



Azura-Edo Independent Power Project

Environmental Impact Assessment

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Azura Power West Africa Limited

Azura-Edo Independent Power
Project: *Environmental Impact
Assessment*

February 2012

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For and on behalf of
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EXECUTIVE SUMMARY

INTRODUCTION

Azura Power West Africa Limited ('Azura Power'), a Nigerian-registered subsidiary of Amaya Capital Limited ('Amaya'), proposes to develop a 450 MW Open Cycle Gas Turbine (OCGT) Power Plant on the outskirts of Benin City, Edo State, Nigeria. The Project comprises a power plant, a short transmission line connecting the power plant to the adjacent Benin North Substation, and a short pipeline spur connecting the power plant to the Escravos Lagos Pipeline System.

The proposed site for the Project is located in the north-eastern outskirts of Benin City, Edo State in Nigeria. The Project site is adjacent to the Ihovbor Power Plant which is currently under construction under the auspices of the National Integrated Power Project (NIPP).

The Project requires an EIA in terms of the Nigerian Environmental Impact Assessment Act No 86 (1992) and in order to fulfil World Bank requirements for financing. The purpose of the EIA is to ensure that potential environmental and social impacts associated with development of the Project are identified, assessed and managed appropriately. Mitigation measures are then developed and incorporated into the project to eliminate, minimise or reduce adverse impacts and, where practicable, to enhance benefits. Azura Power has appointed Environmental Accord (EnvAccord) and Environmental Resources Management Limited (ERM) to develop the EIA, the main results of which are presented in this executive summary.

PROJECT OVERVIEW

The Project will comprise a 450 MW (net) gas-fired power plant a short transmission line (less than 1 km) connecting the power plant to the Benin North substation (adjacent to the Project site) and a short underground gas pipeline spur (circa 1km in length) connecting the power plant to the country's main gas trunk line, the Escravos Lagos Pipeline System (ELPS).

The Project and this EIA do not include the Benin North substation which is currently being constructed under the management of the National Integrated Power Project (NIPP). This substation was initiated and funded prior to the establishment of Azura Power and its construction and operation is not dependent upon the Azura-Edo IPP.

PROJECT JUSTIFICATION

The project is justified primarily on the basis of the need for additional electricity supply to meet and support the growing demand for power in Nigeria to support economic growth.

In 2005, the Government launched an ambitious capital investment program under the title of the National Integrated Power Project (NIPP). The NIPP projects comprise both gas-fired power plants and transmission lines and, when completed, are intended to add nearly 5,000 MW to the country's electricity capacity. The Government has made it clear that it would not be desirable or possible for such enormous investments to be funded and directed by the Federal Government, and hence the Nigerian Government has stressed repeatedly, that the requisite investments in the power sector will only be achievable if the private sector is incentivised to make these investments.

In this context, the Azura-Edo IPP is regarded as a critical project to provide the necessary power supply capacity and also a test of the country's ability to resuscitate the power sector and provide much-needed employment opportunities for its large, young and rapidly urbanising citizens.

Other positive benefits of the proposed project include the following:

- At a national level, an increase in grid based power generation capacity. At a local level, the development of Benin City area and the State to provide employment opportunities (direct and indirect) from the increased availability of power within the region).
- In line with the Government's plans for power sector reform, the Project will assist to promote stronger relationships and collaboration between the Federal Government of Nigeria, the Local State Government (relevant Edo State departments/ ministries) and relevant regulatory bodies. In particular, the partnership with Edo State (a minority shareholder - up to 5 percent – and which will provide land and roads) is intended to provide a foundation for collaboration with local government and other relevant parties in the future
- The selection of world-class expertise enlisted for the project will bring a wealth of skills and technology for wider energy sector within Edo State.
- The Project has been nominated for participation in a series of Partial Risk Guarantees (PRGs) initiated by the World Bank to support the Nigerian electricity supply industry and has applied for political risk insurance (PRI) from the Multilateral Investment Guarantee Association (MIGA). These will encourage external investors and also raise the investment profile of other, similar, projects in Nigeria.

EIA PROCESS

The EIA for the Azura Edo IPP was undertaken in accordance with the Environmental Impact Assessment Act (Act No. 86 of 1992) and World Bank requirements. Accordingly, the EIA process comprised of a number of key steps, namely:

- Screening and scoping
- Baseline data collection
- Stakeholder consultation
- Impact assessment
- Management plans
- Reporting and disclosure

A brief description of each step is provided below.

Screening and Scoping

A project proposal containing a summary of the proposed project was submitted to Federal Ministry of Environment (FMEnv) for their Initial Environmental Evaluation (IEE) to determine the project's category under the study activities list.

Following this, a scoping report, including Terms of Reference (ToR) for the EIA and an application form, was submitted to FMEnv on 20 December 2010. The report contained a description of the project, a description of the existing environmental and socio-economic baseline, a preliminary assessment of the potential environmental and social impacts, identification of key data gaps and stakeholder input from the consultation process. The scoping report was approved on 21 February 2011 and the Project placed in Category I, requiring a mandatory EIA Study and a panel review exercise.

Baseline data collection

Available data was gathered as a basis against which the impacts of the project can be assessed. In addition to a desktop review of existing reports such as EIAs and the neighbouring NIPP plant, primary data was collected by field studies carried out by biophysical and socio-economic specialists as indicated in *Table 1*.

Table 1 ***Fieldwork for Baseline Data Collection***

Data Collection	Date	Team
Dry season biophysical data collection	19 – 21 March 2011	EnvAccord
Qualitative data collection	19 – 13 June 2011	Janice Olawoye and team
Wet season biophysical data collection	24- 26 July 2011	EnvAccord
Socio-economic enumeration survey	22 – 26 August 2011	Janice Olawoye and team

Stakeholder Consultation

The public participation process comprised the following activities:

- identification of a preliminary list of stakeholders;
- creation of background information document (BID) for use in communicating with stakeholders;
- meetings with a number of government departments and stakeholder groups; and
- various focus group meetings with local community members.

Key stakeholders consulted during public participation are listed in *Table 2*.

Table 2 *Stakeholders Consulted During Stakeholder Engagement*

Stakeholder Group	Stakeholders
National Government Authorities	<ul style="list-style-type: none"> • Nigerian Electricity Regulatory Commission (NERC) • The Federal Ministry of Power • Federal Ministry of Environment
State Government Authorities	<ul style="list-style-type: none"> • Edo State Ministry of Energy and Water Resources. • Edo State Ministry of Lands, Surveys and Housing. • Edo State Ministry of Environment and Public Utilities. • The Edo State Governor’s, Benin City; • Edo State Rural Electrification Board; • Edo State Public Private Partnership office • Edo State Ministry of Lands, Surveys and Housing
Local Government Authorities	<ul style="list-style-type: none"> • Uhumwode Local Government Area Council. • Lands Officials; • Public Private; Partnership (PPP) Representatives; • Local Councillors;
Non Governmental Organisations Community Groups	<ul style="list-style-type: none"> • Nigeria Conservation Foundation (NCF) • Communities of Orior-Osemwende, Ihovbor-Evboeka and Idunmwumowinna-Urho-Nisen: • Local chiefs and elders • Youth groups • Women’s groups

Impact Assessment

The impact assessment process has the following four main components.

1. Prediction of the consequences of project activities on the environmental and social receptors.
2. Evaluation of the importance and significance of the impact.
3. Development of mitigation measures to manage significant impacts where practicable.
4. Evaluation of the significance of the residual impact.

Where significant residual impacts remain, further options for mitigation may be considered and impacts re-assessed until they are reduced to as low as reasonably practicable (ALARP) levels. This approach takes into account the technical and financial feasibility of mitigation measures.

In addition to predicted impacts from planned activities, those impacts that could result from an accident or unplanned event within the Project (eg a pollution event) are taken into account.

In support of this impact assessment noise and air emissions modelling were undertaken. Impact assessment methodologies for these impacts (dust, NO², greenhouse gases and noise) were developed using US EPA limits, IFC guidelines (both NO² and greenhouse gases) and World Health Organisation (WHO) noise limits.

Management plans

The EIA process identified a range of mitigation measures, management actions and monitoring requirements to be implemented during the project to eliminate or reduce adverse environmental and social impacts, enhance positive impacts and monitor the effectiveness of mitigation measures implemented. Delivery of these will be through the project Environmental and Social Management Plan (ESMP). The EIA report presents a provisional ESMP detailing the specific actions that are required to implement these controls and mitigation measures.

Reporting and disclosure

The EIA process and outcomes were drawn together into a draft EIA report which will be submitted to for review. The draft EIA report will be submitted to FMEnv for their review. In accordance with EIA requirements, FMEnv will disclose the EIA report to the public for review and comment and will also be the subject of a technical review by FMEnv and appointed experts. FMEnv will base the decision to grant or deny the certification for the EIA, which provides environmental authorisation for the project, on the outcome of the review process.

Inline with World Bank requirements for stakeholder consultation, the draft EIA report will be disclosed through the World Bank InfoShop when the report is submitted to FMEnv, to allow for stakeholder consultation and comment in parallel with FMEnv's review.

LEGAL AND POLICY FRAMEWORK

National Administrative Framework

The Project is subject to regulations implemented and enforced by the following government organisations:

- The FMEnv is the primary authority for regulation and enforcement of environmental laws. FMEnv enforces a number of policies, acts and guidelines including the National Policy on the Environment (1989, revised 1999), the Environmental Impact Assessment Act No. 86 (1992) and National

Guidelines and Standards for Environmental Pollution Control in Nigeria (1991).

- The Edo State Ministry of Environment and Public Utilities (MEPU) is responsible for waste management, flood and erosion control, forest depletion and degradation and general environmental and atmospheric pollution. The Edo State Waste Management Board is an agency under the direct supervision of the Edo State Ministry of Environment and Public Utilities with the responsibility for collection, transport, processing, recycling or disposal and monitoring of waste materials.

Nigerian Environmental Legislation

Nigerian environmental legislation relevant to this project includes the following.

- Environmental Impact Assessment Act No 86 (1992);
- Water Resources Act of 1993;
- National Environmental Protection (Management of Solid and Hazardous Wastes Regulations), 1991;
- National Environmental Protection (Effluent Limitation) Regulations, 1991;
- Harmful Wastes (Special Criminal Provisions etc) Act No 42 (1988);
- Federal Environmental Protection Agency Act (Act of 1998)
- National Guidelines and Standards for Environmental Pollution Control in Nigeria (1991).

The Environmental Impact Assessment Act (Act No. 86 of 1992) is the primary Act governing EIA in Nigeria.

Nigerian Social Legislation

Nigerian social legislation relevant to this project includes the following.

- Factories Act (Act of 1990);
- Labour Act (1990); and
- Land Use Act (Act No. 6 of 1978).

Edo State Development Plans

The Edo State Development policy aims to create an enabling environment for private entrepreneurship to thrive and mirrors national political and trade liberalisation programmes. As a general rule, the Edo State Government does not take shareholding stakes of more than 20 percent in commercial enterprise. Instead, it helps to facilitate the establishment of industrial estates by allocating plots of land to private investors.

International Standards and Guidelines

Azura Power is seeking to obtain a Partial Risk Guarantee from the World Bank's International Development Association together with insurance cover from the World Bank's Multilateral Investment Guarantee Agency. As a result, the following international requirements and standards have been considered within the EIA process and are described below:

- Equator principles.
- World Bank's environmental and social safeguard policies, including:
 - OP 4.01 – Environmental Assessment.
 - OP 4.12 – Involuntary Resettlement.
 - OP 4.11 – Physical Cultural Resources.
- World Bank Group General Environmental, Health and Safety Guidelines.
- World Bank Group Environmental Health and Safety (EHS) Guidelines on Thermal Power Plants.

Equator Principles

The Equator Principles are a set of ten principles adopted banks all over the world in order to manage the social and environmental risks associated with their investments. The Equator Principles identify the requirements of a borrower to conduct an EIA, ensuring that all applicable environmental and social standards are adhered to throughout and beyond the ESIA.

World Bank's Environmental and Social Safeguard Policies

The World Bank's environmental and social safeguard policies are fundamental to the bank's support for programmes and provide guidelines for bank and borrower staff in the identification, preparation, and implementation of programmes and projects. There are a total of ten environmental, social and legal Safeguard Policies of the World Bank, of which OP 4.01 – Environmental Assessment and OP 4.12 – Involuntary Resettlement are the most relevant to this EIA and have been taken into account in the development of this EIA report.

World Bank Group EHS Guidelines on Thermal Power Plants

The World Bank EHS guidelines provide guidance on emission limits, management measures and monitoring for emissions, waste and community health and safety for all fossil-fuel thermal-based power plants with a production capacity of more than 50 MW.

PROJECT DESCRIPTION

Project Location

The Project site comprises approximately 102 ha and is located in the north-eastern outskirts of Benin City in Edo State, in the Federal Republic of Nigeria. The site is adjacent to the Ihovbor NIPP Power Plant, which is currently under

construction. The 450 MW power plant will cover approximately 12.5 ha of the site and will be constructed to allow for a potential conversion to a Combined Cycle Gas Turbine (CCGT) if deemed economically viable in the future.

Project Components

The Project comprises the following components:

- a 450 MW (net) gas-fired power plant;
- a short transmission line (less than 1 km) connecting the power plant to the Benin North substation, which is located adjacent to the Project Site;
- a short underground gas pipeline spur (circa 1km in length) connecting the power plant to the country's main gas trunk line, the Escravos Lagos Pipeline System (ELPS).

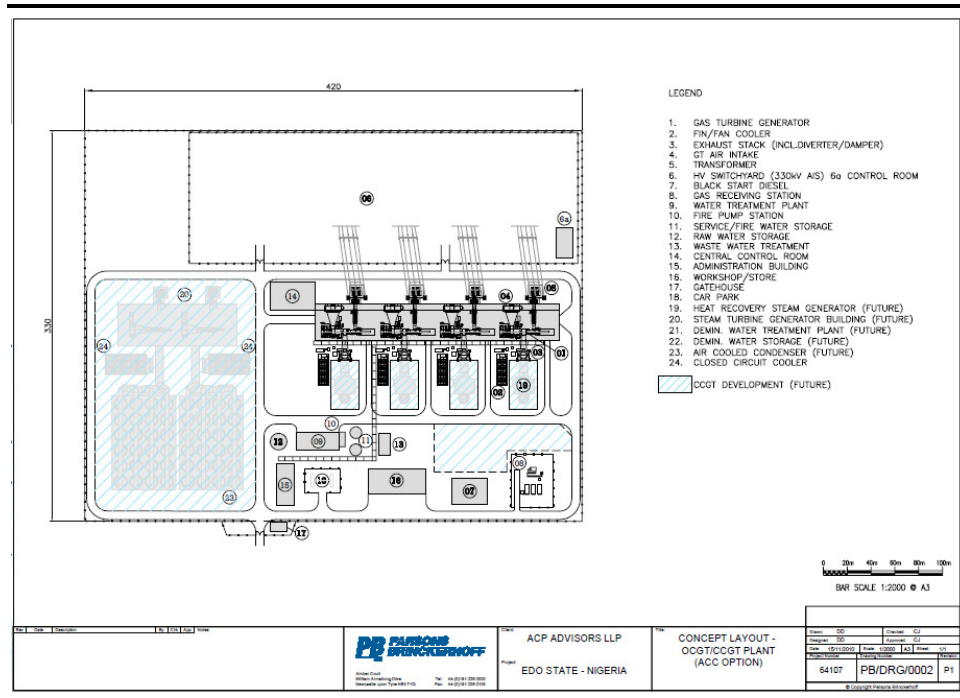
Power Plant

The OCGT plant has been designed to accommodate the potential conversion to Closed Cycle Gas Turbine (CCGT) with a total net output of approximately 670 MW. The CCGT will form an extension adjacent to the OCGT facilities with Heat Recovery Steam Generators (HRSG) installed next to each gas turbine.

An OCGT Power Plant consists of a gas turbine and a generator. The gas turbine comprises a compressor, combustion system and a power turbine. The compressor draws in fresh air and raises the air pressure by compressing it. Fuel is added to the compressed air in the combustion system and ignited. The resulting expanding burning gases turn the power turbine which is connected to the generator thereby creating electricity. The Azura-Edo IPP will be constructed around four Frame E gas turbine generators, operating in open cycle with a nominal output of 112.5 MW from each unit, and a total capacity of the power station of approximately 450 MW.

The proposed layout of the power plant is provided in *Figure 1* below. This figure illustrates a conceptual layout for an OCGT plant and includes potential future conversion to CCGT technology (with air cooling).

Figure 1 Layout of Proposed Power Plant



Source: Azura Power West Africa, 2011

The typical full load fuel flow for a 9E configuration burning natural gas is 1,350 GJ per hour, equivalent to approximately 120 mmscf per day. As a result of potential power outages from the National Grid used for startup, Azura Power plans to install three 3.7 MVA diesel units (approximately 40 m³, with piping to the black start units) to provide the estimated 7.4 MVA required to “Black Start” the power station.

Transmissions Line

The OCGT power station will have four transformers to step up the voltage from 15 kV to the transmission voltage of 330 kV from where it will then be fed over a short length of overhead cable to an air-insulated switchyard before being exported via overhead cables on a single tower to the new substation at Benin North, located adjacent and to the south to the Project site. A Risk Assessment for the transmission line and gas pipeline spur components will be conducted and key recommendations will be incorporated into the EMP.

Gas Pipeline Spur

The Project site is located less than 1 km from the ELPS, the country’s main natural gas trunkline. Natural gas will be delivered to the plant via the ELPS and a circa 1 km spur line from the ELPS to a gas receiving station on the plant site. This spur will share the same right of way used by the spur that connects the ELPS to the adjacent NIPP power plant.

Ancillary Utilities

Roads

The existing road currently leading from the main dual carriageway (Benin City Bypass) to the Project site will be used as the primary access route to the site and is tarred and in good condition. No new roads will be required for the Project.

Fire Protection

The gas turbine enclosures will be fitted with fire detection and protection systems and a fire water system will be installed for the rest of the site a pump station and a hydrant and hose points. The two service/ fire water tanks (storage capacity of 700 m³) will include a fire water reserve of 300 m³ per tank.

Other ancillary utilities and services include a workshop, administration buildings, lube oil systems, compressed air and ventilation systems and an overall control system.

A summary table of the emissions and wastes is provided below in

Table 0.2 *Summary of Emissions and Wastes*

Type of Emission	
Air emissions	The key point sources of emissions from the power plant will originate from the four gas turbine stacks, and the black start diesel engine stacks and will include approximately 20 ppm NO _x , 30 ppm SO _x and trace amounts of H ₂ S. Approximately 2,178,000 tonnes of carbon dioxide is expected to be released per annum as a result of the operation of the power station.
Noise	Noise emissions will result from a variety of sources including the gas turbines during operation and mobile machinery and plant during construction and decommissioning. The gas turbines, however, will be built in a noise reducing enclosure, with the outside target noise reaching a maximum of 85 dBA.
Waste water	Both oily water and chemical waste water effluents will be generated by the power plant operations, from pressure filters, regeneration effluent from the demineralisation plant as well as other chemical laboratory wastes and battery waste water and gas turbine compressor wash water. Sludge will also be generated from the waste water treatment process. All effluent will be collected and treated, and then collected in a central waste water monitoring basin. Effluent will be pumped and discharged from this collection basin once the water meets the Nigerian and World Bank discharge criteria for discharge of effluent. The final discharge of effluent, after passing through the oil/water separator will be discharged via the plant effluent drainage system to a small stream located approximately 800 m from the Project site. Non-contaminated water will be routed into a storm water system and discharged to the surrounding area as per Nigerian and World Bank requirements. Domestic sanitary waste that will be treated in a small package sewerage treatment plant.

Type of Emission

Solid waste	All solid wastes generated during construction (surplus spoil) and operation (waste chemicals, office waste and small amounts of hazardous waste) will be disposed of at an appropriately licensed landfill site. Azura Power will identify appropriate landfill sites during the detailed design phase.
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Project Schedule

It is estimated that the facility will be operational by second quarter of 2015. Site preparation and construction is expected begin in the fourth quarter of 2012 and to be completed by the fourth quarter of 2014. Testing and commissioning is expected to be undertaken between the fourth quarter of 2014 and be completed by the first quarter of 2015. The lifetime of the Project is expected to be 20 years and decommissioning to take place from 2035.

Project Activities

Construction Phase

Project activities will commence with site clearance of vegetation, earthworks, site levelling and construction of site roads. The "lay down" area will be on the area reserved for the Heat Recovery Steam Generators (HRSGs) and steam turbines. A temporary construction camp will be established to house the employees during the construction phase within the site (on the western portion) and will include (to be confirmed on appointment of EPC contractor) housing, kitchens, eating areas and latrines. Site preparation will involve vegetation clearing activities and removal of organic material, removal of unsuitable material and top soil, and levelling and compaction, including cut to fill, and borrowing to fill from an approved source of material.

Screw piling (auger piling) of the foundations for the gas turbines and other large items of equipment will commence six months into the construction schedule, and will last for three to four months. Once the piles are in place, concrete slabs and turbine pedestals will be formed using large concrete pours.

The gas turbine building and overhead 330 kV cables will be constructed at around 15 months while gas turbines and other heavy equipment will be delivered at 12 - 18 months, associated with abnormal loads on the roads. Raw materials will be sourced locally to the extent possible.

Construction will generally be during daylight hours, however the final stages of installation and commissioning may proceed 24 hours a day, seven days a week. Approximately 500 people will be employed during the construction phase and up to 70 percent of the construction workers can be sourced locally, from within 30 km of the Site.

Operational Phase

Following testing and commissioning activities, the power plant is expected to generate approximately 3.25 TWh (3,250,000 MWh) per year.

Approximately 50 permanent site employees will be employed during the operational phase, including plant management staff, maintenance staff, skilled technicians, drivers, cleaning staff and a number of semi-skilled operators.

Ongoing maintenance inspections are expected to be carried out annually in the following sequence with the associated outages: two Combustion Inspections (14 days each), a Hot Gas Path Inspection (25 days), two Combustion Inspections and then a Major Inspection (60 days).

Consideration of Alternatives

The EIA includes a consideration of alternatives by providing a comparative analysis of the no project alternative, location alternatives, design/ technology and fuel alternatives. The no project alternative is shown not to be viable due to the national demands for power supply and the government priority of economic growth. The project location was chosen because this site has good road access, is in a relatively peaceful area and within Edo State, as per Azura Power's partnership with the Edo State Government. Hydropower can only meet a small percentage of Nigeria's power requirements. Natural gas is the preferred fuel source, as it is more readily available (with large reserves) than coal and associated with lower emissions than both coal and oil.

DESCRIPTION OF THE EXISTING ENVIRONMENT - BIOPHYSICAL

For the purposes of this non-technical summary, the description of the baseline environmental conditions is limited to those aspects that are directly relevant to the proposed project and anticipated impacts, ie on-site soil condition, water quality, ecology and social conditions and infrastructure.

Climate and Air

Edo State (and the Study Area) is situated in the Tropical/megathermal climate. Average monthly rainfall levels for Benin City and adjacent areas during 1999 and 2000 were 187.5 and 186.7 mm respectively (Federal Department of Meteorological Services). Wind patterns are determined by the Inter-Tropical Discontinuity zone, with westerly and southwardly winds prevalent during the wet season, and north-easterly winds during the dry season (Federal Ministry of Power, 2010). Meteorological data from the closest inland meteorological station (Bohicon) with complete yearly data indicate that south-westerly winds are prevalent (USEPA AERMET program). In the recent years the maximum sustained wind speed has reached 44 km/h, equivalent to approximately 28 m/h (Weather2, 2011).

An ambient air quality survey was conducted during the wet and dry seasons using a hand-held meter. Dry and wet season results from the neighbouring

NIPP were used for NO₂. The results show a relatively clean air shed with low values of SO₂ and Total Suspended Solids (TSP) and NO₂ values within the Nigerian Ambient Air Quality and WHO standards.

Geology and Soils

The Study Area is located within the Niger-Delta Basin and Benin formation, characterised by deposits laid during the tertiary and cretaceous periods (Alile et al, 2007). The Benin Formation has been created from weathered sedimentary rock (Ogunkule et al, 1980). This mixture of sediment demonstrates a highly permeable sand aquifer system with multilayer aquifer characteristics. The Study Area falls into the southern belt of forest soils and red-yellow ferrasol on loose sandy sediments. Soils comprise a mixture of sand, silt and clay with a predominance of sand and hence can be defined as sandy loam (Royal Horticultural Society, 2011 and NIPP, 2010).

A soil survey was undertaken during the wet and dry season to characterise the soil's baseline physico-chemical characteristics and determine any existing contamination. Soil quality was generally found to be good across the Project site, with low levels of heavy metals and hydrocarbons (with one exception at the western-most portion of the Project site).

Water Resources

No streams or rivers were identified on the Project site and the closest water resource is a small non-perennial pond located approximately 800 m to the north of the site boundary. The Ikpoba River, into which the pond drains, lies approximately 4 km east from the proposed site.

Two boreholes are located in the area surrounding the Project site, at Ihovbor-Evboeka and Orior-Osemwende. Water samples from these boreholes were tested during the wet and dry seasons and water quality ranged between good to generally good, although the pH lies outside of the WHO and FMEnv optimal ranges for potable water. Nitrogen levels at Ihovbor-Evboeka were higher than FMEnv levels (but within WHO limits) during the dry season. Similarly for Nickel concentrations during both seasons. Water quality from these boreholes is considered to be fair.

Noise

A survey of the ambient noise levels on the site was undertaken during the wet and dry seasons. Noise levels measured were higher than expected for the semi-rural environment, likely due to short-term construction noise from the neighbouring site and rainfall at the time of measurement. The true baseline measurement was therefore not possible. The average overall for the NIPP site and surrounds (prior to NIPP construction activities) was measured at 34 dB (A) during wet season and 37 dB (A) during the dry season. As with standard methodology, the baseline noise levels are therefore considered to be below the

IFC Noise Level Guidelines for daytime, 55 dB(A) LAeq, 15hr, and 45 dB(A) LAeq, 9hr, for night time for residential, institutional or educational receptors.

Terrestrial Ecology

An ecological survey was undertaken during the wet and dry seasons to describe the existing terrestrial habitat types within the study area and to identify fauna and flora species using a combination of line and belt (10m by 5m) transects.

The Study Area is characterised by human activities and vegetation types encountered areas of fallow bush of varying ages, abandoned and functional subsistence and commercial farmland, plantations for wild and domesticated oil palm and rubber species and degraded secondary rainforest as well as statutory, personal and communal forests. This is a result of non-intensive agricultural activity, including slash-and-burn clearing, the construction and use of roads, dwellings and other structures and footpaths. A total of 48 plant families comprising 125 species were encountered. The most commonly encountered plant species and vegetation ecosystems identified were cassava, rubber plantations, secondary forest and guinea grass. One Endangered and eight Vulnerable floral species were identified (IUCN, 2001).

Faunal species identified in the project area include the Mona Monkey (*Cercopithecus mona*), Crested Porcupine (*Hystrix cristata*), African Giant Rat (*Crecomys gambianus*). Several species of squirrels (notably the African tree squirrel – *Heliosciurus gambianus* and Striped ground squirrel – *Xerus erythropus*), Monitor Lizards (*Varanus albigularis*), and the red necked Cobra (*Naja pallida*) are expected to occur in the area. Local inhabitants indicated that local fox (*Vulpes* species), antelope (*Tragelaphus* species) and deer (*Cervus elaphus*) are also known to occur within the Project area. Two faunal species (the Soldier Ant and a Dragon Fly species) were identified during the wet season to be of Vulnerable ecological status. These are listed in *Table 4.5* below.

Protected Areas

There are no protected areas in close vicinity to the Study Area or that will be directly affected with the development of the Project. The closest natural forest reserve is the Sakoba Forest Reserve located approximately 20 km to the south of the Project site. According to the Nigerian Forestry Act (1958) and the Edo State Forestry Law CAP 59 (1976), the forest areas in proximity to the Study Area fall under anthropogenic or natural forest. It has been identified that the Project site is located on anthropogenic forest, fallow land none of which is cordoned off, and it is not well maintained by surrounding owners.

DESCRIPTION OF THE EXISTING ENVIRONMENT - SOCIO-ECONOMICS AND HEALTH

A socio-economic and health study was undertaken during the EIA based on a review of available secondary information and primary data collected in the local communities and from Edo State Government. Primary data collected for this

analysis are both qualitative and quantitative and derived from key informant interviews, village-level surveys and focus group discussions.

Demographics

The proposed Project is located in Uhumwode LGA of Edo State, which occupies an area of 2,033 km². The 2006 population of the LGA recorded 120,813 inhabitants, 53 percent of which were male and 47 percent of which were female (National Nigerian Population Commission, 2006).

The main ethnic groups in Edo State are Bini (also referred to as Edo), Afemai, Esan, Owan and Akoko Edo. Non-indigenous peoples living in the Project area include Urobos, Ishan, Ora, Efik, Ijaws, Hausas, Ibos and Yorubas, as well as a small number of Ghanaians and Togolese. In line with national and state level trends, the population of all three communities is fairly youthful. Residents reported noticing an increase in youth populations in the area, due to the presence of construction work at the site for the neighbouring NIPP.

Traditional religion is widely practiced in the study area which includes visiting and presenting sacrifices to sacred sites in and around the communities. While some of these sacred sites are located within the communities, many are located in nearby forests. These forest areas are very important to the communities and the only activity that is permitted is worship of the traditional gods (ie no economic activity is permitted). Christianity and Islam are also widely practiced, often alongside traditional religious practices. There are no reports of tension between religious groups in the Project area.

The communities of Orior-Osemwende, Ihovbor-Evboeka and Idunmwowina-Urho-Nisen will be affected by the Project activities. These lie within Omagbae South Ward Six of the Uhumwode LGA in Edo State, Nigeria. The demographics of each of the communities is outlined in *Box 1* below.

Orior-Osemwende is the smallest of three communities comprising approximately 1,000 residents and is almost exclusively inhabited by the indigenous Bini, with only a few Ijaw, Ibo, Calabar, Yoruba and Hausa migrants. Half the population are Christian with the remainder divided among Muslims and practitioners of traditional beliefs. From their own estimation, the level of poverty in the community is approximately 80 percent. The majority of the community residences are situated along the road that runs from Ihovbor-Evboeka / Idunmwowina-Urho-Nisen to Benin City. Agricultural areas in the community are situated close to the households.

Ihovbor-Evboeka has a population of approximately 400 inhabitants and report increasing population density over the past few years, credited to the development of the neighbouring NIPP power plant. The majority of the community are Bini with a few members of other ethnic groups (Yoruba, Igbo, Urhobo, Efik and Esan). Traditional beliefs appear to be more prevalent (60 percent) in this community, while 20 percent claim to be exclusively Christian and seven percent say they are exclusively Muslim.

Idunmwowina is the most densely populated of the three communities, consisting of approximately 1,500 inhabitants and is populated primarily by Bini and a few people of other tribes including Ibo, Ijaw, Isoko, Calabar and Hausa. About half of the residents practice traditional religion and the remaining are split between Christian and Muslim.

From the focus group discussions and In-Depth Interviews conducted, the Ihovbor-Evboeka community is perceived by the other communities to have benefited disproportionately to the other communities from the NIPP power plant in that compensation was unfairly distributed to the residents of this community. This has resulting in ongoing legal action and created a degree of resentment among the other communities in the Project area.

Vulnerable groups within the Project affected communities were found to be women, children, migrant farmers, disabled people and the elderly. These were classed as vulnerable by virtue of their economic vulnerability and their lack of opportunity to participate in decision making systems within the local cultural context.

Community-based Organisations

Religious groups were most commonly reported and women and youth groups were also frequently cited. Relatively few residents belong to informal work exchange groups, which are more common in areas that have a higher proportion of farmers and food processors. Informal savings and credit groups also have a relatively low level of patronage in the communities; possible due to the high numbers of people who are employed outside the community.

Economics, Livelihoods and Employment

The main occupations reported in the three communities are typical of semi-urban communities in Nigeria, and include farming, trading, logging and hunting and processing of agricultural products (eg cassava). Trading may range from a small shop in front of a house to large scale buying and selling in local markets. Other common occupations include carpentry, bricklaying, and

other forms of salary jobs or service provision. Men are generally responsible for heavy work (eg cutting and clearing of trees) whereas women are more likely to tend plots of land and be involved in other informal sector activities, such as small scale trading and cassava processing.

Major crops include yam, cassava, maize, plantain, banana and coco yam, plantation crops in the area are rubber and cocoa while melon, okra, peppers and other crops are grown in smaller quantities (NIPP, 2010). Livestock rearing (poultry, sheep, goats and some pigs) is also significant, primarily on a smaller scale although there are a few large scale intensive livestock operations owned by wealthier residents.

Some community residents engage in petty trading and transport local produce to towns to sell, or sell products obtain in other towns to local residents. There are no markets in the three communities. The NIPP power plant is one of few formal employers (if not the only one) in the study area.

During the data collection process, participants generally evaluated their socio-economic status as “poor” or “average, while the cost of living in these communities is lower than that in nearby towns.

Land Tenure

All land including the communities within the study area, belongs to the State under Nigeria’s Land Use Act of 1978. However, in the Project area, land allocations are normally presided over by the traditional leader (Enogie) and residents must apply to him to request land use allocations, which are granted for a period of two years.

Infrastructure

Ihovbor-Evboeka and Idunmwowina-Urho-Nisen have access to electricity while Orior-Osemwende does not. The existing supply is erratic as a result of small transformers servicing the communities. Few residents have privately owned generators to provide back-up electricity. There are no public wells in the three communities and most residents rely on private wells and/or local water bodies (located offsite) for water supply. Although private boreholes are found in each of the communities in the study area, the proportion of residents with access is very small. It is accepted within the community that all land users have rights of access over water resources on their land.

The 2006 State Census results indicate that 80 percent of men and 72 percent of women (above the national average) in Edo State were literate. Literacy levels in the Project area are much lower than this, possibly because there is very little in the way of educational infrastructure in the Project area. Idunmwowina-Urho-Nisen has only a nursery school, Orior-Osemwende has a primary school. A new school was constructed within the Ihovbor-Evboeka area through their EPC contractor. The school is not yet functional. As a result of poor educational services and access, education levels in the Project-affected communities are low.

Sacred sites

The fact that the Project will require acquisition of community land will likely require movement of at least 14 sacred sites from the Project area. The presence of sacred sites and the cultural heritage value of the Benin moats in the vicinity will also trigger OP 4.11.

Although the removal of sacred sites will disrupt local worship practices and could create or exacerbate tension with the communities, community members, indicated during consultation that it is possible to move the sites to accommodate the Project. Close and extensive consultation would be required with local religious leaders and authorities, and should involve appropriate consultation and compensation.

Health

Nigeria reportedly has high rates of infectious disease. Maternal mortality is 545 deaths per 100,000 live births (World Bank, 2010) and there are reportedly only 5.0 hospital beds per 10,000 people (WHO, 2011). General health status in the area is considered to be typical of Edo State and the rest of Nigeria. Common illnesses include rheumatism, arthritis, malaria, fever, typhoid, cough, skin conditions, diarrhoea, pneumonia and respiratory tract infections. There is no reported incidence of HIV/ AIDS in the area although these results may be inaccurate due to the social stigma.

There are no good primary health centres in the three communities and the closest hospital is in Benin City. A health care centre is located at Orior-Osemwende but this is not well-equipped and is without a doctor. Residents reported obtaining treatment at informal medicine shops or from traditional native doctors or herbalists.

SUMMARY OF IMPACTS AND MITIGATION

The Project activities will give rise to a range of impacts of varying magnitude and significance. The impacts for the short-term construction and decommissioning phases and the long-term operational phase were considered separately, where appropriate. The assessment methodology used to assess the significance of impacts took into account impact magnitude and sensitivity of receptors and resources affected. Impacts were assessed pre-mitigation and a significance rating determined. Mitigation measures to avoid, reduce, remediate or compensate for potential negative impacts and actions to be taken to enhance benefits were identified. Residual impacts were then assessed taking into account any mitigation and enhancement measures that Azura Power has agreed to implement. All impacts identified and assessed within the EIA are outlined in *Chapter 7* and cumulative impacts are discussed in *Chapter 9*. Key mitigation measures that Azura Power has agreed to implement are also outlined in *Chapter 8* and *Chapter 10*.

Table 4 Summary of Impacts, Mitigation and Residual Significance

Impact	Impact Description	Phase	Pre-mitigation Significance	Summary of Mitigation and Enhancement Measures	Residual Significance
Air Quality	Dust impacts from plant, mobile machinery and vehicles and site clearing and earth works	Construction	Major negative	<ul style="list-style-type: none"> Spray surfaces prior to excavation and clearing, apply liquid asphalt and use binder materials for exposed surfaces and fit dust suppression/ extraction to equipment ; Cover trucks transporting spoil and waste; Regular cleaning of equipment, drains and roads;; Limit speed onsite to 15 kph on unhardened surfaces; No dropping from heights; No heating of bitumen with an open flame; Regular cleaning of drains and guttering on site; Cover all pots and tanks containing hot bitumen; Bowsers (water tankers) or similar equipment will be made available to wash down equipment; and Dampening of surfaces that are to be excavated or cleared 	Minor-Moderate Negative
		Decommissioning	Major Negative	<ul style="list-style-type: none"> Spray surfaces prior to excavation and clearing, apply liquid asphalt and use binder materials for exposed surfaces and fit dust suppression/ extraction to equipment ; Cover trucks transporting spoil and waste; Regular cleaning of equipment, drains and roads;; Limit speed onsite to 15 kph on unhardened surfaces; No dropping from heights; and No heating of bitumen with an open flame; 	Minor-Moderate Negative
	Increased levels of PM ₁₀ and NO ₂ / NO _x	Construction	Insignificant Negative	<ul style="list-style-type: none"> There are no specific mitigation measures applicable;; All vehicles to be regularly maintained; Sulphur hexafluoride from the transformers should not be released to the atmosphere, but be reclaimed for reuse, if possible; The use of a dry low NO_x combustion system; and NO_x emissions monitoring. 	Insignificant Negative
		Decommissioning	Insignificant Negative		Insignificant Negative
	Increased levels of NO ₂	Operation	Minor Negative		Minor Negative
	Increased levels of CO	Operation	Insignificant Negative		Insignificant Negative

Impact	Impact Description	Phase	Pre-mitigation Significance	Summary of Mitigation and Enhancement Measures	Residual Significance
	Increased levels of greenhouse gases	Operation	Significant Negative		Significant Negative
Noise	Increased noise levels due to plant, mobile machinery, construction and decommissioning activities as well as during operation	Construction	Negligible Negative	<ul style="list-style-type: none"> • Develop detailed noise control plan, use temporary noise barriers and use 'low noise' equipment (including alternative reversing alarms), where possible; • Train construction staff on noise control plan during health & safety briefings; • Select 'low noise' equipment, or methods of work; • Use most effective mufflers, enclosures and low-noise tool bits and blades; • Investigate use of alternatives to audible reversing alarms (such as broadband noise emitting models) or configure to maximise forward movements of mobile plant; • Use alternatives to diesel/petrol engines and pneumatic units, such as hydraulic or electric-controlled units, where feasible and reasonable; • Use temporary noise barriers for small equipment, where required; • Reduce throttle settings and turn off equipment and plant when not used; • Avoid dropping from heights and metal-to-metal contact; • Avoid clustering of mobile plant near receptors and enforce rest periods for unavoidable maximum noise events; • Ensure periods of respite are provided in the case of unavoidable maximum noise level events; • Appoint Community Liaison Officer (CLO) and inform potentially impacted residents of potential noise; and • Regular inspection and maintenance of all plant and equipment. 	Negligible Negative

Impact	Impact Description	Phase	Pre-mitigation Significance	Summary of Mitigation and Enhancement Measures	Residual Significance
		Operation	Insignificant negative	<ul style="list-style-type: none"> • Air conditioning/air flow requirements shall be designed to take account of noise breakout; • Exhaust stacks will be designed to meet a power level of 92 dB(A); • Design an acoustic enclosure for the gas turbines with a Hushclad double-skin enclosure with good door seals which will be replaced regularly to meet the specifications for 82 dB at 1 m from the source; • The fitting of a silencer into the exhaust gas system; • Design gas turbine building (including air conditioning, walls, roof, windows and doors) to have a high noise reduction rating and ensure that there are no significant gaps; • Configure plant layout and orientation to minimise noise; • Use acoustic enclosure/ absorption materials in internal walls; • In cases where noise levels cannot be reduced below guideline levels, the Project will investigate the relocation of these households; • Implementing design measures such as attenuators on the stacks, cladding on the turbine building and/ or noise barriers to reduce noise level requirements of 45dBA for the four identified receptors; and • Establish a grievance mechanism. 	Insignificant Negative

Impact	Impact Description	Phase	Pre-mitigation Significance	Summary of Mitigation and Enhancement Measures	Residual Significance
		Decommissioning	Insignificant Negative	<ul style="list-style-type: none"> • Develop detailed noise control plan, use temporary noise barriers and use 'low noise' equipment (including alternative reversing alarms), where possible; • Staff training; • Ensure periods of respite are provided in the case of unavoidable maximum noise level events; • Avoid dropping from heights and metal-to-metal contact; • Avoid clustering of mobile plant near receptors and enforce rest periods for unavoidable maximum noise events; • Select 'low noise' equipment, or methods of work; • Use most effective mufflers, enclosures and low-noise tool bits and blades; • Investigate use of alternatives to audible reversing alarms (such as broadband noise emitting models) or configure to maximise forward movements of mobile plant; • Use alternatives to diesel/petrol engines and pneumatic units, such as hydraulic or electric-controlled units, where feasible and reasonable; • Use temporary noise barriers for small equipment, where required; • Reduce throttle settings and turn off equipment and plant when not used; • Appoint Community Liaison Officer (CLO) and inform potentially impacted residents of potential noise; and • Regular inspection and maintenance of all plant and equipment. 	Insignificant Negative
Soils and Geology	Removal of soils during site clearance and potential for contamination through spills and incidents. Increased soil erosion and surface run-off particularly during heavy rains due to soil disturbance.	Construction	Moderate Negative	<ul style="list-style-type: none"> • Develop and implement of a waste management plan; • Low impact excavation, in-fill and trenching methods, minimise bare ground and stockpiles and rehabilitate cleared areas before wet season; • Effective site drainage using cut-off drains, temporary drainage channels; • Use oil/ water separators and silt traps; • Bund hazardous substances storage areas; 	Moderate Negative

Impact	Impact Description	Phase	Pre-mitigation Significance	Summary of Mitigation and Enhancement Measures	Residual Significance
		Operation	Minor Negative	<ul style="list-style-type: none"> Develop and implement of a waste management plan; No open ground left unpaved or rehabilitated; The use of gravel (or similar material) across the plant area to minimise surface run-off; Effective operation of the wastewater treatment plant with effluent flowing offsite comply with FMEnv requirements. 	Insignificant Negative
		Decommissioning	Minor Negative	<ul style="list-style-type: none"> Update and implement waste management plan, to be updated as part of the Site Closure and Restoration Plan; and Minimise transportation and excavation and rehabilitate before wet season. 	Insignificant-Minor Negative
Water Resources	Impacts on ground and surface water resource quality due to contamination and siltation	Construction	Moderate Negative	<ul style="list-style-type: none"> Develop a waste management plan including waste separation, waste storage on hardstanding/ bunding; Effective site drainage, and sediment/silt trapping mechanism, cut-off drains, oil/ water separators and silt traps and drainage installations for heavy rainfall events; Bund storage areas for hydrocarbons, fuels, lubricants; Regular maintenance of all plant and machinery; Use manual positive lift pumps to remove water from bunds; Staff training on rapid spill response and cleanup techniques; Minimise vegetation clearing and re-vegetate before the wet season; Minimise stockpiling, 10 m buffer between drainage channels and stockpiles and placement to minimise exposure; Adequate sewage collection and treatment; and Line all areas for concrete mixing. 	Minor Negative
		Operation	Minor Negative	<ul style="list-style-type: none"> Develop Spill Control and Response plans; Develop a waste management plan including waste separation, waste storage on hardstanding/ bunding; International standards for diesel storage tanks, cathodic protection, if required, periodic inspections, alarms, automatic shut-off devices and oil/ water separators in diesel storage area; Bund storage areas for hydrocarbons, fuels, lubricants; and Waste water and groundwater monitoring programme to ensure adherence to Nigerian, WHO and World Bank limits. 	Minor Negative

Impact	Impact Description	Phase	Pre-mitigation Significance	Summary of Mitigation and Enhancement Measures	Residual Significance
		Decommissioning	Minor Negative	<ul style="list-style-type: none"> • Develop a waste management plan including waste separation, waste storage on hardstanding/ bunding; • Bund storage areas for hydrocarbons, fuels, lubricants; • Regular maintenance of all plant and machinery; • Staff training on rapid spill response and cleanup techniques; • Minimise vegetation clearing and re-vegetate before the wet season; • Minimise stockpiling, 10 m buffer between drainage channels and stockpiles and placement to minimise exposure; • Adequate sewage collection and treatment; • Line all areas for concrete mixing; and • Waste separation and storage on hardstanding (or banded). • Decommission or cap (if to remain in use) boreholes on site. 	Minor Negative
	Potential over-exploitation of groundwater resources	Construction	Insignificant Negative	<i>No mitigation identified.</i>	Insignificant Negative
		Operation	Minor Negative		Minor Negative
		Decommissioning	Insignificant Negative		Insignificant Negative

Impact	Impact Description	Phase	Pre-mitigation Significance	Summary of Mitigation and Enhancement Measures	Residual Significance
Biodiversity	Clearing of vegetation and habitat, disturbance of fauna due to noise, dust, traffic and potential contamination of soil and water	Construction	Major Negative	<ul style="list-style-type: none"> • Limit vegetation clearing and revegetate, demarcate work areas, establish habitat corridors; • Driver (and general staff) training on ecological sensitivities and enforce 25 km/h speed limit on site; • Effective site drainage, and sediment/silt trapping mechanism, cut-off drains, oil/water separators and silt traps and drainage installations for heavy rainfall events; • Development of a BMP enlisting the services of an entomologist and botanist. This will include demarcation of floral and faunal species to avoid accidental damage during construction, and the retention or relocation of Threatened species creating suitable habitats; • Train all staff on ecological sensitivities to ensure that they are aware of any specific migratory routes for faunal species, are able to identify species of a Threatened status and enforce an anti-poaching policy; • Spray surfaces prior to excavation and clearing, apply liquid asphalt and use binder materials for exposed surfaces and fit dust suppression/ extraction to equipment; and • Shielded and downward-directed security and work lighting and avoid tall mast lights, if possible. 	Moderate Negative
		Operation	Minor-Moderate Negative	<ul style="list-style-type: none"> • Shielded and downward-directed security and work lighting and avoid tall mast lights, if possible. • Driver (and general staff) training on ecological sensitivities and enforce 25 km/h speed limit on site; and • Effective site drainage, and sediment/silt trapping mechanism, cut-off drains, oil/water separators and silt traps and permanent drainage installations for heavy rainfall events. 	Minor Negative
		Decommissioning	Moderate Negative	<ul style="list-style-type: none"> • Demarcate work and demolition areas; • Spray surfaces prior to excavation and clearing, apply liquid asphalt and use binder materials for exposed surfaces and fit dust suppression/ extraction to equipment; and • Rehabilitation and revegetation of the site using native floral species, where appropriate and before the wet season. 	Insignificant-Minor Negative

Impact	Impact Description	Phase	Pre-mitigation Significance	Summary of Mitigation and Enhancement Measures	Residual Significance
Waste	Potential contamination of water resources and soil	Construction	Moderate Negative	<ul style="list-style-type: none"> Identify suitable waste disposal facilities. All waste disposal in line with Nigerian requirements; Develop a waste management plan including waste separation, waste storage on hardstanding/ bunding; and Use spoil for on-site levelling and allow local communities to use cleared vegetation. 	Minor Negative
		Operation	Minor Negative	<ul style="list-style-type: none"> Identify suitable waste disposal facilities. All waste disposal will be in line with Nigerian requirements; Develop a waste management plan including waste separation, waste storage on hardstanding/ bunding; Recycle spent oils; Regular wastewater monitoring. 	Insignificant-Minor Negative
		Decommissioning	Moderate Negative	<ul style="list-style-type: none"> Identify suitable waste disposal facilities. All waste disposal in line with Nigerian requirements; Develop a waste management plan including waste separation, waste storage on hardstanding/ bunding; Use spoil for on-site levelling and allow local communities to use cleared vegetation; and Sell or recycle all metal and building components. 	Minor Negative
Physical Resettlement	Loss of physical and cultural assets, land, including productive agricultural land	Pre-construction	Major Negative	<ul style="list-style-type: none"> Implementation of an international standard RAP. Relocate sacred sites in close consultation with traditional religious leaders and appropriate monitoring. 	Moderate Negative
Economic Resettlement	Loss of physical and cultural assets, land, including productive agricultural land	Pre-construction	Major Negative	<ul style="list-style-type: none"> Implementation of a RAP to WB/ IFC standards. 	Moderate Negative
Demographic profile	Potential changes to the demographic profile of the area including population numbers, gender balance, age profile, ethnicity and increased social tension	Construction	Moderate Negative	<ul style="list-style-type: none"> Camp and workforce management protocols; Prioritise local employment and run transparent recruitment process; and Establish grievance mechanism. 	Minor Negative
		Operation	Minor Negative		Insignificant Negative
		Decommissioning	Moderate Negative	<ul style="list-style-type: none"> Implement Influx Management Plan; SME development, support and annual training; Invest in infrastructure development; and Staff training. 	Insignificant-Minor Negative

Impact	Impact Description	Phase	Pre-mitigation Significance	Summary of Mitigation and Enhancement Measures	Residual Significance
Impacts to Cultural Institutions	Disruption of local customs, change in traditional leadership structures and removal of sacred sites (during pre-construction).	Construction	Moderate Negative	<ul style="list-style-type: none"> Appoint CLO; Establish a Grievance Mechanism; Develop and implement a Local Employment Strategy and camp and workforce management protocols; Implementation of the Physical Cultural Resources (PCR) Management Plan; Involve traditional leaders in Project development process; Implementation of a RAP to WB/ IFC standards; and Clearly communicate Project updates to local communities; 	Minor Negative
		Operation	Minor Negative		Insignificant Negative
		Decommissioning	Insignificant Negative		Insignificant Negative
Impacts to Employment and Economy	Employment, increased income, increased secondary economic activity and skills development. <i>Local employment expectations need to be managed appropriately in order for the impacts to remain positive</i>	Construction	Minor Positive	<ul style="list-style-type: none"> Staff training (and local communities) to develop local workforce and supplier capacity; Local suppliers and contractors and implement Local Employment and Local Procurement Policies; and Disclosure of employment and procurement information. 	Moderate Positive
		Operation	Major Positive		Major Positive
	Loss of employment, indirect business opportunities and economic activity and decreased income	Decommissioning	Minor Negative	<ul style="list-style-type: none"> Staff training (and local communities) to develop local workforce and supplier capacity, including career development and personal finances; Training to local and regional contractors on effective business management; and Develop credit and loan programmes for small business development. 	Insignificant-Minor Negative
Impacts to Infrastructure	Pressure on or development of infrastructure, increased waste, contamination of water resources and traffic disruption	Construction	Minor Negative	<ul style="list-style-type: none"> Implement Community Investment plan, Influx Management Plan and Traffic Management Plan (after Traffic study to input into this plan); Detailed rehabilitation and implementation framework; and Regular water monitoring in local communities. 	Insignificant – Minor Negative
	Construction, reinforcement and paving of roads and local community projects (eg borehole construction and health and education projects)	Construction	Minor Positive		Minor Positive

Impact	Impact Description	Phase	Pre-mitigation Significance	Summary of Mitigation and Enhancement Measures	Residual Significance
	Pressure on or development of infrastructure increased waste, contamination of water resources, traffic disruption and increased power supply. Increased local power supply in addition to the national power grid.	Operation	Major Positive	<ul style="list-style-type: none"> Community Investment Plan outlining local distribution of electricity; Investments to upgrade services; and Regular water monitoring in local communities. 	Major Positive
	Reduced power to the national grid, local power supply loess and decline in infrastructure maintenance and local authority investment	Decommissioning	Minor Negative	<ul style="list-style-type: none"> Implement Influx Management Plan; SME development, support and annual training; Invest in infrastructure development; and Staff training. 	Insignificant Negative
Health Impacts	Community health and safety impacts as a result of traffic, contamination risks as well as air and noise impacts, and potential safety risks due to the transmission line and gas pipeline spur	Construction	Moderate Negative	<ul style="list-style-type: none"> Local Employment Strategy, Traffic Management Plan (after Traffic study to input into this plan) and camp and workforce management protocols; Health awareness programme incorporating an HIV/AIDS awareness and prevention program which will include voluntary testing, the provision of condoms, and education of local communities; Communication of Project transport plans; Establish a Grievance Mechanism. Establish parameters around use of security forces; Approve contractor HSE plans prior to contract award; All contractors comply with Azura Power's occupational health and safety guidelines and standards; Fire and explosion risk management including routine safety checks, training, first aid boxes, emergency spill prevention plans; Risk Assessment identifying key safety risks of the transmission line and gas pipeline spur which will inform the EMP; Community safety awareness campaigns; and Consider investing in local health care facilities. 	Minor Negative
		Operation	Minor Negative		Minor Negative
	Improved access to health care facilities for the local communities	Construction	Minor Positive		Minor Positive
		Operation	Minor Positive		Minor Positive
	Ongoing effects from the operational phase, safety risks and noise and dust nuisance	Decommissioning	Moderate Negative		<ul style="list-style-type: none"> Establish contingency fund to address potential contamination; Provide treatment to victims of H&S impacts after closure; and Consider investing in local health care facilities.
Workplace Health and	Physical health impacts due to increased	Construction	Major Negative	<ul style="list-style-type: none"> Encourage testing (Azura Power and contractors) for sexually 	Minor Negative

Impact	Impact Description	Phase	Pre-mitigation Significance	Summary of Mitigation and Enhancement Measures	Residual Significance
Safety Impacts	activity and traffic, explosion risk, infectious diseases, dust and noise emissions, accidents in and around site including slips, spillages, explosions and contact with electrical infrastructure.	Operation	Major Negative	<ul style="list-style-type: none"> transmitted infections (STIs); • Health awareness programme incorporating an HIV/AIDS awareness and prevention program; • Registration and regular communication with the nearby health care facilities • Ensure that employees adhere to recommended preventative medical procedures; • Warning signs in place including for electrical and mechanical equipment; • Treatment of infectious diseases contracted and accidents; • Mandatory health and safety training, including contractors, and toolbox talks; • The provision and use of appropriate PPE at all times; • Develop camp and workforce management and H&S protocols; • Risk Assessment identifying key safety risks spur which will inform the EMP; • First aid training with aid certificates upon completion; • Establish reporting system to the Edo State Government's Ministry of Employment, Labour and Productivity; and • Maintain emergency and first line first aid at strategic locations through out the plant; • Develop and maintain emergency and spill prevention and response/countermeasures plans for all phases of the project; and • Construction/ decommissioning techniques to reduce disease vector breeding grounds 	Minor Negative
		Decommissioning	Major Negative		Minor Negative

CUMULATIVE IMPACTS

Cumulative impacts were assessed for each of the impacts identified as the results assuming implementation of mitigation measures. The cumulative noise impacts are considered to be major prior to mitigation, but are considered insignificant after the implementation of further design iterations and modeling prior to operation, monitoring and construction of barriers if necessary. The cumulative impact on biodiversity was assessed to be moderate negative due to the presence of a number of vulnerable species. Cumulative impacts on soils and geology, water resources (contamination), cultural institutions and infrastructure were found to be minor negative, while cumulative impacts on air quality, water resources (availability of water) and workplace H&S were considered negligible. The cumulative impacts on physical and economic resettlement and the demographic profile were considered to be minor – moderate due to existing influx from the construction of the neighbouring NIPP facility as well as current disputes in the communities regarding compensation and NIPP project benefits. The positive cumulative impact of the Project was assessed to be moderate.

MITIGATION AND MONITORING

A key objective of the EIA was to develop and describe practical, commensurate and cost effective mitigation and management measures that avoid, reduce, control, remedy or compensate for negative impacts and enhance positive benefits. The objectives of mitigation have been established through legal requirements or industry good practice standards and where standards were not available, project-specific standards have been established.

The approach taken to defining mitigation and management measures is based on a hierarchy of decisions and measures (*Box 2*). The majority of mitigation and management measures fall within the upper two tiers of the hierarchy and are effectively built into the design of the project. *Chapter 8* summarises the key mitigation measure proposed by Azura Power.

A series of monitoring programmes are proposed to obtain data to verify project performance against agreed standards (eg discharge limits) to record trends to aid continuous improvement (eg responses to complaints) and to obtain information to verify prediction (eg air emissions).

Box 2 *Mitigation Hierarchy for Planned Activities*

Avoid at Source; Reduce at Source: avoiding or reducing at source through the design of the Project (eg avoiding by siting or re-routing activity away from sensitive areas or reducing by restricting the working area or changing the time of the activity).

Abate on Site: add something to the design to abate the impact (eg pollution control equipment).

Abate at Receptor: if an impact cannot be abated on-site then control measures can be implemented off-site (eg traffic measures).

Repair or Remedy: some impacts involve unavoidable damage to a resource (eg material storage areas) and these impacts require repair, restoration and reinstatement measures.

Compensate in Kind; Compensate Through Other Means where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate (eg financial compensation for degrading agricultural land and impacting crop yields). It is emphasised that compensation to individuals with residual impacts to livelihood or quality of life will generally be non financial and will have a focus on restoring livelihoods.

Box 3 *Mitigation Hierarchy for Unplanned Events*

Control: this aims to prevent an incident happening or reduce the risk of it happening to *as low as reasonably practicable* (ALARP) through reducing the likelihood of the event (eg preventative maintenance regimes, traffic calming and speed limits, community road safety awareness training);

Reducing the consequence (eg bunds to contain hazardous substance spills); and

A combination of both of these.

Recovery/Remediation: this includes contingency plans and response, eg Emergency Response Plans and Procedures.

ENVIRONMENTAL MANAGEMENT PLAN

Implementation of the findings and outcomes of the EIA process are described in the EMP for the proposed Project. Elements of this provisional plan will be taken forward and incorporated into a comprehensive project EMP that will be used to deliver the project's health, safety and environmental (EHS) regulatory compliance objectives and other related commitments. The EMP provides an outline of the procedures and processes that will be incorporated into project activities to check and monitor compliance and effectiveness of the mitigation measures to which Azura Power has committed. The outline EMP is provided in *Chapter 9* of the EIA report. In addition, the EMP is used to ensure compliance with statutory requirements and corporate safety and environmental policies. Further to the ESIA, a Risk Assessment of the gas pipeline spur and power station will be conducted and the results of which will be incorporated and inform the EMP.

With respect to the significant impacts identified by the EIA, the EMP provides the linkage between each significant impact, the relevant mitigation measures and the monitoring approach. Significant impacts are referenced to:

- applicable regulatory requirements, lenders requirements and other commitments; and
- relevant operational controls (eg management best practices, construction and operation specifications, procedures, and work instructions).

Azura Power will manage key contractors to ensure that the EMP is implemented and monitored through contractual mechanisms and day-to-day management where required. Azura Power will have its own supervisory personnel and the Nigerian Government will oversee the project through its various agencies.

The EMP contains the recommendation for the development of a number of detailed management plans and procedures that lay out the specifications for compliance with specific environmental and social elements. Key plans are listed below.

- Construction Management Plan;
- Traffic Control Management Plan;
- Waste Management Plan;
- Site Closure and Restoration Plan;
- Influx Management Plan;
- Employment and Workforce Policy;
- Comprehensive Community Investment Plan;
- Local Employment and Procurement Policy;
- Local Employment Strategy;
- Occupational Health and Safety Policy;
- Spill Response Plan; and
- Emergency Response Plan.

CONCLUSIONS

The findings of the EIA presented in *Chapter 7* indicate that there are no issues of *Major* significance that could not be mitigated such that the proposed project was not acceptable from an environmental and socio-economic perspective.

Air quality (dust during construction and decommissioning and greenhouse gases during operation), biodiversity, physical resettlement, economic resettlement and workplace health and safety impacts were identified as negative impacts of major significance and significant (for greenhouse gases) prior to mitigation. These negative impacts require careful implementation of effective mitigation measures and ongoing monitoring. The significance of biodiversity impacts, physical resettlement impacts and economic resettlement impacts can be reduced to moderate; the workplace health and

safety impacts are reduced to minor and the air quality impacts (dust) can be reduced to minor-moderate with the implementation of the mitigation measures and monitoring requirements outlined in *Chapter 8*. The impacts of greenhouse gases during operation are considered to remain significant, as there are no suitable mitigation measures available to reduce these emissions. The only other residual negative impact with significance ratings of moderate is the impact on soils and geology during construction, , however, the severity of these impacts could be reduced to acceptable levels through the mitigation identified in the report. The remaining impacts, including noise, water resources, waste, impacts on demographics and worker considered were assessed to be of insignificant or low significance after mitigation.

The EIA also identified a number of positive impacts associated with the proposed development. In particular, the impacts to the national economy and local employment were also assessed to be of high significance post-mitigation. The positive impacts of the Project on employment and economic impacts are considered to remain of high significance with enhancement measures. The positive impact to infrastructure is considered to be moderate positive during operation, in addition to the training (health and safety) that will be provided to employees which is assessed to be minor positive.

Although there is a post-mitigation impact as a result of the production of greenhouse gases which is considered to be significant, the residual positive impacts on economy and employment are considered to be of high significance. Based on these considerations and in the context of the severe electricity supply deficit in Nigeria and the dependency of economic growth and development on the availability of power, there is a reasonable justification for the authorisation of the power plant contingent that the mitigation and enhancement measures described in the EIA and monitoring for potential environmental and social effects are implemented.

EXECUTIVE SUMMARY

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ACRONYMS

ACL	Amaya Capital Limited
APWA	Azura Power West Africa Limited
AQS	Air Quality Standard
ALARP	As Low As Reasonability Practicable
BID	Background Information Document
CBO	Community Based Organisation
CLO	Community Liaison Officer
CCGT	Combined Cycle Gas Turbine
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
COD	Chemical Oxygen Demand
CSR	Corporate Social Responsibility
DE	Department of Environment
DPR	Department of Petroleum Resources
DMRB	Highways Agency Design Manual for Roads and Bridges
DO	Salinity, Dissolved Oxygen
DR	Death Rate
EBI	Energy and Biodiversity Initiative
ECN	Energy Commission of Nigeria
ELPS	Escravos Lagos Pipeline System
EDSG	Edo State Government
EDSEPA	Edo State Environmental Protection Board
EDSWMB	Edo State Waste Management Board
EDSMEPU	Edo State Ministry of Environment and Public Utilities
EDSFL CAP 59	The Edo State Forestry Law CAP 59 (1976)
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMS	Environmental Management System
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
EnvAccord	Environmental Accord
ERM	Environmental Resources Management Limited
EPC	Engineering, Procurement and Construction
FAO	Food and Agriculture Organisation
FEPA	Federal Environmental Protection Agency
FMEnv	Federal Ministry of Environment
FGDs	Focus Group Discussions
GHG	IFC Guidance for Greenhouses Gases
GIIP	Good International Industry Practice
GO	Grievance Officer
Ha	Hectares
HIV	Human Immunodeficiency Virus
HRSG	Heat Recovery Steam Generators
H ₂ S	Hydrogen Sulphide
ITD	Inter-Tropical Discontinuity Zone

IAEA	International Atomic Energy Agency
IDA	International Development Association
IFC	International Finance Corporation
IFC PSs	International Finance Corporation Performance Standards
IFCGTPP	International Finance Corporation Guidelines on Thermal Power Plants
IPP	Independent Power Producer
LA	Labour Act (1990)
LGA	Local Government Area
LASEPA	Lagos State Environmental Protection Agency
LUA	The Land Use Act of 1978
LTSA	Long Term Service Agreement
MW	Megawatt
MEPU	Edo State Ministry of Environment and Public Utilities
MEPU	Ministry of Environment and Public Utilities
MIGA	Multilateral Investment Guarantee Agency/ Association
NESREA	National Environmental Standards and Regulations Enforcement Agency
NGSEPCN	The National Guidelines and Standards for Environmental Pollution Control in Nigeria
NBET	Nigerian Bulk Electricity Trading PLC
NPE	National Policy on the Environment
NEP	National Environmental Policy
NGC	Nigerian Gas Company
NIPP	National Integrated Power Project
NH ₃	Ammonia
NCF	Nigerian Conservation Foundation
NERC	Nigerian Electricity Regulatory Commission
NESREA	The National Environmental Standards and Regulations Enforcement Agency
NGO	Non Governmental Organisation
NO _x	Oxides of Nitrogen
NO	Nitric Oxide
NO ₂	Nitrogen Dioxide
NSRs	Noise Sensitive Receptors
O&M	Operations and Maintenance
OCGT	Open Cycle Gas Turbine
OEM	Original Equipment Manufacturers
PHCN	Power Holding Company of Nigeria
PPP	Public Private Partnership
PC	Process Contribution
PCR	Physical Cultural Resources
PEC	Predicted Environmental Concentration
PLC	Programmable Logic controller
PPA	Power Purchase Agreement
PRGs	Partial Risk Guarantees
PRI	Political Risk Insurance
RAP	Resettlement Action Plan
RP	Resettlement Plan
SCADA	Supervisory Control and Data Acquisition System

SEP	Stakeholder Engagement Plan
SL	Searchgate Laboratories Ltd
SME	Small and Medium Enterprise
SO _x	Sulphur Oxides
SO ₂	Sulphur Dioxide
STIs	Sexually Transmitted Infections
ToR	Terms of Reference
THC	Total Hydrocarbon Content
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
TSP	Total Suspended Particulates
UN	United Nations
UNESCO	United Nations Education Science and Cultural Organisation
UNEP	United Nations Environment Programme
VOC	Volatile Organic Compounds
WB OP 4.01	World Bank's Operational Policy on Environmental Assessment
WB OP 4.12	World Bank's Operational Policy on Involuntary Resettlement
WHO	World Health Organization

1 INTRODUCTION

1.1 BACKGROUND

This document presents the Environmental Impact Assessment (EIA) for the proposed Azura-Edo Independent Power Project (IPP) ('the Project'). The Project proponent is Azura Power West Africa Limited ('Azura Power'), a Nigerian-registered subsidiary of Amaya Capital Limited (ACL) ('Amaya'), a firm focused on investing in Nigeria and other fast growing markets in West Africa.

Azura Power proposes to develop a gas fired power plant on the outskirts of Benin City, Edo State, Nigeria. Under the terms of the Environmental Impact Assessment Act No 86 (1992) and in order to fulfil World Bank requirements for financing, an EIA and the necessary environmental approvals are required to be undertaken or obtained respectively, prior to implementation of the Project. Azura Power has appointed Environmental Accord (EnvAccord) and Environmental Resources Management Limited (ERM) to develop the EIA in accordance with the local Nigerian regulatory requirements and World Bank standards. The purpose of the EIA is to ensure that potential environmental and social impacts associated with development of the Project are identified, assessed and managed appropriately.

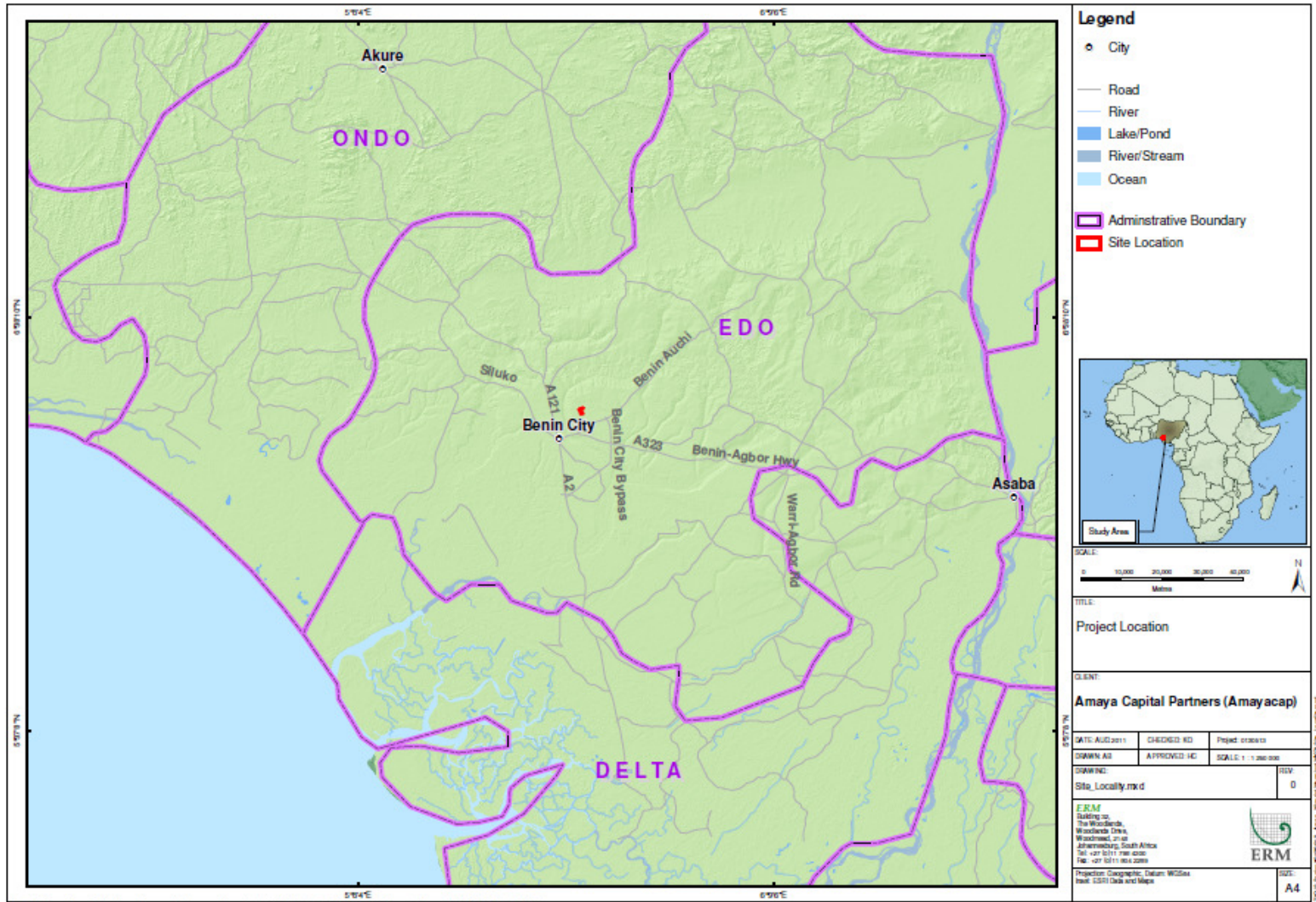
1.2 INTRODUCING THE PROJECT

1.2.1 Project Overview

The Project comprises a 450 MW Open Cycle Gas Turbine (OCGT) power plant, a short transmission line connecting the power plant to the adjacent Benin North Substation, and a short underground gas pipeline connecting the power plant to the Escravos Lagos Pipeline System. The proposed power plant will be constructed in such a way as to allow for potential later conversion to a Combined Cycle Gas Turbine (CCGT) plant with a nominal output of around 670 MW.

The proposed site for the Project is located in the north-eastern outskirts of Benin City, Edo State in Nigeria (*Figure 1.1*). The Project site is adjacent to the Ihovbor-Evboeka Power Plant which is currently under construction under the auspices of the National Integrated Power Project (NIPP).

Figure 1.1 Locality Map



1.2.2 *Project Context*

The Project will help to address Nigeria's urgent need for the provision of electricity. At 158 million, the country's population is the 7th largest in the world and accounts for nearly 15 percent of the entire African continent. Approximately 40 percent of its citizens are less than 15 years old and the total population is growing at 2.5 percent per annum (one of the highest growth rates in the world). On the current estimates produced by the United Nations (UN), Nigeria's population will reach nearly 230 million within the next 20 years.

At present, the current power generated and transmitted across the national grid is less than 4,000 MW. By way of comparison, South Africa's consumption of grid-based electricity per capita is 35 times greater than Nigeria's. It is evident that there is a need to augment the power supplied by the Power Holding Company of Nigeria (PHCN). To do this, the Federal Government intends to stimulate the construction of new power plants and transmission lines to increase the supply of power. In accordance with the government strategy, Independent Power Producers (IPP), such as Azura Power, are being encouraged to invest in the country's power sector.

Given the strong and inescapable link between electricity supply and economic development, the Project is expected to exert a substantial benefit to the country's productive and commercial industries.

1.3 *PURPOSE OF THE EIA PROCESS*

1.3.1 *Objectives of the EIA*

Azura Power recognizes that comprehensive planning and management of environmental and socio-economic issues are essential to the execution of any successful project and, therefore, intends to fully integrate environmental and socio-economic considerations into the lifecycle of the proposed Project. A key objective of the EIA is thus to assess the potential impacts of the Project and Project-related activities on the biophysical and socio-economic resources and receptors, and where necessary to design mitigation measures to avoid, mitigate, reduce or compensate for negative impacts and enhance benefits.

Furthermore, this EIA aims to achieve an acceptable level of compliance with the applicable international standards ie the World Bank, OP 40.1 in particular, in order to provide the World Bank with assurance that environmental and social risks are comprehensively understood by Azura Power and that systems and processes are in place to manage these to an acceptable level.

In addition, the EIA process focused on the following objectives::

- provide input to the Azura Power Project team and design engineers to ensure an optimised design that reduces as far as practicable, environmental and socio-economic impacts;
- identify, and enhance, positive impacts and opportunities arising from the development of the Project;
- be thoroughly integrated, meaning that impacts and related mitigation measures for environmental and socio-economic aspects are coordinated;
- communicate at key points with a full range of stakeholders; and
- incorporate stakeholder feedback throughout the process.

1.3.2 *The EIA Team*

Environmental Resources Management (ERM) and EnvAccord are jointly referred to as the EIA team. The project team comprised environmental and social specialists with a combination of EIA experience in Nigeria and experience in undertaking EIAs for power sector and other infrastructure developments elsewhere.

In addition, a series of studies were undertaken by a number of other specialists to address key issues. The core team members from EnvAccord and ERM and the specialists that have contributed to this report are listed in *Table 1.1*. Analytical services were provided by Searchgate Laboratories Ltd (SL), a Federal Ministry of Environment (FMEnv) and Lagos State Environmental Protection Agency (LASEPA) certified laboratory.

Table 1.1 The EIA Team

Name	Organisation	Role	Qualifications and Experience
EIA PROJECT MANAGEMENT TEAM			
Henry Camp	ERM SA	EIA Project Director	BA, 27 years
Karen Opitz	ERM SA	EIA Project Manager	BSc, M(Phil) (Env Mgt), 6 years
Nomsa Fulbrook-Bhembe	ERM SA	Project Consultant	MSc, 2 yrs
EIA SPECIALISTS			
Tunde Morakinyo	ERM UK	Social and health	BSc (Eng), 14 years
Bhavin Vyas	ERM UK	Social, health and resettlement	Bsc(Eng), MA, 8 years
Ibrahim Salau	EnvAccord	EnvAccord Environmental Lead	B.Eng, 12 years
Prof J Olawoye	Univ. of Ibadan	Social and health	PhD, 32 years
Dr JO Oladeji	Univ. of Ibadan	Social and health	PhD, 12 years
Dr OB Oyesola	Univ. of Ibadan	Social and health	PhD, 12 years
SPECIAL TOPIC EXPERTS			
Rod Linnett	ERM UK	Noise	Dipl(Eng), 20 years
Dr Chris Hazell-Marshall	ERM UK	Air Emissions	PhD, 13 years
Hanco Roux	ERM	Groundwater	BTech(Geology), 15 years

1.3.3 Scope of the EIA

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

The overall EIA process is shown schematically in *Figure 1.3* and the following key steps are described in the subsequent sections.

- Screening and scoping
- Baseline data collection
- Stakeholder consultation
- Impact assessment
- Management plans
- Reporting and disclosure

Screening and Scoping

One of the main objectives of scoping is to identify the potentially significant environmental issues relating to the implementation, operation and decommissioning of the proposed Project that should be addressed as part of the EIA. This enables the developer to address the key issues from the outset,

allowing early recognition of these issues in the design and evolution of the Project. Scoping helps to define the extent of the EIA, which will examine and report the full suite of impacts associated with the Project. The main objectives of the scoping phase were as follows.

- Provide an overview description of the Project.
- Describe the existing environmental and socio-economic baseline, using secondary data obtained from EIAs both conducted on the power plant adjacent to the proposed site as well as EIAs for other power plant projects.
- Undertake a preliminary assessment of the potential environmental and social impacts associated with the Project.
- Identify key data gaps.
- Obtain early input from key stakeholders in the identification of potential impacts and mitigation measures.
- Define a proposed Terms of Reference (ToR) for an EIA study and define an appropriate program for consultation with stakeholders. This was included in the Scoping Report and has been approved by FMEnv.

A scoping report, including ToR for the EIA and an application form, was submitted to FMEnv on 20 December 2010. The scoping report was approved on 21 February 2011 and the Project classified as a 'Category I' project, requiring a mandatory EIA Study and a panel review exercise.

Baseline Data Collection

The EIA report provides a description of the existing environmental and socio-economic conditions as a basis against which the impacts of the Project can be assessed. The main objective of the baseline description is to identify the key environmental and socio-economic resources and conditions in areas potentially affected by the Project (such as air quality, geology and soil, groundwater, surface water, fauna and flora) and key receptors.

Baseline data collection involved desktop studies of existing reports that contain information relevant to the Project. Sources have included EIAs and other publicly available technical reports associated with the neighbouring NIPP Ihovbor-Evboeka Power Plant and other relevant projects in the area. Project engineering studies have also been reviewed for quantitative information on environmental elements.

Primary data were collected during field investigations carried out by biophysical specialists (geology and hydrogeology, soil, air quality and ecology) as well as socio-economic specialists as indicated in *Table 1.2*. For the

EIA, sampling has been completed for the dry season and the wet season and the results are presented in *Chapter 5*.

Table 1.2 *Fieldwork for Baseline Data Collection*

Data Collection	Date	Team
Dry season biophysical data collection	19 – 21 March 2011	EnvAccord
Qualitative data collection	19 – 13 June 2011	Professor Janice Olowoye and team:
Wet season biophysical data collection	24- 26 July 2011	EnvAccord
Socio-economic enumeration survey	22 – 26 August 2011	Professor Janice Olowoye and team

Stakeholder Consultation

The objective of the consultation process is to present the proposed project and EIA process to stakeholders and to identify associated issues, concerns and opportunities. The following tasks were undertaken:

- identification of a preliminary list of stakeholders;
- creation of background information document (BID) for use in communicating with stakeholders;
- meetings with a number of government departments and stakeholder groups; and
- various focus group meetings with local community members.

Further details on the stakeholder consultation process for the Project are included in *Chapter 6* and a Stakeholder Engagement Plan is included in *Annex A*.

Impact Assessment

Impact assessment and development of mitigation measures is a process that commences during the scoping phase and continues throughout the EIA process. The key objectives of the impact assessment phase are the following:

- An analysis of how the Project may interact with the baseline in order to define, predict and evaluate the likely extent and significance of environmental and social impacts that may be caused by the Project.
- Development and description of acceptable and cost effective mitigation measures that avoid, reduce, control, remedy or compensate for negative impacts and enhance positive benefits.
- Evaluation of the predicted positive and negative residual impacts of the Project.

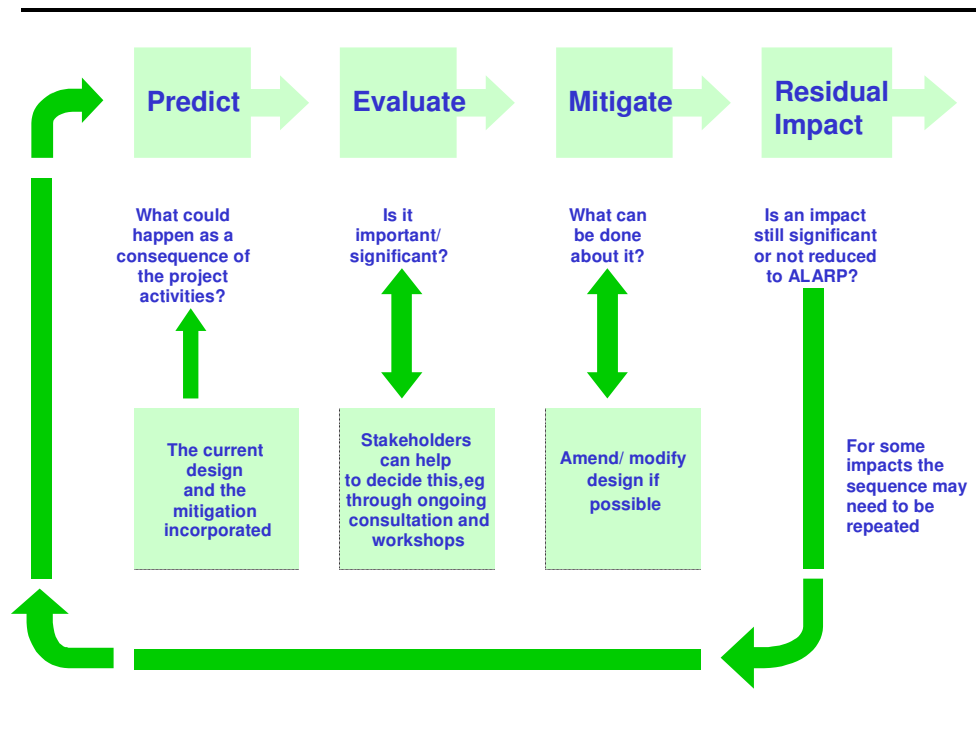
- Development of a system whereby mitigation measures will be integrated with the Project and will be taken forward as commitments. This is achieved through the development of a provisional EMP.

The impact assessment process is illustrated in *Figure 1.2* and has the following four main components.

1. Prediction of the consequences of project activities on the environmental and social receptors.
2. Evaluation of the importance and significance of the impact.
3. Development of mitigation measures to manage significant impacts where practicable.
4. Evaluation of the significance of the residual impact.

Where significant residual impacts remain, further options for mitigation may be considered and impacts re-assessed until they are reduced to as low as reasonably practicable (ALARP) levels. This approach takes into account the technical and financial feasibility of mitigation measures.

Figure 1.2 Prediction, Evaluation and Mitigation of Impacts



In addition to predicted impacts from planned activities, those impacts that could result from an accident or unplanned event within the Project (eg a pollution event) are taken into account. In these cases the likelihood (probability) of the event occurring is considered. The impact of non-routine

events is therefore assessed in terms of the risk, taking into account both the consequence of the event and the probability of occurrence.

The impact assessment methodology used to evaluate the significance of the biophysical and socio-economic impacts identified, is provided in *Chapter 7*.

Management Plans

The various measures to mitigate impacts identified through the EIA process are reported in the EIA report within the Project description and mitigation chapters. These are drawn together into a provisional environmental management plan (EMP) for the Project (see *Chapter 10*).

The provisional EMP consists of the set of management, mitigation and monitoring measures to be taken during implementation of the project to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels.

Reporting and Disclosure

The outputs of the above tasks have been drawn together into the draft EIA report and will be submitted to the FMEnv for review. In line with World Bank requirements for stakeholder consultation, the draft EIA report will also be submitted to the World Bank's InfoShop to allow for stakeholder consultation and comment. Following this, the draft EIA report will then be submitted to the FMEnv, where the report will be subjected to a review by a panel of experts constituted by FMEnv comprising experts from within FMEnv and external specialists. Following the review period, the findings will be presented to stakeholders and this may be in the form of a public hearing. Azura Power will then need to take appropriate action to address the FMEnv's findings. This may include revision to the report text to correct or clarify content, or development of additional mitigation measures or management actions.

As part of the formal regulatory process, FMEnv will publish a public notice to provide stakeholders with information on the Project and obtain comments on the draft EIA report. The FMEnv generally requires that the draft EIA report is made public for 21 working day period at venues decided by the FMEnv. Comments received on the draft EIA report from the FMEnv and stakeholders' written comments will be addressed in the final EIA report by the EIA team and this will then be submitted to FMEnv for their decision on whether to issue certification for the EIA. This certification provides environmental authorisation for the Project.

The approximate schedule for the Project EIA is provided in *Table 1.3* below.

Table 1.3 EIA Schedule

Activity	Timing	
	Start	Finish
Scoping	November 2010	December 2010
Authority Review of Scoping Report	December 2010	January 2011
TOR Approval	February 2011	
Specialist Field Surveys	May 2011	September 2011
EIA Report Drafting	August 2011	September 2011
Submission of Draft Final EIA Report	October 2011	
Authority Review, Provisional Approval	October 2011	January 2011
Final Updates	During Q1 2012	Beginning Q2 2012
Final Review and Approval by Authorities	Q2 2012	Q2 2012

1.4 PROJECT LEGISLATIVE AND POLICY CONTEXT

1.4.1 Environmental Management in Nigeria

In the African context, environmental protection has largely been synonymous with conservation of natural resources. In Nigeria’s case, a need for environmental enforcement was recognized in 1988, when illegal dumping of toxic wastes became an issue of concern, especially due to the fact that the toxic wastes were of international origin (Adegoroye, 1991). This incident resulted in the launch of the Federal Environmental Protection Agency (FEPA), as the overall (unitary) body charged with the responsibility of protecting the environment in Nigeria. The FEPA executed its functions in accordance with the goals of the National Policy of the Environment, which was launched on 27th November 1989.

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

1.4.2 Administrative and Institutional Context

The following section provides a summary of the Nigerian governmental entities with responsibilities for the environmental and social aspects of the Project. Other government and administration entities have environmental and social requirements but these generally follow from the EIA process. An analysis of governmental stakeholders has been conducted as part of the EIA. Further details are included in *Chapter 6*.

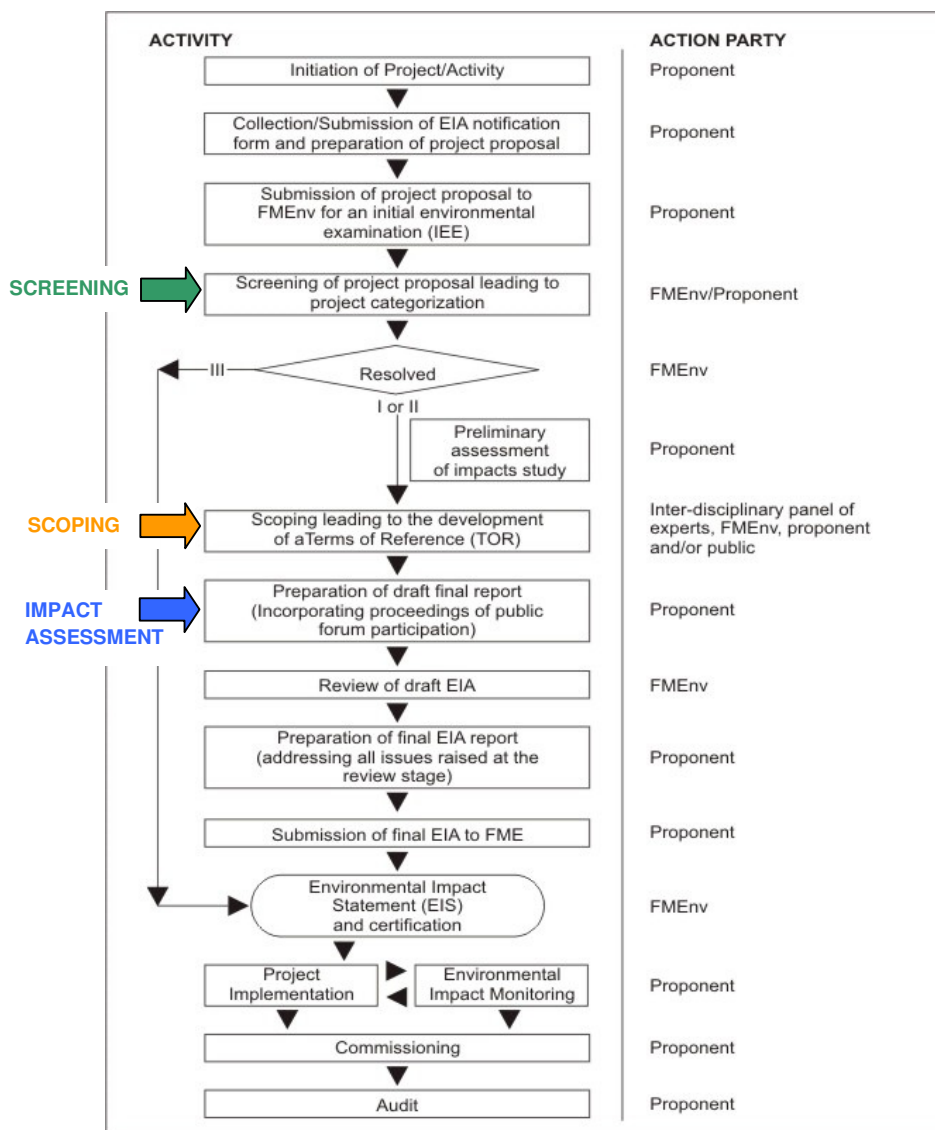
Federal Ministry of Environment

Primary authority for regulation and enforcement of environmental laws rests with the FMEnv. The specific policies, acts and guidelines enforced by FMEnv that are relevant to the Project include:

- National Policy on the Environment (1989, revised 1999);
- Environmental Impact Assessment Act No 86 (1992);
- National Guidelines for Environmental Auditing In Nigeria (1999);
- Water Resources Act of 1993;
- National Environmental Protection (Management of Solid and Hazardous Wastes Regulations), 1991;
- National Environmental Protection (Effluent Limitation) Regulations, 1991;
- Harmful Wastes (Special Criminal Provisions etc) Act No 42 (1988);
- Federal Environmental Protection Agency Act (1988); and
- National Guidelines and Standards for Environmental Pollution Control in Nigeria (1991).

The FMEnv EIA process is shown in *Figure 1.3* . The Azura-Edo IPP is a Category I project.

Figure 1.3 Federal Ministry of Environment Environmental Impact Assessment Process



Edo State Ministry of Environment and Public Utilities

The Ministry of Environment and Public Utilities (MEPU) is the regulatory body of Edo State, responsible for managing issues pertaining to the environment. In particular, the MEPU is responsible for waste management, flood and erosion control, forest depletion and degradation and general environmental and atmospheric pollution. It should be noted that the MEPU transformed from the Edo State Environmental Protection Board (EDSEPB) into a full fledged Ministry in line with the national realignments during 2000. The ministry comprises five departments and a Board. The involvement of the Department of Environment (DE) is of particular importance to the Project. MEPU's functions also include the formulation of policies for environmental protection and control (Nigerian Government, 2011).

The Edo State Waste Management Board (EDSWMB) is an agency under the direct supervision of the Edo State Ministry of Environment and Public Utilities (EDSMEPU). The Board's functions include the collection, transport, processing, recycling or disposal and monitoring of waste materials. This includes solid, liquid and gaseous substances. Other responsibilities include the development of guidelines, standards and regulations for pollution control and waste management as well as inspection and compliance monitoring of industrial facilities (Nigerian Government, 2011).

1.4.3 National Environmental Policy and Legislation

National Policy on the Environment (1989)

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

- secure a quality of environment for all Nigerians, which is adequate for their health and well being;
- conserve and use the environment and natural resources for the benefit of present and future generations;
- restore, maintain and enhance the ecosystems and ecological processes essential for the functioning of the biosphere, to preserve biological diversity and the principle of optimum sustainable yield in the use of these natural resources and ecosystems; and
- raise public awareness and promote understanding of essential linkages between the environment and development and to encourage individual and community participation in environmental improvement efforts.

All environmental regulation in Nigeria is intended to align with the NPE.

The NESREA Act (2007)

The National Environmental Standards and Regulations Enforcement Agency (NESREA) Act repealed the Federal Environmental Protection Agency Act (FEPA Act) and establishes the NESREA. The Agency has the responsibility to enforce compliance with environmental standards, regulations, rules, laws, policies and guidelines. NESREA is also responsible for the protection and development of the environment, biodiversity conservation, sustainable development and the development of environmental technology. The NESREA Act is an over-arching piece of legislation providing a framework for other detailed legislation.

Nigerian EIA Act No 86 (1992)

The EIA Act No 86 (1992) is the primary Act governing EIAs in Nigeria. The Act was promulgated in order to enable the prior consideration of an EIA on specified public or private projects.

The Act sets out the procedure to be followed and methods to be used in undertaking an EIA. Section 2 (2) of the Act requires that where the extent, nature or location of the proposed project or activity is such that it is likely to significantly affect the environment, an EIA must be undertaken in accordance with the provisions of the Act. The Act requires that project proponents apply in writing to FMEnv prior to embarking on the proposed project, to ensure that an EIA is undertaken in the planning stages of the Project.

Section 4 (a) – (g) sets out the following minimum requirements for an EIA:

- description of the proposed activities;
- description of the potentially affected environment of the proposed project including specific information necessary to identify and assess the environmental effects of the proposed activities;
- description of practical activities, as appropriate;
- assessment of the likely potential environmental impacts of the proposed activities and the alternatives, including direct or indirect, cumulative, short and long term effects;
- identification and description of measures available to mitigate adverse environmental impacts of the proposed activities and an assessment of these measures;
- indication of gaps in knowledge and uncertainty;
- indication of whether the environment of any other state or Local Government Area(s) (LGA) or areas outside Nigeria are likely to be affected by the proposed activity or its alternatives; and
- brief and non-technical summary of the information provided under the above provisions.

Section 7 of the Act requires that FMEnv must provide government agencies, members of the public, experts in any relevant discipline and interested groups an opportunity to comment on EIAs prior to making a decision. Section 9 (1) requires that FMEnv provides its decision in writing, and includes reasons for the decision and required provisions, if any, to prevent, reduce or mitigate any negative impacts on the environment.

The proposed Project requires an EIA under the terms of the Nigerian EIA Act (1992). An EIA is required for projects listed in the Schedule to the Act. Paragraph 13 (a) of the Schedule lists the following:

- (a) *'Construction of steam generated power stations burning fossil fuels and having a capacity of more than 10 megawatts.'*

The Act allows a list to be drawn up of projects that are likely to have minimal environmental effects and which do not need EIA. Where a project is not listed in the Schedule to the Act and is not listed as being excluded, a screening report must be produced.

Nigeria's Cultural Policy (1996)

The national cultural policy is generally regarded as an instrument of promotion of national identity and Nigerian unity, as well as of communication and cooperation among different Nigerian and/or African cultures.

Edo State has no listed United Nations Environment Programme (UNEP) World Heritage sites. In addition, there are no known nationally protected cultural resources in the area of the Project.

The Forestry Act (1958)

The principal legislation in force for the regulation of the forest sector is the Forestry Act 1958. The Forestry Law CAP 51 of 1994 prohibits any activity that may lead to the destruction of or cause injury to any forest produces, forest growth or forest property.

The Edo State Forestry Law CAP 59 (1976) (EDSFL CAP 59) (previously known as Bendel State Forestry Law CAP 59 (1976)), provides classification for forest types. Since its enactment, the EDSFL CAP 59 has undergone legislative amendment, including the Forestry (Amendment) Edict No 13 of 1984 and the Forestry (Amendment) Law, 2002. The former contains provisions to control logging and other forestry activities in the federal state while latter prohibits any act that may lead to destruction of forest reserve and/or protected forest areas in the State.

The EDSFL CAP 59 defines two types of forest close to the Project site, namely anthropogenic forest and natural forest. The anthropogenic forest is not closed, is young and not well maintained. The Natural forest close to the study area is the SAKPOBA Forest Reserve, situated over 20km from the proposed project site. No natural forest reserves or protected areas will be disturbed by the implementation of the Project.

1.4.4 *National Social Legislation*

In the consideration of Nigerian social legislation, the following issues may be some of the important social aspects of the Project:

- resettlement and displacement;
- community health and safety;
- labour, working conditions and employment;
- cultural property;
- economic activities; and
- access to fishing.

The following pieces of legislation would be the applicable regulatory instruments.

The Labour Act, (1990)

The Labour Act (1990) (LA) is the primary law protecting the employment rights of individual workers. The LA covers protection of: wages; contracts; employment terms and conditions; and recruitment. It also classifies workers and special worker types. Union membership is governed by the Trade Union Amendment Act (1995). A 1999 constitution includes stipulation of “*equal pay for equal work without discrimination on account of sex, or any other ground whatsoever*”.

While Nigeria has ratified all eight core International Labour Organisation Conventions and enacted laws to enforce the provisions, there are indications of restrictions on the trade union rights of workers in Nigeria, discrimination, child labour and forced labour. Azura Power will need to take these into consideration within the implementation of the Project.

Land Use Act No 6 (1978)

The Land Use Act of 1978 (LUA), the Constitution of 1999 and the Public Lands Acquisition Laws of the relevant states constitute the governing policy for land acquisition in Nigeria. As is the case with most national and state laws on compulsory acquisition of land in the public interest or for a public purpose, the legislation enables the State to acquire land (more precisely, to abrogate leases and other authorizations to occupy land). The Acts also specify the procedures the State must follow to clear the land, and define the compensatory measures the State must implement in order to compensate the people affected.

Under the LUA, there are two types of land rights (US AID, 2010)

- **Statutory occupancy rights:** Individuals and entities can obtain a statutory right for occupancy of urban and non-urban land. Recipients of certificates of occupancy are obligated to pay the state for any unexhausted improvements (ie improvements with continuing value such

as a building or irrigation system) on the land at the time the recipient takes possession and must pay rent fixed by the state. Rights are transferrable with the authorization of the state governor.

- **Customary right of occupancy:** Local governments may grant customary rights of occupancy to land in any non-urban area to any person or organization for agricultural, residential, and other purposes, including grazing and other customary purposes ancillary to agricultural use. The term for customary rights (which is contained in the application form and not the legislation) is 50 years, and may be renewed for a second 50-year term. Recipients of customary rights of occupancy must pay annual tax on the land and cannot transfer any portion of the rights without approval of the governor (for sales of rights) or the local government (other transfers).

The LUA vests all land in the urban areas of each state under the control and management of the governor of the state. The governor of the state holds the land in trust for the people of the state and is solely responsible for the allocation of land in all urban areas to individuals who reside in the state and to organizations for residential, agricultural and commercial purposes. All other land in the state subject to conditions under the LUA is under the control and management of the local government. The act divests traditional owners of land and vests such land in the state governor for the benefit and use of all Nigerians. It provides the processes through which land may be acquired by the federal government.

On rural land where there are no formal title deeds and any land rights are customarily held, compensation for land acquisition is only provided for buildings, crops and other 'improvements' to the land as well as rent for the year the land was occupied. Payment is not paid for land itself since customary ownership is not recognised by government.

For community-owned land where ownership is not claimed by any one individual or family, the governor will determine who receives the compensation. This might be the community or the chief or a community leader who can make use of the money according to customary law. Alternatively, money can be paid into a community fund. The governor has the power to cancel the right that any person has to live on or make use of any piece of land, if the land is required for use in the interest of the public. This includes mining and oil pipelines. Rights to land cease with immediate effect upon receipt of notice from the governor.

There are some differences between the Nigerian laws for resettlement and the World Bank requirements. These differences are related to: the requirements for seeking alternative sites; preparation of a Resettlement Plan (RP) and Restoration Plan; timing, formal consultation requirements (with resettled and host communities); emphasis on vulnerable groups and indigenous people; definitions of a cut-off date; the requirements to provide assistance; grievance mechanisms and monitoring; and evaluation requirements. Azura Power will be implementing additional measures within the development of the

Resettlement Action Plan (RAP) in order to ensure that the resettlement and compensation comply with World Bank requirements.

The Factories Act, 1990

The Factories Act 1990 (FA) is the primary law regulating the health, safety and welfare of workers in the country's factories. The law holds management and staff personally responsible for violations of the provisions in the Act.

With respect to safety, there are general provisions as to the securing, fixing, usage, maintenance and storage of prime movers, transmission machinery, other machinery, unfenced machinery, dangerous liquids, automated machines, hoists and lifts, chains, ropes and lifting tackle, cranes and other lifting machines, steam boilers, steam receivers and containers, and air receivers. There are, in addition to these, standards set for the training and supervision of inexperienced workers, safe access to any work place, first aid boxes, prevention of fire, and safety arrangements in case of fire.

The law requires that all accidents and industrial diseases be notified to the nearest inspector of factories and be investigated. The Act also prohibits the owner or occupier of a factory from making any deductions from the wages of any employee in respect of anything to be done or provided in pursuance of the FA.

Environmental Impact Assessment Act No 86 (1992) - Public Participation and Disclosure in EIA Planning

To a large extent, public authorities are required to inform the public of environment-related issues. Section 6(b) of the FEPA Act provides that FEPA has the power to collect and make available through publications and other appropriate means and in cooperation with public or private organisations, information pertaining to pollution and environmental protection regulations.

Section 55 of the EIA Act provides for the maintenance of a Public Registry for the purpose of facilitating public access to records relating to environmental assessments. The FMEnv issues guidelines from time to time for environmental impact assessments for different industries and it also has publications that inform the public of the prohibition of environmental pollution.

Furthermore, members of the public and persons requiring clarifications on environmental issues can visit the offices of the FMEnv or the relevant State environmental agency for environment-related information. Public hearings to which interested members of the public are invited are a key part of the approval process for EIA reports by the FMEnv.

1.4.5 National Environmental Guidelines and Standards

The National Guidelines and Standards for Environmental Pollution Control in Nigeria (NGSEPCN) were defined in March 1991 to serve as a basic

instrument for monitoring and controlling industrial and urban pollution. The main considerations of the guidelines and standards include:

- effluent limitations;
- pollution abatement in industries and facilities generating wastes; and
- management of solid and hazardous wastes.

Some of these guidelines and standards later evolved into national regulations in August 1991. Key regulations are summarised below.

National Effluent Limitation Regulation

The National Effluent Limitation Regulation, S1.8 of 1991 (No 42, Vol. 78, August, 1991) makes it mandatory for industries such as waste generating facilities to install anti-pollution and pollution abatement equipment on site. The Regulation is specific for each category of waste generating facility with respect to limitations of solid and liquid discharges or gaseous emissions into the environment. Appropriate penalties for contravention are also prescribed.

Pollution Abatement in Industries Generating Wastes Regulations

The Pollution Abatement Regulation, S1.9 of 1991 (No 42, Vol 78, August, 1991) imposes restrictions on the release of toxic substances and stipulates requirements for pollution monitoring units, machinery for combating pollution and contingency planning by industries, submission of lists and details of chemicals used by industries to FMEnv, permits for the storage and transportation of harmful or toxic waste and the waste generator's liability. The Act also provides regulations on strategies for waste reduction, permissible limits of discharge into public drains, protection of workers and safety requirements, environmental audit (or environmental impact assessment for new industries) requirements and penalties for contravention.

Management of Hazardous and Solid Wastes Regulations

The Management of Hazardous and Solid Wastes Regulation, S.1.15 of 1991 (No 102, Vol. 78, August, 1991) defines the requirements for groundwater protection, surface water impoundment, land treatment, waste piles, landfills, and incinerators. It also describes the hazardous substances tracking programme with a comprehensive list of acutely hazardous chemical products and dangerous waste constituents. In addition, the Act also contains the requirements and procedures for inspection, enforcement and penalties.

1.4.6 Edo State Development Plans

Edo State Industrial Policy

The current policy of the Edo State Government (EDSG) is to create an enabling environment for private entrepreneurship to thrive. In turn, this policy mirrors the recent political and trade liberalisation programmes at the Federal level.

The State has the capacity to support major manufacturing and service industries such as power supply (Edo State Government, 2010). As a general rule, the EDSG does not take shareholding stakes of more than 20 percent in commercial enterprise. Instead, it helps to facilitate the establishment of industrial estates by allocating plots of land to private investors.

1.4.7 *International Agreements and Conventions*

Nigeria is a signatory to a number of international conventions and agreements relating to industry, development and environmental management. In certain cases conventions and agreements have influenced policy, guidelines and regulations and must be complied with during the planning, construction and operation of the Project.

Table 1.4 lists some of the key relevant international conventions and protocols to which Nigeria is a signatory. Each convention is briefly described thereafter.

Table 1.4 *International Conventions Relating to Industry and the Environment*

Date of Ratification by Nigeria	Name of Convention
1994	United Nations (UN) Convention on Biological Diversity
1994	Framework Convention on Climate Change
1991	United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Convention
1988	Convention on the Conservation of Migratory Species of Wild Animals
1987	Montreal Protocol on Substances that Deplete the Ozone Layer
1968	African Convention on Conservation of Nature and Natural Resources

Convention on Biological Diversity (1992)

The objectives of the Convention include the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising out of the utilisation of genetic resources.

Framework Convention on Climate Change (1992)

To achieve stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

Convention Concerning the Protection of the World Cultural and Natural Heritage Sites (1972)

The convention sets aside areas of cultural and natural heritage for protection. The latter is defined as areas with outstanding universal value from the aesthetic, scientific and conservation points of view.

Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) (1979)

The Bonn Convention concerns the promotion of measures for the conservation (including habitat conservation especially for endangered species listed in Bonn) and management of migratory species.

Montreal Protocol on Substances that Deplete the Ozone Layer (1987)

The purpose of this protocol is to protect the ozone layer through enhanced international cooperation by taking precautionary measures to control equitably total global emissions of substances that deplete it. Signatories undertake to communicate statistics on annual production, imports and exports of the substances as indicated in the Protocol and to promote research and development activities and information exchange.

African Convention on Conservation of Nature and Natural Resources (1968)

The contracting countries undertook to adopt the measures necessary to ensure conservation, utilization and development of soil, water, flora and faunal resources in accordance with scientific principles and with due regard to the best interests of the people.

1.4.8 *International Best Practice Standards and Guidelines*

To help protect the security of the Project's revenues, Azura Power is seeking to obtain a Partial Risk Guarantee from the World Bank's International Development Association (IDA) together with insurance cover from the World Bank's Multilateral Investment Guarantee Agency (MIGA). Development finance institutions such as the World Bank provide guidance on their requirements for the EIA process and place particular emphasis on achieving sustainable environmental, social and health outcomes.

Such international institutions also provide environmental standards and limits for emissions and discharges. The overall project design and this EIA are based on relevant guidelines published by the World Bank and therefore are expected to meet the environmental requirements of potential lending institutions.

The following international requirements and standards have been considered within the EIA process and are described below:

- Equator principles (EP)

- World Bank's environmental and social safeguard policies, including:
 - OP 4.01 – Environmental Assessment (World Bank OP 4.01)
 - OP 4.11 – Physical Cultural Resources (World Bank OP 4.11)
 - OP 4.12 – Involuntary Resettlement (World Bank OP 4.12)
- World Bank Group General Environmental, Health and Safety Guidelines (EHS)
- World Bank Group EHS Guidelines for Thermal Power Plants (IFCGTPP)

Equator Principles

The Equator Principles have been adopted by a wide range of banks and lenders all over the world in order to manage the social and environmental risks associated with potential investment.

Box 1.1 *Equator Principles*

The principles comprise the following:

- Principle 1 Categorisation of projects
- Principle 2 The borrower has to conduct an Environmental and Social Impact Assessment (ESIA)
- Principle 3 Applicable Social and Environmental Standards
- Principle 4 Action Plan and Management System
- Principle 5 Consultation and Disclosure
- Principle 6 Grievance Mechanism
- Principle 7 Independent Review
- Principle 8 Covenants
- Principle 9 Independent Monitoring and Reporting
- Principle 10 Equator Principles Financial Institutions (EPFI) Reporting

World Bank's Environmental and Social Safeguard Policies

The World Bank's environmental and social safeguard policies are a cornerstone of its support for programmes aimed at sustainable poverty reduction. The objective of these policies is to prevent and mitigate undue harm to people and their environment in the development process. These policies provide guidelines for lenders (including banks) and borrower staff in the identification, preparation, and implementation of programmes and projects. Safeguard policies have often provided a platform for the participation of stakeholders in the project design, and have been an important instrument for building a sense of project "ownership" among local populations. There are a total of ten environmental, social and legal Safeguard Policies of the World Bank, of which the seven most relevant are listed in *Box 1.2* below.

The safeguard policies and guidelines include:

- World Bank OP 4.01 for Environmental Assessment
- World Bank OP 4.04 for Natural Habitats
- World Bank OP 4.12 for Involuntary Resettlement
- World Bank OD 4.10 for Indigenous People
- World Bank OPN 4.11 for Physical Cultural Resources
- World Bank EA Sourcebook Update No 4: Sectoral EA (October 1993)
- World Bank EA Sourcebook Update No 25: EMPs (January 1999)

More specifically, the following policies are likely to be triggered by the project activities:

OP 4.01 – Environmental Assessment

Environmental Assessment is used in the World Bank to identify, avoid and mitigate the potential negative environmental impacts associated with the Bank's lending and guarantee operations. In World Bank operations, the purpose of Environmental Assessment is to improve decision making in order to ensure that project options under consideration are sound and sustainable and that potentially affected people have been properly consulted.

OP 4.01 – Environmental Assessment contains guidance on the World Bank requirements on various aspects of the EIA process. These include guidance on the categorisation of projects during Project screening, provisions for sector investing and financial intermediaries, exemptions for emergency situations, requirements for institutional capacity and requirements for public consultation and disclosure.

According to the World Bank OP 4.01, the proposed project is likely to be classified as a Category A project. Projects under this Category are likely to have significant adverse environmental impacts that are considered sensitive, diverse, or unprecedented and which may affect an area beyond the site or facilities. An EIA for a Category A project is required to identify and assess potential negative and positive environmental and social impacts, compare these with those of feasible alternatives (including the no project alternative), and recommend mitigation measures to reduce negative impacts and enhance benefits. The EIA process and this EIA report have been conducted and prepared in line with OP 4.01.

OP 4.12 – Physical Cultural Resources

The World Bank recognises physical cultural resources (PCR) as valuable scientific and historical assets and an integral part of a people's cultural identity and practices. Thus development projects that are likely to have an impact on PCR must work to avoid or mitigate adverse impacts. In the event

that PCR are impacted by project activities the developer is required to adhere to Nigerian legislation and, World Bank or any other international obligations.

The following steps, which are integrated into the EIA process, will take account of the PCR in the area of interest: screening, developing a terms of reference (TOR), collecting baseline data, impact assessment and formulating mitigating measures and a management plan.

If the Project is identified to have adverse impacts on PCR, the proponent must identify appropriate measures for avoiding or mitigating these impacts as part of the EIA. These measures may range from full site protection to selective mitigation, including salvage and documentation, in cases where a portion or all of the physical cultural resources may be lost. The proponent is also required to develop a PCR management plan.

In addition, OP4.12 requires the proponent to engage with project-affected groups, concerned government authorities, and relevant non-governmental organisations to document the presence and significance of PCR, assess potential impacts, and explore avoidance and mitigation options. The findings of the physical cultural resources component of the EIA are disclosed as part of, and in the same manner as, the EIA report.

OP 4.12 – Involuntary Resettlement

According to the World Bank's safeguard policy on Involuntary Resettlement, physical and economic dislocation resulting from World Bank funded developmental projects should be avoided or minimized as much as possible. Unavoidable displacement should involve the preparation and implementation of a RAP to address the direct economic and social impacts resulting from the resettlement. Under World Bank OP 4.12, the steps required for resettlement preparation and planning are as follows (World Bank, 2004):

- **Step 1. Land Acquisition Assessment:** to establish the extent, location and current use of the land required for the Project.
- **Step 2. Avoid/Minimise Resettlement:** seek alternative locations/routes for the Project.
- **Step 3. Household Census and Socioeconomic Survey:** an inventory of persons displaced by the project and associated assets (including physical structures and land based assets such as crops and grazing land). They are usually conducted in close coordination with local government officials so that the data can be validated.
- **Step 4. Legal Framework:** used as a basis for acceptance and enforcement of terms included in the RAP. It also enables eligibility criteria and entitlements to be decided based on relevant local and international requirements. This step defines the cut-off date for entitlements.

- **Step 5. Stakeholder Consultation:** consultation with the affected population in order to ensure that the resettlement plan is implemented fairly, meeting the needs of all concerned. It allows local communities to express their concerns and answer questions, and is the forum in which valuation and grievance procedures are discussed and agreed.
- **Step 6. Feasibility Study of Resettlement Sites:** determines the viability, of residential and agricultural sites. It includes a host population capacity assessment to evaluate the availability of water, soil quality and topography; it also includes a needs assessment to ensure that the sites meet the needs of both the host and resettled communities.
- **Step 7: Feasibility of Income Improvement Measures / Livelihood Restoration and Capacity Development:** determines the technical, economic and financial feasibility of programmes proposed to restore the livelihoods of those economically affected by the Project and includes assessing training needs, vacancies and opportunities for job creation.
- **Step 8. Implementation:** involves setting up the working groups/institutional framework to manage resettlement, putting the grievance mechanism in place, moving and resettling affected persons, distributing compensation and managing livelihood restoration programmes.

Environmental Health and Safety Guidelines for Thermal Power Plants

This World Bank Group guideline provides guidelines on emission limits, management measures and monitoring for all fossil-fuel thermal-based power plants with a production capacity of more than 50 MW. The document outlines guidelines on assessing the industry-specific impacts and identifying management measures related to air emissions (SO₂, NO₂, particulates), energy efficiency and GHG emissions, water use, handling and treatment of effluent (including thermal discharges, waste water and sanitary wastewater), solid waste, hazardous material handling and noise. Similarly, the guideline provides management measures for occupational and community health and safety (H&S).

Furthermore the guidelines provide suggested limits for treated effluent discharged to surface water bodies, air and noise emission levels as well as guidelines on suggested emissions monitoring parameters. These are discussed further in the assessment of the various impacts in *Chapter 7*.

In addition, the World Bank's general EHS Guidelines provide guidance on ambient conditions including on air and noise, and health and safety guidelines for the workplace which will be relevant for the Project.

An outline of the contents of the main volume of the EIA report is provided in *Table 1.5* below. The structure follows the proposed structure included within the Scoping Report and is in line with guidance provided by FMEnv.

Table 1.5 *EIA Report Structure*

Chapter	Title	Description
Front Pages		Title page, acknowledgements, authors and contributors, table of contents (including lists of figures, tables, and maps) and list of abbreviations
Executive Summary		A summary of the EIA report.
1	Introduction	This Chapter outlines the development and structure of the EIA report including the background, terms of reference and declaration. The policy, legal and institutional framework within which the EIA has been conducted is discussed. National regulations are summarized along with relevant international agreements and conventions to which Nigeria is party, as well as applicable international best practice guidelines and project standards.
2	Project Justification	This Chapter includes a discussion of the Project background, objectives, need for the Project, value of the Project, envisioned sustainability, alternatives considered (including no project alternative), development options considered and site selection.
3	Project Description	This Chapter provides a concise description of the Project and its geographical and temporal context. It also includes a site description, an overview of the Project design and details of project inputs and outputs.
4	Description of the Environment - Biophysical	This Chapter summarises the available baseline data on the environment within the Project study area. It is based on both primary and secondary data sources and considers changes in the baseline conditions without the development in place.
5	Description of the Environment - Socio-economic	This Chapter summarises the available baseline data on social resources and receptors within the Project study area. It is based on both primary and secondary data sources and considers changes in the baseline condition without the development in place.
6	Consultations and Disclosure	This Chapter presents the results of consultation undertaken as part of the EIA, plus plans for future consultation. It also identifies key project stakeholders and present their feedback on the Project.
7	Biophysical and Socio-economic Impacts	This Chapter summarises the predicted positive and negative impacts of the Project. Cumulative impacts are also assessed.

Chapter	Title	Description
8	Mitigation measures and Residual Impacts	This Chapter outlines general and specific mitigation measures to reduce, remove or avoid negative impacts to environmental and social receptors. Residual impacts (post mitigation) are outlined.
9	Cumulative Impacts	This Chapter outlines the cumulative impacts of the Project providing assessment of the overall significance.
10	Environmental Management Plan (EMP)	The EMP draws together the possible mitigation measures; groups them logically into components with common themes; define the specific actions required and timetable for implementation; identify training needs, institutional roles and responsibilities for implementation; and estimate the costs of the measures.
11	Conclusion	This Chapter summarises conclusions that are made based on the assessment as well as outlines any further recommendations.
	References	All references made in the report and documents drawn upon during the course of the assessment.
	Annexes	These include technical annexes with details of specific technical surveys, the bibliography and list of acronyms.

2.1 NEED FOR THE PROJECT

Addressing Nigeria's electricity demand is becoming increasingly urgent not only to bridge the current enormous gap between supply and demand but also to match the expected growth of the country's population. Nigeria's population (at circa 160 million people) is already the seventh largest in the world and accounts for nearly 15 percent of Africa's total. It is also a young population with 40 percent of its citizens below the age of 15 and has a population growth rate of 2.5 percent per annum. On the current estimates produced by the United Nations, Nigeria's population will reach nearly 230 million within the next 20 years.

Although the first electricity was produced in Nigeria in Lagos in 1896, there has been very little investment in the Nigerian power sector. This was particularly true of the twenty years between 1979 and 1999, during which capacity expansion crawled to a halt and there was limited maintenance of existing power stations. Since the return of the country to civilian rule in 1999, the Government has attempted to increase the country's power generation, transmission and distribution capacity but (as noted below) the impact of these efforts has been slow and the gap between supply and demand has further grown. In turn, the impact on Nigeria's economic growth and the living standards of its citizens has been devastating.

By way of example, small scale self-generation of electricity from diesel and petrol generators in Nigeria is currently estimated at more than 6,000 MW, constituting more than twice the average generation of electricity from the grid during 2009 (according to the Government's "Roadmap for Power Sector Reform" published in 2010). The majority of the Nigerian population (and most notably the country's poor) are not connected to the national grid.

In 2005, the Government launched an ambitious capital investment program under the title of the NIPP. The NIPP projects comprise both gas-fired power plants and transmission lines and, when completed, are intended to add nearly 5,000 MW to the country's electricity capacity. Unfortunately, the NIPP programme has been subject to long delays and serious cost overruns.

The NIPP's contribution is very small compared to the investments that are required for the country to meet the generating target that it has set for 2020, namely 40,000 MW. Even if this target of 40,000 MW is met, Nigeria's power capacity per head of population in 2020 would still be less than a quarter of what South Africa currently enjoys.

According to Government estimates, reaching this relatively modest target of 40,000 MW by 2020 will require investments in power generating capacity of at least USD 3.5 billion per annum for the next ten years (excluding the

commensurate sums that will need to be spent on other parts of the value chain).

The Government has made it clear that it would not be desirable for such enormous investments to be funded and directed by the Federal Government (in light of the erratic and inefficient management of capital expenditures by the State-owned power company over the past two decades). More importantly, the Nigerian Government recognises that it would not even be possible for investments on this scale (in a single industry sector) to be made by the Federal Government.

Hence, the Nigerian Government has stressed, repeatedly, that the requisite investments in the power sector will only be achievable if the private sector is incentivised to make these investments.

In this context, the Azura-Edo IPP is regarded as a critical litmus test of the country's ability to resuscitate its crippled power sector and (through the multiplier effects thereof) provide the much-needed employment opportunities for its large, young and rapidly urbanising citizens.

2.2 *AZURA POWER'S COMPANY OBJECTIVES*

Azura Power was established in 2010 to address Nigeria's growing demand for the provision of electricity across both the domestic and business sectors. The company's long-term objective is to build an internationally rivalled, low-cost, power company through the following strategies:

- The development of greenfield IPPs with the Azura-Edo IPP being the first such greenfield project;
- Acquisition of Government owned NIPP and/or PHCN power plants and/or other IPPs;
- Optimising performance of the assets;
- Leveraging the skills and asset base of local and international partners to identify growth opportunities;
- Working closely with the Federal Government of Nigeria, the Local State Governments and all relevant regulatory bodies to help deliver the Government's power sector reform; and
- Being a good corporate citizen through contributing towards the development of local communities.

PROJECT BENEFITS

At a national level, the construction of the power plant will result in an increase in grid based power generation capacity. At a local level, the Project directly contributes to the development of Benin City area and the State as a whole (through the employment opportunities it will directly create and through the multiplier and agglomeration effects that will flow from the increased availability of power within the region).

Apart from the evident contribution of electricity to the grid, the Azura-Edo IPP Project endeavours to promote stronger relationships with numerous parties involved in the Project. Inherent within Azura Power's long-term strategy is the collaboration with the Federal Government of Nigeria, the Local State Government (relevant Edo State departments/ ministries) and all relevant regulatory bodies. This collaboration is intended to assist in delivering the Government's power sector reform. In addition, the Edo State Government will be a minority shareholder (up to 5 percent) in the Azura-Edo IPP Project, and has agreed to provide the necessary land and road infrastructure for project completion. The partnership with Edo State is intended to provide a foundation for collaboration with local government and other relevant parties in the future.

Azura is also working to develop close partnerships with leading suppliers, contractors, service providers and advisors who have extensive knowledge and experience in their respective industries, particularly in the development and operation of power plants in West Africa. The selection of world-class expertise enlisted for the Project will bring a wealth of skills and technology not only to the Project but the wider energy sector within Edo State.

The Azura-Edo IPP has been nominated by the Nigerian Federal Ministry of Finance for participation in a series of Partial Risk Guarantees (PRGs) initiated by the WB to support the Nigerian electricity supply industry. In addition, the Project has applied for political risk insurance (PRI) from the Multilateral Investment Guarantee Association (MIGA). Both WB Programmes work to instil greater certainty and hedge financial risks for potential investors. Indeed, it is likely that these guarantees (and other aspects of the Project's financing structure) will not encourage external investors but will also raise the investment profile of other, similar, projects in Nigeria.

ENVISAGED SUSTAINABILITY ASPECTS

The sustainability of the Project can be assessed and discussed in terms of the environmental, economic and social aspects of the proposed development. The EIA is a key component of the efforts designed to increase the sustainability of the Project and includes an analysis of the potential Project alternatives. Azura Power will ensure that the Project meets and/or exceeds the requirements of the Nigerian FMEnv, the WB, and the IFC with regard to minimising the environmental and social impact of the construction and

operation of the Project. The implementation of recommendations provided as a result of the EIA and the Environmental and Social Management Plan (ESMP) will aid in achieving environmental, economic and social sustainability.

2.4.1 *Environmental Sustainability*

The power plant will be fuelled by natural gas, with a small amount of diesel fuel reserved for instances in which the generators may need to be “black-started” in the event of a grid-collapse. Natural gas has a much less damaging impact on the environment than other fossil fuels (eg coal or heavy fuel oil). More specifically, it emits lower levels of greenhouse gas emissions, as well as other air and tropospheric ozone pollutants.

The use of gas as the feedstock will also help to address the problem of gas flaring that commonly occurs in Nigeria as a result of oil extraction.

The power station has been designed to allow for a conversion into a combined cycle power station at a later date. Conversion to combined cycle will increase energy output by approximately 50 percent with no increase in fuel consumption or carbon emissions. Furthermore, the envisioned cooling technology for the combined cycle power station is air based (to minimize water consumption).

The gas turbines required for the power plant are not manufactured in Nigeria, or anywhere else on the continent. Plant and machinery will be sourced by the appointed Engineering, Procurement and Construction (EPC) contractor. However, Azura will request that the EPC contractor source raw materials locally to the extent possible as this contributes to the local economy and reduces unnecessary transportation of materials and resulting emissions.

2.4.2 *Economic Sustainability*

As previously indicated, there is a high demand for supply of power in Nigeria in order to support national economic growth. In addition to the employment and investment opportunities such projects will bring, the proposed Project will contribute to wealth generation and industrial growth in the region and assist in meeting the national electricity demand.

The Project is expected to add a significant number of employment opportunities to the local labour market. It is envisioned that at the peak of construction up to 500 workers will be employed by the Project. Around 70 percent of the workers will be hired from the local communities within a 30 km radius of the site. The EPC contractor will be made responsible for the selection and management of all sub-contractors. Azura Power will however, reserve the right to review all suppliers of major equipment and materials (specified in the bidder’s proposal or subsequently identified during the design phase) and to reject any suppliers where they do not meet desired

quality standards or performance. More specifically, Azura Power will seek to monitor and guide the sub-contracting practices of the EPC contractor.

The International Development Association’s Partial Risk Guarantee programme will provide 12 months of dedicated power purchase agreements in the event of payment defaults. The WB, from their experience of operating in other countries, has indicated that the PRG is also a powerful deterrent against the persistence of payment delays, which in turn enhances the financial viability and provides a mechanism for ensuring the sustainability of the project. Azura Power West Africa is also seeking to obtain Political Risk Insurance (PRI) from the World Bank’s MIGA. Azura Power West Africa has also applied for three other forms of MIGA PRI coverage, shown in *Table 2.1*.

Table 2.1 *MIGA PRI Coverage Relevant to the Project*

Cover	Description
War, terrorism, civil disturbance and sabotage	<p>The cover protects against loss from, damage to, or the destruction or disappearance of, tangible assets or total business interruption (the total inability to conduct operations essential to the Project’s overall financial viability) caused by politically motivated acts of war or civil disturbance in the country, including revolution, insurrection, coups d’état, sabotage, and terrorism. The cover protects against losses directly attributable to the physical damage of assets and total business interruption.</p> <p>At Azura’s request, temporary business interruption has also been included and would cover damage of assets, forced abandonment, and loss of use. This coverage encompasses not only violence in the host country directed against a host country government, but also against foreign governments or foreign investments, including the investor’s government or nationality.</p>
Expropriation of investment or funds	<p>The cover protects against losses arising from government actions that may reduce or eliminate ownership of, control over, or rights to the insured investment. In addition to outright nationalization and confiscation, "creeping" expropriation—a series of acts that, over time, have an expropriatory effect—is also covered. Coverage is available on a limited basis for partial expropriation (eg confiscation of funds or tangible assets). In case of total expropriation of equity investments, compensation to the insured party is based on the net book value of the insured investment. On expropriation of funds, MIGA pays the insured portion of the blocked funds. For loans and loan guaranties, MIGA can insure the outstanding principal and any accrued and unpaid interest.</p>
Currency inconvertibility and inability to transfer	<p>The cover protects against losses arising from an investor’s inability to legally convert local currency (capital, interest, principal, profits, royalties, and other remittances) into foreign exchange and transfer local currency or foreign exchange outside the country due to government action or failure to act. Currency depreciation is not covered. In the event of a claim, MIGA pays compensation in the currency specified in the contract of guarantee.</p>

Source: Azura Power West Africa, 2011

2.4.3 *Social Sustainability*

A detailed stakeholder consultation process has been implemented throughout the EIA process to assist in ensuring that all stakeholders have had the opportunity to provide input into the project planning process. This has also assisted in laying a sound foundation for building relationships with stakeholders for the ongoing engagement that will continue throughout the lifecycle of the Project. Further detail on the stakeholder engagement plan for the Project is included in *Chapter 6*.

Azura is committed to ensure that a portion of the revenues earned by the Azura-Edo IPP is spent on programmes that will benefit the local communities. These programmes are likely to comprise projects aimed at improving the health and education of the inhabitants of these communities. The specific form and extent of these programmes will ultimately be guided by the company's Corporate Social Responsibility Policy (which will have input from all stakeholders including the Company's employees) and by the profitability and liquidity of the Company.

3 *PROJECT DESCRIPTION*

3.1 *PROJECT OVERVIEW*

3.1.1 *Project Background*

Azura Power, a subsidiary of Amaya Capital Limited ('Amaya'), is proposing the construction of the Azura-Edo IPP in Edo State, Nigeria.

The first phase of the Project will comprise:

- a 450 MW (net) gas-fired power plant;
- a short transmission line (less than 1 km) connecting the power plant to the Benin North Substation, which is located adjacent to the Project Site; and
- a short underground gas pipeline spur (circa 1 km in length) connecting the power plant to the country's main gas trunk line, the Escravos Lagos Pipeline System (ELPS) ⁽¹⁾.

The Project and this EIA do not include the Benin North Substation which is currently being constructed under the management of the National Integrated Power Project (NIPP). This substation was initiated and funded prior to the establishment of Azura Power. The construction and operation of the Benin North Substation is not dependent upon the Azura-Edo IPP.

3.1.2 *Project Site*

The Project site (Site) is located in the north-eastern outskirts of Benin City in Edo State, in the Federal Republic of Nigeria. The Site is located adjacent to the Ihovbor Power Plant, which is currently under construction under the auspices of the NIPP.

The Site will comprise a total area of 102 ha. The power plant will require approximately 12.5 ha of this total area (*Figure 1.1*). The OCGT will be constructed in such a way so as to allow for potential conversion to a CCGT if and when such a conversion is deemed economically viable.

3.1.3 *Land Acquisition Process*

The Edo State Government is partnering with Azura Power in the development of the Project and its principal contribution thereto is the provision of the land upon which the power plant will be constructed. The transfer of this land to the Azura Power commenced in 2010 following the

(1) Although the gas spur line is considered an associated facility, this will be constructed not by Azura Power but by the gas supplier. This EIA includes the assessment of the impacts associated with the short gasline spur.

signing of a Memorandum of Understanding (MoU) between the company and the Edo State Government. Under the MoU, the Edo State Government committed to provide the project land and associated easement rights. The second stage in the acquisition process took place in the second quarter of 2011 when the land was surveyed by the Edo State Ministry of Lands, Surveys and Housing and property beacons (delineating the boundaries of the project land) were erected on the site.

Subsequent to this exercise, the Edo State Government issued a formal public notice of the Government's intention to make use of the land, revoking all existing rights and interests in the land and requesting affected parties to register any claims. The registration of claims is required so that compensation payments can be made by the Edo State Government (in conjunction with Azura Power) in due course. The formal notice of revocation was published in the official Government Gazette on 16 June 2011 and in two Nigerian newspapers on 23 June 2011, namely the Vanguard Newspaper (with a national circulation) and the Observer Newspaper (with a local circulation). ERM have compiled a Resettlement Action Plan (RAP) inclusive of an entitlement matrix, which upon review and acceptance by the World Bank will be implemented in the early stages of 2012. The RAP will outline compensation measures for all relevant communities including means of implementation and timeframes.

The land acquisition process will be completed with the transfer of title to the land to Azura Power by the issuance of a Certificate of Occupancy. This certificate will be issued upon submission of the EIA Report and completion of the RAP.

3.1.4 *Project Components*

The proposed Project will comprise the following:

- Power generating facilities comprising a OCGT system; and
- An aboveground (with one pylon) 330 kV transmission line from the power plant to the Benin North substation adjacent to the Project site.
- An underground gas pipeline spur (of circa 1 km in length) connecting the gas receiving station on the Project Site to the ELPS.

3.1.5 *Comparison between OCGT and CCGT*

A comparison of OCGT and CCGT technology was undertaken to determine the preferred technology for the power plant. The criteria considered were:

- operating efficiency and therefore the heat rate of the generating units;
- capital costs of the units;
- resilience to grid instabilities;
- maintenance costs and the ease of maintaining them in Nigeria; and

- duration required for construction and maintenance activities in a Nigerian context.

Based primarily on the operating efficiency of OCGT this technology was selected for the proposed power plant. The price of the gas feed-stock was also a determining factor.

3.1.6 *Possible Future Conversion of OCGT to CCGT*

The OCGT plant has been designed to accommodate the potential conversion to CCGT with a total net output of approximately 670 MW. The gas turbines exhausts and stacks have been orientated in such a way as to allow for the Heat Recovery Steam Generators (HRSGs) to be built directly behind them. The CCGT will form an extension adjacent to the OCGT facilities with HRSGs installed next to each gas turbine.

The conversion of the plant to CCGT will require the construction and installation of four heat recovery steam generators (HRSGs) which will be connected to the exhaust of each of the existing four gas turbines. It will also involve the installation of two steam turbine generators. This will create two CCGT blocks (each a two plus one configuration) such that the gas turbine and the steam turbine generators are of a similar size, and the transformers are of a similar size so that they are interchangeable. The principle aim is to capture excess exhaust heat of the OCGT engine, thus extracting more useful energy from the fuel and thereby increasing the system's overall efficiency.

The construction of the CCGT plant will take place if and when it is deemed that the plant conversion from OCGT to CCGT is economically viable. Consequently, the CCGT plant is excluded from consideration in this EIA. The environmental and social impacts resulting from the conversion of the plant to a CCGT system have therefore not been considered within this EIA and will be identified and assessed within a separate EIA, if required.

3.2 *POWER PLANT*

3.2.1 *Overview of Power Plant Components*

The key Project components are listed in *Table 3.1*.

Table 3.1 *Key Project Components*

Key Component	Additional Information
Gas Turbine Power House	Four Frame E gas turbines and generators each with a nominal output of 112.5MW with stack diverter/ damper units. The gas turbines have incorporated Dry Low NO _x burners.

Key Component	Additional Information
OCGT Associated Machinery	Auxiliary compartments, including fin fan coolers, and inlet air filter baghouses for four gas turbines
Black start diesels	Three 3.7 MVA black start diesel units. Diesel oil storage - amount for around 24 h of operation at full load will be required (40m ³)
Pump System & Water Treatment Plant	A small water treatment plant (approximately 5 m ³ of demineralised water per day) and a treated water storage tank with seven days storage capacity (850 m ³). A raw water tank (1,200 m ³) and two fire/ service water storage tanks (700 m ³ each with 300 m ³ fire water reserve).
High voltage switchgear	330 kV air insulated switchgear, with one bus section breaker and two bus coupler breakers
Transformers	Four step-up transformers (15 kV/330 kV) Two station transformers (15 kV to 11 kV)
Gas Receiving Station	Will contain an emergency shutdown system with a Slam Shut Valve Station. It will also include a metering station, scrubbers, filters, gas heaters, and pressure reducing equipment.
Ancillary systems and facilities	Including electrical annex housing the switchgear, control cubicles and cabling for gas turbine units, Turbine Crane, unloading area, fire water system including a fire water pump station, administration building, a central control room, gatehouse, and workshop.
Waste Treatment	This will include a waste water treatment plant and/or effluent treatment plant, and a domestic waste treatment plant.

Source: Azura Power West Africa, 2011

3.2.2 OCGT Plant Process

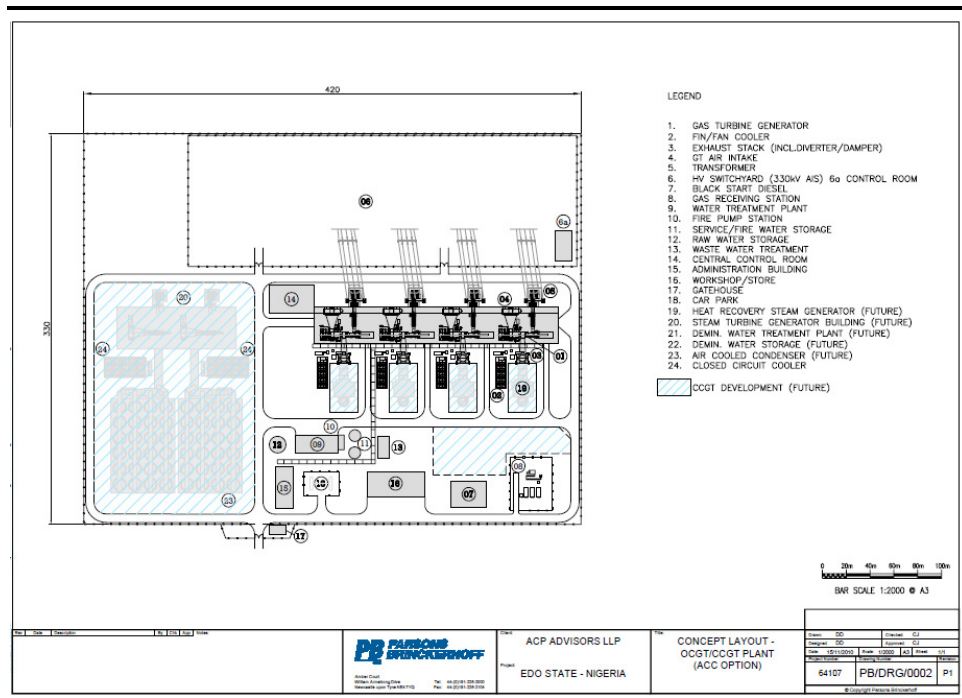
An OCGT power plant consists of a gas turbine and a generator. The gas turbine comprises a compressor, combustion system and a power turbine. The compressor draws in fresh air and raises the air pressure by compressing it. Fuel is added to the compressed air in the combustion system and ignited. The resulting expanding burning gases turn the power turbine which is connected to the generator thereby creating electricity.

The Azura-Edo IPP will be constructed around four Frame E gas turbine generators, operating in open cycle with a nominal output of 112.5 MW from each unit, and a total capacity of the power station of approximately 450 MW. The power plant will run in a base load regime, with a load factor of 95 percent such that the power will be offered to the system operator for dispatch whenever it is available. Power will be offered on a net basis (ie the plant internal load will be satisfied from generation before the main power station fiscal meters). When operating base load, as described above, the expected annual generation will be 3.25 TWh (3,250,000 MWh).

3.2.3 Proposed Site Layout

The proposed layout of the power plant is illustrated in *Figure 3.1* below. This figure illustrates a conceptual layout for an OCGT plant and includes potential future conversion to CCGT technology (with air cooling).

Figure 3.1 *Layout of Proposed Power Plant*



Source: Azura Power West Africa, 2011

Gas Turbine Building

The four gas turbines will be arranged in a line within the gas turbine building. A turbine crane will run the length of the building, with main access doors for maintenance from each end of the gas turbine building. An access corridor will run through the building along one side of the gas turbine units and a low level electrical annex will be situated close to the transformer and below the level of the gas turbine air intake filter housings.

The electrical annex will house the switchgear, control cubicles and cabling for the gas turbine units and their auxiliaries. Diverter or damper units with bypass stacks will be included in each gas turbine exhaust to allow for future conversion to a CCGT plant. The gas turbines will be installed in a noise reducing enclosure to keep the noise levels from the gas turbines below 85 dBA.

Gas Turbines

The initial design assumes a General Electric Frame 9E machine, but the chosen gas turbine may be a different E class gas turbine from an alternative manufacturer. It is estimated that the year of manufacture will be 2012 or later and that the Warranty will be for at least two years. These turbines have the following characteristics:

- Maximum turbine capacity of 112.5 MW (140.625 MVA) and minimum turbine capacity of 67.5 MW (minimum turndown of 60 percent).
- New and clean Heat Rate of 11,100 Btu/kWh (lower heating value) at the Project site conditions; new and clean efficiency of 32 percent.
- The gas turbines will be fuelled by natural gas.
- The gas turbine pressure ratio will be 12.6:1.
- The gas turbines will be built in a noise reducing enclosure. The target noise outside of the enclosure will be less than 85 dBA (see *Section 3.2.12*).
- The run-up and run-down rates will be 10 MW per minute for each unit or higher if more than one machine is running up or running down at any one time.
- The Piezo ignition system or an equivalent electrical gas ignition system will be used.
- Standard gas turbine accessories, including oil pumps, water pumps, fin fan coolers, electrical equipment and controls etc.
- The air intake system consisting of a bag filter.

- Emission levels of NO_x at 20ppm, and CO at 30ppm (see *Section 3.2.12*).

High Voltage Switchgear

The dimensions of the high voltage switchyard are based on 330 kV air insulated switchgear, with an arrangement of one bus section breaker and two bus coupler breakers. The configuration allows for six incoming overhead line circuits from the power plant ie four from the four OCGT gas turbine generator transformers and two from the future steam turbine generator transformers. There will also be two outgoing overhead line circuits.

3.2.4 *Generator Specifications*

The exact type of generator will be determined in the detailed negotiations with the EPC contractor and will be subject to a competitive bidding process. The generator rating would be 112.500 MW (140.625 MVA) with a terminal voltage of 15 kV, a rated voltage of 50 Hz and a rated speed of 3000 RPM. The rated power factor will be 0.8 (lagging) and the generator efficiency between 98.5 to 98.8 percent depending on the unit load. Each generator will have automatic voltage regulator and a turbine speed control governor. A totally enclosed water-to-air cooling system will be used with re-cooling by air-water (fin fan) heat exchangers. The generators shall be equipped with a protection scheme to protect and prevent damage to the plant.

3.2.5 *Electricity Distribution from the Power Plant*

The OCGT power plant will have four transformers that will step up the voltage from 15 kV, at the gas turbine generator terminals, to the transmission voltage of 330 kV. Electricity will then be fed over a short length of overhead cable to an air-insulated switchyard before being exported via overhead cables on a single tower or by underground cable, to the major new substation at Benin North.

The switchyard will consist of circuit breakers and other high voltage electrical equipment together with associated supporting steel structures. At the substation there will be at least two main busbars where SF₆ (sulfur hexafluoride) is used. The SF₆ is used to extinguish the arc caused when a circuit breaker is opened, either by a control switch or due to a fault. Disconnectors or isolating switches (manually or automatically operated) are included on either side of each circuit breaker to allow for electrical isolation during maintenance work.

The electricity will then flow either onto the National Grid or via the Benin North 330/132 kV transformers or the Benin North 132/33kV transformers into Benin City and surroundings.

The Project intends to contract for the supply of power at the national level. Azura Power is currently negotiating a Power Purchase Agreement (PPA) with the Nigerian Bulk Electricity Trading PLC (NBET), a Federal

Government parastatal that has been established for the purpose of acquiring the bulk of the power generated from new IPPs.

3.2.6 *Power Plant Fuel Supply and Consumption*

Fuel Supply and Supply System

The Project site is located less than a kilometre away from the ELPS, the country's main natural gas trunkline. The plant, therefore, will use natural gas as the only fuel source. Natural gas will be delivered to the plant via the ELPS and a circa 1 km spur line from the ELPS to a gas receiving station on the plant site. Between the interconnect point on the ELPS and the boundary of the Project Site, this spur will share the same right of way used by the spur that connects the ELPS to the adjacent NIPP power plant.

The ELPS is owned and operated by the Nigerian Gas Company (NGC), the centrepiece of which is a 36 inch trunk line with a capacity of 1 billion scf/d. The ELPS is currently undergoing expansion and a second "twinning" pipeline following the same right of way is under construction. Based on the current speed of the pipeline construction, the ELPS Expansion is scheduled to reach Ihovbor-Evboeka village and the Project site before the end of 2012, at least 18 months in advance of when the Project is likely to need commissioning gas.

The specification of the gas delivered to the gas receiving station will be in line with the national gas specification adopted by the NGC.

The gas receiving station will be located in a fenced compound, and will include an emergency shutdown system with a slam shut valve station. The gas receiving station will also include scrubbers, filters, metering, dew point heating units and pressure reducing equipment.

Black Start System

During power outages from the National Grid system (a frequent occurrence in Nigeria) power required for the auxiliaries and for the gas turbine starting (cranking) motors will not be available. As a result, Azura Power plans to install three 3.7 MVA diesel units to provide the estimated 7.4 MVA required to "Black Start" the power station. These units will also be available to assist in the emergency shutdown required in the event of a total grid system collapse.

Fuel Consumption

The typical full load fuel flow for a 9E configuration burning natural gas is 1,350 GJ per hour. This is equivalent to approximately 120 mmscf per day of gas.

3.2.7 *Power Plant Water Supply and Consumption*

Plant water supply to the site will be from borehole water piped to the site and stored in the raw water storage tank located adjacent to the planned steam turbine generator building. The raw water storage tank will have a capacity of 1,200 m³ which will be sufficient for water storage for a few days in case of disturbance to the raw water supply.

A small water treatment plant will be required for the Project to supply process water for the washing of the gas turbine compressor, for the closed circuit cooling system and general service water to the plant and potable water to the office buildings. In addition two fire/service water storage tanks with a capacity of 700m³ each will be installed with a 300m³ fire water reserve. The power plant will require approximately 1000 m³ of water from the boreholes per day.

3.2.8 *Hazardous Materials*

Approximately 40 m³ of diesel will be stored onsite for black starts. This volume is equivalent to approximately 24 h of operation. Diesel will be stored in a 40 m³ tank with a surrounding bund which will have a capacity of at least 44 m³. The diesel will be piped from the storage tank to the black start units.

3.2.9 *Transport and Traffic*

The existing road currently leading from the main dual carriageway (Benin City Bypass) to the Project site will be used as the primary access route to the site and is tarred and in good condition.

During construction, an estimate of 20 to 30 Project vehicles will use this road daily. A maximum of ten Project vehicles will use this road daily during operation. The peak number of vehicle movements during both construction and operation is estimated at between 50 to 100 concrete mixers per day. Azura Power will liaise with the Edo State government to repair any sections of the road that may be damaged during construction.

Traffic levels will also peak during the annual shutdowns and periods of major maintenance. The maintenance period is likely to be two weeks in most years, with a major maintenance every six years which is estimated to last around six weeks.

Onsite Traffic

The Project currently has one 4x4 vehicle and is anticipated to require one light truck (7.5 tonne), two pick up trucks, a fork lift truck and three 4X4 vehicles, which will operate onsite and for use offsite by Project staff. The intention is that all vehicles, new and old will be serviced and refuelled at an off site public service station. No refuelling or vehicle maintenance will take place onsite.

3.2.10 *Fire Protection*

The gas turbine enclosures will be fitted with self-contained fire detection and protection systems based on a carbon dioxide fire suppressant system (or equivalent). For the auxiliary plant areas, a fire water system will be installed comprising the following:

- a pump station using an electrical motor and diesel driven pumps as well as a jockey pump for the sprinkler and deluge systems; and
- hydrant and hose points.

The two service/ fire water tanks (storage capacity of 700 m³) will include a fire water reserve in each tank of approximately 300 m³.

3.2.11 *Control Room*

The power plant will be operated from the plant control room. The control room will comprise a two or three storey building housing cable flats, electrical and electronic equipment, the main control room and some office space. The control room will form an annex to the gas turbine building so that the operators can access the gas turbine hall from the control room.

3.2.12 *Overview of Emissions and Wastes*

Atmospheric Emissions

The principal source of air emissions will arise from the combustion of natural gas in the combustion cans of the gas turbines and also the operation of the three small (3.7 MVA) diesel units. The air emissions of the latter however will be significantly less, as it is anticipated that these units will run for less than 100 h per year.

All air emissions will be released via a stack, the design of which will be determined by detailed dispersion modelling to ensure that the stacks are of the optimal diameter, and that the efflux velocity will be sufficiently high for ground level air concentrations to be within the World Health Organization (WHO) limits at all times. This standard will be applied even if the predicted ground level concentrations from dispersion modelling are in a depopulated area. The air dispersion modelling (ERM, 2011) has used four stacks 50 m high, with a diameter of 14 m for the air dispersion modelling parameters. The results of the air quality modelling are discussed in *Chapter 7*.

It is anticipated that four gas turbines will be used for power generation. An open tender process will invite EPC contractors to tender for the construction of the Project based on using E class gas turbines. There are a number of gas turbines available on the market which complies with this specification, namely GE 9E; Siemens V94.2; Alstom 13E2; and Mitsubishi 701DA, which all produce similar levels of emissions.

The level of oxides of nitrogen (NO_x) in the stack gases is controlled through the use of a dry low NO_x burner in all of the above gas turbine models. Furthermore, the level of carbon monoxide (CO) in the stack gases will be controlled by mixing natural gas with air, and will be controlled by the gas turbine control system. There is also the potential for emissions of hydrogen sulphide (H₂S) to the air which will be dependent on the quantity of sulphur in the gas supplied to the power station. Natural gas normally contains negligible quantities of sulphur. The gas receiving station will contain scrubbers in order to control the amount of sulfur present in the fuel stream.

A summary of the overall air emissions from the four gas turbines (open cycle operations) and exhaust parameters including stack height, diameter, flow rate and temperature are all provided in *Table 3.2* below.

Table 3.2 Emissions to Air from Four GE 9E Gas Turbines (CCGT)

Summary of Emissions to Air from the Azura-Edo IPP		
Parameter	Emission from one unit	Emission from the power station
Number of stacks	1	4
Estimated height of the stacks (m)	50	50
Temperature of release (°C)	543	543
Stack diameter (m)	7	7
Actual flow rate (kg/s)	418	1,672
Actual flow rate (m ³ /s)	995	3,980
Efflux velocity at stack exit (m/s)	26	26
Emission concentrations		
NO _x (ppm)	20	20
CO (ppm)	30	30
H ₂ S	Trace	Trace
Carbon Dioxide (tonnes/yr)	545,000	2,178,000

Source: Azura Power, 2011

The key point sources of emissions from the power plant will originate from the four gas turbine stacks, and the black start diesel engine stacks and will include approximately 20 ppm NO_x, 30 ppm CO and trace amounts of H₂S.

Approximately 2,178,000 tonnes of carbon dioxide is expected to be released per annum as a result of the operation of the power station. Supplementary design measures in order to increase efficiency were considered, including conversion to CCGT technology. Azura Power will convert the power plant to CCGT if and when this is found to become economically viable.

Sulphur hexafluoride, a potent greenhouse gas is contained in transformers. On decommissioning, measures should be taken such that this is not be released to the atmosphere, but be reclaimed for use if possible.

Noise Emissions

Noise emissions will result from a variety of sources including the gas turbines. The key noise sources during construction phase will be from the mobile machinery and plant. Auger piling will be used to drive in the

foundations and is associated with lower levels of noise than driven piling. The gas turbines, however, will be built in a noise reducing enclosure, with the outside target noise reaching a maximum of 85 dBA at 1 m. In addition, the following will be used to reduce noise as a result of the Project:

- Gas turbine filter and ventilation apertures are to be fitted with silencers, and designed such that they face towards the existing plant, or towards new plant such that all sensitive receptors benefit from screening.
- High performance silencers will be used and will be tuned to attenuate low frequencies from the gas turbine exhausts.
- Azura's design ensures that reverberant sound from the gas turbine is minimised internally, for instance by using an acoustic enclosure. A Hushclad double-skin enclosure will be used with good door seals which will be replaced regularly to meet the specifications for 82 dB at 1 m from the source. If the 82 dBA for the enclosure is not feasible with these measures, then the turbine building will be upgraded to heavier walls or more internal absorption or a concrete block wall to achieve the same result. All plant items will be controlled to minimise noise of an impulsive or tonal nature, such that the rating level as defined in British Standard (BS) 4142: 1997 is equal to the specific noise level.
- Exhaust stacks will be designed to meet a power level of 92 dB(A).
- Azura's design shall ensure that all walls, roof, windows and doors to the building have a high noise reduction rating and ensure that there are no significant gaps. Air conditioning/air flow requirements shall be designed to take account of noise breakout. Low noise air coolers will be used.
- Azura Power will further refine the noise modeling of the plant to avoid > 45 dB at the four farms to the west of the plant by implementing design measures such as attenuators on the stacks, cladding on the turbine building and/ or noise barriers at the four receptors.

The results of the noise modelling study undertaken as part of the EIA are presented in *Chapter 7*.

Heat Emissions

The new and clean heat rate of the General Electric Frame 9E machine is 10,100 Btu/kWh. The heat emissions will chiefly originate from the stacks at a heat transfer rate of approximately 820 GJ an hour and some additional heat emissions from the fin fan cooler.

Liquid Effluents

Both oily water and chemical waste water effluents will be generated by the power plant operations. Effluents generated will include backwash effluent from pressure filters, regeneration effluent from the demineralisation plant as well as other chemical laboratory wastes, battery waste water, gas turbine compressor wash water and sludge. Further details of the effluents generated are provided in *Table 3.3* below.

Table 3.3 *Details of Effluent Generated*

SI. No	Waste Water	Source	Characteristics \ Contaminants	Disposal Method
1.	Chemicals	Bulk chemical drains in water treatment plant	Various chemicals	<p>Fed into the neutralisation pit, treated with acid/alkali and transferred to the central monitoring basin.</p> <p>Effluent (containing detergent, dirt and oil) from the gas turbine compressor on-line and off line wash and exhaust plenum drain will be fed to the wash water recovery pit. It will then be passed through the oil water separator and disposed by pumping to tankers.</p>
2.	Oil in water	Lube oil and transformer oil mixed with water from transformer yard, gas turbine water wash drain, diesel fuel from oil tank, oil water run off and drains	Oil contents: 500 – 10000 ppm (in case of fire), pH:5-9, Suspended solids:0-30 ppm	<p>This will be collected into an oily water capture basin and pumped into tankers for disposal offsite and the water effluent will be pumped into an oil water separation tank for secondary treatment.</p> <p>The oil separation tank will collect oil by an oil skimmer, which will then run into the oil holding tank and will be transferred to a tank truck for final disposal offsite. The oily wastes will be disposed of at a registered waste disposal facility. Heavier suspended solids will settle at the bottom of the separation tank and this sludge will be removed via the sludge tank and disposed to sludge drying beds. The treated effluent from this oil separation tank will be led to the central waste water monitoring basin before final discharge. Effluent discharge will be as per Nigerian and World Bank requirements.</p> <p>The oil removal from the catch basin, sludge disposal, gas turbine wash water and lube oil drain disposal shall be done manually by using portable sump pumps.</p>

SI. No	Waste Water	Source	Characteristics \ Contaminants	Disposal Method
3.	Water Based	DM plant regeneration waste	Dissolved solids: <1000 ppm PH: 6-9	This will be directed to a filter backwash drain pit, and then transferred to a tube settler. The clarified effluent will be discharged into the central monitoring basin. Non-contaminated water will be directed to the stormwater system and discharged to surrounding area as per Nigerian and World Bank requirements.
		Equipment drain	Chemical traces, traces of suspended solids, pH: 6-9	Sludge from the collection of the suspended solids will be disposed of as hazardous waste at a licensed waste disposal facility in Port Harcourt.

Source: Azura Power West Africa, 2011

In addition to the above, there will be domestic sanitary waste that will be treated in a small package sewerage treatment plant. Non-contaminated water from rainwater, floor drains, and other water drains from the equipments will be routed into a storm water system and discharged to the surrounding area as per Nigerian, WHO and World Bank requirements.

All individual streams of effluents will be collected and treated as required, and the treated effluent will be collected in a central waste water monitoring basin. Effluent will be pumped and discharged from this collection basin once the water meets the discharge criteria for discharge of effluent. The effluent collection and treatment system will be controlled and monitored through a Programmable Logic controller (PLC) based local control panel situated in the water treatment building. All pumps will be equipped with pressure gauges, locking valves by chain and padlocks wherever required. The waste water treatment area will be located close to the fire water station and raw water storage dam. Effluent will be tested for pH measurement *in situ* before leaving the site. Turbidity and conductivity measurements will be measured at an onsite laboratory through periodic sampling at the outlet of the central monitoring basin.

Azura Power has identified a small stream where waste will be discharged, located approximately 800 m from the NIPP Ihovbor-Evboeka site. The final discharge of effluent, after passing through the oil/water separator will be discharged via the plant effluent drainage system.

Solid Waste

During construction, the major waste stream will be the disposal of surplus spoil from the Site. Other wastes will comprise general domestic waste (construction camp) including sanitary and food waste, office waste, organic material, small volumes of wastes arising from mobile plant, chiefly waste lubricating oil and packing materials (eg crates).

During operation, the major solid waste stream will be waste chemicals from the demineralisation plant and office waste including paper cardboard, glass, food wastes and cans. It is anticipated that small amounts of hazardous waste will be generated in the form of fuel oil residues, cleaning solvents and sludge from oil tanks.

All solid wastes generated will be disposed of at an appropriately licensed landfill site. Azura Power will identify appropriate landfill sites during the detailed design phase.

3.3 UTILITIES AND ANCILLARY SERVICES

3.3.1 Electrical Systems and Transmission Line

The transmission line (330 kV) will link the power plant to the Benin North Substation that is being built adjacent to the Site. The transmission line will be placed aboveground and require one pylon. Details of the additional electrical systems are described under *Section 3.2.6*.

3.3.2 Gas Pipeline Spur

The gas pipeline spur will be constructed (by the gas supplier) along the cleared existing right of way for the spur constructed for the neighbouring NIPP plant to the ELPS line. This right of way runs for 1 km along the southern boundary of the NIPP site to the ELPS pipeline. A separate spur line comprising a 1 km 18 inch pipe will be buried parallel to the existing line used for the NIPP plant and will be for the sole use of the Project.

The gas supplier may also consider a route which runs a maximum of 50 m directly from the eastern corner of the Project site to the ELPS line *Error! Reference source not found.*

3.3.3 Workshop/ Store Building

A workshop/ store building will be located adjacent to the administration buildings and close to the car park (see *Figure 3.1*). The workshop will contain the following:

- work areas with equipment eg welding unit, lathe, grinder and drilling machine;
- storage areas for engine tools and spare parts;
- an electrical instrument workshop;
- a laboratory; and
- male and female toilets, washing facilities and changing rooms.

3.3.4 Administration Buildings

The administration buildings will be located next to the workshop and will comprise office space, kitchen and toilet facilities.

3.3.5 Access Roads and Unloading Areas

The proposed site location is directly accessed via a three kilometre length of tarred road which, in turn, connects to the Benin City Bypass. This bypass which encircles Benin City is a major expressway and is in excellent condition. It is anticipated that there will only be a couple of dozen vehicles on or visiting the Site during a normal working day, see *Section 3.2.9*. In addition there will be turning areas for trucks and parking areas for cars.

3.3.6 Compressed Air and Ventilation Systems

The compressed air system compresses, stores and delivers medium pressure (30 bars) compressed air to start the diesel engines. The system includes:

- dual air compressors;
- compressed air storage tanks;
- air-start system for engines; and
- instrument and service air system.

All the offices onsite and the control room and control equipment rooms will be air conditioned. The gas and steam turbine buildings will be ventilated by natural ventilation (louvres).

3.3.7 Lube Oil System

The purpose of the lube oil system is to deliver clean, cool, lubricating oil to the engines at the proper pressure and temperature. This is accomplished by a series of pumps, coolers, tanks, and filters. Lube oil is circulated to the engine and back in a continuous loop, via a 12,500 l lube oil circulating tank that serves as a central receiver. Each gas turbine has its own independent lubricating oil system.

3.3.8 Control System and Communications

The power plant will include state-of-the-art communication and controls systems comprising a freestanding common plant control PLC panel, a measurement and protection unit and a plant desktop SCADA (Supervisory Control and Data Acquisition) system. Security camera supervision systems and internal communications systems will also be installed within the plant and elsewhere within the Project site.

3.4 PROJECT SCHEDULE

3.4.1 Overview

Construction activities will involve site preparation activities and construction of the Project infrastructure, the power plant and the transmission line. Site roads will also be constructed at this stage to assist the movement of heavy equipment. A temporary construction camp will be built adjacent to the power plant site.

During operation, the power plant will be operated on a 24 hour, seven days a week basis. The number of workers on site during commercial operations will be around 50 permanent site employees and a smaller number of ancillary and contract workers (including security, cleaning and gardening etc).

A provisional schedule for Project Activities is outlined in *Table 3.4*. The facility is planned to be operational in the second quarter of 2015.

Table 3.4 Proposed Project Schedule

Activity	Approximate Date
EPC Contractor Negotiations	Q2 and Q3 2012
Site preparation	Q4 2012
Construction period	Q4 2012 – Q4 2014
Testing and Commissioning	Q4 2012 – Q1 2015
Operation	Q2 2015
Decommissioning	2035

Please note: This schedule is approximate and is based on information and planning available at the compilation of the EIA Report

3.5 CONSTRUCTION AND COMMISSIONING

3.5.1 Appointment of EPC Contractor

The selected EPC Contractor will be responsible for designing the plant on a turnkey basis. The selected EPC Contractor will need to demonstrate that it has successfully designed and completed a number of similar plants. Azura Power will use an experienced power plant consulting engineer to assist in the EPC contractor appointment process.

The EPC contract will be either a single large “turnkey” agreement (Azura Power’s preferred option) or a series of smaller EPC contracts with a management contract to hold these separate contracts together. Azura Power has commenced the process of prequalification of potential EPC contractors.

3.5.2 Overview of Activities and Schedule

The initial stage of construction will involve site clearance of vegetation and earthworks and levelling of the Site. Site roads will be constructed at this stage to allow for the movement of heavy plant during the construction phase. The “lay down” area for the construction of the OCGT power plant will be on

the area reserved for the HRSG and steam turbines which can later form part of the CCGT power station (*Figure 3.1*).

Construction is expected to start in the fourth quarter of 2012 as indicated in *Table 3.4*. Construction activities will generally be restricted to daylight hours, however the final stages of installation and commissioning may proceed 24 hours a day, seven days a week.

Screw piling (auger piling) of the foundations for the gas turbines and other large items of equipment will commence six months into the construction schedule, and will last for three to four months. Once the piles are in place, concrete slabs will be constructed and turbine pedestals constructed which will involve some large pours of concrete. At this stage the gas turbine building will be constructed which will be the first visible impact of the power plant. The construction of the overhead 330 kV cables, which will evacuate power from the power plant and onto the national grid, will commence soon after financial close and will connect the power plant to the national grid at around 15 months.

The gas turbines and other heavy equipment will be delivered in the period from 12 to 18 months which will involve some abnormal loads being moved on the roads during this period.

After around 18 months general site activity will decrease as the project moves into commissioning where there will be a relatively small group of highly skilled engineers and technicians commissioning the power plant.

3.5.3 *Sourcing of Equipment and Material*

Equipment supply within the EPC Agreement will be for the EPC contractor to determine, with Azura Power retaining rights of approval. The manufacturer of the gas turbines and the manufacturer of the large items of machinery will be agreed at the time of the tender for the EPC contract. Azura will reserve the right to review all suppliers of major equipment and materials specified in the Bidder's proposal or subsequently identified during the design phase, and to reject any suppliers whose equipment quality, performance or repair service has been unsatisfactory on other projects. The supply of smaller items of equipment and machinery will be mostly at the discretion of the EPC contractor with either some right of approval by Azura Power or some period of extended warranty made available to Azura Power by the EPC contractor.

Raw materials will be sourced locally to the extent possible. Heavy equipment that is sourced externally will be transported using the main transportation route identified. The bridges on the route between Koko Port and the Project site have a proven capacity to withstand the weight of the heavy equipment required (up to 200 tonnes).

3.5.4 Construction Personnel and Logistics

Azura Power expects that up to 500 workers will be required for the construction of the power plant. It is anticipated that up to 70 percent of the construction workers can be sourced locally, from within 30 km of the Site. The majority of the employees required during construction will be unskilled and semi-skilled labourers.

As previously indicated, Azura Power proposes to enter into a turnkey contract with the EPC contractor, in which the EPC contractor will be the responsible party for the selection and management of all sub-contractors, particularly those at a local level. More specifically, Azura will seek to monitor and guide the sub-contracting practices of the EPC contractor.

With regards to the supply of equipment and materials and entering into contracts with suppliers, Azura will reserve the right to review all suppliers of major equipment and materials specified in the Bidder's proposal or subsequently identified during the design phase, and to reject any suppliers whose equipment quality, performance or repair service has been unsatisfactory on other projects.

A temporary construction camp will be constructed within the boundaries of the Project Site. The exact nature of the accommodation will be determined in discussion with the EPC contractor but will likely include accommodation, ablution, cooling and sanitary facilities for construction workers, laydown areas and vehicle parking areas. The construction camp will be fenced and access will be controlled and restricted to employees.

3.5.5 Security

The site will be secured by a permanent fence at an early stage of construction. Security guards will be employed to patrol the site and control access 24 hours a day. All vehicles entering and leaving the site will be searched. All personnel will be required to display personal identification and all visitors will be required to sign in. It is estimated that approximately ten security staff will be used during operations. The EPC Contractor will be responsible for site security during construction.

3.5.6 Other Infrastructure

At this stage there are no anticipated construction, alterations or upgrades planned to the local infrastructure as part of the Project activities, apart from the aforementioned temporary construction camp.

3.6 OPERATION

3.6.1 Maintenance

It is anticipated that all routine maintenance will be conducted by the plant's own maintenance team. This will include preventative, corrective and predictive maintenance in addition to any maintenance or repair required as a result of emergency breakdowns. In the event that major outages occur it is anticipated that the services of sub-contractors will be engaged to maximize economic efficiency. Routine preventative maintenance will be carried out as part of a Long Term Service Agreement (LTSA) covering the gas turbines, the gas turbine auxiliary equipment and the gas turbine alternators. Routine preventative maintenance will be carried out by the operations and maintenance contractor for the period between inspections.

It has been identified that both the gas turbine Original Equipment Manufacturers (OEM) and several third party contractors are able to carry out such long term maintenance on the gas turbines. In addition, the Operations and Maintenance (O&M) contractor will be required to create preventative maintenance plans for all of the plant areas, using software to generate work orders for pieces of machinery and equipment; and all maintenance activities will be recorded on the preventative maintenance programme.

Inspections are expected to be carried out annually and will be carried out in the following sequence: two Combustion Inspections (14 days each), a Hot Gas Path Inspection (25 days), two Combustion Inspections and then a Major Inspection (60 days). The LTSA will also include emergency repair of equipment.

Planned Maintenance Events

A typical general schedule for inspections and maintenance outages (planned maintenance events) for the plant is outlined below in *Table 3.5*. The duration of outages depends upon the work schedule as well as the number and types of personnel assigned.

Table 3.5 *Planned Maintenance Events*

Maintenance Event	Routine	Outage Duration
Gas Turbine Preventative Maintenance Inspections	This will be performed annually after offline water wash. It will assess the overall condition of the gas turbine with the objectives of reducing unplanned maintenance, increasing gas turbine availability and, potentially, to increase the intervals between Planned Maintenance Events.	Two days
Gas Turbine Combustion Inspections	This will be performed at approximately 12,000 Factored Fired Hours for the Gas turbine, or as modified by the mutual agreement of the Parties.	Six days

Maintenance Event	Routine	Outage Duration
Gas Turbine Hot Gas Path Inspections	Performed at approximately 24,000 Factored Fired Hours for the gas turbine, or as modified by the mutual agreement of the Parties.	Sixteen days
Gas Turbine Major Overhaul	Performed at approximately 48,000 Operating Hours for the gas turbine, or as modified by the mutual agreement of the parties. Generator Major Inspections will be performed in conjunction with the Gas Turbine Major Overhaul.	Twenty-eight days

Condition Monitoring

Condition monitoring will be adopted as part of Azura Power's O&M Company philosophy. The change in the various conditions measured will be fed back into the planned preventative maintenance system to adjust and optimise maintenance cycles. The condition monitoring will include the following:

- Turbine on-line vibration monitoring;
- Vibration monitoring of other key rotating equipment such as fans and pumps;
- Thermal imaging;
- Generator (cooling flow) condition monitoring;
- Lube oil temperature and quality monitoring;
- Transformer oil quality monitoring;
- Ultrasonic leak detectors (to monitor the condition of steam traps and valves); and
- Ultrasonic thickness measurements (on various pipework).

3.6.2 *Employment*

There will be approximately 50 permanent site employees onsite during commercial operations. These will include plant management staff, maintenance staff, skilled technicians, drivers, cleaning staff and a number of semi-skilled operators who will operate and maintain the Azura-Edo IPP plant.

Further details are provided in *Table 3.6* below.

Table 3.6 *Overview of Employment Positions*

Job title	Level of Skill	Description	Number of Positions
A Plant Manager	Skilled	Operation and maintenance of the plant and the management of the business, will have field and operation and maintenance experience, and will be in charge of handling all contractual issues, of overseeing the operation of the Facility, and of leading and managing the rest of the team.	1

Job title	Level of Skill	Description	Number of Positions
Business Manager	Skilled	Day-to-day primary responsibility for management of the business and liaising with contract counterparties, the financing parties, and Government entities.	1
Financial Manager	Skilled	All financial dealings relating to the running of the business.	1
Plant Accountant	Skilled	General book keeping, handling invoices and payroll.	1
Operations Manager	Skilled	Managing operations team and day to day running of the power plant.	1
Environmental, Health and Safety Manager	Skilled	Responsible for overall Health and Safety of workers on site and that plant operations comply with environmental legislative requirements.	1
Procurement Assistant	Skilled	Responsible for general procurement of supplies, parts and consumables, making and tracking purchases made and administering the plant work order system.	1
Community Liaison Officer (CLO)	Skilled	Liaise with local communities and government regulators on the Project's behalf. Implement EHS awareness and education programmes with communities.	1
Plant Secretaries	Skilled	Provide administrative support.	2
Initial operation troubleshooter	Skilled	Manage initial operation problems, warranty issues and claims under the direction of, and responsible to, the Plant Manager. It is anticipated that this person would not be required for longer than six months from the commercial operation date.	1
Maintenance Manager	Skilled	General planning, coordination and management of maintenance activities and liaising with the other contractors.	1
Lab technician	Skilled	Collect and analyse water, effluent and other samples and ensuring the quality of consumables and effluents is according to the relevant standards.	1
Skilled Mechanical Fitters	Skilled	Carrying out general mechanical maintenance work.	5
Skilled Electricians	Skilled	Carrying out general electrical maintenance work.	2
I&C technicians	Skilled	Responsible for carrying out general control and instrumentation maintenance work.	2

Job title	Level of Skill	Description	Number of Positions
General Helpers	Semi-skilled/ unskilled	Assistants to fitter and electricians (as required) and cleaners.	5
Warehouse Keeper/ Driver	Semi-skilled	Keeping and maintaining the warehouse and issuing parts and consumables.	1
Drivers	Semi-skilled	Driving on-site.	3
Control room operators	Skilled	Monitor the operation of the Facility from the control room and support the general operators in their duties.	10 (one per shift, plus one on standby)
General operators or watchkeepers	Semi-skilled	General operation and plant monitoring duties.	10 (on rotating shifts)

In addition, up to 40 ancillary and contract workers will be employed during the operation phase of the power plant and this will include security, cleaning and gardening staff.

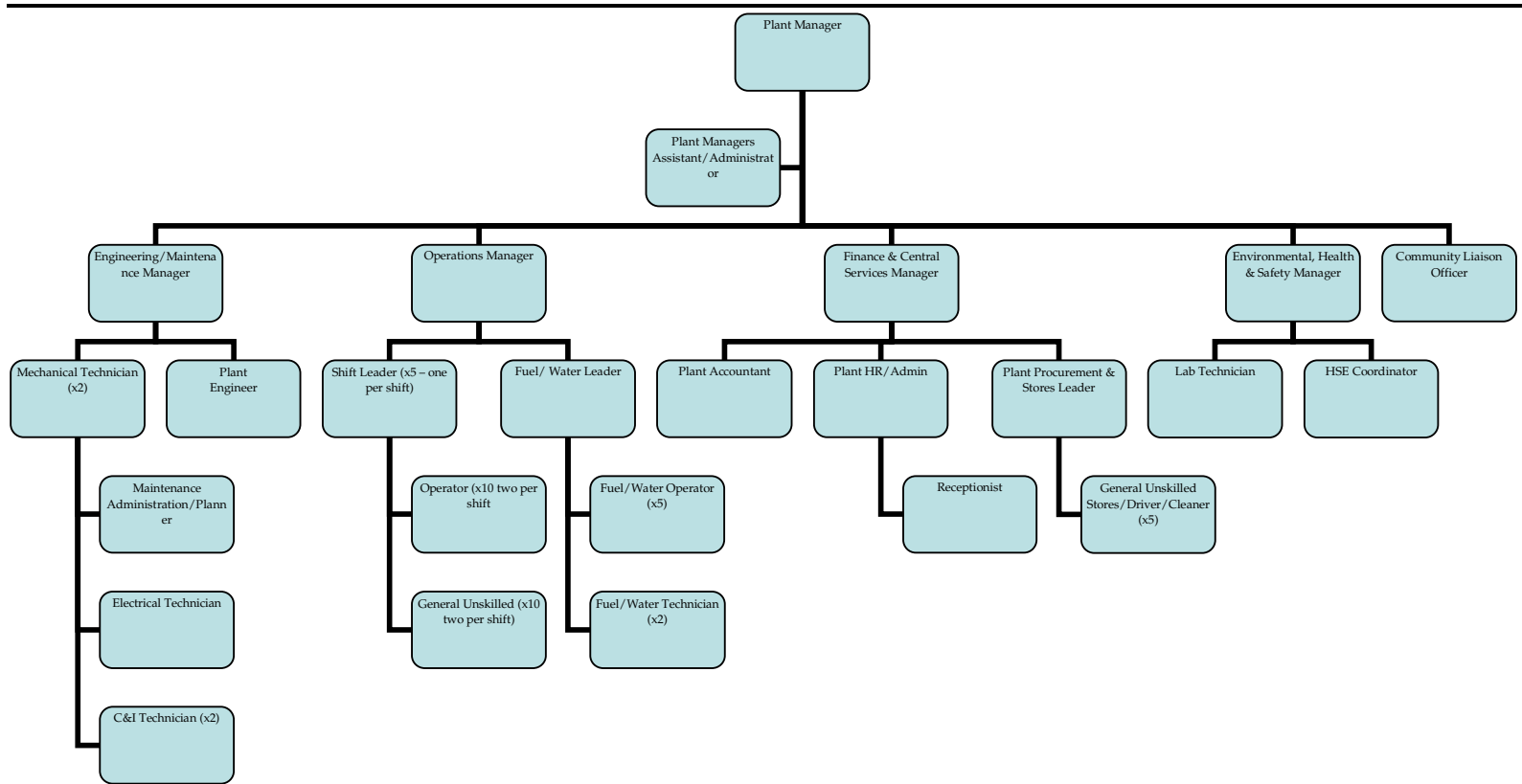
Azura Power will seek to promote the development of local skills and the transfer of international technologies and expertise to local manpower and local manufacturers. It will also ensure that activities are fully compliant with the relevant (and evolving) “local content” provisions of Nigerian law and regulation.

Furthermore, the selection of sub-contractors by Azura Power will ensure that only high quality sub-contractors (whether of local, national or international provenance) are selected. They will be required to adopt Azura Power’s policies on community liaison and local workforce employment. Based on its analysis of other projects, Azura Power believes that this approach will have a more direct and positive impact on the local community workforce and will lead to a greater degree of skills transfer.

Permanent staff

The operating company does not currently have any permanent employees in Nigeria. Upon employment of local labour, Azura Power will comply with all relevant Nigerian employment laws and practices including those requirements related to retrenchment policies, dismissal procedures, discipline procedures and grievances. The majority of staff based in Nigeria will be hired locally through job adverts and interviews.

Figure 3.2 Staff Organogram



Source: Azura Power West Africa, 2011

3.7 *DECOMMISSIONING*

The proposed Project has a lifespan of 20 years. There is currently no agreement in place which defines what will happen to the facility at the end of its lifecycle, but it is anticipated that the Project site will be returned to its original state. A site closure and restoration plan will be developed prior to initiation of decommissioning activities.

All infrastructure (including the cables and pylon for the connection to the Benin North Substation) will be dismantled and removed. Machinery, steel and dismantled materials will be recycled where possible and disposed of at licensed disposal sites.

3.8 *ANALYSIS OF ALTERNATIVES*

In order to ensure the environmental and social sustainability of the Project, the EIA should include an analysis of the potential Project alternatives. The following section provides an overview of the various alternatives considered during the design phase and within the EIA process, these include:

- No Project alternative;
- Location alternatives for the power plant; and
- Design, technology and fuel feedstock alternatives.

The preferred alternative will be considered during the assessment of potential impacts.

3.8.1 *No Project Alternative*

One of the potential alternatives considered is the No Project Alternative. This involves retaining the status quo of the Site, ie no development and the Site would remain covered by disturbed secondary forest and agricultural fields and activities. There would be no additional air, noise and effluent emissions into the environment.

The rationale behind the proposed Project is that current demand for electricity outstrips supply (generation) and, that current electricity supply is unreliable and suffer interruptions. This is detailed further in *Chapter 2*. If the Project does not go ahead, the wider benefits to the stability and availability of electricity and associated benefits to the national economy will not be realized and Nigeria's economic development may therefore be hampered. No additional employment would be generated during the construction and operational phases. Furthermore if power demands are not met it is likely that power production using private diesel generators will increase resulting in higher emissions of air pollutants (decrease in CO₂ and NO_x but increase in methane) than a gas-fired power plant (Singh, 2001).

The No Project Alternative is not considered to be a viable alternative.

3.8.2 *Alternative Site Location*

Several locations within Edo State were considered during the design phase of the Project but the preferred Site chosen for the Project is considered to be the site which offers the least disruption to the natural environment and to the local community.

More specifically, the Site is located adjacent to all three of the following: the existing NIPP (Ihovbor-Evboeka) Power plant, the Benin North Substation and the ELPS. The proposed power generation activities are therefore compatible with surrounding land uses; and fuel supply to (and power evacuation from) the Site are both available at minimal cost and with minimal social and environmental disruption. Other salient factors are listed below:

- The Project Site has good existing road access, as well as close proximity to an inland port (Koko Port). This is key for the inland transportation of equipment and materials for the power plant.
- From a security perspective, in comparison to other key oil and gas producing States Edo State has witnessed fewer instances of civil disturbance and unrest.
- The Edo State Government is a key player and minority shareholder in the project which is a confirmation of the Project's match with government policies and priorities.

3.8.3 *Design, Technology and Fuel Diversification Options*

The power plant will be fuelled by natural gas, with diesel used for start-ups. Natural gas has a much less damaging impact on the environment than other fossil fuels (eg coal or heavy fuel oil) as it produces lower greenhouse gas emissions and other air and ozone pollutants. The use of gas as the feedstock will also help to address the problem of gas flaring that commonly occurs in Nigeria as a result of oil extraction.

Recent analysis has demonstrated that hydroelectric power can only meet a small portion of Nigeria's long-term power generation requirements. Moreover, the Federal Government has signalled its commitment to the development of three large power plants at Mambilla (2,600 MW); Zungeru (760 MW) and Gurara (300 MW). Should these projects ever to come to fruition, the country's potential hydropower generating capacity (including the existing hydropower facilities of Kainji, Jebba and Shiroro) would be substantially exhausted; although a modest amount of additional hydro capacity might be still be accessible via a succession of smaller "mini-hydro" projects. Nevertheless, even on the most optimistic of estimates, the country's long-term hydro-generating capacity is unlikely to exceed 6,000 MW (Azura Power, 2011).

With regard to coal-fired generating power, there are few reliable projections of the potential capacity that could be (economically) extracted from this fuel source. Having reached a peak of just 730,183 tonnes per annum in 1965, the country's coal production declined in the subsequent decades until, by the early 1990s, coal production had declined to less than 100,000 tonnes per annum. For several years, the Federal Bureau of Public Enterprises has been trying to privatise some of the coal mines owned by the Nigerian Coal Corporation; but it appears to have met with little success (Azura Power, 2011).

The results in *Table 3.7* demonstrate that emissions from a coal-fired power plant in comparison to an OCGT or CCGT power plant are significantly higher for all pollutants with the exception of greenhouse gases. Based on this; coal firing is considered the least favourable option from an air quality perspective. Whilst the emissions from the oil-fired station are not as high as a coal-fired station, they are significantly higher for both NO_x and SO₂ than the gas-fired options. The oil-fired scenario is also the highest emitter of greenhouse gases, due to the higher emissions of N₂O.

Table 3.7 *Fuel Alternatives Analysis*

Emissions (tonnes/yr) ^{1,2,3,4}	Base Case:	Combined	Coal fired station ⁵	Oil fired station ⁶
	Open Cycle Gas Turbine (OCGT) Power Plant	Cycle Gas Turbine (CCGT) Power Plant		
Standard Pollutants				
NO _x	1154	697	19602	9693
CO	1577	952	5201	516
SO ₂	34	20	35492	3753
Particulate Matter (PM ₁₀ /PM _{2.5})	119	72	12329	132
Non-Methane Volatile Organic Compounds (NMVOC)				
Greenhouse Gases (GHG)	136	82	2149	129
CO ₂	2329	1406	4071	3138
CH ₄	1017	614	30	301
N ₂ O	65	39	34	602
CO ₂ (e)	43856	26470	15363	196018

¹For NO_x, CO, NMVOCs, CO₂, CH₄, N₂O emission factors from EMEP/CORINAIR Emission Inventory Guidebook, European Environment Agency, 2007 were used.

²For SO₂ and Particulate Matter, emission factors from AP-42, Compilation of Air Pollutant Emission Factors, US EPA, Sections 1.1 and 1.3 (updated 1998 and 2010) were used.

³For the gas turbines, the ratio of the actual manufacturer emissions of NO_x and CO for the base case were used to scale the emissions predicted using the general emission factors.

⁴To apply the emission factors, the following indicative efficiencies were assumed: 56% CCGT and 33% coal-fired / oil-fired

⁵To convert the emission factors for SO₂ and Particulate Matter, a calorific value of coal was assumed of 5500 cal/g.

⁶To convert the emission factors for SO₂ and Particulate Matter, a calorific value of oil was assumed of 140 MMBTU/1000 US gal.

Apart from hydropower and coal-fired power, the only other major source of base-load fuel consists of the country's natural gas reserves. These are currently estimated at 187 Tcf and the general industry expectation is that, for

the next 20 years, the vast bulk of all new power generating capacity will consist of gas-fired power plants similar to the one being developed by the Azura-Edo IPP.

A significant increase in the plant's overall efficiency could be possible via conversion of the currently proposed OCGT configuration to a CCGT configuration. A CCGT would result in 40 percent less air emissions compared to the OCGT configuration, based on improved efficiency of the CCGT option. However, the conversion to a CCGT plant is only economically viable under a certain set of conditions which are largely dependent on the price of natural gas and the electricity tariff. Although it is currently difficult to assess if and when such a conversion will become possible, the current power plant design has been developed so as to allow for a future conversion to a CCGT power plant

4 DESCRIPTION OF THE ENVIRONMENT – BIOPHYSICAL BASELINE

4.1 INTRODUCTION

This chapter provides a description of the existing environmental conditions against which the potential impacts can be assessed.

For the biophysical baseline description, the *Study Area* is defined as the direct Project footprint and environment immediately surrounding the Project site. The Study Area for ambient air and noise extends to the wider area including the communities of Ihovbor-Evboeka and Orior-Osemwende. The environmental study for air impacts includes a 5km buffer ⁽¹⁾ surrounding the Site.

The information on the biophysical baseline is derived from published sources as well as from the dry and wet season field surveys that were conducted during 18 to 21 March and 24 to 27 July 2011 respectively. The laboratory analysis of all groundwater and soil sample analysis was conducted by Searchgate Laboratories Limited, an FMEnv accredited laboratory located in Lagos, Nigeria. Information is also drawn from secondary data sourced from the EIA report for the NIPP on the neighbouring site, as well as published journal articles and online sources.

4.2 TOPOGRAPHY

Edo State is 19,794 km² in size and is bound in the north and east by Kogi State, in the south by Delta State and in the west by Ondo State. It is predominantly low lying except towards the north axis (Edo State Government, 2011).

In keeping with the rest of Edo State, the topography of the Project site is generally flat with elevation ranging between 128 m above sea level on the northern side of the Project site to approximately 120 m on the southern boundary, indicating a slight downward slope to the south.

4.3 CLIMATE

The climate of the Edo State is characteristic of the humid tropics, with seasonal winds. According to the Köppen climate classification system, Edo State (and the Study Area) is situated in the Tropical/megathermal climate. More specifically the Study Area is primarily located in the Tropical Monsoon (Am)

climate but straddles the Tropical Wet and Dry climate (Aw) climate where rainfall is a key climatic variable. The two key air masses are the dry Tropical Continent air mass originating from the Sahara in the north, and the moist Tropical Maritime from the Atlantic Ocean in the south. The two air masses are separated by an Inter-Tropical Discontinuity (ITD) zone. This zone is characterised by high levels of rainfall which move north and south with the seasonal movements of the sun.

There are four characteristic seasons that are generally observed across Nigeria:

- An extended dry season from mid December to late March;
- An extended wet season from early April to the end of July;
- A short dry season running from late July to late August; and
- A short wet season running from September to November.

Nigeria's climate varies across the country with tropical humidity in the centre, an equatorial climate across the south, and arid areas in the north. Edo State is characterised by a humid tropical climate in the south, and sub-humid climates in the north (Uyigue and Agho, 2006). The *in situ* weather parameters were sampled at ten sampling locations (A1 – A10) during the wet season using a handheld Kestrel (4500NV model) weather meter (Table 4.1).

Table 4.1 *Wet Season Measurement of Weather Parameters*

Parameters	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
Sampling Date (dd/mm/2011)	25-07	25-07	25-07	25-07	25-07	25-07	25-07	26-07	26-07	26-07
Ambient Air Temperature (°C)	26.0	25.2	26.2	24.9	25.0	24.2	25.0	24.8	25.5	26.5
Humidity (%)	83.3	92.3	83.0	96.5	93.0	87.6	74.2	98.1	99.4	99.3
Wind speed (m/s)	0.2	0.3	0.2	0.9	2.8	4.7	2.8	3.0	2.1	2.0
Heat Index (°C)	27.8	28.1	28.0	26.2	26.7	26.0	30.6	27.3	22.8	25.1
Dew point (°C)	23.1	24.6	23.1	23.5	24.1	24.3	24.6	24.3	22.8	23.1
Wet bulb (°C)	23.5	23.4	25.1	24.9	25.0	25.1	24.8	24.5	23.1	23.1
Altitude (ft)	352	351	335	353	356	365	370	343	353	378

The results of the wet season sampling were supported by the literature review, as discussed below.

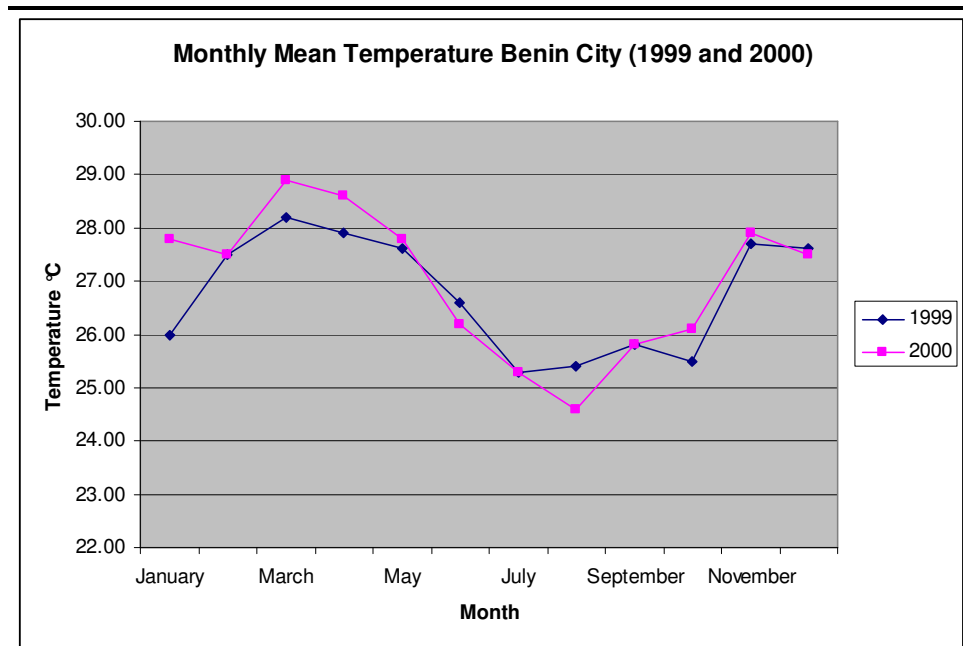
4.3.1 *Temperature*

The key factors that influence temperature in the area are the movement of the sun, wind speed and direction, and land configuration. During 2011 (thus far) the average temperature reached a maximum of 30.6 °C and a minimum of 24.8

(1) The IFC requires an assessment of air quality impacts to 10km from the proposed Project site. Given the stack height and plant design, however, the maximum impacts will occur at a maximum of 1-2 km from the plant and thus setting the receptor grid at 5km from the plant is adequate to ensure that the maximum impacts are assessed.

°C. This is supported by meteorological data recorded in Benin City (Figure 4.1) from results taken over the year of 1999 and 2000 showing an average temperature of 26.9 °C (NIPP, 2010) and 27.6 °C in 2009 (Atedhor, Odjugo and Uriri, 2010) . Further review of data illustrated average temperatures of 25 °C in the wet season and 28 °C during the dry season (Uyigüe and Agho, 2006). The temperatures recorded during the wet season survey (Table 4.1) all fall within these literature values.

Figure 4.1 *Monthly Mean Temperature for Benin City (1999 and 2000)*



Source: NIPP, 2010

4.3.2 *Rainfall and Humidity*

According to the Federal Department of Meteorological Services average monthly rainfall levels for Benin City and adjacent areas during 1999 and 2000 were 187.5 and 186.7 mm respectively. However due to the pronounced wet and dry seasons, in 1999 the monthly mean rainfall varied between 9.4 and 472.5 mm. In 2000 the monthly mean rainfall varied between 4.0 and 351.2 mm. More recently in 2011, the mean monthly precipitation levels have been recorded at an average of 97.0 mm 2011 (thus far). This is considerably lower than that observed in the years of 1999 and 2000, however, between April and June and between September and October the average precipitation levels were recorded between 106 and 278 mm. This relatively high level of rainfall is directly related to the proximity of the Atlantic Ocean which complements the rainfall driven by the ITD zone (NIPP, 2010).

The relative humidity of Nigeria is generally high with readings above 80 percent during the wet season (*Table 4.1*). During the dry season the relative humidity decreases to approximately 75 percent which is brought about by the dry Tropical Continent air mass (NIPP, 2010).

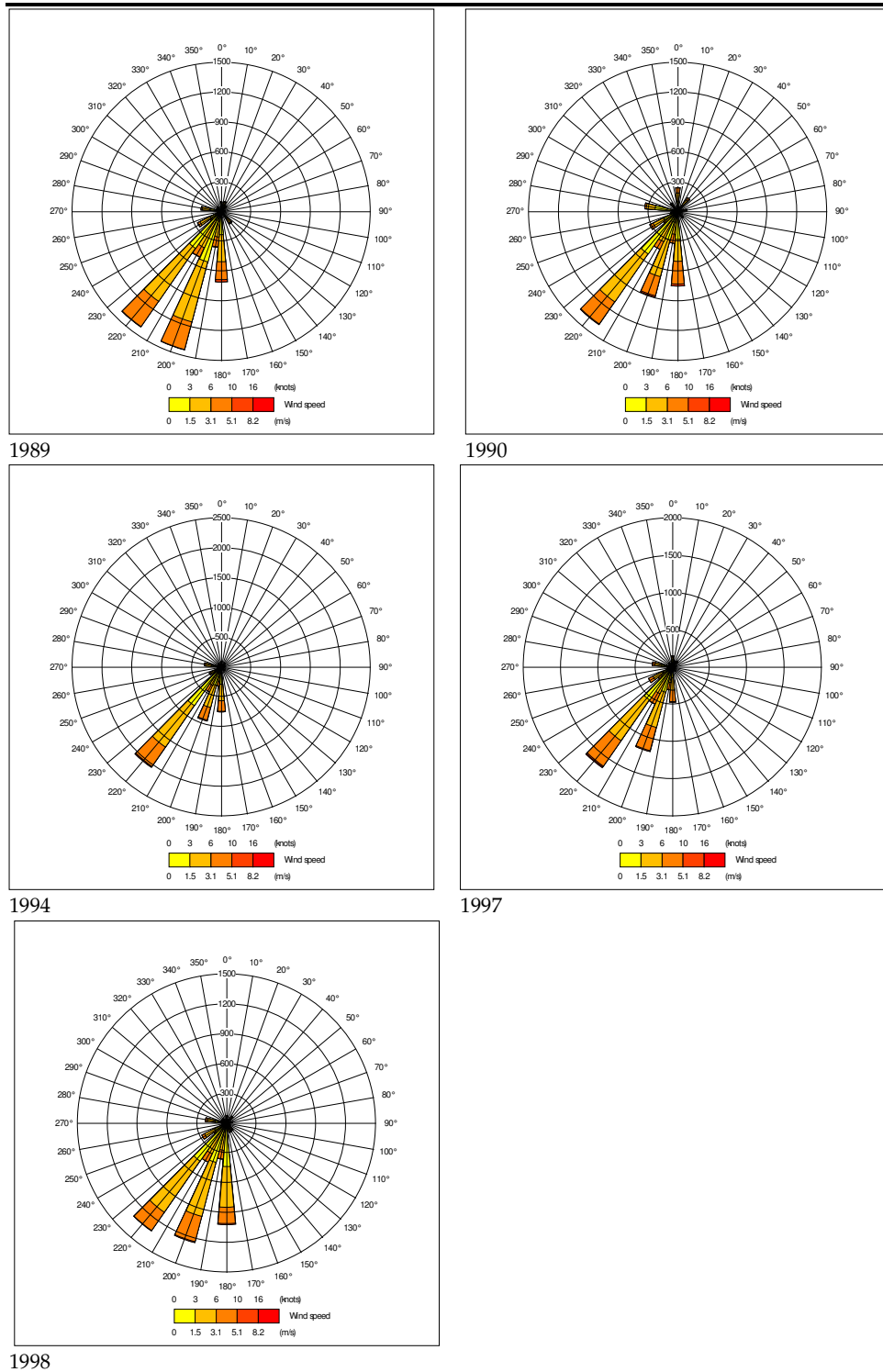
4.3.3

Wind Patterns

Wind patterns are determined by the ITD zone, with westerly and southwardly winds prevalent during the wet season, and north-easterly winds during the dry season (NIPP, 2010). Meteorological data from the Bohicon meteorological station (the closest inland meteorological station for which complete yearly data is available) for 1989, 1990, 1994, 1997 and 1998. The use of meteorological from a site some 400 km distant is recognised as a limitation in the assessment, as s discussed further in *Chapter 7*. However, in the absence of a station closer to the site that monitors all the relevant parameters the use of this data is deemed necessary.

The meteorological data indicates that south-westerly winds are prevalent within the area (USEPA AERMET program). In the recent years the maximum sustained wind speed has reached 44 km/h, equivalent to approximately 28 m/h (Weather2, 2011). The wind roses produced from the data are shown in *Figure 4.2*.

Figure 4.2 Wind Roses for the Bohicon Meteorological Station, Years 1989, 1990, 1994, 1997 and 1998



Source: USEPA AERMET program in ERM, 2011

4.4

GEOLOGY

The Study Area is located within the Niger-Delta Basin and Benin formation and along with Edo State is geologically characterized by deposits laid during the tertiary and cretaceous periods (Alile, Molindo and Nwachokor, 2007). The Benin Formation has been created from weathered sedimentary rock (Aziegbe, 2006). The Niger Delta Basin is one of the sedimentary basins in Nigeria that derives from weathered and eroded materials of Precambrian basement complex rocks of the South-Western part of Nigeria (NIPP, 2010).

The Benin Formation comprises unconsolidated iron oxide-rich sands with alternating beds of shale, clay and sandy clay. The sands range from fine to medium and in places demonstrate coal lignite streaks and wood fragments. The formation is covered with loose brownish sand (quaternary drift) varying in thickness and is about 800 m thick; almost all of which is water bearing with water level varying from about 20 m to 52 m. It is generally believed to be highly permeable, porous and prolific in water yield. The aquifer yields range from 28.4 m³ hr⁻¹ at Iyanomo (south of the City), 125 m³ hr⁻¹ at Uselu (central part) to 208 m³ hr⁻¹ at Ogba (northern part) with a draw down ranging from 4.8 m at Iyanomo, 1.8 m at Uselu to 6.7 m at Ogba. Due to the estimated rainfall for Benin City of over 2000 mm per annum (Erah, Akujieze and Oteze, 2002)

The upper layer of the Benin formation is composed of iron-rich red earth derived from iron-stained fragmented parent rock (NIPP, 2010) and derives from the Oligocene era.

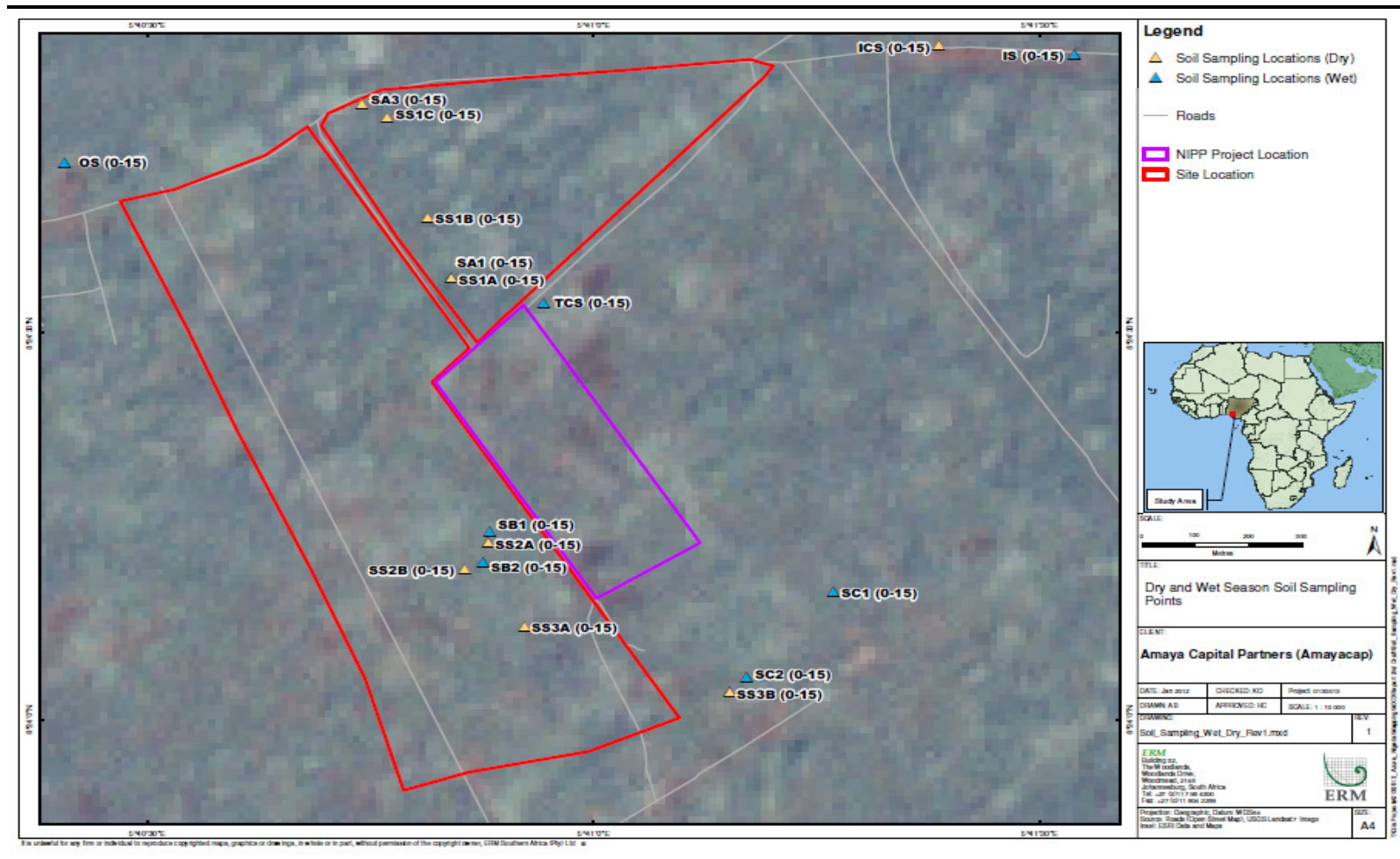
4.5

SOILS

Soil sampling was conducted at nine locations during the dry season in the Study Area (including areas to the south and west of the proposed plant location) and at nine locations during the wet season (*Figure 4.3*). The sampling locations with latitude and longitude coordinates for all biophysical variables measured are included in *Annex B*.

All core soil samples were taken at two depth intervals (0 - 15cm of topsoil and 15 - 30cm of subsoil) using a stainless steel auger. The soil samples were then stored in plastic buckets, and homogenised before sub-sampling. The sub-soil samples were subsequently stored on ice (below 4 °C) and transported to Searchgate Laboratories. The soil samples were analysed according to their physico-chemical, heavy metals, oil and grease, hydrocarbons, and microbiological properties. Soils were also analysed on site for colour, texture and moisture content. Soil analysis results are outlined below, and full laboratory results are provided in (*Annex B*).

Figure 4.3 Dry and Wet Season Soil Sampling Points



Note: Two of the locations sampled during the wet season were a considerable distance from the Project site (2.6 km) and therefore are not shown

4.5.1

Soil Types

The key soil types in Nigeria, as identified by the Food and Agriculture Organisation (FAO) soil taxonomy legends are fluvisols, regosols, gleysols, acrisols, ferrasols, alisols, lixisols, cambisols, luvisols, nitosols, arenosols and vertisols (FAO, 2009). Within Edo State the soil type is chiefly a red-yellow ferrasol on loose sandy sediments. Research from the neighbouring LGA of Esan also illustrates ferrasol soils ranging in colour between red-brown in the north of the region, to yellow-brown in the south, demonstrating a variation in the leaching of the soil (yellow-brown soils indicate a higher level of leaching). (Omofonmwan and Kadiri, 2007).

More specifically, Benin City is underlain by sedimentary formation of top reddish clayey sand capping highly porous freshwater –bearing loose pebbly sands, and sandstone with local thin clays and shale interbeds which are considered to be of braided stream origin. Sands, sandstones and clays vary in colour from reddish brown to pinkish yellow on weathered surfaces to white in the deeper fresh surfaces. Limonitic coatings are responsible for the brown reddish-yellowish colour.

The Study Area falls into the southern belt of forest soils. The soil types within the forest soils zone are largely determined by the parent rock. The soil type on the site is a mixture of sand, silt and clay with a predominance of sand and hence can be defined as sandy loam (Royal Horticultural Society, 2011 and NIPP, 2010). The percent composition of silt and clay did however vary considerably between seasons (Environmental Accord Limited Nigeria, 2011).

4.5.2

Soil Quality

The soils sampled were predominantly friable in nature during the dry season, with evidently higher moisture content during the wet season. Soils were found to be fine grained with soil colour ranging between a reddish and dark brown. Soils were lighter in colour to the south of the Project site (southern portion) indicating poorer soils with less organic matter and a lower nutrient content.

Northern Portion

Heavy Metal Composition. All heavy metals corresponded to levels that naturally occur in soils (Allen, 1974) and fell within the limits tolerated by plants and organisms indicating the low levels of pollution in the soil. The highest concentration of heavy metals analysed across the Study Area during the dry and wet season was iron, which was higher in the topsoil (864.10 – 20,000 mg/kg) compared with soil sampled at 15 – 30 cm depth (656.20 – 18,500 mg/kg). Nickel had the second highest concentration sampled during the dry season (4.6000 - 10.150 in the topsoil and 5.6000 – 17.050 mg/kg in the subsoil). The levels of nickel were less than 0.050000 mg/kg at all points sampled during the wet season. Chromium recorded the second highest

concentration in the soils sampled during the wet season (7.0000 – 15.000 mg/kg in topsoil and 2.0500 – 8.5000 mg/kg in the subsoil). Of the heavy metals detected copper, lead and zinc had some of the lowest concentrations in both layers of the soil. Mercury was found to fall below the detection levels (<0.050000 mg/kg) in both seasons.

Anion and Cation Analysis. The highest concentration of the cations sampled during the dry season was sodium (20.000 – 94.500 mg/kg in the topsoil, 16.500 – 65.000 mg/kg in the subsoil) followed by calcium (225.0 – 450.0 and 225.00 – 450.00 mg/kg in the top and subsoil respectively). During the wet season potassium had the highest concentration of cations present in the soil (10.820 – 166.80 and 12.440 – 226.80 mg/kg in the top and subsoil respectively). Nitrate had the highest anionic concentration ranging between 8,064.0 - 53,088 and 940.00 – 6,250.0 mg/kg during the dry and wet seasons respectively (this ranged between 3,500.0 – 15, 624 and 940.00 – 53,088 mg/kg in the top and subsoil respectively). The high levels of nitrate correspond with the high total nitrogen content of the soil (discussed below). Of all the anions analysed phosphate recorded the lowest concentrations at 52.000 – 216.00 and 47.500 – 720.00 mg/kg in the top and subsoil across both the wet and dry seasons respectively.

Hydrocarbon Content. Oil and grease were found to be below the detection limit of 0.5000 mg/kg during both seasons indicating low levels of hydrocarbon pollution in the soil. The total hydrocarbon content (THC) of the soil sampled across the proposed site was recorded during the dry and wet seasons (ranging between 0.6620 – 2.630 and 0.1120 – 12.92 mg/kg in the topsoil and subsoil respectively) (*Annex B*). However, the significantly higher reading (12.92 mg/kg in the subsoil) during the dry season was only observed at one sampling location and may have been associated with a particular hydrocarbon spill.

Physico-chemical Properties. The soil was found to be slightly acidic during both seasons (pH range 5.2000 - 6.0200, with a slightly lower pH observed in the subsoil sampled). The soil was mainly composed of sand and clay. The average sand concentration was 53.890 percent in the dry season, with a considerably higher concentration in the wet season of 94.610 percent. The sand content of the soil was similar across both depth intervals. Clay constituted an average of 40.370 percent during the dry season, with a noticeable decline in clay soil composition during the wet season (4.2400 percent). Furthermore there was greater variation in the clay content across the depth intervals during the dry season (17.150 – 92.550 and 21.540 – 40.660 mg/kg in the top and subsoil) compared to the wet season (0.72000 – 1.7900 and 0.94000 – 2.2200 mg/kg in the top and subsoil respectively). Total nitrogen concentration ⁽¹⁾ ranged between 2,289.9 - 13,645 mg/kg and 3,150.0 – 10,200 mg/kg during the dry and wet season respectively. Phosphorus concentration levels ranged between 7,700.0 - 46, 200 mg/kg during the dry

(1) Total Nitrogen concentration includes all forms of nitrogen in the soil including organic nitrogen, ammonium, nitrates and nitrites. Nitrate levels are also reported separately.

season and were observably lower during the wet season (20.800– 38.200 mg/kg). Nitrogen concentration generally increased with depth with concentrations ranging between 2,742.3 – 13, 645 mg/kg in the subsoil, and 2,289.8 – 7,105.0 mg/kg in the topsoil. The reverse was observed for phosphorus concentration (28.700 – 46,200 and 20.800 – 18, 700 mg/kg in the top and the subsoil respectively).

Microbial Analysis. The total heterotrophic bacteria (THB) count ranged between 65.00×10^3 and 450.0×10^3 cfu/g during both seasons, with a mean count of 210.6×10^3 and 195.5×10^3 during the dry and wet seasons respectively. The THB was generally higher in the topsoil (80.00 – 450.0 mg/kg) compared to the subsoil (65.00 – 320.0 mg/kg). The total heterotrophic fungi count ranged between 4.000×10^3 and 150.0×10^3 cfu/g, which also demonstrated higher levels in the topsoil (20.00 -150.0 mg/kg) compared to the subsoil (2.000 – 60.00 mg/kg). Coliform was also identified in the soil samples (1.000×10^3 – 175.0×10^3 cfu/g) during the dry season (*Annex B*). Hydrocarbon-utilising bacteria and fungi were not detected at any depth intervals in the soil during the dry and wet season.

Portion Directly West of the NIPP Plant

The soil directly west of the NIPP plant does not show evidence of contamination and demonstrates physico-chemical properties similar to the other areas sampled.

Heavy Metal Composition. Iron had the highest recorded concentration amongst the heavy metals analysed both during the dry (7,400.0 - 14,720 mg/kg) and wet season (6,300.0 – 10,500 mg/kg). The nitrogen did not vary substantially across measured depth intervals (6,300.0 – 14,720 and 7,000.0 – 12,800 mg/kg in the top and subsoil respectively). Nickel had the second highest concentration in the dry season; however similar to concentrations observed at the proposed site, nickel recorded one of the lowest concentrations in the wet season (< 0.15000 mg/kg). The concentration of nickel did not vary greatly from 0 - 30 cm (17.300 - 19.200 and 14.950 - 18.500 mg/kg in the top and subsoil respectively) Mercury was identified to be below the detection levels during both seasons and across all depth intervals sampled (0.05000 mg/kg).

Anion and Cation Analysis. During the dry season, the concentration of nitrate ranged between 33,768 – 51,408 mg/kg (ranging between 33,768 – 45,528 and 36,288 – 51,408 mg/kg in the top and subsoil respectively). The nitrate concentrations were lower and also more consistent during the wet season (2,300.0 – 3,800.0 and 3,600.0 – 4,250.0 mg/kg in the top and subsoil respectively). Sulphate, phosphate, and chloride concentrations showed similar patterns to those observed at the proposed site during both seasons. During the dry season, sodium had the highest concentration levels particularly in the topsoil (1,625.0 – 2,450.0 mg/kg), however, during the wet season the concentration of potassium was the highest at 250.00 – 700.00 and 510.00 – 2,000.0 mg/kg in the topsoil and subsoil respectively.

Hydrocarbon Content. The hydrocarbon parameters (THC and oil and grease) in the soil samples indicated low concentrations, with oil and grease levels falling below the detection point across both depth intervals (0.5000mg/kg). The THC was recorded between 0.8830 – 2.920 and 0.4080 – 2.810 mg/kg in the top and subsoil respectively.

Physico-chemical Properties. The results of the soil sampling identified the soil to be of an acidic nature (pH 5.2000 - 5.8000) with no substantive variation between the topsoil and subsoil. The pH was also found to fall within the optimal pH range that supports plant growth (Ojo-Afere et al, 1990). The analysis also identified that sandy loam is the predominant soil type with an average composition of 60.660 and 96.260 percent during the dry and wet seasons respectively. The sand content of the soil was observably higher during the wet season (94.860 - 97.440 percent in the topsoil and 94.620 – 98.000 percent in the subsoil). The percentage sand composition during the dry season was recorded at 56.840 – 65.870 mg/kg in the topsoil and at 52.410 – 68.220 mg/kg in the subsoil.

Microbial Analysis. The total heterotrophic bacteria count from the soil samples collected at western portion ranged between 110.0×10^3 and 450.0×10^3 cfu/g, with a mean count of 251.7×10^3 and 231.3×10^3 cfu/g over the dry and wet season respectively. The count did not illustrate significant changes over the two depth intervals (175.0 – 362.0 and 110.0 – 450.0 mg/kg in the top and subsoil respectively). Heterotrophic fungi were also identified in the soil ranging between 8.000×10^3 and 102.0×10^3 cfu/g in the wet and dry season. The heterotrophic fungi were found to be at a higher level in the topsoil ($62.00 - 102.00 \times 10^3$ cfu/g) compared to the subsoil ($8.000 - 60.00 \times 10^3$ cfu/g). Similar to the Proposed Site, hydrocarbon utilizing bacteria and fungi were not detected in the soil during both sampling periods.

Southern Portion of the Site

Sampling was also conducted on the southern portion of the site and results are outlined below.

Heavy Metal Composition. Other heavy metals examined were recorded at low concentrations similar to those recorded at the other locations sampled across the site, during both seasons. Concentration levels fall within the limits tolerated by plants and soil organisms and correspond to levels naturally occurring in soils (Allen et al, 1974). Iron was identified as having the highest concentration ranging between 2,320 and 36, 000 mg/kg over both the dry and wet seasons. The iron concentrations were notably higher in the subsoil during both wet seasons (11,500 – 36,000) compared to the topsoil (2,320.0 – 15,280 mg/kg).

Anion and Cation Analysis. Nitrate ions were found, as with the other locations sampled across the Project site, to have the highest concentration among the anions analysed (3,450.0 - 61,152 mg/kg). The nitrate concentration

increased with depth, showing a significant increase at 15 – 30cm (6,250.0 – 61,152 mg/kg) versus 3,4500 – 32,928 mg/kg in the topsoil. Sulphate and phosphate demonstrated similar patterns in their concentration levels to the other sampled sites. Among the cations, sodium ion concentrations were recorded to be the highest during the dry season (1,700.0 – 1,950.0 mg/kg in the topsoil and 1,500.0 mg/kg in the subsoil), with potassium ions recording the highest concentrations during the wet season (400.00 – 2,730.0 mg/kg). The potassium concentration was also found to be of a higher concentration in the subsoil (1,950.0 – 2,730.0 mg/kg) compared to concentrations observed in the topsoil (400.00 – 1,650.0 mg/kg).

Hydrocarbon Content. Oil and grease levels were found to be below detection limits during both seasons, indicating that there is no detectable hydrocarbon pollution. THC was detected in the soil with a greater concentration range during the dry season (0.9000 - 21.60 mg/kg), while the THC during the wet season was 0.4000 – 0.9000 mg/kg. Generally the THC content was higher in the topsoil. In three out of the four samples collected the THC range were between 0.6720 – 2.990 g/kg in the topsoil, compared to the THC range in the subsoil (0.4230 – 0.8600 g/kg, while the fourth sample indicated noticeably higher THC values, which may be as the result of a spill.

Physico-chemical properties. Sandy loam soil dominates the soil composition of the area both during the dry and wet seasons (sand percentage in the topsoil was between 58.220 – 98.240 percent, and between 51.100 – 98.690 percent in the subsoil).. Other particle size distribution pattern (average values) was calculated during the dry and wet seasons respectively: silt (8.0400 and 2.1500 percent), and clay (30.270 and 0.63000 percent). The silt composition across both seasons ranged between 1.1400 – 11.940 and 0.90000 – 6.8800 percent in the top and subsoil respectively. The soil is slightly acidic with the pH ranging between 5.0300 and 5.7100 and did not vary significantly across the two depth intervals.

Microbial Analysis. The total heterotrophic bacteria count in the soil ranged between 70.00×10^3 and 450.0×10^3 cfu/g across both sampling periods. The total heterotrophic bacteria count was notably higher in the topsoil ($250.0 - 450.0 \times 10^3$ cfu/g) in comparison to subsoil ($70.00 - 210.0 \times 10^3$ cfu/g). The mean count was recorded at 293.3 and 205.67×10^3 cfu/g during the dry and wet season respectively. Similarly, the total heterotrophic fungi count ranged between 30.00×10^3 and 205.0×10^3 cfu/g. The total heterotrophic fungi count was also higher in the topsoil compared to the subsoil (72.00 – 205.00 and $30.00 - 132.0 \times 10^3$ cfu/g in the top and subsoil respectively). In contrast to the other two sites sampled during the dry season, hydrocarbon utilizing bacteria were only detected in one location (SS3A 0-15 at 15-30 cm) in the dry season and were not detected during the wet season.

Ihovbor-Eboeka Community

Heavy Metal Composition. Iron had the highest concentration levels during both the dry and wet season (12,021 – 22,080 and 5,000 – 15,000 mg/kg). In

both seasons the iron content of the soil was considerably higher in the topsoil (15,000 and 22,080 mg/kg) compared to the subsoil (5,000.0 and 12,021 mg/kg), Vanadium, cadmium and chromium had the lowest concentrations during the dry season (0.2000, 0.4000 and 0.6000 mg/kg), with all respective concentrations recorded at a higher level in the topsoil (0.24000, 0.44000, and 0.61000 mg/kg respectively). Lead and nickel recording the lowest concentrations during the wet season (0.9000 and 0.1000 mg/kg), and there was no variation observed in the lead concentrations across both depth intervals. The only marked difference between seasons in heavy metal composition was nickel (<0.05000 – 0.1000 and 6.900 – 9.000 in the wet and dry seasons respectively). In the wet season nickel was found to be below 0.05000 mg/kg in the topsoil, and recorded at 0.10000 mg/kg in the subsoil.

Anion and Cation Analysis. The highest anion concentration observed across both the wet and dry seasons was nitrate (4,650.0 – 6,900.0 and 51,072 – 53,424 mg/kg) noting the elevated nitrate levels during the dry season. Again the concentrations levels of nitrate were higher in the topsoil in both the wet and dry season (53,424 and 6,900.0 versus 51,072 and 4,650.0 mg/kg in the subsoil). Sodium had the highest concentration levels of the cations during the dry season (1,125.0 – 2,175.0 mg/kg) with a range between 8.0000 - 2,175.0 and 13.500 - 1,125.0 mg/kg in the top and subsoil respectively. While potassium had the highest cation concentration during the wet season (300.00 – 2,000.0 mg/kg (topsoil, 300.00 mg/kg, and subsoil, 2,000.0 mg/kg), in the dry season the concentration was a more moderate range of 11.800 – 347.20 mg/kg (topsoil, 347.20 mg/kg, and subsoil, 11.840 mg/kg).

Hydrocarbon Content. Oil and grease were not detected during both the dry and wet seasons. The concentration range of THC was greater during the dry season (1.800 – 8.000 mg/kg, higher in the subsoil) compared with levels during the wet season (0.2000 – 0.3000 mg/kg, little variation with depth).

Physico-chemical properties. The soil composition is chiefly sandy, although this varies across the dry and wet seasons (averages of 62.015 and 97.825 percent respectively) and with depth (topsoil: 67.070 – 96.990 percent and subsoil: 56.960 – 98.660 percent). The clay concentration of the soil decreased from the dry to wet season with average levels falling from 26.375 percent (dry season), likely an anomaly, to 0.42500 percent (wet season) and between 0.59000 – 20.790 (topsoil) and 0.26000 – 31.960 (subsoil) respectively. The silt concentration also declined from an average of 11.610 to 1.7500 percent from dry to wet season (with percent ranges in the topsoil between 2.4200 – 12.140, and 1.0800 – 11.080 in the subsoil).

Microbial Analysis. The average heterotrophic bacteria count in the soil was 105.0 and 208.5 in the dry and wet season respectively, noticeably higher in the topsoil (210.0 – 315.0 × 10³ cfu/g) than the subsoil at 102.0 × 10³ cfu/g for the wet season and heterotrophic bacteria not recorded in the subsoil in the dry season. The total heterotrophic fungi ranged between 15.00 × 10³ and 400.0 × 10³ cfu/g across both sampling periods and were higher in the topsoil in both seasons (125.0 -400.0 × 10³ cfu/g) compared to the levels observed in the

subsoil (15.00 - 35.00 x 10³ cfu/g), as would be expected from the higher levels of contact with air and organic material in the topsoil. Hydrocarbon utilising bacteria and fungi were not detected during either season.

Orior-Osemwende Community

Please note sampling in the Orior-Osemwende community was undertaken during the wet season only.

Heavy Metal Composition. Iron had the highest heavy metal concentration from the soil sampled in the Orior-Osemwende community (5,500.0 – 9,000.0 mg/kg), followed by chromium which demonstrated a narrow range of concentration (13.500 – 14.000 mg/kg). Iron concentrations were higher in the topsoil (9,000.0 mg/kg) than the subsoil (5,500.0 mg/kg) while chromium concentrations were slightly elevated in the subsoil (14.000 mg/kg) compared with the topsoil (13.500 mg/kg).

Anion and Cation Analysis. Nitrate had the highest anionic concentration levels (4,500.0 – 5,300.0 mg/kg) followed by phosphate (72.000 – 101.00 mg/kg). As found to be the case at the other sampling locations, the nitrate concentrations were found to be higher in the topsoil (5,300.0 mg/kg) than the subsoil (4,500.0 mg/kg). Sulphate was not detected within the soil. Among the cations sampled, potassium recorded the highest (1,950.0 – 2,405.0 mg/kg), and sodium the lowest concentrations (14.000 – 35.500 mg/kg). The potassium concentrations were higher in the subsoil compared with the topsoil (2,405.0 and 1,950.0 mg/kg respectively), while sodium concentrations were higher in the topsoil than the subsoil (35.500 and 14.000 mg/kg respectively).

Hydrocarbon Content. Oil and grease were not detected in the soil. THC was detected between 0.268 – 0.339 mg/kg in the top and subsoil respectively indicating low levels of hydrocarbon pollution.

Physico-chemical properties. The soil composition was predominantly sand with the soil on average having the following composition: sand (96.980), silt (1.5200) and clay (1.5100). The percent composition of the respective components in the topsoil were recorded at 97.000, 2.1500 and 0.85000. In the subsoil the percentage compositions were recorded at 96.950, 0.88000 and 2.1700.

Microbial Analysis. The total heterotrophic bacteria count ranged between 50.00 x 10³ and 290.0 x 10³ cfu/g. The total heterotrophic fungi ranged between 11.00 x 10³ and 58.00 x 10³ cfu/g. In both instances the total heterotrophic bacteria and heterotrophic count were found to be higher in the topsoil (290.0 and 58.00 x 10³ cfu/g) compared to those observed in the subsoil (50.00 and 11.00 x 10³ cfu/g). Hydrocarbon utilising bacteria and fungi were not detected during either season.

Transmission Line Corridor

Please note sampling in the transmission line corridor was undertaken during the wet season only.

Heavy Metal Composition. Iron had the highest concentration from the soil sampled along the transmission line corridor (14,500 – 33,000 mg/kg in the top and subsoil respectively). The second highest heavy metal concentration was chromium which illustrated the same levels as those observed in the Orior-Osemwende community.

Anion and Cation Analysis. Nitrate had the highest anionic concentration levels (3,350.0 – 7,750.0 mg/kg in the sub and topsoil respectively) followed by phosphate (50.000 - 91.500 mg/kg in the sub and topsoil respectively). Sulphate was not detected within the soil. Among the cations sampled, potassium recorded the highest concentration (350.00 – 1,650.0 mg/kg in the sub and topsoil respectively), with sodium again showing the lowest concentration in the soil (46.000 – 62.000 mg/kg in the top and subsoil respectively).

Hydrocarbon Content. Oil and grease was not detected in the soil. The THC concentration ranged between 0.4430 and 0.6020 mg/kg along the transmission line corridor. The THC concentration was higher in the topsoil, as illustrated in the concentration levels listed above.

Physico-chemical properties. The soil composition was predominantly sand with the soil having on average the following percentage composition: sand (96.500), silt (2.0900) and clay (1.4200). Sand and silt were found to be at higher concentrations in the topsoil (96.880 and 2.6800 percent). The clay composition was higher in the subsoil (0.44000).

Microbial Analysis. The total heterotrophic bacteria count ranged between 80.00×10^3 and 375.0×10^3 cfu/g. The total heterotrophic fungi ranged between 2.000×10^3 and 106.0×10^3 cfu/g. The total heterotrophic bacteria and fungi count were found to be higher in the topsoil (375.0 and 106.0×10^3 cfu/g) compared to the levels observed in the subsoil (80.00 and 2.000×10^3 cfu/g). Hydrocarbon utilising bacteria and fungi were not detected during the wet season.

Overview

The soil sampling was conducted across the Project site and included southern, northern and western portions as well as sampling at the communities of Ihovbor-Evboeka and Orior-Osemwende and within the proposed transmission line corridor. The physico-chemical properties across the different portions of the Project site were similar, with soils on average demonstrating a pH range between 5.00 and 6.00, with the soil mainly being composed of sandy loam. The microbial content of the soil also illustrated similar patterns across the different portions of the Project site, with slightly

higher heterotrophic fungi concentrations at the southern portion of the Project site. Furthermore the heavy metals and hydrocarbons were relatively low; however at one of the samples taken at the portion located directly west of the NIPP plant demonstrated a high hydrocarbon reading indicating previous hydrocarbon spillage.

4.6 *HYDROLOGY AND GEOHYDROLOGY*

4.6.1 *Hydrology*

No streams or rivers were identified on the Project site. A small pond is located approximately 800 m to the north of the boundary of the proposed site. The neighbouring NIPP plant proposed to pump the site effluent (mainly rainwater) to this pond which then drains into Ikpoba River during the rainy season. The Ikpoba River lies approximately 4 km east from the proposed site.

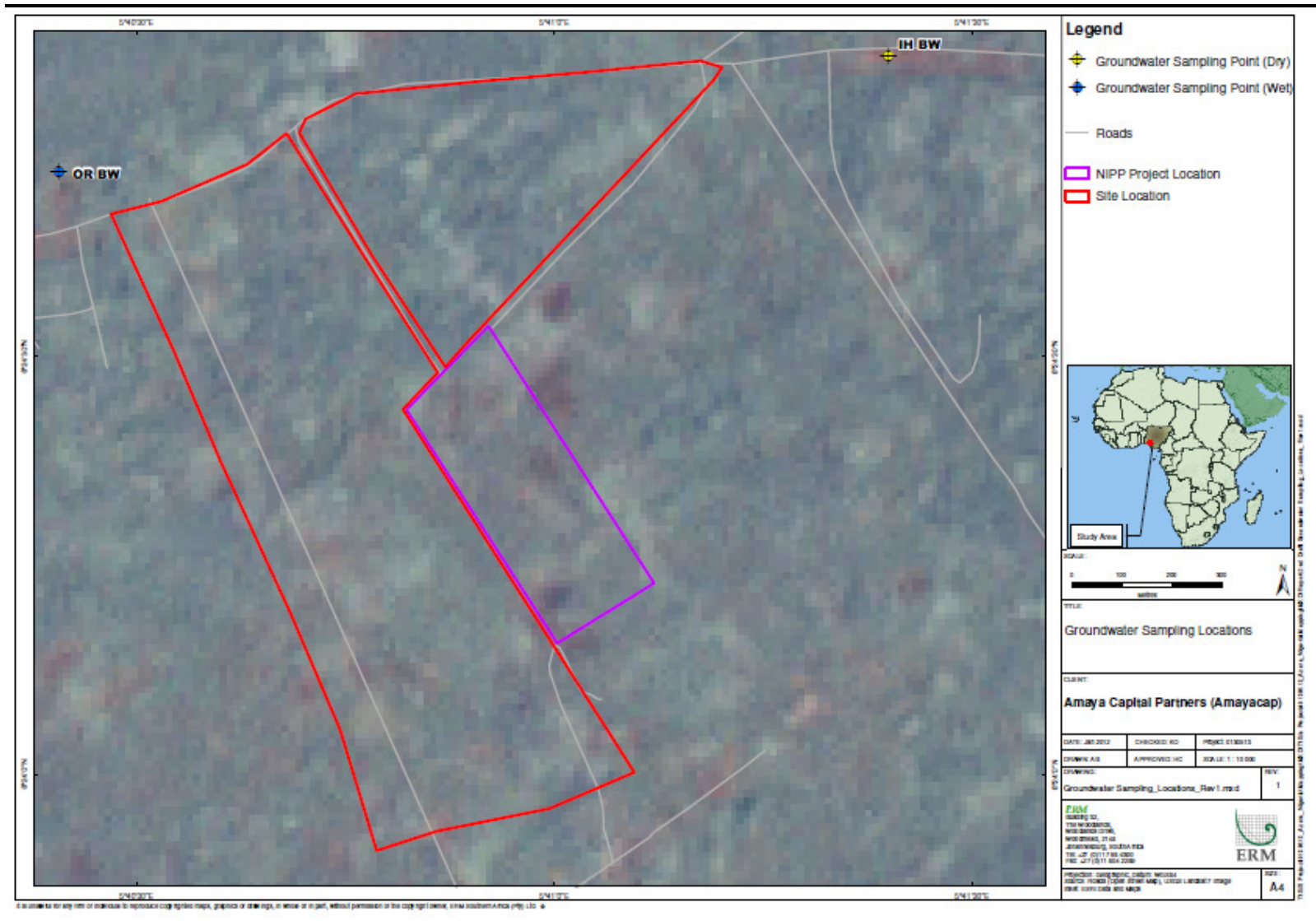
4.6.2 *Geohydrology*

Groundwater sampling was undertaken during the dry season at existing boreholes located in the Ihovbor-Evboeka and Iguemokhua communities. The borehole located in the Iguemokhua community was identified to fall approximately 34 km away, it is therefore anticipated that this will not be impacted on by the Project.

A second borehole was also sampled in the Ihovbor-Evboeka community during the wet season, in addition to an existing borehole in the Orior-Osemwende community. The collected samples were analysed for physico-chemical properties, oil and grease, heavy metals, microbiological characteristics, and THC. *In situ* field analysis measurements of pH, conductivity, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Salinity, Dissolved Oxygen (DO) and temperature were taken using handheld *in situ* water sampling metres at the various sampling locations. Laboratory analysis was conducted on the samples by Searchgate Laboratories Limited (an FMEnv accredited laboratory) in Ifako-Gbagada, Lagos.

The sampling locations of the boreholes (sampling points) are illustrated in *Figure 4.4*. Further details of the equipment used for sampling and latitude and longitude coordinates of the sampling locations are contained in *Annex B*.

Figure 4.4 Dry and Wet Season Groundwater Sampling Points



The results of the inorganic and organic parameters from the groundwater samples collected are provided below.

Groundwater Quality

Groundwater was sampled at three boreholes close to the Project site, namely two Ihovbor-Evboeka community boreholes and the Orior-Osemwende community borehole and results are presented in *Table 4.2*. The pH value was recorded at 5.2 and 5.4 at the Ihovbor-Evboeka community boreholes and 5.1 (wet season) at the Orior-Osemwende community borehole. These values lie outside of the WHO optimal range for drinking water (between 6.9 and 9.5) (WHO, 2007) and the recommended FMEnv range for drinking water quality (*Annex B*). The *in situ* temperature of the groundwater at the Ihovbor-Evboeka community boreholes was measured at 28.4 and 24.5 °C. The temperature at the Orior-Osemwende borehole was recorded at 23.5 °C.

The results of the analysis of the other parameters are presented below.

- **Salinity and Conductivity.** The conductivity values were recorded at 18.4, 23.2 and 43.6 $\mu\text{S}/\text{cm}$ at the Ihovbor-Evboeka (Borehole 1) and Ihovbor-Evboeka (Borehole 2) and Orior-Osemwende communities respectively. The results are within the FMEnv standards of 1000 $\mu\text{S}/\text{cm}$ and below the WHO and EU maximum upper limit for drinking water of 250 $\mu\text{S}/\text{cm}$ (Lenntech, 2011). The salinity of the groundwater at the Ihovbor-Evboeka community borehole was recorded at 0.007 percent during the dry season and 0.008 percent during the wet season. Salinity was measured as 0.020 percent at the Orior-Osemwende community (wet season).
- **Dissolved Oxygen and Oxygen Demand.** The dissolved oxygen content of the water recorded at Ihovbor-Evboeka was 2.15 (dry season), 4.20 (wet season) and at Orior-Osemwende community was 4.20 mg/l (wet season). All dissolved oxygen values fall below the FMEnv limit of 7.50mg/l (FEPA, 1991). The Biological Oxygen Demand (BOD) of the groundwater was less than 1.0 mg/l during both sampling surveys. In addition, the Chemical Oxygen Demand (COD) at the Ihovbor-Evboeka borehole was recorded at 8.0 mg/l (Borehole 1, dry season) and fell below 1.0 mg/l during the (Borehole 2, wet season).
- **Turbidity and Dissolved and Suspended Solids.** The turbidity of the groundwater was recorded at 1.0 NTU ⁽¹⁾ at both boreholes. This falls just outside the WHO drinking water standards for turbidity (<1.0 NTU) for urban areas and rural areas. However it falls within the WHO limit for areas with limited or no treatment (below 5.0 NTU) (WHO, 2011). The TDS at the boreholes were recorded at 9.70 at the Ihovbor-Evboeka borehole (Borehole 1, dry season) and 11.1 mg/l (Borehole 2, wet season). The TDS at Orior-

(1) Nephelometric Turbidity Units

Osemwende was measured at 27.2 mg/l (wet season), and was comparably higher than the TDS at both Ihovbor-Evboeka borehole. However, all values falls within the FMEnv limit of 500 mg/l, and the WHO drinking water guideline of 600 – 1,000mg/l (WHO, 2011). The TSS from the groundwater sample also fell within the 10.0 mg/l limit set by FMEnv (refer to *Annex B*), with values recorded at 9.0 mg/l at the Ihovbor-Evboeka borehole (Borehole 1, dry season) and 1.0 mg/l (Borehole 2, wet season). TSS was measured as 3.0 mg/l at Orior-Osemwende borehole during the wet season.

- **Nutrients.** The nutrient load of the groundwater is identified in *Table 4.2*. The nitrate levels for the Ihovbor-Evboeka borehole was 19.0 mg/l (Borehole 1, dry season), which is above the FMEnv limit of 10.0 mg/l but which fell within the WHO guideline of 50.0 mg/l (WHO, 2011). According to WHO, in most countries, “nitrate levels in drinking water originating from surface water do not exceed 10.0 mg/l, however water derived from wells often is above 50 mg/l” (WHO, 2011: p 398). The high presence of nitrate in the groundwater sample maybe a result of leaching from natural vegetation and agricultural activity including excess application of inorganic nitrogenous fertiliser. The nitrate concentration at Ihovbor-Evboeka however also decreased significantly during the wet season (Borehole 2) and was measured as 1.30 mg/l, well within both FMEnv and WHO limits. The nitrate level at the Orior-Osemwende community demonstrated similarly low levels (4.00 mg/l). The phosphate and sulphate concentrations are within the indicated FMEnv levels (*Table 4.2*) and sulphate levels were recorded within the WHO and EU standards of 500 and 250 mg/l respectively (Lenntech, 2011).
- **Cations.** The concentration levels of sodium, calcium and magnesium were within the FMEnv standards and WHO standard for sodium (less than 200 mg/l) (WHO, 2011).
- **Heavy Metals.** The heavy metals (copper, zinc, iron and nickel) that were detected are provided in *Table 4.2*, and apart from nickel (sampled during the dry season - Borehole 1 - at the Ihovbor-Evboeka borehole) all were recorded below FMEnv levels (*Annex B*). Nickel concentrations were recorded at 0.060 mg/l or 0.010 mg/l above the FMEnv limit (0.050 mg/l) but within the WHO drinking water standards of 0.070 mg/l (WHO, 2011).
- **Total Hydrocarbon Content.** The hydrocarbon parameters of oil and grease and THC for both boreholes during both wet and dry seasons, fell below the detection limit of 0.05 mg/l.
- **Microbiology.** Of the heterotrophic organisms analysed, only heterotrophic bacteria were detected at the boreholes. Heterotrophic bacteria levels at Ihovbor-Evboeka were noticeably lower during the dry season (Borehole 1) (1.0×10^3 cfu/100ml) compared wet season (Borehole 2) results of 10×10^3 cfu/100ml. The heterotrophic bacteria levels were recorded as 5.0×10^3

cfu/100ml at Orior-Osemwende during the wet season. Heterotrophic fungi, hydrocarbon utilizing bacteria and hydrocarbon utilizing fungi as well as coliform bacteria were not detected in the samples.

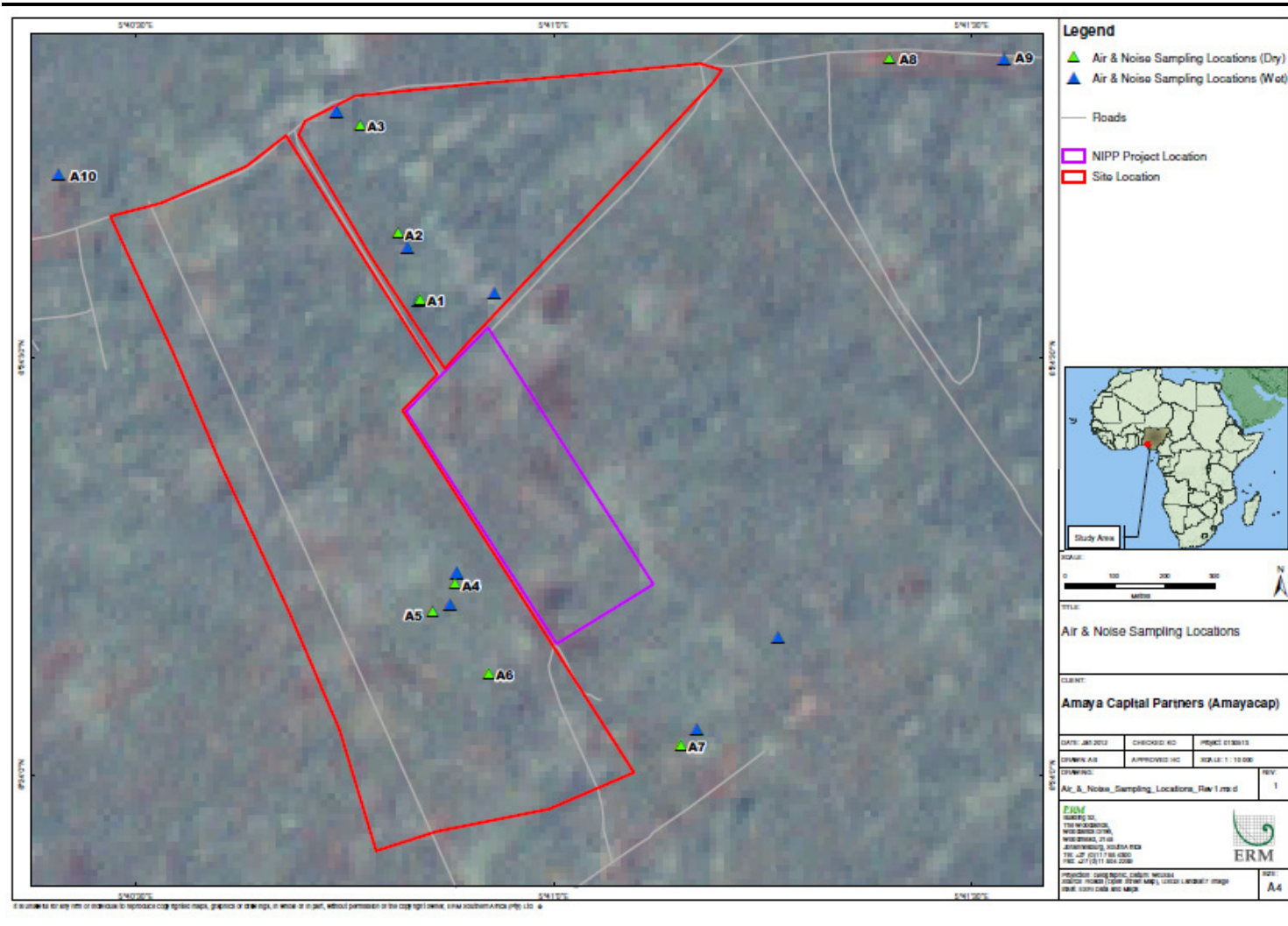
Table 4.2 *Groundwater Analysis Results*

Parameter (mg/l)	Ihovbor-Evboeka		Orior-Osemwende
	Dry Season (Borehole 1)	Wet Season (Borehole 2)	
Heavy Metals			
Copper	0.0010	0.060	0.030
Zinc	0.040	0.040	0.030
Iron	0.070	0.030	0.050
Nickel	0.070	< 0.0010	< 0.0010
Cations			
Sodium	25.2	0.0600	0.500
Potassium	0.900	0.400	6.40
Calcium	0.800	0.900	1.70
Magnesium	0.700	0.500	0.900
Anions			
Sulphate	1.00	<1.00	1.00
Phosphate	0.100	0.20	0.0800
Nitrate	19.0	1.30	4.00

4.7 AMBIENT AIR QUALITY

An ambient air quality survey was conducted during the wet and dry seasons. *In situ* air quality measurements were taken at eight locations in and around the Study Area and at sampling locations in close vicinity to the Ihovbor-Evboeka community during the dry season (*Figure 4.5*). During the wet season ten sampling points were selected that were spread across the Study Area in addition to the Orior-Osemwende and Ihovbor-Evboeka communities. A short transmission line corridor (located along the southern boundary of the Project site, to the north east of the NIPP site) connecting the site to the substation was also covered.

Figure 4.5 Dry and Wet Season Sampling Points (Air and Noise)



Air quality measurements were taken using handheld instruments (Multi Gas Detector and Handheld Aerosol Monitoring) and the following parameters were measured: CO, carbon dioxide (CO₂), sulphur dioxide (SO₂), Volatile Organic Compounds (VOC), H₂S, ammonia (NH₃) and Total Suspended Particulates (TSP). The results of the ambient air quality measurements are presented in *Table 4.3* and *Table 4.4* below.

Table 4.3 *Dry season air quality results*

Sample Code	VOC	CO ₂	CO	SO ₂	H ₂ S	TSP
	ppm	mg/m ³				
A1	0.2	580	1.0	ND	ND	0.088
A2	0.2	630	1.0	ND	ND	0.091
A3	0.2	550	1.0	ND	ND	0.078
A4	0.1	520	2.0	0.1	ND	0.073
A5	0.1	530	1.0	ND	ND	0.065
A6	0.4	590	1.0	ND	ND	0.058
A7	0.5	630	ND	0.1	ND	0.051
A8	0.7	660	2.0	ND	ND	0.057
FME _{Env} Limits	NS	NS	10	0.1	NS	0.25

Source: EnvAccord Fieldwork, 2011 NS= Not Specified ND= Not Detected

Table 4.4 *Wet season air quality results*

Sample Code	VOC	CO ₂	CO	SO ₂	H ₂ S	NH ₃	TSP
	ppm	mg/m ³					
A1	ND	470	3.0	ND	1.0	ND	0.036
A2	ND	660	2.0	ND	ND	ND	0.046
A3	ND	860	1.0	ND	ND	ND	0.038
A4	ND	730	ND	ND	ND	ND	0.046
A5	0.1	470	1.0	ND	ND	ND	0.025
A6	ND	560	1.0	ND	ND	ND	0.079
A7	ND	510	1.0	ND	ND	ND	0.028
A8	0.1	430	2.0	ND	ND	ND	0.023
A9	0.1	520	3.0	ND	1.0	ND	0.040
A10	ND	510	ND	ND	ND	ND	0.082
FME _{Env} Limits	NS	NS	10	0.1		NS	0.25

Source: EnvAccord Fieldwork, 2011 NS= Not Specified ND= Not Detected

Results of the concentration levels of nitrogen dioxide (NO₂) were taken from the ambient air quality study conducted for the neighbouring NIPP, during both the wet season (7 – 12 August 2006). The air sampling was done at two hour intervals at each sample location for ten hours in the morning, afternoon and evening periods. A Toxi Rae Single Gas Monitor was used to take the

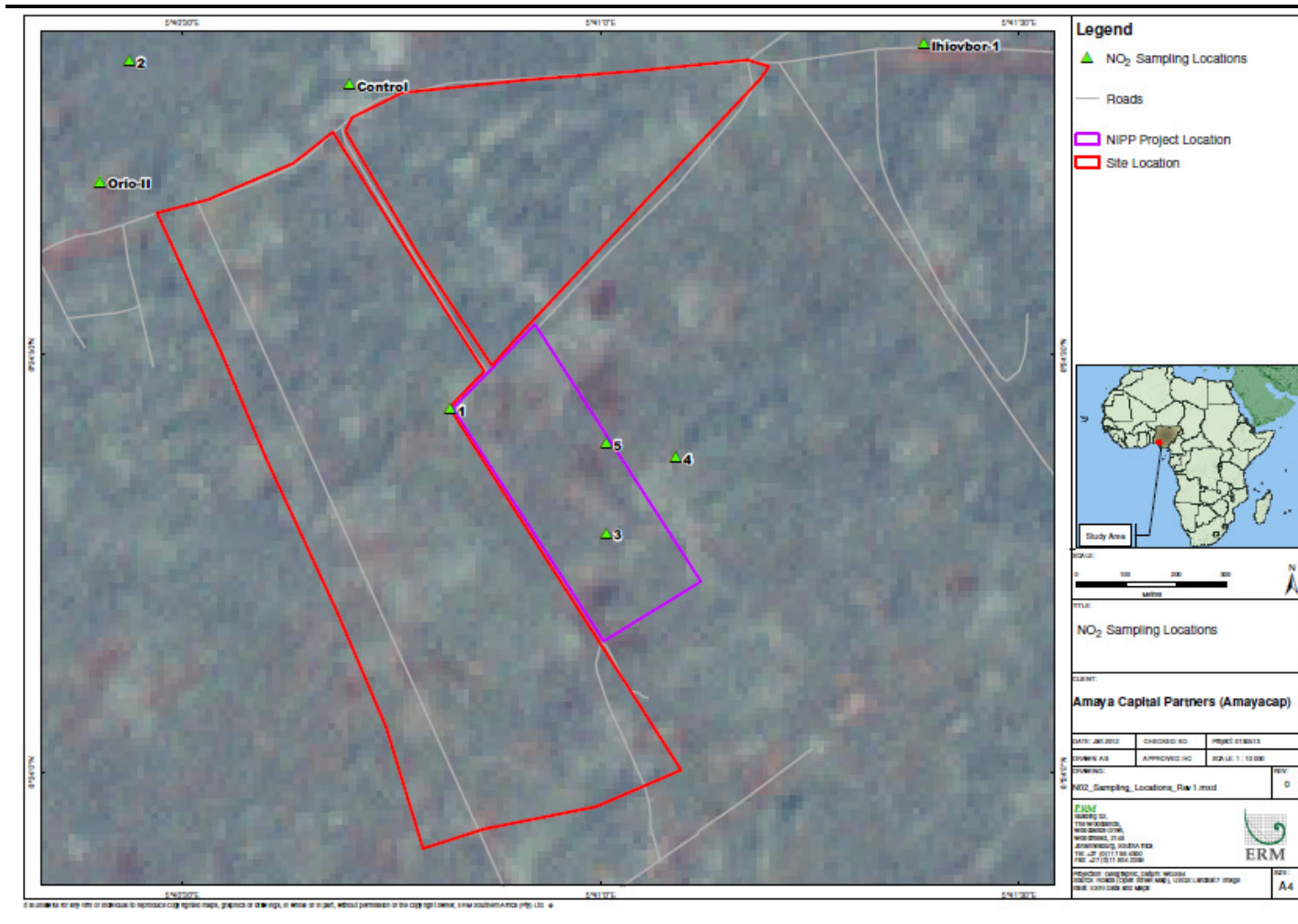
measurements. The sampling locations were mapped and are shown below in *Figure 4.6* and NO₂ results are presented in *Table 4.5* below.

Table 4.5 *Wet season air quality (NO₂) results*

	NO ₂ (ppm) wet season			
IHVB1	0.02	0.02	0.02	0.02
IHVB2	0.02	0.02	0.02	0.02
IHVB3	0.02	0.02	0.01	0.01
IHVB4	0.02	0.02	0.02	0.02
IHVB5	0.02	0.02	0.02	0.02
IHVB6 (control)	0.01	0.01	0.02	0.02
IHVB7 (Ihovbor)	0.01	0.01	0.02	0.02
IHVB8 (Orior Ozolua)	0.02	0.01	0.01	0.02
IHVB9 (Orior Osemwede)	0.01	0.01	0.01	0.02
IHVB10 (Idumwuno-wina)	0.02	0.01	0.01	0.02

Source: NIPP, 2010

Figure 4.6 Sampling Locations for NO₂



- **SO₂.** The SO₂ levels (ppm) were recorded at 0.1 ppm at two of the sampling locations, however at several locations SO₂ was not detected during the dry season, with no SO₂ detected during the wet season sampling.
- **TSP.** The approximate concentration level of TSP matter of 10 µm in size - PM₁₀) was given between 2.6 – 4.6 and 1.2 – 4.1 µg/m³ for the dry and wet seasons respectively.

NO₂. The results of the ambient air quality survey are indicative of a relatively clean air shed with values within the Nigerian Ambient Air Quality Standards, and international WHO standards for NO₂. This may be reflective of the rural nature of the environment with little or no existing emissions sources.

Ambient air quality was monitored across ten locations including the Orior-Osemwende, Ihovbor-Evboeka and Idunmwowina-Urho-Nisen communities. In addition, a control site was selected 1 km from the Project site. The results demonstrated that the NO₂ levels did not go above 0.02 ppm across both the wet and dry seasons.

4.8

AMBIENT NOISE ENVIRONMENT

The site is directly accessed via a tarred road connecting the Project site to the Benin City Bypass, a major expressway approximately 3 km to the east of the Site. Surrounding communities engage in informal trading, slash and burn agriculture and some employment in the formal sector. It is anticipated that the main underlying sources of noise will be road traffic and farming activities and short-term construction noise from the neighbouring NIPP.

The measurement of ambient noise levels were recorded using an Extech Integrating Sound Level Meter (model number 407780). A total of eight sampling locations were selected during the dry season including a sampling location in close vicinity to the Ihovbor-Evboeka community. A total of ten sampling locations were chosen during the wet season including the transmission line corridor, and the Orior-Osemwende and Ihovbor-Evboeka communities. The results of the noise sampling are illustrated in *Table 4.6*.

Table 4.6 *Noise Data - Wet and Dry Season*

Sample Code	Noise Level - dB (A)	
	Wet Season	Dry Season
A1	53.8	49.9
A2	50.4	53.7
A3	51.3	51.2
A4	49.6	58.5
A5	45.0	47.0
A6	46.0	54.5

Sample Code	Noise Level - dB (A)	
A7	46.0	49.9
A8	52.9	44.9
A9	62.9	Not measured
A10	51.0	Not measured

The highest noise levels were observed in the Ihovbor-Evboeka community (wet season) and sampling site A4 (dry season), where the noise levels were recorded as 62.9 and 58.5 dB (A) respectively. These are considered high for the semi-rural context of the Project site, and it is expected that this is as a result of the short-term construction noise from the activities at the NIPP site as well as weather conditions (heavy rain during the wet season) during sampling.

Due to the ongoing construction activities close to the site during the baseline sampling fieldwork, it was not possible to measure the baseline noise conditions. The noise modeling and the impact assessment assumes noise levels of below 45 dB(A) $L_{Aeq, 9hr}$ consistent with the semi-rural environment of the area around the Project site (*Chapter 7*). In addition, the NIPP EIA provides results of ambient noise levels (*Table 4.7*) measured as part of their specialist investigations..

Table 4.7 *NIPP Baseline Noise Survey*

Locations	Wet Season	Dry Season
	Noise Level dBA	Noise Level dBA
IHVB1	33.3	33.1
	34	33.3
	34.1	34.1
		34.1
IHVB2	33	33.1
	33.2	33.2
	34.3	34.5
	34.2	34.5
IHVB3	33	33.2
	33.1	31.1
	34	34.1
		34.5
IHVB4	33.8	31.8
	33.8	31.8
	34.8	34.5
	34.9	31.4
IHVB5	33.4	31.4
	33.3	33.3
	34.4	34.4
	34.3	34.4
IHVB6	33.7	31.7
	33.4	32.4
	34	34.5
	34.4	34.5
IHVB7	33.5	31.5

	Wet Season	Dry Season
	34.6	31.6
	33.6	34.5
	33.6	34.5
IHVB8	34.5	32.5
	34.4	34.4
	33.5	33.5
	33.4	45.1
IHVB9	34.5	38.5
	34.4	38.4
	34.6	39
	33.6	44
IHVB10	33	35
	33.1	35.1
	34	45.1
	33.1	45.1
Average Overall	34	37

The average overall for the NIPP site and surrounds is 34 dB (A) during wet season and 37 dB (A) during the dry season. As with standard methodology, the baseline noise levels are therefore considered to be below the IFC Noise Level Guidelines for daytime, 55 dB(A) $L_{Aeq, 15hr}$, and 45 dB(A) $L_{Aeq, 9hr}$, for night time for residential, institutional or educational receptors.

4.9 TERRESTRIAL ECOLOGY

4.9.1 Flora

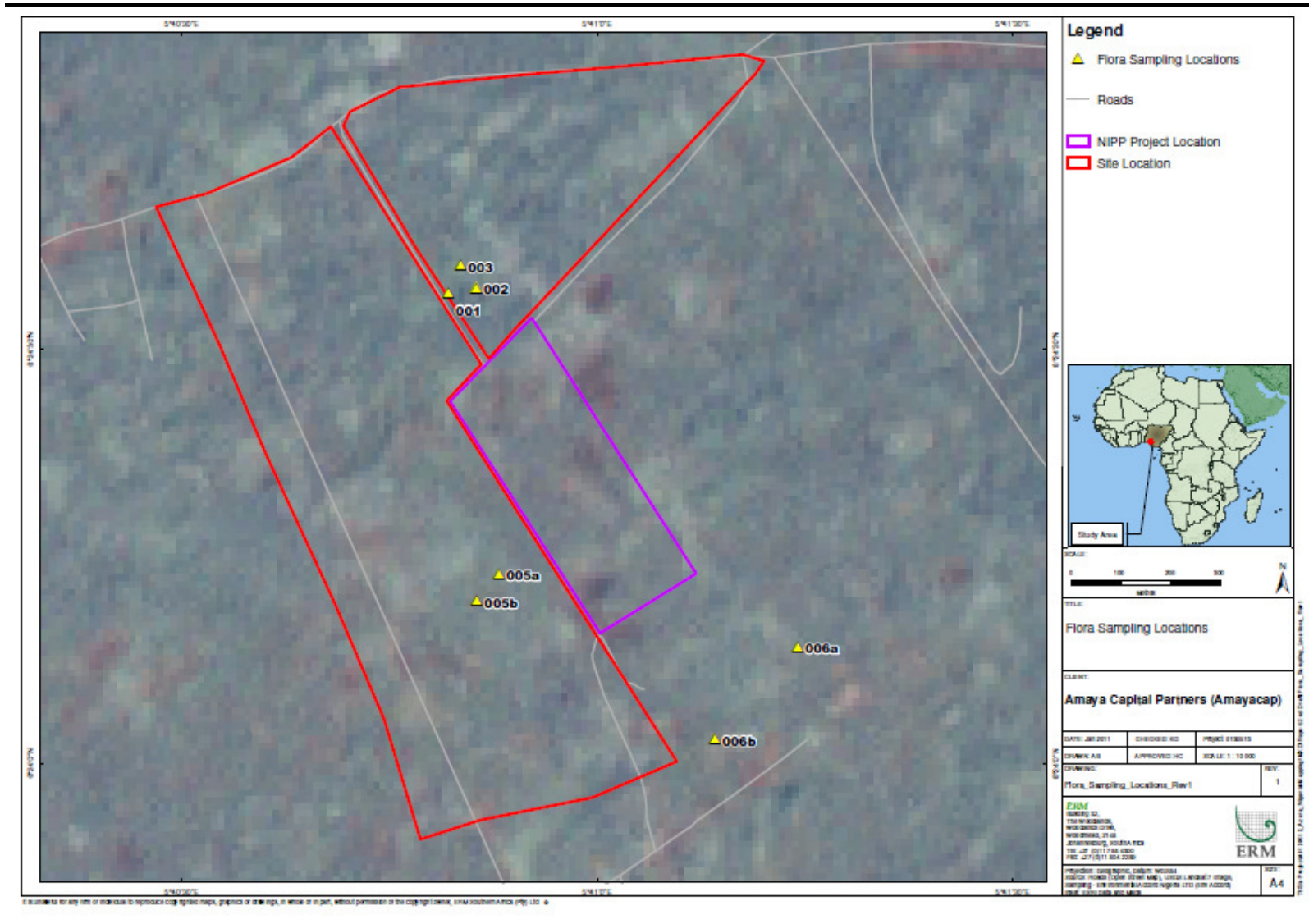
The assessment of vegetation was conducted to provide information on:

- floristic composition;
- plant species including the presence or absence of species;
- profile of the vegetation type; and
- inventory of economic plants including any crops of medicinal value.

The identification of species was conducted both *in situ* and *ex situ*. Representative samples of plant species were collected and prepared as standard herbarium species, to serve as a record of the vegetative composition of the area and identification of those species not identified in the field.

A combination of line and belt transect were used for the rapid assessment of the vegetation types. The belt transect used a 10 m by 5 m plot size. The sampling included locations at either end of the proposed Project site with seven points sampled in total during the dry season. The same sampling points were also chosen during the wet season to include the proposed Site in addition to the southern and south-eastern portions of the Project site. *Figure 4.7* illustrates the sampling locations for surveying vegetation.

Figure 4.7 Sampling Points (Flora) (for both Dry and Wet Seasons)



Overview of Results

Edo State flora is characterised by a combination of lowland rainforest, farm land, mangrove swamp vegetation, plantations (particularly for rubber and oil palm) and derived savannah.

The Study Area in particular is also characterised by human activities that have impacted upon the vegetation structure. This is a result of non-intensive agricultural activity, the construction and use of roads, dwellings and other structures and footpaths. The level of agricultural activities is shown in *Figure 4.8* illustrating the typical slash and burn practice conducted in the area.

Figure 4.8 *Typical Agricultural Activities at Proposed Plant Facility Location*



Source: Environmental Accord Nigeria Limited, 2011

The vegetation types encountered within the Study Area were similar to those in the rest of the State and included:

- areas of fallow bush of varying ages;
- abandoned and functional subsistence and commercial farmland;
- plantations for wild and domesticated oil palm and rubber species; and
- degraded secondary rainforest as well as statutory, personal and communal forests.

Photographic evidence of the secondary forests that were observed during the wet and dry season sampling is shown in *Figure 4.19* and *Figure 4.20* respectively. Inclusion of both figures allows for a comparison in the vegetation changes between seasons, in addition to any human influences that may have affected growth between the two seasons.

All flora habitats surveyed were found to comprise shrubs, grasses, sedges and a mixture of mature trees and re-growing juvenile trees. The dominant species recorded were spermatophytes both on Site and in the adjacent areas surveyed. The most commonly encountered plant species and vegetation ecosystems identified were cassava, rubber plantations, secondary forest and guinea grass (Figure 4.9 to Figure 4.16).

A total of 48 plant families comprising 125 species were encountered. Similar plant species were identified during both the wet and dry seasons, but as mentioned above there was variation in the abundance. Of the plant species observed, herbs (vascular plants) had the highest abundance with a total of 55 herb species. In addition, 22 shrubs, 34 trees and six climbers were identified during the dry season. A comprehensive species list for the Study Area is provided in *Annex B*.

Again, the difference in vegetation and the resulting growth between the two seasons is illustrated in *Figure 4.9 to Figure 4.16*. It was observed that the vegetation was evidently of a higher density during the wet season.

Figure 4.9 *Fallow land with Chromolaena odorata at the Proposed Project Site – Dry Season*



Source: Environmental Accord Nigeria Limited, 2011

Figure 4.10 *Abandoned Farmland with Cassava (Manihot esculenta) and other Secondary Forest Scramblers at the Proposed Site – Dry Season*



Source: Environmental Accord Nigeria Limited, 2011

Figure 4.11 *Abandoned Farmland with Cassava (Manihot utilissima) and other Secondary Forest Scramblers at the Proposed Site – Wet Season*



Source: Environmental Accord Nigeria Limited, 2011

Figure 4.12 *Fallow Land with Guinea Grass (*Panicum maximum*) and Oil Palm Trees (*Elaeis guineensis*) at the Proposed Site – Dry Season*



Source: Environmental Accord Nigeria Limited, 2011

Figure 4.13 *A rubber plantation (*Hevea brasiliensis*) at the Project Site (mixture of old and young trees (5-10 years old) occupying approximately 250m² at 1m interval) – Dry Season*



Source: Environmental Accord Nigeria Limited, 2011

Figure 4.14 *A rubber plantation (Hevea brasiliensis) at the Project Site (mixture of old and young trees (5-10 years old) occupying approximately 250m² at 1m interval) – Wet Season*



Source: Environmental Accord Nigeria Limited, 2011

The most frequently observed ecosystem in the Study Area was secondary forest. The secondary forest is categorised as re-growing or degraded secondary forest, as shown in *Figure 4.15* and *Figure 4.16*.

Figure 4.15 *A view of re-growing secondary forest within the Project site - Dry Season*



Source: Environmental Accord Nigeria Limited, 2011

Figure 4.16 A view of re-growing secondary forest within the Study Area - Wet Season



Source: Environmental Accord Nigeria Limited, 2011

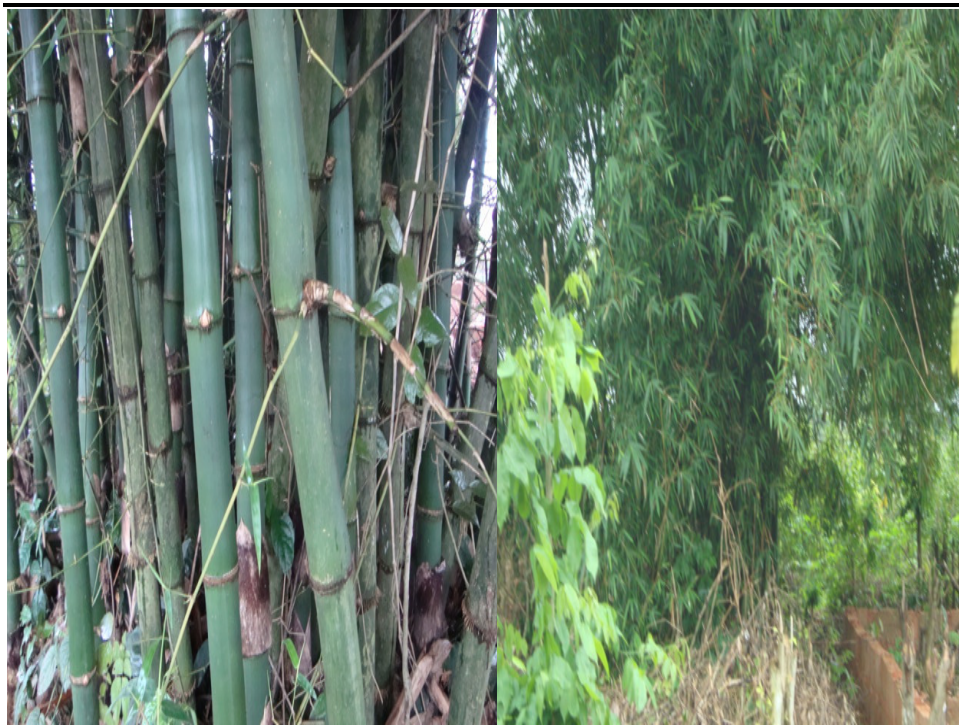
Additional plant species that were observed around the Study Area during the wet season include *Thonningia sanguinea* (ground pineapple), *Bambusa vulgaris* (common bamboo), and *Discoreaceae* family (a key species being yams) and are illustrated in *Figure 4.19*. It was evident that the vegetation observed during the wet season was of higher density, and illustrated a healthy floral system. There was, however, evidence of anthropogenic interference mainly the felling of trees for firewood. The floral species identified were not noted to be of specific endemicity as they are also found across the region.

Figure 4.17 *Thonningia sanguine* in the Project Area



Source: Environmental Accord Nigeria Limited, 2011

Figure 4.18 *Plant Species Bambusa vulgaris*



Source: Environmental Accord Nigeria Limited, 2011

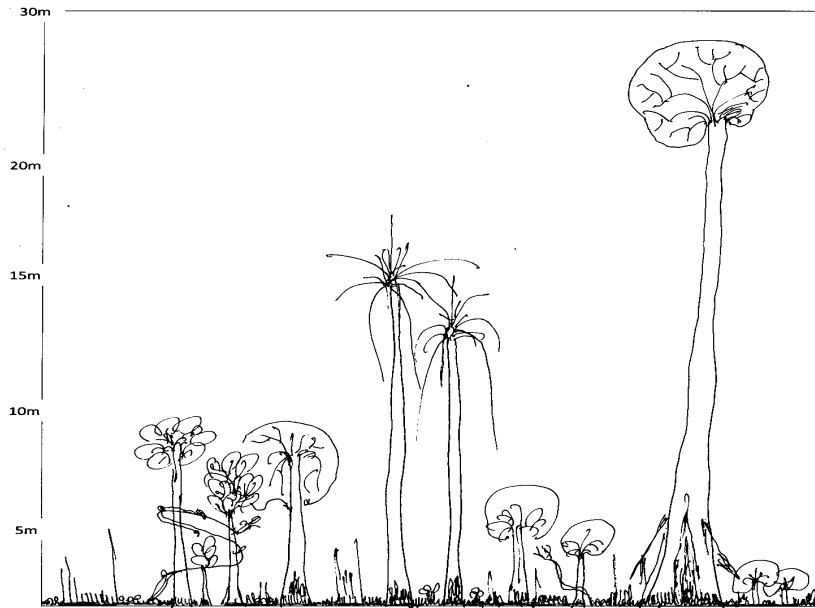
Figure 4.19 Plant Species Discorea and Zea Mays



Source: Environmental Accord Nigeria Limited, 2011

The profile of the vegetation was analysed with respect to the vertical arrangement of species (stratification) and horizontal arrangement (spatial distribution) of the various plant species within the Study Area. These distributions are illustrated in *Figure 4.20* below.

Figure 4.20 Vegetation Profile of the Study Area. Tree width varies from 15 cm to 1.5 m



Source: Environmental Accord Nigeria Limited, 2011

Biodiversity and Ecological Status Determination

Thirteen plant species with heightened classification status were identified in the Study Area and are listed in Table 4.8 according to their IUCN 2001 classification ie Endangered, Vulnerable and Near Threatened. The endangered and vulnerable plant species collectively fall into the Threatened classification.

Table 4.8 Ecological Status of Plant Species

Conservation Status	Scientific Name	Common Name
Endangered	<i>Artanema longifolium</i>	A leafy vegetable
Vulnerable	<i>Nauclea diderrichii</i>	Opepe
	<i>Hallea ciliate</i>	Abura
	<i>Hallea stipulosa</i>	Abura
	<i>Terminalia ivorensis</i>	Black afara
	<i>Dendrocalamus strictus</i>	Iron bamboo
	<i>Daniellia ogea</i>	Ogea
	<i>Pycnanthus angolensis</i>	Ilomba
	<i>Mimosa indica</i>	Giant sensitive
Near Threatened	<i>Antiaris africana</i>	Bark-cloth tree
	<i>Uvaria chamae</i>	Bush Banana
	<i>Milecia excelsa</i>	Iroko
	<i>Iringia gabonensis</i>	Wild Mango/ Ogbono
	<i>Spondias mombin</i>	Iyeye/ ngulungwu

Conservation Status	Scientific Name	Common Name
	<i>Xanthoxylum zanthoxyloides</i>	Artar root

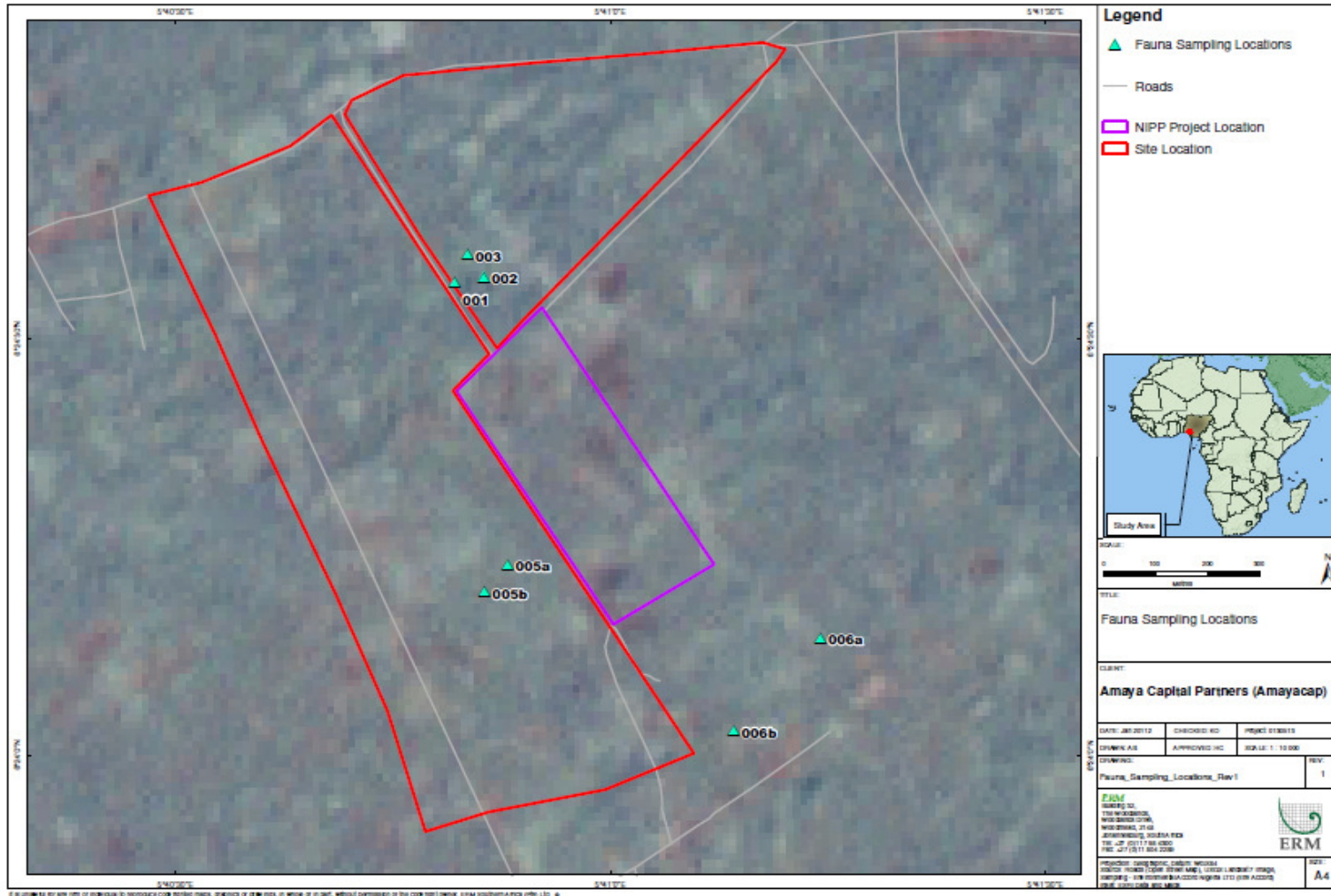
Please note: According to version 3.1 of IUCN 2001, the Threatened category includes Critically Endangered, Endangered and Vulnerable species.

4.9.2

Fauna

Terrestrial fauna that occurs in the study area was sampled both during the dry and wet seasons. Various visual and auditory sampling methods were used which included analysis of footprints, faecal samples, vocalisations and interviews conducted with local inhabitants. The sampling locations for the fauna examined during the dry season in the Study Area are shown in *Figure 4.21*.

Figure 4.21 Sampling Points (Fauna) – (for both Dry and Wet Seasons)



Species identified in the project area include the Mona Monkey (*Cercopithecus mona*), Crested Porcupine (*Hystrix cristata*), African Giant Rat (*Crecomys gambianus*). Several species of squirrels (notably the African tree squirrel – *Heliosciurus gambianus* and Striped ground squirrel – *Xerus erythropus*), Monitor Lizards (*Varanus albigularis*), and the red necked Cobra (*Naja pallida*) are expected to occur in the area. Local inhabitants indicated that local fox (*Vulpes* species), antelope (*Tragelaphus* species) and deer (*Cervus elaphus*) are also known to occur within the Project area. The complete list of amphibians, reptiles, bird and mammalian species identified are provided in *Annex B*.

Two faunal species were identified during the wet season to be of vulnerable ecological status. These are listed in *Table 4.9* below.

Table 4.9 *Vulnerable Faunal Species in the Study Area*

S/N	Local Names	Species	Family	Group
18	Soldier Ant	<i>Strongylognathus alboini</i>	Formicidae	Insecta
20	Dragon fly	<i>Acanthaeschna Victoria</i>	Aeishnidae	Insecta

4.10 *PROTECTED AREAS*

According to the Nigerian Forestry Act (1958) and the Edo State Forestry Law CAP 59 (1976), the forest areas in proximity to the Study Area fall under anthropogenic or natural forest. It has been identified that the Project site is located on anthropogenic forest, fallow land none of which is cordoned off, and it is not well maintained by surrounding owners. The closest natural forest is the Sakoba Forest Reserve located approximately 20 km to the south of the Project site. According to the Forestry Law 2002 (an amendment of the Forestry Law Cap 59 Vol III) the destruction or modification of forest and protected areas is prohibited. There are no protected areas in close vicinity to the Study Area or that will be directly affected with the development of the Project.

5.1 INTRODUCTION

This section provides information on the social and socio-economic baseline conditions in the proposed Project area. The baseline provides a critical contextual component to benchmark existing conditions and to help identify and assess potential impacts of the proposed development.

The information presented has been obtained during a desktop study and through the results of primary data collected through a census, natural resource assessments, socio-economic surveys and consultations undertaken in July 2011. Further details of the data collection are included in the Stakeholder Engagement Plan (*Annex A*).

5.1.1 The Study Area

The proposed Project will be situated in Edo State, located in south central Nigeria. It is bordered in the north and east by Kogi State, to the south by Delta State and to the west by Ondo State (*Figure 5.1*).

Figure 5.1 Map of Edo State, Nigeria



Source: First Bank of Nigeria, 2011

Edo State is divided into 18 Local Government Areas (LGAs), and the proposed Project will be located in the central LGA of Uhumwode.

The study area and geographic scope of the social baseline includes the communities of Orior-Osemwende, Ihovbor-Evboeka and Idunmwowina-

Urho-Nisen-Urho-Nisen, which will be affected by the Project activities. They are in Omagbae South Ward Six of the Uhunmwode LGA in Edo State, Nigeria.

This baseline section provides information for Edo State, the Uhunmwode LGA and the local communities in the vicinity of the Project. In order to provide further context to the social baseline, some commentary is also provided at a national level.

The data reflected in this ESIA baseline is mostly quantitative and based on the outcome of the qualitative surveys carried out (ie Focus Group discussions). A baseline based on the outcomes of the quantitative data surveys is documented in the baseline section of the associated Resettlement Action Plan (RAP) *Section 4*.

5.2

METHODOLOGY

A combination of research methods were used to collect socio-economic data, including the following:

- Review of secondary data;
- Reconnaissance survey to identify all communities that will be directly or indirectly affected and to alert communities leaders and residents to the Project and to the proposed studies;
- In-depth interviews with community leaders of the identified communities (traditional leaders, women leaders, religious leaders and youth leaders);
- Focus Group Discussions (FGDs) with groups of adult males, adult females and youths;
- Direct observations; and
- Participatory tools used during FGDs, specifically community mapping, Venn diagram and paired needs ranking and case studies formulation.

Table 5.1 assesses the range of methodologies used in the social baseline study.

Table 5.1 Data Collection Methodologies

Objectives	Methods Used						
	Secondary Data	Survey	Interviews	FGD	Direct Observation	Community Mapping	Paired Needs Ranking
Describe in general terms population size and structure, settlement patterns, ethnic structure and groups, leadership patterns, other	X	X	X	X	X	X	
Identify administrative and socio-cultural institutions, leadership patterns, migrant status of residents	X		X	X			X
Assess level of infrastructure development (eg social amenities, infrastructure availability and condition)		X	X	X	X	X	X
Gender analysis of livelihoods		X		X			X
Find out potential for conflict and attitudes/ perceptions re: proposed Project	X	X	X	X			
Determine livelihood strategies (eg farming, hunting, forest collection, logging)	X	X	X	X			
Identify marginalized groups within the community		X	X	X			
Identify and assess status of resources (land, forest, water) and level of dependence upon these	X	X	X	X	X	X	
Suggest mechanisms to minimize negative effects of proposed Project upon local population	X	X	X	X			X

5.2.1 Data Collection Sampling Methodology

Sampling of stakeholders for engagement and data collection was based on the following criteria:

- Adequate representation from all relevant social groups in each of the communities;
- Inclusion of groups/ individuals with different population characteristics/ socio-economic status;

- Participation of those with access to relevant information;
- Evidence of different types of livelihood activities; and
- Inclusion of males, females and youth where possible.

For key informant interviews, a sample of local leaders in each community was selected including the traditional community leader or other men, women and religious leaders (in cases where the traditional leader was not available).

A total of nine FGDs, seven interviews, and three infrastructure checklists were conducted in the three affected communities. FGDs were conducted with different groups in each of the communities with stakeholders including a group of adult males, a group of adult females and a youth group.

Figure 5.2 *Focus Group Discussions*



5.2.2 *Limitations and Assumptions*

This section describes the key limitations and assumptions of the data collection.

This socio-economic baseline seeks to generate a thorough understanding of the lives and livelihoods, aspirations and perceptions, as well as the

constraints and potential concerns of key Project stakeholders. To gain this perspective, the study recognizes the following theoretical assumptions:

- Past social conflicts over resource acquisition and use are likely to be a relevant predictor of potential new conflicts, as greater competition for natural resources evolves; and
- There is another, ongoing, power plant project under development in the area which has had a considerable impact on local communities. This is likely to have influenced perceptions and reactions to the proposed Project among stakeholders.

These assumptions have been considered in the socio-economic assessment. They were factored into the determination of the methodology and the identification of the issues that needed to be given particular focus and attention.

5.2.3 *Structure of the Socio-Economic Baseline Chapter*

The Socio-Economic Baseline chapter is structured as follows:

- Overview of key socio-economic indicators;
- Demographic profile;
- Administrative and socio-cultural institutions;
- Economics, livelihoods and employment;
- Use of natural resources;
- Infrastructure;
- Cultural sites and cultural heritage; and
- Health profile.

5.2.4 *Overview of Key Socio-Economic Indicators*

Table 5.2 summarises key socio-economic indicators at the national level to provide context to the social baseline for the proposed Project.

Table 5.2 Key Socio-Economic Indicators for Nigeria

Socio-Economic Indicator	National Level	Source
Population (m)	158.4 (2010)	World Bank – Data Bank http://databank.worldbank.org/ddp/home.do?Step=1&id=4
Population growth rate (% per annum)	3.0 (2010)	World Bank – Data Bank http://databank.worldbank.org/ddp/home.do?Step=1&id=4
Life Expectancy (years)	51.0 (2009)	World Bank – Data Bank http://databank.worldbank.org/ddp/home.do?Step=1&id=4
HDI index Value*	0.423 (2010)	UNDP International Human Development Indicators http://hdrstats.undp.org/en/tables/default.html
Religion	50 percent Muslim, 40 percent Christian, 10 percent Indigenous beliefs	CIA World Factbook https://www.cia.gov/library/publications/the-world-factbook/geos/ni.html
GDP per capita (2008 PPP USD)	2,289 (2010)	UNDP International Human Development Indicators http://hdrstats.undp.org/en/tables/default.html
Inflation rate (%)	13.7 (2010)	CIA World Factbook https://www.cia.gov/library/publications/the-world-factbook/geos/ni.html
School enrolment, primary (% net)	61 (2007)	World Bank – Data Bank http://databank.worldbank.org/ddp/home.do?Step=1&id=4
Literacy rate (%)	74.8 (2010)	UNDP, UNESCO Institute for Statistics http://hdrstats.undp.org/en/tables/default.html
Proportion of total population served with piped water (%)	58 (2008)	World Bank Data – Data Bank http://databank.worldbank.org/ddp/home.do?Step=1&id=4
Hospital beds (per 10,000 population)	5.0 (2004)	World Health Organisation http://apps.who.int/whosis/database/core/core_select_process.cfm
Estimated adult rate (15-49) of people living with HIV/AIDS (%)	4 (2009)	World Bank Data – Data Bank http://databank.worldbank.org/ddp/home.do?Step=1&id=4

* The Human Development Index (HDI) is a summary measure of human development. It measures the average achievements in a country in three basic dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living. The HDI is the geometric mean of normalized indices measuring achievements in each dimension. 1 shows high human development whilst 0 shows low human development.

Nigeria is the most populous country in Africa, and is experiencing relatively strong economic growth. According to the World Bank, in 2009, Nigeria's GDP grew by six percent, which is considered to be moderate in comparison with other African countries (World Bank, 2010, Economic Commission for Africa, 2011). Life expectancy at birth is lower than the sub-Saharan average (52 years) and is considerably lower than that of an average lower-middle

income country (68 years). These statistics contribute to Nigeria's ranking 142 (out of 169) in the HDI Index, comparable to nations such as Senegal (144), Haiti (145) and Yemen (133), with an index value indicating low human development. The GDP per capita is above the Sub-Saharan average but considerably lower (approximately half) of that of an average lower-middle income country (World Bank, 2009).

5.3 *DEMOGRAPHIC PROFILE*

5.3.1 *Population Distribution*

The total population of Nigeria in 2010 was estimated to be 158.4 million, with a population growth rate of three percent per year (World Bank, 2010). Approximately 51 percent of the national population is male, against 49 percent female. In 2009, Nigeria reported an average life expectancy at birth of 51 years, which was broken down into a life expectancy of 50 years for men and 52 years for women (World Bank, 2010). In 2007, the WHO reported that 70.8 percent of the population was living below the poverty line of less than USD1 per day (WHO, 2010).

In 2010, the urban population of Nigeria was 50 percent of the total, and urban growth was estimated at four percent – higher than the three percent annual growth for the overall population (World Bank, 2010).

In 2010, Nigeria reported an international migrant stock of just over 1 million people, or one percent of the total population. However, there was a net migration of negative 300,000 (World Bank, 2010).

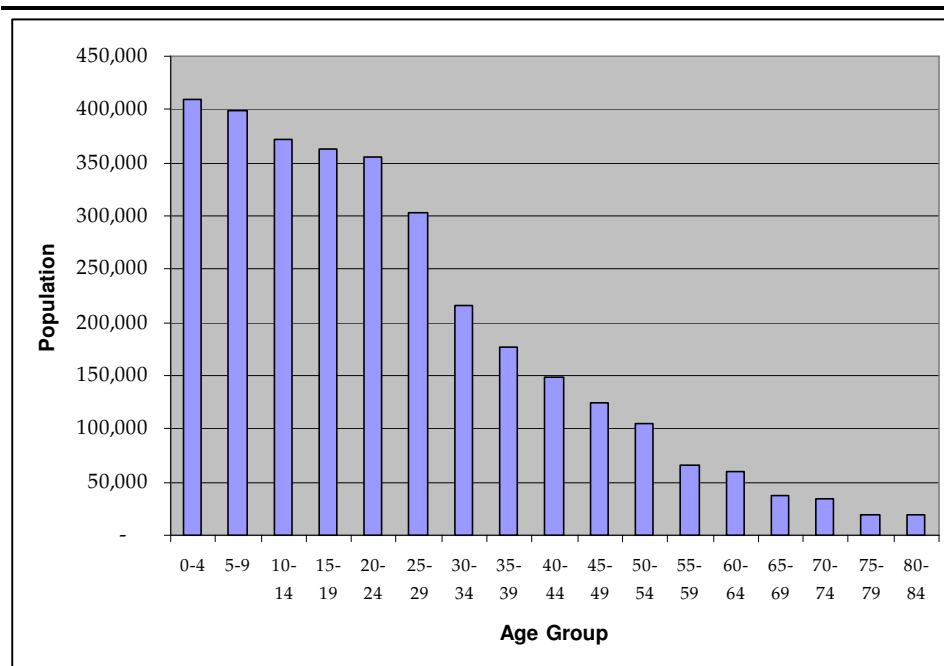
The official spoken language of Nigeria is English; however, a combination of Igbo, Hausa, Yoruba, Fulani and over 500 additional indigenous languages are also spoken (CIA World Factbook, 2011).

Edo State is 17,450 km² in area. As of the 2006 census, it had a population of approximately 3.2 million people, of which approximately 51 percent were male and 49 percent female. The population of Edo State is less urban than at the national level, with roughly 67 percent of the population residing in rural areas in 2006. However, the capital city of Benin is home to nearly a third of the state's population (National Nigerian Population Commission, 2006).

The proposed Project is located in Uhumwode LGA of Edo State, which occupies an area of 2,033 km². The 2006 population of the LGA recorded 120,813 inhabitants, 53 percent of which were male and 47 percent of which were female (National Nigerian Population Commission, 2006).

The age distribution within Edo State is skewed towards young people, with 48 percent of the population under the age of 20 (see *Figure 5.3*). Nevertheless, this is lower than the national average of Nigeria, which shows that 52 percent of the population are younger than age 20.

Figure 5.3 Age Distribution, Edo State (2006)



Source: 2006 Population and Housing Census of the Federal Republic of Nigeria

Typically, developing countries demonstrate younger populations due to high birth rates, limited family planning and poor access to health infrastructure. Although Edo State demonstrates a comparatively young population, the gap between the national and state averages may be explained by the youth migration (driven by employment seeking) from the rural areas surrounding Benin City to larger urban areas such as Lagos or Abuja.

Population Distribution and Trends in the Project Area

Within the three communities in the vicinity of the Project, it was observed that Idunmwowina-Urho-Nisen is comparatively more densely populated when compared to Ihovbor-Evboeka and Orior-Osemwende. Similarly to the national and state level trends, the population of all three communities is fairly youthful.

During FGDs and interviews, community stakeholders stated they believed that there had been changes in the age composition in the last ten years. Informants in Orior-Osemwende stated that that the youth had been moving to urban areas in search of jobs, vocational training and schooling, influencing the age makeup of the local population.

However, residents of Ihovbor-Evboeka and Idunmwowina-Urho-Nisen reported an increase in the youth population in the area, due to migration for the construction work at the neighbouring NIPP being built right now. These reports indicate an expected trend in youth migration toward opportunities for employment in the local area, and away from locations elsewhere in Nigeria where opportunities might be limited.

5.3.2 *Ethnicity, Language and Religion*

The main ethnic groups in Edo State are Bini (also referred to interchangeably as Edo), Afemai, Esan, Owan and Akoko Edo. There are numerous ethnic groups under what is known as Edo-speaking people of Nigeria. These include the Bini, Esan, Etsako, Owan, Isoko, Urhobo, Itsekiri, Akoko-Edo, Aniocha, Ouru, Izone and Ika.

Although Edo State is the home of several ethnic groups, it is considered one of the most homogeneous states in Nigeria, as many of the communities in the state trace their roots to the ancient kingdom of Benin, which was centred on present-day Benin City. As a result, customs, burial rites, diet and traditional modes of dress tend to be similar throughout the state. Non-indigenous peoples living in the Project area include Urobos, Ishan, Ora, Efik, Ijaws, Hausas, Ibos and Yorubas, as well as a small number of Ghanaians and Togolese.

The major languages spoken in the state are Ebira, Edo, Esan and Okpamheri, with dialects varying according to distance from the city (Edo State Government, 2011).

Traditional religion is widely practiced in the study area. Observance includes visiting and presenting sacrifices to sacred sites in and around the communities (see *Section 5.7.6*). Christianity and Islam are also widely practiced, often alongside traditional religious practices. There are no reports of tension between religious groups in the Project area.

5.3.3 *Community Migration Status and Patterns*

Historical migration into the area is assumed to be minimal. From the qualitative data gathered, including responses from community stakeholders, it was found that majority of the residents are native to this area. This is consistent with the responses of informants that they are Bini people and the general comments from FGDs stating that inhabitants are nearly all from the local area rather than being migrants from other parts of Nigeria.

However, as previously mentioned, during the FGDs a recurrent statement was made concerning the out-migration of the youth. Repeatedly, informants complained that the lack of employment opportunities in the area has resulted in their sons and daughters moving out of the area in search of jobs.

5.3.4 *Vulnerable or Marginalised Groups*

Vulnerable groups includes people who, by virtue of gender, ethnicity, age, physical or mental disability, economic disadvantage or social status may be more adversely affected by a project than others, and who may be limited in their ability to take advantage of a project's development benefits.

Vulnerable groups within the Project affected communities were found to be women, children, migrant farmers, disabled people and the elderly. These

were classed as vulnerable by virtue of their economic vulnerability and their lack of opportunity to participate in decision making systems within the local cultural context.

Women and migrant farmers are considered to be more vulnerable to Project related impacts, particularly if the land on which their livelihoods are dependent is taken and not compensated for adequately.

It should be noted that female-headed households might be underreported, as it is culturally held that a man is the head of the household even if that man is not a permanent resident or is a male member of the extended household. As such, it may be difficult to effectively identify which households fall within this category.

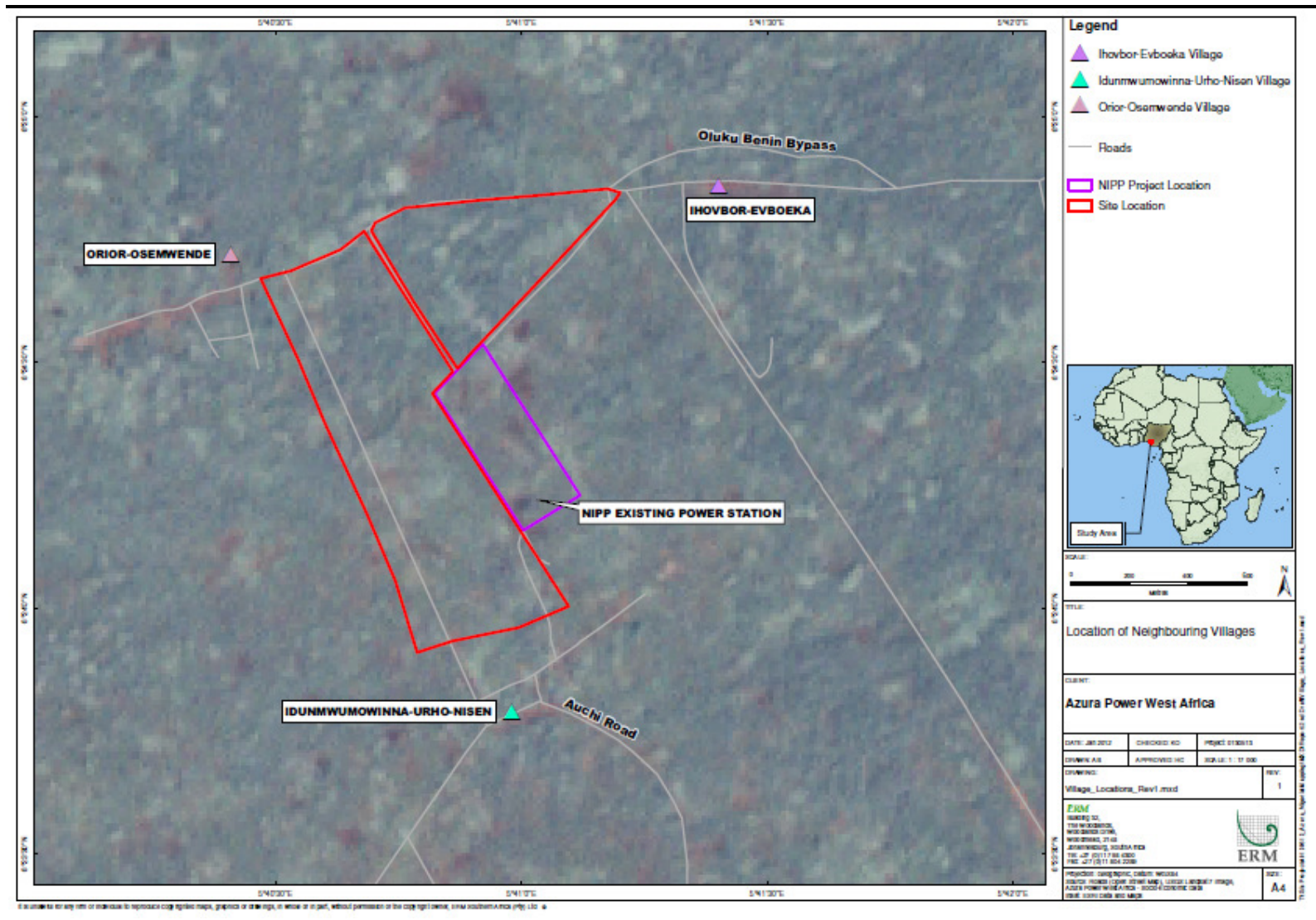
Official statistics indicate that 60,400 people (approximately two percent of the population) have recorded disabilities within Edo State. Of this total, 41 percent have a visual disability, 14 percent have restricted mobility, 12 percent a hearing disability, 12 percent a speaking disability, and nine percent a mental disability. These figures reflect the trends at the national level ⁽¹⁾. It is assumed that the statistics for disability within the Project area approximately mirror these percentages.

5.3.5 *Community Profiles*

Figure 5.4 shows a community map of the Project area and the approximate location of the three communities in relation to the proposed Project and the neighbouring NIPP power plant.

(1) 2006 Population and Housing Census of the Federal Republic of Nigeria

Figure 5.4 Community Map of the Proposed Project Area showing the Three Communities Closely Affected



Orior-Osemwende

Orior-Osemwende is the smallest community in the Project area, with an estimated population of approximately 1,000 residents. According to data collected in the field, it is almost exclusively inhabited by the indigenous Bini, with only a few Ijaw, Ibo, Calabar, Yoruba and Hausa migrants. Half the people in the community are Christian with the remainder divided among Muslims and practitioners of traditional beliefs. From their own estimation, the level of poverty in the community is approximately 80 percent.

The gender breakdown of the community is weighted towards females. This may be due to young men leaving the community to find work elsewhere. Residents of the community support this assumption, noting an ongoing trend of youth outmigration from the community in search of jobs, vocational training and education.

The majority of the community residences are situated along the road that runs from Ihovbor-Evboeka / Idunmwowina-Urho-Nisen to Benin City, demonstrating the importance of this route. In addition, roads to and from Ihovbor-Evboeka and Idunmwowina-Urho-Nisen are important inter-community transport links. Agricultural areas in the community are situated in close proximity to the households.

Ihovbor-Evboeka

Ihovbor-Evboeka has a population of approximately 400 inhabitants. In contrast with residents of Orior-Osemwende, stakeholders in Ihovbor-Evboeka report increasing population density over the past few years, particularly in the number of youths. This has been credited to the development of the neighbouring NIPP ("Ihovbor-Evboeka") power plant and associated job opportunities. This is also likely a factor in the gender breakdown of the community, which is weighted toward the male population.

Nearly all of the inhabitants of Ihovbor-Evboeka are Bini with a few members of other ethnic groups including the Yoruba, Igbo, Urhobo, Efik and Esan. Traditional beliefs appear to be more prevalent in this community than others in the Project area: according to the EIA for the Ihovbor-Evboeka. Power Plant, approximately 60 percent of residents of Ihovbor-Evboeka practice traditional worship while 20 percent claim to be exclusively Christian and seven percent say they are exclusively Muslim (NIPP, 2010). This assessment is supported by stakeholder feedback in the community. There are no churches or mosques in the community.

From the FGDs and IDIs conducted in the Orior-Osemwende and Idunmwowina-Urho-Nisen it was evident that there was a degree of resentment (see *Section 5.4.4*) due to the fact that the Ihovbor-Evboeka community was felt to have benefited disproportionately compared to the other two communities from the NIPP power plant. It is perceived that

compensations for land taken and livelihood impacted were unfairly distributed to the residents of this community, to the detriment of the other communities in the LGA. Such responses arose as a result of consultations with several groups within the communities, and therefore it can be deduced that the dissatisfaction is throughout the two communities. It should be noted that the NIPP is a federal project, and therefore previous benefits derived from the NIPP power plant project relate directly to the federal government).

Idunmwowina-Urho-Nisen

Idunmwowina-Urho-Nisen is the most densely populated community in the Project area, and consists of approximately 1,500 inhabitants. As in the town of Ihovbor-Evboeka, residents report population increase over the past few years, particularly among youth and males. Similarly to Ihovbor-Evboeka, this trend is associated with the NIPP power plant and associated employment opportunities.

As with the other communities in the proposed Project area, Idunmwowina-Urho-Nisen is populated primarily by Bini and a few people of other tribes including Ibo, Ijaw, Isoko, Calabar and Hausa. About half of the residents practice traditional religion.

5.4 ADMINISTRATIVE AND SOCIO-CULTURAL INSTITUTIONS

5.4.1 Government Institutions

The Federal Republic of Nigeria is made up of 36 states and one federal capital territory and has a mixed legal system of English common law, Islamic law and traditional law.

Edo State, which has its capital in Benin City, comprises 18 LGAs. The Project facilities will be located in Uhumwode LGA. Key ministries in the state that have been consulted in reference to this Project at the state level include:

- Ministry of Environment and Public Utilities;
- Ministry of Lands, Surveys and Housing; and
- Ministry of Power and Water Resources.

5.4.2 Traditional Leadership Patterns and Representation

As in many parts of Nigeria, traditional leadership remains a strong and respected structure in Edo State. Although the powers of traditional leaders have declined in modern times, the rituals and respect that surround these positions remain strong, and these leaders retain significant influence over their people.

The study area falls within the Kingdom of Benin, which is headed by the Oba of Benin – the traditional leader of the Bini people. Although some small differences in traditional power structures exist among the communities, all of

the communities within the Project area identify the Oba of Benin as the traditional leader of highest authority. At the local level, the Enogie (also referred to as 'His Royal Highness') sits below the Oba of Benin and is appointed by him (as are all traditional leaders). Below the Enogie sits the traditional leader ('Odiwere') of the community. All three communities also have a council of elders, which maintain major decision-making influence at the local level. Also significant are the Land Allocation Committees, which act under guidance of a chairman and are responsible for distributing and supervising allocation of land in the communities.

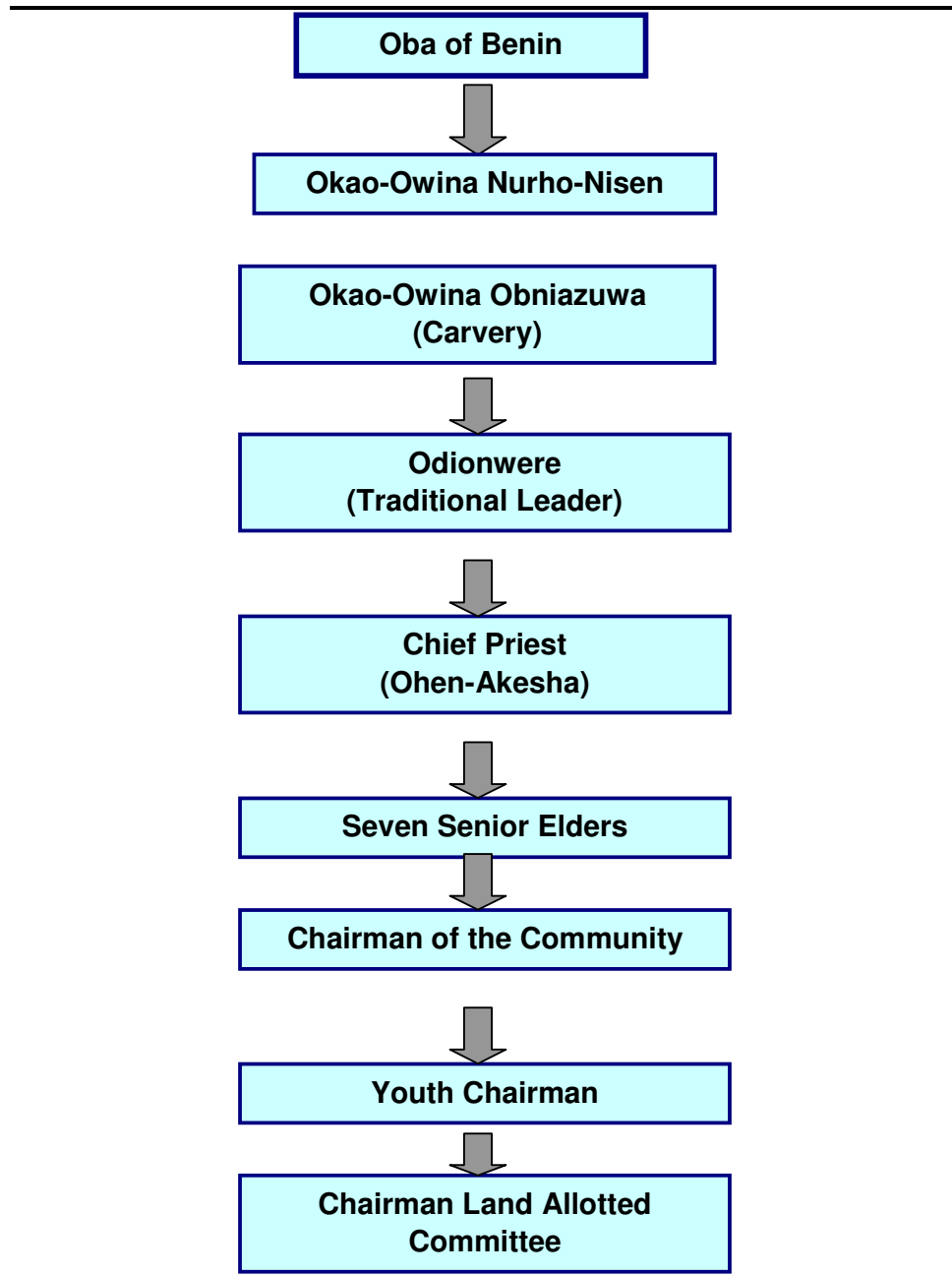
The following Figures (, *Figure 5.6*, and *Figure 5.7*) illustrate the traditional leadership structures of the three communities in the vicinity of the Project.

Idunmwowina-Urho-Nisen

According to historical accounts, Idunmwowina-Urho-Nisen was originally established by the chief carver of the Oba of Benin. Currently, the position of traditional leader in this community is vacant. The eldest carver in the community is acting as local traditional leader until the position is filled by appointment from the Oba.

Please note that the hierarchy indicated in the diagram does not indicate that someone in a certain position was "appointed" the person above them. The hierarchy reflects reporting. So in the structure below for example, the seven Senior Elders might report to the Chief Priest, but would be selected by the community rather being appointed by the Chief Priest.

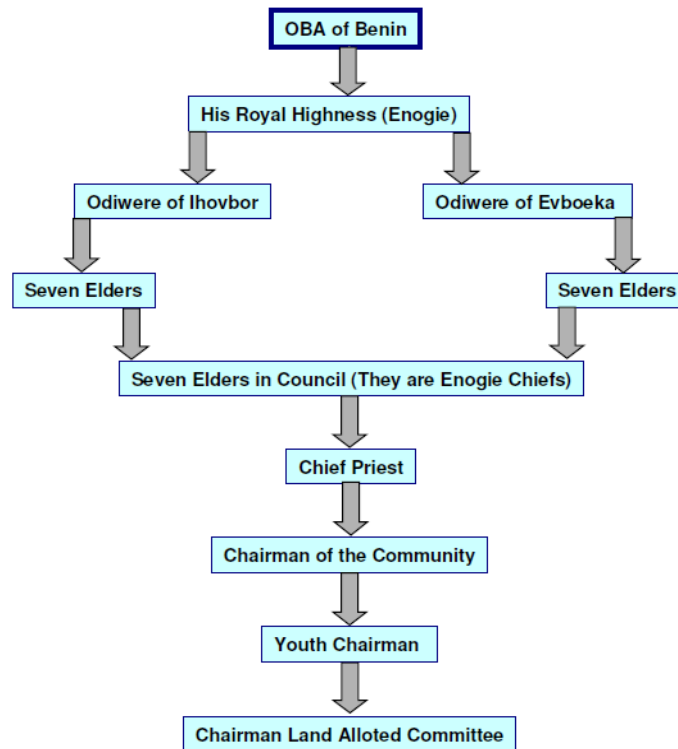
Figure 5.5 Traditional Leadership Structure of Idummwowina-Ne-Urho



Ihovbor-Evboeka

Ihovbor-Evboeka is made up of four clan groups including the Odionwere, Oshodin, Enobore and Oloha. Each of these is controlled by a traditional chief. These sit on the Elders Council with others who all report to and advise the Enogie (NIPP, 2010).

Figure 5.6 Traditional Leadership Structures Ihovbor-Evboeka

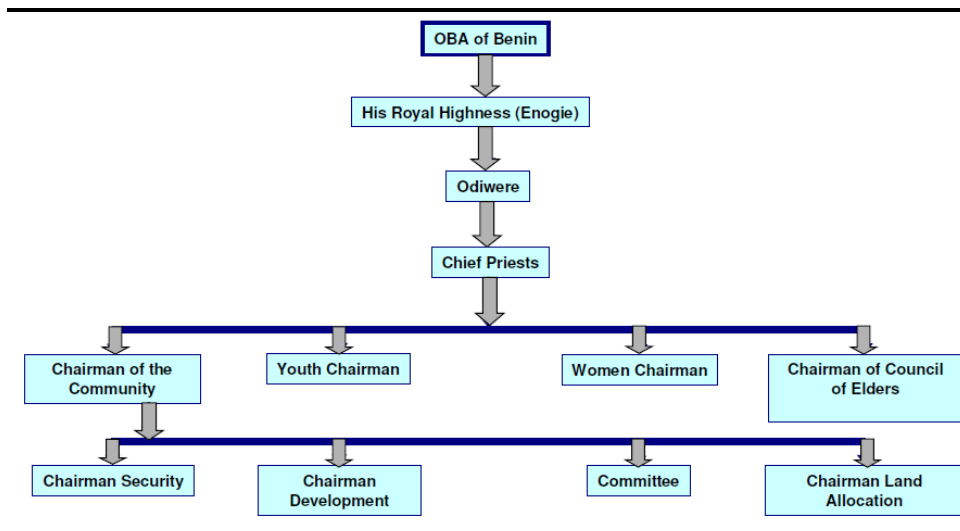


Orior-Osemwende

In Orior-Osemwende, the Enogie and his council of chiefs administer the community on a daily basis. The council of chiefs act as traditional advisors and are made up of the following clans:

- Aimogiemwinya
- Ogiesughe
- Ogieoyanevbo
- Ogiekhere.

Figure 5.7 Traditional Leadership Structure Orior-Osemwende



5.4.3 Community-based Organisations and Other Local Institutions

Community groups are an important source of social capital in Nigeria, providing social, livelihood, financial and religious support. Most communities in the country typically have a variety of associations, including livelihood-based groups, savings groups, religious groups, and other community-based organisations that play an important role in the management of the community. Most groups have open membership, and people may belong to more than one group; however, others have restricted participation, such as the Elders Forums and Traditional Cultural Groups.

Within the communities of the Project area, religious groups were most commonly reported by residents. Women and youth groups were also frequently cited. Relatively few residents belong to informal work exchange groups, which are more common in areas that have a higher proportion of farmers and food processors. Informal savings and credit groups also have a relatively low level of patronage in the communities; this may be due to the high numbers of people who are employed outside the community, in places such as Benin City, and who may belong to other associations and groups.

5.4.4 Social Conflict

The survey team has found that there is some tension between the communities at the moment, though the historical origins of the tension are unclear. All available information from the social survey regarding the social tension in the communities is included in the chapter. Furthermore previous knowledge of the historical tension of the communities is included here. It would appear that recent tension between the communities started with the government naming the NIPP power station after Ihovbor-Evboeka community alone. In addition, according to one of the local leaders, the people felt 'cheated', and will not be willing to tolerate land take for a project again without adequate compensation. Another stakeholder noted that

conflict could be a problem in the future “*if our land is acquired without compensation duly paid to the owners of the land*”.

This strained relationship was exacerbated when a notice was published by the government in the newspapers stating that the NIPP plant was located on land belonging to Ihovbor-Evboeka. On seeing this notice, the other two communities held meetings with the Ministry of Lands, Survey and Housing who then agreed to amend the state gazette and to re-publish the newspaper notice reflecting the interest of all three communities.

Dispute between Ihovbor-Evboeka and Orior Osemwede Communities

During the social survey, community members in Orior-Osemwede and Idumwowa complained that the bulk of the compensation for the land acquired for the Ihovbor-Evboeka NIPP plant had gone to Ihovbor-Evboeka alone with little going to the other two communities. It is also understood that a dispute between Orior-Osemwede and Ihovbor-Evboeka communities (over compensation payments) is in the process of being resolved in the courts.

Both Ihovbor- Evboeka and Orior Osemwede communities are ethnically the same and trace their origins to Benin Kingdom. Their peoples have intermarried over the years and coexisted without animosity for centuries. The tranquillity was broken when the Nigerian government decided to locate the NIPP power project in the area apparently without recognising the interests however small of the other two adjacent communities: Orior-Osemwede and Idumwowa.

The federal government of Nigeria has completed payment of compensation but only in respect of improvements and crops on the land. Payment was made through a legal representative as appointed by the community which was overseen by government valuers and officials of NEPA (predecessor of the NIPP). It was reported that the members of all three communities who were viewed as having an interest in the land were paid and a separate lump sum payment voluntarily made to all communities by the government.

Local communities report that employment, contracts and small supply opportunities and Corporate Social Responsibility (CSR) project considerations were given exclusively to Ihovbor-Evboeka community. During the enumeration survey dissatisfaction due to the unequal distribution of benefits was observed, however records validating distribution of compensation were not seen, as the core focus of the survey was to engage communities on the Azura-Edo IPP Project.

All respondents surveyed said that there is no deep hatred or ethnic/religious tensions between the communities apart from this. Only recently, both communities working together mutually agreed on a 50 percent sharing ratio of the compensation for the strip of land on which the NIPP waste water channel was constructed in September 2011.

Ihovbor-Evboeka community filed an action at the Abudu High Court, Edo State, in 2007 challenging Orior-Osemwede's description of the proper boundary between both communities. Orior-Osemwede alleged that it owns all the land east of the moat located just after the NIPP access road based on a decision of the Palace (Oba of Benin). The boundary dispute was referred to the Palace of the Oba of Benin in 2005 and a verdict was delivered in 2007 in Orior-Osemwede's favour. Traditionally, and under customary law, all lands in the Benin-speaking part of Edo State belonged to the Oba of Benin, and it is within the remit of the Palace to decide on the boundaries of communities under the Benin Kingdom, including Ihovbor-Evboeka and Orior-Osemwende.

The matter was heard in court in October 2011 and was adjourned until December to determine whether the Palace was a proper/necessary party to be joined in the suit and the legitimacy of the decision. These tensions between the communities will need to be carefully managed during the development of the Project going forward.

5.5 *ECONOMICS, LIVELIHOODS, AND EMPLOYMENT*

5.5.1 *Key Livelihoods*

The total Nigerian labour force is estimated to be 49.6 million people, or approximately 32 percent of the total population (World Bank, 2009). Females are estimated to represent 35 percent of the national labour force. Roughly 67 percent of males are employed, compared with 37 percent of adult females (World Bank, 2010). According to figures from 2004, an estimated 71 percent of the population of Nigeria lives below the poverty line of USD1 per day (EHO, 2010).

Agriculture is the largest economic sector nationally, employing approximately 70 percent of the labour force as of 1999. Key products include cocoa, peanuts, cotton, palm oil, rubber, maize and rice. Industry accounts for 10 percent and other services the final 20 percent (CIA World Factbook, 2011).

Agriculture is the also the dominant economic sector in Edo State. The major cash crops produced are rubber, cocoa and palm produce. In addition, the state produces such crops as yams, cassava, rice, plantains, guinea-corn, and assorted types of fruits and vegetables.

The main occupations reported in the three communities of the study area are typical of semi-urban communities in Nigeria, and include farming, trading, logging and hunting and processing of agricultural products (eg cassava). Trading may range from a small shop in front of a house to large scale buying and selling in local markets. Other common occupations include carpentry, bricklaying, and other forms of salary jobs or service provision.

There are distinct gender divisions within the economic and livelihood roles of men and women in the area. Men are generally responsible for heavy work, including cutting and clearing of trees, whereas women are more likely to tend plots of land, including harvesting of fruits and vegetables. Women are also more likely to be involved in other informal sector activities, such as small scale trading and cassava processing. There are also occasionally gender divisions among crops: for example, in Edo State, yams are viewed as a 'man's crop' and women are not allowed to plant or harvest them.

Agriculture

Agriculture is the primary livelihood activity across the study area, although it has reportedly declined somewhat due to reduced land available for cultivation. Major crops include yam, cassava, maize, plantain, banana and coco yam (NIPP, 2010). The most important plantation crops in the area are rubber and cocoa, which have both local and international markets. Melon, okra, peppers and other crops are planted in smaller quantities in gardens close to the communities.

The following table presents the seasonal calendar of agricultural activities in the area which corresponds with the four weather seasons (NIPP, 2010):

Table 5.3 *Seasonal Calendar*

Month	Season	Activity
December	Long dry season with few days of rain	Nothing on the farm. Resting period.
January		Land clearing, planting of cocoyam, weeding of cassava farm.
February		Land clearing for the raining season farm, harvesting of cassava and processing of cassava
March		Bush burning, weeding of cassava farm, planting of vegetable at the stream side, planting of yam and plantain.
April	Long wet season, with rain 20-24 days per month	Planting of cassava, corn, cocoyam, plantain and pepper, planting of yam, plantain and pineapple.
May		Weeding of farm land, harvesting of vegetables.
June		Harvesting of corn, harvesting of cassava.
July		Harvesting of corn continue, also harvesting of cassava planted the previous year.
August	Short dry season with fewer days of rain	Weeding of farm plots and selling of farm produce; planting of maize.
September	Short wet season, with as much or	Harvesting of cassava and planting of cassava.

Month	Season	Activity
October	more rain than June/ July, decreasing in	Weeding of cassava plots and harvesting of cassava.
November	frequency toward December	Harvesting of late maize.

The seasonal calendar shows that January to May are the most intensive periods of agricultural preparation while harvesting occurs between June and November. Significantly it was stated that agricultural land is commonly left fallow in December, presumably as a cultural management system to allow the land to recuperate.

Rubber and bamboo do not feature in this seasonal calendar. This may be explained by their role as cash crops which are grown in one-off single crop plantations. It should be noted that some of the native forest trees in the area that are left to remain on farmland after forests are cleared have significant value as lumber and, although not cultivated, are intermittently harvested to augment household income (NIPP, 2010).

Livestock rearing is also significant within the three communities, though primarily on a smaller scale. Many residents keep poultry, sheep, goats and some pigs for livelihood and subsistence purposes. There are a few large scale intensive livestock operations in the communities (*Figure 5.8*). These larger agricultural operations are primarily owned by wealthier residents.

Figure 5.8 *Large Scale Poultry Enterprise*



Petty Trading

According to FGDs some of the community residents in the study area engage in petty trading. These 'middle-men' purchase farm produce locally and transport it to towns where they make a profit on the goods sold. Many also sell goods obtained from the towns to the communities, also with a mark-up. There are no markets in the three communities. Residents tend to take their products to Ehor town, the LGA headquarters, on market days. Trading activities might be more significant within the Project area if not for poor roads which limit transportation. Nevertheless, stakeholders report that increased local income has benefitted local trading activities.

5.5.2 *Formal Employment*

There is minimal information available regarding formal employment in the study area. Based on observations and FGDs however, it can be assumed that the NIPP power plant is one of few formal employers (if not the only one) in the study area.

The NIPP power plant will require at least 40 employees during the operational phase, however, it is unclear to what extent these will be local employees or otherwise.

5.5.3 *Income Levels and Poverty*

During the data collection process, participants generally evaluated their socio-economic status as "poor" or "average". Stakeholders felt that poverty levels have increased over time, citing contributing factors such as reduction in farmland and shortage of formal employment opportunities. The residents of Orior-Osemwende and Idunmwowina-Urho-Nisen also complained that they had not been properly compensated for lands (belonging to their communities) which were acquired by the NIPP power plant.

The cost of living in these communities is low, compared with nearby towns; however, it varies considerably according to seasons. During the rainy season the cost of food tends to increase due to flooding on the roads and the increased cost of transporting food to markets (NIPP, 2010).

5.6 *USE OF NATURAL RESOURCES*

5.6.1 *Land Tenure and Ownership*

The 2006 census of Edo State found that 52 percent of households in the state owned their own homes, while 36 percent rented their homes (Nigerian Census, 2006). Across the state, private land ownership is most common in urban areas, where ownership is transferred through title deeds.

In rural areas, the majority of land still remains under traditional land tenure, administered through the traditional power structure. As such, all land

including the communities within the study area, belongs to the State under Nigeria's Land Use Act of 1978. However, in the Project area, usufruct allocations are normally presided over by the traditional leader (Enogie) and residents must apply to him to request land use allocations. Decisions around land allocation and use are made in consultation with the Land Allocation Committee, through the chairman of the Committee. Land may be allocated to both native and non-native (migrant) residents for farming purposes without payment, though only native males may plant oil palms or other trees. Traditionally land is allocated to a user for a period of two years, after which it is reallocated to another user.

While agricultural land can be distributed without payment, land for home construction must be purchased. Houses in the three communities are mostly constructed of mud with corrugated iron or zinc roofing.

In recent times, a number of people have begun to gain use of land through purchase or inheritance, when community land is sold off. This has created opportunities for women, who traditionally could only gain land rights through their husbands.

Aside from agricultural lands for cultivation and livestock, forest areas located around the communities are also important to some residents, who rely on them for the collection of forest products particularly firewood, rattans, and various fruits and vegetables. These are used for household consumption or are sold to traders to supplement household income.

5.7 ***INFRASTRUCTURE***

5.7.1 ***Access to Electricity***

In the study area, Orior-Osemwende does not have a supply of electricity. The other two communities have access to public electricity supply; however, this supply is erratic and nearly all residents complained about its irregularity. Part of the reason for this poor supply, according to community stakeholders, is that the transformers servicing the communities are too small, which leads to low supply and frequent cut-offs. There are no public or communally-owned generators, but a few residents have privately owned generators to provide back-up electricity.

5.7.2 ***Access to Water***

According to the World Bank, 58 percent of the national population of Nigeria had access to an improved water source in 2008. Such access was significantly better in urban areas than in rural areas (World Bank, 2010).

In Edo State, only a small percentage of households in communities outside Benin City are likely to have access to piped water. According to the 2006 state census, only five percent of households in the state have piped water within their dwellings and another nine percent have access to piped water outside

the house. Almost a quarter of households rely on river water as their primary water source (Nigerian Census, 2006).

Although private boreholes are found in each of the communities in the study area, the proportion of residents having access to this source of water is very small. Some residents have private boreholes and they may allow other residents to collect water from their compounds, though often for a fee. Most residents rely on private wells and/or the river or stream located offsite. According to feedback from stakeholders and first hand observations, there are no public wells available to the people. It is accepted within the community that all land users have rights of access over water resources on their land.

5.7.3 *Telecommunications and Transportation*

In 2010, Nigeria reported 54 airports, 38 of which have paved runways. The country's major port terminal is located in Lagos (World Bank, 2010). There are a total of 3,505 km of rail networks in the country, and 193,200 km of roadways, approximately 28,980 km of which are paved (CIA World Factbook, 2011). Data from 2007 reports that there are approximately 31 motor vehicles per 1,000 people in the country (World Bank, 2010).

The WB estimates that there were roughly 1.4 million telephone lines in Nigeria in 2009, which constituted approximately one telephone line per 1,000 people. Mobile telephone coverage is relatively well-developed in Nigeria, with 73.1 million mobile users recorded in 2009. Internet use has also grown considerably, increasing from approximately 10.0 million users in 2007 to 44.0 million users by 2009 (World Bank, 2010).

Within the study area, the communities of Ihovbor-Evboeka, Orior-Osemwende and Idunmwowina-Urho-Nisen are served by a mix of paved and unpaved roads that link them to the Lagos and Benin highway. The condition of the paved roads is good but the condition of the unpaved roads is generally considered to be 'poor'. Since commercial buses do not service the local area, transport of goods and people out of the communities is either by private car, motorcycle or bicycle.

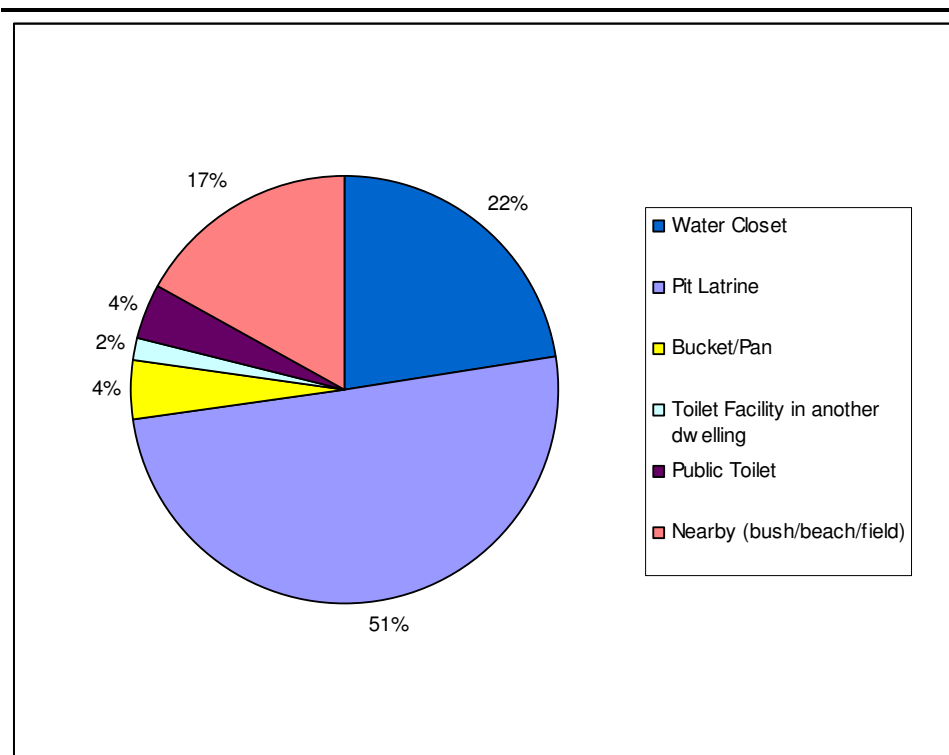
Motorcycles are mostly used by residents to get to the main express road to Benin City, particularly when the unpaved sections of the roads become impassable for cars during the rainy season. For community roads, using bicycles and walking are also common ways of getting from one place to another.

Residents in the three communities have access to mobile phones and all national networks are available in the communities. Stakeholders reported that mobile communication is affordable to most residents.

5.7.4 Waste Management

National statistics indicate that standards of sanitation are higher in Edo State than elsewhere in Nigeria. Approximately 22 percent of households in Edo State have access to a water closet (most served by an overhead tank rather than from piped water) compared with 15 percent at the national level, while 51 percent of households have access to a pit latrine (see Figure 5.9). In Orior-Osemwende, 56 percent of households have water closets in the home and 39 percent of households have access to a pit latrine.

Figure 5.9 Distribution of Households by Type of Toilet Facility, Edo State



Source: 2006 Population and Housing Census of the Federal Republic of Nigeria

According to information gathered in the study area, the three communities stated that there are several ways that they dispose of their household waste including burning their refuse or waste or dumping it in improvised landfills.

5.7.5 Access to Education

In 2009, 61 percent of Nigeria's population (aged above 15) was literate, with an even breakdown between men and women (World Bank, 2011). Net primary school enrolment in the country is 21.7 million, or roughly 60 percent, and girls make up 46 percent of the primary school student body (World Bank, 2011).

The 2006 State Census results indicate that 80 percent of men and 72 percent of women in Edo State were literate, putting the state above the national average. Approximately 18 percent of men and 25 percent of women over the age of six

have no formal schooling; while approximately 15-17 percent of both men and women have finished nursery school and the same percentage have finished primary school (Nigerian Census, 2006).

Literacy levels in the Project area are much lower than the state average, possibly because there is very little in the way of educational infrastructure in the Project area. At the time that an EIA was conducted for the Ihovbor-Evboeka Power Plant, Ihovbor-Evboeka community had no schools at all, Idunmwowina-Urho-Nisen had only a nursery school and Orior-Osemwende had a primary school. Thus children from the communities had to travel to Benin to go to secondary school.

As a result of poor educational services and access, education levels in the Project-affected communities are low. However, NIPP has constructed new school within the Ihovbor-Evboeka area through their EPC contractor. The school is currently non-functional since the handing over of the school from NIPP to local authority has not been done.

5.7.6 *Cultural Sites and Cultural Heritage*

As noted in *Section 5.3.2*, traditional religious worship is widely practiced in the Project area, often alongside other formal religions (namely Christianity and Islam). Among stakeholders in the three communities, men were more likely to report practicing traditional worship than women.

Traditional worship involves making sacrifices or offering gifts at sacred sites and shrines to traditional deities. While some of these sacred sites are located within the communities, many are located in nearby forests. These forest areas are very important to the communities and all economic activity of any sort (eg logging, hunting or the collecting of any non-timber forest products ⁽¹⁾) is expressly forbidden. The only activity that is permitted is worship of the traditional gods.

Table 5.4, Table 5.5 and Table 5.6 list the sacred sites identified within the EIA conducted for the NIPP within and around Orior-Osemwende, Ihovbor and Idunmwowina-Urho-Nisen with their location, the offerings made at these sites, when and how often such worship takes place.

Table 5.4 *Cultural Sites in Ihovbor-Evboeka*

Name of sacred site worshipped in community	Location	Materials used for worshipping	Time of year/frequency of worship
Osun-Ewuare	Forest	Goat, sheep, cow, chicken	April-May/ annually

(1) Non-Timber Forest products include forest fruit, forest vegetables, rattan canes, honey, nuts, bush meat. These are commonly collected by people and might be consumed in the household or sold in markets for cash income.

Name of sacred site worshipped in community	Location	Materials used for worshipping	Time of year/ frequency of worship
Osun-Ukokomo	Forest	Goat, sheep, cow, chicken	November/ annually
Ovia	Forest	Dog, chicken, tortoise	March/ annually
Edion	House	Goat, antelope, chicken	February/ annually
Isakpana	House	Chicken, corn	January/ annually
Edion-Ugbo	Road Junction	Male goat	June/ annually
Ake	Forest	Chicken	August/ annually
Ovator	Forest	Dog, chicken	October/ annually
Osun-Egbon	Road Junction	Male goat, chicken	December/ annually

Source: NIPP, 2010

Table 5.5 *Cultural Sites in Orior-Osemwende*

Name of sacred site worshipped in community	Location	Materials used for worshipping	Time of year/ frequency of worship
Erhinmwini Idu	Royal palace	Cow	February/ annually
Owegie	Opposite the palace	Cow	March/ annually
Edion	Opposite the palace	Pounded yam, antelope	All men, in March / annually
Ovia	Along the road	Dog, chicken, male goat.	March / annually
Osa	Priest house	Pounded yam, antelope	April/ annually

Source: NIPP, 2010

The most significant shrines in Orior – Osemwende, are the ones located opposite the Palace of Enogie and its adjoining grounds, as listed in the table above.

Table 5.6 *Cultural Sites in Idunmwowina-Urho-Nisen*

Name of sacred site worshipped in community	Location	Materials used for worshipping	Time of year/ frequency of worship
Ugbenowewe	Beside Edion shrine	Goats, dogs, tortoise	Irregular/ annually
Edion	Road junction	Goats, chicken	May/ annually
Okhuae	Before Edion shrine	Male goat, dog, chicken	September/ annually

Name of sacred site worshipped in community	Location	Materials used for worshipping	Time of year/ frequency of worship
Isakpana	Community centre	Chicken, yam, native herbs	July/ annually
Enigie	Forest	Fish, antelope, okro	May/ annually

Source: NIPP, 2010

Historically, Idunmwowina-Urho-Nisen community were the carvers and carpenters for the Oba of Benin's Palace. The three shrines/sacred sites of greatest significance to the community are:

- Egua Edion (literally meaning Elders meeting place)
- Shrine to the Guild of carvers
- The Sacred Groove – Ugbo"Ebo

Figure 5.10 Chief Kennedy Aiworo beside the Osun Iviakhure shrine, Orior



In Nigeria, the cultural significance of these sites varies depending on who uses them. While some might be significant at a national or state level and thus are well known across the state, others are important at a community level (ie the entire community worships at these), or at a family or individual level. The tables and text above list the most significant sacred sites for the communities as a whole. In the project area, these tend to be those found in the centre of the communities or close-by.

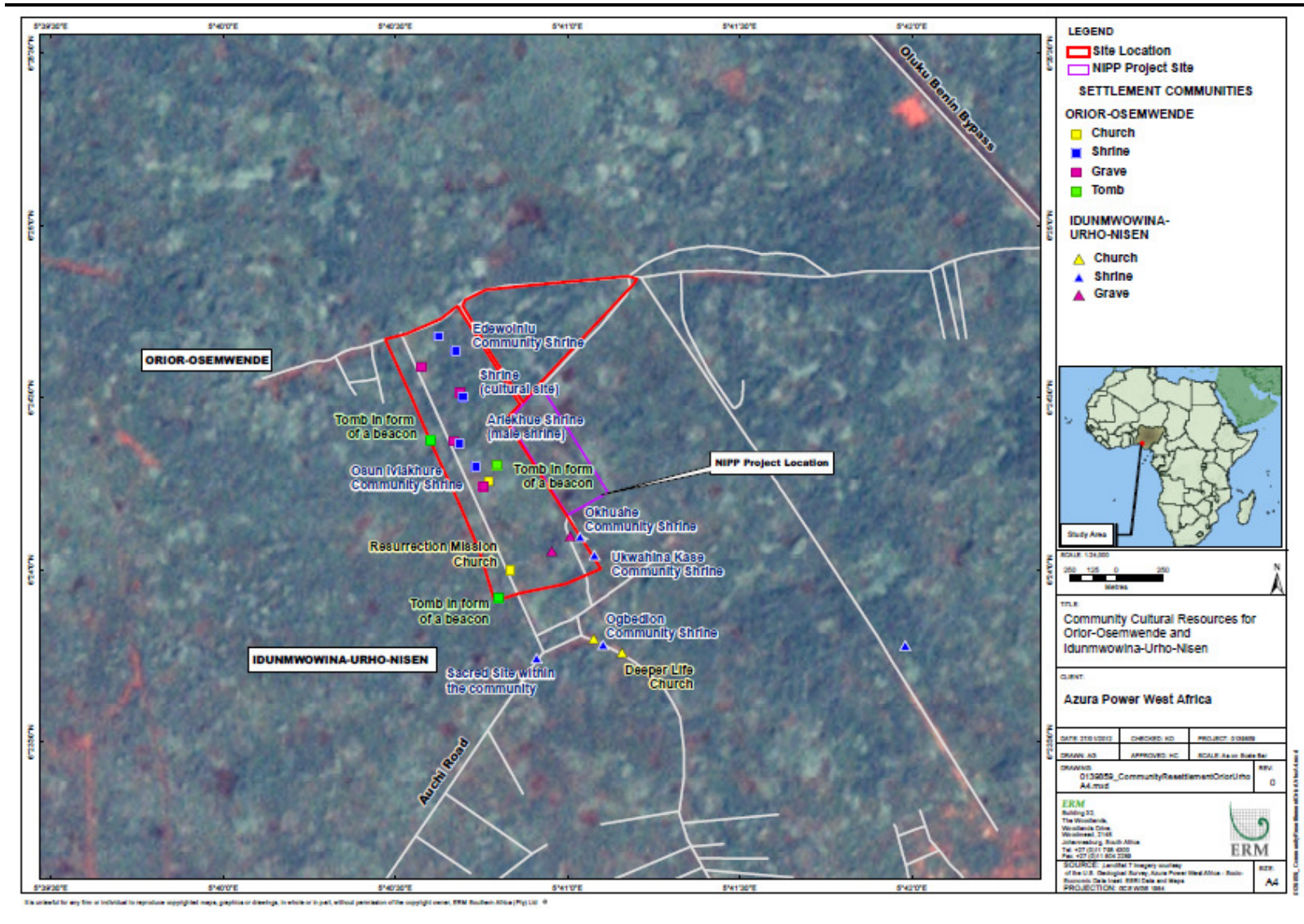
In addition to the cultural sites mentioned in the text above, there are a number of other sacred/religious sites that are found on the plot to be

acquired. *Table 5.7* below lists these sites, while *Error! Reference source not found.* overleaf is a map indicating where these sites are located on the project plot. This excludes the cultural sites located within the Ihovbor.

Table 5.7 *Cultural Sites Found within the Project Area*

Community	Type	Name	Details
Idunmwowina	Community shrine	Isapana	Further data to be collected
	Community shrine	Ogbedion	Further data to be collected
	Community shrine	Okhuahe	Under the care of Chief Jolly Omorogbe, Chief Priest of Idunmwowina community.
	Community shrine	Ukwahina Kase	Under the care of Chief Jolly Omorugbe, Chief Priest of Idunmwowina community. Community relies on shrine for worship and cleansing of the land from bad spirits.
	Sacred site	-	Further data to be collected
	Church	Deeper Life Church	Further data to be collected
Orior	Shrine (cultural site)	-	Under the care of Florence N. Omoregbe. Located on Ohenzuwa Road.
	Community shrine	Ariekhue	Male shrine under the care of Iyewui Stephen. Located on Ohenzuwa Road.
	Community shrine	Osun Iviakhure	Under the care of Chief Kennedy Aiworo, a senior priest in the Orior Community. Shrine is used for celebrations at New Yam Festivals and New Year. The community believe it provides a source of protection and connection with their ancestors.
	Community shrine	Edewoiniu	Under the care of Chief Osayende Iduriase, a senior priest. Community relies on shrine for worship of traditional gods.
	Tomb	-	Located on Ohenzuwa Road.
	Church	Misson church	Under the care of Pastor Gideon Ekuwogbe.
	Church	-	Under the care of Pastor Ikponmwosa Orhue.
Government approved traditional medical centre	-	Located on Ohenzuwa Road.	

Figure 5.11 Map showing the location of cultural sites on the Project Land



The families and priests consulted cautioned against disturbing these sacred sites unnecessarily. However they recognised that in some cases these sites were on the land required for the Project. Stakeholders said it was possible to move the sacred sites, but stressed that this must be carried out in close consultation with local religious leaders, and should involve appropriate compensation to pay for the appropriate ceremonies required.

Benin Moats

The project site is also located close to the Benin Moats or earthworks. These are the largest ancient earthworks in the world and are scattered across the state. These earthworks are a complex linear system of 16,000 km of moats and ramparts (some up to 18 m high) spread over some 6,500 square kilometres. The Benin City Walls consist of a set of inner and outer interlocking rings originally built to delineate the royal precinct of the Oba, or king, from the surrounding area. Following their construction, numerous other walls were erected in the surrounding countryside (including those around Orior-Osemwende, Ihovbor-Evboeka and Idunmwowina-Urho-Nisen) to mark the agricultural boundaries around distinct settlements. These earthworks attest the development of urbanization and rise of state societies in sub-Saharan Africa, a process that began in the seventh century A.D. and culminated in the founding of the Benin Kingdom of Bronze and Ivory in the fourteenth century.

Figure 5.12 Picture of a typical moat in the Benin area



Source: School of Conservation Sciences, Bournemouth University website

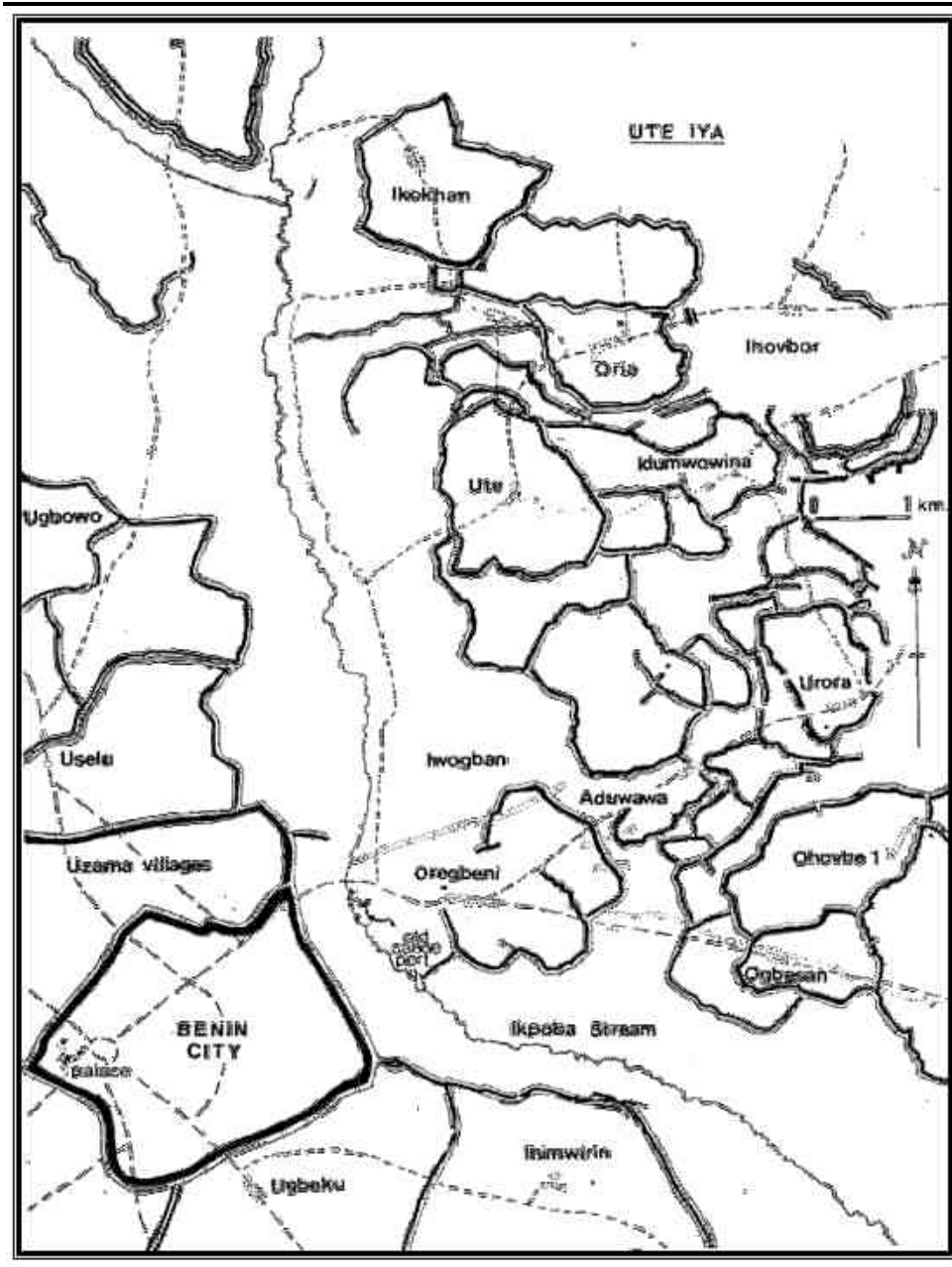
Since the walls and moats were constructed, portions of these have gradually vanished in the wake of modernization. Large segments have been cannibalized for the construction of other buildings, however, significant

stretches of the walls and moats remain. Though the walls and moats have been protected by national legislation since 1961, no conservation plan exists and it is recognised by the government that the earthworks need to be mapped and assessed, a public awareness campaign launched, and a plan for long-term management developed. The earthworks are of national and international significance and are listed on the UNESCO website as one of Nigeria's tentative World Heritage Sites. This means that Nigeria has nominated them as a tentative sites but the country has not yet submitted a formal application to UNESCO for their consideration.

In the project area, the locations of the moats are well known to the local people and also to the project since they essentially demarcate the boundaries between Idunmwowina-Urho-Nisen and Ihovbor communities. A map/diagram of the walls and moats around Benin Kingdom is attached.¹

¹ Unpublished work of the Foundation for the Protection of the Benin Heritage and Relics

Figure 5.13 Map Illustrating the Benin Kingdom Earthworks



Source: [http://whc.unesco.org/en/tentative list/488](http://whc.unesco.org/en/tentative%20list/488)

Figure 5.14 The Location of Moats Surrounding the Three Communities



Looking at the map above, one can see the three project affected communities located to the north-east of Benin City and the system of moats surrounding each one.

Physical Cultural Resources Plan

An outline of the 'Physical Culture Resource Plan (PCR)' has been developed and is attached as an Annex. A detailed PCR will be prepared by a specialist prior to the commencement of construction activity, based on this outline plan.

5.8 HEALTH PROFILE

Nigeria reportedly has high rates of infectious disease, including HIV, malaria, yellow fever, rabies, hepatitis A and E, and meningococcal meningitis (CIA Factbook, 2010). According to the World Bank, in 2009 four percent of the population (aged 15-49) were infected with HIV, with higher rates of infection for women (three percent) than for men (one percent) (World Bank, 2010).

Maternal mortality was estimated in 2008 to be 545 deaths per 100,000 live births (World Bank, 2010). The WHO reports that in 2004, there were 5.0 hospital beds per 10,000 people (WHO, 2011).

Nigeria's crude birth rate in 2009 was 40 per 1,000 people, compared to a crude death rate (DR) of 15 per 1,000 people. The total fertility rate in 2009 was 6 births per woman (World Bank, 2010).

Most of the participants in the study area expressed a view that the general health status in the area is typical of that in Edo State, which in turn is similar to the rest of Nigeria. Common illnesses mentioned included rheumatism, arthritis, malaria, fever, typhoid, cough, skin conditions, diarrhoea, pneumonia and respiratory tract infections. During FGDs participants indicated that there was no incidence of HIV and AIDS in the locality; however it is recognized that this may be inaccurate due to the social stigma associated with HIV/AIDS.

The table below lists the common diseases in the communities in the study area and their causes.

Table 5.8 *Common Diseases in the Study Area*

Diseases	Predisposing Factors
Malaria	<ul style="list-style-type: none"> • Refuse dumped in bushes and road sides provide breeding sites for mosquitoes. • Bushes that provide mosquito breeding grounds. • Stagnant water that provide mosquito breeding grounds.
Typhoid	<ul style="list-style-type: none"> • Faecal contamination of source of drinking water. • Poor sanitary conditions that contribute to faecal contamination.
Skin Conditions	<ul style="list-style-type: none"> • Poor sanitation and personal hygiene practices that contribute to the spread of infection.
Diarrhoea	<ul style="list-style-type: none"> • Poor sanitary conditions and personal hygiene practices that contribute to contamination.
Pneumonia	<ul style="list-style-type: none"> • Poor sanitation and personal hygiene practices that contribute to the spread of infection. • Inadequate clothing and poor housing that contribute to incubation.
Respiratory track infection	<ul style="list-style-type: none"> • Over crowding and poor sanitation. • Indoor air pollution.
Physical deformities (polio)	<ul style="list-style-type: none"> • Absence of immunization.

Source: NIPP, 2010

None of the communities in the study area have good primary health centres. It was found for example that there is a primary health centre in Orior-Osemwende community with two nurses but no doctor. In addition, the centre is not well equipped. Many residents interviewed said that they obtain treatment at informal medicine shops, operated by people who have no formal medical training. Alternatively, some residents seek the help of traditional

native doctors or herbalists. With serious illnesses, people have to travel to the hospitals in Benin City for treatment (NIPP, 2010)

6 *STAKEHOLDER ENGAGEMENT AND DISCLOSURE*

6.1 *BACKGROUND*

As part of the EIA and RAP, ERM compiled a Stakeholder Engagement Plan (SEP) on behalf of Azura Power, as required by Nigerian legislation. This Chapter represents a summary of the SEP and focuses on providing a description of the consultation and disclosure activities undertaken during this EIA process. In addition, the SEP also sets out the strategy for the engagement required as part of the ongoing operation of the power plant.

The SEP (*Annex A*) is a 'live' document, which was updated and adjusted as the EIA progressed and will continue to be amended as the RAP continues and project planning evolves. The SEP therefore provides a framework to facilitate and manage effective and meaningful engagement with key stakeholders.

6.2 *OBJECTIVES OF STAKEHOLDER ENGAGEMENT*

Engagement is understood to be a single or a series of inclusive and culturally appropriate interactions aimed at providing stakeholders with opportunities to express their views, so that these can be considered and incorporated into the EIA decision making process. Effective engagement requires the prior disclosure of relevant and adequate project information to enable stakeholders to understand the risks, impacts, and opportunities of the project.

The primary objectives of stakeholder engagements and disclosure are outlined below:

- ensuring that adequate and timely information is provided to identified stakeholders;
- providing sufficient opportunity to stakeholders to voice their opinions and concerns, and to ensure that these concerns influence project decisions; and
- establishing a cordial link between the proponent, Azura Power, and affected communities for the lifetime of the Project.

6.3 *STAKEHOLDER IDENTIFICATION*

For the purposes of the Project, a stakeholder is defined as any individual or group who is potentially affected by a project or who has an interest in the

project and its potential impacts⁽¹⁾. The objective of stakeholder identification is therefore to establish which organisations and individuals may be directly or indirectly affected (positively and negatively) by, or have an interest in, the project. Stakeholder identification is an ongoing process, requiring regular review and updating of the stakeholder database as the Project proceeds. The sections that follow provide an overview of stakeholder groups that have been identified to date as well as an indication of their interest in the Project.

6.3.1 *Government Authorities*

Regulatory Agencies

National and regional Government individuals are important stakeholders within the Project's engagement process, both as sources of information, and as those issuing the necessary permits for the Project. It is therefore important to engage with all appropriate regulators from an early stage and to maintain relationships with these agencies throughout the Project lifecycle. The following regulatory authorities were identified during the Scoping Phase of the EIA:

- FMEEnv, Abuja;
- The Federal Ministry of Power, Abuja;
- Nigerian Electricity Regulatory Commission (NERC), Abuja;
- The Edo State Ministry of Environment and Public Utilities (MEPU), Benin City; and
- The Department of Petroleum Resources (DPR) offices in Benin City, Edo State.

Other Local, State and National Government Agencies

The Project falls within the Unhumnwonde LGA Council, located within the Edo State Government. Azura Power engaged with the relevant council departments of the LGA and asked them to consider Project activities in the wider planning for the LGA. In addition, the following ministries within Edo State and national Government will be engaged through the Project lifecycle to ensure that they are kept informed and are given an opportunity to provide input in their respective planning areas:

- The Edo State Governor's, Benin City;
- Ministry of Environment and Public Utilities, Benin City;
- Ministry of Lands, Surveys and Housing, Benin City; and
- Ministry of Energy and Water Resources, Benin City.

(1) This is considered to be equivalent to the definition of "the public concerned" as discussed in the 2000 Implementation Guide to the Aarhus Convention (UN/ECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (see <http://www.unece.org/env/pp/acig.pdf>))

6.3.2 *Communities and Traditional Leaders*

Traditional leaders, their councils and the leaders of other social groups in the community (such as women and local farmers), health workers and teacher groups, should all be engaged on a continuous basis in a discussion of all aspects of the Project that may impact on their community, lands and other assets. Meetings with these groups will follow local practices and norms and will be held prior to any wider communication in the villages in order to respect traditional structures.

The Project-affected communities identified during the Scoping Phase were Orior-Osemwende, Ihovbor-Evboeka and Idunmwowina-Urho-Nisen (including chiefs, farmers, women, teachers, health workers and other groups). These are communities located within 1 km of the power plant site.

6.3.3 *Vulnerable Groups*

In addition, it is important to consult with groups classified by the World Bank as potentially marginalised or vulnerable. Vulnerable groups may be affected by the Project by virtue of their physical disability, social or economic standing, limited education and a lack of employment or housing. They may also have difficulty participating in the stakeholder engagement process and thus may not be able to fully express their concerns regarding the Project.

Women have been identified as a vulnerable group for the Project, due to their economic vulnerability and inability to participate in decision-making processes within the traditional context. Women in the Project area may not always be able to attend or speak freely at open meetings and/or may have household restrictions on when they are able to attend such meetings. The Project will hold women's meetings at times and places that suit the women in each community. These meetings will be led by a female member of the Project team, where possible. Where appropriate, these meetings will be organised through women-focused Community Based Organisations (CBOs).

Other potential vulnerable groups identified as part of the EIA include the elderly, youth and migrant farmers. Vulnerability of these groups is also based on reduced opportunities to participate in local decision-making, as well as their economic vulnerability, particularly with regard to employment. As such, engagement activities have been designed to ensure representation of these groups among stakeholders, and to seek to understand potential Project interactions with their livelihood opportunities and agency within the communities.

6.3.4 *Non-Governmental Organisations (NGOs)*

NGOs are organisations with direct interest in the Project and that are able to influence the project directly or through public opinion. Such organisations may also have useful data and insight and may be able to become partners to the Project in areas of common interest.

The Project identified the Nigerian Conservation Foundation (NCF) as a key stakeholder. The main mechanism for engagement with NCF and any other relevant NGOs will be through face-to-face meetings at key stages of project development (eg during the EIA and at the onset of construction).

6.4 *STAKEHOLDER ENGAGEMENT*

This section provides an overview of the stages of stakeholder engagement in the Project. The stakeholder engagement and disclosure process has been divided into four stages, each having different objectives for engagement. The key elements of each stage of the stakeholder engagement process have been outlined in the sections that follow.

6.4.1 *Stage 1: Scoping*

Stage 1 sets out the process of engagement throughout the lifecycle of the Project and involves:

- stakeholder identification and mapping; and
- initial engagement with Government authorities to inform them of the Project.

The aim of this stage is to identify issues which would inform the focus of the stakeholder engagement within the EIA Study. This stage of stakeholder engagement was completed in October 2010.

6.4.2 *Stage 2: EIA Study*

The primary objective of Stage 2, EIA Study, is to inform local stakeholders of the preliminary Project design, to understand their key concerns and expectations and for the results of consultation to be incorporated into the impact assessment and development of mitigation measures for the Project. In order to achieve this, further engagement was undertaken with the stakeholders consulted during the Scoping Phase, as well as with additional stakeholder groups. Stakeholder Engagement during this phase included the following activities:

- A series of meetings with Government departments including:
 - Edo State Ministry of Lands, Surveys and Housing (*Figure 6.4* and *Figure 6.5*);
 - MEPU (*Figure 6.6*);
 - Edo State Rural Electrification Board;
 - Edo State Ministry of Energy and Water Resources;
 - Edo State Public Private Partnership office (*Figure 6.*);
 - Unhumnwonde LGA.

- Consultation with local community leaders and groups of key stakeholders in Orior-Osemwende (*Figure 6.1*), Ihovbor-Evboeka (*Figure 6.2*) and Idunmwowina-Urho-Nisen (*Figure 6.3*) communities to provide them with an overview of the proposed Project, the EIA process, potential project impacts and to discuss likely mitigation measures. This was carried out alongside the collection of further baseline data using qualitative and consultative processes to better understand the socio-economic context of the Project area, stakeholders and their perceptions of the Project.
- Meetings and correspondence with NGOs and research institutions for the gathering of baseline information.

This stage of stakeholder engagement was completed in November 2011.

Figure 6.1 Community Engagement in Orior-Osemwende Community



Figure 6.2 *Community Engagement in Ihoṣbor-Eṣboeka Community*



Figure 6.3 *Community Consultation in Idunmwuowina-Urho-Nisen Communities*



Figure 6.4 Consultation with Minister of Land, Survey and Housing



Figure 6.5 Consultation with the Permanent Secretary for Edo State Ministry of Lands



Figure 6.6 *Consultation with the Edo State Public Private Partnership*



6.4.3 *Stage 2A: EIA Study - Training and Capacity Building for RAP*

A training workshop was organised by ERM for EIA sub-consultants and the local Government authorities during the EIA and RAP Phase (documentation is included in *Annex A*). The brief workshop aimed to:

- Discuss Project risks and the importance of stakeholder engagement as well as key 'dos and don'ts' of stakeholder engagement;
- Outline and explain the need for resettlement and a RAP;
- Define and provide an understanding of resettlement and key resettlement terms, including an overview of WB OP 4.12 and key resettlement principles;
- Provide an overview of the resettlement process and an understanding of the processes involved in a RAP;
- Carry out a comparative analysis and gap assessment between the RAP process followed by the Government and that set out by the WB OP 4.12; and
- Facilitate an understanding of eligibility and entitlement for a RAP.

The training also served as an opportunity to finalise the socio-economic baseline survey and asset valuation questionnaires. The training workshop was concluded in June 2011.

6.4.4 Stage 2B: EIA Study - Detailed Enumeration Study for RAP

Following preliminary investigations it was found that resettlement of certain communities was required and would thus require an enumeration survey. Although this enumeration survey is required for the RAP, the results of the survey were also used to augment the socio-economic study. The associated stakeholder engagement activities are described below.

The socio-economic enumeration survey was conducted 22-27 August 2011 by a team composed of four surveyors from the Ministry of Lands, Survey and Housing and the four social specialists from the University of Ibadan. The survey covered the three key communities of Ihovbor-Evboeka, Orior-Osemwende and Idunmwowina-Urho-Nisen with the aim of obtaining baseline socio-economic data, and a quantitative description of the communities surrounding the proposed Project. The survey focussed on identifying all households, graves and shrines within these three communities.

The collection of additional data on the existing land users in the area also provided an opportunity to inform the community about the Project, obtain community approval for the forthcoming asset census survey and to define cut-off date for this survey. The results of the survey are being used to plan an asset census survey, which will assess the direct economic and social impacts resulting from the proposed resettlement.

The detailed outcome of the survey will be further discussed in the RAP, which is being produced alongside the EIA. Further details of meetings held as part of the enumeration survey can be found in *Annex A*.

6.4.5 Stage 2C: Asset Census Survey for RAP

As part of the requirements for an international standard RAP, an asset census survey was carried out in the Project-affected communities of Ihovbor-Evboeka, Orior-Osemwende and Idunmwowina-Urho-Nisen. The census made use of detailed questionnaires and census forms to develop a thorough understanding of the socio-economic profile of the affected communities, including property, livelihoods, housing and income/ savings.

In addition to being used to calculate compensation as part of the RAP, the information gathered during the asset census survey will be contribute to the data used to evaluate the social baseline, impact assessment and development of management measures. The asset census survey was completed in October 2011.

Details of the asset census survey and other activities associated with the RAP are provided in *Section 7.10.1* of the impacts chapter. Further details are also provided the associated Project RAP.

6.4.6 ***Stage 3: EIA Disclosure***

As part of the formal regulatory process, FMEnv will disclose the draft EIA report for the Project and invite public comments. ERM will consult with the FMEnv regarding the disclosure process and notification to ensure it is done to World Bank standards, and to facilitate any further disclosure requirements. Public stakeholders at both the state and LGA levels will be invited to provide their input, most likely with a public hearing being conducted by the FMEnv as part of their review activities. This notification is typically done through a newspaper announcement and is currently planned to be undertaken in December 2011.

There will be simultaneous disclosure of the draft EIA report on the World Bank InfoShop website which the The FMEnv will be notified about.

6.4.7 ***Stage 4: Project Execution***

This stage involves ongoing engagement after submission of the EIA. Engagement activities will be carried out to monitor implementation and effectiveness of mitigation measures. The engagement activities will also be designed to build on positive stakeholder relationships established during the EIA and carry these forward through Project implementation and operation. The grievance mechanism as illustrated in *Section 6.6* will be implemented to be effective throughout the Project lifecycle. The mechanism will be advertised and announced to all affected stakeholders to ensure stakeholders are fully informed about how to implement the grievance procedure. Thus throughout the Project execution there will be ongoing engagement between stakeholders and Azura Power.

Stakeholder consultation activities and specific discussion areas for Stages 1 and 2 of the stakeholders engagement process are detailed in *Table 6.1* below.

Table 6.1 Stakeholder Engagement Activities to Date

Stakeholder Engagement	Engagement Activity	Stakeholders	Specific Discussion Areas	Timing
Stage 1: Scoping				
Government Authorities: National, state and local authorities whose support is needed for political and regulatory approval of the Project	• Meeting with State Government Officials	• Edo State Ministry of Energy and Water Resources.	<ul style="list-style-type: none"> • Engagement with affected communities: continuous engagement with stakeholders is needed throughout Project implementation; • Employment opportunities • Improvement in electricity supply; • Potential linkages with reduction of gas flaring in Nigeria. • Compensation for affected farmland. 	December 2010
		• Edo State Ministry of Lands, Surveys and Housing.	<ul style="list-style-type: none"> • None. The Permanent Secretary declined to comment on the Project until his Ministry has conducted a visit to the proposed Project site at Ihovbor-Evboeka. 	December 2010
		• Edo State Ministry of Environment and Public Utilities.	<ul style="list-style-type: none"> • Engagement with affected communities: continuous engagement with stakeholders is needed throughout Project implementation; • Compensation for affected farmland: Concern that a poor inventory of assets would lead to inadequate compensation of affected communities; • Risk of accidents for people living near the plant: The power plant should be built in line with the highest safety standards; and • Employment opportunities • Potential linkages with reduction of gas flaring in Nigeria. 	December 2010
	• Meeting with Local Government Officials	• Uhumwode Local Government Area Council.	<ul style="list-style-type: none"> • Engagement with affected communities; • Compensation for affected farm land; and • Potential positive impacts: employment opportunities for local people and provision of electricity to local people. 	December 2010
Stage 2: EIA Study				

Stakeholder Engagement	Engagement Activity	Stakeholders	Specific Discussion Areas	Timing
Community Engagement, engagement with local groups and traditional leaders, further engagement with Government authorities.	<ul style="list-style-type: none"> Meeting with Edo State Land Department 	<ul style="list-style-type: none"> Lands Officials; Public Private Partnership (PPP) Representatives; ERM Representatives; and Local Community Liaison Officer (CLO). 	<ul style="list-style-type: none"> Cut off date for enumeration and asset census. No legislative concept of a cut off date which can be followed by the land department; Issue of new graves and other construction activities, as compensation only given for improvements to land; Once compensation money allocated, people will go to the Enogie and pay a fee to gain permission to settle into new communities; The enumeration process is asset, not household driven, and no format exists at present for use by the land department; The acquisition process steps; and Common understanding of issues between ERM and the land department. 	27 July 2011
	<ul style="list-style-type: none"> Meeting with Edo State Ministry of Lands, Survey and Housing 	<ul style="list-style-type: none"> Government Officials; and Azura Representatives. 	<ul style="list-style-type: none"> The ministry has previously worked on projects funded by the WB and understands WB's requirements for resettlement; The ministry has no objections to working with ERM and to the standards set by the WB and suggested that the land department work with ERM on the resettlement process; The asset census form used by the Government will be shared with ERM, and ERM's census survey and social baseline will be used to achieve WB standards; Power is vested in the state and Edo State governor, who has the authority to make decisions with respect to land; and The land expropriation process; the revocation of land rights is first approved by the governor and published in the gazette. Field surveys are conducted and final compensation payments are allocated, on approval of the governor. 	27 July 2011
	<ul style="list-style-type: none"> Meeting with Edo State Ministry Office Public Private Partnership Office 	<ul style="list-style-type: none"> Government Officials; Azura Representatives; and PPP Office. 	<ul style="list-style-type: none"> Update on the EIA and RAP process; Key concerns of the ministry; and Request for support in conducting the EIA and RAP process. 	27 May 2011
		<ul style="list-style-type: none"> Local Councillors; Local People; and Azura Representatives. 	<ul style="list-style-type: none"> Enogies are the traditional leaders of the communities; Institutional clarity between the LGA and Councillors and traditional leadership; and The need for a grievance mechanism throughout the Project. 	27 July 2011

Stakeholder Engagement	Engagement Activity	Stakeholders	Specific Discussion Areas	Timing
Engagement with NGO sector	<ul style="list-style-type: none"> Meeting with Nigerian Conservation Foundation (NCF) 	<ul style="list-style-type: none"> NGO representatives 	<ul style="list-style-type: none"> Confirming that there are no protected areas within the Project site; Proximity of the Project to the Sokka pipeline; Implementation and monitoring within the operational phase; Need for detailed mapping; Concerns over erosion; Need to community engagement, especially regarding bush fires close to the pipeline; and Including the technical specifications for the gas pipeline. 	November 2011
Stage 2A Resettlement Action Plan	<ul style="list-style-type: none"> Training for local Government officials 	<ul style="list-style-type: none"> Officials from the Ministry of Land and Surveys. 	<ul style="list-style-type: none"> Key Project risks; Criteria around resettlement, including WB standards and process; Procedures for stakeholder engagement; and Eligibility and entitlement for compensation as part of the RAP. 	June 2011
	<ul style="list-style-type: none"> Detailed Enumeration Study for RAP 	<ul style="list-style-type: none"> Communities of Orior-Osemwende, Ihovbor-Evboeka and Idunmwowina-Urho-Nisen. 	<ul style="list-style-type: none"> Collection of socio-economic baseline data; Enumeration of physical and cultural community resources; Description of Project and EIA; Upcoming asset census survey; and Cut-off date for census survey. 	August 2011
	<ul style="list-style-type: none"> Asset Census Survey for RAP 	<ul style="list-style-type: none"> Communities of Orior-Osemwende, Ihovbor-Evboeka and Idunmwowina-Urho-Nisen. 	<ul style="list-style-type: none"> Household and community socio-economic conditions; Enumeration and valuation of household assets; Enumeration and valuation of land and livelihood assets; and Public perceptions of the Project 	October 2011

6.5 *KEY ISSUES RAISED*

This section provides an overview of the key issues raised by stakeholders during Stage 1 and Stage 2 of the stakeholder engagement process. Issues that are raised during the consultation process will continuously be registered in order to monitor and manage stakeholder concerns with the Project.

6.5.1 *Level of Stakeholder Engagement and Engagement Activities*

Project stakeholders have requested that ongoing stakeholder engagement be undertaken throughout the Project lifecycle and that the engagement activities involve accredited members of the executive council and chiefs of the community. Stakeholder engagement activities must also take into consideration the traditions and customs of stakeholders, in particular, showing respect to the community leader and chiefs.

There is uncertainty among the stakeholders with respect to the frequency of engagement activities and who is responsible for undertaking these activities.

The Edo State Government issued a formal public notice of the Government's intention to make use of the land, revoking all existing rights and interests in the land and requesting affected parties to register any claims. The formal notice of revocation was published in the official Government Gazette on 16 June 2011 and in two Nigerian newspapers on 23 June 2011, namely the Vanguard Newspaper (with a national circulation) and the Observer Newspaper (with a local circulation).

The communities claim that the communities of Orior-Osemwende and Idunmwowina-Urho-Nisen were omitted from the revocation of right of occupancy and compensation notice issued by the Government in public newspapers. The two communities filed a formal complaint and refused to participate in further stakeholder engagement until a correction had been published. The communities have requested that a post-survey meeting is held with all three communities and representatives from the Government and the Project, to discuss what lands will be contributed from each of the communities. The surveys were completed during early October 2011 and Azura Power will arrange a meeting between all parties during November.

6.5.2 *Compensation*

There is a concern that a poor inventory of assets would lead to inadequate compensation of affected communities. For the Azura-Edo IPP compensation of communities will be made by the Edo State Government according to the provisions of Nigerian law. Azura Power will be responsible for meeting the compensatory terms and additional requirements of the World Bank.

6.5.3 *NIPP related Community Issues*

During the last NIPP development (the Ihovbor-Evboeka Power Station), the communities of Orior-Osemwende and Idunmwowina-Urho-Nisen stated that compensation was unfairly distributed. Although all three communities gave up land, the project was named for the community of Ihovbor-Evboeka, which is perceived to have benefited from the associated opportunities (employment, contracts and infrastructure development). These two communities during the stakeholder consultation have repeatedly stated that they do not want to see a repetition of these issues for this Project.

6.5.4 *Social Infrastructure*

There is general concern regarding the provision of basic social infrastructure and amenities such as schools, hospitals and potable water supply.

6.5.5 *Health and Safety*

There is a fear of 'heat' from buried gas pipelines to nearby communities. Further to this, there is concern about the potential risk of accidents for people living near the plant and pipeline (eg from bush fires). Therefore, the stakeholders request that the power plant and pipeline spur must be built in line with the highest safety standards.

To the extent possible, the Project should create the minimum disruption to communities by adopting measures to mitigate any adverse impacts. In addition, all road traffic regulations and speed limits should be obeyed to prevent accidents, loss of life and property, throughout the different stages of the Project.

6.5.6 *Employment*

There are expectations that the Project will provide employment opportunities for the local community and it must be ensured that preferential employment is given to the people who are likely to lose their land.

6.5.7 *Provision of Electricity*

The results of the consultations with the communities indicated that there is a high expectation of the Project improving access to electricity in the area.

6.5.8 *Reduction of Gas Flaring*

The Project stakeholders also wish for a reduction of gas flaring. It is, however, not anticipated that the Project will use recovered associated gas that would otherwise be flared. Gas for the power station will be obtained through the ELPS.

Grievances are complaints or comments concerning the way a project is being implemented. A grievance mechanism provides a formal and ongoing avenue for stakeholders to engage with the company, whilst the monitoring of grievances provides signals of any escalating conflicts or disputes. Identifying and responding to grievances supports the development of positive relationships between the Project proponent and the communities, and other stakeholders. An effective grievance management process should include the components described in *Box 6.1* below.

Box 6.1 *Key Components of an Effective Grievance Mechanism*

Simple Process: It should be convenient to submit complaints. There should be several, appropriate channels through which community stakeholders can submit complaints free of charge.

Simple Internal Procedure: A simple and consistent procedure is required to record grievances, identify those responsible for addressing them and ensure that they are resolved.

Staff Arrangements: Roles and responsibilities in the grievance management process need to be defined and agreed.

Training: The launch or modification of the grievance management process should include internal induction and/or training for operational staff and a Community Liaison Officer.

A Set Timeframe: The grievance process should set a timeframe within which complainants can expect acknowledgement of receipt of grievance and a response and/or resolution of grievance.

Sign Off: Actions planned to resolve grievances considered to be of significant concern by the Grievance Officer should be signed-off by a member of the senior management, suitably qualified to assess the effectiveness of the response.

System of Response: A clear system of response is required to identify who should respond to the complainant and how.

Monitoring Effectiveness: Mechanisms should be set in place for monitoring the effectiveness with which complaints are being recorded and resolved.

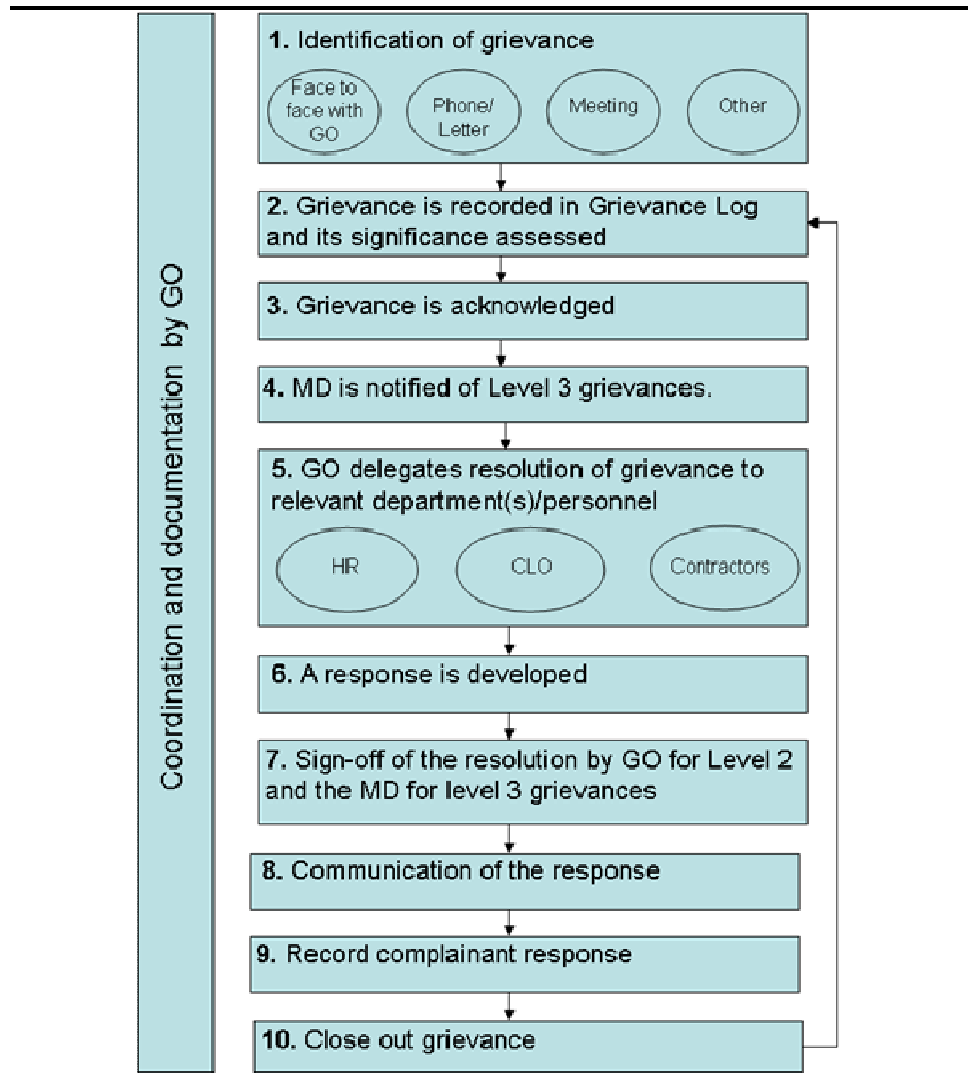
Source: ERM, 2011

6.6.1 *Process for Managing Grievances*

The grievance mechanism will be advertised and announced to affected stakeholders parties so that they are aware of their rights to submit comments, the mechanism of the grievance process and how their grievance will be addressed.

The grievance process is summarised in *Figure 6.7*. Currently it is anticipated that Azura Power will employ a CLO who will serve to meet all community liaison responsibilities, in addition to the implementation and operation of the grievance mechanism, thus fulfilling both the role of Grievance Officer and CLO outlines in *Figure 6.7*.

Figure 6.7 Grievance Process



Please note: Grievance Officer (GO), Human Resources (HR), Community Liaison Officer (CLO) and Managing Director (MD).

Source: Azura Edo ESIA Stakeholder Engagement Plan (August 2011)

6.7 PROCESS OF MANAGING GRIEVANCE DURING THE ESIA AND RAP IMPLEMENTATION

Both OP 4.12 and PS 5 require that projects implement a Grievance Mechanism in order to accommodate any grievances, complaints or other concerns that stakeholders may have throughout the operational phase as well as for the resettlement process. An effective grievance mechanism is fundamental to facilitating an effective and sensitive resettlement process, and

to ensure that projects can proceed on schedule, without delays induced by community disputes.

Details of the grievance mechanism (currently being implemented) is provided as part of the Stakeholder Engagement Plan compiled as part of the RAP (see *Annex A*).

In the resettlement context, it is also important to note that the Community Liaison Officer (CLO) referred to above will also have an important role in the implementation of the grievance mechanism. The Azura CLO will report to the Azura Project Manager who has already been working on site for just over one year.

The CLO will be responsible for:

- liaising with both the affected people and the host community;
- recording grievances, both written and oral, of the affected people, categorising and prioritising them, and providing solutions within an agreed timeframe;
- discussing the grievances on a regular basis with the Project Resettlement Unit and identifying decisions and actions for issues that can be resolved at that level; and
- reporting to the aggrieved parties about the developments regarding their grievances and the decisions of the Resettlement Steering Committee and PRU.

6.8 *RESOURCES AND RESPONSIBILITIES*

ERM has composed a core social team of ERM and local Nigerian subconsultants (University of Ibadan) for all stakeholder engagement activities. This team is led by a qualified social scientist and overseen by a lead social specialist and overall Partner in Charge.

In-field engagement activities for the EIA were conducted by a team of local Nigerian specialists, headed by a social expert Professor Janice Olawoye. ERM's local consultants have the required skills to undertake engagement activities with potentially affected communities and carry out other social/socio-economic data collection surveys.

6.9 *MONITORING AND REPORTING OF STAKEHOLDER ENGAGEMENT ACTIVITIES*

Azura Power will develop a stakeholder engagement database, which will be used to store, analyse and report stakeholder engagement activities. The database has been populated with information derived through engagement

meetings with government stakeholders, communities and NGOs, data collected by Azura Power through the EIA, as well as the experience and knowledge of the social consulting team fielding Nigeria. The list of stakeholder groups will be continually revised and updated as additional stakeholders are identified through the life of the Project.

Records of all engagement activities (minutes and lists of attendees) will be kept on file so that they can be referred to by the Project team for consideration, to identify any trends in grievances, and to design necessary corrective actions.

7.1 INTRODUCTION

This chapter provides an assessment of potential environmental and socio-economic impacts from the proposed OCGT power plant facility and associated infrastructure. The impacts for the short-term construction phase and the long-term operational phase have been considered as well as impacts associated with the decommissioning phase, which are considered to be similar to the construction phase.

A description of the assessment methodology used to assess the significance of impacts, taking into account impact magnitude and sensitivity of receptors and resources affected, is provided below. Mitigation measures that Azura Power has agreed to implement to avoid, reduce, remediate or compensate for potential negative impacts and actions to be taken to enhance benefits are also provided in *Chapter 8*. Cumulative impacts of the Project are assessed in *Chapter 9*.

The impacts that remain following implementation of mitigation measures (called residual impacts) are then assessed. An impact assessment summary table is provided at the end of the chapter. All the mitigation measures identified in this chapter have been collated into the Environmental and Social Management Plan (ESMP) presented in *Chapter 10*.

7.1.1 Project and Associated Activities

The following activities are associated with the construction, operation and decommissioning of the Project:

Construction

- Awarding of the contract;
- Surveying of the site;
- Site clearing;
- Construction of access roads;
- Assembly of heavy machinery and equipment;
- Bulldozing, grading and compaction of soil;
- Disposal of vegetation and excavation spoils;
- Soil excavation; and
- Borehole drilling and completion.

Operation

- Operation of equipment and plant;
- Drawing of borehole water for use within the process;
- Routine maintenance of equipment and plant; and

- Security of facilities.

Decommissioning

- Tender process and awarding of contract for decommissioning and demolition;
- Removal and disposal of hazardous materials;
- Disassembling equipment and plant;
- Removal of piping, cabling, storage facilities and reusable components;
- Demolition of buildings and breaking up for removal; and
- Site leveling and filling.

7.1.2 *Biophysical and Socio-economic Indicators*

The primary biophysical indicators for this impact assessment are the following:

- Climate and meteorology;
- Air quality;
- Noise levels;
- Groundwater;
- Geology and geomorphology;
- Soils and soil erosion;
- Drainage patterns and flooding;
- Unique physical features; and
- Vegetation including economic trees and crops.

The primary socio-economic indicators for this impact assessment are the following:

- Land use;
- Employment and income;
- Community population and ethnicity;
- Community relations; and
- Services (eg water and electricity supply).

7.2 *ASSESSMENT METHODOLOGY*

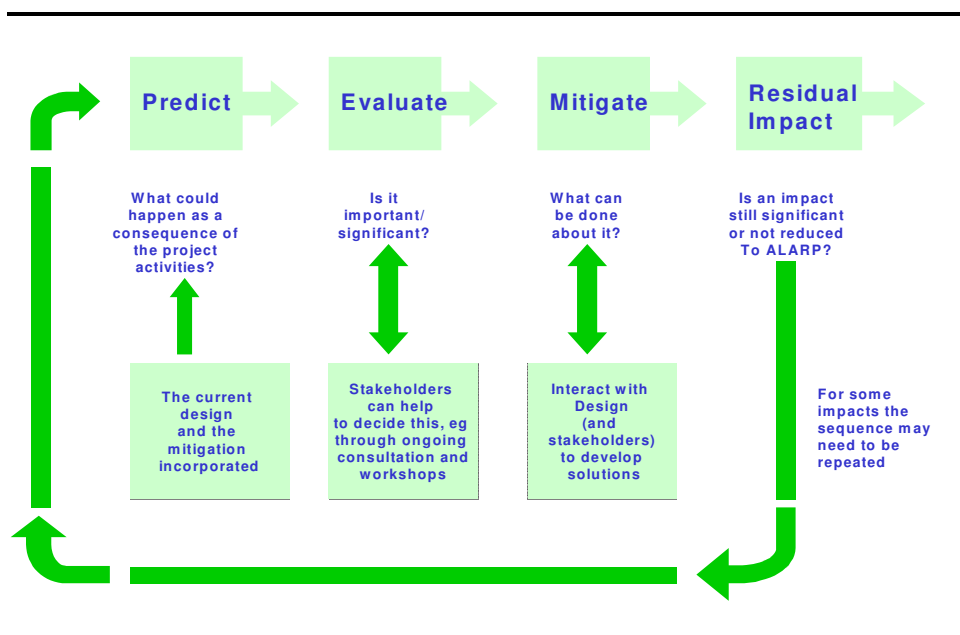
This section describes the overall approach used for the assessment of impacts and the identification of mitigation options. Topic-specific methodologies are described in the introductory part of each section of the impact assessment. In general, the assessment of impacts has proceeded through an iterative process considering four key elements (*Figure 7.1*).

1. Prediction of potential impacts and their magnitude ie the consequences of the proposals on the natural and social environment.

2. Evaluation of the importance (or significance) of impacts taking the sensitivity of the environmental resources of human receptors into account.
3. Development of mitigation measures to avoid, reduce or manage the impacts
4. Assessment of residual significant impacts after the application of mitigation measures.

Where significant residual impacts remain, further options for mitigation may be considered and impacts re-assessed until they are as low as reasonably practicable for the project.

Figure 7.1 Prediction, Evaluation and Mitigation of Impacts



7.2.1 Defining Impacts

There are a number of ways that impacts may be described and quantified. The definitions adopted for this EIA are described in *Box 7.1* below.

Box 7.1 Definitions of Impacts

1. Nature of Impact:

An impact is essentially any change to a resource or receptor brought about by the presence of a project component or by the execution of a project related activity.

Negative – an impact that is considered to represent an adverse change from the baseline or to introduce a new undesirable factor.

Positive – an impact that is considered to represent an improvement to the baseline or to introduce a new desirable factor.

2. Type of Impact:

Direct (or primary) – impacts that result from the direct interaction between a planned project activity and the receiving environment (eg between stack emissions and the ambient air quality).

Secondary – impacts that result from the primary interaction between the Project and its environment as a result of subsequent interactions within the environment.

Indirect – impacts that result from other activities that are encouraged to happen as a consequence of the Project.

3. Temporal Scale of Impact:

Temporary - impacts are predicted to be of short duration, reversible and intermittent/occasional in nature. The receptor will return to a previous state when the impact ceases or after a period of recovery.

Short-term - impacts that are predicted to last only for a limited period (ie during construction) but will cease on completion of the activity, or as a result of mitigation measures and natural recovery (eg non local construction workforce-local community interactions).

Long-term - Impacts that will continue for the life of the project, but cease when the project stops operating (ie 20 years) . These will include impacts that may be intermittent or repeated rather than continuous if they occur over an extended time period.

Permanent - impacts that occur during the development of the Project and cause a permanent change in the affected receptor or resource that endures substantially beyond the Project lifetime.

Continuous – impacts that occur continuously or frequently during the life of the phase of the Project.

4 Spatial Scale of Impact:

On-site – impacts that are limited to the Project site.

Local - impacts that affect locally important environmental resources or are restricted to a single (local) administrative area or a single community. For this EIA, *local* impacts are restricted to the Project site and adjacent areas.

Regional - impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries (ie Edo State).

National - impacts that affect nationally important environmental resources; affect an area that is nationally important/protected; or have macro-economic consequences (ie Nigeria).

International - impacts that affect internationally important resources such as areas protected by International Conventions.

Trans-boundary - impacts that are experienced in one country as a result of activities in another.

4 Probability:

Unlikely – unlikely to occur

Likely – likely to occur under most conditions

Definite – will occur

In addition to predicted impacts, those impacts that could result in the event of an accident or unplanned event within the Project (eg traffic accident, fire) are required to be taken into account. In these cases, the probability of the event occurring needs to be considered. The probability is defined as low (impact is unlikely to occur), medium (impact may occur infrequently) and high (impact may occur frequently).

7.2.2 *Assessment of Significance*

There is no statutory definition of ‘significance’ and its determination is therefore necessarily partially subjective. For the purposes of this EIA, the following definition of significance has been adopted:

“An impact is significant if, in isolation or in combination with other impacts, it should, in the judgment of the EIA team, be taken into account in the decision-making process, including the identification of mitigation measures (by the Project) and consenting conditions (from Regulators and Stakeholders).”

Criteria for assessing the significance of impacts stem from the following key elements:

- Status of compliance with relevant Nigerian legislation, policies and plans and any relevant Nigerian or industry policies, standards or guidelines;
- The magnitude (including nature, scale and duration) of the change to the natural or socio-economic environment (eg an increase in noise, an increase in employment opportunities), expressed, wherever practicable, in quantitative terms. The magnitude of all impacts is viewed from the perspective of those affected by taking into account the likely perceived importance as understood through stakeholder engagement;
- The nature and sensitivity of the impact receptor (physical, biological, or human). Where the receptor is physical, the assessment considers the quality, sensitivity to change and importance of the receptor. For a human receptor, the sensitivity of the household, community or wider societal group is considered along with their ability to adapt to and manage the effects of the impact; ⁽¹⁾ and
- The likelihood (probability) that the identified impact will occur. This is estimated based upon experience and/or evidence that such an outcome has previously occurred.

(1) Although not directly relevant to this assessment, in cases where the receptors were biological, its importance (eg its local, regional, national or international importance) and its sensitivity to the impact would have been considered.

For this assessment, significance has been defined based on five levels described in *Box 7.2*, and application of the latter three is shown in *Table 7.1* for environmental impacts.

Box 7.2 *Categories of Significance*

<p><i>Positive impacts</i> provide resources or receptors, most often people, with positive benefits. It is noted that concepts of equity need to be considered in assessing the overall positive nature of some impacts such as economic benefits, or opportunities for employment.</p>
<p><i>Negligible impacts (or Insignificant impacts)</i> are where a resource or receptor (including people) will not be affected in any way by a particular activity or the predicted effect is deemed to be 'negligible' or 'imperceptible' or is indistinguishable from natural background variations.</p>
<p><i>An impact of minor significance ('Minor impact')</i> is one where an effect will be experienced, but the impact magnitude is sufficiently small (with or without mitigation) and well within accepted standards, and/or the receptor is of low sensitivity/value.</p>
<p><i>An impact of moderate significance ('Moderate impact')</i> is one within accepted limits and standards. Moderate impacts may cover a broad range, from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly to design an activity so that its effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is ALARP. This does not necessarily mean that 'Moderate' impacts have to be reduced to 'Minor' impacts, but that moderate impacts are being managed effectively and efficiently.</p>
<p><i>An impact of major significance ('Major impact')</i> is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of EIA is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (ie ALARP has been applied). It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones such as employment, in coming to a decision on the Project.</p>

Table 7.1 *Overall Significance Criteria for Environmental Impacts in the EIA*

	Low Magnitude Impact	Moderate Magnitude Impact	High Magnitude Impact
Low value / low sensitivity receptor or resource, within standards	Minor	Minor	Moderate
Moderate value / sensitivity receptor or resource, within standards	Minor	Moderate	Major
High value / sensitivity receptor or resource, exceeding standards	Moderate	Major	Major

Significance for Socio-economic Impacts

For social impact assessment, the perceptions of stakeholders, expressed as opinions around certain issues, can be as important as actual impacts. Consequently, the concept of perception is explicitly brought into the evaluation of significance after an impact is evaluated. When an impact is of significant stakeholder concern, this may be cause to raise the significance rating. This prompts the formulation of more rigorous and appropriate mitigation measures which focus on the source of the impact and also address stakeholder perceptions. The risk of not addressing stakeholder perceptions is that reputational damage could arise, resulting in the loss of a 'social licence to operate'.

7.2.3 *Predicting the Magnitude of Impacts*

The impact assessment describes what will happen by predicting the magnitude of impacts and quantifying these to the extent practical. The term 'magnitude' covers all the dimensions of the predicted impact to the natural and social environment including:

- the nature of the change (what resource or receptor is affected and how);
- the spatial extent of the area impacted or proportion of the population or community affected;
- its temporal extent (ie duration, frequency, reversibility); and
- where relevant (accidental or unplanned events), the probability of the impact occurring.

For biophysical impacts, the definitions for the spatial and temporal dimension of the magnitude of impacts used in this assessment are provided in *Box 7.1*.

For social impacts, the magnitude considers the perspective of those affected by taking into account the likely perceived importance of the impact, the ability of people to manage and adapt to change and the extent to which a human receptor gains or loses access to, or control over socio-economic resources ⁽¹⁾ resulting in a positive or negative effect on their well-being ⁽²⁾. For impacts on ecological resources, the criteria used to assess the magnitude of impacts are presented in *Box 7.3* (based on Duinker and Beanlands, 1986).

Box 7.3 *Magnitude Criteria for Ecological Impacts*

A **High Magnitude Impact** affects an entire population or species at sufficient magnitude to cause a decline in abundance and/or change in distribution beyond which natural recruitment (reproduction, immigration from unaffected areas) would not return that population or species, or any population or species dependent upon it, to its former level within several generations*. A high magnitude impact may also adversely affect the integrity of a site, habitat or ecosystem.

(1) Socio-economic resources in this context refers to natural, physical, social and financial capital (stock of resources)

(2) A concept combining an individual's health, prosperity, their quality of life, and their satisfaction.

A **Moderate Magnitude Impact** affects a portion of a population and may bring about a change in abundance and/or distribution over one or more generations*, but does not threaten the integrity of that population or any population dependent on it. A moderate magnitude impact may also affect the ecological functioning of a site, habitat or ecosystem but without adversely affecting its overall integrity. The area affected is also important.

A **Low Magnitude Impact** affects a specific group of localised individuals within a population over a short time period (one generation* or less) but does not affect other trophic levels or the population itself.

* These are generations of the animal / plant species under consideration not human generations. It should be noted that the restoration potential of an affected habitat also needs to be considered in applying the above criteria.

The assessment of impact magnitude needs to consider each of these factors. It is important to acknowledge that the scale of magnitude (from small to large) is in practice a continuum, and evaluation along the spectrum requires the exercise of careful professional judgement and experience. Each impact is evaluated on a case by case basis, and the rationale is explicitly described in the analysis of each impact.

7.2.4 *Sensitivity of Resources and Receptors*

The significance of an impact of a given magnitude will depend on the sensitivity of resources and receptors to that impact. For ecological impacts, sensitivity can be assigned as low, medium or high based on the conservation importance of habitats and species. For habitats, these are based on naturalness, extent, rarity, fragility, diversity and importance as a community resource.

For the sensitivity of individual species, *Table 7.2* presents the criteria for deciding on the value or sensitivity of individual species⁽¹⁾. This approach follows the guidelines produced by the Energy and Biodiversity Initiative (EBI) (2003)⁽²⁾.

(1) The above criteria should be applied with a degree of caution. Seasonal variations and species lifecycle stage should be taken into account when considering species sensitivity. For example, a population might be deemed as more sensitive during the breeding/spawning and nursery periods.

(2) Energy & Biodiversity Initiative, Integrating Biodiversity into Oil & Gas Development, 2003 - A framework formed by several leading oil and gas companies working alongside conservation organisations to form a partnership designed to produce practical guidelines, tools and models to improve the environmental performance of energy operations, reduce harm to biodiversity, and maximise opportunities for conservation wherever oil and gas resources are developed.

Table 7.2 Species Value / Sensitivity Criteria

Value / Sensitivity	Low	Medium	High
Criteria	Not protected or listed and common / abundant; or not critical to other ecosystem functions (eg key prey species to other species).	Not protected or listed but: a species common globally but rare in Nigeria; important to ecosystem functions; or under threat or population decline.	Specifically protected under Nigerian legislation and/or international conventions eg CITES ⁽¹⁾ . Listed as rare, threatened or endangered eg IUCN

For socio-economic impacts, the degree of sensitivity of a receptor is defined as ‘a stakeholder’s (or groups of stakeholders’) resilience or capacity to cope with sudden changes or economic shocks’. The sensitivity of a resource is based on its quality and value/importance, for example, by its local, regional, national or international designation, its importance to the local or wider community, or its economic value (Table 7.3).

Stakeholders may be more sensitive for a variety of reasons and for the purpose of this scheme the following factors have been considered:

- age, gender, race or religion;
- land rights and ownership patterns;
- income/employment/unemployment;
- livelihood (current and extent of livelihood alternatives);
- services, e.g. health, amenities (quality and access);
- access to, and use of, natural resources including water;
- food security and reliance on subsistence farming;
- education/skills;
- health or disability;
- support networks; and
- exclusion or marginalisation (e.g. degree of access to resources, services and formalised rights).

The groups which have been identified as being potentially sensitive in Edo State, Nigeria drawing on the above criteria include unemployed youth, female headed households and the elderly. In addition to these groups, those who will be affected by involuntary resettlement as a consequence of the Project will also experience a higher level of impacts.

(1) Convention on International Trade in Endangered Species of Wild Fauna and Flora

Table 7.3 Socio-economic and Health Sensitivity Criteria

Sensitivity	Low	Medium	High
Criteria	Those affected able to adapt with relative ease and maintain pre-impact status	Able to adapt with some difficulty and maintain pre-impact status but only with a degree of support	Those affected will not be able to adapt to changes and continue to maintain-pre impact status

7.2.5 Mitigation Measures

One of the key objectives of an EIA is to identify and define socially, environmentally and technically acceptable and cost effective mitigation measures. These should avoid unnecessary damage to the environment; safeguard valued or finite resources, natural areas, habitats and ecosystems; and protect humans and their associated social environments.

Mitigation measures are developed to avoid, reduce, remedy or compensate for any negative impacts identified, and to create or enhance positive impacts such as environmental and social benefits. In this context, the term “mitigation measures” includes operational controls as well as management actions. These measures are often established through industry standards and may include:

- changes to the design of the project during the design process (eg changing the development approach);
- engineering controls and other physical measures applied (eg waste water treatment facilities);
- operational plans and procedures (eg waste management plans); and
- the provision of like-for-like replacement, restoration or compensation.

For impacts that are assessed to be of *Major* significance, a change in design is usually required to avoid or reduce these. For impacts assessed to be of *Moderate* significance, specific mitigation measures such as engineering controls are usually required to reduce these impacts to ALARP levels. This approach takes into account the technical and financial feasibility of mitigation measures. Impacts assessed to be of *Minor* significance are usually managed through good industry practice, operational plans and procedures.

In developing mitigation measures, the first focus is on measures that will prevent or minimise impacts through the design and management of the Project rather than on reinstatement and compensation measures. A ‘hierarchy’ of mitigation measures for planned activities and unplanned events is outlined in *Box 7.4* and *Box 7.5*.

Box 7.4 *Mitigation Hierarchy for Planned Activities*

Avoid at Source; Reduce at Source: avoiding or reducing at source through the design of the Project (eg avoiding by siting or re-routing activity away from sensitive areas or reducing by restricting the working area or changing the time of the activity).

Abate on Site: add something to the design to abate the impact (eg pollution control equipment).

Abate at Receptor: if an impact cannot be abated on-site then control measures can be implemented off-site (eg traffic measures).

Repair or Remedy: some impacts involve unavoidable damage to a resource (eg material storage areas) and these impacts require repair, restoration and reinstatement measures.

Compensate in Kind; Compensate Through Other Means where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate (eg financial compensation for degrading agricultural land and impacting crop yields). It is emphasised that compensation to individuals with residual impacts to livelihood or quality of life will generally be non financial and will have a focus on restoring livelihoods.

Box 7.5 *Mitigation Hierarchy for Unplanned Events*

Control: this aims to prevent an incident happening or reduce the risk of it happening to ALARP through reducing the likelihood of the event (eg preventative maintenance regimes, traffic calming and speed limits, community road safety awareness training);

Reducing the consequence (eg bunds to contain hazardous substance spills); and

A combination of both of these.

Recovery/Remediation: this includes contingency plans and response, eg Emergency Response Plans and Procedures.

A description of the proposed mitigation measures for each impact are described in *Chapter 8*.

7.2.6 *Assessing Residual Impacts*

Impact prediction takes into account any mitigation, control and operational management measures that are part of the project design and project plan. A residual impact is the impact that is predicted to remain once mitigation measures have been designed into the intended activity. The residual impacts are described in terms of their significance in accordance with the categories identified in *Box 7.2* above.

Social, economic and biophysical impacts are inherently and inextricably interconnected. Change in any of these domains will lead to changes in the other domains. This section looks at how the local way of life might change as a result of the proposed Project and includes the way people live, work and interact with one another on a day-to-day basis. Potential changes to local culture, livelihoods, health and well-being, personal and communal property rights are examined.

7.3 *AIR QUALITY*

The assessment has been undertaken using computer-based dispersion modelling and this section sets out the approach and methodology for the assessment, as well as the model inputs, assumptions and limitations.

7.3.1 *Methodology and Assumptions for Dispersion Modelling*

The dispersion modelling for the Project considered the following:

- Emissions of dust arising during construction activities; and
- Emissions arising from the combustion process during operation of the facility.

The study area is primarily defined as an area within 2 km of the proposed development location. This study area is defined as such, as the maximum ground level concentration will be within this zone based on the local terrain and exhaust height. As the air quality standards are applicable anywhere off-site, this is considered appropriate for the purposes of this assessment.

Road traffic emissions have been excluded from consideration in the dispersion model. The UK Highways Agency Design Manual for Roads and Bridges (DMRB) suggests that impacts on air quality are unlikely where a scheme generates less than 200 additional HGVs per day, or less than 1000 vehicles per day. In this case it is predicted that during operations there will be little over ten percent of this number. In addition, there are considered to be insignificant impacts associated with odour, as there are no significant emission sources on site during the project lifecycle.

Assessment of Stack Emissions

The power plant will be operated on Natural Gas and as a result, the pollutants of concern will be:

- Oxides of nitrogen (expressed as both NO_x and NO₂); and
- CO.

The emission values used in the dispersion model were provided by Azura Power. The model used in the assessment is the USEPA AERMOD dispersion model, one of a number of 'new generation' models, characterised by two main features:

- The description of the boundary layer in terms of two parameters: the boundary layer depth and the Monin-Obhukov length, and;
- Dispersion under convective meteorological conditions uses a skewed Gaussian concentrations distribution.

AERMOD is considered to be appropriate for this type of assessment as the model is well recognised within the air quality and impact assessment practice by numerous organisations including the IFC, the USEPA and the UK Environment Agency.

Model Inputs

Table 7.4 sets out the model inputs used in this assessment while *Table 7.5* sets out the values used in the model relating to emissions arising from the plant.

Table 7.4 *Model Inputs*

Building	Co-ordinates	Length (m)	Width (m)	Height (m)
Power Plant	5.681176 E, 6.409856 N	395	330	25 (assumed worst case)
Criteria Emission parameters – engines			Units	Value
Source Location ¹ (Stacks 1, 2, 3 and 4)			Latitude,	5.681176 E,
Stack height			Longitude	6.409856 N
Stack diameter (effective) ¹			m	50
			m	14

1: The four stacks are co-located adjacent to one another and modelled here as a single stack. This is reflected in model input values and the effective diameter is based upon 4x 14 m diameter stacks

Table 7.5 *Power Plant Emissions Values*

Fuel type	Units	Value
Emission flow rate	Am ³ /s	3980
Emission temperature	Celsius	543
CO	mg m ⁻³	37.5
NO _x	mg m ⁻³	27.5
CO	g/s	50
NO _x	g/s	36.6

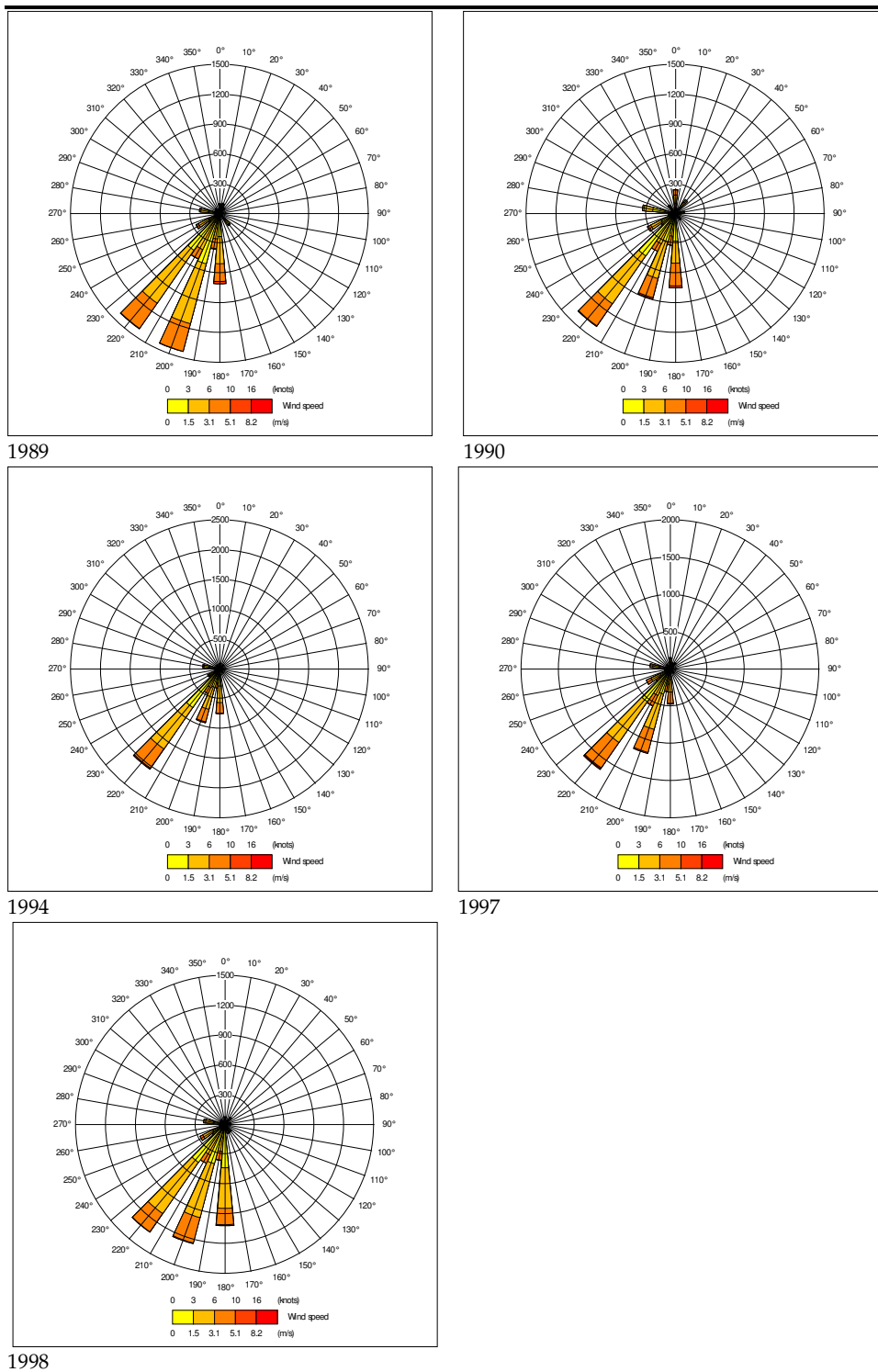
Meteorological Data

In line with best practice, five years of hourly sequential meteorological data were obtained and processed through the USEPA AERMET program to generate files suitable for use in the air dispersion model. Data from the Bohicon meteorological station, approximately 400 km west of Benin City was selected. Although the use of meteorological from a site some 400 km distant does limit the assessment, in the absence of a station closer to the site that monitors all the relevant parameters the use of this data was necessary. Data from a number of meteorological sites in West Africa was reviewed including Bohicon, Lagos, Cotonou and Lome. The Bohicon station is the closest site for which complete years of data are available for all the required parameters and is also not coastal (unlike nearer meteorological stations) and therefore is more likely to be representative of this inland site. In addition, a review of the data

from Bohicon, Lagos, Cotonou and Lome stations demonstrated a relatively small amount of regional variation, providing confidence that the choice of meteorology is unlikely to be a critical factor in the assessment. The model used data for the years 1989, 1990, 1994, 1997 and 1998, which represent the most complete years available. That the years are non-sequential is not considered a limitation.

The wind roses produced from this meteorological data set (*Figure 1.1*) identify that the prevailing wind direction is predominantly from the southwest for all years assessed. With the prevailing wind direction being almost exclusively from the southwest, air quality impacts from the Project will therefore be predominantly experienced to the northeast of the Project site for both short term and annual average concentrations.

Figure 7.2 Wind Roses for Bohicon, 1989, 1990, 1994, 1997 and 1998



Source: Bohicon meteorological station

Terrain Data

The terrain surrounding an emission source can significantly affect dispersion, particularly where there are hills and valleys which will tend to divert and funnel winds and therefore the plume trajectory. Terrain effects are typically significant where there are sustained gradients of greater than 1:10 in the

vicinity of the plant. Terrain has not been included in the model as there are no significant elevations in close proximity to the site.

Surrounding Land Use

The pre-analysis of the meteorological and terrain data has reflected the land use in the vicinity of the Project which is characterised primarily by a mixture of generally degraded forest, secondary vegetation and agricultural land.

Percentage Oxidation of Nitric Oxide to Nitrogen Dioxide

During the combustion process, two nitrogen based pollutants are generated, namely NO₂ and nitric oxide (NO) and together these comprise emissions of oxides of nitrogen. NO₂ is the pollutant of interest from a health perspective as this is considered the more toxic of the two, with NO being largely inert.

The emissions from the combined stack will comprise, initially, primarily NO, but through various chemical reactions that will take place in the atmosphere, the NO will be converted to NO₂. A worst case assumption would be that all the NO is converted to NO₂ by the time the emissions reach ground level and therefore human receptors. However, in reality this does not occur and only a proportion of the NO emitted will be converted to NO₂. This is due to the chemical reactions taking time to occur and also 'mopping up' other atmospheric chemicals such as ozone, a process which will limit the reaction rate and therefore limit the generation of NO₂. The conversion of NO to NO₂ is in part a function of the amount of ozone in the ambient air, and the travel time of the plume in the atmosphere (allowing more ozone to be entrained into the plume, and thus more conversion). It is expected that, in the area most impacted by the plume from the power plant, ozone concentrations will be low due to the absence of significant ozone precursor emissions upwind of the plant. Furthermore, this most impacted area is within 1 km of the proposed power plant stack, and at an average wind speed of 4 m/s ie plume travel time of about 250 seconds, there is very little time for ozone to be entrained. Therefore there is only minimal NO to NO₂ conversion likely to occur.

A number of international agencies have developed guidelines for including in assessments the conversion of NO to NO₂. A summary of the main guidelines and ratios are set out below in *Table 7.6* and indicate that a wide range of ratios to convert NO to NO₂ are recommended by a variety of country agencies.

Table 7.6 *Recommended NO to NO₂ conversion ratio*

Country	Averaging period	Recommended NO to NO ₂ conversion ratio
United States	24 hour	75%
	Annual	75%
Germany	24 hour	60%
	Annual	60%

Country	Averaging period	Recommended NO to NO ₂ conversion ratio
United Kingdom	Short term (1 hour)	50%
	Annual	100%
Hong Kong	24 hour	20%
	Annual	20%
Ontario, Canada	24 hour	52%
	Annual	68%

On the basis of the recommended ratios, adopting a pragmatic approach and assuming that the suggested ratios are equally valid, it is recommended that for long term a conversion ratio of 100 percent is appropriate, and for short term a conversion ratio of 50 percent is appropriate. These conversion factors have been applied in the results interpretation.

Assumptions

The modelling adopted a conservative approach and the following conservative assumptions have been made in relation to the air dispersion modelling undertaken as part of this assessment:

- Modelling has only been undertaken for emissions relating to the power plant gas turbines ie not potential emissions relating to the back up diesel generator, vehicles movements and construction activities.
- No assessment of changes in emissions during start-up and shut-down have been made, as the plant is designed to supply base load.
- The proposed plant will operate at 100 percent capacity on a continuous basis (24 hours per day).

7.3.2 *Methodology for the Assessment of Dust*

Emissions of dust will arise from the site during construction activities, primarily as a result of earth moving activities and the passage of vehicles over open ground. Dust emissions are primarily associated with nuisance issues at nearby sensitive receptors, due to the deposition of dust on surfaces, such as window sills, washing and vehicles.

Dust emissions related to construction activities are considered qualitatively, on the basis of the potential for these emissions to primarily result in nuisance issues. This approach is used as modelling of these emissions is not appropriate due to uncertainties in the model source term. In considering the location of possible receptors, the United States Environmental Protection Agency (USEPA) states, in relation to dust emissions (EPA, 1995):

“... [dust particles 10-30µm in diameter] are likely to settle within a few hundred feet [30-90m]... from the edge of the road or other point of emission.”

Ameliorating weather conditions such as rainfall and wind speed should also be considered, as dust emissions are negligible during wet and calm periods.

The USEPA state that precipitation of greater than 0.2 mm/h will affectively attenuate dust and wind speeds of >5.3 m/s are typically required to lift dust from open surfaces. This will be lower for dust generated by mechanical means (ie during excavation and due to the movement of vehicles over unpaved surfaces), at around 3 m/s. Taking this into account, the following can be concluded:

- At all but the most extreme wind speeds, dust will typically travel a maximum of 200 m from source before falling from the air column (IFC, 2007);
- At the highest wind speeds, dust is unlikely to travel more than 500 m from source; and
- Precipitation will effectively attenuate dust, with rainfall of >0.2 mm/h likely to effectively attenuate dust emissions.

The assessment of the potential for significant dust nuisance to arise is undertaken with due consideration of these weather factors, the proximity of receptors to dust sources and the duration of dust generation activities. On the basis of these factors the risk matrix set out in *Table 7.7* has been developed.

Table 7.7 *Dust Nuisance Assessment Matrix*

Likely magnitude of impacts	Conditions
Likely major significant impact	<ul style="list-style-type: none"> • Dust generating activities for >12 months • Receptor within 200 m of dust source • Downwind for >10 percent of the year where wind and rainfall conditions promote dust generation
Likely moderate significant impact	<ul style="list-style-type: none"> • Dust generating activities for <12 months • Receptor within 200 m of dust source • Downwind for >10 percent of the year where wind and rainfall conditions promote dust generation
Likely minor significant impact	<ul style="list-style-type: none"> • Dust generating activities for <12 months • Receptor within 200 m of dust source • Downwind for 2-5 percent of the year where wind and rainfall conditions promote dust generation • Dust generating activities for >12 months • Receptor within 500 m of dust source • Downwind for 2-5 percent of the year where wind and rainfall conditions promote dust generation
Insignificant impact	<ul style="list-style-type: none"> • Receptor > 500 m of dust source • Receptor 200 m – 500 m from dust source • Downwind for <2 percent of the year where wind and rainfall conditions promote dust generation

7.3.3 *Methodology for Assessment of Air Quality Impacts*

Air Quality Standards

The air quality standards considered in the assessment are the Nigerian Federal Environmental Protection Agency (FEPA) interim ambient air quality standards, European Union (EU) air quality standards and WHO guidelines.

The WHO guidelines are particularly conservative and do not consider economic factors; however they have been employed in this assessment as they are recommended by the IFC and represent the most conservative approach. Where Nigerian standards are set out in terms of parts per million, these have been converted to μgm^{-3} .

Table 7.8 *Air Quality Standards used in the Assessment*

Pollutant	FEPA Standards		EU Standards			WHO Guidelines		
	Average Period	Criterion (μgm^{-3})	Pollutant	Average Period	Criterion (μgm^{-3})	Pollutant	Average Period	Criterion (μgm^{-3})
CO	1 hr	11400	CO	-	-	-	-	-
CO	-	-	CO	8-hour	10000	CO	8hr	40000
CO	-	-	CO	-	-	CO	1hr	30000
NO ₂	1 hr	75-113	NO ₂	1 hr	200	NO ₂	1 hr	200
NO ₂	-	-	NO ₂	Annual mean	40	NO ₂	Annual mean	40
Particulates	24 hr	250	-	-	-	-	-	-
-	-	-	PM ₁₀	24 hr	50	PM ₁₀	24 hr	50
-	-	-	PM ₁₀	Annual mean	40	PM ₁₀	Annual mean	20

Significance criteria

In order to determine the potential significance of the predicted impacts, two parameters are considered:

- the Process Contribution (PC) which is the concentration of the pollutant which would occur due to the emissions from source (ie stack emissions); and
- the Predicted Environmental Concentration (PEC) as a percentage of the relevant Air Quality Standard (AQS). The PEC is the addition of the baseline concentration of the pollutant of interest and the PC.

The baseline air quality information available (*Chapter 4*) is not sufficiently accurate for the determination of the PEC. Air quality measurements were taken using handheld instruments (Multi Gas Detector and Handheld Aerosol Monitoring) and are not derived from continuous monitoring results. On this basis, the significance criteria normally used for this type of process which makes reference to the PEC is not appropriate. However, the PEC is relevant in terms of assessing cumulative impacts associated with emissions from the neighbouring NIPP facility.

The IFC General EHS guidelines state (IFC, 2008):

“As a general rule, this Guideline suggests 25 percent of the applicable air quality standards to allow additional, future sustainable development in the same airshed”.

This rule applies to undegraded airsheds, where 'degraded' is defined as "an airshed should be considered as having poor air quality if nationally legislated air quality standards or WHO Air Quality Guidelines are exceeded significantly."

The IFC General EHS guidelines also state:

"Facilities or projects located within poor quality airsheds, and within or next to areas established as ecologically sensitive (eg national parks), should ensure that any increase in pollution levels is as small as feasible, and amounts to a fraction of the applicable short-term and annual average air quality guidelines or standards as established in the project-specific environmental assessment."

In terms of mitigation required for air quality impacts, the general guidelines provide the following:

"Suitable mitigation measures may also include the relocation of significant sources of emissions outside the airshed in question, use of cleaner fuels or technologies, application of comprehensive pollution control measures, offset activities at installations controlled by the project sponsor or other facilities within the same airshed, and buy-down of emissions within the same airshed. Specific provisions for minimising emissions and their impacts in poor air quality or ecologically sensitive airsheds should be established on a project-by-project or industry-specific basis. Offset provisions outside the immediate control of the project sponsor or buy-downs should be monitored and enforced by the local agency responsible for granting and monitoring emission permits. Such provisions should be in place prior to final commissioning of the facility / project".

On the basis of the IFC guidelines, the significance criteria set out in Table 1.6 were developed for the study. For this impact assessment, the airshed is considered undegraded and a criteria of PC<25 percent was used.

Table 7.9 **Significance Criteria**

Significance	
Major adverse	PC >100% of AQS, or PEC >100% of AQS
Moderate adverse	PC between 25% and 100% of AQS, and PEC >100% of AQS
Minor adverse	PC between 25% and 100% of AQS, and PEC <100% of AQS
Insignificant	PC <25% of AQS

7.3.4 **Methodology for Calculation of Greenhouse Gas Emissions**

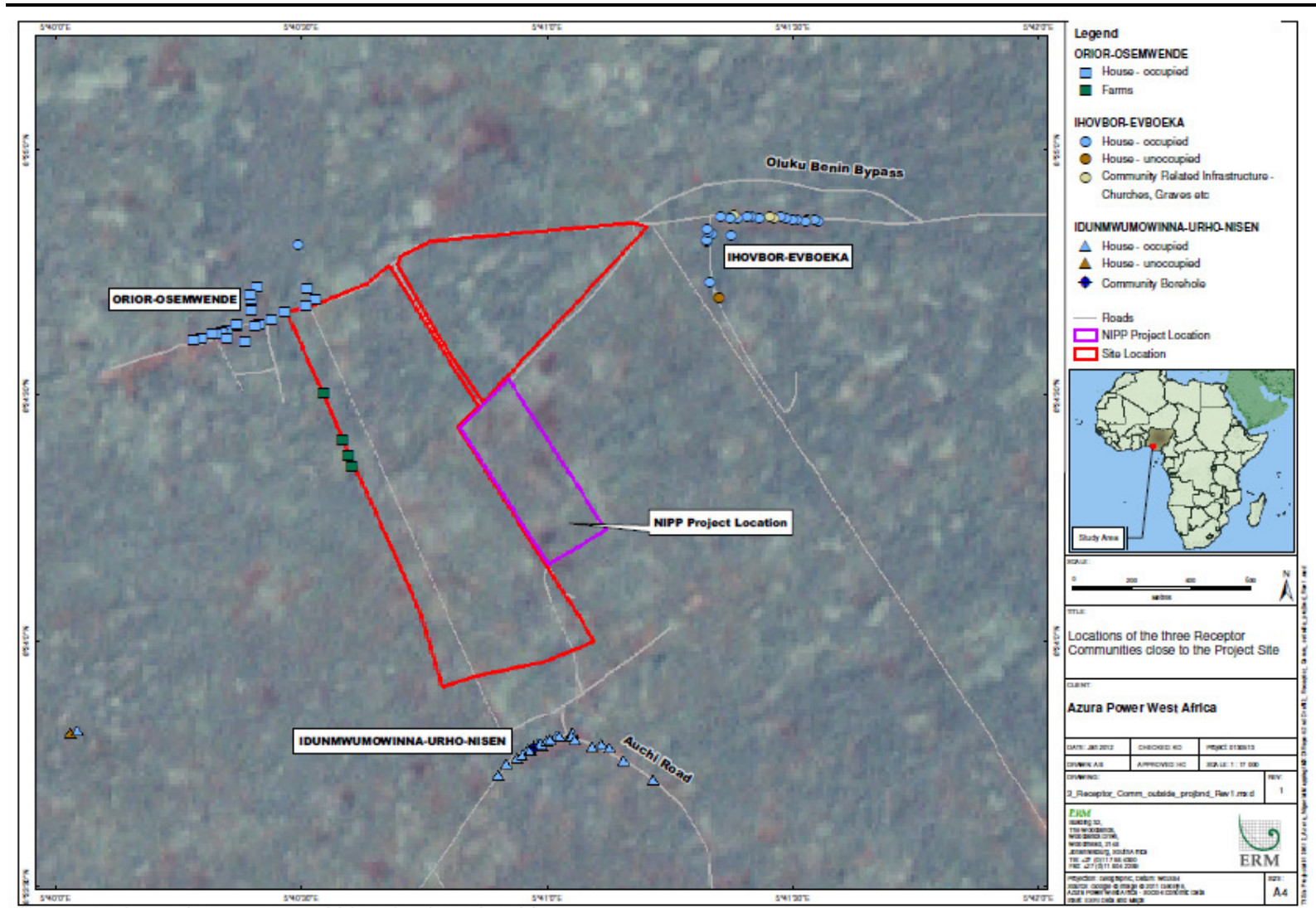
In addition to the significance criteria set in relation to impacts on air quality, significance criteria have also been defined based upon IFC guidance for greenhouses gases (GHG), in this case, CO₂. The GHG assessment criteria are based on *IFC Performance Standard 3 for Pollution Prevention and Abatement*, which sets the threshold for significance as 100 kilo tonnes CO₂-equivalents

per year for a single project or development. The total GHG emission forecast is presented as tonnes of CO₂ equivalent (CO₂-e).

7.3.5 *Receptors*

Within the model, and due to the location of the site in a rural/ peri-urban area away from densely populated areas, a receptor grid has been defined in order to capture the maximum off-site locations. The grid was defined with a resolution of 200 m and extends 5000 m in each cardinal direction and was used to predict pollutant concentrations in the vicinity of the Project. The proposed site boundary and the closest receptors to the site are illustrated in *Figure 7.3*

Figure 7.3 Receptor locations Outside of the site Boundary



Note: For clarity, the farms as part of Orior-Osemwende are located outside of the Project site boundary

7.3.6 *Impact Description and Significance: Construction*

Impact Description

With regard to air quality, there are no specific positive impacts relating to the construction of the proposed project.

The negative impacts identified due to air borne emissions at the Project site are primarily relate to some PM₁₀ and NO₂ / NO_x contributions from vehicles used during construction and emissions of dust arising from construction activities at the site

Construction vehicles will include heavy vehicles used for transporting raw materials and equipment, plant for levelling of the site and assistance with clearance of vegetation and smaller vehicles for staff.

The potential for dust nuisance is unlikely at locations between 200 m and 500 m, except in the most extreme wind conditions. In addition, wind speeds of <5.6 m/s are unlikely to lift dust and rainfall of >0.2 mm/hour will effectively attenuate dust. The latter is particularly pertinent as 50 percent of the proposed construction programme is likely to occur in the rainy season.

A review of receptor locations identified (local communities of Orior-Osemwende, Ihovbor-Evboeka and Idunmwowina-Urho-Nisen), that lie within 500 m of the site, indicate that there are three communities (including a primary school within 500 m) surrounding the site to the north and to the south and east. There are a small number of receptors (13) within the community of Orior-Osemwende and four farms so the south of Orior-Osemwende within 200 m of the site boundary.

Meteorological data for 1994 have been used to assess the dust conditions, the results of which are set out in *Table 1.7*. The table sets out the percentage of the year when the wind speed and precipitation are sufficient to generate dust, and the direction towards which the wind is blowing.

Table 7.10 *Summary of Dust Generating Conditions and Migration, 1994*

Wind direction (wind blowing from)	Number of hours per year with wind speed >5.3m/s and precipitation ≤ 0.2 mm/hour	Percentage of year
East	26	0.3
North	19	0.2
South	485	5.5
Southeast	56	0.6
Southwest	304	3.5
West	20	0.2
<i>Weather conditions unlikely to result in dust being generated</i>		89.2

This analysis demonstrates that for >89 percent of the year the weather conditions (all wind directions) are such that significant dust generation is unlikely. For the remainder of the year (11 percent), any generated dust will migrate towards north and northeast where this may impact three of the eastern most receptors in the communities of Orior-Osemwende and the western most receptor within the Ijobvor-Evboeka community (see *Figure 7.3*). The remainder of the receptors within the community of Ijobvor-Evboeka are over 1 km from the areas of the site to the south and south west and are therefore unlikely to be impacted by dust emissions. The community of Idunmwumowinna-Uhro-Nisen lies to the south of the site and is therefore unlikely to be impacted by dust generated due to wind direction.

Impact Significance

The duration of the construction period is expected to last approximately two years and thus the dust-generating activities are likely to occur for >12 months. The conditions are unsuitable for dust-generation on site for > 89 percent of the time and although there are only a small number of receptors (within the Orior-Osemwende and Ijobvor-Evboeka) within 200 m of the source, these receptors are highly sensitive to these impacts.

The impact of dust on surrounding receptors is therefore considered to be *major* prior to mitigation and steps will need to be taken to minimise the effects.

The emissions arising from traffic associated with the construction activities on the local receptors are considered likely to be *insignificant* due to the low number of vehicles.

7.3.7 *Impact Description and Significance: Operation*

With regard to air quality, there are no specific positive impacts relating to the operation of the proposed project. The negative air quality impacts predicted during operation are related to the following:

- Process emissions (NO_x and CO);
- Cumulative process emissions (NO_x and CO); and
- Greenhouse Gases.

During operations there are unlikely to be any significant emissions of dust or odour and these have therefore not been assessed. In addition, there will be relatively few vehicles movements associated with the operation of the facility, and therefore impacts associated with road traffic have also not been assessed.

Process Emissions: NO_x and CO

The negative impacts identified due to air borne emissions at the Azura Edo IPP site are impacts on human health from emissions of NO_x and CO arising from the combustion of fuel in the power plant.

The impacts of emissions arising from the operation of the power plant have been quantified. A summary of the results are set out in *Table 7.11*. The table details the maximum impact at any location. In order to assess potential impacts, comparison has been made with EU and Nigerian FEMA air quality standards.

Table 7.11 *Summary of Impacts due to Process Emissions (Azura Edo IPP)*

Pollutant	Averaging Period	Source	Criterion (µg/m ³)	Maximum Impact (µg/m ³)	Percent of Criterion (%)	Significance
NO ₂	Annual mean	EU/WHO	40	0.33	0.8%	Insignificant
	1 hour mean	EU/WHO	200	60.2	30.1%	Minor adverse impact
	1 hour mean	Nigerian	75-113	60.2	80.3%-53.3%	Minor adverse impact
CO	8 hour rolling average not to be exceeded more than 3 times per year	EU	10000	121.2	1.2%	Insignificant
	8 hour mean	WHO	40000	121.2	0.3%	Insignificant
	1 hour mean	WHO	30000	164.3	0.5%	Insignificant
	1 hour mean	Nigerian	11400	164.3	1.4%	Insignificant

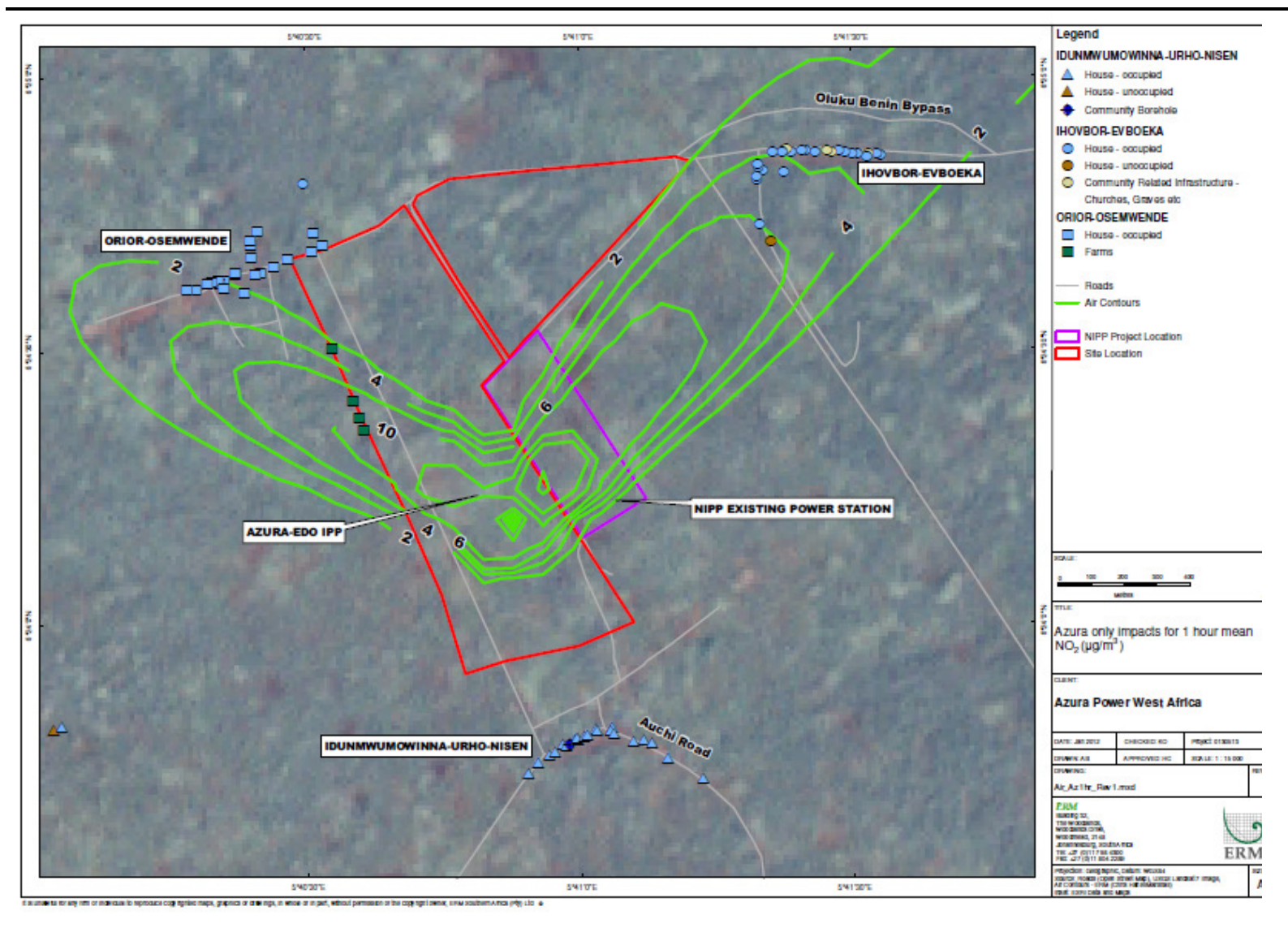
As the table indicates, the annual mean NO₂ concentration and all the averaging periods for CO are less than 25 percent of the criterion (EU, WHO and Nigerian emission limits), resulting in insignificant impacts for CO. Although the 1 hr ambient NO₂ concentration remains considerably below any standards used, this is however greater than 25 percent of the EU/ WHO and Nigerian air quality standards.

Overall, the assessment indicates that the emissions from the Project will result in a *minor* adverse impact on air quality as a result of emissions of NO₂ and an *insignificant* impact as a result of emissions of CO.

The results of the assessment are presented graphically in *Figure 7.4* and *Figure 7.5* showing nearby sensitive receptors and the following:

- Annual mean NO₂, Azura Edo IPP only; and
- 1 hour maximum NO₂, Azura Edo IPP only.

Figure 7.5 1 h maximum NO₂, the Project only, showing nearby sensitive receptors



Emissions of Greenhouse Gases

The proposed facility will contribute to greenhouses gases through the emission of fossil fuel derived carbon dioxide (CO₂) to the atmosphere. The main source of CO₂ emissions during operation is the combustion of natural gas to generate power. GHG emissions from the proposed facility, as provided by Azura Power, is calculated to be a total CO₂ emissions of 2,718 kt/yr.

This value exceeds the *IFC Performance Standard 3 for Pollution Prevention and Abatement* threshold for a single project/ development of 100 kilo tonnes CO₂-equivalents per year for a single project or development, and is therefore considered a *significant negative* impact.

7.3.8 *Impact Description and Significance: Decommissioning*

Impact Description

With regard to air quality, there are no specific positive impacts relating to the decommissioning of the proposed project. The negative impacts identified during decommissioning activities are due to emissions of dust resulting from demolition of buildings, site levelling and filling activities at the site. There may also be some emissions due to traffic associated with decommissioning.

This analysis demonstrates that for >89 percent of the year the weather conditions (all wind directions) are such that significant dust generation is unlikely. For the remainder of the year (11 percent), any generated dust will migrate towards north and northeast where this may impact three of the eastern most receptors in the communities of Orior-Osemwende and the western most receptor within the Ihobvor-Evboeka community (see *Figure 7.3*). The remainder of the receptors within the community of Ihobvor-Evboeka are over 1 km from the areas of the site to the south and south west and are therefore unlikely to be impacted by dust emissions. The community of Idunmwumowinna-Uhro-Nisen lies to the south of the site and is therefore unlikely to be impacts by dust generated due to wind direction.

Impact Significance

The duration of the decommissioning period is expected to be less than a year (ie <12 months). Based on an assessment of the meteorological condition, the conditions are suitable for dust-generation on site for <11 percent of the time and there are (currently) a small number of receptors within 200 m of the source. Since these receptors are, however, highly sensitive, the impact of dust on surrounding receptors is therefore considered to be *major* prior to mitigation.

The emissions arising from traffic associated with the decommissioning activities are considered likely to be *insignificant*.

7.3.9 *Impact Description and Significance: Summary*

Table 7.12 provides a summary of the key impacts to air quality associated with the construction, operation and decommissioning of the proposed power plant.

Table 7.12 *Summary of Impact Significance Pre-mitigation*

Impact	Source	Significance
<i>Construction</i>		
Dust	Site traffic associated with construction, worse in dry seasons	Major negative
PM ₁₀ and NO ₂ / NO _x	Site Vehicle Emissions and vehicles accessing site	Insignificant Negative
<i>Operation</i>		
NO ₂	Burning of natural gas	Minor Negative
CO	Burning of natural gas	Insignificant Negative
Greenhouse gases	Emissions of greenhouse gases during operations	Significant Negative
<i>Decommissioning</i>		
Dust	Site traffic associated with decommissioning, worse in dry seasons	Major Negative
PM ₁₀ and NO ₂	Site Vehicle Emissions and vehicles accessing site	Insignificant Negative

7.4 **NOISE**

7.4.1 *Impact Assessment Methodology*

Nigeria Interim Guidelines and Standards for Noise

The Federal Environmental Protection Agency Decree 1988 *Interim Guidelines and Standards for Industrial Effluent, Gaseous Emissions and Noise Limitation* (Government Notice 1991) provides guidelines and standards to ensure industrial activities are compatible with a clean and safe environment in Nigeria. Chapter 4 of the Guidelines present noise exposure limits for Nigeria. These limits relate to occupational noise exposure and set out limits protect workers from noise induced hearing loss. The limits for daily noise exposure for workers should not exceed an equivalent noise level of 90 dB over an 8-hour working period. This standard is, however, applicable for occupational noise exposure only, and is not suitable as criteria for assessing the significance of environmental noise impacts to receptors outside the project

footprint. It does provide a design standard that plant and equipment associated with the project should aim to achieve where practicable.

In the absence of suitable environmental noise criteria, and given Azura Power may be seeking funding and/or guarantees from international financial institutions, the World Bank/ IFC noise guidelines levels for industrial facilities have been used.

World Bank/ IFC General Environmental, Health and Safety Guidelines

The IFC gives guidance on noise impacts in two ways. The IFC General EHS Guidelines differentiates between two principal receptor categories, residential and industrial, but are not specific to any particular source. The guidelines set out prevention and control measures, noise level guidelines and advice on monitoring.

The Noise Level Guidelines make reference to noise originating from facilities as well as stationary noise sources, and are commonly applied as design standards for industrial facilities. Although the guidelines relate to noise effects thresholds in a general sense, the IFC has indicated that these are not directly applicable to transport or mobile noise sources. Measurements should therefore be taken at noise receptors located outside the project property boundary.

Table 7.13 *IFC Noise Level Guidelines*

Type of Receptor	Daytime (0700 – 2200) LAeq, 1hr dB(A)	Night time (2200 – 0700) LAeq, 1hr dB(A)
Residential, institutional or educational	55	45
Industrial or commercial	70	70

In some cases, the baseline noise may be sufficiently high that even noise levels from the plant that exceed the above standards may only give rise to small changes in ambient noise. In this case, the noise impacts that will not cause a significant change. In line with the approach of the IFC, if changes in background noise as a result of noise emissions from the plant are no greater than 3 dB(A) then noise impacts are not deemed significant, even if they are above the Nigerian standards. In summary, these general IFC guidelines also note a significance standard that noise impacts should not:

- Exceed the levels presented in *Table 7.13* above; or
- Result in an increase of background noise levels of more than 3 dB.

These are outdoor noise levels and also state that *'highly intrusive noises, such as noise from aircraft flyovers and passing trains, should not be included when establishing background noise levels'*.

The values in *Table 7.13* will therefore form the basis of assessing significance for the construction and operational phases.

Table 7.14 *Impact Assessment Methodology for Residential Receptors*

	Major	Moderate	Minor	Negligible	Not significant
Construction and Decommissioning Noise	Noise level >15 dB above criteria	Noise level between 10 to 15 dB above criteria	Noise level up to 10 dB above criteria	Noise level up to 5 dB above criteria	Noise level below criteria
Operational Noise	Noise level between >10 dB above criteria	Noise level between 5 to 10 dB above criteria	Noise level between 3 and 5 dB above criteria and above baseline	Noise level below criteria but above baseline < 3dB	Noise level > 10 dB below criteria and below baseline

Note: Criteria for construction is 70 dB LAeq, 1hr
Daytime: 07:00 to 22:00; night time: 22:00 to 07:00

These operational noise criteria have been used on numerous international development projects and although they do not have a specific legal basis, they are considered as best practice with respect to significance impact rating of noise.

Construction sites, however, have special characteristics compared with other major noise generators. Construction is generally undertaken in the open, is usually of a temporary duration, and varying levels of noise are produced by several different types of noise sources. Noise levels created by construction equipment can vary greatly and depend on factors such as type of equipment, the specific model, the operation being performed, duration of the activity, and the condition of the equipment.

Construction equipment operates in two modes, namely stationary and mobile. Stationary equipment operates in one place for one or more days at a time, with either fixed power operation (pumps, generators, compressors) or a variable noise operation (pile drivers, pavement breakers).

There are no standardised criteria for assessing construction noise and associated impacts, and consequently such criteria must be determined on a project specific basis. The Project construction noise criteria should take into account the existing noise environment, the absolute noise levels during construction activities, and the receptor land use. The following reviews of recognised construction noise guidelines provide guidance to develop suitable construction noise criteria. For construction, noise criteria of 70 dB LAeq,1hr are set to take account of the fact that it is temporary, and to acknowledge that construction work by its very nature is noisy and a lower, strictly enforced criteria, can limit development.

Existing Noise Environment

Noise measurements were taken of the existing noise environment during the wet and dry seasons (and are presented in *Chapter 4*). The background noise levels could not be accurately determined due to the prevalence of

construction noise associated with the NIPP project. From review of the NIPP ESI Report, the average overall noise levels measured as part of their baseline studies were recorded at 34 dB (A) (wet season) and 37 dB (A) (dry season).

As with standard methodology, and based on this, the baseline noise levels are therefore considered to be below the IFC Noise Level Guidelines for daytime, 55 dB(A) $L_{Aeq, 15hr}$, and 45 dB(A) $L_{Aeq, 9hr}$, for night time for residential, institutional or educational receptors.

7.4.2 *Noise Receptors*

The noise sensitive receptors close to the site and considered in the impact assessment include a number of occupied and unoccupied houses, farms and community infrastructure such as churches and sacred sites within the three communities of Orior-Osemwende, Ihovbor-Eveboeka and Idunmwumowinna-Uhro-Nisen.

There are twenty-four occupied houses within the community of Orior-Osemwende and four farms. Within Ihovbor-Eveboeka, there are twenty occupied farms, one unoccupied house and five receptors consisting of community-related infrastructure (churches or graves). In addition, within the community of Idunmwumowinna-Uhro-Nisen, there are twenty-two occupied houses and one unoccupied house (lying approximately 1 km to the west of the site and therefore not shown on the map).

7.4.3 *Impact Description and Significance: Construction*

Impact Description

With regard to noise emissions, there are no specific positive impacts relating to the construction of the proposed project.

Construction of the plant will take up to two years, and will include approximately two months of earthworks and site clearance, the preparation of footings for the plant, heavy earthworks and the construction and installation of the superstructures.

Proposed construction hours are 0700 – 1800 Monday to Saturday. Auger (“screw”) piling will take place; but no impact piling is anticipated and as such, vibration impacts are not considered likely given the distance between the site and the closest sensitive properties. Noise from construction activities are likely to be perceptible at the closest noise sensitive properties during the key phases of the work, particularly earthworks and any activities where a number of items of plant will be operating simultaneously.

Impact Significance

In the absence of specific details on the proposed construction work programme and method, it is not possible to quantify construction noise

impacts exactly or take account of the duration of such works to determine significance.

Although construction noise may be noticeable during civil works such as site clearance, or the use of jackhammers, pile drivers and the like. However, due to the overall types of activity and distance between main work sites and nearest sensitive receptors, there is a low likelihood of the noise levels exceeding 70 dB LAeq, 1hr and if so, this will be of short duration. The negative noise impacts are therefore considered to be of *negligible* significance at the nearest receptors.

7.4.4 Impact Description and Significance: Operational

Impact Description

With regard to noise emissions, there are no specific positive impacts relating to the operation of the proposed project.

Noise during operation is expected to be generated by various components of the Azura Edo IPP, including the gas turbines and associated fin-fan coolers and bag filter houses, the high-voltage and power station transformers and switchyard, the black-start diesel generators, the turbine hall, the workshops and ancillary facilities such as the water treatment plants and the administration buildings.

The noise levels from each of these components and sources were modelled to be able to understand the combined noise emissions from the operations and therefore present a reasonable worst case scenario. Operational noise has been modelled based on the assumptions and the proposed design of the Azura Edo IPP, according to the design specifications of the proposed plant to meet 45 dB(A) at 300m from the plant boundary. This specification was used to determine input source noise levels in terms of sound power and was used to calculate the predicted noise levels. Potential noise impacts from the Project at the nearest noise sensitive properties are therefore considered to be representative of typical operations from the project.

Impact Significance

The results of the modeling indicate that operational noise levels from the Azura Edo IPP will remain below the IFC Guideline Noise Levels, both during the day and night at all receptors (*Figure 7.6*). According to the methodology presented in *Section 7.4.1*, the overall noise impacts are therefore deemed to be negative and of *insignificant* significance prior to mitigation.

7.4.5 Impact Description and Significance: Decommissioning

Impact Description

The decommissioning of the plant will take place in approximately 2035 and take approximately 12 months. Much of the work will be broadly similar to

construction activities, and as such, similar impacts are expected. Noise from decommissioning activities is likely to be perceptible at the closest noise sensitive properties during the key phases of the work.

Impact Significance

Noise levels for decommissioning may be similar to that for construction, but of lesser intensity. Noise levels are unlikely to exceed 70 dB LAeq, 1hr which is a broadly acceptable criteria for decommissioning noise impacts given the type of activity and distance between the main work sites and nearest sensitive receptors. Noise impacts during decommissioning are therefore considered to be *insignificant* prior to mitigation.

7.4.6 *Impact Description and Significance: Summary*

Table 7.17 provides a summary of the noise impacts associated with the construction, operation and decommissioning of the proposed power plant.

Table 7.15 *Summary of Impact Significance Pre-mitigation*

Phase	Impact	Significance (pre-mitigation)
Construction	Noise from construction activities including site clearance, vehicles and plant, civil works and equipment use	Negligible, negative
Operation	Noise from power plant operations (including turbines and ancillary facilities)	Insignificant, negative
Decommissioning	Noise from decommissioning activities such as vehicles, decommissioning and equipment use	Insignificant, negative

7.5 *SOILS AND GEOLOGY*

The soil within Edo State and on the Project site is reported to be chiefly ferrosols on loose sandy sediments. Ferrosol soils are typically found to have deep internal drainage and high porosity and samples demonstrated this high porosity and a fine grained texture.

Ferrasols are also characterised by low water and cation retention. They are indicated to have good physical properties but unfavourable chemical properties for cultivation and are not noted to demonstrate high soil fertility properties (Richards et al, 2009). It is however reported that ferrosol soils normally support shifting cultivation, and in tropical areas cocoa and rubber plantations, all of which is present on the site.

The soils across the Study Area were not found to have a high organic content or soil fertility and no evidence of heavy metal or hydrocarbon pollution was identified. Heterotrophic bacteria, heterotrophic fungi and coliform were identified with levels varying across the site. Ferrosols are not considered to be a highly fertile soil type.

7.5.1 *Impact Description and Significance: Construction*

Impact Description

The construction of the plant will take up to 24 months, and will include approximately two months of earthworks and site clearance, the preparation of footings for the plant, heavy earthworks and the construction and installation of the superstructures.

Site clearing and construction activities will result in the removal of the vegetation and topsoil present at the 102 ha site. Site clearance activities will

also be required for the burial of the pipeline. The vegetation clearing will impact upon several aspects of the soil characteristics including water flow, microbial activity and nutrient content. The removal of the topsoil will result in alterations to the drainage and surface run-off regime on the site, particularly during the wet season, reduce the fertility of the site and result in the potential for increased erosion. There may be potential changes in siltation patterns as a result of construction activities which will destabilize soils potentially leading to soil erosion during heavy rainfall and sedimentation in downstream water bodies. In addition, the compaction of the soil will also reduce the permeability and water infiltration of the soil. This may result in increased surface water during the wet season, and hence effective site drainage will be key.

The presence of diesel on site during construction may also result in spillages and soil contamination.

It is not expected that additional fill material will be required from offsite to level the site. All fill used will be sourced from excavations on site.

Impact Significance

Thus the resulting impacts will be negative and both direct and secondary. The changes observed on site will be permanent, beyond the life of the Project; the scale of the impacts will be at a local level. The magnitude of the impacts are therefore considered to be high.

The soils on the site are not considered to be of high agricultural value and have been disturbed by anthropogenic activity (agricultural and construction). There are no water bodies in the immediate vicinity of the site. The sensitivity of the receptor is considered to be low.

The significance of the impacts are therefore considered to be *moderate* prior to mitigation.

7.5.2 *Impact Description and Significance: Operation*

Impact Description

The area occupied by the buildings and the roads on site will be paved or otherwise covered by a surface with low permeability. Thus the area paved or thus covered is expected to be as low as 25 percent of the total site during the OCGT plant construction and operation. The rest of the site area will be covered with gravel or another form of highly permeable surface.

The area which will be covered by hard standing (or less permeable surface) may result in increased soil surface runoff and consequently continued erosion, leaching and nutrient loss of adjacent land during the operational phase. This is particularly relevant due to the characteristic heavy rainfall in

the Study Area, however as much as possible the site will be covered in gravel or an equivalent porous material.

Diesel will be stored on site during operation for the black start diesel units and constitutes a potential impact if there are any resulting spills. Incorrect waste disposal may also result in potential soil contamination.

Impact Significance

The negative impacts on soil will be long-term, for the lifetime of the project and are local, restricted to the site and adjacent areas. The impact magnitude is therefore considered to be minor.

Given the low sensitivity of the surrounding areas, which are already disturbed, the resulting impacts are considered to be *minor* prior to mitigation. Furthermore it should be ensured that to the extent possible the site is covered with gravel or equivalent materials to ensure that the impacts on run-off are kept to a minimum.

7.5.3 *Impact Description and Significance: Decommissioning*

Impact Description

It is assumed that decommissioning will involve removal of the plant and equipment and restoration of the site. It is possible that the site will be redeveloped for other industrial use, depending on the situation at the time of the end of the Project's life. For this assessment it is assumed that the decommissioning activities will include dismantling and demolition of Project facilities as well as subsequent earthworks and site levelling. Since certain areas of the site are likely to be covered with hard standing, this would be removed. The resulting disturbance and associated soil compaction could result in negative impacts such as increased erosion. Improper handling of the waste generated during decommissioning from the dismantling and demolition activities could result in contamination of soils. After decommissioning, the soil profile will be allowed to be re-established through artificial means and through colonisation by plants.

Impact Significance

The impacts on soil during decommissioning will be local and temporary and the magnitude is therefore considered to be low. The soil on the Project site will have already been modified and disturbed to a large degree once the decommissioning phase of the Project occurs and the receptor is therefore considered to be low.

The overall significance of the impacts on soils during decommissioning are *minor* prior to mitigation.

7.5.4 *Impact Description and Significance: Summary*

Table 7.16 illustrates the summary of Project impacts on the soil on site. The summary takes into account impact magnitude, receptor sensitivity and the resulting impact significance pre and post mitigation.

Table 7.16 *Summary of Impact Significance Pre-mitigation*

Phase	Impact	Significance (pre-mitigation)
Construction	Removal of soils, increased erosion and potential contamination	Moderate Negative
Operation	Compaction and increased erosion, potential contamination	Minor Negative
Decommissioning	Disturbance to soil profile, increased erosion and potential contamination	Minor Negative

7.6 **WATER RESOURCES**

Impacts on water resources during the construction, operation and decommissioning of the Project will arise from Project activities which may lead to the contamination of water resources from construction, operation and decommissioning activities as well as from the use of local water resources to provide water. The Project intends to obtain all the water required from a borehole that will be sunk on the Project site.

7.6.1 *Impact Description and Significance: Construction*

Impact Description

The two main activities that may result in impacts on hydrology and hydrogeology are the:

- Potential contamination of groundwater resulting from construction of borehole(s) and accidental spills resulting from drilling; and
- Construction of boreholes to abstract groundwater; actual water use; and construction activities which may result in contamination of water resources.

Site clearances and preparation activities, including the removal of soils and vegetation could result in increased surface water run-off and sedimentation of surface water bodies. The nearest surface water body (a moat) is located 800 m from the boundary of the Project site which is fills up during the rainy season, and has the potential to impacted by increased sedimentation due to Project activities. In addition effluent generated from the site will be discharged into the moat in accordance with Nigerian, WHO and World Bank effluent discharge requirements.

Water resources may be at risk during these construction activities from pollution from the accidental spillage of fuel and hazardous materials, lubricants, cement and wet concrete, or from the inadequate or unsafe storage of waste and disposal of sanitary wastewater and domestic water from the contractors during the construction work site and facilities. The construction of the water abstraction boreholes may have negative impacts on groundwater quality due to the new permanent or temporary pathways created between pollutant sources and the aquifers.

Contamination of water resources would impact on water abstraction for domestic, agricultural and other commercial uses in the vicinity and cause harm to ecosystems, including animals and crops, and potentially human health. The potential health impacts on the local community resulting from contamination of water resources is discussed and assessed in *Section 7.15*.

Water uses during construction include drinking water for construction staff, water for concrete batching and dust mitigation and management and could result in drawdown of groundwater resources and stress on water supply. The EIA assumes that the aquifer yields at the Project site are in line with the general yields for the Benin City area. Azura Power will confirm that there is sufficient groundwater available for use for the Project during the detailed design phase.

Impact Significance

Potential Contamination of Water Resources

The potential impacts on water resources during construction will be negative and local as any impacts are likely to be felt on the site and adjacent areas. The construction impacts are likely to be long-term as they may be felt after the end of the construction phase. The magnitude of the impact is therefore considered to be moderate as there may be some effect on the ecological functioning, but this will not impact the overall integrity of the ecosystem.

There are no surface water bodies located on site. The closest surface water bodies are:

- a small non-perennial pond (which partially fills up with water during the rainy season) which is located approximately 800 m to the north of the boundary of the proposed site; and
- the Ikpoba River Dam which lies approximately 4 km east from the proposed site.

The underlying groundwater aquifer is considered to be highly permeable, porous, with a prolific water yield, lies approximately 800 m thick, with the water level varying between 20 and 52 m below the surface (Erah, Akujeze and Oteze, 2002). The overall receptor sensitivity of ground and surface water resources is considered to be moderate.

The impact of the Project on water resources is therefore considered to be *moderate* prior to mitigation.

Potential Over-exploitation of Groundwater Resources

The underlying aquifer is considered to have a prolific yield (Erah, Akujieze and Oteze, 2002). The impact on groundwater resources are considered to be negative and temporary since the receptor is expected to return to the previous state when the impact ceases, and local (restricted to the site and the adjacent areas). The magnitude is therefore considered to be insignificant – low.

The sensitivity of the aquifer for water availability is considered to be low due to the reported prolific water yield in the area (Erah, Akujieze and Oteze, 2002). Pending technical confirmation of water availability by Azura Power, the negative impact of groundwater use on groundwater resources is considered to be *insignificant*.

7.6.2 *Impact Description and Significance: Operation*

Impact Description

During operation the water requirements for the OCGT plant will be for the fire fighting system, office use as well as welfare and hygiene, cleaning and equipment washing and the cooling systems. The power plant will require a maximum of approximately 50 m³ (50, 000 litres) per day over the lifetime of the Project. There is potential for the over exploitation of the groundwater resources if not properly managed. Over exploitation of the groundwater may result in direct depletion of water resources which may cause harm to ecosystems. This could result in potentially long-term effects on the water resources at a local and regional level.

Operation of the OCGT Plant could result in water resource contamination from surface water drainage containing pollutants, incorrect process effluent and sewerage management and incidents relating to accidental releases of fuel, oils and hazardous chemicals, storage and incorrect handling of waste including the sludge generated from waste water treatment.

During operation the introduction of hard standing on the site will change the existing surface water regime and may result in increased runoff which may impact neighbouring agricultural plots and result in increased erosion.

Impact Significance

Potential Contamination of Water Resources

The potential contamination of the groundwater and surface water from construction activities would be direct and secondary and local as the impact

would be experienced on the site and adjacent areas. The impact would be long-term as the impact will last for the lifetime of the Project. The impact magnitude is therefore considered to be moderate.

Since the sensitivity of the receptors is judged to be low, the overall impact is therefore assessed to be of *minor* significance prior to mitigation.

Potential Over-exploitation of Groundwater Resources

The impacts resulting from the Project's water use during operation is likely to be negative and experienced at a local scale, on the Project site and adjacent areas. The impact is considered to be long-term and the magnitude is therefore assessed to be low-moderate.

Since the sensitivity of the aquifer for water availability is low, the significance of the potential impact is considered to be *minor* prior to mitigation.

7.6.3 *Impact Description and Significance: Decommissioning*

Impact Description

The decommissioning will include decommissioning, demolition and removal of fuel storage tanks and associated pipe work, dismantling of effluent treatment plant, removal of diesel engines and transformers and the removal of piles and foundations. During decommissioning it will also be necessary to carefully decommission the groundwater abstraction boreholes, or if they are to remain in continued use for these to be capped to contain a potential pathway for contaminants.

As such, the potential negative impacts to water resources are likely to be very similar to those considered during the construction phase of the Project and will include potential contamination from leaching from demolition and incorrect disposal of waste generated and chemicals (including transformer oil, residual sludge from the wastewater treatment works and diesel) and/ or incidents and spills.

Impact Significance

The potential impacts on water resources during decommissioning will be negative, local in scale and short-term as they would be experienced only for a limited period, during decommissioning. The impact magnitude is therefore considered to be low.

The sensitivity of the water resources is considered to be moderate and the impact significance is therefore assessed to be *minor* prior to mitigation.

7.6.4 *Impact Description and Significance: Summary*

Table 7.17 provides a summary of the significant impacts likely to arise during construction, operation and decommissioning prior to the implementation of mitigation measures (see Chapter 8).

Table 7.17 *Summary of Impact Significance Pre-mitigation*

Phase	Impact	Significance (pre-mitigation)
Construction	Potential contamination of water resources	Moderate Negative
	Potential over-exploitation of groundwater resources	Insignificant Negative
Operation	Potential contamination of water resources	Minor Negative
	Potential over-exploitation of groundwater resources	Minor Negative
Decommissioning	Potential contamination of water resources	Minor Negative
	Potential over-exploitation of groundwater resources	Insignificant Negative

7.7 **BIODIVERSITY**

The general ecosystem profile across Edo State is a combination of lowland rainforest, farm land, and plantations. In keeping with Edo State's profile the Project site was found to be largely characterised by secondary forests, abandoned and functional subsistence and commercial farmland and plantations (chiefly oil palm and rubber). All ecosystems surveyed demonstrated a presence of grasses, shrubs and sedges. The plantations are established as monocultures and hence have relatively low biodiversity.

The interaction of people with the surrounding environment was also evident across the Project site, including felling of trees for firewood in the surrounding secondary forests, agricultural activities (mostly typical slash and burn practice), road construction, dwellings and footpaths. The Project area and the surrounds have largely been modified by infrastructure projects such as the neighbouring NIPP plant. The selected location for the Project is located on degraded and re-growing secondary forest (some of which is situated in the Ihovbor-Evboeka community), plantations and fallow land.

Although the Project site is not considered an area of high biodiversity status, some faunal and floral species of ecological significance were identified during the sampling that was conducted in the Study Area.

7.7.1 *Impact Description and Significance: Construction*

Impact Description

The key impact during construction is the potential loss of vegetation cover over the 102 ha site Project site, the transmissions line RoW. Some clearing may be required for the laying of the pipeline spur, although this is expected to be very minor as the spur will be located along the existing cleared RoW for the NIPP pipeline. The removal of vegetation and soil in the site clearance could result in an alteration of the surface water run-off regime. This could result in sedimentation of surface drainage networks, which will impact upon the quality of natural water systems and ultimately the biological systems that use these water bodies (IFC, 2007).

Vegetation clearing may allow for opportunistic grass species (and any other species) to generate in place of the original floral species, resulting in the potential loss of vegetation. However this will not likely affect the overall population of species in the broader area.

The change in floral species will also impact upon the availability of the relevant habitats for faunal species. The potential fragmentation of habitats may also occur in the Study Area. It is also important to note that any tree species that are cleared will affect bird species in the Study Area, in addition to influencing the pollination of any trees that rely upon birds for pollination. During the wet and dry season baseline studies numerous 'light' forest areas were observed with a mixture of juvenile and old trees. An example of this is the rubber plantation (*Hevea brasiliensis*) that was identified in the forested area. Specifically the older trees may be a considerable source (and habitat) for faunal species particularly insects. The increased presence of traffic and people on site will also act as a barrier to any faunal species that are normally mobile in the area.

Other activities which will contribute to impacts on biodiversity include construction lighting, including high mast lighting for activities and dust emissions.

Impact Significance

The impacts on biodiversity will be negative and restricted to the site and the immediate local surroundings. Although some of the impacts will be reversible over the long term, the loss of habitat will be permanent. The magnitude of the impact will therefore be moderate.

The study area comprises fallow land and secondary forest (either degraded or re-growing), with a few farms and areas currently under development (both residential and commercial). The habitats in the Study Area have been previously disturbed and are not protected ⁽¹⁾. One endangered floral species,

(1) The Convention on Biological Diversity incorporates ecosystems, habitats, species and communities and the protection of genetic diversity within the definition of biodiversity. The requirements of the IFC's Performance Standard 6 are also

Artanema longifolium (a flowering plant) was identified on the site. Furthermore eight vulnerable plant species were identified. The local dragon fly (*Acanthaescha Victoria*), and soldier ant (*Strongylognathus alboini*) were also identified in the area and are classified as vulnerable according to the IUCN's Red List. In particular, dragonflies are noted to have narrow habitat ranges and are sensitive to habitat quality. They are normally used as indicators of environmental health, and are found to reside in areas close to water bodies. In the past decade there has been an observed decline in this species due to rapid land-use change, structural alteration of running and still water bodies, pollution of water bodies and abstraction of groundwater (Moore, 1997 and IUCN, 2011). Due to the identification of endangered and vulnerable species, the receptor sensitivity of the study area is considered to be high.

The significance of the impact on biodiversity during construction is therefore considered to be *major* prior to mitigation.

It should be noted that with an increase in distance from the Project site it cannot be inferred that the impacts will decline. This is due to the reason that ecosystems are intricately related and are sets of open systems in which physical, chemical, and biological processes form interactive subsystems (Environmental Lab, 2011). Thus the impacts of the Project must not only be assessed in the direct proximity of the Project, but the impacts on water bodies that are further afield must be considered, particularly for the drainage and disposal of water. It is anticipated that this will have more of a long term impact.

In addition it is necessary to identify any opportunities to enhance habitats and protect and conserve biodiversity as part of their operations, particularly for species that were identified to be of a higher ecological status (vulnerable and endangered) (as outlined in *Chapter 8*).

7.7.2 *Impact Description and Significance: Operation*

Impact Description

During the operation phase there will be an increase in the noise levels in the Study Area. In addition any lighting that will be used in the area during night time operations may also disturb faunal nocturnal activities. This may result in faunal species relocating away from the immediate vicinity of the site, and thus increasing competition on the peripheries of the Study Area. Wastewater floor drains, and other water drains from the equipment will be routed into a storm water system and discharged to the surrounding area via a moat located 800 m from the site. This may have a negative impact on water quality and affect faunal species.

applied to projects in all habitats, whether or not those habitats have been previously disturbed and whether or not they are legally protected (IFC, 2007).

Approximately ten vehicles are expected to be used during operation, which may disrupt wildlife corridors, decrease the movement of certain species in the area, and delay migration. This would be particularly relevant for the local deer (*Cervus elaphus*), antelope (*Tragelaphus* species) and fox (*Vulpes* species), that were observed in the Study Area.

Impact Significance

The impacts during the operational phase are likely to be local and continuous. The magnitude is therefore considered to be negligible - low.

As analysed for the construction phase, the sensitivity of the environment is considered to be high.

The significance of the negative impacts on biodiversity during operation is considered to be of *minor – moderate* significance.

7.7.3 *Impact Description and Significance: Decommissioning*

Impact Description

All infrastructure (including the cables and pylon for the connection to the Benin North Substation) will be dismantled. Machinery, steel and dismantled materials will be recycled where possible and disposed of at licensed disposal sites. In the short-term, the noise, dust and vehicle emissions generated during decommissioning may be similar to those observed during construction. Potential impacts may also relate to contamination from incorrect disposal of wastes generated during decommissioning.

In the long-term, however, particularly if the site is rehabilitated, the ecological health and biodiversity could be restored over time.

Impact Significance

The impact of the Project on the biodiversity during decommissioning will be negative, temporary and local. The magnitude of the impact is therefore considered to be low.

The sensitivity of the receptor is expected to remain the same as for the other Project phases, ie high.

The impacts during decommissioning are therefore judged to be of *moderate* significance prior to mitigation.

7.7.4 *Impact Description and Significance: Summary*

A summary of the impacts of the Project on biodiversity is included in *Table 7.18* below.

Table 7.18 Summary of Impact Significance Pre-mitigation

Phase	Impact	Significance (pre-mitigation)
Construction	Clearing of vegetation and habitat, disturbance of fauna due to noise, dust, traffic and potential contamination of soil and water	Major Negative
Operation	Disturbance of fauna due to noise, dust, traffic	Minor-Moderate Negative
Decommissioning	Disturbance of fauna due to noise, dust, traffic and potential contamination of soil and water	Moderate Negative

7.8 WASTE

The potential impacts of wastes generated during the construction, operation and decommissioning of the Project have been assessed based on the general environmental significance criteria outlined in *Section 7.2* and the EIA team’s experience from similar power generation projects. Reference has also been made to international standards and guidelines such as the World Bank Group Environmental, Health and Safety Guidelines for Thermal Power Plants.

7.8.1 Impact Description and Significance: Construction

Impact Description

Waste streams generated during construction of the Project are likely to consist of the following:

- excavation spoil;
- general construction waste;
- general waste; and
- sewage and wastewater.

By far the largest quantity of waste arising during construction will be spoil generated from the excavation of the terraces to create level platforms for the installation of the major items of plant and equipment and from the burial of the pipeline spur. The spoil which is excavated in creating the platforms will, wherever possible, be re-profiled around the site or re-used for landscaping. The surplus of excavated material will be disposed offsite.

General construction waste generated comprises a variety of non-hazardous materials including wood (used timber), excess concrete, vehicle tyres, paints, vehicle batteries, fluorescent light bulbs and contaminated containers (old paint tins, etc). Waste will also include packaging waste such as wooden pallets, plastic, paper, and cardboard from the delivery of the equipment and machinery to be used by the Project. Small amounts of hazardous wastes will

be generated, such as used lubricating and hydraulic oils (from vehicles and machinery), filters: air and oil filters, batteries (mainly lead-acid batteries) and washout water from concrete mixing plant. In addition, general refuse, similar to domestic waste, will be generated by the construction workforce at the work site, comprising food residues, paper, used bottles and cans, packaging and broken furniture.

Sewage and wastewater will be generated by the sanitation facilities provided for the construction workforce. Septic tanks will be installed and used for the treatment of sewage generated at the construction site.

Incorrect disposal of these wastes could result in leaching and the contamination of soil and water resources, which could have secondary impacts on local community health, and restrict the use of the water obtained from these sources. The use of existing dumpsites could worsen existing environmental problems at these sites, namely windblown litter, vermin and other disease vectors as well as potential health impacts from the direct contact of scavengers with the waste. In addition, there are nuisance impacts related to the dust creation and impacts from the transport of rubble to disposal sites.

Impact Significance

The scale of the potential impact of the incorrect disposal of wastes generated during construction is regional, as the impacts of disposal would extend beyond the Project site and immediate vicinity. The impacts are deemed to be long-term as the impacts will be felt after the end of the construction phase. The magnitude is therefore considered to be moderate.

The sensitivity of the receptors is considered to be moderate.

The overall impacts of waste creation, handling and disposal during construction are therefore considered to be of *moderate* significance prior to mitigation.

7.8.2 *Impact Description and Significance: Operational*

Impact Description

During the operational phase of the Project there will be a number of wastes generated from the Project processes (process wastes) and a range of other wastes from the transport operations and administration associated with the Project. The main process waste streams created during the operation of the proposed power plant will comprise air intake filters, used lubricating oils from plant machinery and vehicles, used hydraulic oils, sludge from the wastewater treatment plant, process sludge, separated oil sludge from oil/water separators, oily rags and used chemical containers.

The site will also generate general domestic waste (for example, food and packaging) and office waste (mainly paper). The quantities of general waste generated during the operation will be relatively small because of the small numbers of staff employed on each shift.

The incorrect disposal of these wastes could result in contamination of surface water and ground water resources and soils, which could have negative impacts on ecosystem functioning and also on human health for those living close to the dump sites. The disposal of wastes at existing dumpsites will exacerbate associated environmental problems such as windblown litter, vermin and other disease vectors. There are also health impacts related to the direct contact of waste scavengers with the disposed waste.

Impact Significance

The impacts during operation are likely to be experienced beyond the Project site and the immediate surroundings and are therefore considered to be regional. The impacts will be permanent, and they may persist after the operational phase. The impact magnitude is considered to be moderate.

The sensitivity of the receptors is considered to be low as the receptors will be able to adapt with relative ease and maintain pre-impact status as the volumes of waste are very low.

The overall impacts during operation are therefore assessed to be *minor* prior to the implementation of mitigation measures.

7.8.3 *Impact Description and Significance: Decommissioning*

A variety of different types of wastes will be generated by the decommissioning and demolition of infrastructure and buildings. These wastes include machinery, metal (mainly ferrous) and demolition waste including rubble and used concrete.

It may be possible to sell much of the redundant machinery and electrical equipment, including cabling, from the power plant. Equipment that it is not possible to sell for reuse elsewhere will probably be sold for scrap. The majority of the ferrous metals could be sold for scrap.

Lubricating, hydraulic and transformer oils from machinery, fuel and chemical containers and sludge residues may need to be removed prior to transport and disposal of the machinery. The incorrect handling and disposal of these wastes may result in the contamination of soils and water resources.

Demolition wastes will comprise mainly inert materials from the fabric of the buildings but will also include wood, plastics, metals. It is possible to recycle demolition waste (rubble etc) if there is a suitable construction project or road building scheme nearby. If there are no such projects that can utilise the rubble, it may be possible to use it to form access roads or as daily cover for

the local dumpsites, thereby improving the dump site’s environmental conditions.

Impact Significance

The impacts of waste handling and disposal during decommissioning will be regional as the impacts will be experienced beyond the site and immediate surroundings. The potential impacts will be permanent, as these impacts may be felt after the decommissioning phase. The overall magnitude of the impact is therefore considered to be moderate.

The sensitivities of the receptors is considered to be medium.

The overall impact during decommissioning is therefore assessed to be of *moderate* significance prior to mitigation.

7.8.4 Impact Description and Significance: Summary

A summary of the impacts of wastes generated by the Project is provided in *Table 7.19* below.

Table 7.19 Summary of Impact Significance Pre-mitigation

Phase	Impact	Significance (pre-mitigation)
Construction	Potential contamination of water resources and soil	Moderate Negative
Operation	Potential contamination of water resources and soil	Minor Negative
Decommissioning	Potential contamination of water resources and soil	Moderate Negative

7.9 PHYSICAL RESETTLEMENT

7.9.1 Background to the Resettlement Process

The site intended for the Azura-Edo IPP originally comprised two plots of land. Plot A comprised approximately 70 ha in the Orior and Idunmwowina communities while Plot B to the east comprised approximately 30 ha in Ihovbor community. Although the leaders of the Ihovbor community allowed the valuers chosen by ERM to enumerate the structures on Plot B in August 2011, they subsequently insisted that only Government’s valuers be allowed to value the structures located on the plot.

Due to the Ihovbor community leaders’ reluctance to permit the project to conduct its own census and asset inventory during 2011, Azura Power decided (in October 2011) to alter the footprint of the Project to avoid any displacement of members of the Ihovbor community. Accordingly, the Project impacts on Ihovbor are not analysed and therefore this EIA Report does not

include estimates for the physical and economic displacement of the Ihovbor community. Although, the Ihovbor community subsequently invited Azura Power to undertake a valuation during February 2012 and it is possible that the project footprint may expand to encompass this land at a later date, the current Project footprint currently excludes the eastern portion (Plot B).

Table 7.20 provides a brief overview of the displacement impacts that the two communities of **Orior-Osemwende** and **Idunmwowina-Urho-Nisen** are expected to face, and the predicted scale of these impacts. This table excludes the numbers associated with Ihovbor community.

Table 7.20 *Key Displacement Impacts and Associated Magnitude (Physical and Economic)*

Key Displacement Impacts		Displaced Community	
		Orior-Osemwende	Idunmwowina-Urho-Nisen
Loss of residential housing	Physical displacement	34 households	12 households
Loss of agricultural land	Economic displacement	322 individuals	68 individuals
Loss of crops / trees		332 individuals	71 individuals
Loss of business structures		1 business structure (1 pure water factory)	12 business structures (7 livestock farms, 1 chemist shop, 2 lock up shops, 1 welder workshop).
Loss of non-agricultural income / livelihood sources		30 households affected	35 households affected
Loss of community resources / assets		7 community assets (3 community shrines / sacred sites / tombs, 2 church buildings, 1 community health centre, 1 Government approved traditional medical centre)	6 community assets (1 community borehole, 4 community shrines / sacred sites / tombs , 1 church building)

In the following sections, each of these key displacement impacts are examined. However, a more detailed analysis along with measures for compensation, mitigation and livelihood restoration are set out in the associated RAP.

Impact Description and Significance: Pre-construction

Impact Description

The Project will acquire land from the local communities for the power plant, transmission line, and associated facilities which will cover approximately 102 ha. This will involve physical involuntary resettlement during the pre-construction phase affecting the three communities of Orior-Osemwende, Ihovbor-Evboeka and Idunmwowina-Urho-Nisen. Approximately 42

households who are resident on the plot of land to be acquired will be affected by the resettlement, along with 600 incomplete and unoccupied houses. A number of cultural and religious sites are also located within the land to be acquired. Physical resettlement for the Project is expected to result in four key impacts:

- Loss of physical assets;
- Loss of cultural sites;
- Loss of land; and
- Loss of productive agricultural land.

A RAP for the Project is being developed that will confirm the number of affected households and their losses. It will also assess potential relocation sites and the impact of resettlement on host communities.

Resettlement for the proposed Project will take place several years after a land acquisition process which was carried out for the neighbouring NIPP Project, also on land belonging to the same three communities. This resettlement process was carried out by the Nigerian Federal Government, and resulted in as-yet unresolved grievances between the communities (and between the communities and the Federal Government), over compensation for lost assets, distribution of community investment and other project benefits. As a result, notwithstanding that this Project is led by a private sector developer, there is concern in the local community with regard to the compensation and resettlement that will be associated with the Azura-Edo IPP. Furthermore Edo State will be responsible for compensation of the communities inline with Nigerian legislation. Azura Power will ensure that compensation is provided in accordance with World Bank standards.

Impact Significance

The extent of the physical resettlement impact will regional, affecting the three communities of Orior-Osemwende, Ihovbor-Evboeka and Idunmwowina-Urho-Nisen and the new areas where people will settle, with direct and indirect implications. The duration of resettlement impacts will be permanent, beginning in pre-construction and continuing beyond the life of the Project.

Residents of these communities are heavily reliant on agriculture for their livelihoods, and their lack of skills means that their ability to find alternative employment is low. As such, Project activities that affect access to agricultural land or the viability of remaining land mean that relocated stakeholders will be less able to adapt to changes without considerable on-going support. The sensitivity of receptors is considered to be high.

Based on the context of high expectations, and suspicion, combined with the extent and duration of impacts and sensitivity of the affected population, the significance of impacts associated with physical resettlement before mitigation are considered to be negative and *major*.

7.9.2 *Impact Description and Significance: Summary*

A summary of the impacts of physical resettlement is provided in *Table 7.19* below.

Table 7.21 *Summary of Impact Significance Pre-mitigation*

Phase	Impact	Significance (pre-mitigation)
Pre-construction	Loss of physical and cultural assets, land, including productive agricultural land	Major Negative

7.10 *ECONOMIC RESETTLEMENT*

7.10.1 *Impact Description and Significance: Pre-construction*

Impact Description

Economic resettlement is defined as the loss of assets, or access to assets, that result in a loss of income or means of livelihood. Economic resettlement is expected to result in the following key impacts:

- Loss of on-going income;
- Loss of initial investment (time and resources) for establishing crops;
- Inability to repay loans;
- Reduced income and economic activity within the communities;
- Increased food insecurity; and
- Tensions between stakeholders and the project developers.

This type of resettlement therefore can have a greater impact than physical resettlement. In the Project area, in addition to the approximately 642 houses (although approximately 600 of these are uncompleted buildings) that will be acquired by the Project, roughly 60 households will lose farmland. A further unknown number will lose access to forest products that are also important for local livelihoods.

The communities in the Project area are primarily dependent on land cultivation for income and livelihood, supplemented by fishing, livestock farming and forestry. The majority of people living in this area hold small or medium sized land plots (2 - 7 acres); very few households (roughly ten percent) in the area can be classified as 'large' landowners, with over ten acres of land.

Cultivation of land, particularly plantations or trees, requires significant investment of time and resources before income can be generated through harvests. As many people are unable to obtain loans from banks or other agencies, people often rely on friends and family, or loan and credit associations, for investment.

The land in the Project area remains under traditional jurisdiction (and thus is owned by the state under Nigeria's land use decree). As such, none of the users of affected land have formal land title. Women are particularly vulnerable in this regard, as they are also not entitled to land allocation under the traditional land management system.

Cultivation and agriculture in the area has already been affected by development of the neighbouring NIPP project. Some individuals in the surveyed communities reported that land acquisition for the NIPP Project has reduced the availability of agricultural land and created pressure to reduce the fallow periods for remaining agricultural land, reducing productivity of the soil. However, their principal grievance was allied to their perception that they had not received the compensation they felt they were due (because of perceived irregularities and failures in the Federal Government-led land acquisition compensation process).

Impact Significance

The extent of the impact associated with economic resettlement will extend across the three communities of Orior-Osemwende, Ihovbor-Evboeka and Idunmwowina-Urho-Nisen and beyond, and is considered to be regional. Wider impacts could be experienced in neighbouring communities if the general availability of agricultural products is reduced as a result of the relocation.

The loss of land, and therefore impacts to livelihood and income generation, will be permanent in duration. Based on the recent experience of resettlement for the neighbouring NIPP plant, coupled with the perceived Federal Government's inability thus far to deliver on compensation commitments equitably, tensions between the communities and the developers of the Project are considered highly likely.

Affected stakeholders in the area lack (formal or informal) training required to adopt alternative livelihoods, making them more sensitive to the loss of agricultural land. Vulnerable groups, including single woman-headed households, are particularly anxious about the compensation they will receive from the Azura-Edo IPP since they are unlikely to have either formal land title deeds or rights under customary land tenure. The sensitivity of the local population to the loss of livelihoods is further compounded by the cumulative impact of the previous NIPP resettlement, which resulted in loss of land without (allegedly) sufficient compensation. The receptor sensitivity is therefore considered to be high.

Based on the high sensitivity of stakeholders in the area coupled with the tension that exacerbates the situation, the negative impact of economic resettlement is assessed to be *major* before mitigation.

7.10.2 *Impact Description and Significance: Summary*

A summary of the impacts of economic resettlement is provided in *Table 7.22* below.

Table 7.22 *Summary of Impact Significance Pre-mitigation*

Phase	Impact	Significance (pre-mitigation)
Pre-construction	Loss of physical and cultural assets, land, including productive agricultural land	Major Negative

7.11 *IMPACTS TO DEMOGRAPHIC PROFILE*

The demographic profile of the three communities in the Project area is broadly reflective of demographics at the state level. The three Project-affected communities are considered to be relatively ethnically homogenous in comparison with other parts of Nigeria.

The gender breakdown is relatively equal, and the age distribution is weighted toward youth. Stakeholders in these communities have reported a steady exodus of young people from the area towards urban centres in search of jobs, education and training. However, the development of the neighbouring NIPP facility appears to have resulted in increased numbers of youth returning to Ihovbor-Evboeka and Idunmwowina-Urho-Nisen, in pursuit of new jobs. Aside from this internal population movement, migration into the region has historically been minimal.

The baseline demographic profile for the region is described in *Section 7.11*. Key characteristics include the following:

- A relatively homogenous ethnic profile;
- Balanced gender distribution;
- Youth-biased age distribution, but with reports of youth leaving the area for employment and education opportunities; and
- Historically low in-migration.

7.11.1 *Impact Description and Significance: Construction*

Impact Description

Azura Power expects that up to 500 workers will be required for the construction of the power plant (which will last between 24 and 36 months) and will require the EPC contractor to source at least 70 percent of the workers from within 30 km of the site. This implies a foreign workforce of roughly 30 percent from outside the region, amounting to possibly 150 workers.

A temporary construction camp will be constructed on the north western portion of the Project site. The exact nature of the accommodation will be

determined in discussion with the EPC contractor but will likely include accommodation, cooking and sanitary facilities for construction workers, laydown areas and vehicle parking areas. The construction camp will be fenced and access will be controlled and restricted to employees. Policies for the management of this camp and the construction workforce are yet to be developed.

The Project is expected to impact the demographic profile of the area in the following ways:

- Population increase due to influx of opportunistic job seekers and construction workforce;
- Change to gender balance, due to significant numbers of male workers;
- Change in age profile of the area with larger numbers of young people;
- Increased social tensions from the temporary presence of young male job seekers and workers; and
- Change to the ethnic structure of the region, caused by the influx of foreign workforce.

Impact Significance

The extent of impacts to demographics will largely be contained within the Project-affected communities, and will therefore be local in scale. The duration of impacts associated with the construction phase will be largely short-term, lasting only as long as construction continues. In some cases, impacts will be of shorter duration, particularly if opportunistic job seekers who are unable to secure work leave the area. The probability of impacts, however, is highly likely, based on past experience in the region and current conditions. The overall impact magnitude is considered to be moderate.

The communities of Orior-Osemwende, Ihovbor-Evboeka and Idunmwowina-Urho-Nisen are fairly small (with Idunmwowina-Urho-Nisen observed to have the largest population) and ethnically homogenous, which means that even small numbers of newcomers, particularly foreigners, will be keenly felt. However, this will be balanced by the fact that the communities live on the outskirts of Benin City (and next to the neighbouring NIPP plant) and so will be used to outsiders.

It is also important to take into consideration the existing tensions within the communities over management of the compensation from the neighbouring NIPP project and potential expectations regarding employment opportunities. Adding large numbers of young males, arriving in the communities in search of job opportunities, could exacerbate these tensions. The increase of young men in the communities may also affect other social groups, such as women. The sensitivity of the receptor is considered to be moderate.

Despite the short term and localised nature of these impacts, the scale of influx and sensitivity of the affected communities increases the significance rating

for impacts to demographics during construction, so that this is considered to be *moderate* prior to mitigation.

7.11.2 *Impact Description and Significance: Operation*

Impact Description

The operational phase of the Project is expected to begin in 2015 and continue for approximately 20 years. This phase is currently estimated to require 90 direct permanent employees (including 50 permanent site employees and 40 ancillary/ contract workers). Where the skills base exists, Azura Power and its contractors will source these positions from the Project area: based on the assessed workforce capacity in the region. Employment opportunities that will be made available and the stakeholder expectations (particularly of the three communities) in this regard must be managed appropriately. The majority of local and regional recruitment will be for semi-skilled and unskilled positions (eg kitchen staff, security guards, cleaners). It is expected that at least 15 percent of the workforce will be sourced from outside the state, or from outside Nigeria.

During operation, the plant will be operated on a 24 hour, seven days a week basis. Thus control room operators, general operators and watch keepers will work on rotating shifts; however, plans for accommodation of the operational workforce are yet to be developed.

The impacts of the Project on the demographic profile of the area during the operational phase are expected to be more or less similar to those identified for the construction phase, described above. These include:

- Reversal of youth outmigration trends and increase in youth demographic;
- Population increase due to influx of opportunistic job seekers and operation workforce; and
- Change to the ethnic structure of the local area, created by non-local workforce.

In contrast to the construction phase, demographic change during operations are less likely to be male specific, as the long-term nature of opportunities with the Project will encourage successful candidates to come with, or establish families.

Depending on how this workforce is managed and the degree to which it intermingles with the community, this could have a noticeable impact on the community, particularly in light of existing tensions. However, it is unlikely that foreign Project workers will actually reside within the local area; based on the limited capacity of the communities, it can be assumed that workers from outside will either be housed on site in Project accommodation, or will find housing in Benin City.

Impact Significance

The extent of impacts to demographics during the operations phase will remain largely contained within the Project-affected communities, and will therefore be local in nature. The duration of impacts associated with the operations phase will be long term, continuing for the life of the Project and ceasing when the Project stops operating. In some cases, impacts will be of shorter term, particularly if opportunistic job seekers who are unable to secure work leave the area. The probability of impacts, however, is highly likely, based on past experience in the region and current conditions. The overall magnitude is considered moderate.

As discussed above, the small and ethnically homogenous, nature of the three affected communities increases their sensitivity to the arrival of newcomers, particularly foreigners. However, this will be balanced by the fact that the communities live on the outskirts of Benin City and so will be used to outsiders and the low numbers of staff employed during operation. The sensitivity of the receptors is considered to be low.

The assessed significance of impacts to demographics during operations is judged to be negative and *minor*.

7.11.3 *Impact Description and Significance: Decommissioning*

Impact Description

Azura Power expects that up to 100 workers will be required for the decommissioning of the power plant and will require the EPC contractor to source at least 70 percent of the workers from within 30 km of the site. This implies a foreign workforce of roughly 30 percent from outside the region.

Decommissioning and closure of the Project will bring an end to the direct and indirect employment opportunities. Without parallel development of alternative industries or job sectors in the area, it is likely that this would result in the following impacts to demographic profile:

- Decline in population, as people seek alternative employment elsewhere;
- Rebalance of age demographic, as youth would be most likely to leave; and
- Some loss of ethnic diversity, as the outside workforce departs the region.

Impact Significance

The extent of impacts will be felt primarily at the local and regional levels, which is where the Project workforce will have settled during Project operations. The duration of impacts from decommissioning will be permanent. Population decline following closure of a major facility is a well-understood and documented impact of decommissioning; however, due to the level of uncertainty around the future socio-economic context and decommissioning plans, the probability of impacts can only be assessed as likely. The overall impact magnitude is considered to be low- moderate.

As discussed above, and due to the levels of uncertainty regarding the future communities surrounding the site, the sensitivity of the communities is regarded as moderate – high.

The total number of direct and indirect population growth associated with the Project by the time of decommissioning is difficult to estimate, but based on a loss of at least 200 people (the projected workforce), the significance of the impact on demographic profile without intervention would be negative and *moderate*.

A summary of the impacts of physical resettlement is provided in *Table 7.19* below.

7.11.4 *Impact Description and Significance: Summary*

Table 7.23 provides a summary of the significant impacts likely to arise during construction; operation and decommissioning prior to the implementation of mitigation measures (see *Chapter 8*).

Table 7.23 *Summary of Impact Significance Pre-mitigation*

Phase	Impact	Significance (pre-mitigation)
Construction	Potential changes to the demographic profile of the area including population numbers, gender balance, age profile, ethnicity and increased social tension	Moderate Negative
Operation	Potential changes to the demographic profile of the area including population numbers, gender balance, age profile, ethnicity and increased social tension	Minor Negative
Decommissioning	Potential changes to the demographic profile of the area including population numbers, gender balance, age profile, ethnicity and increased social tension	Moderate Negative

7.12 *IMPACTS TO CULTURAL INSTITUTIONS*

Edo State and the three Project communities within it are considered to be relatively ethnically homogenous. This means that customs, diet, traditional dress and language tend to be similar throughout the state. Traditional leadership structures remain firmly established in the region, from the state level and extending down through the local communities. Traditional leaders continue to exert significant authority in the area, and operate in parallel (though not always in collaboration) with official administration. Traditional religion is also widely practiced in the Project area. This involves worship at local shrines and sacred sites, often located in and around the communities.

Key characteristics include:

- A relatively homogenous ethnic community meaning similarity in customary practices;
- Firmly established local leadership structures;
- Significant authority exerted by traditional leaders; and
- Widespread practice of traditional religion.

7.12.1 *Impact Description and Significance: Construction*

Impact Description

The Project will require a workforce of 500 people during the 24 month construction phase and it is expected that up to 30 percent or more will be outsiders from other states or from outside Nigeria.

The Project will also require acquisition of up to 102 ha of land in the area of the three communities. This will likely require movement of an undetermined number of sacred sites out of the Project area. The RAP that is currently underway will look at ways of managing this.

Drawing on the experience of the neighbouring NIPP plant, there may also be some tension between traditional community leaders and the Project developers and Edo State Government (a minority equity partner in the Project).

Impact Significance

The construction phase is expected to incur the following impacts on local culture:

- Influx of outsiders could disrupt traditional customs in local communities;
- Formal approval and development process of the Project may sideline traditional leaders, and disrupt existing authority systems; and
- The removal of sacred sites would disrupt local worship practices and could create significant tension with the communities.

The extent of impacts to cultural institutions is limited primarily to the local area, namely the three communities of Orior-Osemwende, Ihovbor-Evboeka and Idunmwowina-Urho-Nisen. However, although the construction phase is relatively short term, the duration of impacts on cultural institutions such as traditional leadership and removal of sacred sites could be permanent. Based on current plans for the Project, as well as precedence set by the neighbouring NIPP project, the probability of impacts occurring is likely. The localised extent of impacts to cultural institutions during the construction phase is offset by the potential permanence of impacts and high likelihood of occurrence and the overall impact magnitude is considered to be moderate.

The sensitivity of stakeholders to impacts is moderated by the high degree of allegiance to traditional leadership structures and worship. While the

Project's construction phase will likely affect the ability of stakeholders to continue their traditional practices and ways of life, it is unlikely that these practices will be replaced. Stakeholders have reported that there is flexibility to accommodate the Project through the moving of shrines and other sacred areas, but they have emphasised that this must be done through extensive consultation with local religious authorities and leaders. The sensitivity of the receptor is therefore considered to be moderate.

Impacts to cultural institutions are assessed to be *moderate* and negative.

7.12.2 *Impact Description and Significance: Operation*

Impact Description

Acquisition of up to 102 ha of land for the Project is expected to require the relocation of a number of sacred sites. The impact of this on local cultural practices, initially assessed for the pre-construction period, will continue through the operations phase.

Azura Power will seek to promote the development of local skills and the transfer of international technologies and expertise to local manpower and local manufacturers. This should increase the possibility of local employment during the operations phase of the Project; however in the early stages at least, it is estimated that a minimum of 15 percent of the operations workforce will come from outside the state. Accommodation plans for these workers is not yet known, but it is likely that they will be housed either on-site in Project housing, or they will find housing in nearby towns. However their presence may impact on local cultural beliefs and ways of life.

During the operational phase of the Project, the impacts to cultural institutions will be:

- Ongoing disruption of traditional religious observance associated with removal/relocation of sacred sites; and
- Increased number of outsiders in the region, affecting the ethnic structure and associated customs, rites, language, etc.

Impact Significance

With the exception of the increase in the number of outsiders, which would have a regional impact, the extent of impacts would be limited to the local area. The duration would be long-term, although removal of sacred sites is a permanent impact. While the removal of sacred sites is a definite impact under current Project plans, the probability of other impacts to cultural institutions during operation is actually unlikely, given current conditions, and the precedence set by the neighbouring NIPP project, which neither resulted in a large foreign influx nor in the erosion of traditional leadership structures. The magnitude of the impacts is therefore considered to be low.

Local stakeholders report that impacts associated with relocation of sacred sites may be managed through careful consultation and planning, indicating a level of flexibility and adaptability. The sensitivity of the receptor is therefore considered to be low.

The impact associated with removal of sacred sites is the most significant of Project impacts; other impacts are low in probability and scale. Viewed together, then, Project impacts to cultural institutions during the operations phase are considered to be *minor* negative.

7.12.3 *Impact Description and Significance: Decommissioning*

Impact Description

As noted previously in this impact assessment, land acquisition for the Project will require disturbance and relocation of sacred sites and shrines in the local area, as well as relocation of certain communities. This will be a permanent change, and will not be reversed following Project decommissioning.

It is assumed that impacts to cultural institutions during the construction and operation phases will have been managed effectively, including strict controls on the behaviour and conduct of Project workforce, appropriate involvement of traditional leaders in Project operations, and effective implementation of RAP recommendations for resettlement and land acquisition. As such, cultural institutions will not have been significantly impacted during Project operations.

It is impossible to accurately predict how local cultural practices will have changed during the 20+ year lifespan of the Project. However, some areas where Project closure may have an impact include:

- Any ongoing impacts associated with the permanent removal of sacred sites/ shrines;
- Any ongoing or unresolved issues between resettled and host communities;
- Project closure may remove a source of authority and influence for local and regional traditional leaders; and
- Departure of foreign workers, who may have affected the cultural profile of the region.

Impact Significance

The extent of potential impacts to cultural institutions will be primarily local, although some impacts associated with traditional leadership and the presence of foreign workforce would be felt at a regional level. While cultural institutions and practices can be reasonably expected to adapt over a period of time, without mitigation the duration of the impact is likely to be long term. Based on the assumed implementation of mitigation measures against cultural impacts during previous phases of the Project, the probability of impacts

during decommissioning is expected to be unlikely. The overall magnitude is therefore considered to be low.

Natural changes to cultural practices and institutions are to be expected over any significant period of time, and associated with general development; and the sensitivity of the receptor is therefore considered to be insignificant - low.

Assuming effective management of Project-related impacts over the Project life-cycle, impacts to cultural institutions associated with decommissioning are expected to be *insignificant*.

7.12.4 *Impact Description and Significance: Summary*

Table 7.24 provides a summary of the significant impacts likely to arise during construction, operation and decommissioning prior to the implementation of mitigation measures (see Chapter 8).

Table 7.24 *Summary of Impact Significance Pre-mitigation*

Phase	Impact	Significance (pre-mitigation)
Construction	Disruption of local customs, change in traditional leadership structures and removal of sacred sites.	Moderate Negative
Operation	Ongoing disruption of local customs and impacts related to removal of sacred sites as well as change in ethnic structure and customs.	Minor Negative
Decommissioning	Ongoing disruption of local customs and impacts related to removal of sacred sites, unresolved resettlement issues, loss of sense of authority and change in ethnic structure and customs.	Insignificant Negative

7.13 *IMPACTS TO EMPLOYMENT AND ECONOMY*

7.13.1 *Impact Description and Significance: Construction*

Impact Description

The proposed Project is a staged development involving a construction phase of 24 to 36 months. The Project is expected to require a direct workforce of approximately 500 during this phase; this workforce will be primarily recruited via contractors and will include both skilled and unskilled roles, most of which will be temporary.

Azura Power has made a commitment to source employees from local communities where the skills base makes that possible, and will recommend its contractor(s) to follow a similar recruitment policy.

All of the major semi skilled and unskilled jobs such as drivers, cleaners, field workers, supervisors, and technicians should be sourced from the local residents with both on-the-job training and off the job training support from Azura. Management level and skilled positions will also be made available to Nigerian nationals or international consultants.

Benin is an industrial town with a substantial skills base. Moreover, Edo State's high unemployment rates amongst semi-skilled skilled youth means that the majority of the semi-skilled workforce required for the construction phase will be available within Edo State. It is therefore likely that the majority of the Project benefits will be retained within the region.

In addition to direct and indirect employment, increased economic activity among Project suppliers and Project expenditure will result in induced employment and income generation.

The construction phase for the Project is expected to result in the following positive impacts:

- Generation of direct, indirect and induced employment;
- Increase in household income through wages and Project spending;
- Increase in economic activity among local businesses; and
- Development of skills through job training and applied work experience.

Although Azura Power identifies the EPC contractor as the responsible party for the selection and management of all sub-contractors, Azura Power will seek to monitor and guide the sub-contracting practices of the EPC contractor. Azura Power emphasizes the need for high quality sub-contractors that will adopt Azura's policies on community liaison and local workforce employment. Azura Power's CLO will work to oversee that all policies are adhered to with regards to liaison with the community.

Impact Significance

The extent of impacts to employment and economy is expected to be regional. While employment skills and service/supply capacity for construction phase activities exists in Edo-State, primarily Benin City, skill levels and numbers of available workforce are currently insufficient within the local communities for the Project to have a significant impact at that level. The duration of the impacts will be primarily limited to the construction phase, and will therefore be short term. Azura Power has committed to maximise local employment and contracting, both directly and through subcontractors. Moreover, the region has experience with this type of project and has begun training construction workforce for recruitment. As such, the probability of the impact occurring is likely. The overall magnitude is therefore considered to be minor.

Due to the high unemployment rate in Edo State and sensitivity around local opportunities engendered by the neighbouring NIPP project, the potential regional workforce and supply base is considered to be a receptor of medium sensitivity.

Despite the large number of construction labourers required, the short term duration of positive impacts reduces the overall significance rating to *minor*.

7.13.2 *Impact Description and Significance: Operation*

Impact Description

The Operation Phase of the Project is expected to begin in 2015 and continue for approximately 20 years. This phase is currently estimated to require 90 permanent employees (including 50 permanent site employees and 40 ancillary/contract workers). Where the skills base exists, Azura Power and its contractors will source these positions from the Project area. Based on the assessed workforce capacity in the region, the majority of local and regional recruitment will be for semi-skilled and unskilled positions (eg kitchen staff, security guards, cleaners). Other positions during this phase will require technical supervisory and managerial skills which are less likely to be available locally, and will therefore be sourced from outside.

In some cases, such as during large scale maintenance operations, additional temporary personnel may be required. These will consist of a small number of specialised individuals who will be called in to supervise maintenance programmes and carry out performance testing. It is not known how many of these temporary employees will be required, or how often, during operations; however, it is unlikely that a significant number of these positions will be sourced from the Project area.

A small number of service and supply contracts will be signed for the Project during the Operation Phase. Where capacity exists, these contracts will be sourced from the surrounding region.

The Operation Phase of the Project is expected to result in the following positive impacts:

- Generation of approximately 90 permanent positions, many of which will be semi-skilled or unskilled;
- Generation of induced employment through service and supply contracts;
- Increase in household income through wages and Project spending;
- Increase in regional and local economic activity; and
- Development of skills and capacity through training and applied experience.

Impact Significance

The extent of impacts to employment and economy is expected to be primarily national and regional, although a number of unskilled positions may be sourced from local communities, following training and capacity building initiatives for the local workforce and contractors. Azura Power has also committed to maximise local employment and contracting, both directly and through subcontractors. The duration of impacts will extend over the life of the Project; with certain induced impacts (such as economic activity and capacity building) continuing beyond Project closure and is therefore long-term or permanent. As for the probability of impacts, the probability is highly likely. The overall impact magnitude is considered to be *high*.

Local employment and contracting is a key priority among local populations. It is also important to consider strong public resentment amongst some community members against the neighbouring NIPP Project for its perceived failure to offer equitable local employment and contracting opportunities to all three communities. As such, this impact will be viewed with a high degree of importance by local communities and stakeholders. Evaluation of this impact also considers the small population at the local level and relatively low employment, which implies that even a small number of stable, long term jobs that provide opportunities for training could have a significant positive impact to household income and spending. Sensitivity to these impacts is high, due to high local unemployment, high local job expectations and relatively low levels of training and work experience.

The proponent is committed to ensuring that the requisite infrastructure is put in place to enable the distribution of electricity (at lower voltages) to the local communities, as well as evacuation to the national grid at a higher voltage level. The exact means by which this will be done will be established with the distribution company. This measure combined with targeted social investment support to local entrepreneurs will enable the three local communities to establish small business enterprises that can take advantage of the increased power supply. The multiplier effects (on all economic sectors) of this additional power supply will be significant (in an economy where the gap between supply and demand is amongst the highest in the world).

Therefore, impacts to employment and economy (both locally and nationally) during the Operation Phase after mitigation, are expected to be positive and *high*.

7.13.3 *Impact Description and Significance: Decommissioning*

Impact Description

Land acquisition for the Project is expected to further reduce the viability of agriculture as a source of livelihood in the region. However, during the 20 year operation phase, the Project is expected to require a steady workforce of 90 employees, including 50 permanent site employees and 40 ancillary/

contract workers. An additional number of employment and contract opportunities will be required for Project servicing and support, and will be generated through local economic development and investment. Through targeted training and capacity building, the Project expects that the majority of jobs during the operation phase will be offered locally, as a priority, or regionally. This is expected to have a significant impact on local employment levels and local economic development.

Decommissioning will necessitate elimination of employment positions and subcontracts directly associated with the Project, as well as related economic activities in the region.

Impact Significance

Positive impacts to employment and economy during the operation phase of the Project could be of major significance, bringing much needed development and opportunities to the area. This means, though, that the impact of decommissioning on the employment and economic situation of the area could be of equal significance, and negative. This could go beyond simple reversal of positive impacts, as Project activities will have made it impossible for people to return to the primarily agricultural livelihoods practiced before Project development. Particular issues could include:

- Loss of direct and contracted employment positions and service/supply contracts;
- Loss of indirect business opportunities and associated employment;
- Decline in economic productivity and household income; and
- Decline in regional and local economic activity.

The extent of impacts will be regional, since the majority of the affected workforce and businesses will be regionally-based. Without initiatives to encourage development and economic diversification, the duration of impacts would be long term, if not permanent. The probability of the impacts occurring, based on pre-Project levels of economic activity, is considered to be likely and the overall magnitude is considered to be moderate.

Because the Project will have reduced the viability of agriculture as an alternative livelihood in the area, the sensitivity rating for receptors of this impact is moderate - high.

As such, the significance of the impact of Project decommissioning on employment and economy is considered to be negative and *minor*.

7.13.4 *Impact Description and Significance: Summary*

Table 7.25 provides a summary of the significant impacts likely to arise during construction, operation and decommissioning prior to the implementation of mitigation measures (see *Chapter 8*).

Table 7.25 Summary of Impact Significance Pre-mitigation

Phase	Impact	Significance (pre-mitigation)
Construction	Employment, increased income, increased secondary economic activity and skills development.	Minor Positive
Operation	Employment, increased income, increased secondary economic activity and skills development.	Major Positive
Decommissioning	Loss of employment, indirect business opportunities and economic activity and decreased income.	Minor Negative

7.14 IMPACTS TO INFRASTRUCTURE

Existing social infrastructure in the Project area is poor. Access to piped water is extremely limited, as are toilet sanitation facilities and solid waste disposal. Residents rely on river water; boreholes and wells for their water supply, and either dump household waste in improvised landfills or burn it.

Access to electricity in the three communities varies: in Orior-Osemwende, there is no electricity supply, while the communities of Ihovbor-Evboeka and Idunmwowina-Urho-Nisen are connected to the public electricity supply, though service is reported to be unreliable and irregular, due to the inadequate capacity of the local electricity transformers. During the field survey it was noted that community members expressed a hope that there would be improvements in the local electricity supply.

There is a mix of paved and unpaved roads that link the communities to the Lagos and Benin highway Roads. In general, transport routes between the communities and linking to the rest of the state are considered to be in poor condition, and local roads often become impassable during the rainy season.

Access to education is limited in the three communities, and the quality of education provided is considered to be inadequate. Current information suggests that the neighbouring NIPP project has recently built a school in the community of Ihovbor-Evboeka. There is also a primary school in Orior-Osemwende and a nursery school in Idunmwowina-Urho-Nisen. However stakeholders reported that many young people are forced to leave the area in pursuit of higher education or vocational training.

In order to use the roads for Project traffic, some improvements to local roads will have to be made. Moreover, the developers of the Azura-Edo IPP have budgeted in excess of a million dollars per annum (during both the construction and operation phases of the Project) for programmes that will

benefit the local communities. These programmes will be aimed primarily at improving the health and education of the inhabitants of these communities.

7.14.1 *Impact Description and Significance: Construction*

Impact Description

The main negative impacts to infrastructure associated with the construction phase will be associated with the influx of opportunistic job seekers and the resulting pressure on already inadequate social amenities. These include:

- Influx of opportunistic job seekers into the communities, adding pressure onto already overburdened infrastructure services (roads, schools, health facilities, etc);
- Increased household waste and the inability to dispose of this in a safe and healthy manner;
- Contamination of water resources used by local communities; and
- Disruption to road access from Project vehicles.

The main positive impacts to infrastructure associated with the construction phase will be the construction, reinforcement and paving of roads and the expenditures made by the developers on local community projects (eg assistance in borehole construction and health and education projects).

Impact Significance

The extent of these impacts will be mainly local as the impact will be experienced in the three communities only. The duration of the negative impacts is restricted to the period of the construction phase but the duration of the positive impacts is likely to subsist beyond the construction phase. Since the Project plans around infrastructure use are yet to be fully developed, the probability of impacts occurring is cautiously given as likely. The overall magnitude of the impact is therefore low.

The sensitivity of the receptors is considered to be moderate as there is little existing infrastructure.

It is also important to note the possible benefit to local education associated with Project training opportunities. At this point, however, there is insufficient information about how the Project proposes to provide training, nor to what extent this will benefit local stakeholders. Thus the significance rating of this neutral (negative and positive aspects) impact is assessed to be *minor* prior to mitigation.

7.14.2 *Impact Description and Significance: Operation*

Impact Description

Key concerns during the operational phase include:

- Inadequate electricity supply;
- Limited piped water;
- Poor toilet sanitation and solid waste disposal;
- Poor health facilities; and
- Inadequate road systems.

The Power Plant will provide 450 MW of electricity to the national grid at the Benin North Substation via a 300 KV transmission line. This will increase the total electricity available on the national grid by 450 MW (a figure representing more than 10 percent of the country's total on-grid generating capacity as at 2011).

The Project will make use of public roads for Project-related transport and the frequency of vehicle movements will be significantly lower than that experienced during the construction phase.

The level of Project accommodation to be provided on site is not yet known; however, it can be assumed that any infrastructure requirements for these accommodations would be developed by the Project, and would not impact on existing community facilities. However, an increase in community population through an influx of opportunistic job seekers could increase the pressure on already limited infrastructure services.

Impacts to infrastructure associated with the Project are focussed around the following key areas:

- Influx of opportunistic job seekers, increasing pressure on local infrastructure services;
- Contamination of water resources used by local communities;
- Project use of local roads could further reduce their capacity; and
- Increased power supply for the national power grid.

Impact Significance

The extent of impacts on infrastructure will be felt locally, with the exception of increased electricity generation, which is a cumulative impact that will be felt at a national level. The duration of the impact will be long term, during the period of the Project. Viewed from a wider perspective, the probability of benefits to the electrical power supply is highly likely, while the probability of negative impacts from increased pressure on local infrastructure and pollution of water sources is less certain. The overall magnitude of the impact on infrastructure during operation is therefore considered to be moderate and positive.

The restricted capacity of infrastructure services within the communities naturally limits the extent to which negative pressure may be added, by forcing the Project and any new inhabitants to either supply their own infrastructure or live without. However, the sensitivity of local communities to contamination of water sources would be high as this would have a serious

impact on a small number of inhabitants. This is not likely under normal operating conditions. Although negative impacts associated with the operation phase are limited, the low capacity of local infrastructure means a low sensitivity of the receptor such that the extent to which the local communities might benefit from increased power supply is restricted. The overall sensitivity of the receptors to impacts on infrastructure is assessed to be moderate. With these comments in mind, it is clear that provision of increased local access to electricity is likely to be one of the project's largest positive impacts on infrastructure.

Based on these considerations, the overall impact of the Project on infrastructure is considered to be positive and the significance is *major*.

7.14.3 *Impact Description and Significance: Decommissioning*

Impact Description

The Azura Edo IPP is expected to provide 450MW of electricity to the national power grid, helping to meet Nigeria's growing demand for energy. Locally, it is not known to what extent the Project will rely on or invest in infrastructure, including roads, sewerage and water supply. This assessment has assumed that there will be at least some investment in infrastructure development by the Project over the course of operations, in order to support Project activities (such as road improvements for Project transport). It is also assumed that increases in population and economic activities in the region associated with Project operation will lead to some level of ancillary infrastructure investment.

There are currently no clear plans for infrastructure development at the local level, which limits the impact Project closure would have. However, the decline in population and economic activity that would accompany Project decommissioning would likely have an impact on government investment in infrastructure in the area. Potential implications include:

- Some loss of power to the national grid due to closure of the Project;
- Associated loss of power at the local level;
- Decline in local infrastructure maintenance by the Project; and
- Decline in government investment in local infrastructure development and maintenance.

Impact Significance

While impacts to power supply will be national, it is assumed that closure of the Project would be associated with an increase in national electricity production in some other way. As such, the extent of the impacts of closure will be limited to the regional level. The duration of impacts would likely be long term. Due to the high level of uncertainty around the state of infrastructure in the area at the point of Project implementation, the probability of impacts can only be assessed as likely, resulting in an overall minor impact magnitude.

As described in *Section 7.14.2*, the sensitivity of the receptors is considered to be low.

Because the Project is not expected to have a significant impact on infrastructure during the operation phase, decommissioning and closure of the facility is expected to result in a possible negative impact of not more than *minor* significance.

7.14.4 *Impact Description and Significance: Summary*

Table 7.26 provides a summary of the significant impacts likely to arise during construction, operation and decommissioning prior to the implementation of mitigation measures (see *Chapter 8*).

Table 7.26 *Summary of Impact Significance Pre-mitigation*

Phase	Impact	Significance (pre-mitigation)
Construction	Pressure on or development of infrastructure, increased waste, contamination of water resources and traffic disruption.	Minor Neutral
Operation	Pressure on or development of infrastructure increased waste, contamination of water resources, traffic disruption and increased power supply.	Major Positive
Decommissioning	Reduced power to the national grid, local power supply loss and decline in infrastructure maintenance and local authority investment	Minor Negative

7.15 *IMPACTS TO HEALTH PROFILE*

Health care facilities in these communities are limited; health centres, where they exist, have insufficient health workers as well as services and supplies. Partly due to cost, many residents choose instead to go to traditional healers or herbalists, or to informal medicine shops that are run by people without formal medical training. The most common health conditions in the area are caused or exacerbated by poor hygiene and sanitation facilities.

7.15.1 *Impact Description and Significance: Construction*

Impact Description

The construction phase of the Project will involve many potentially hazardous activities, including excavation, facility construction, heavy vehicle traffic and a large construction workforce, many of whom are likely to be foreign.

Besides the construction of the plant itself, there will also be activities relating to the laying of the gas pipeline spur connecting the ELPS and the plant and the NIPP project. There may also be risks associated with gas leaks from testing the gas pipeline at the end of construction, and the laying and operation of the transmission line. These activities will be taking place in and around the Project site, which is located in close proximity to the three small communities of Orior-Osemwende, Ihovbor-Evboeka and Idunmwowina-Urho-Nisen.

Health impacts include both impacts to physical health, as well as emotional and psychological well-being of stakeholders. The following negative health impacts are therefore considered possible during the construction phase of the Project:

- Psychological impacts associated with the influx of outsiders and disruption to community and local culture;
- Psychological impacts associated with unmet expectations for local employment and contract opportunities;
- Physical impacts due to noise and dust pollution;
- Impacts to physical health due to community interactions with foreign workers;
- Safety risks associated with accidents from poor construction practices, heavy traffic, accidental explosions and accidental contact with the transmission line; and
- Psychological stress and possible physical impacts associated with tensions towards the Project.

The expenditures made by the Project (during the construction phase) on community health programmes (including support for well and borehole construction) may only partially offset these negative effects.

Impact Significance

The extent of impacts to health will mainly be local, although certain impacts may be felt at the regional level. While the duration of most (negative) impacts will be limited to the 24 to 36 months of the construction phase, it is likely that some of the psychological and physical health impacts could continue beyond this, resulting in the impacts being long-term. Based on the current lack of information about the origin of foreign workers and how the workforce and activities during construction will be managed, it must be assumed that the probability of impacts occurring is likely. The overall magnitude of the impact on health are assessed to be minor but negative.

The sensitivity of the affected communities is based on existing weaknesses in the health care system, which means that changes to the health profile in the area will not easily be accommodated. Existing challenges with the current facilities for sanitation and hygiene would also exacerbate any impacts around physical health. The quality of the road system around the Project area is reportedly poor, and most stakeholders move between communities in small

vehicles, motorcycles or by bicycle, implying a high risk for accidents between the public and Project vehicles. There is also a long history of poor construction practices in Nigeria and so there is a considerable risk of health and safety accidents to workers if construction of the plant and the gas pipeline is not carefully managed. Transmission of STIs is a major concern, but is surrounded by social stigma in the Project area, making it even more of a challenge to address. The overall sensitivity of the local communities to the impact on health is considered to be moderate.

Based on these considerations, as well as the fact that some risks (including those associated with poor construction practices, heavy traffic and HIV/AIDS and other infectious disease transmission) have potentially fatal consequences, the negative impacts on community health during the construction phase are considered to be *moderate* prior to mitigation; whilst the positive impacts are considered to be *minor*.

7.15.2 *Impact Description and Significance: Operation*

Impact Description

Key concerns related to community health during the operational phase include the following:

- Limited health care capacity, including lack of facilities and personnel;
- Potential explosions from the gas pipeline due to community sabotage;
- Negative perceptions from the community relating to the fear of gas leakages from the pipeline;
- Residual tension, associated with frustrated expectations from the development of the neighbouring NIPP project; and
- Prevailing physical health issues associated with poor hygiene and sanitation facilities.

As noted previously, the Project has committed to hiring locally where possible, and there are high expectations within local communities for employment and contract positions. However, skilled positions will require some foreign recruitment which implies that workers will almost certainly have the opportunity to mix with local communities.

The operation phase will also require regular light to medium traffic, using existing road networks.

The majority of negative impacts to physical and psychological health will occur during the construction phase, when activities are most hazardous. Negative impacts during operation are reduced in number, but may include:

- Psychological impacts associated with unmet expectations for local employment and contract opportunities;
- Psychological impacts associated with community tensions caused or exacerbated by the Project;

- Psychological impacts associated with community fear of gas leakage or explosions from the plant/gas pipeline;
- Impacts to physical health due to community interactions with foreign workers (and the spread of infectious diseases);
- Safety risk associated with Project traffic; and
- Health impacts associated with Project contamination of surrounding environment.

By contrast, the majority of positive impacts to physical and psychological health will occur during the operation phase and will be associated with the increased availability of electricity in the surrounding communities and the Project's annual expenditure on local community programmes (via a social investment programme that will include health).

Impact Significance

The extent of health impacts is primarily local, with the potential for impacts associated with traffic and contamination reaching the regional scale. The duration of impacts will be long-term or permanent, depending on the severity of health consequences.

Based on current limitations for local employment and contracting, as well as existing community tension around the neighbouring NIPP Project, it is possible that local expectations around Project opportunities might not be met. Interaction between foreign workers and the local communities is also highly likely, along with associated risks of transmission of disease, particularly STIs. The Project is likely to improve the overall condition of the roads but it may also result in an increased number of traffic accidents. In light of these considerations, the probability of impacts to health is considered likely and the overall impact is deemed to be minor and negative.

There is a long history of community sabotage of oil and gas pipelines in the Niger Delta. Edo State is located just north of this area of Nigeria. Communities routinely tap gas pipelines to obtain condensate that can be sold illegally. The rate of sabotage of oil pipelines is also high. Communities are also likely to have a poor understanding of how gas leakages will be managed by the Project.

The quality of the road system around the Project area is poor, and most people move between communities in small vehicles, motorcycles or by bicycle increasing the potential for traffic accidents with Project vehicles. Transmission of STIs is also a major concern and is surrounded by social stigma in the Project area, making it even more of a challenge to address. The sensitivity of the affected communities is influenced by the existing weaknesses in the health care system, such that changes to the health profile in the area would not easily be accommodated. Existing challenges with the current facilities for sanitation and hygiene may also exacerbate any impacts around physical health. These factors result in a sensitivity of receptors that is considered to be moderate.

Along with the reduced scale of exposure from the construction phase, negative health negative impacts during operation are considered to be *minor* prior to mitigation and the positive impacts are also cautiously assumed to be *minor*.

7.15.3 *Impact Description and Significance: Decommissioning*

Impact Description

Project impacts to health during the construction and operation phases will be related to the presence of direct and associated workforce and their potential interactions with communities, as well as safety risks associated with Project activities, such as road use and heavy vehicle transport. There is also concern about the potential for environmental impacts from the Project to contaminate local agricultural production or water sources that are used for household cooking, drinking, as well as irrigation.

Decommissioning will result in the removal of health and safety risks associated with the Project. However, any manifestations of health impacts having arisen from the construction or operation phases, such as STI transmissions, injuries or deaths from traffic accidents, or pollution of groundwater, will remain in effect after Project closure. Therefore, while decommissioning will not result in any new impacts to health, closure of the Project could remove any treatment or support for victims of health impacts manifested during Project construction or operation.

Impact Significance

The extent of this impact is the same as during operation, affecting the local and regional levels, and the duration of impacts remains long term or permanent. The probability of impacts is based on the residual probability of serious health impacts occurring. Assuming effective implementation of recommended mitigation measures in construction and operation phases, this is considered to be unlikely. The overall impact magnitude is assessed to be low-moderate.

The sensitivity of affected communities to health impacts remains an issue – without significant development, the capacity of health care services will remain weak and unable to accommodate significant health issues left behind by the Project. This means that affected populations are unlikely to receive the care or treatment that they require following Project decommissioning and an overall high sensitivity.

Negative impacts to health associated with Project closure are cautiously considered to be *moderate* prior to mitigation.

7.15.4 *Impact Description and Significance: Summary*

Table 7.27 provides a summary of the significant impacts likely to arise during construction, operation and decommissioning prior to the implementation of mitigation measures (see Chapter 8).

Table 7.27 *Summary of Impact Significance Pre-mitigation*

Phase	Impact	Significance (pre-mitigation)
Construction	Psychological impacts related to changes in culture, unmet expectations, noise and dust nuisance, physical health and STIs and safety risks, improvements to electricity supply, health care facilities and water resources.	Moderate Negative & Minor Positive
Operation	Psychological impacts related to unmet expectations, noise and dust nuisance, physical health and STIs, safety risks and contamination risks, improvements to electricity supply, health care facilities and water resources.	Minor Negative & Minor Positive
Decommissioning	Ongoing effects from the operational phase, safety risks and noise and dust nuisance.	Moderate Negative

7.16 **WORKPLACE HEALTH AND SAFETY**

7.16.1 *Impact Description and Significance: Construction*

Impact Description

Activities related to excavation, facility construction, heavy vehicle traffic on site and potential additional habitats for mosquito-breeding will pose risks to the health and safety (H&S) of employees. The following negative health impacts have been identified during the construction phase of the Project:

- Physical health impacts due to noise and dust pollution on site;
- Impacts to the physical health of employees due to infectious disease and vector and/or water-borne diseases such as malaria. During construction there will be an increased numbers of people, and in the cases that transmission is a function of direct contacts the prevalence will increase with group size; and
- Physical H&S impacts resulting from any accidents occurring on and around site including trips, falls, operation of machinery, movement of plant on site and electrical incidents associated with the laying of the transmission line.

Impact Significance

The extent of impacts to workplace H&S will mainly be local, although in cases where serious health related accidents occur the impacts will be beyond the local level (treatment at state level health care facilities or internationally). The duration of most (negative) impacts will be limited to the 24 to 36 months of the construction phase, although if there is a severe injury (or fatality), this impact would be permanent. The probability of the impact occurring is considered to be likely prior to mitigation. The overall magnitude of the impact on workplace H&S is therefore assessed to be moderate and negative prior to mitigation. As the sensitivity of the receptors, is considered to be high, the overall significance of the impact on workplace H&S is considered to be *major* prior to mitigation.

7.16.2 *Impact Description and Significance: Operation*

During operation, the likely impacts to workplace H&S will include accidents relating to machinery operation, trips and falls, falling from heights, electrical related incidents and explosions and accidents related to traffic movement on site.

Impact Significance

The extent of the impacts relating to accidents will be local and on site. The duration of impacts will be long-term or permanent, depending on the severity of health consequences. The probability of impacts occurring is likely prior to mitigation and the magnitude of the impact is considered to be high. As the sensitivity of the receptors, is considered to be high, the overall significance of the impact on workplace H&S during operation is considered to be *major* prior to mitigation.

7.16.3 *Impact Description and Significance: Decommissioning*

Impact Description

Activities related to demolition, decommissioning, heavy vehicle traffic on site and potential additional habitat for mosquito-breeding will pose workplace H&S risks. In particular, the following negative health impacts have been identified during the decommissioning phase of the Project:

- Physical health impacts due to noise and dust pollution on site;
- Impacts to physical health of employees due to infectious disease and vectors and/or water-borne diseases such as malaria; and
- Physical H&S impacts resulting from any accidents occurring on and around site including trips, falls, operation of machinery, movement of plant on site and incidents (eg electrocution and explosions) associated with the decommissioning of the transmission line and gas piping and pipeline.

Impact Significance

The extent of the impacts relating to workplace H&S during decommissioning will be local and on site and the impact duration will be long-term or permanent, depending on the severity of health consequences of the H&S incident. The probability of impacts occurring is likely prior to mitigation and the magnitude of the impact is considered to be high. As the sensitivity of the receptors, is considered to be high, the overall significance of the impact on workplace H&S is considered to be *major* prior to mitigation.

7.16.4 Impact Description and Significance: Summary

Table 7.27 provides a summary of the significant impacts likely to arise during construction, operation and decommissioning prior to the implementation of mitigation measures (see Chapter 8).

Table 7.28 Summary of Impact Significance Pre-mitigation

Phase	Impact	Significance (pre-mitigation)
Construction	Physical health impacts related to noise, dust, infectious diseases (particularly malaria). and other accidents, incidents, trips and falls related to moving plant, excavations, working at heights, exposed electrical wiring and operation of machinery.	Major negative
Operation	Physical health impacts related to noise, dust and other accidents, incidents, trips and falls related to traffic on site, working at heights and accidents/ incidents and explosions.	Major negative
Decommissioning	Physical health impacts related to noise, dust, infectious diseases (particularly malaria). and other accidents, incidents, trips and falls related to moving plant, excavations, decommissioning and demolition activities, working at heights, demolition of gas and electrical infrastructure.	Major negative

8.1 AIR QUALITY

8.1.1 Construction

Recommended mitigation measures during construction are outlined below:

- Upon completion of finish grading, earth firebanks and slopes that shall remain unseeded shall be temporarily protected against erosion by applying a coat of liquid asphalt as indicated below;
 - Loosely bonded coarse-grained surfaces: 1.4 ℓ/ m²
 - Loosely bonded coarse-grained surfaces: 3.6 ℓ/ m²
- Binder material shall also be used for erosion and dust control, if required, for example on long term exposed surfaces, or on long term stockpiles;
- All materials with the potential to lead to dust emissions shall be transported in sheeted trucks;
- Wash down of dirty equipment, such as excavators, dump trucks and drilling equipment shall be undertaken as required, to avoid excessive build up of dirt and mud on equipment;
- Water suppression or dust extraction shall be fitted where possible to construction equipment that has the potential to generate dust, eg during drilling and excavating;
- Surfaces that are to be excavated or cleared shall be dampened prior to clearing or excavation where there is potential for excessive dust to be created;
- Build up of dirt or mud on access roads of the Highway shall be cleaned regularly;
- On-site vehicle speeds on unhardened roads and surfaces shall be limited to less than 15 kph;
- Drop heights for material transfer activities such as unloading materials shall be minimised;
- Bowsers (water tankers) or similar equipment shall be available for use to wash down surfaces and roads and damp down surfaces;
- Drains and guttering on site shall be maintained in a clean state to reduce the potential for materials to become dry and friable;

- Bitumen shall not be overheated and where possible, bitumen shall not be heated with open flame burners; and
- Pots and tanks containing hot bitumen shall be covered to minimise fume production.

With the strict implementation of the mitigation measures listed above, the magnitude of the dust impact will be reduced such that the residual significance is considered to be *minor-moderate*.

8.1.2 *Operation*

The turbines will use a dry low NO_x combustion system which will form a key mitigation measure during the Operation phase. In addition all vehicles used shall be regularly maintained.

The impact significance air emissions during operation will remain *minor* (NO₂) and *insignificant* (CO) and *significant* (greenhouse gases).

8.1.3 *Decommissioning*

Whilst there are no significant impacts identified associated with the decommissioning phase of the Project, it is recommended that best practice measures are implemented to minimise the potential for dust to be generated and escape off-site. These mitigation measures shall be developed as part of the decommissioning plan and shall be broadly similar to those identified during construction and the remainder of the above section describing management of dust impacts during construction. For example also, sulphur hexafluoride, a greenhouse gas, from the transformers should not be released to the atmosphere, but be reclaimed for reuse, if possible.

On the basis of the potential impacts identified for the decommissioning phase, a dust mitigation programme shall be developed in the Site Closure and Restoration Plan.

The implementation of mitigation measures will reduce the dust produced as part of the decommissioning activities and prevent the dust from leaving the site. The residual impacts during decommissioning are likely to be *minor-moderate* after the implementation of mitigation.

8.2 *NOISE*

8.2.1 *Construction*

The construction contractor shall implement the recommendations set out in the British Standard 5228: 2009 or similar standards as well as the IFC Guideline Noise Levels. The following general noise control strategies shall be adopted and enforced where practicable:

- develop a detailed plan that relates to noise control for relevant work practices and discuss this with construction staff during health & safety briefings;
- avoid dropping materials from height, where practicable;
- avoid metal-to-metal contact on equipment;
- avoid mobile plant clustering near residences and other sensitive land uses;
- ensure periods of respite are provided in the case of unavoidable maximum noise level events;
- inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as providing the contact details of the CLO;

The following plant and equipment noise control strategies shall be considered, adopted and enforced where practicable:

- ensure, where feasible and reasonable, that 'low noise' equipment, or methods of work with the lowest noise impacts are selected;
- select the most effective mufflers, enclosures and low-noise tool bits and blades;
- use alternatives to audible reversing alarms (such as broadband noise emitting models) that provide a safe system of work, or configure the site to maximise forward movements of mobile plant;
- use alternatives to diesel/petrol engines and pneumatic units, such as hydraulic or electric-controlled units, where feasible and reasonable;
- use a temporary noise barrier for small equipment such as hand tools;
- reduce throttle settings and turn off equipment and plant when not used;
- regular inspection and maintenance of all plant and equipment to ensure it remains in good working order;
- for machines with fitted enclosures, check that doors and door seals are in good working order and that the doors close properly against the seals;
and
- ensure air lines on pneumatic equipment do not leak and generate noise.

With the implementation of the mitigation measures, the construction noise during civil works such as site clearance, or the use of jackhammers, pile drivers and the like, there is a potential of the noise exceeding more than 5 dB above the IFC noise guideline limit (ie 60 dB during the day and 50 dB during the night). If this occurs, this would result in major residual impacts for the duration of these (unmitigated) works.

However, the likelihood of the noise levels reaching above these levels is low and the duration of the impact would be very intermittent and would occur only under specific circumstances. Taking this into account, the residual impact is considered to remain *negligible*.

8.2.2 *Operation*

The most significant operational noise sources at the closest noise sensitive properties (NSR 1, 2 and 3) are the walls and roofs of the Gas Turbine Generator building. Mitigation will be focused on the highest noise sources identified in *Table 7.17* and therefore noise will be reduced from this source.

Noise from the generators within the buildings are likely to be significantly greater than 85 dB(A) internally. As part of mitigation through design and to reduce the noise levels, the walls and roofs have been modelled as emitting facades with an equivalent sound pressure level of 85 dB(A) at 1 m from the facades. The gas turbine generator building is well designed to ensure breakout noise from the gas turbine is minimised. The following measures form part of this design:

- Azura's design ensures that reverberant sound from the gas turbine is minimised internally, for instance by using an acoustic enclosure. A Hushclad double-skin enclosure will be used with good door seals which will be replaced regularly to meet the specifications for 82 dB at 1 m from the source. If the 82 dBA for the enclosure is not feasible with these measures, then the turbine building will be upgraded to heavier walls or more internal absorption or a concrete block wall to achieve the same result.
- Exhaust stacks will be designed to meet a power level of 92 dB(A).
- Azura's design shall ensure that all walls, roof, windows and doors to the building have a high noise reduction rating and ensure that there are no significant gaps. Air conditioning/air flow requirements shall be designed to take account of noise breakout.

Mitigation for Cumulative Impacts

- Azura Power will further refine the noise modeling of the plant to avoid > 45 dB at the four farms to the west of the plant by implementing design measures such as attenuators on the stacks, cladding on the turbine

building and/ or noise barriers at the four receptors. Azura Power will report these noise modeling results to FMEnv prior to implementation.

- If found to be required, Azura Power will implement these measures and construct noise barriers at the four farms.
- Azura Power will conduct ongoing monitoring and noise level readings monthly for the first two years of operation at the four farms to confirm the efficacy of the design mitigation or noise barriers and report these results to FMEnv.
- Establish a grievance mechanism for communities that allow residents to communicate concerns regarding noise levels and have them addressed in a timely and effective manner.

With the implementation of the mitigation measures, the negative noise impacts as a result of the Project (and cumulative impacts) will remain *insignificant*.

8.2.3 *Decommissioning*

The mitigation measures listed during construction shall also be implemented during decommissioning. The decommissioning contractor shall implement the recommendations set out in the British Standard 5228: 2009 or similar standards as well as the IFC Guideline Noise Levels.

As such noise levels are unlikely to exceed 70 dB LAeq, 1hr which is a broadly acceptable criteria for decommissioning noise impacts given the type of activity and distance between the main work sites and nearest sensitive receptors. Residual noise impacts during decommissioning are therefore considered to be *insignificant* prior to mitigation.

8.3 *TERRESTRIAL SOIL AND GEOLOGY*

8.3.1 *Construction*

The site is located on a mixture of secondary forest and fallow land which will be cleared during the construction phase. The following mitigation measures have been recommended as part of addressing the anticipated impacts to the local soils:

- Effective site drainage to allow for the directed flow of surface water off site. This shall include cut-off drains to divert surface runoff from exposed soils or construction areas;
- Particularly during construction temporary drainage channels shall be constructed to channel and divert surface water away from any down slope land and agricultural plots;

- Oil interceptors and silt traps shall be put in place to manage and retain sediments on site;
- Avoid erosion by ensuring that all roads used on and off site are suitable for heavy vehicles (during construction and operation);
- As far as possible implement low impact excavation, in-fill and trenching methods;
- The amount of bare ground and stockpiles shall also be minimised to avoid silt runoff;
- Rehabilitation and revegetation of cleared areas adjacent to the Project site which shall include the re-vegetation of bare soils before the next wet season;
- Bunding of areas where hazardous substances are stored (eg fuel, waste areas);
- Development and implementation of a waste management plan (as part of the ESMP) to ensure that waste is disposed of correctly such that soil contamination is minimised.

With the implementation of the mitigation measures listed above and decreased erosion potential, the impact magnitude will be reduced to moderate. The receptor sensitivity remains low, and therefore the residual impact will remain *moderate*.

8.3.2 *Operation*

During operation it is important that effective site drainage and silt retention methods have been implemented by the time the Project has reached the operational phase. The following mitigation measures shall also be in place during the operation phase:

- Paving of the area occupied by the plant and roads on site, which will cover approximately 25 percent of the total area of the site ;
- The majority of the surface of the site area will be covered with gravel or a similar material with a higher permeable surface to reduce surface run-off particularly during heavy rains;
- Development and implementation of a waste management plan (as part of the ESMP) to ensure that waste is disposed of correctly such that soil contamination is minimised; and
- Effective operation of the wastewater treatment plant to ensure that waste water and oil contaminated waste water are in compliance with relevant standards after treatment to avoid soil contamination.

Following implementation of the mitigation measures outlined above, it is anticipated that the impact magnitude will be reduced to insignificant. The overall residual significance of the impact will therefore become *insignificant*.

8.3.3 *Decommissioning*

The mitigation measures identified during construction shall be most relevant for the decommissioning phase. Apart from implementing the mitigation measures identified above, there shall be concentrated effort on the following mitigation measures:

- Minimisation of concentrated transportation and excavation during decommissioning to reduce erosion;
- Rehabilitation and revegetation of cleared areas adjacent to the Project site which shall include the re-vegetation of bare soils before the next wet season.
- Development and implementation of a waste management plan (as part of the ESMP) to ensure that waste is disposed of correctly such that soil contamination is minimised.

Following the implementation of the mitigation measures the magnitude may decrease to negligible - low. The residual impact is therefore assessed to be of *insignificant – minor* significance.

8.4 *WATER RESOURCES*

8.4.1 *Construction*

The following mitigation measures shall be implemented during construction for the prevention of contamination of water resources:

- Ensure proper placement of soil stockpiles to reduce exposure of sediment-generating materials to wind or water;
- Reduce or prevent off-site sediment transport using appropriate methods such as effective site drainage, and sediment/silt trapping mechanisms;
- Design permanent drainage installations for heavy rainfall events and protect stormwater channels using slope, limitation techniques, rip-rap and lining;
- Any hydrocarbons, fuels, lubricants and chemicals to be used will be stored in bunded and lockable oil storage tanks, with hoses and gauges kept within the bund. Regular checking and maintenance of all plant and machinery to minimise the risk of fuel or lubricant leakages;

- All surface water or other contaminated water which accumulates in the bund shall be removed by manually controlled positive lift pumps and not by means of a gravity drain;
- Training and equipping relevant staff in safe storage and handling practices, and rapid spill response and cleanup techniques;
- Minimal or total avoidance of soil disturbance and no stockpiles close to open drainage channels (preferably establishing a 10 m buffer zone and leaving existing vegetation in place);
- Exposed ground and stockpiles will be minimised to reduce silty runoff, and if necessary measures such as geotextiles will be used to shield spoil mounds.
- Azura Power shall use effective construction site drainage measures, utilising cut-off drains (to divert surface runoff from exposed soils or construction areas), oil interceptors and silt traps to manage and retain sediments on site;
- Leaving vegetation *in situ* wherever possible, and re-vegetation of bare soil before the next rainy season;
- Adequate provision for the collection, treatment and disposal of sewage from site offices;
- Ensure that all areas used for concrete mixing are lined so that the runoff from these areas is prevented from entering any watercourses; and
- Waste shall be separated on site and waste storage areas shall be located on hardstanding (or bunded, if suitable) to prevent potential contamination.

With the implementation of the mitigation measures during construction, the residual impact magnitude will be reduced to low and the residual impact on water resources will be reduced to *minor* significance.

The negative impact of groundwater use on groundwater resources will remain *insignificant*.

8.4.2 *Operation*

The following mitigation measures shall be implemented during operation for the prevention of contamination of water resources:

- Waste and storage areas for hazardous substances shall be separated on site and waste storage areas shall be located on hardstanding (or bunded,

if suitable) to prevent potential contamination. These include areas around gauges, pumps, sumps and loading/unloading areas.

- Ensure that the diesel storage tanks and components shall and will meet international standards for structural design and integrity and provide corrosion protection by cathodic protection inside steel tanks and piping if required. Undertake periodic inspection for corrosion and integrity of storage tanks, pipes and components and regular maintenance pipes, seals, connectors and valves and other components. Equip tanks with spill and overfill prevention devices (eg alarms, automatic shut-off devices and catch basins).
- Construct stormwater channels and oilwater separators in diesel storage, handling and transfer areas.
- Develop spill control and response plans to respond to spills and leaks.
- Develop and implement a monthly monitoring programme for sampling and analysis of effluent released from the facility site in accordance with local, national and World Bank requirements.
- Develop and implement monthly ongoing groundwater monitoring for early detection of hydrocarbon leaks.
- The site will undertake monitoring of waste water discharge (prior to discharge) to ensure that water quality remains within Nigerian, WHO and World Bank limits. Any sludge that is produced will be disposed of as hazardous waste to an appointed licensed waste disposal facility in Port Harcourt.

With the implementation of the mitigation measures during construction, the residual impact magnitude will be reduced to low-moderate but due to the existence of sensitive receptors (ie communities using the local water resources for water abstraction purposes) the residual impact on water resources is still considered to be of *minor* significance.

The negative impact of groundwater use on groundwater resources will remain *minor*.

8.4.3 *Decommissioning*

The following mitigation measures are recommended for the decommissioning phase for the prevention of contamination of water resources:

- Ensure proper placement of soil stock piles to reduce exposure of sediment-generating materials to wind or water;

- Reduce or prevent off-site sediment transport using appropriate methods such as effective site drainage, and sediment/silt trapping mechanisms;
- Design permanent drainage installations for heavy rainfall events and protect stormwater channels using slope, limitation techniques, rip-rap and lining;
- Any hydrocarbons, fuels, lubricants and chemicals to be used will be stored in bunded and lockable oil storage tanks, with hoses and gauges kept within the bund. Regular checking and maintenance of all plant and machinery to minimise the risk of fuel or lubricant leakages;
- Azura Power shall carefully decommission the groundwater abstraction boreholes, or if they are to remain in continued use, ensure they are capped to prevent the development of a potential pathway for contaminants.
- Ensure correct disposal of demolition waste and chemicals (including transformer oil, residual sludge from the wastewater treatment works and diesel) and/or incidents and spills.

With the implementation of the mitigation measures during decommissioning, the residual impact magnitude will be reduced to insignificant - low but the residual impact on water resources will remain of *minor* significance.

The negative impact of groundwater use on groundwater resources will remain *insignificant*.

8.5 *BIODIVERSITY*

8.5.1 *Construction*

The following mitigation measures shall be implemented in the construction phase of the Project:

- Vegetation clearing shall be limited to areas where it is absolutely necessary. The development of biodiversity management plan (BMP) which will include demarcation of the floral species on site by a botanist, identifying measures to protect floral species from accidental damage during construction. To the extent possible the site design will consider retaining as many floral species as possible, and the relocation of those that cannot be retained and protected;
- Provide training to staff to enable the identification of all floral and faunal species of a Threatened status. An anti-poaching policy will also be communicated to staff;

- Incorporation of protection measures for the Vulnerable faunal species with input from an entomologist as two faunal species of IUCN Vulnerable status were identified;
- Areas cleared for construction and not required for buildings, facilities or infrastructure shall be revegetated or covered with hardstanding;
- Demarcate work areas clearly for construction workers to ensure that the disruption of vegetation does not occur outside of designated areas;
- In areas where there is dense vegetation, the disruption (clearing of secondary forests on site) will likely cause fragmentation of species habitats. To allow for species to migrate between habitats, habitat corridors can be established. The habitat corridors will enable habitat continuity which is relevant in the event that species are impacted directly by site clearing, thus allowing them to move further away from the disturbance without the loss of habitats. The habitat of the two vulnerable faunal species will require identification, and preservation or creation of alternative suitable habitats with the specialist advice of an entomologist. This will be addressed in the BMP.
- Where possible, ensure roads do not cut through or run directly adjacent to sensitive/large areas of forested land;
- Ensure that all drivers receive training on the ecological sensitivities and driving techniques required to minimise disturbance to fauna which may be nocturnal or have specific migratory routes during the day. Speed limits shall be established and enforced;
- In relation to the point above, the Project shall train all staff through an awareness raising session (which could form part of induction) with all workers that will be on site to ensure that they are aware of ecological sensitivities;
- Implement effective site drainage, and sediment/silt trapping mechanisms to mitigate the impacts of surface run-off into the closest surface water bodies;
- Dust suppression measures (such as spraying) shall be implemented if required;
- Protect storm water channels from erosion to reduce downstream siltation;
- Use appropriate excavation, infill and trenching methods that minimise the disturbance to soils and vegetation directly on and around the site;
- Design permanent drainage installations for heavy rainfall events with sufficient capacity for 1:50 year rainfall events; and

- After construction, rehabilitate and revegetate disturbed areas to the extent that this is feasible.

With the implementation of the mitigation measures, the residual impact magnitude will become medium and the residual impact on biodiversity will be reduced to *moderate* significance during construction.

8.5.2 *Operation*

The following mitigation measures shall be implemented in the construction phase of the Project:

- Security and work lighting (both during construction and operation) shall be shielded and directed downwards to prevent side-spill; the use of tall mast lights shall be carefully assessed, and avoided if possible, to minimise light impacts both during construction and operation;
- Implementation of the BMP and refresher training for all staff to ensure that they are aware of all measures to protect floral and faunal species in the Study Area;
- Ensure that all staff receive training on the ecological sensitivities to minimise disturbance to floral and faunal species particularly those identified to be of an elevated ecological status. Staff will be trained so that they are aware of any specific migratory routes for faunal species, and an enforcement of an anti-poaching policy. In addition drivers will receive training to ensure safe driving techniques particularly near or through nocturnal and migratory routes with appropriate speed limits established and enforced;
- Control of any invasive floral species that may occur on the site boundaries as a result of clearing the vegetation. This shall be managed through the re-vegetation strategy.

With the implementation of the mitigation measures during operation, the residual impact magnitude will be insignificant and the residual impact on biodiversity will be reduced to *minor* significance.

8.5.3 *Decommissioning*

The mitigation measures identified for the decommissioning phase will follow those identified for the construction phase. This is largely due to the fact that the level of disturbance during this phase will mirror that observed during construction.

Focused attention shall be on the re-vegetation of the Study Area, attempting to return the site to its original status. One of the core aims of the mitigation measures implemented during this phase shall be to increase and re-establish

the connectivity of native plant and animal populations. The following measures are particularly relevant:

- Demarcate work and demolition areas to avoid unnecessary disruption to biodiversity;
- Ensure that the dust emissions arising from the roads used are minimised; and
- Restore species diversity and structure in the disturbed areas through rehabilitation and revegetation of the site using native floral species (except where non-native species are appropriate). The measures through which this will be achieved should carefully take into consideration the Threatened floral and faunal species identified in the Study area;

With the implementation of the mitigation measures during decommissioning, the residual impact magnitude will be insignificant – low and the residual impact on biodiversity will be reduced to *insignificant - minor* significance.

8.6 WASTE MANAGEMENT

8.6.1 Construction

The following mitigation measures shall be implemented during the construction phase:

- The EPC contractor shall develop a waste management plan which will include requirements for separation, handling and disposal of all wastes generated. Azura Power will ensure that a waste management plan is development across all the phases of the Project;
- All waste shall be disposed of in line with Nigerian requirements at a suitable and licensed waste disposal facility.
- Azura Power shall identify suitable disposal sites and confirm capacities for disposal for general and hazardous wastes prior to the initiation of site clearance activities. There are several suitable facilities that are known to the Project, and that are located in Port Harcourt. A selection of facilities will be audited and the facility which meets the Project's standards will be chosen.
- Soil spoil shall be used for on-site levelling and compaction as much as possible to limit volumes requiring disposal offsite;
- Local communities shall be encouraged to remove logs and branches for fuel; and

- Waste shall be separated on site and waste storage areas shall be located on hardstanding to prevent potential contamination.

With the implementation of the mitigation measures during construction, the residual impact magnitude will be reduced to low and the significance of the residual impact on biodiversity will be *minor*.

8.6.2 *Operation*

The following mitigation measures shall be implemented during operation:

- The Operator shall develop a waste management plan which will include requirements for separation, handling and disposal of all wastes generated. Azura Power will ensure that a waste management plan is development across all the phases of the Project;
- All waste shall be disposed of in line with Nigerian requirements at a suitable and licensed waste disposal facility. It is envisaged that the Project will use the services of a facility located in Port Harcourt;
- Azura Power shall identify suitable disposal sites and confirm capacities for disposal for general and hazardous wastes prior to the operational phase;
- Waste shall be separated on site and waste storage areas shall be located on hardstanding (or banded, if suitable) to prevent potential contamination;
- Spent oils (including transformer oil) shall be recycled; and
- Azura Power shall undertake regular monitoring of wastewater discharged offsite including the by product of sludge from waste water treatment.

With the implementation of the mitigation measures during the operational phase, the residual impact magnitude will be reduced to low and the significance of the residual impact on biodiversity will be *insignificant - minor*.

8.6.3 *Decommissioning*

The following mitigation measures shall be implemented during the construction phase:

- The EPC contractor shall develop a waste management plan which will include requirements for separation, handling and disposal of all wastes generated. This will form part of a Site Closure and Restoration Plan to be developed;

- All waste shall be disposed of in line with Nigerian requirements at a suitable and licensed waste disposal facility. ;
- Azura Power shall identify a suitable disposal site at Port Harcourt which meets the required capacity for the disposal of general and hazardous wastes prior to decommissioning;
- Waste shall be separated on site and waste storage areas shall be located on hardstanding to prevent potential contamination; and
- All metal shall be sold for scrap and machinery; and infrastructure and buildings shall be dismantled such that as much of this waste can be reused or recycled.

With the implementation of the mitigation measures during operation, the residual impact magnitude will be reduced to low and the significance of the residual impact on biodiversity will be *minor*.

8.7 *PHYSICAL RESETTLEMENT*

As noted earlier, an international standard RAP is being developed for the Project resettlement. The relevant mitigation measures will be outlined in the RAP but encompass the following:

- Accurately define entitlement;
- Fair compensation;
- Livelihood restoration; and
- The movement of community structures.

Resettlement will disrupt the lives of the resettled communities and significant support will be required to ensure that the affected communities are able to re-establish their communal resources, homes and other assets lost through the process, as well as to re-establish their livelihood.

The proposed mitigation and management measures are intended to facilitate adjustment to the impacts of resettlement; however, such management measures will not prevent resettlement and associated loss of communal facilities and cultural heritage from occurring.

The negative residual impact is reduced to a *moderate* significance rating following the implementation of the Entitlement Framework and compensation measures defined in the RAP, as these will support affected households in the re-establishment of their livelihoods to match or exceed pre-resettlement standards.

As noted earlier, an international standard RAP is being developed for the Project resettlement. This will seek to accurately define entitlement, fair compensation and livelihood restoration and the movement of community structures and assets. Economic resettlement will disrupt local livelihoods and significant support will be required to ensure that affected communities are able to re-establish these.

The proposed mitigation and management measures are intended to facilitate adjustment to the impacts of resettlement; however, such management measures will not prevent resettlement and associated disruption from occurring.

The negative residual impact is reduced to a *moderate* significance rating following the implementation of the Entitlement Framework and compensation measures defined in the RAP, as these will support affected households in the re-establishment of their livelihoods to match or exceed pre-resettlement standards.

Construction

The following mitigation and management measures are recommended to reduce the potential impact on demographics during the construction phase of the Project:

- Develop camp and workforce management protocols. Ensure that these are clearly communicated to the entire workforce (both Azura and contractors) and ensure that measures are strictly enforced;
- Wherever possible, prioritise local employment for the construction phase workforce;
- Develop a transparent recruitment process for the construction workforce, and ensure that this is clearly communicated to all potential workforce in advance of the construction phase, in order to manage expectations and opportunistic influx; and
- Establish a grievance mechanism for communities that allow residents to communicate concerns and have them addressed in a timely and effective manner.

The presence of a relatively large construction workforce during this phase of the Project cannot be avoided. However, by implementing the recommended mitigation measures, the impact on demographics can be reduced.

The extent of the impact will remain the same, as will the duration. However, the scale will have been reduced and local sensitivities taken into consideration to manage impacts over the construction period. As such, the negative residual impact will be reduced to *minor*.

8.9.2 *Operation*

The following mitigation and management measures are recommended to reduce the potential impact on demographics during the operations phase of the Project:

- Develop camp and workforce management protocols. Ensure that these are clearly communicated to all workforce (both Azura and contractors) and ensure that measures are strictly enforced;
- Wherever possible, prioritise local employment for the operations phase workforce;
- Develop a transparent recruitment process for the operations workforce, and ensure that this is clearly communicated to all potential workforce in advance of the operations phase, in order to manage expectations and opportunistic influx; and
- Establish a grievance mechanism for communities that allow residents to communicate concerns and have them addressed in a timely and effective manner.

Mitigation of impacts to demographic profile involves facilitating parallel development of industry and livelihood opportunities in the Project area. These alternatives must not be dependent on the Project, in order for them to continue after the Project has been decommissioned. Specific recommendations include:

- Facilitate Small and Medium Enterprise (SME) development in the local communities and surrounding region;
- Invest in infrastructure development that can provide long-term benefit to the communities;
- Identify and facilitate training opportunities for local workforce to participate in other job sectors; and
- Support sustainable development and implementation of new technologies in local agricultural production.

With the implementation of these mitigation measures, the extent of the impact will remain the same, as will the duration. However, the scale will have been reduced and local sensitivities taken into consideration to manage

impacts over the operations period. As such, the impact will be reduced to *insignificant*.

8.9.3 *Decommissioning*

Implementation of measures to build the local and regional economy and develop sustainable alternative employment and livelihood opportunities will help to minimise or prevent a significant decline in population following the end of the Project. While some outmigration, particularly of foreign workforce, is to be expected, the residual impact of this on demographics will be *insignificant - minor*.

8.10 *IMPACTS TO CULTURAL INSTITUTIONS*

8.10.1 *Construction*

The following mitigation measures are recommended to minimise impacts to cultural institutions during the construction phase:

- Develop and implement a Local Employment Strategy to maximize local employment during the construction phase;
- Develop camp and workforce management protocols. Ensure that these are clearly communicated to all workforce (both Azura and contractors) and ensure that measures are strictly enforced;
- Ensure that traditional leaders are formally involved in the Project development process;
- Establish a grievance mechanism for communities that allows residents to communicate concerns and have them addressed in a timely and effective manner;
- Ensure that sacred sites are identified well in advance of construction and are relocated and re-established in close consultation with traditional religious leaders making sure that religious leaders are fully engaged throughout the process. There shall be appropriate monitoring to ensure stakeholders are adapting;
- Ensure an appropriate implementation of the recommendations made under the implementation framework of the RAP. Carry out the RAP and implement proposed mitigation measures; and
- The mitigation measures associated with the Impacts to Cultural Heritage are set out in an outline PCR Plan which will need to form a new and separate annexe to the ESIA. The Project will prepare a full and detailed PCR plan prior to commencement of construction based upon this outline plan.

The proposed mitigation measures are designed to manage, from an early stage, interactions between a foreign workforce and the communities and to identify issues early on so that they can be addressed before becoming more serious.

Effective and ongoing implementation of mitigation measures will reduce the potential residual negative impacts on cultural institutions to *minor*.

8.10.2 *Operation*

The mitigation measures recommended to minimize impacts to cultural institutions during the operations phase will be the same as those identified during the construction phase, and will serve as a continuation of the existing implemented measures:

- Ensure that traditional leaders are formally involved in the Project operations, including monitoring and evaluation of management plans; and
- Maintain a grievance mechanism for communities that allow residents to communicate concerns and have them addressed in a timely and effective manner.

The proposed mitigation measures are designed to manage communications between the Project workforce and the local community and traditional leadership structures. If these have been successfully relocated or re-established there shall be no reason that cultural practices and ways of life cannot resume and continue undisturbed during the Project operations phase.

Effective and ongoing implementation of mitigation measures will reduce the potential residual negative impacts on cultural institutions to *insignificant*.

8.10.3 *Decommissioning*

Mitigation is not required for insignificant impacts. However, the Project is advised to follow the measures outlined below to ease the transition process during decommissioning:

- Continue to work with traditional leadership structures during the decommissioning process;
- Ensure that Project plans and decommissioning activities are clearly communicated to local and regional stakeholders; and
- Ensure effective completion and, where appropriate, handover of responsibilities identified through the RAP.

Effective and ongoing implementation of mitigation measures will reduce the potential residual negative impacts on cultural institutions during decommissioning to *insignificant*.

8.11 IMPACTS TO EMPLOYMENT AND ECONOMY

8.11.1 Construction

ERM recommends the following mitigation measures during and throughout construction to maximise the positive impacts of the Project on employment and the economy:

- A Local Supplier and Contractor Development Unit should be established and should continue to operate throughout the construction phase. This unit should seek to increase services and contracts sourced from local suppliers, and should provide training and mentoring support to local entrepreneurs and vendors;
- Implement a Local Employment Policy within Azura and its subcontractors, to prioritize recruitment of residents from the local communities first, followed by the region, as far as is practicable given the skill and experience requirements of different jobs. The policy will outline Azura's requirements on community liaison and local workforce employment which the EPC contractors (and other contractors) will be expected to adhere to;
- Implement a Local Procurement Policy that favors capable businesses and service providers from the local communities first, followed by the region, ahead of providers from outside the area;
- Ensure that recruitment and training is transparent and equitable (by implementing procedures that prevent payment of bribes for recruitment, for example) and that the training programmes meet national and international standards for employment and occupational health and safety;
- Develop and implement training programmes to develop local workforce and supplier capacity;
- All Project staff shall receive on-the-job training associated with their role, with associated certification for employees to use in future employment;
- Disseminate information about local employment and contracting opportunities equitably by using accessible communication channels such as local government bulletins, village notice boards, registration with district employment departments, and advertisements in local newspapers; and

- Disclose Project employment and procurement information frequently and regularly through transparent communication on hiring policies amongst local communities, which aid in managing expectations and demonstrating to local communities that Azura Power is providing training and employment opportunities to their full ability.

The majority of jobs generated will still be short term in nature (during construction); however, the extent of the benefit will be more likely to be felt in the local communities, where sensitivity of receptors is highest. These measures will maximise the number of local employees and suppliers, and will ensure that advantages associated with training and capacity building opportunities are implemented, thereby increasing the duration of impacts. The positive residual impacts to employment and economy are therefore assessed to be *moderate*.

8.11.2 *Operation*

A positive impact of major significance does not require specific mitigation or enhancement; however, Azura has an opportunity to maximise this important benefit through a small number of targeted measures:

- Local Employment and Procurement Policies implemented during the construction phase shall be extended into the operation phase.
- Training priorities for operation shall be identified early and pre-employment training shall begin as early as possible (prior to commencement of the operation phase).
- During operation, Azura Power shall implement internal training and promotion initiatives for upward mobility of the workforce, particularly local employees; this shall result in gradual phasing out of some foreign nationals from higher level positions.
- Ensure that recruitment and training is transparent and equitable (by implementing procedures that prevent payment of bribes for recruitment, for example) and demonstration that during recruitment processes the local workforce will be considered in the first instance) and that they meet national and international standards for employment and occupational health and safety.
- Clearly and equitably communicate information about local employment and contracting opportunities through accessible communication channels. These communication channels shall be reviewed following the construction phase for relevance and effectiveness. Besides helping to maximize local access to information on recruitment and procurement opportunities, this will also help to manage expectations around these two issues.

- Frequent and regular disclosure of Project employment and procurement information and transparent communication on hiring policies amongst local communities, beginning in the construction phase and continuing through operation.

Recommended enhancement measures are designed to increase the extent of positive employment and economic impacts within the local area and region. Furthermore, by implementing a transparent and well-communicated recruitment and training programme, the Project can help mitigate negative perceptions among local stakeholders, who may be sensitive about availability of local opportunities.

Through these measures, therefore, the residual positive impacts to local employment and economic activity could be as high as *major*.

8.11.3 *Decommissioning*

Implementation of the following mitigation measures shall begin during operation, in order for them to be in effect by the time decommissioning is underway. The mitigation measures shall have a strong focus around capacity building and investment in economic development and diversification of the region, thus having long-lasting effects. Recommendations are similar to those presented for demographic impacts; this is because the two impacts are directly linked:

- Facilitate SME development in the local communities and surrounding region;
- Work with local and regional organizations to develop credit and loan programmes for small business development;
- Invest in infrastructure development that will support a strong SME environment;
- Identify and facilitate training opportunities for the local workforce to participate in other job sectors;
- Provide training to the local and regional workforce on career development and management of personal finances;
- Provide training to local and regional contractors on effective business management; and
- Support sustainable development and implementation of new technologies in local agricultural production.

The recommended mitigation measures will help to develop the capacity of small and medium enterprises in the region, and prepare them for survival

after Project closure reducing the negative impact of Project closure to *insignificant - minor*.

8.12 *IMPACTS TO INFRASTRUCTURE*

8.12.1 *Construction*

ERM recommends the following mitigation measures prior to or during the construction phase to manage the impacts of the Project on infrastructure ⁽¹⁾ :

- Implement a comprehensive Community Investment plan to facilitate an appropriate and coordinated response with local government authorities and Non Governmental Organisations (NGOs) to address impacts of increased pressure on social infrastructure. This will maximise the ability of local communities to benefit from the increased power generation of the Project from operation onwards. This will include the local distribution of power however the Community Investment Plan does not make provision for the payment of transformers, pre-paid meters etc.
- Develop an Influx Management Plan in close collaboration with the local government, the communities and NGOs to address infrastructure requirements (health, education, water, transport, etc), natural resource use/management, solid waste management (of larger settlements) and strengthening of local community support networks.
- Develop a detailed rehabilitation and implementation framework as a part of the RAP to provide a clear overview of how impacts on infrastructure in host communities will be mitigated and managed.
- Develop a traffic management plan to limit Project use of community roads during busy periods and to minimise disruption; and
- Carry out regular monitoring of water quality in the local communities to identify incidences of contamination and respond appropriately.

Together with the social investment plan and resettlement action plan, strict implementation of these mitigation measures and ongoing monitoring of effectiveness throughout the construction phase will reduce the potential negative residual impacts to the infrastructure to *insignificant - minor*, while potential positive impacts during the construction phase remain *minor* in significance.

(1) The timing of the early interventions that Azura will be undertaking (in connection with the development of the social infrastructure of the local communities) can be seen in Table 10.1 of the RAP.

8.12.2 *Operational*

The mitigation measures identified during construction shall be carried over and monitored through the operation phase. Any negative impacts identified during the operation phase shall be mitigated through the following measures, in addition to those outlined above:

- Any Project use of local infrastructure (such as roads or river water) shall involve investments to upgrade services; and
- Carry out regular monitoring of water quality in the local communities to identify incidences of contamination and respond appropriately.

Taking the mitigation measures above into account, the residual impact of the increased electricity generation will remain *major* positive. The impact is positive due to the benefits of improved electricity supply, but it remains moderate due to the fact that the impacts are largely cumulative at the national and regional level, compared to the local level.

8.12.3 *Decommissioning*

Mitigation of impacts of minor significance is not mandatory; however, implementation of recommended mitigation measures for impacts to demographics and employment and the economy will effectively mitigate negative impacts to infrastructure, by reducing population decline and reduction in economic activity.

Assuming that mitigation measures associated with impacts to demographic profile and employment and economics are effectively implemented, and assuming that closure of the Azura power plant will be tied to increased electricity generation through a different source, residual impacts to infrastructure from Project decommissioning are considered to be *insignificant*.

8.13 *HEALTH PROFILE*

8.13.1 *Construction*

The high significance of the risk rating for health impacts (including, in some cases, the possibility of fatalities) is associated with Project activities in the local context. With this in mind, the following mitigation measures to be implemented prior to, and during, the construction phase are strongly recommended:

- Develop and implement a Local Employment Strategy to maximize local employment during the construction phase;

- Encourage the construction workforce to undergo testing (Azura and contractors) for sexually transmitted infections (STIs);
- Develop camp and workforce management protocols that include workforce behaviour and interactions with local communities. Ensure that these are clearly communicated to all workforce (both Azura and contractors) and ensure that measures are strictly enforced;
- Develop a Traffic Management Plan that sets out maximum speeds for Project vehicles, defensive driving techniques, timing of Project vehicle movements (to avoid busy periods), dust and noise suppression/management, and establishes a monitoring mechanism to ensure effectiveness;
- Communicate Project transport plans to communities, along with safety notices as appropriate;
- Work with the Government to set out parameters around use of security forces to support the Project, including acceptable force and use of weapons;
- Azura Power will ensure that all contractors maintain HSE plans and contractors HSE plans shall be reviewed for adequacy prior to all contract awards. All contractors and workers shall be required to comply with Azura Power's occupational health and safety guidelines and standards for general work practices, hours of work, air emissions, noise and light;
- Consider investing in local health care facilities, and supporting them in carrying out ongoing monitoring of the health profile in the area; and
- Conduct a risk assessment for the laying of the gas supply and transmission line included as part of the Project scope. The Risk Assessment and the results of which will be incorporated into the EMP once completed.

During construction there may be also be an increase in sexually transmitted diseases due to the interaction between immigrant and construction workers and local women in the area. In addition, there may be a heightened risk of unwanted pregnancies amongst local women. Mitigation measures for this shall include a programme raising awareness on general health issues. This will incorporate an HIV/AIDS awareness and prevention program which will include voluntary testing, the provision of condoms, and education of the workforce and local communities. In addition, if the Project considers in investing in local health care facilities as outlined above, particular focus shall be paid to sexual and reproductive health.

Strict implementation and ongoing monitoring of the effectiveness of the mitigation measures for any health related impacts outlined above shall

reduce the potential residual negative impacts during the construction phase to *minor*.

8.13.2 *Operation*

Recommended mitigation measures for operation impacts to health are similar to the mitigation recommendations during construction outlined above. There should be a particular focus on maintaining the mitigation measures identified during construction, in particular the Traffic Management Plan and the workforce management protocol.

- There will also need to be a focus on putting in place measures relating to fire and explosion risk management including:
- Routine safety checks shall be carried out on the plant in line with standard safety procedures for power plants;
- Azura workers shall be trained on basic safety procedures and environmental issues;
- Azura shall maintain emergency and first line first aid at strategic locations through out the plant;
- Azura will develop and shall maintain emergency and spill prevention and response/countermeasures plans for all phases of the project (this should include preparation for any accidental spillages or explosions from the gas supply line and transmission line); and
- Azura will conduct community health and safety awareness campaigns for its workers and communities particularly around the presence of the gas pipeline and transmission line and the dangers of sabotage and what to do in the event of an emergency.

Strict implementation of these mitigation measures and ongoing monitoring of effectiveness throughout the operation phase will result in the significance of negative residual negative impacts to health remaining *minor*.

8.13.3 *Decommissioning*

Assuming mitigation measures for health impacts during previous Project phases are implemented, the following measures are recommended to address residual health impacts following decommissioning:

- Establish a contingency fund to address contamination of the surrounding environment prior to Project closure;
- Ensure that any victims of health or safety impacts of the Project are rehabilitated with treatment and support that can continue after closure of the Project; and

- Consider providing sustainable investment in local health care facilities during the operation phase so that capacity is there to provide ongoing support as needed following Project closure.

Strict implementation of these mitigation measures will reduce the significance of the potential residual negative impacts to health to *insignificant - minor*.

8.14 WORKPLACE HEALTH AND SAFETY

8.14.1 Construction

Given that the negative impacts on workplace health and safety, including the potential for accidents in the workplace, and contracting infectious diseases, is proposed to be of high significance, several mitigation measures have been identified below.

- Registration with the nearby health care facilities including the Primary Health Care Facility (PHC) in Orior-Osemwende community, the central hospital south of Benin City, and the University of Benin teaching hospital located north of Benin City. Registration with local health care facilities will ensure that any accidents that occur in the workplace will be addressed immediately.
- Encourage the construction workforce to undergo testing (Azura Power and contractors) for sexually transmitted infections (STIs).
- Health awareness programme incorporating an HIV/AIDS awareness and prevention program which will include voluntary testing, the provision of condoms, and education of the workforce.
- Worker induction will include detailed H&S training, including awareness raising regarding disease vectors, for all staff and daily H&S toolbox talks will be conducted daily with the entire workforce prior to commencement of construction activities.
- Specific H&S training programmes should be provided for workers assigned to tasks associated with particular H&S risks ie working at heights, hot work, drivers, machine operators, those working in areas with elevated dust and noise levels. First aid training for key staff will also be provided, and include issuing of first aid certificates.
- First aid kits and defibrillators will be made readily available at several locations at the plant.
- Warning signs in place, including those for the electrical and mechanical equipment safety warning, and chemical hazard warning.

- Personal Protective Equipment (PPE) will be worn at all times during construction, where required. This will depend on the type of work being conducted but will include hard hats, safety boots, hearing protection, eye protection, ventilators and visibility clothes, where appropriate.
- Contractors will be required (through contractual requirements) to abide by Azura Power's H&S requirements.
- Azura Power should liaise with the Edo State Government's Ministry of Employment, Labour and Productivity to report any health and safety incidents as a legal requirement. Azura Power should work with the State Government for support with security for the site.
- Azura Power should conduct a Risk Assessment for the laying of the pipeline and operation of the power plant to understand the explosion risks and contours. The results of the Risk Assessment along with monitoring measures will be incorporated into an updated EMP.
- Site clearance and construction techniques should be planned to minimise the amount of standing water on site, to reduce potential breeding grounds for disease vectors. A spray programme to control disease vectors shall be implemented if necessary.

During the construction period, the Health, Safety and Environmental (HSE) officer of the selected construction company will be responsible for the health and safety aspects of the construction activities. It is not envisaged that Azura Power will have an ambulance on site due to the vicinity of hospitals in Benin City with the appropriate facilities.

Strict implementation and ongoing monitoring of the effectiveness of the mitigation measures for any H&S related impacts outlined above will reduce the likelihood to unlikely, the impact magnitude to moderate and the sensitivity of the receptors to low. With mitigation, the residual impact on workplace H&S during construction will therefore be reduced to *minor*.

8.14.2 *Operation*

Recommended mitigation measures for operation impacts to workplace health and safety are similar to the mitigation measures recommendations for construction. Focus should be paid to maintaining the standards and procedures implemented during construction. The mitigation measures outlined above will be similar but may be amended to reflect the nature of activities during operation.

- Worker induction will include detailed H&S training, including awareness raising regarding disease vectors, for all staff and weekly H&S toolbox talks will be conducted daily with the entire workforce prior to provide an

opportunity to ensure that procedures are being adhered to, and to discuss any incidents in the workplace.

- Encourage the construction workforce to undergo testing (Azura Power and contractors) for sexually transmitted infections (STIs).
- Health awareness programme incorporating an HIV/AIDS awareness and prevention program which will include voluntary testing, the provision of condoms, and education of the workforce.
- Specific H&S training programmes should be provided for workers assigned to tasks associated with particular H&S risks ie working at heights, hot work, drivers, operation of machinery or equipment with the potential to cause electrocution, those working in areas with elevated dust and noise levels. First aid training for key staff will also be provided, and include issuing of first aid certificates.
- PPE shall be provided and worn at all times during construction, where required. This will depend on the type of work being conducted but will include hard hats, safety boots, hearing protection, eye protection, ventilators and visibility clothes, where appropriate.
- Routine safety checks shall be carried out on the plant in line with standard safety procedures for power plants and any recommendations from the risk assessment.
- Warning signs in place, including those for the electrical and mechanical equipment safety warning, and chemical hazard warning.
- Azura Power shall maintain emergency and first line first aid at strategic locations through out the plant.
- Azura Power will develop and shall maintain emergency and spill prevention and response/countermeasures plans for all phases of the project. This will include emergency responses to any explosions or spillages associated with the gas piping or pipeline.

The HSE officer of the operating company will assume responsibility for all health and safety aspects during operation.

Strict implementation of these mitigation measures and ongoing monitoring of effectiveness throughout the operation phase will reduce the likelihood to unlikely, the impact magnitude to moderate and the sensitivity of the receptors to low. With mitigation, the residual impact on workplace H&S during operation will therefore be reduced to *minor*.

8.14.3 *Decommissioning*

The health and safety procedures identified and implemented during construction and operation will be maintained during decommissioning. During this phase particular attention should be paid to potential incidents that may occur with the increase in traffic on site. The following measures are recommended during decommissioning:

- Worker induction will include detailed H&S training, including awareness raising regarding disease vectors, for all staff and daily H&S toolbox talks will be conducted daily with the entire workforce prior to commencement of decommissioning activities.
- Encourage the construction workforce to undergo testing (Azura Power and contractors) for sexually transmitted infections (STIs).
- Health awareness programme incorporating an HIV/AIDS awareness and prevention program which will include voluntary testing, the provision of condoms, and education of the workforce.
- Specific H&S training programmes should be provided for workers assigned to tasks associated with particular H&S risks ie working at heights, hot work, drivers, machine operators, dismantling of electrical cables, those working in areas with elevated dust and noise levels. First aid training for key staff will also be provided, and include issuing of first aid certificates.
- Warning signs in place, including those for the electrical and mechanical equipment safety warning, and chemical hazard warning.
- First aid kits and defibrillators will be made readily available at several locations at the plant.
- PPE shall be provided and worn at all times during construction, where required. This will depend on the type of work being conducted but will include hard hats, safety boots, hearing protection, eye protection, ventilators and visibility clothes, where appropriate.
- Decommissioning and site rehabilitation techniques should be planned to minimise the amount of standing water on site, to reduce potential breeding grounds for disease vectors. A spray programme to control disease vectors shall be implemented if necessary.

Strict implementation of these mitigation measures and ongoing monitoring of effectiveness throughout the operation phase will reduce the likelihood to unlikely, the impact magnitude to moderate and the sensitivity of the receptors to low. With mitigation, the residual impact on workplace H&S during operation will therefore be reduced to *minor*.

In theory, any development such as the Azura power plant may also be taking place at the same time as other developments, causing impacts affecting the same resources or receptors, such that there will be cumulative effects with the proposed Project. The impacts of developments already underway or committed (in particular, the neighbouring NIPP plant and the associated construction of the substation) have been taken into account in modelling future air and noise emissions and assessment of these impacts by including them in the future baseline for the Project within this impact assessment. Apart from the NIPP plant, research of relevant documents (eg the EIA for the neighbouring NIPP facility) and consultations with local and state authorities has not identified any other significant future developments whose cumulative impacts should be considered in this ESIA.

9.1

AIR QUALITY

The proposed Azura IPP plant is located adjacent to the NIPP plant, which is currently under construction and during operation will release similar emissions to that of the Azura Edo IPP. As such, an assessment of the cumulative air quality impacts will need to understand the impacts related to the operation of both plants.

Based on the limited public information about the details of the design of the neighbouring NIPP plant, it has been assumed that the plant and emissions and impacts will be the same as that of the Azura Edo IPP. This is considered to be a reasonable assumption, as both power plants operate on natural gas and are of a similar production capacity. The assessment of cumulative impacts was performed by modelling the emissions from both plants. The results of the assessment of cumulative impacts are presented in *Figure 9.1* and *Table 9.1* below.

Cumulative impacts from the Project and neighbouring NIPP have been quantified for NO_x (*Table 9.1*), but not for CO, as these levels are considered to be very low and not associated with significant impacts on air quality. The cumulative dust impacts are also expected to be low since the construction phase for the NIPP will be completed once the construction of the Azura Edo IPP is initiated.

Figure 9.1 Annual mean NO₂, cumulative impact for the Azura Edo IPP and neighbouring NIPP

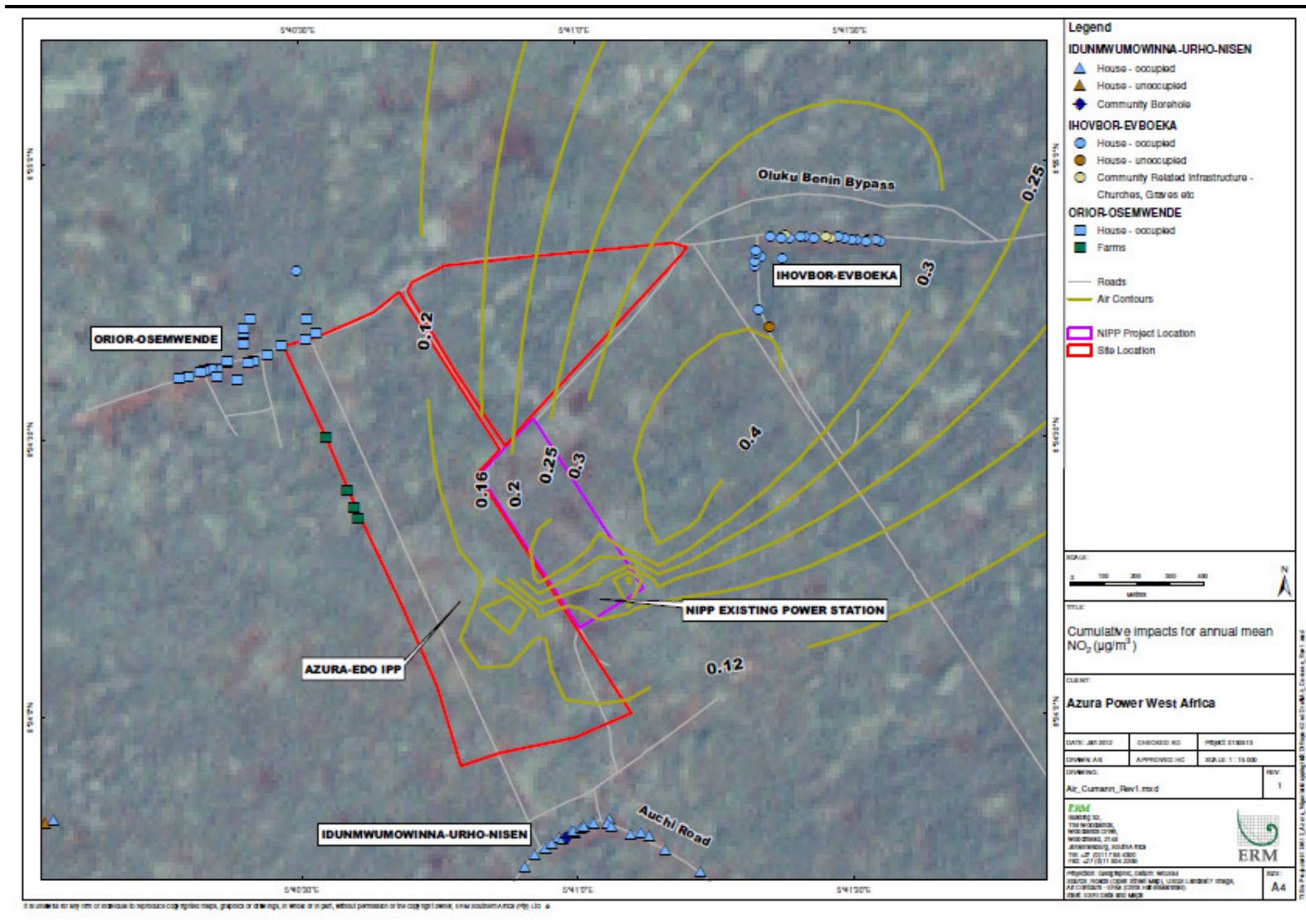


Figure 9.2 1h maximum NO₂, cumulative impact for the Azura Edo IPP and neighbouring NIPP

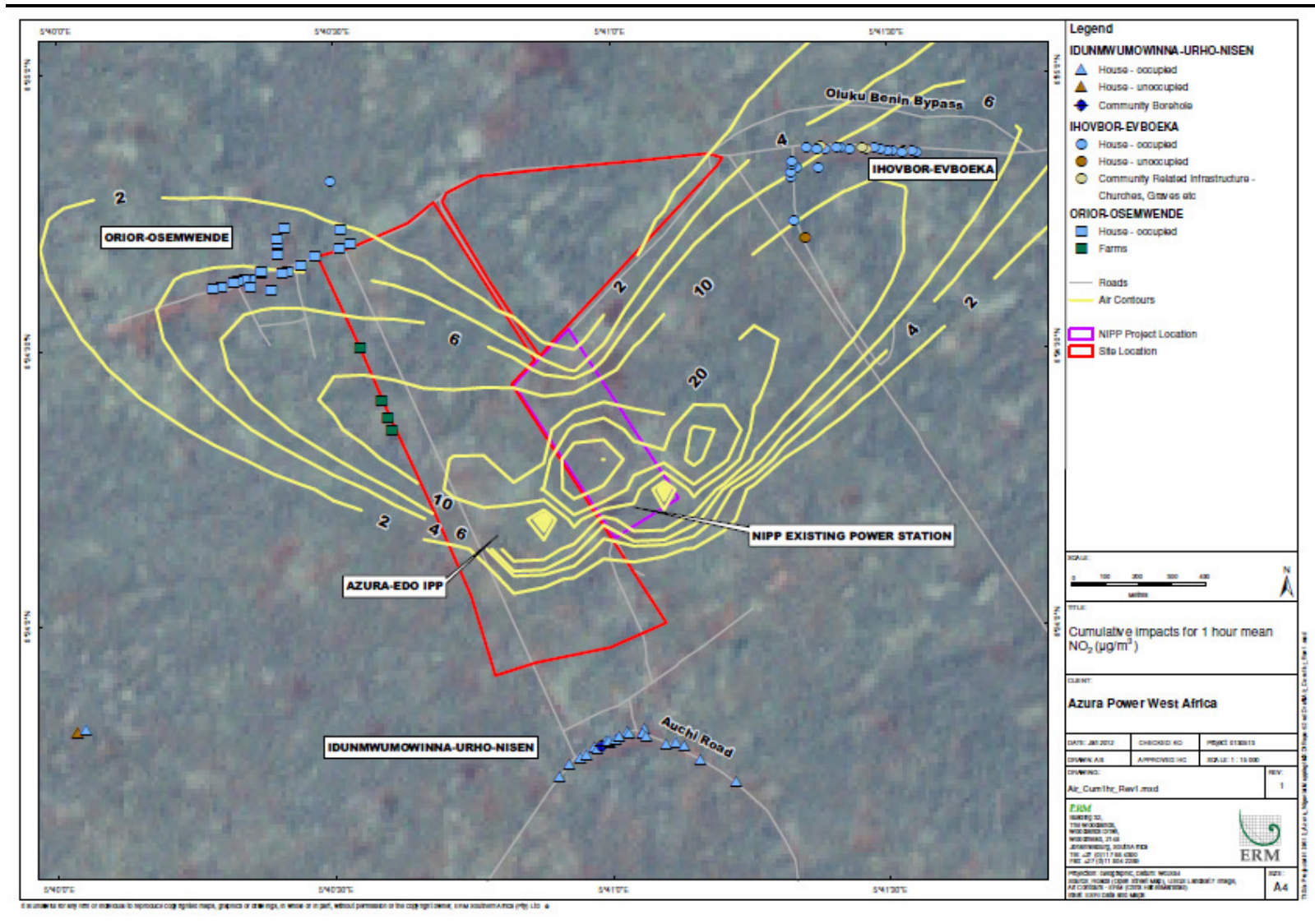


Table 9.1 *Summary of cumulative impacts due to Azura Edo IPP and NIPP emissions*

Pollutant	Averaging Period	Source	Criterion $\mu\text{g}/\text{m}^3$	Max. Impact $\mu\text{g}/\text{m}^3$
NO ₂	Annual mean	EU/WHO	40	0.438
	1 hour mean	EU/WHO	200	60.9
	1 hour mean	Nigeria	75-113	60.9

The cumulative emission is only marginally higher than that of the Azura Edo IPP alone and none of the predicted levels exceeded the criteria. The 1 hour average predicted emissions of NO₂ from both the Azura Edo IPP and NIPP are such that no air quality standard is exceeded or approached.

The predicted dispersion pattern also shows that the peak impact occurs over a very small area primarily due to directional wind conditions. On this basis, the 25 percent threshold for protection of the airshed for future development is less significant than would be the case where the peak impacts are across a larger area.

The cumulative impacts on air quality are therefore considered to be of *insignificant* negative significance as a result of emissions of NO₂.

9.2 *NOISE*

The proposed Azura Edo IPP plant is located adjacent to the NIPP plant, which is currently under construction. As such, an assessment of the cumulative noise impacts is required to understand the impacts related to the operation of both of these plants in close proximity. There are no other known developments in the area which could contribute significantly to the noise levels.

The EIA produced for the neighbouring NIPP plant states:

“The Project operational phase Noise is not expected to be significant on the receptions in the vicinity of the site. The communities that are nearest receptions live not less than 1km from the power plant. Although the project operational noise will not affect them, the plant will be designed so that ambient noise at the perimeter fence will not exceed FMEnv standard, for power plant of 93dB(A) at 1m distance. Operational noise will not be audible at the nearest receptor. The noise impact of the communities will be insignificant. (p.148)”

There are no technical details to support this conclusion, that is, no assessment and calculation methodology were given in the EIA for the neighbouring NIPP plant.

Table 9.2 Comparison of Significant Noise Sources in Design, Azura, NIPP

Noise Source	Noise Specification	
	Azura	NIPP
OCGT (Turbines)	82 dB(A) @ 1m	85 dB(A) @ 1m
Turbine Building Design	Double skin cladding or equivalent	No building
Waste Heat Stack	92 dB(A) Lw ¹	No specification ²
Fin Fan Coolers	85 dB(A) @ 1m	85 dB(A) @ 1m

Note 1: Sound Power level re 10⁻¹² Watts

Note 2: NIPP plant noise source assumed to be 85 dB(A) at 1m.

Therefore to effectively determine the cumulative noise impact from both the Azura Edo Plant and the NIPP plant, the assumptions shown in *Table 9.2* have been used to predict the cumulative noise levels from both plants. *Figure 9.3* shows that the cumulative noise emission levels remain below 45 dB(A) L_{Aeq, 1hr} at all receptors within the three communities, except for the four farms identified within the Orior-Osemwende community.

The noise levels at the northern-most farm is predicted at 47 dB (A), while levels at the three farms to the south are predicted to be 49 dB(A), and are predicted to experience noise levels in compliance with the day time limit of 55 dB(A) L_{Aeq, 15hr} but to exceed the night time limit of 45 dB (A) L_{Aeq, 1hr}.

Table 9.3 presents the individual contributed noise from the Azura Edo IPP and NIPP plants as well as the cumulative noise level at the four farm locations. It is evident that the cause of the excessive noise is attributable to the calculated noise emission from the NIPP plant and further mitigation of the Azura Edo IPP plant would be fruitless as long as the noise attributable to the NIPP plant exceeds 42 dB(A). If the NIPP and Azura Edo IPP Plant contribute 42 dB (A) at these receptors, the cumulative noise level would 45 dB (A).

Table 9.3 Cumulative Noise at Farms

ID	Description	Predicted Noise Level, dB(A), L _{Aeq, 1hr}		
		Azura	NIPP	Azura + NIPP
SN_116	Farm 4	38	46	47
SN_142	Farm 3	41	48	49
SN_150	Farm 2	40	48	49
SN_156	Farm 1	42	49	49

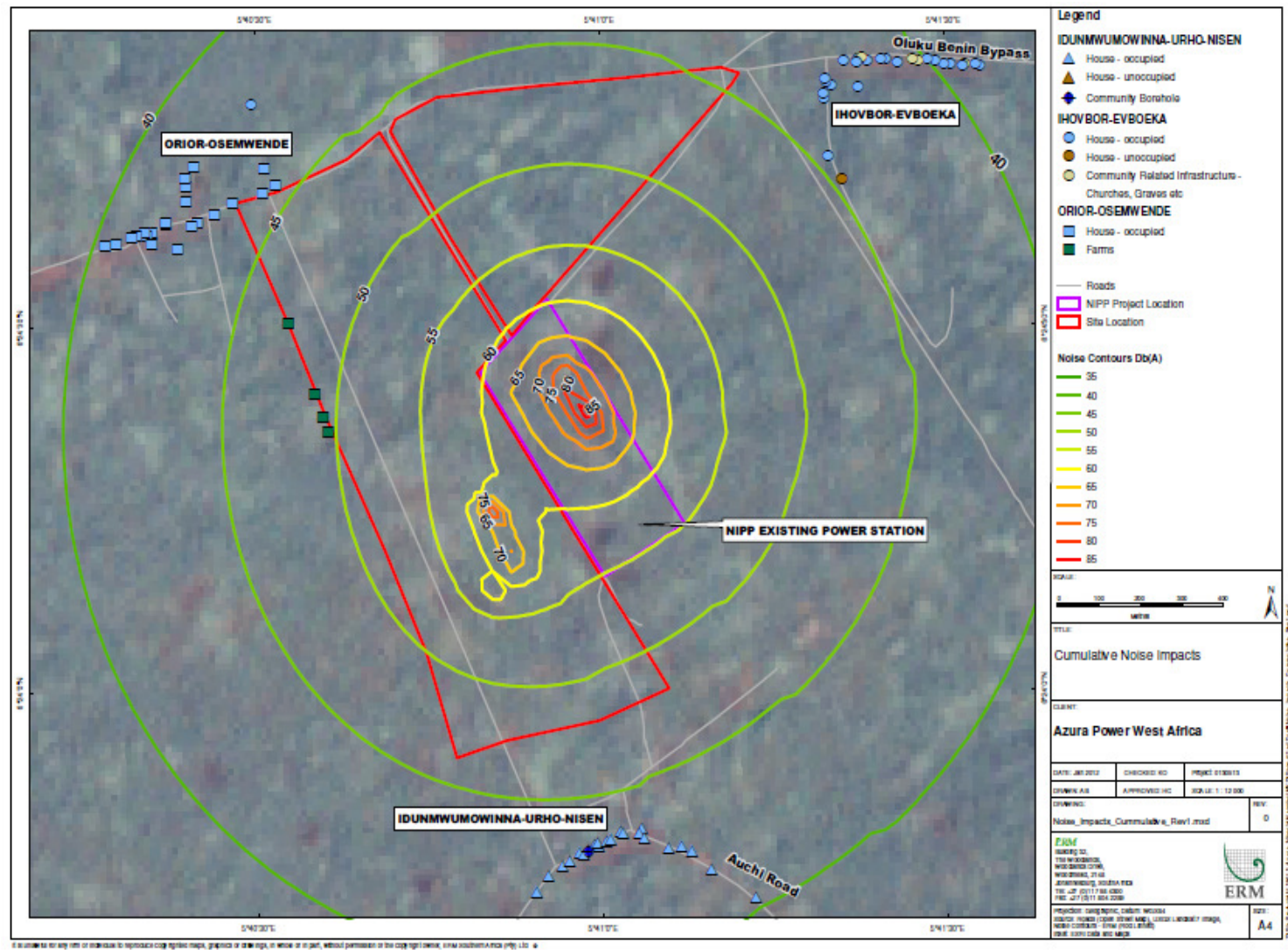
The noise impact at these farms are considered to be of *major* significance prior to mitigation, as the noise levels exceed 45 L_{Aeq, 1hr} and existing background noise levels have been increased by greater than 3 dB (A). This

impact is not due to the operation of the Azura Edo IPP plant, but is an impact associated with the operation of the NIPP plant, being the dominant contributing noise source. The cumulative impacts at other receptors is considered to be *insignificant*.

As such, Azura Power's implementation of mitigation measures will include clarification of the NIPP plant design and mitigation and undertaking further noise modelling before operation in order to confirm the potential impact at the four farms. Ongoing monitoring of the noise levels (*Chapter 8*), reporting to FMEnv and identified mitigation methods (eg construction of barriers if refined modeling shows this to be necessary) would reduce the cumulative noise impacts at the four farms to below 45 dB(A) $L_{Aeq, 1hr}$. The cumulative impact after the implementation of mitigation measures would then be considered to be *insignificant*.

The cumulative impacts are assessed based on the current location of residential receptors close to the site. Any changes in the population density during the operational phase due to other developments and growth of the settlements may mean encroachment into areas where the noise levels may exceed the IFC guidelines. In this case, Azura Power will rely on communications with local communities through the CLO and the grievance mechanism which will be established to record and address complaints.

Figure 9.3 Cumulative noise emissions for Azura Edo IPP and NIPP plants



9.3 SOILS AND GEOLOGY

The implementation of the Project will result in the removal of vegetation and soil of a 102 ha area during the construction phase, changes in drainage regime (including increased runoff due to compaction) and increased erosion potential offsite and increased runoff and siltation of any run during construction, operation and decommissioning. There is also the potential for contamination due to diesel storage onsite.

When considered with construction of the NIPP to the east of the site and in the context of current clearing for slash and burn agriculture and with the implementation of mitigation measures, the cumulative impacts on soils and geology over the three phases of the Project is considered to be *minor*.

9.4 WATER RESOURCES

There is potential contamination due to borehole construction, accidental spills and increased run-off, sedimentation of surface water bodies (closest is 800 m from the site and Ikpoba River Dam, 4 km from the site) and groundwater resources. There is also potential contamination from waste water run-off and possible overuse of to water requirements during operation.

The cumulative impacts are related to these impacts occurring in addition to similar impacts from the neighbouring Ihvobor NIPP plant. Since these sites are located adjacent to one another, the impacts are likely to be felt in similar off site areas, the cumulative potential impacts of contamination and siltation are therefore likely to be *minor* with the implementation of mitigation measures. The sensitivity of the aquifer for water availability is considered to be low and as such the cumulative impact is assessed to be *negligible*.

9.5 BIODIVERSITY

The Project site consists of secondary forests, abandoned and functional subsistence and commercial farmland and plantations. Although the Project site is not considered an area of high biodiversity status, some faunal and floral species of ecological significance were identified and further development such as this Project, contributes to the of conversion from natural/semi-natural to agricultural land and habitat fragmentation within the area. The Project represents clearance of 102 ha in an area where a similarly sized area was cleared for the adjacent NIPP project. Although the impacts are considered of high significance, with the implementation of mitigation measures (*Chapter 9*) the cumulative impacts on biodiversity are therefore considered to be *moderate*.

9.6 WASTE

The Project will generate various types of general and hazardous wastes during the life of the project, resulting in the potential for the contamination of soil and water resources. Wastes will include spoil, excess concrete, used timber, general and household refuse, sewage and waste water, machinery parts and building rubble (during decommissioning) and small amounts of hazardous waste. Due to the relatively low magnitude of the contribution to the regional wastes generated and assuming implementation of mitigation (Chapter 9), the cumulative impacts are considered to be *minor*.

9.7 PHYSICAL AND ECONOMIC RESETTLEMENT

The physical resettlement of the community's assets as a result of the Project is required as part of the land acquisition process, resulting in the loss of agricultural land, and crops as well as houses and other structures.

The cumulative impacts of the Azura Project would include potential decrease in agricultural land in the area, loss of further resource. A similar resettlement process was undertaken for the land on which the NIPP plant is situated, and compensation was paid for this land. As a result of this process, there are historical and cumulative impacts due to existing disputes over resettlement in the local communities. Assuming implementation of mitigation measures (Chapter 9), the significance of the cumulative impacts are considered to be *minor-moderate*.

9.8 DEMOGRAPHIC PROFILE

The impacts of the Project are expected to include a population increase, a skewing of the gender and age balance towards young males, increased social tensions and increase in foreigners in the area. These changes are cumulative to those being experienced in the area due to the (current) construction phase of the NIPP project. The change in demographic is expected to exacerbate the existing tensions regarding the resettlement process and compensation for the NIPP facility. The cumulative impacts on demographics are expected to be *minor – moderate*, with implementation of mitigation measures.

9.9 CULTURAL INSTITUTIONS

The Project will also require acquisition of up to 102 ha of land in the area of the three communities which will result in movement of 14 sacred and cultural sites out of the Project area as well as the disruption of traditional customs and authority systems. The cumulative impact of this adjacent to the NIPP project with similar impacts is likely to result in a negative by *minor* cumulative impacts on cultural institutions, after the implementation of mitigation.

9.10 *EMPLOYMENT AND ECONOMY*

The Project will result in employment opportunities during all phases of the project, also resulting in secondary and induced positive impacts on the economy with the increased demands for goods and services in the area and skills development. The provision of electricity to the communities close to the Project site and the increase in electricity supply to Nigeria will result in significant economic benefits locally, regionally and nationally. The cumulative impacts of this additional employment in the area and electricity supply to the Nigerian grid with the NIPP development will result in *minor-moderate* positive cumulative impacts.

9.11 *INFRASTRUCTURE*

Although the influx of job-seekers will result in pressure on existing overburdened infrastructure, the Azura Power will invest in local community project(s) to upgrade local roads, construct boreholes and health and education projects and will facilitate the provision of electricity locally.

The additional influx of job-seekers associated with this Project will result in *minor* cumulative impacts on infrastructure. It is expected that there will also be cumulative positive impacts on infrastructure although details of the infrastructural developments currently planned by the Government authorities or by the developers of the NIPP for the area are unclear.

9.12 *HEALTH PROFILE*

There are community health and safety risks associated with the Project which include explosions from the gas pipeline, traffic hazards and noise and dust. In addition, there are higher risks of STIs (including HIV/ AIDs) and potential psychological impacts related to influx, unmet expectations and increased tension in the local communities. In addition, there will be potentially positive impacts from improved sanitation due to borehole construction (and other community investment projects). These impacts are likely to be negative and cumulative also as there are similar hazards associated with the neighbouring NIPP plant. There is already tension in the local area stemming from the dissatisfaction of some stakeholders with the compensation payments made by the NIPP and jealousies between communities in respect of opportunities to provide labour to the NIPP project and obtain contracts there from. Overall the cumulative impacts to the community health profile are considered to be of *minor-moderate* significance.

9.13 *WORKPLACE HEALTH AND SAFETY*

There are limited cumulative impacts related to workplace H&S. There are related to the potential for increased breeding sites for disease vector (eg

related to malaria), which may result from other construction in the area. These cumulative impacts are considered to be *negligible*.

Any future potential development in the area around the Project site will require a variety of permits, including an EIA approval. By building good relationships with the local authorities through an ongoing engagement process, Azura Power will be in a position to influence the nature of future developments, and to lobby against those that are inappropriate or not compatible with the Azura-Edo IPP and the neighbouring NIPP power plant. This approach will also mitigate against the possibility of future constraints on the plant's operations.

10.1 INTRODUCTION

This chapter provides the ESMP for the Azura-Edo IPP. Elements of this plan will be taken forward and incorporated into a comprehensive project Environmental and Social Management System (ESMS) that will be used to deliver the Project's EHS regulatory compliance objectives and other related commitments.

This ESMP is a delivery mechanism for environmental and social mitigation measures made in the EIA Report. The purpose of the ESMP is to ensure that these recommendations are translated into practical management actions which can be adequately resourced and integrated into the Project phases. The ESMP is, therefore, an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of construction, operation and decommissioning are prevented and that the positive benefits of the Projects are enhanced (Lochner, 2005).

10.1.1 Overview and Scope

The ESMP has been developed to meet international standards on environmental and social management performance, specifically those set out by the WB and IFC. This ESMP will be incorporated into Azura Power's Environmental Management System (EMS), which Azura Power will develop before the Project becomes operational.

The ESMP is intended to cover those activities described in *Chapter 3* of this EIA report. It covers project activities during construction, operation and decommissioning and will be subject to thorough reviews prior to the commencement of activities to ensure completeness. The ESMP does not include measures for activities related to equipment and facility fabrication being done offsite. It should be noted that this provides the outline requirements for environmental management. Provision will be made for updating the outline ESMP once the detailed project design is complete and for adapting the ESMP to relevant project stages as part of the overall ESMS.

The plan details the mitigation and enhancement measures Azura Power has committed to implement through the life of the Project and includes desired outcomes; performance indicators; targets or acceptance criteria; and timing for actions and responsibilities. Azura Power will have principal responsibility for all measures outlined in the ESMP, but may delegate responsibility to its contractors, where appropriate. In cases where other individuals or organisations have responsibility for mitigation measures, this is clearly indicated within the ESMP table.

Capacity building and training requirements are also described, where these relate to specific skills required to deliver the ESMP action in question. General training, which will be provided to staff (and contractors' staff as appropriate), is not indicated in the plan. An example of training that is not listed here is the general worker health and safety training that all staff will receive.

10.1.2 Objectives

The ESMP is essential for successfully implementing the Project's social and environmental performance throughout the life of the Project. Having this framework in place ensures a systematic approach to bringing environmental and social considerations into decision making and day-to-day operations. It establishes a framework for tracking, evaluating and communicating environmental and social performance and helps ensure that environmental risks and liabilities are identified, minimised and managed. The ESMP will be a living document, and will continue to develop during the design and construction phase to enable continuous improvement of the Project's social and environmental performance.

In particular, the objectives of the ESMP are to:

- promote environmental management and communicate the aims and goals of the ESMP;
- ensure that all workers, subcontractors and others involved in the Project meet legal and other requirements with regard to environmental management;
- incorporate environmental management into project design and operating procedures;
- address concerns and issues raised in the EIA's stakeholder consultation process and those that will likely continue to arise during the Project's lifetime;
- serve as an action plan for environmental management for the Project;
- provide a framework for implementing project environmental commitments (ie mitigation measures identified in the EIA); and
- prepare and maintain records of project environmental performance (ie monitoring, audits and non compliance tracking).

10.2 ENVIRONMENTAL MANAGEMENT ORGANISATION

Azura Power is committed to provide resources essential to the implementation and control of the ESMP. Resources include the appropriate human resources and specialised skills. Azura Power will have dedicated personnel competent on the basis of appropriate education, training, and experience that will manage and oversee the EHS aspects of project construction.

Table 10.1 Environmental Management Organisation Roles and Responsibilities

Position	Responsibility
<i>Azura Power Team</i>	
General Manager	Oversee and coordinate all activities pertaining to the Project; ultimately responsible for EHS. Ensure delivery by the Project of its EHS and operational targets. Ensure effective communication with all stakeholders.
Operations Manager	Technical aspects of the Project including subcontractor supervision during operations. Responsible for the execution of Emergency Response Plan.
Construction Manager	Technical aspects of the Project including subcontractor supervision during construction.
EHS Coordinator	Ensuring that the Project and subcontractors operate in accordance with the applicable regulatory environment, health and safety requirements and plans. Monitor implementation of environmental and social protection measures, and assist with technical input into spill response requirements.
Community Liaison Officer (CLO)	Liaise with local communities and government regulators on the Project's behalf. Implement EHS awareness and education programmes with communities.
<i>Subcontractor</i>	
Project Manager	Responsible for subcontractor technical performance and compliance.
EHS Manager	Ensure that environment, health and safety regulatory requirements are met and that ESMP requirements are properly implemented.

Supervision of subcontractor activities will be conducted by the Azura Power General Manager and the Operations Manager. This will be accomplished through management controls over strategic project aspects and interaction with subcontractor staff where project activities take place. The Azura Power organisation will be staffed at a level to allow for continuous effective supervision of subcontractor activities and work products.

The Construction Manager and EHS Coordinator will be placed locally at the Project site to supervise subcontractors during construction while the Operations Manager and EHS Coordinator will supervise subcontractors during operational activities. The organisation includes a CLO whose role is crucial to the successful implementation of the ESMP and the continuation of liaison with the local community.

10.2.1 *Training and Awareness*

Azura Power will identify, plan, monitor, and record training needs for personnel whose work may have a significant adverse impact upon the environment or social conditions. The project recognises that it is important that employees at each relevant function and level are aware of the Project's environmental and social policy; potential impacts of their activities; and roles and responsibilities in achieving conformance with the policy and procedures.

This will be achieved through a formal training process. Employee training will include awareness and competency with respect to:

- environmental and social impacts that could potentially arise from their activities (including dust, biodiversity and soil/water contamination);
- necessity of conforming to the requirements of the EIA and ESMP, in order to avoid or reduce those impacts; and
- roles and responsibilities to achieve that conformity, including those in respect of change management and emergency response.

The EHS Coordinator is responsible for coordinating training, maintaining employee-training records, and ensuring that these are monitored and reviewed on a regular basis. The EHS Coordinator will also periodically verify that staff are performing competently through discussion and observation.

Employees responsible for performing site inspections will receive training by drawing on external resources as necessary. Training will be coordinated by the EHS coordinator prior to commissioning of the facilities. Upon completion of training and once deemed competent by management, staff will be ready to train other people.

Similarly the Project will require that each of the subcontractors institute training programmes for its personnel. Each subcontractor is responsible for site EHS awareness training for personnel working on the job sites. The subcontractors are also responsible for identification of any additional training requirements to maintain required competency levels.

The subcontractor training program will be subject to approval by Azura Power and it will be audited to ensure that:

- training programs are adequate;
- all personnel requiring training have been trained; and
- competency is being verified.

10.2.2 *Communication*

Azura Power will maintain a formal procedure for communications with the regulatory authorities and communities. The EHS Coordinator is responsible for communication of EHS issues to and from regulatory authorities whenever required. Meetings will be held, as required, between Azura Power and the appropriate regulatory agency and community representatives to review EHS performance, areas of concern and emerging issues. Dealings will be transparent and stakeholders will have access to personnel and information to address concerns raised.

The CLO will be responsible for disseminating information and coordinating community communications through the course of the Project.

The Project will develop and implement a grievance mechanism whereby community members can raise any issues of concern. Grievances may be verbal or written and are usually either specific claims for damages/injury or complaints or suggestions about the way that the Project is being implemented. When a grievance has been brought to the attention of the Project team, and more specifically the GO, it will be logged and evaluated. The person or group with the grievance is required to present grounds for making a complaint or claiming loss so that a proper and informed evaluation can be made.

Where a complaint or claim is considered to be valid, then steps are required to be undertaken to rectify the issue or agree compensation for the loss. In all cases the decision made and the reason for the decision will be communicated to the relevant stakeholders and recorded. Where there remains disagreement on the outcome then an arbitration procedure may be required to be overseen by a third party (eg government official). Local community stakeholders will be informed on how to implement the grievance procedures.

10.2.3 *Documentation*

Azura Power will control EHS documentation, including management plans; associated procedures; and checklists, forms and reports, through a formal procedure. All records will be kept on site and will be backed up at several offsite locations (including secure cloud storage facilities). Records will be kept in both hard copy and soft copy formats. And all records will be archived for the life of the project.

Furthermore the document control procedure will describe the processes that the Project will employ for official communication of both hardcopy and electronic (through the internet) document deliverables. In addition, it will describe the requirement for electronic filing and posting and for assignment of document tracking and control numbers (including revision codes).

The EHS Coordinator is responsible for maintaining a master list of applicable EHS documents and making sure that this list is communicated to the

appropriate parties. The EHS Coordinator is responsible for providing notice to the affected parties of changes or revisions to documents, for issuing revised copies and for checking that the information is communicated within that party's organisation appropriately.

The subcontractors will be required to develop a system for maintaining and controlling its own EHS documentation and describe these systems in their respective EHS plans.

10.2.4 *Operational Control Procedures*

Each potentially significant impact identified in the EIA will have an operational control associated with it that specifies appropriate procedures, work instructions, best management practices, roles, responsibilities, authorities, monitoring, measurement and record keeping for avoiding or reducing impacts. Operational controls are monitored for compliance and effectiveness on a regular basis through a monitoring and auditing procedure described in the ESMP.

Operational control procedures will be reviewed and, where appropriate, amended to include instructions for planning and minimising impacts, or to at least reference relevant documents that address impact avoidance and mitigation.

10.2.5 *Emergency Preparedness and Response*

Azura Power will prepare plans and procedures to identify the potential for, and response to, environmental accidents and health and safety emergency situations and for preventing and mitigating potentially adverse environmental and social impacts that may be associated with them.

Emergency preparedness and response will be reviewed by Azura Power on at least an annual basis and after the occurrence of any accidents or emergency situations to ensure that lessons learnt inform continuous improvement. Emergency exercises will be undertaken on a regular basis to confirm adequacy of response strategies. Investigations of accidents or incidents will follow formal documented procedures.

10.2.6 *Managing Changes to Project Activities*

Changes in the Project may occur due to unanticipated situations. Adaptive changes may also occur during the course of final design, commissioning or even operations. The Project will implement a formal procedure to manage changes in the Project that will apply to all project activities.

The objective of the procedure is to ensure that the impact of changes on the health and safety of personnel, the environment, plant and equipment are identified and assessed prior to changes being implemented.

The management of change procedure will ensure that:

- proposed changes have a sound technical, safety, environmental, and commercial justification;
- changes are reviewed by competent personnel and the impact of changes is reflected in documentation, including operating procedures and drawings;
- hazards resulting from changes that alter the conditions assessed in the EIA have been identified and assessed and the impact(s) of changes do not adversely affect the management of health, safety or the environment;
- changes are communicated to personnel who are provided with the necessary skills, via training, to effectively implement changes; and
- the appropriate Azura Power person accepts the responsibility for the change.

As information regarding the uncertainties becomes available, the Project ESMP will be updated to include that information in subsequent revisions. Environmental and social, as well as engineering feasibility and cost, considerations will be taken into account when choosing between possible alternatives.

10.3

ADDITIONAL MANAGEMENT PLANS

Additional detailed policies and plans will need to be developed to support the implementation of this ESMP and as part of the development of the Azura Power ESMS. The timing of the development of the plans may be staged, ensuring that the appropriate focus and level of detail is provided for construction and operational activities. They will be finalised by Azura Power, where appropriate in consultation with the FMEnv and other key stakeholders. A full list of the management plans for this Project are provided below and an overview of the contents on the key plans are provided in the relevant annexes:

- Construction Management Plan;
- Biodiversity Management Plan;
- Traffic Control Management Plan (*Annex C*);
- Construction Spoil and Waste Management Plan (*Annex D*);
- Site Closure and Restoration Plan;
- Influx Management Plan;
- Comprehensive Community Investment Plan;
- Local Employment and Procurement Policy;
- Local Employment Strategy;
- Occupational Health and Safety Management Plan (*Annex E*);
- Spill Response Plan;

- Physical Cultural Resources Management Plan (*Annex F*);
- Unplanned Events and Emergency Response Plan (*Annex G*); and
- Employment and Workforce Management Plan (*Annex H*).

The table below shows which management plans are associated with which impacts.

Table 10.2 *Impacts and Management Plans*

Impacts	Management Plans
Air Quality	<ul style="list-style-type: none"> • Construction Management Plan; and • Traffic Management Plan.
Noise	<ul style="list-style-type: none"> • Construction Management Plan; • Traffic Management Plan; and • Site Closure and Restoration Plan.
Soils and Geology	<ul style="list-style-type: none"> • Construction Management Plan; • Traffic Management Plan; • Waste Management Plan; • Site Closure and Restoration Plan; • Spill Response Plan; and • Emergency Response Plan.
Water Resources	<ul style="list-style-type: none"> • Construction Management Plan; • Waste Management Plan; • Site Closure and Restoration Plan; • Spill Response Plan; and • Emergency Response Plan.
Biodiversity	<ul style="list-style-type: none"> • Biodiversity Management Plan; • Construction Management Plan; • Traffic Management Plan; • Waste Management Plan; • Site Closure and Restoration Plan; • Spill Response Plan; and • Emergency Response Plan.
Waste	<ul style="list-style-type: none"> • Construction Management Plan; • Waste Management Plan; • Site Closure and Restoration Plan; • Spill Response Plan; and • Emergency Response Plan.
Physical Resettlement	<i>None (covered by the RAP)</i>
Economic Resettlement	<i>None (covered by the RAP)</i>
Impacts to Demographic Profile	<ul style="list-style-type: none"> • Influx Management Plan; • Local Employment and Procurement Policy; and • Local Employment Strategy.
Impacts to Cultural Institutions	<ul style="list-style-type: none"> • Comprehensive Community Investment Plan; • Physical Cultural Resources (PCR) Management Plan; • Local Employment and Procurement Policy; and • Local Employment Strategy.

Impacts	Management Plans
Impacts to Employment and Economy	<ul style="list-style-type: none"> • Employment and Workforce Policy; • Comprehensive Community Investment Plan; • Local Employment and Procurement Policy; and • Local Employment Strategy.
Impacts to Infrastructure	<ul style="list-style-type: none"> • Influx Management Plan; and • Comprehensive Community Investment Plan.
Impacts to Health Profile	<ul style="list-style-type: none"> • Traffic Management Plan,

10.4 CHECKING AND CORRECTIVE ACTION

10.4.1 Introduction

Checking includes inspections and monitoring as well as audit activities to confirm proper implementation of checking systems as well as effectiveness of mitigations. Corrective actions include response to out-of-control situations, non-compliances, and non-conformances. Actions also include those intended to improve performance.

10.4.2 Inspection

EHS inspections will be conducted weekly on an *ad hoc* basis and formally at least once every six months. The results of the inspection activities will be reported to Azura Power to be addressed.

10.4.3 Monitoring

Monitoring will be conducted to ensure compliance with regulatory requirements as well as to evaluate the effectiveness of operational controls and other measures intended to mitigate potential impacts. Monitoring parameters are included in the ESMP.

Monitoring methodologies or processes must be put in place in order to ensure the efficacy of the mitigation measures identified in the EIA. Monitoring methodologies should be established to address the following:

- alteration to the biological, chemical, physical, social and health characteristics of the recipient environment;
- alterations in the interactions between project activities and environmental sensitivities, and interactions among the various sensitivities;
- to monitor the effectiveness of the mitigation measures;
- determination of long term and residual effects; and
- identification of Project specific cumulative environmental effects.

The FMEnv guidelines require an environmental monitoring plan as part of an EIA. The aim of the monitoring programme is to ensure that the negative environmental impacts identified in this EIA are effectively mitigated in the

construction, installation, operations and decommissioning stages of the proposed Project.

10.4.4 *Auditing*

Beyond the routine inspection and monitoring activities conducted, audits will be carried out internally by Azura Power to ensure compliance with regulatory requirements as well as their own EHS standards and policies. Audits to be conducted will also cover the subcontractor self-reported monitoring and inspection activities. The audit shall be performed by qualified staff and the results shall be reported to Azura Power to be addressed.

The audit will include a review of compliance with the requirements of the EIA and ESMP and include, at a minimum, the following:

- completeness of EHS documentation, including planning documents and inspection records;
- conformance with monitoring requirements;
- efficacy of activities to address any non-conformance with monitoring requirements; and
- training activities and record keeping.

There will be a cycle of audits into specific areas of the Project such as waste management. The frequency of audits will be risk based and will vary with the stage of the Project and will depend on the results of previous audits.

10.4.5 *Corrective Action*

Investigating a 'near miss' or actual incident after it occurs can be used to obtain valuable lessons and information that can be used to prevent similar or more serious occurrences in the future.

Azura Power will implement a formal non compliance and corrective action tracking procedure for investigating the causes of, and identifying corrective actions to, accidents or environmental or social non-compliances. This will ensure coordinated action between Azura Power and its subcontractors. The EHS coordinator will be responsible for keeping records of corrective actions and for overseeing the modification of environmental or social protection procedures and/or training programs to avoid repetition of non-conformances and non-compliances.

10.4.6 *Reporting*

Throughout the Project, Azura Power will keep the regulatory authorities informed of the Project performance with respect to EHS matters by way of written status reports and face-to-face meetings. Azura Power will prepare a report on environmental and social performance and submit it to FMEnv. The

frequency of this reporting will be agreed upon between Azura Power and FMEnv.

If required, Azura Power will provide appropriate documentation of EHS related activities, including internal inspection records, training records, and reports to the relevant authorities. Subcontractors are also required to provide EHS performance reporting to Azura Power on a regular basis through weekly and monthly reports. These will be used as inputs to the above.

Table 10.3 *Design Phase: Environmental and Social Management Measures*

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Costs (USD)
1.1	Waste Impacts	Ensure responsible waste disposal and minimise contamination	<ul style="list-style-type: none"> Identify a licensed waste disposal facility in Port Harcourt for general and hazardous wastes and confirm that required capacity exists for disposal during construction and operational phases. 	In accordance with Nigerian legislation	Copies of correspondence	Prior to construction	Azura Power	Costs associated with identification and inspection (approx 2,000 USD)
1.2	Key impacts identified due to physical resettlement: <ul style="list-style-type: none"> Loss of physical assets; Loss of cultural sites; Loss of land; and Loss of productive agricultural land. 	Minimise amount of physical resettlement required, where possible.	<ul style="list-style-type: none"> Implementation of an international standard RAP. Ensure that sacred sites are relocated in close consultation and negotiation with traditional religious leaders, with appropriate monitoring. The implementation measures will be outlined in the Physical Cultural Resources Management Plan; 	Adherence to the IFC Performance Standards	The RAP will set out monitoring requirements Grievance mechanism records	Pre-construction phase and throughout the Project	Azura Power	To be determined based on the outcome of RAP

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Costs (USD)
1.3	Key economic resettlement impacts include: <ul style="list-style-type: none"> • Loss of on-going income; • Loss of initial investment for establishing crops; • Inability to repay loans; • Reduced income and economic activity; • Increased food insecurity; and • Increased tensions between stakeholders and the government. 	Minimise impacts on employment legacy issues associated with the change in land use.	<ul style="list-style-type: none"> • Implementation of a RAP to WB/ IFC standards. 	Adherence to the IFC Performance Standards	The RAP will set out monitoring requirements	Pre-construction phase and monitoring throughout the Project	Azura Power	To be determined based on the outcome of RAP
1.4	Anticipated impacts on local culture resources	Ensure good communication between Azura and local communities	<ul style="list-style-type: none"> • Appoint CLO to liaise with the local communities. • Implementation of the Physical Cultural Resources Management Plan; and • Establish a Grievance Mechanism. 	Grievance mechanism records	Ensure that grievance mechanism is in place	Prior to construction	EHS Coordinator	Salary cost for CLO (approximately 15,000 USD per annum)

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Costs (USD)
1.5	Anticipated impacts on biodiversity	Ensure the protection and preservation of endangered and vulnerable faunal and floral species	<ul style="list-style-type: none"> Site design to consider retaining as many floral species as possible, and the relocation of those that cannot be retained and protected; and Mark and protect any Threatened floral species on site. 	Biodiversity Management Plan (BMP) including a record of the abundance and distribution of threatened floral and faunal species	Ensure that the measures identified in the BMP are implemented	Prior to construction	Azura Power	Approximately 10,000 USD
1.6	Noise impacts	Ensure that cumulative noise impacts are minimised	<ul style="list-style-type: none"> Undertake further modeling and design refinement to confirm cumulative noise impact results prior to operation and construct noise barriers at four farms on the western boundary of the site (see <i>Chapter 9</i>) if required. Submit results to FMENV; Establish grievance mechanism for local community members to register complaints; 	Modeling results Documented grievance mechanism document	Confirmation of requirement for barrier to reduce noise at the four farms	During detailed design	Azura Power	Approximately 15,000 USD

Table 10.4 Construction Phase: Environmental and Social Management Measures

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
2.1	The anticipated negative ambient air quality impacts are: <ul style="list-style-type: none"> Dust emissions; and Vehicle Emissions. 	Minimise deterioration of current ambient air quality by minimising dust emissions.	<ul style="list-style-type: none"> Apply liquid asphalt to prevent surface erosion: loosely bonded coarse-grained surfaces: 1.4 ℓ/ m2 or 3.6 ℓ/ m2; Use binder material for erosion and dust control for long term exposed surfaces; Use covered trucks for the transportation of materials that release dust emissions; Regular cleaning of equipment, drains and roads to avoid excessive build up of dirt and mud; Water suppression or dust extraction fitted to construction equipment where possible; Spray surfaces prior to excavation and clearing; Speed limit on-site of 15 kph on unhardened roads and surfaces; and Avoid dropping material from heights. Avoid heating bitumen with an open flame and avoid overheating. 	The IFC Performance Standards The WHO and EU Emission Standards Nigerian Emission Standards	Visual inspection and photographic record	Daily	EHS Coordinator Azura Power	Part of HSE Coordinator's duties
2.2	Noise impacts from general construction noise	Minimise noise nuisance to sensitive receptors	<ul style="list-style-type: none"> Develop a detailed plan that relates to noise control for relevant work practices and discuss this with construction staff during health & safety briefings; Avoid dropping materials from height, where practicable; Avoid metal-to-metal contact on equipment; Avoid mobile plant clustering near residences and other sensitive land uses; Ensure periods of respite are provided in the case of unavoidable maximum noise level events; Inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as providing the contact details of the CLO; Train construction staff on noise control plan during health & safety briefings; Enforce rest periods for unavoidable maximum noise level events; Select 'low noise' equipment, or methods of work; 	Noise at sensitive receptors to not exceed Nigerian and WHO limits	Noise monitoring at sensitive receptors	Weekly	HSE Coordinator, Azura Power	Cost associated with monthly noise monitoring (approx 500 USD) No other costs assuming that further noise reduction controls are not needed

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
			<ul style="list-style-type: none"> • Use most effective mufflers, enclosures and low-noise tool bits and blades; • Investigate use of alternatives to audible reversing alarms (such as broadband noise emitting models) or configure to maximise forward movements of mobile plant; • Use alternatives to diesel/petrol engines and pneumatic units, such as hydraulic or electric-controlled units, where feasible and reasonable; • Use temporary noise barriers for small equipment, where required; • Reduce throttle settings and turn off equipment and plant when not used; and • Regular inspection and maintenance of all plant and equipment; and • Perform ongoing monitoring of noise levels at the four farm receptors (see <i>Chapter 9</i>) and submit results to FMEEnv. 					
2.3	Terrestrial Soils and Geology <ul style="list-style-type: none"> • Removal of soils and earthworks • Soil compaction • Increased erosion and sedimentation of water resources • Potential contamination from spills 	Minimise soil loss, reduce erosion and decrease, risk of siltation of water resources and risk of contamination	<ul style="list-style-type: none"> • Effective site drainage including cut-off drains to divert surface runoff from exposed soils or construction areas; • Construct temporary drainage channels to channel and divert surface water away from any down slope land and agricultural plots; • Install oil/ water separators and silt traps before effluent leaves the site; • Implement low impact excavation, in-fill and trenching methods; • Minimise bare ground and stockpiles to avoid silt runoff; • Rehabilitate and revegetate cleared areas before the next wet season; • Bunding of areas where hazardous substances are stored (eg fuel, waste areas); and • Develop and implement of a waste management plan (as part of the ESMP). 	Visual inspection	Visual inspection and photographic record	Daily	HSE Coordinator, Azura Power	Part of HSE Coordinator's duties
2.4	Water Resource impacts: <ul style="list-style-type: none"> • Potential 	Prevent contamination of water	<ul style="list-style-type: none"> • Placement soil stock piles to reduce exposure to wind or water; • Reduce or prevent off-site sediment transport using 	Effluent quality meeting	Water quality monitoring before	Every three months	HSE Coordinator, Azura Power	Cost for sampling and analysis of

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
	contamination from borehole construction, accidental spills and increased erosion • Water use	resources	<p>appropriate methods such as effective site drainage, and sediment/silt trapping mechanism.</p> <ul style="list-style-type: none"> • Use cut-off drains to divert surface runoff from exposed soils or construction areas; • Install oil/water separators and silt traps before effluent leaves the site; • Design permanent drainage installations for heavy rainfall events and protect stormwater channels using slope limitation techniques, rip-rap and lining; • Store hydrocarbons, fuels, lubricants and chemicals in bunded and lockable oil storage containers, with hoses and gauges kept within the bund. • Regular checking and maintenance of all plant and machinery to minimise the risk of fuel or lubricant leakages; • Remove all water accumulation within bunds using manually controlled positive lift pumps not gravity drains; • Training of relevant staff in safe storage and handling practices, and rapid spill response and cleanup techniques; • Minimise stockpiling, 10 m buffer zone between drainage channels and stockpiles (leaving existing vegetation in place and shield stockpiles using geotextiles if necessary); • Minimise vegetation clearing and re-vegetate bare soil before the wet season; • Adequate sewage collection and treatment of sewage on site; • Adequate collection and disposal of sludge on site; • Line all areas for concrete mixing; and • Separate all waste on site and locate waste storage areas on hardstanding (or bunded). 	Nigerian, WHO and World Bank requirements	effluent leaves the site			liquid effluent and receiving water bodies (approx 1,000 USD for set-up and 5,000 USD for each monitoring event)
2.5	Biodiversity Impacts related to: • Clearing of vegetation and habitat, • disturbance of fauna due	Minimise habitat loss, potential soil/ water contamination and disturbance of fauna	<ul style="list-style-type: none"> • Limit vegetation clearing to what is absolutely necessary; • Cleared areas not required for buildings, facilities or infrastructure should be revegetated or covered with hardstanding; • Clearly demarcate work areas to limit disturbance; • Mark and protect any Threatened floral species on site; • Development of a BMP enlisting the services of an entomologist and botanist. This will include demarcation 	Hectares of rehabilitated land Implementation of measure	Visual inspection and photographic record	After construction Daily	HSE Coordinator, Azura Power	Part of HSE Coordinator's duties

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
	to noise, dust, traffic		of floral and faunal species to avoid accidental damage during construction, and the retention or relocation of Threatened species creating suitable habitats;					
	• potential contamination of soil and water		<ul style="list-style-type: none"> Establish habitat corridors where possible; Ensure driver training on ecological sensitivities and driving techniques to minimise fauna disturbance Establish and enforce speed limits of 25 km/h on site; Train all staff on ecological sensitivities to ensure that they are aware of any specific migratory routes for faunal species, are able to identify species of a Threatened status and an enforcement of an anti-poaching policy; Implement effective site drainage, and sediment/silt trapping mechanism; Implement dust suppression measures (such as spraying) if required; Protect storm water channels from erosion to reduce downstream siltation; Use excavation, infill and trenching methods that minimise the disturbance on soils and vegetation directly on and around the site; Design permanent drainage installations for heavy rainfall events with sufficient capacity for 1: 50 year rainfall events; After construction, rehabilitated and revegetated disturbed areas as this is feasible; and Avoid tall mast lights if possible. 					
2.6	Waste impacts related to potential contamination of water resources and soil	Reduce contamination of water and soil resources	<ul style="list-style-type: none"> The EPC contractor will develop a waste management plan with requirements for separation, handling and disposal of all wastes. This will be complemented by the development of waste management license by Azura Power across all Project phases ; All waste disposal in line with Nigerian requirements at a suitable and licensed waste disposal facility. It is proposed that the services of a waste disposal facility in Port Harcourt will be used; Use spoil for on-site levelling and compaction as much as possible; Make cleared vegetation available for removal by local communities; and 	Visual inspection	Visual inspection and photographic record	Daily, throughout construction	HSE Coordinator, Azura Power, EPC contractor	Part of HSE Coordinator's duties

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
			<ul style="list-style-type: none"> Separate and store waste on hardstanding. 					
2.7	<p>Impacts to the demographic profile due to influx of workers and job seekers include:</p> <ul style="list-style-type: none"> Population increase; Change to the gender balance; Change in age profile; Increased social tensions; and Change to the ethnic structure. 	Minimise impacts on local demographics due to influx	<ul style="list-style-type: none"> Protocols for camp and workforce management; Prioritising local employment; Transparent recruitment process; and Establishing a grievance mechanism. 	Adherence to the IFC Performance Standards	Internal monitoring regarding local employment should be done by HR Manager and or Communication Manager and external monitoring should be either done by government or consortium of industry.	Throughout construction	Internal Monitoring Azura Power is responsible and for external monitoring related to influx, stress on infrastructure should be done by government.	Part of normal operations
2.8	<p>Anticipated impacts on local culture during construction include:</p> <ul style="list-style-type: none"> Disruption of traditional customs in local communities; Disruption of existing authority systems due to formal approval and development 	Minimise disruption to traditional practices and worship due to influx	<ul style="list-style-type: none"> Develop and implement a Local Employment Strategy; Management protocols for camp and workforce; Establish a grievance mechanism; Ensure that traditional leaders are formally involved in the Project development process; and Carry out the RAP and implement proposed mitigation measures. 	Adherence to the IFC Performance Standards	RAP will outline monitoring requirements .Religious Chiefs and traditional leader should be involved in monitoring.	Throughout construction	RAP will define the responsibility	Part of CLO routine duties

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
	<p>process of the Project; and</p> <ul style="list-style-type: none"> • Disruption of local worship practices potentially creating significant tension with the communities. 							
2.9	<p>Impacts to employment and economy are likely to include:</p> <ul style="list-style-type: none"> • Generation of direct, indirect and induced employment; • Increase in household income through wages and Project spending; • Increase in economic activity among local businesses; and • Development of skills through job training and 	<p>Maximise impacts on employment and the local economy during operation.</p>	<ul style="list-style-type: none"> • Continued operation of the Local Supplier and Contractor Development Unit; • Local Employment and Local Procurement Policies including requirements for local worker, engagement with local communities and clear communication of procurement policies and criteria for employment opportunities; • Training programmes to develop local workforce and supplier capacity; • On-the-job training to all Project staff associated with their role; and • Disclosure of employment and procurement information. 	<p>Nigerian labour law and the IFC Performance Standards</p>	<p>The Local Employment and Local Procurement Policies will outline monitoring requirements</p>	<p>Throughout construction</p>	<p>The Local Employment and Local Procurement Policies will define the responsibility.</p>	<p>Cost of training programmes (approx 10,000 USD over the construction period)</p>

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
2.10	<p>applied work experience.</p> <p>The main impacts to infrastructure will be associated with the influx of opportunistic job seekers, including:</p> <ul style="list-style-type: none"> Increased pressure onto overburdened infrastructure services; Increased household waste and the inability to dispose of this safely; Pressure on water resources; and Disruption to road access from Project vehicles. 	<p>Minimise any increase in pressure on infrastructure and services associated with influx of workers and job seekers</p>	<ul style="list-style-type: none"> Develop and implement Community Investment plan which will include the potential distribution of power to local communities (it will not include payment for transformers, pre-paid metres etc); Influx Management Plan; Traffic Management Plan and conduct associated detailed Traffic Study to inform its development; Detailed rehabilitation and implementation framework as a part of the RAP; and Regular monitoring of water quality in local communities to identify incidences of contamination and respond appropriately. 	<p>Adherence to the IFC Performance Standards</p>	<p>The Community Investment and Influx Management, Plans and the RAP will outline monitoring requirements</p>	<p>Throughout construction</p>	<p>The Community Investment and Influx Management, Plans along with RAP will define the responsibility.</p> <p>Azura Power is primary responsible for preparing the plans.</p>	<p>Part of EHS Coordinator's duties</p>
2.11	<p>Possible health impacts:</p> <ul style="list-style-type: none"> Psychological impacts associated with influx of outsiders and 	<p>Minimise impacts of a new workforce on community health and wellbeing</p>	<ul style="list-style-type: none"> Local Employment Strategy; Traffic Management Plan; Workforce management protocols; Encourage the construction workforce to undergo testing (Azura and contractors) for sexually transmitted infections (STIs); Health awareness programme incorporating an HIV/AIDS 	<p>Nigerian labour law and the Adherence to the IFC Performance Standards</p>	<p>The Occupational Health and Safety Management Plan and Community</p>	<p>Throughout construction</p>	<p>The Occupational Health and Safety Management Plan and Community</p>	<p>Part of normal operations</p>

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
	<p>disruption to local culture and impacts due to unmet expectations for local employment and procurement;</p> <ul style="list-style-type: none"> Physical impacts due to noise and dust pollution; Impacts to physical health due to community interactions; Safety risk associated with heavy traffic and laying of the gas pipeline and the transmission line; and Psychological stress and possible physical impacts associated with tensions. 	during construction.	<p>awareness and prevention program which will include voluntary testing, the provision of condoms, and education of the workforce and local communities;</p> <ul style="list-style-type: none"> Communication of Project transport plans; Grievance mechanism; Establish parameters around use of security forces to support the Project; Risk Assessment reviewing the safety risks of the gas pipeline and transmission line. The results of which will be included in the updated EMP; Ensure that all contractors maintain HSE plans and review plans for prior to contract awards. All contractors to comply with Azura Power's occupational health and safety guidelines and standards for general work practices, hours of work, air emissions, noise and light; and. Consider investing in local health care facilities, and supporting them in carrying out ongoing monitoring of the health profile in the area. 		Health and Safety Management Plan will set out monitoring requirements		Health and Safety Management Plan will define the responsibility for managing the performance. Azura Power will be responsible for the preparing the concerned plan.	
2.12	Potential workplace health and	Minimise the likelihood of incidents	<ul style="list-style-type: none"> Registration and regular communication with the nearby health care facilities; 	Nigerian H&S law (Nigerian	Emergency Response Plan,	Prior to and throughou	Azura Power will have the responsibility	Part of normal operations

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
	<p>safety impacts:</p> <ul style="list-style-type: none"> Physical health impacts associated with noise and dust pollution; Physical health impacts of infectious diseases prevalent in the area (vector, water and food borne diseases) Exacerbation of health impacts due to interaction with residents from the surrounding area. Impacts relating to any accidents that occur on and around site including safety risks posed by the gas pipeline and laying of the 	<p>occurring in the workplace. In addition protecting the health of employees from contracting infectious diseases.</p>	<ul style="list-style-type: none"> Treatment of any cases of infectious diseases contracted and accidents that occur in the workplace; Worker induction and awareness-raising regarding disease vectors. Daily toolbox talks prior to commencement of construction activities; First aid training with first aid certificates; The provision and enforcement of use of appropriate PPE; Mandatory job-specific H&S; Develop camp and workforce management protocols that reflects Azura Power's H&S standards and contractually require all contractors to comply as minimum standard; Conduct Risk Assessment for gas pipeline and power station and update EMP with results; First aid kits and defibrillators made available at several locations at the plant; Warning signs in place, including those for the electrical and mechanical equipment safety warning, and chemical hazard warning; Establish a reporting system for reporting to the Edo State Government's Ministry of Employment, Labour and Productivity; and Plan clearance and construction techniques to reduce potential breeding grounds for disease vectors and implement spray programme if necessary. 	<p>Institute of Safety Professionals, Factories Act 1990), the adherence to the IFC Occupational Health and Safety Guideline and incidents record</p>	<p>Occupational Health and Safety Management Plan, Employment and Workforce Policy and Spill Response Plan will set out monitoring requirements</p>	<p>t construction</p>	<p>to prepare the plans, within the plans individual responsibilities will be detailed</p>	

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
			transmission line.					

Table 10.5 Operational Phase: Environmental and Social Management Measures

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
3.1	<p>The negative air quality impacts predicted during operation are related to the following:</p> <ul style="list-style-type: none"> • Process emissions (NOx and CO); • Cumulative process emissions (NOx and CO); • Greenhouse gas emissions (which exceed the IFC Performance Standard 3 for Pollution Prevention and Abatement threshold for a single project/development of 100 kilo tonnes CO2-equivalents per year) 	Emissions limited to minimise impact on human health.	<ul style="list-style-type: none"> • Dry low NOx combustion system; • However all vehicles used should be regularly maintained; and • Emissions monitoring for NOx. 	The IFC Performance Standards The WHO and EU Emission Standards Nigerian Emission Standards	Emissions monitoring. Details to be agreed with FMEnv prior to operation.	Monthly	HSE Coordinator, Azura Power with subcontractors if necessary	Cost of ambient air monitoring programme: (approx 1,000 USD for set-up costs; 2,000 USD for sampling and analysis per monitoring event. Stack monitoring: approx 20,000 USD per year)

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
3.2	Noise nuisance impacts from general operations	Reduce noise nuisance at receptors	<ul style="list-style-type: none"> Air conditioning/air flow requirements shall be designed to take account of noise breakout; Exhaust stacks will be designed to meet a power level of 92 dB(A); Design an acoustic enclosure for the gas turbines with a Hushclad double-skin enclosure with good door seals which will be replaced regularly to meet the specifications for 82 dB at 1 m from the source; The fitting of a silencer into the exhaust gas system; Design gas turbine building (including air conditioning, walls, roof, windows and doors) to have a high noise reduction rating and ensure that there are no significant gaps; Configure plant layout and orientation to minimise noise; Use acoustic enclosure/ absorption materials in internal walls; In cases where noise levels cannot be reduced below guideline levels, the Project will investigate the relocation of these households; Implementing design measures such as attenuators on the stacks, cladding on the turbine building and/ or noise barriers to reduce noise level requirements of 45dBA for the four identified receptors; and Establish a grievance mechanism. 	Noise levels below IFC limits	Noise monitoring. Details to be agreed with FMEnv prior to operation.	Monthly	HSE Coordinator, Azura Power with subcontractors if necessary	Cost associated with monthly noise monitoring (approx 500 USD) No other costs assuming that further noise reduction controls are not needed
3.3	Terrestrial Soils and Geology including: <ul style="list-style-type: none"> Increased runoff and potential erosion Potential contamination from spills 	Minimise soil loss, reduce erosion and risk of siltation of water resources and risk of contamination	<ul style="list-style-type: none"> No open ground left unpaved or rehabilitated and revegetated. To the extent possible covering large areas of the site with gravel (or similar material) to allow for greater permeability particularly during heavy rains. Development and implementation of a waste management plan. Effective operation of the wastewater treatment plant. Effluent flowing offsite to comply with FMEnv requirements for disposal of effluent offsite. 	Visual inspection	Visual inspection and photographic record	Daily	HSE Coordinator, Azura Power	Part of HSE Coordinator's duties

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
3.4	Water Resource impacts: <ul style="list-style-type: none"> Potential contamination from accidental spills and increased erosion and runoff Water use 	Prevent contamination of water resources	<ul style="list-style-type: none"> Ensure location of storage areas for hazardous substances on hardstanding (or bunded, if suitable) to prevent potential contamination, including areas around gauges, pumps, sumps and loading /unloading areas; Diesel storage tanks and components to meet international standards for structural design and integrity; Provide cathodic protection inside steel tanks and piping, if required. Periodic inspection for corrosion and integrity of storage tanks, pipes and components and regular maintenance pipes, seals, connectors and valves and other components. All tanks to be equipped with alarms, automatic shut-off devices and catch basins. Construct stormwater channels and oilwater separators in diesel storage, handling and transfer areas. Develop Spill Control and Response plans. Monthly monitoring programme of effluent released from the site. Monthly groundwater monitoring, especially for hydrocarbon leaks. 	Effluent quality meeting Nigerian, WHO and World Bank requirements	Water quality monitoring before effluent leaves the site	Monthly	HSE Coordinator, Azura Power	Cost for sampling and analysis of liquid effluent and receiving water bodies (approx 1,000 USD for set-up and 5,000 USD for each monitoring event)

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
3.5	Biodiversity impacts resulting from disturbance of fauna due to noise, dust, traffic	Minimise soil/ water contamination and disturbance to fauna	<ul style="list-style-type: none"> Security and work lighting (both during construction and operation) will be shielded and directed downwards to prevent side-spill; Avoid tall mast lights if possible; Ensure driver training on ecological sensitivities and driving techniques to minimise fauna disturbance Establish and enforce speed limits of 25 km/h on site; Implement the BMP enlisting the services of an entomologist and botanist where necessary; Train all staff on ecological sensitivities to ensure that they are aware of any specific migratory routes for faunal species, are able to identify species of a Threatened status and enforce an anti-poaching policy; Mark and protect any Threatened floral species on site; and Implement effective site drainage, and sediment/silt trapping mechanism. 	Implementation of measure	Visual inspection and photographic record	Daily	HSE Coordinator, Azura Power	Part of HSE Coordinator's duties
3.6	Waste impacts related to potential contamination of water resources and soil	Reduce contamination of water and soil resources	<ul style="list-style-type: none"> The Operator to develop and implement a waste management plan which includes requirements for separation, handling and disposal of waste including the production of sludge; Waste to be disposed of in line with Nigerian requirements at a suitable and licensed waste disposal facility. It is proposed that the services of a waste disposal facility in Port Harcourt will be used once a facility that meets the standards of the Project is selected; Waste should be separated on site and waste storage areas should be located on hardstanding (or bunded, if suitable) to prevent potential contamination; All waste disposal in line with Nigerian requirements at a suitable and licensed waste disposal facility; Separate and store waste on hardstanding; Recycle spent oils (including transformer oil); and Regular monitoring of wastewater discharged (before it is discharged from the site). 	Effluent quality meeting Nigerian, WHO and World Bank requirements	Visual inspection and photographic record Water quality monitoring before effluent leaves the site	Monthly	HSE Coordinator, Azura Power. EPC contractor	Part of HSE Coordinator's duties

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
3.7	Operational impacts to demographic profile include: <ul style="list-style-type: none"> • Reversal of youth outmigration trends; • Population increase due to influx; • Change to the ethnic structure due to influx. 	Minimise impacts of a worker influx and increased population on community demographics	<ul style="list-style-type: none"> • Camp and workforce management protocols; • Transparent recruitment process; • Local employment where possible; and • Establish a grievance mechanism for communities. 	Adherence to the IFC Performance Standards	The Local Employment and Local Procurement Policies will and Influx Management Plan will outline monitoring requirements	Throughout operation	The Local Employment and Local Procurement Policy in addition to the Influx Management Plan will define the responsibility. Azura Power would be responsible for preparing the plan.	Part of HSE Coordinator's duties
3.8	Impacts to cultural institutions during operations include: <ul style="list-style-type: none"> • Ongoing disruption of traditional religious observance due to with removal/relocation of sacred sites; and • Influx affecting the ethnic structure and associated customs, rites, language, etc. 	Minimise impacts of a new workforce on existing community traditions and customs	<ul style="list-style-type: none"> • Camp and workforce management protocols; • Ensure that traditional leaders are formally involved in the Project operations; • Implementation of the Physical Cultural Resources Management Plan; • Maintain a grievance mechanism; • Carry out the RAP and implement proposed mitigation measures. 	Adherence to the IFC Performance Standards	RAP will outline monitoring requirements Religious Chiefs and traditional leader should be involved into monitoring. The Physical Cultural Resources Management Plan	Throughout operation	RAP will define the responsibility.	Part of normal operations

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
3.9	<p>Positive impacts to employment and the economy are expected during operation:</p> <ul style="list-style-type: none"> • Generation of approximately 90 permanent positions; • Generation of induced employment; • Increase in household income; • Increase in regional and local economic activity; and • Development of skills and capacity. 	<p>Maximise impacts on employment and the local economy during operation due to increased livelihood opportunities</p>	<ul style="list-style-type: none"> • Local Employment and Procurement Policies and Local Employment Strategy; • Identify training priorities • Procedures to ensure transparent recruitment and training; • Communication about local employment and contracting opportunities; • Implement internal training and promotion initiatives; and • Transparent communication on hiring policies amongst local communities. 	<p>Nigerian labour law and the Adherence to the IFC Performance Standards</p>	<p>The Local Employment and Local Procurement Policies will outline monitoring requirements</p>	<p>Throughout operation</p>	<p>For Internal mitigation department of Azura Power would be responsible for external aspects government and NGO would be responsible.</p> <p>Azura West would be responsible for preparing Local Employment and Procurement Policy.</p>	<p>Part of HSE Coordinator's duties</p>

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
3.10	<p>Impacts to infrastructure include:</p> <ul style="list-style-type: none"> Influx of opportunistic job seekers, increasing pressure on local infrastructure services; Pollution of the river from which residents source their water; Project use of local roads could further reduce their capacity; and Increased local power supply in addition to the national power grid. 	<p>Minimise any increased pressure on existing infrastructure due to influx and increased Project usage</p>	<ul style="list-style-type: none"> Investments to upgrade services where the Project makes use of local infrastructure; Regular monitoring of water quality in local rivers to identify incidences of contamination and respond appropriately; and Comprehensive Community Investment Plan. 	<p>Adherence to the IFC Performance Standards</p>	<p>The Community Investment Plan will outline monitoring requirements</p>	<p>Throughout operation</p>	<p>Government Planning Department.</p>	<p>Cost for service upgrades vary according to infrastructure type (Azura has budgeted more than \$1 million per annum for its Community Investment Plan)</p>

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
3.11	<p>Impacts to physical and psychological health will less than during the construction phase, but may include:</p> <ul style="list-style-type: none"> Psychological impacts associate with unmet expectations for local employment opportunities or with community tension and opposition to the Project; Impacts to physical health due to community interactions with foreign workers; Safety risk associated with Project traffic and explosions/spill ages from the gas pipeline; and Health impacts associated with Project contamination of surrounding environment. 	<p>Minimise impacts to physical and psychological health as a result of worker and jobseeker influx</p>	<ul style="list-style-type: none"> Local Employment Strategy; Encourage the construction workforce to undergo testing (Azura and contractors) for sexually transmitted infections (STIs); Health awareness programme incorporating an HIV/AIDS awareness and prevention program which will include voluntary testing, the provision of condoms, and education of the workforce and local communities; Camp and workforce management protocols; Traffic Management Plan; Communicate Project transport plans; Grievance mechanism; Consider investing in local health care facilities, and supporting them in carrying out ongoing monitoring of the health profile in the area; Fire and explosion risk management including routine safety checks, training, first aid boxes, emergency spill prevention plans; and Conduct community safety awareness campaigns regarding presence of the gas pipeline and the dangers of sabotage and what to do in the event of an emergency. 	Adherence to the IFC Performance Standards	<p>The Occupational Health and Safety Management Plan and Community Health and Safety Management Plan will set out monitoring requirements</p>	Throughout operation	<p>The Occupational Health and Safety Management Plan and Community Health and Safety Management Plan will define the responsibility for managing the performance. Azura Power will be responsible for the preparing the concerned plan.</p>	Part of normal operations

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
3.12	<p>Potential workplace health and safety impacts:</p> <ul style="list-style-type: none"> Accidents in the and around site (operation of machinery, accidental slips, explosions/spill ages from the gas pipeline etc) ; Traffic related accidents on site; and Impacts to physical health due to infectious disease. 	<p>Minimise the likelihood of incidents occurring in the workplace. In addition protecting the health of employees from contracting infectious diseases.</p>	<ul style="list-style-type: none"> Routine safety checks in line with standard safety procedures for power plants; The provision and use of PPE at all times during operation; Warning signs in place, including those for the electrical and mechanical equipment safety warning, and chemical hazard warning; Specific H&S training programmes should be provided for workers assigned to tasks associated with particular H&S risks; Mandatory health and safety training programmes (including awareness-raising of disease vectors) will be provided to all employees, including contractors to ensure staff are aware of the health and safety guidelines; Develop and maintain emergency and spill prevention and response/countermeasures plans for all phases of the project; and Toolbox talks or health and safety meeting on a weekly basis - ensure that procedures are being adhered to, and to discuss any incidents that have occurred. 	<p>Nigerian H&S law (Nigerian Institute of Safety Professionals, Factories Act 1990), the adherence to the IFC Occupational Health and Safety Guideline and incidents record</p>	<p>Emergency Response Plan, Occupational Health and Safety Management Plan, Employment and Workforce Policy and Spill Response Plan</p> <p>will set out monitoring requirements</p>	<p>Throughout Operation</p>	<p>Azura Power will have the responsibility to prepare the plans, within the plans individual responsibilities will be detailed</p>	<p>As part of normal operations</p>

Table 10.6 Decommissioning Phase: Environmental and Social Management Measures

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
4.1	The negative ambient air quality impacts identified during decommissioning activities are:	Minimise health and nuisance impacts on local communities	<ul style="list-style-type: none"> • Apply liquid asphalt to prevent surface erosion: loosely bonded coarse-grained surfaces: 1.4 ℓ/ m² or 3.6 ℓ/ m²; • Use binder material for erosion and dust control for long term exposed surfaces; • Use covered trucks for the transportation of materials that release dust emissions; • Regular cleaning of equipment , drains and roads to avoid excessive build up of dirt and mud; • Water suppression or dust extraction fitted to construction equipment where possible; • Spray surfaces prior to excavation and clearing; • Speed limit on-site of 15 kph on unhardened roads and surfaces; • Avoid dropping material from heights; • Do not release sulphur hexafluoride from the transformers to the atmosphere and reclaimed for reuse, if possible. • Avoid heating bitumen with an open flame and avoid overheating. 	<p>The IFC Performance Standards</p> <p>The WHO and EU Emission Standards</p> <p>Nigerian Emission Standards</p>	Dust mitigation programme as part of the Site Closure and Restoration Plan	Implemented in the decommissioning phase , and to be monitored throughout and past the decommissioning phase	Azura Power	Cost for non-routine dust suppression measures will be part of normal operations.

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
4.2	Noise nuisance impacts from demolition activities	Minimise noise nuisance to sensitive receptors	<ul style="list-style-type: none"> • Develop a detailed plan that relates to noise control for relevant work practices and discuss this with construction staff during health & safety briefings; • Avoid dropping materials from height, where practicable; • Avoid metal-to-metal contact on equipment; • Avoid mobile plant clustering near residences and other sensitive land uses; • Ensure periods of respite are provided in the case of unavoidable maximum noise level events; • Inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as providing the contact details of the CLO; • Train construction staff on noise control plan during health & safety briefings; • Select 'low noise' equipment, or methods of work; • Use most effective mufflers, enclosures and low-noise tool bits and blades; • Investigate use of alternatives to audible reversing alarms (such as broadband noise emitting models) or configure to maximise forward movements of mobile plant; • Use alternatives to diesel/petrol engines and pneumatic units, such as hydraulic or electric-controlled units, where feasible and reasonable; • Use temporary noise barriers for small equipment, where required; • Reduce throttle settings and turn off equipment and plant when not used; and • Regular inspection and maintenance of all plant and equipment. 	Noise at sensitive receptors to not exceed Nigerian and WHO limits	Noise monitoring at sensitive receptors	Monthly	HSE Coordinator, Azura Power	Cost associated with monthly noise monitoring (approx 500 USD)

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
4.3	Terrestrial Soils and Geology: <ul style="list-style-type: none"> • Earthworks and soil compaction • Increased erosion and sedimentation of water resources • Potential contamination from spills 	Minimise soil loss, reduce erosion and decrease risk of siltation of water resources and risk of contamination	<ul style="list-style-type: none"> • Minimisation of concentrated transportation and excavation during decommissioning to reduce erosion; • Rehabilitation and revegetation of the site following demolition and levelling before the next wet season; • Update and implement waste management plan, to be updated as part of the Site Closure and Restoration Plan. 	<ul style="list-style-type: none"> • Visual inspection • Updated Site Closure and Restoration Plan on file 	<ul style="list-style-type: none"> • Visual inspection and photographic record • Check on file 	<ul style="list-style-type: none"> • Daily • Prior to initiation of decommissioning phase 	HSE Coordinator, Azura Power	Part of HSE Coordinator's duties
4.4	Water Resource impacts: <ul style="list-style-type: none"> • Potential contamination from accidental spills and increased erosion and runoff • Water use 	Prevent contamination of water resources	<ul style="list-style-type: none"> • Store hydrocarbons, fuels, lubricants and chemicals in bunded and lockable oil storage containers, with hoses and gauges kept within the bund. • Regular checking and maintenance of all plant and machinery to minimise the risk of fuel or lubricant leakages; • Training of relevant staff in safe storage and handling practices, and rapid spill response and cleanup techniques; • Minimise stockpiling, 10 m buffer zone between drainage channels and stockpiles (leaving existing vegetation in place and shield stockpiles using geotextiles if necessary); • Correct and timeous waste separation, storage and disposal of demolition waste and chemicals (including transformer oil, residual sludge from the wastewater treatment works and diesel) and/ or incidents and spills at licensed waste disposal facility; and • Decommission or cap (if to remain in use) the groundwater abstraction borehole(s) to prevent the development of a potential pathway for contaminants. 	<ul style="list-style-type: none"> • Effluent quality meeting FMEnv, WHO and World Bank requirements • Training Records • Visual inspection 	<ul style="list-style-type: none"> • Water quality monitoring before effluent leaves the site • Visual inspection and photographic record 	<ul style="list-style-type: none"> • Monthly • Weekly visual inspections 	HSE Coordinator, Azura Power	Cost for sampling and analysis of liquid effluent and receiving water bodies (approx 1,000 USD for set-up and 5,000 USD for each monitoring event)

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
4.5	Biodiversity impacts: Disturbance of fauna due to noise, dust, traffic and potential contamination of soil and water	Minimise soil/water contamination and disturbance to fauna	<ul style="list-style-type: none"> • Demarcate work and demolition areas to avoid unnecessary disruption to neighbouring areas; • Minimise dust emissions using dust suppression techniques listed in dust emissions arising from the roads used is minimised; • Restore species diversity and structure in the disturbed areas through rehabilitation and revegetation of the site using native floral species (except where non-native species are appropriate) taking into consideration the Threatened floral and faunal species identified in the Study area; • Train all staff on ecological sensitivities to ensure that they are aware of any specific migratory routes for faunal species, are able to identify species of a Threatened status and enforce an anti-poaching policy; and • Implement measures outlined in the BMP including rehabilitation and revegetation before the wet season and using locally indigenous species; and • Monitor and train staff to ensure that there is no poaching in the area. 	Visual inspection	Visual inspection and photographic record	Daily	HSE Coordinator, Azura Power	Part of HSE Coordinator's duties
4.6	Waste impacts related to potential contamination of water and soil resources	Reduce contamination of water and soil resources	<ul style="list-style-type: none"> • Update and implement a waste management plan with requirements for separation, handling and disposal of all wastes as part of a Site Closure and Restoration Plan; • Azura Power should identify suitable disposal sites and confirm capacities for disposal for general and hazardous wastes prior to decommissioning; • All waste disposal in line with Nigerian requirements at a suitable and licensed waste disposal facility, and store waste on hardstanding. It is proposed that the services of a waste disposal facility in Port Harcourt will be used, following the identification of a suitable facility; • Use spoil and excavated soil for on-site levelling and compaction as much as possible; • All metal should be sold for scrap and machinery, infrastructure and buildings should be dismantled such that as much of this waste can be reused or recycled. 	<ul style="list-style-type: none"> • Visual inspection • Updated Site Closure and Restoration Plan 	<ul style="list-style-type: none"> • Visual inspection and photographic record • Confirm Site Closure and Restoration Plan is on file 	<ul style="list-style-type: none"> • Daily, throughout construction • Prior to decommissioning 	HSE Coordinator, Azura Power, EPC contractor	Part of HSE Coordinator's duties

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/ Frequency	Responsibility	Estimated Cost (USD)
4.7	Impacts to demographic profile: <ul style="list-style-type: none"> Decline in population,; Rebalance of age demographic,; and Some loss of ethnic diversity. 	Minimise impacts to local demographics through facilitating parallel development of industry and livelihood opportunities in the Project area	<ul style="list-style-type: none"> Facilitate SME development and support sustainable development and implementation of new technologies through the provision of training annually to local communities for three years prior to decommissioning; Invest in infrastructure development; Identify and facilitate training opportunities for local workforce; and Establish Influx Management Plan. 	Adherence to the IFC Performance Standards	Government department deals with population monitors the decline in population and loss on ethnic diversity. The Influx Management Plan will establish monitoring responsibility	Annually	Azura Power	Cost for support to re-training programmes (approx \$10,000 per year for 3 years)

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
4.8	<p>Impacts to cultural institutions include:</p> <ul style="list-style-type: none"> Ongoing impacts due to the permanent removal of sacred sites; any unresolved issues between the resettled and host community; Removal of sources of authority and influence for traditional leaders; and Departure of foreign workers. 	<p>Minimise any ongoing impacts and impacts to cultural heritage and existing cultural practices as a result of decommissioning</p>	<ul style="list-style-type: none"> Continue to work with traditional leadership structures during the decommissioning process; Ensure that Project plans and decommissioning activities are clearly communicated to stakeholders; and Ensure effective completion and, where appropriate, handover of responsibilities identified through the RAP. 	<p>Adherence to the IFC Performance Standards</p>	<p>RAP and Influx Management should set out the role for monitoring.</p>	<p>Throughout operational phase</p>	<p>RAP and Influx Management Plan should set out the responsibility. Azura Power would be responsible for preparing RAP and Influx Management Plan.</p>	<p>Part of HSE Coordinator's duties</p>

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
4.9	<p>Employment and economy issues include:</p> <ul style="list-style-type: none"> Loss of direct and contracted employment; Loss of indirect business opportunities; Decline in economic productivity and household income; and Decline in regional and local economic activity. 	<p>Minimise impacts on employment legacy issues associated with loss of employment following decommissioning of the Project</p>	<ul style="list-style-type: none"> Facilitate SME development and support sustainable development and implementation of new technologies through the provision of training annually to local communities for three years prior to decommissioning; Develop credit and loan programmes for small business development; Identify and facilitate training opportunities for local workforce; Provide training to local and regional workforce on career development and management of personal finances; and Provide training to local and regional contractors on effective business management. 	<p>Nigerian labour law and the Adherence to the IFC Performance Standards</p>	<p>The Local Employment and Local Procurement Policies will outline monitoring requirements</p>	<p>Through out Operational Phase</p>	<p>For Internal mitigation department of HR Azura Power would be responsible for external aspects government and NGO would be responsible for managing impact.</p> <p>Azura Power would be responsible for preparing Local Employment and Procurement Policy.</p>	<p>Cost captured in 4.7</p>

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/ Frequency	Responsibility	Estimated Cost (USD)
4.10	<p>Potential infrastructure implications include:</p> <ul style="list-style-type: none"> • Some loss of power to the national grid; • Associated loss of power at the local level; • Decline in infrastructure investment and maintenance by the Project; and • Decline in government investment in infrastructure. 	<p>Minimising impacts to local infrastructure as a result of population decline and reduced economic activity</p>	<ul style="list-style-type: none"> • Implementation of recommended mitigation measures for impacts to demographics and employment and economy will effectively mitigate negative impacts to infrastructure, by reducing population decline and reduction in economic activity. 	<p>Adherence to the IFC Performance Standards</p>	<p>As per mitigations for decommissioning impacts to demographics and employment and economy</p>			

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
4.11	Decommissioning will not result in any new impacts to health; however closure of the Project could remove any treatment or support for victims of health impacts manifested during Project construction or operation.	Minimise any impacts caused as a result of the presence of the Project workforce during construction and operation on community health and wellbeing.	<ul style="list-style-type: none"> Establish a contingency fund to address contamination of the surrounding environment prior to Project closure; Health awareness programme incorporating an HIV/ AIDS awareness and prevention program which will include voluntary testing, the provision of condoms, and education of the workforce and local communities; Ensure that any victims of health or safety impacts of the Project are rehabilitated with treatment and support that can continue after closure of the Project; and Consider providing sustainable investment in local health care facilities during the operation phase to provide ongoing capacity for support beyond the life of the Project. 	Adherence to the IFC Performance Standards	The Occupational Health and Safety Management Plan and Community Health and Safety Management Plan will set out monitoring requirements	Through out Operational Phase	The Occupational Health and Safety Management Plan will set out monitoring requirements	Negligible (without contamination)

Ref #	Potential impact	Desired Outcome	Description of mitigation	Performance Indicator	Monitoring	Timing/Frequency	Responsibility	Estimated Cost (USD)
4.12	<p>As with the construction and operation phases the potential workplace health and safety impacts will be:</p> <ul style="list-style-type: none"> Accidents due to the increased presence of temporary workforce; Traffic related accidents; Safety related to the dismantling of cables and pylons, and explosions from gas pipeline; and Health impacts of workforce interacting with the surrounding communities (particularly temporary workforce) 	<p>Minimise any potential accidents that may occur during decommissioning particularly with demolition and removal activities</p>	<ul style="list-style-type: none"> Conduct toolbox talks on a daily basis; The provision and use of PPE at all times during decommissioning; Warning signs in place, including those for the electrical and mechanical equipment safety warning, and chemical hazard warning; Ensure that all employees (including contractors) are aware and adhere to health and safety procedures; Review health and safety procedures of any additional contractors that may be employed during decommissioning; and Ensure that any victims of incidents on site are rehabilitated with treatment and support that can continue after closure of the Project if necessary. Plan decommissioning and site rehabilitation techniques to reduce potential breeding grounds for disease vectors and implement spray programme if necessary. 	<p>Nigerian H&S law (Nigerian Institute of Safety Professionals, Factories Act 1990), the adherence to the IFC Occupational Health and Safety Guideline and incidents record</p>	<p>Emergency Response Plan, Occupational Health and Safety Management Plan, Employment and Workforce Policy and Spill Response Plan</p> <p>will set out monitoring requirements</p>	<p>Throughout decommissioning</p>	<p>Azura Power will have the responsibility to prepare the plans, within the plans individual responsibilities will be detailed including contractor responsibilities</p>	<p>All costs will be incorporated into the decommissioning phase</p>

11 CONCLUSIONS

11.1 THE EIA PROCESS

This EIA for the proposed Azura Power power station was undertaken in accordance with the Environmental Impact Assessment Decree (Decree No. 86 of 1992) and WB requirements. The aim of the EIA process is to provide information for decision-making to contribute to environmentally sound and sustainable development. The overall EIA process comprised of a number of key steps, namely:

- Screening and scoping
- Baseline data collection
- Stakeholder consultation
- Impact assessment
- Management plans
- Reporting and disclosure

This draft EIA report provides a description of the EIA process followed to date. It also provides a description of the public participation process that was undertaken during the EIA whereby stakeholders were notified and consulted regarding the project and its anticipated consequences.

Baseline information on receptors and resources was collected during the EIA from available data sources and field surveys during the rainy and dry seasons. A description of the existing environmental and socio-economic conditions is provided as a basis against which the impacts of the project can be assessed. The biophysical, social-economic and health impacts of the proposed project have been assessed and mitigation measures identified to avoid or reduce adverse impacts and enhance positive impacts. A register of mitigation measures and monitoring requirements is included in *Chapter 7* and *Chapter 8* and an EMP is provided in *Chapter 10*.

11.2 SUMMARY OF IMPACTS AND MITIGATION

Air quality (dust during construction and decommissioning and greenhouse gases during operation), biodiversity, physical resettlement, economic resettlement and workplace H&S impacts were identified as negative impacts of major significance and significant (for greenhouse gases) prior to mitigation. These negative impacts require careful implementation of effective mitigation measures and ongoing monitoring. The significance of biodiversity impacts, physical resettlement impacts and economic resettlement impacts can be reduced to moderate; and the air quality impacts (dust) can be reduced to minor-moderate, and workplace H&S impacts can be reduced to minor with the implementation of the mitigation measures and monitoring requirements outlined in *Chapter 10* are implemented. The noise

impacts were considered to be negligible or insignificant prior mitigation. The impacts of greenhouse gases during operation are considered to remain significant, as there are no suitable mitigation measures available to reduce these emissions. The only other residual negative impact with significance ratings of moderate is the impact on soils and geology during construction, however, the severity of these impacts could be reduced to acceptable levels through the mitigation identified in the report.

A number of positive impacts were identified; the impacts to the national economy and local employment were assessed to be of major significance post-mitigation. The positive impacts of the Project on employment and economic impacts are considered to remain of major significance with enhancement measures. Positive impacts on infrastructure are also considered to be moderate positive during operation.

Although there is a post-mitigation impact as a result of the production of greenhouse gases which is considered to be significant, the residual impacts on economy and employment are positive and of major significance. In the context of the severe electricity supply deficit in Nigeria and the dependency of economic growth and development on the availability of power, there is a reasonable justification for the authorisation of the power plant, contingent that the mitigation and enhancement measures described in the EIA and monitoring for potential environmental and social effects are implemented.

Apart from those cumulative impacts considered to be minor, cumulative impacts on physical and economic resettlement and the demographic profile were considered to be minor – moderate due to existing influx from the construction of the neighbouring NIPP facility as well as current disputes in the communities regarding compensation and NIPP project benefits. The cumulative impact on biodiversity was assessed to be moderate negative due to the presence of a number of vulnerable species and cumulative noise impacts at four closest receptors were considered to be major prior to mitigation and insignificant with the implementation of mitigation measures. The overall positive cumulative impact of the Project was assessed to be moderate.

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