrence of the problem in the future. This resolution shall be accordingly communicated to the grievant within 10 working days of completing the site investigation.

In case the issue is beyond the purview of the social safeguard officer/ manager, it should be escalated to the Head PMU of DtP (as appropriate). Communication regarding the same shall be provided to the grievant. The Head PMU of the DtP shall in turn endeavour to resolve the grievance within 10 working days of the escalation.

If, however, the grievance remains unsettled, and the Head PMU of DtP 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.

If at any stage, the grievant is not satisfied with the solution, s/he may choose to ask for an escalation of the grievance to the next level. Where grievance is found to be not a real problem a clear explanation will be provided to the complainant.

9.2.8 Update of Records

The records of the grievance register shall be updated every working week with the present status of the grievance. Once the grievance is resolved, and the same has been communicated to the grievant, the grievance shall be closed in the grievance register. The grievance register should also provide an understanding of the manner in which the grievance was resolved. These instances shall then serve as references for any future grievances of similar nature. Where there is evidence of recurring issues or grievance coming up on the project, it is necessary to flag this up to Head PMU of the DtP in order to assess if the project design requires updating.

9.3 Summary of Public Consultations.

The proposed Solar Hybrid Mini-Grid Project at the African Aviation and Aerospace University (AAAU) Abuja, 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 ESIA study, consultation activities were conducted at different stages of the assessment process. The sections that follow present a summary of the key issues raised by stakeholders and how these have been addressed in the project design and mitigation measures.

Table 32: Consultation with University Community

Consultation at the African Aviation and Aerospace University, FCT Abuja	
Date	10th July, 2026
Location	Campus Permanent site, AAAU.
Attendees:	Director of Works and Physical Planning, AAAU; Deputy Director of Works and Planning; Quantity Surveyor; Director of Academic Planning; Students (FGD Groups); ESIA Consulting Team

Summary of consultation

School Administration and Staff

- ❖ University management expressed strong support for the proposed solar hybrid mini-grid project, acknowledging its critical importance to the institution's academic and operational development.
- ❖ The Director of Works and Physical Planning confirmed that the university holds full ownership of the 4-hectare project footprint, with no encumbrances, third-party claims or competing land uses.
- ❖ Management confirmed that the campus currently has no national grid connection and relies entirely on diesel-powered generating sets for all electricity supply.
- ❖ The need for a transformer to enable future connection to the national grid was noted by management, with acknowledgement that this falls outside the scope of the proposed project.

Students

- ❖ Students raised concern about the significant noise generated by diesel generators, noting that generator noise frequently disrupts lectures and impairs concentration during class sessions.

- Students raised concern that the generators do not carry sufficient electrical load to power air conditioning units, resulting in extremely hot and uncomfortable classrooms during lectures, particularly during the dry season.
- Students requested that construction activities be scheduled to avoid examination periods and convocation seasons, to prevent disruption to academic activities.
- They expressed interest in employment opportunities and hands-on training in renewable energy systems during the construction phase of the project.

Consultant's Response

- The concern about noise impacts on the guest house was acknowledged. Stakeholders were informed that noise will be minimised through appropriate siting of equipment, installation of sound attenuation measures, and implementation of mitigation measures as detailed in the ESMP.
- The need for a transformer and grid connection was noted and acknowledged as falling outside the scope of the proposed project. This matter will require separate consideration by the relevant authorities.
- The concerns about generator noise and hot classrooms were noted. The solar hybrid system is specifically designed to provide stable and sufficient electrical power to support the full campus load, including air conditioning units, directly addressing these concerns upon commissioning.
- A commitment was given to coordinate construction scheduling with the university academic calendar to avoid examination periods and convocation seasons.
- Local employment prioritization was confirmed in accordance with AfDB safeguard standards, with contractors required to adopt a local-first approach for unskilled and semi-skilled roles.

Table 33: Community-Wide Consultation

Consultation with Iddo Sarki Community Leadership and Members	
Date	11th July 2026
Location	Iddo Sarki Community
Attendees:	District Head of Iddo Sabo; Community Leaders and Elders; Male and Female Community Members; Youth Representatives; Women's Group Representatives; ESIA Consultant Team

Summary of consultation

Community Leadership

- The District Head of Iddo Sabo and community leaders expressed strong support for the proposed project and welcomed the ESIA team warmly, confirming prior awareness of the project through earlier outreach activities.
- Community leadership requested that local youth and community members be prioritized for employment opportunities generated by the project during both the construction and operational phases.
- The District Head requested that the electricity generated by the solar installation be extended to benefit surrounding communities, including local schools and residents, noting that the communities currently have very limited access to reliable electricity.
- Community members expressed concern about the long-term sustainability of the solar installation and requested assurance that the project will be properly maintained and will remain operational over its full design life.

Women

- Women participants expressed strong support for the project, noting that reliable electricity would significantly enhance small-scale income-generating activities within the community, including food vending, tailoring, phone charging services and petty trading.
- Women requested that they not be excluded from indirect economic benefits of the project and that local women be actively considered for non-specialized roles within the project where feasible.

Youth

- Youth participants expressed keen interest in direct employment opportunities during the construction phase, requesting priority consideration for unskilled and semi-skilled roles such as security, site assistance, materials handling and community liaison.
- Youth requested that a transparent and fair recruitment process be established with a clear project contact for employment enquiries, to avoid exploitation or bias in the selection process.

- Youth expressed interest in skills development and hands-on training opportunities in renewable energy systems that the project could facilitate, to build local technical capacity.

Consultant's Response

- The ESIA team confirmed that local employment will be prioritized in line with AfDB safeguard standards, and that contractors will be required to adopt a local-first approach for all unskilled and semi-skilled roles.
- The request for community energy access was noted. Options for extending electricity supply to surrounding communities, including local schools, will be assessed during detailed design and implementation, subject to technical feasibility and regulatory approvals.
- Long-term sustainability was assured through the provision of robust Operations and Maintenance arrangements, including a dedicated O&M contractor, as detailed in the ESMP.

The inclusion of women in indirect economic benefits and employment opportunities was confirmed as a project commitment consistent with AfDB safeguard requirements on gender inclusion.

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 campus of the African Aviation and Aerospace University (AAAU), Federal Capital Territory, Abuja, has evaluated the potential environmental, social, and occupational health and safety implications associated with the project across its pre-construction, construction, operational and decommissioning phases.

The proposed project is designed to provide reliable and sustainable electricity supply to the AAAU permanent campus, which currently has no national grid connection and relies entirely on diesel-powered generating sets for all electricity needs. The project will directly address existing energy constraints, enhance academic and research activities, improve learning conditions including the provision of stable power for air conditioning in classrooms, and significantly reduce the institution's dependence on fossil fuel-based energy sources. In this regard, the project aligns with national energy development objectives under the Nigeria Electrification Project Phase II, the Energizing Education Programme, and Nigeria's international commitments to sustainable development and climate change mitigation.

Potential adverse impacts identified during the ESIA are largely site-specific, temporary and manageable. During the construction phase, key impacts include dust generation along the cable corridor and access routes, noise, soil disturbance, vegetation clearing, occupational health and safety risks, and minor social disturbances associated with labour influx and construction activities within the active campus environment. The underground cable route connecting the solar installation to the University's central powerhouse represents a significant linear construction element whose environmental and social management has been specifically addressed in the ESMP. During the operational phase, potential impacts are minimal and relate primarily to equipment maintenance, waste management including e-waste from batteries and panels, and occupational safety risks from energized electrical systems.

Appropriate mitigation measures have been developed to address all identified impacts and are presented in Chapter Six, while a comprehensive Environmental and Social Management Plan has been provided in Chapter Seven to guide implementation, monitoring and reporting throughout the project lifecycle. The ESMP outlines clear institutional responsibilities, measurable monitoring indicators and reporting arrangements to ensure effective environmental and social management from pre-construction to decommissioning.

Based on the findings of this ESIA, the proposed approximately 1 MW-class Solar Hybrid Mini-Grid Project at the African Aviation and Aerospace University is environmentally and socially viable provided that the mitigation measures, ESMP and pre-construction hold-points are implemented as binding project requirements. Particular conditions are maintenance of a displacement-free footprint through land-status verification, acceptance of the final PV glint/glare outcome for aviation safety, BESS fire/life-safety design verification, approval and implementation of the Contractor ESMP, and completion of electrical safety/commissioning readiness before energization. With these controls, residual impacts are expected to be predominantly Minor to Moderate and manageable through continued monitoring and adaptive management.

10.2 Recommendations

To ensure the successful and sustainable implementation of the proposed Solar Hybrid Mini-Grid Project at the African Aviation and Aerospace University (AAAU), the following recommendations are provided:

Environmental Management

- All mitigation measures identified in Chapter Six shall be fully implemented by the EPC Contractor under the supervision of the REA Project Management Unit and the designated Environmental and Social Safeguard Officer.
- Site-specific measures shall be adopted to control dust generation along the cable corridor and campus access routes, prevent soil erosion within the project footprint, and manage surface runoff particularly during the wet season.
- Proper waste management practices including segregation, storage and licensed disposal of solid waste and hazardous e-waste from batteries, panels and inverters shall be strictly enforced in compliance with NESREA Electrical/Electronic Sector Regulations S.I. No. 79, 2022 and Battery Control Regulations 2024 and AEPB requirements within the FCT.

Occupational Health and Safety

- A comprehensive Health, Safety and Environment plan shall be developed and implemented by the EPC Contractor prior to mobilization, in accordance with applicable national OHS standards and AfDB good practice requirements.
- All workers shall be provided with appropriate Personal Protective Equipment and trained on its correct use before commencing any site activities.
- Regular safety training, toolbox talks and site inspections shall be conducted throughout the construction period, with particular attention to excavation and trench works, electrical installation activities and equipment handling.
- Adequate safety signage, physical barriers and restricted access controls shall be maintained at all construction zones and energized electrical infrastructure throughout both the construction and operational phases.

Social Management

- The project shall prioritize engagement of local labour from the Iddo Sarki communities and from within the AAAU campus community for all unskilled and semi-skilled roles during construction, in line with AfDB safeguard standards on local employment.
- A functional Grievance Redress Mechanism shall be established, communicated to all stakeholders and maintained throughout the project lifecycle, with grievances logged and responded to within clearly defined timeframes.
- A robust Code of Conduct shall be developed, signed by all workers and enforced throughout the construction period, with specific provisions prohibiting gender-based violence, sexual exploitation and abuse, sexual harassment and child labour.
- The construction schedule shall be coordinated with the AAAU academic calendar to avoid examination periods and convocation seasons, consistent with commitments made during stakeholder consultations.

Monitoring and Reporting

- Environmental and social monitoring shall be carried out in accordance with the ESMP, using the defined monitoring indicators, frequencies and institutional responsibilities specified in Chapter Seven.

- Regular monitoring reports shall be prepared by the Environmental and Social Safeguard Officer and submitted to REA PMU, FMEnv and AfDB at the intervals specified in the ESMP.
- Corrective actions shall be taken promptly where monitoring identifies non-compliance, exceedance of environmental standards or unforeseen impacts, and such actions shall be documented and reported.

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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 Rural Electrification Agency (REA) intends to provide sustainable solar-hybrid mini-grid systems for selected tertiary institutions under the AfDB-financed Nigeria Electrification Project (Desert-to-Power) Phase II. 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 three (3) tertiary institutions under the programme.

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 Tertiary Institutions Under (LOT 2) the AfDB Desert-to-Power Programme for ESIA Study

S/N	Institution	State	Geo-political Zone	Lot
1	African Aviation and Aerospace University	FCT-Abuja	North Central	Lot 1
2	National University of Science and Technology	FCT-Abuja	North Central	Lot 2
3	Admiralty University, Ibusa	Delta	South-South	Lot 2

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 selected tertiary institutions through solar-hybrid mini-grid systems exceeding 1 MW capacity per site. The assignment covered under this Terms of Reference relates specifically to the three (3) institutions listed in Table 1..
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 Institution 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 solar-hybrid power systems and associated infrastructure at the three (3) selected tertiary institutions 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 institution represents a unique environmental, social and institutional setting. Accordingly, standalone Environmental and Social Impact Assessments (ESIAs) shall be prepared for each institution to capture site-specific environmental and social risks, stakeholder concerns and applicable regulatory requirements under the Environmental Impact Assessment Act (Cap E12 LFN 2004) and the African Development Bank Integrated Safeguards System (ISS). 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

- 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)*	*Payment (%age of Total Remuneration)*
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	20%
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	30
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	20

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 separately for each of the three (3) institutions covered under this Terms of Reference 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	30

Note: Each of the three (3) institutions shall be registered separately with the Federal Ministry of Environment, and a standalone ESIA report shall be prepared and disclosed for each institution..

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: ENVIRONMNETAL 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 location	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

STAKEHOLDER CONSULTATION ATTEND [redacted]

Environmental and Social Impact Assessmen

African Aviation and Aerospace University (AAAU)

Nigeria Electrification Project Phase II (Desert-to-Power) | Emerging Education Programme | Rural Electrification Agency (AEI)

Date of Consultation:	11 - 07 - 2026	[redacted]
Venue / Location of consultation:	AAAU	
Time:	2:30 pm	

ATTENDANCE REGISTER

No.	Full Name	Gender (M/F)	Organization / Designation	
1	Oluwadamilare James	F	Student AAAU	[redacted]
2	Daniel Ilang	M	—	
3	Emmanuel Dobson	M	—	
4	Philip Guang	M	—	
5	Ismail Yakubu	M	—	
6	Paul Oluwape Ifedapo	F	—	
7	[illegible] Efosa	M	—	
8	Ishaku Yakubu Usman	M	—	
9	Umar Abdullahi	M	—	
10	Halima Umar	F	—	
11	Rahma [illegible]	F	Student	
12	Saudatu [illegible]	F	—	
13	Nafisat Shehu	F	—	
14	Khadija Bello [illegible]	Female	Student	
15	Nadira Sani	F	—	
16	Grace Hassan	F	Student	
17	Ismel Oyedotun	M	Student AAAU	
18				
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STAKEHOLDER CONSULTATION ATTENDA [redacted]

Environmental and Social Impact Assessment

African Aviation and Aerospace University (AAAU)

Nigeria Electrification Project Phase II (Desert-to-Power) | Emerging Education Programme | Rural Electrification Agency (AEI)

Date of Consultation:	11 - 07 - 2026	[redacted]
Venue / Location of consultation:	IDO SARKI Community	
Time:	11:30am	

ATTENDANCE REGISTER

No.	Full Name	Gender (M/F)	Organization / Designation	
1	Alhaji Usman Dauda	Male	Business Man	[redacted]
2	Kabir Mahmudu	✓	Farmer	
3	Mustapha Abdullahi	✓	Business	
4	Nuhu Ibrahim Sambo	✓	Trader	
5	Salisu Ismail	✓	Businessman	
6	Tijjani Yakubu Umar	✓	Trader	
7	Aliyu Suleiman	✓	Farmer	
8	Garba Bello Ilah	✓	—	
9	Bello Muhammad		— [illegible]	
10	Khadija Yusuf	F	Student	
11	Hafsat Umar	F	—	
12	Asmau Aliyu	F		
13	Yamma Aminu	F		
14	Maryam Bello Ahmed	F	—	
15	Hadiza Abubakar	F	—	
16	Jamilah Baba	F	School	
17	Alhassan Hassan Ahmad	F	Business	
18				
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STAKEHOLDER CONSULTATION ATTEND

Environmental and Social Impact Assessme

African Aviation and Aerospace University (AAAU)

Nigeria Electrification Project Phase II (Desert-to-Power) | Energizing Education Programme | Rural Electrification Agency | AfDB

Date of Consultation:	13 - 02 - 2026
Venue / Location of consultation:	AAAU Female Hostel
Time:	

[redacted]

ATTENDANCE REGISTER

No.	Full Name	Gender (M/F)	Organization / Designation
1	Mohammed Halimah	F	Student
2	Odizoh Morayoluwa	F	Student
3	ABDOUL INNOCENTE	F	Student
4	DANIADI AMAZING GRACE	F	Student
5	FATIMA HASSAN	F	STUDENT
6	MARIAM ABDULAZEEZ	F	STUDENT
7	Ibrahim Halima	F	STUDENT
8	TAMARAI DIAMOND ZOBAMI	F	STUDENT
9	Onique Prosper	F	Student
10	Omaghitse Favour Mene	F	Student
11	Idowu James Oreoluwa	F	Student
12	Elizabeth Johnson	F	Student
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STAKEHOLDER CONSULTATION ATTEND.

Environmental and Social Impact Assessmer

African Aviation and Aerospace University (AAAU)

Nigeria Electrification Project Phase II (Desert-to-Power) | Energizing Education Programme | Rural Electrification Agency | AfDB

Date of Consultation:	11 — 07 — 2026
Venue / Location of consultation:	AAAU
Time:	11:55 am

[redacted]

ATTENDANCE REGISTER

No.	Full Name	Gender (M/F)	Organization / Designation
1	Abdullateef Dolapo Sanyaolu	M	AAAU / MSc Stude
2	Segun Abdulmutin	M	AAAU / MSc Studen
3	Jonathan Daniel	M	AAAU / MSc Studen
4	Alhassan Aliyu Abdussalam	M	AAAU / MSc Stude
5	MAKURENG KIRAM NAHLE	M	AAAU / MSc Student
6	AMIRA BOSEDE	F	AAAU / MSC Studen
7	Pinkrose Laetitia ROBERTS	F	AAAU / MSC Studen
8	ZAINAB ABDULMUTALIB ASHIM	F	AAAU / MSc Student
9	SHAMSADEEN YUSUF	M	AAAU / MSC STUDENT
10	Chinonso Samuel MBAH	M	AAU / MSc Stude
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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 African Aviation and Aerospace University, FCT Abuja, 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 categorisation 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

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 optimise 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 maximise 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 AAAU 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.

All controlled/hazardous/electrical/battery waste transfers shall be documented using waste registers, manifests or equivalent records identifying waste type, quantity, date, transporter/handler, destination and treatment/recycling/disposal route. Informal disposal, open burning and uncontrolled dumping are prohibited.

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 African Aviation and Aerospace University, FCT Abuja 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

AAAU, in Abuja, lies within the Guinea 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
Lightning strike	Damage to solar PV panels, inverters, transformers, and other electrical equipment, resulting in service interruption, fire hazards, and increased maintenance requirements.
Lightning / convective storms	Electrical damage, fire, equipment outage and worker exposure.
Harmattan dust / prolonged dry periods	PV soiling, reduced output, increased cleaning-water demand and worker heat/dust exposure.
High wind / severe storm	Mechanical loading of PV arrays and risk of debris/equipment damage.

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

Protection Against Lightning and Extreme Weather Events

- Incorporation of lightning protection systems for solar PV arrays and associated electrical infrastructure.
- Installation of surge protection devices (SPDs) to safeguard electrical equipment against transient overvoltages.
- Provision of adequate earthing and grounding systems for all PV installations and electrical equipment.
- Routine inspection and maintenance of lightning protection and earthing systems to ensure continued effectiveness.

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
Detailed design climate-resilience review	EPC Designer / REA-NEP-PMU / Owner's Engineer
Operational climate-performance monitoring	O&M Contractor / AAAU asset management

Monitoring Indicators

Aspect	**Indicator**	**Frequency**
Solar efficiency	Energy output vs expected performance	Monthly

Aspect	Indicator	Frequency
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
Extreme rainfall / drainage	Post-storm inspection findings; blocked drainage; erosion/ponding locations	After major storm and monthly in wet season
Heat/ BESS thermal performance	BESS temperature alarms, derating events and HVAC/thermal-management faults	Continuous SCADA; monthly review
Lightning / surge	Protection-system inspection/test results; lightning/surge incidents	Per manufacturer/engineering schedule and after major event

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 African Aviation and Aerospace University, FCT Abuja. 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

Key risks include unsafe recruitment/terms, delayed wages, excessive working hours, discrimination/harassment, child or forced labour, inadequate worker grievance channels, SEA/SH and worker-community misconduct, excavation/work-at-height/lifting/electrical hazards, heat stress, traffic incidents and supply-chain labour risks associated with PV/BESS equipment. The contractor shall verify worker age and identity, issue written terms understandable to workers, comply with wage/hour/leave requirements, prohibit recruitment fees/forced labour, apply non-discrimination/equal opportunity, provide appropriate welfare and OHS protections, and maintain auditable worker records.

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
EPC Contractor HR / Labour Officer	Maintain contracts, age verification, payroll/working-time records, worker induction, non-discrimination controls, subcontractor compliance and worker GRM.
REA/PMU Social/OHS Specialists	Audit labour compliance, review serious grievances/incidents, monitor supply-chain due diligence and corrective actions.

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
Worker GRM	Number received/resolved; acknowledgement/resolution time; non-retaliation	Monthly
Age / forced-labour controls	100% worker age/identity verification; zero forced labour/recruitment fees	At recruitment; monthly audit
SEA/SH / Code of Conduct	100% workers sign CoC and receive induction; confidential referral pathway functional	At induction; quarterly refresher

Worker Grievance Mechanism: Workers shall have a separate confidential and non-retaliatory mechanism independent of line management where practicable, allowing oral/written/anonymous concerns on terms, wages, discrimination, harassment, OHS, accommodation/welfare and supervisor conduct. Receipt should be acknowledged promptly, routine grievances targeted for resolution within 15 business days, and serious OHS/SEA-SH matters escalated immediately through appropriate specialist channels. Use of the worker GRM does not restrict statutory remedies.

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 African Aviation and Aerospace University, FCT Abuja 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 African Aviation and Aerospace University, FCT Abuja. 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.

High-risk activities shall be controlled through task risk assessment/JSA, competent-person authorization and permit-to-work systems where appropriate. Electrical work shall apply isolation, lockout/tagout (LOTO), test-before-touch and controlled energization. BESS emergency arrangements shall address alarm, remote isolation where safe, evacuation, exclusion zones, trained responder notification, re-ignition risk, damaged-battery quarantine and contaminated debris/firewater management. The project shall conduct emergency drills before energization and at least annually during operation.

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: LABORATORY ANALYTICAL REPORTS AND CHAIN OF CUSTODY DOCUMENTATION.

Pollution Control Laboratory, Farm Centre
Ministry of Environment, Kano
Block No. 5 AuduBako Secretariat
No. 125 T/ShanuTarauni, Kano State.
Hon. Commissioner: 064-668371
Perm. Secretary Fax: 669413

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CUSTODY TRANSFER FORM

Client Name:	ECO-FIELDS GLOBAL SERVICES LIMITED	Relinquished by(Sinature): [signature]	Date: 10/7/2026	Time: 10:00am
Project Name:	Proposed Solar Hybrid mini grid	Received by (Signature):	Date:	Time:
Address:	AAU Gidan Zone Abuja	FMEVT Representative:	Date:	Time:
Consultant		Address:		

Type of Simple			**Number of Samples:** 10 soil samples
Water Sample ☐	**Soil Sample** ☑	**Others (Specify):** ☐	**Date Sampled:** 10/7/2026

S/No.	Sample ID	Sample Location	Laboratory Description of Sample
1	AAU SS1	African Aviation Academy	AAU SS1
2	AAU SS2	✓	SS2
3	AAU SS3	✓	SS3
4	AAU SS4	✓	SS4
5	AAU SS5	✓	SS5
6	AAU SS6	✓	SS6
7	AAU SS7	✓	SS7
8	AAU SS8	✓	SS8
9	AAU SS9	✓	SS9
10	AAU SS10	✓	SS10

Water In-situ parameters

S/N	Parameters	Unit	BH 1	BH (10)	Stream I	Stream II
1.	pH	—	6.12	6.54	6.64	7.14
2.	Temperature	°c	32.0	31.8	31.2	32.9
3.	Dissolve oxygen	mg/L	4.3	4.0	4.6	5.1
4.	Electrical Conductivity	us/cm	553	816	96	134

10/7/22.

Lab. Representative

Project: ESIA for the proposed 50Kw-hybrid Mini Grid System at the African Aviation
Site Address: At African Aviation and Aerospace University (AAAU) at plot 2367 Gidkaka/Jare Abuja
Date: 10/7/2026.

Ambient Air Quality Measurements

Station Code	Stations	Latitude	Longitude	Elevation	Parameters									
				CO_2	NO_2 (ppm)	CO (ppm)	H_2S (ppm)	SO_2 (ppm)	HCN (ppm)	NH_3 (ppm)	CL_2 (ppm)	PM_{10} (ppm)	$PM_{2.5}$ (ppm)	(AQI)
1	AAAU AQ1			477	0.1	0	0.0	0.1	0.0	0	0.0	24	20	Excellent
2	AAAU AQ2			467	0.2	0	0.0	0.0	0.0	0	0.0	27	24	Excellent
3	AAAU AQ3			409	0.2	0	0.0	0.1	0.0	0	0.0	29	19	Excellent
4	AAAU AQ4			496	0.1	0	0.0	0.2	0.0	0	0.0	39	25	Good
5	AAAU AQ5			908	0.1	0	0.0	0.1	0.0	0	0.0	38	22	Excellent
6	AAAU AQ6			501	0.2	0	0.0	0.1	0.0	0	0.0	28	29	Excellent
7	AAAU AQ7			484	0.1	0	0.0	0.2	0.0	0	0.0	28	22	Excellent
8	AAAU AQ8			586	0.2	0	0.0	0.1	0.0	0	0.0	24	21	Excellent
9	AAAU AQ9			451	0.1	0	0.0	0.1	0.0	0	0.0	27	25	Excellent
10	AAAU AQ10			469	0.1	0	0.0	0.2	0.0	0	0.0	31	26	Excellent
11														
12														
13														

[illegible] REPRESENTATIVE — DATE

CONSULTANT REPRESENTATIVE — DATE

[illegible] ACCREDITED LABORATORY — DATE 10/7/26

Project: ESIA For the Proposed Solar – Hybrid Mini-grid Systems
Site Address: At African Aviation and Aerospace University (AAAU) Abuja plot 2367 (adjacent/zone
Date: 10/7/2026

Ambient Air Quality Measurements

Station Code	Stations	Latitude	Longitude	Elevation	Parameters									
					HCL (ppm)	TVOC (ppm)	O_3 (ppm)	C_2H_4 (ppm)	PH_3 (ppm)	PM1.0 (ppm)	HCHO (ppm)	Temp (°C)	HUM (%)	Noise (dB)
1	AAU AQ1				0.32	0.003	0.01	0	0.0	16	0.000	28.7	53	48.1
2	AQ2				0.16	0.012	0.00	0	0.0	17	0.000	29.3	47	50.4
3	AQ3				1.43	0.012	0.00	0	0.0	16	0.000	29.5	56	51.2
4	AQ4				1.05	0.004	0.00	0	0.0	20	0.000	29.1	48	49.3
5	AQ5				0.86	0.015	0.01	0	0.0	13	0.000	29.4	72	69.7
6	AQ6				1.00	0.005	0.01	0	0.0	14	0.000	28.9	54	58.4
7	AQ7				1.32	0.014	0.01	0	0.0	16	0.000	29.5	61	58.1
8	AQ8				0.59	0.012	0.00	0	0.0	17	0.000	30.6	60	51.1
9	AQ9				0.61	0.003	0.00	0	0.0	18	0.000	28.3	58	49.6
10	AQ10				0.74	0.006	0.01	0	0.0	19	0.000	29.5	57	47.1
11														
12														
13														

EMEVT REPRESENTATIVE
DATE

CONSULTANT REPRESENTATIVE
DATE

EMEVT ACCREDITED LABORATORY
DATE 10/7/26

ANNEX NINE: PRE-CONSTRUCTION LAND STATUS VERIFICATION PROTOCOL

This protocol is a mandatory construction hold-point used to confirm continued eligibility of the final project footprint for avoidance of AfDB OS5 impacts. The verification shall cover the permanent footprint, underground cable corridor, temporary laydown areas and access works. A FAIL result means the affected area shall not be handed over or disturbed until avoidance is achieved through redesign/relocation or the applicable safeguard process is completed.

Verification Item	**Status**	**Evidence / Action**
Approved work boundary available and physically demarcated	YES / NO	Attach map and geo-referenced photographs
Land remains under AAAU institutional control	YES / NO	AAAU administrative confirmation
No residences or third-party structures within work area	YES / NO	Walkover / photographs
No standing crops or active cultivation within work area	YES / NO	Walkover / photographs
No business or livelihood/economic activity within work area	YES / NO	Walkover / consultation
No grazing/access-dependent/resource use that would be restricted	YES / NO	Walkover / consultation
No new ownership/tenure/compensation claim known	YES / NO	AAAU statement / stakeholder check
Cable corridor and temporary areas satisfy the same conditions	YES / NO	Walkover / map
Conclusion: displacement-free footprint confirmed	PASS / FAIL	FAIL = no handover of affected area; achieve avoidance before works

Sign-off: AAAU Representative _____

REA/DtP-PMU Environmental Specialist _____

REA/DtP-PMU Social Specialist _____

Date _____

ANNEX TEN: CHANCE FINDS PROCEDURE

If archaeological, historical, sacred, burial, palaeontological or other cultural-heritage material is encountered during excavation or trenching, the Contractor shall immediately stop work in the vicinity, secure and protect the find, notify the site supervisor and REA/NEP-PMU E&S team, and notify the competent authority where required. The object or feature shall not be removed, cleaned or disturbed by workers. The location and circumstances shall be recorded without publicly disclosing sensitive location information. Work may resume only after written clearance and completion of any required protection, recovery or design measure. All excavation personnel shall be briefed on this procedure before earthworks.

ANNEX ELEVEN: BESS FIRE AND EMERGENCY RESPONSE FRAMEWORK

The stationary BESS shall be designed and operated using a prevention-first approach. The final system shall include suitable cell chemistry (LiFePO4 preferred), manufacturer BMS and independent protective functions, enclosure/siting and separation appropriate to the hazard, temperature/fault monitoring, alarm and emergency isolation, ventilation/thermal management, fire detection and an engineered response/containment strategy, emergency responder access, signage and exclusion controls.

Safety evidence shall be appropriate for stationary industrial applications, including IEC 62619:2022 and IEC 62485-5:2020 or equivalent; thermal-runaway propagation/fire information shall be considered using UL 9540A/NFPA 855 or technically equivalent GIIP where applicable. Emergency response shall provide for alarm, safe isolation, evacuation, responder notification, re-ignition monitoring, contaminated runoff/debris control, damaged-cell quarantine, incident reporting/investigation and defined return-to-service approval.

ANNEX TWELVE: PUBLIC DISCLOSURE, DATA PRIVACY AND GRIEVANCE CONFIDENTIALITY PROTOCOL

The public-disclosure ESIA shall comply with the Nigeria Data Protection Act 2023 and the project principle of data minimization. Personal telephone numbers, signatures, private addresses, complainant identities and sensitive case details shall be removed or redacted from public copies unless there is a clear lawful basis and disclosure necessity. Attendance records may retain non-sensitive information needed to demonstrate consultation but shall not expose phone numbers or signatures. Grievance registers shall be maintained securely; public reporting shall show anonymized aggregate categories, status and trends. SEA/SH information shall be handled only through confidential survivor-centred channels and shall not be included in ordinary grievance minutes or public records.