Transmission Company of Nigeria - Project Management Unit (TCN-PMU)

Environmental and Social Impact Assessment (ESIA) for the Proposed 132/33kV Transmission Substation at Biliri, Gombe State

DRAFT FINAL REPORT
BY SMEC INTERNATIONAL (PTY) LIMITED

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<th>Description</th>
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<tr>
<td>BOD</td>
<td>Bio-Chemical Oxygen Demand</td>
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<td>CAR</td>
<td>Corrective Action Reporting</td>
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<tr>
<td>COD</td>
<td>Chemical Oxygen Demand</td>
</tr>
<tr>
<td>CSC</td>
<td>Construction Supervision Consultants</td>
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<tr>
<td>dB(A)</td>
<td>Decibels “A” weighted</td>
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<tr>
<td>EHS</td>
<td>Environment Health and Safety</td>
</tr>
<tr>
<td>EHSO</td>
<td>Environment Health &amp; Safety Officer</td>
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<tr>
<td>ELF</td>
<td>Extremely Low Frequency</td>
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<td>EMF</td>
<td>Electro-Magnetic Force</td>
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<td>ESIA</td>
<td>Environmental and Social Impact Assessment</td>
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<td>ESMP</td>
<td>Environmental and Social Impact Management Plan</td>
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<td>FMEnv</td>
<td>Federal Ministry of Environment Nigeria</td>
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<tr>
<td>GIS</td>
<td>Geographical Information System</td>
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<td>GPS</td>
<td>Global Positioning System</td>
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<td>Grievance Redress Mechanism</td>
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<td>PM</td>
<td>Particulate Matter</td>
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<td>PMU</td>
<td>Project Management Unit</td>
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<td>TCN</td>
<td>Transmission Company Nigeria</td>
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<td>WB</td>
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Weights and Measures:
- \( \text{dB} \) – decibel
- \( \text{Km} \) – kilometer
- \( \text{dB(A)} \) (‘A’-weighing = correction factor that weights sound to reflect sensitivity of the human ear)
- \( \text{M} \) – meter
1 Executive Summary

1.1 Description of the Proposed Activities

1.1.1 Background to the Project

The Federal Government of Nigeria is taking steps to improve the quality and reliability of electricity supply while ensuring sustainability of the power provision industry. By bridging the gap between the available electricity supply, and the demand required for industry, commercial businesses and homes, the project will support domestic economic development, improve lifestyles, provide revenue for government and create employment opportunities in the target states. There are also ongoing discussions with neighboring countries on the foreign export and import of electricity in the future.

The Government received funds from the World Bank for the implementation of Nigeria Electricity and Gas Improvement Project (NEGIP). Some of this financing is allocated to the Transmission Company of Nigeria (TCN) for the construction of four proposed transmission substations at New Kano in Kano State, Biliri in Gombe State, Kabba in Kogi State, and Abor (9th Mile) in Enugu State. TCN is proposing a 330/132kV transmission substation at New Kano and 132/33kV transmission substations at Biliri, Kabba and Abor (9th Mile) respectively. However, this ESIA refers only to Biliri in Gombe State.

The physical location of the proposed project site is shown below.

Figure 1 Nigeria and Site Locations: Gombe

This project will be carried out on unoccupied land designated “greenfield” site.
1.1.2 Details of Biliri (Gombe State)

The proposed 132/33kV Transmission sub-station is to be situated at Biliri in Gombe State which is located in the north-eastern part of Nigeria and shares borders with Borno, Yobe, Taraba, Adamawa and Bauchi. Its boundaries correspond, roughly with that of the Gombe Emirate and was created in October 1996 from the old Bauchi State. The state occupies an area of 20,265 km² and had an estimated population of 2,768,452 in 2011 based on projections from the last census figure of 2,353,000 in 2006.

![Figure 1-1 Gombe State Biliri LGA](image)

1.2 Legal and Institutional Framework

1.2.1 Federal Ministry of Environment (FMEnv) ESIA Procedure

The EIA Act 86 (1992) makes EIA mandatory for development projects likely to have adverse impacts on the environment. The EIA must be prepared and approved prior to implementation. The project was submitted for registration with the Federal Ministry of Environment. The FMEnv EIA process has recently been updated and this ESIA complies with these requirements.
1.2.2 World Bank Standards
The project comes under World Bank’s Operation Policies. The project triggered OP/BP 4.01 Environmental Assessment and OP/BP 4.12 – Involuntary Resettlement. These procedures have been followed in the preparation of this ESIA. In terms of involuntary resettlement, it was established that there were no persons found to be resident on or around the immediate vicinity of the proposed site. Some informal growing of crops was taking place for which compensation has been paid. Other than this there are no resettlement issues.

1.2.3 Dissimilar Standards
When host country regulations differ from the levels and measures presented in the World Bank Operation Policies, projects will be required to achieve whichever is more stringent. This also applies if there is a difference between Federal and State standards. The standard which is more stringent must be followed.

1.3 Preparation of the ESIA

1.3.1 Screening and Scoping
A preliminary part of the ESIA process is screening and scoping of the proposed transmission substation site at Biliri for potential adverse environmental and social impacts. This exercise was carried out and defined the scope and depth of the technical issues to be addressed during the preparation of the ESIA. The site reconnaissance for this process was completed and the conclusions confirmed by FMEnv.

1.3.2 Primary Data
Following Screening and Scoping, primary data were obtained by taking samples from the site for subsequent analysis and by taking direct measurements. The site visits were made in August and September 2015. The results were compared with National and International standards and this established the baseline conditions on the sites before activities commenced.

The baseline is used to assess the impacts of project activities on the surroundings. Also if at some time in the future the sites are decommissioned then the sites must be returned to their original condition. The baseline establishes the nature of that condition.

1.3.3 Secondary Data
In addition to primary data collected by the consultants, secondary data were also obtained from other agencies. These included meteorological information or previous environmental reports in similar
locations. These were identified during the literature review.

1.4 Analysis of Alternatives sites

The “do-nothing” option had been considered and discarded because there is an urgent need for more power to be supplied to this area. This opinion was expressed strongly by the residents in the public consultations.

TCN specified the general area where the substation was to be located based on the proximity to high voltage transmission lines and the necessary size of the substations. This information was passed to the state government who reviewed possibilities, consulted with landowners, and arrived at a decision on the site which was then conveyed to TCN.

TCN did not examine alternative sites because the sites were identified and made available by the state government.

As the site was suitable TCN accepted the proposed location. The State Government then transferred to TCN the Site Plan, Survey Plan and Change of Ownership letters. This transaction was confirmed through the various community stakeholders meetings subsequently organised by TCN.

Consequently all negotiations and payments of compensation were carried out by the State Government and the site handed over to TCN free of all encumbrances.

1.5 Summary of Public Consultations

Extensive public consultations took place. During Screening and Scoping, on-site discussions were held with stakeholders such as local land owners and residents. During primary data collection to establish the baseline social conditions, interviews and Focus Group Discussions were conducted. Following this, meetings were held in an open forum.

An Inter-agency Meeting was held in Abuja and a stakeholder consultation was held in Biliri, Gombe state. These were announced well in advance with formal invitations being sent out and and newspaper adverts published in two newspapers. The attendance was high with over 100 people attending each group. In general, the attendees were in favor of the project proceeding and requested commencement of implementation to be accelerated.

In general, all residents were supportive of the project and saw positive outcomes.
1.6 Measures to Address Concerns Raised by Stakeholders

1.6.1 Constraints Mapping and GIS
In accordance with FMEnv requirements the spatial boundaries of the study are 2kms for bio-physical impacts and 4 kms for socio-economic impacts. These are reflected in the boundaries of the constraint mapping. Anything beyond 4kms is considered to be outside the zone of influence of the project. High definition remote sensing satellite imagery was obtained for the site. Digital Terrain maps were also obtained for the site location. DTM files are three dimensional and include vertical height data embedded in the file. These were used directly for determining catchment areas.

1.6.2 Health and Safety during Operation
The strength of both electric and magnetic fields is a function of the voltage, distance from the conductors to the ground and the lateral distance from the line to the receptor. It is also a function of frequency. High frequencies radiate much higher emissions than low frequencies. Transmission lines operate at 50Hz which is regarded as Ultra Low Frequency.
Although there have been many studies published on occupational exposure to Electro-Magnetic Fields (EMF) no clear evidence exists to show that residential exposures to electric and magnetic fields at mains frequency are a threat to human health.
The Operational ESMP contains details on Health and Safety procedures to be followed by staff and operators to avoid the hazards of electrocution. This is TCN Standard Operating Procedure.

1.6.3 Grievance Redress Mechanisms
The public consultations showed that there is already a strong communications pathway between TCN and the local communities and this should continue to be used as a basis for the Grievance Redress Mechanism (GRM) which will be set up for the site.
In the Construction Phase the contractor will be require to establish a Complaints Response procedure immediately upon occupation of the site. Staff will be designated to respond to complaints on a 24/7 basis and their contact details will be advertised on signboards around the site.
During operation TCN will also establish a GRM as part of their ongoing Corporate Social Responsibility program. The GRM will be triggered if complainants are not satisfied with the handling of complaints.
1.7 Potential Adverse Impacts and Mitigation

1.7.1 Drainage
There is a small watercourse running across the site but it was dry as at the time of the site investigation. It is a rainwater run-off channel and should be redirected during site formation. There are no drainage issues on the site. There are no main rivers within 2kms of the site.

1.7.2 Site Access
The site is located near residential development and the existing access is through a restricted narrow roadway crossing a steep sided small stream. It is recommended that a new access road be constructed linking the site with the main road to the north of the site at a distance of about 900m from the site. This will avoid a stream crossing and significantly reduce the risk of traffic accidents. It is also recommended that the contractor be instructed to make a temporary access road to the site from the north off the main road. A new access would remove the road safety hazard.

1.7.3 Noise Levels
The Nigeria National Environmental Noise Standards and Control Regulation (2009) require noise levels of 50 dB(A) Leq(12 hours) during the daytime and 35 dB(A) Leq(12 hours) during nighttime at the perimeter of the site to preclude noise nuisance to residential property that may be built adjacent to the site in the future. Based on the Technical Specification for transformers and measured noise levels, it is recommended that transformers should not be located within 80 m of the boundary of the site. This is a worst case scenario. Following this recommendation would ensure no complaints over noise intrusion both during the night time and during daytime during operation. It also allows a margin for intensification of use in the future.

1.7.4 Climate Change
Climate change projections show that there will be significant differences between sites in the north and sites in the south, with the north being more subject to droughts and the south being more subject to floods. This may impact on the demand load imposed on the transmission system but will not impact on the site of this project

1.8 Positive Impacts
- The proposed projects will provide short term, local employment opportunities during the construction phase for community members in terms of; site clearance, excavation, loading and
offloading of materials. Other short term opportunities may arise from the provision of security services where temporary camps or stores are erected and from opportunities to provide goods and services to construction workers e.g. food kiosks and other shops.

- The long term impact is provision of power to the area with associated improvement in standard of living and economic development.
- All new transformers are specified as being free of PCBs. No PCBs will be present on the sites and there is no need for concern on this issue.

### 1.9 Matrix of Significant Impacts

The Matrix of Significant Impacts is given below. This site is one of four under consideration for project development. The matrix refers to all four although this ESIA refers only to Biliri in Gombe. No key issues have been identified that will preclude the development of the site as intended.

<table>
<thead>
<tr>
<th>ENVIRONMENTAL IMPACTS</th>
<th>Biliri</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Construction</td>
</tr>
<tr>
<td>Physical</td>
<td></td>
</tr>
<tr>
<td>Water Quality</td>
<td>✓ ✓ ✓</td>
</tr>
<tr>
<td>Flooding from sleep gradient</td>
<td>✓</td>
</tr>
<tr>
<td>Soil Contamination from spills</td>
<td>✓ ✓</td>
</tr>
<tr>
<td>Air Quality</td>
<td>✓ ✓ ✓</td>
</tr>
<tr>
<td>Waste solid and liquid</td>
<td>✓ ✓</td>
</tr>
<tr>
<td>Noise</td>
<td>✓ ✓</td>
</tr>
<tr>
<td>Visual impact</td>
<td>✓</td>
</tr>
<tr>
<td>Biological</td>
<td></td>
</tr>
<tr>
<td>Fauna</td>
<td>✓</td>
</tr>
<tr>
<td>Flora</td>
<td>✓</td>
</tr>
<tr>
<td>Socio Economic</td>
<td></td>
</tr>
<tr>
<td>Resetlement</td>
<td>✓</td>
</tr>
<tr>
<td>Cultural</td>
<td>✓</td>
</tr>
<tr>
<td>Occupational Health and Safety</td>
<td>✓ ✓ ✓</td>
</tr>
<tr>
<td>Community</td>
<td>✓ ✓ ✓</td>
</tr>
<tr>
<td>Utilities</td>
<td>✓ ✓</td>
</tr>
</tbody>
</table>

Figure 1-2 Matrix of Significant Impacts
1.10 Proposed Mitigation Measures

1.10.1 Recommendations for Biliri
The site at Biliri in Gombe is located near residential development and the existing access is through a restricted narrow roadway crossing a steep sided small stream. It is recommended that a new access road be constructed linking the site with the main road to the north of the site at a distance of about 900m from the site. This will avoid a stream crossing and significantly reduce the risk of traffic accidents.

1.10.2 Hiring of Local Labor
Several stakeholders expressed concerns over bringing in foreign labor during construction. The contractor will be required to give preference to local labor when hiring his workforce.

1.11 The ESMP

1.11.1 Implementing ESMP
This ESIA contains an ESMP as an integral chapter. The ESMP covers preconstruction, construction, commissioning, operation and decommissioning. This ESMP is written as a stand-alone document. It can be extracted and used as an independent guide. The ESMP will be the guiding document for environmental management and monitoring during construction and operation of the project.

1.11.1.1 Construction
The ESMP will guide TCN in determining whether the contractor is following the recommended mitigation measures prior to site occupancy and during construction.
TCN will issue the ESMP in the tender documents. The responsibility for Environmental Management and Monitoring during project construction lies with the main contractor and his sub-contractors.
TCN will appoint a Construction Supervision Consultant (CSC) to supervise the contractor. The CSC inspectors will check that the contractor is complying with the ESMP. Failure to do so will be brought to the contractor’s attention in monthly progress meetings.
TCN will compile monthly reports and report 6 monthly on EHS issues to World Bank. Annual reports on EHS will be submitted to FMEnv.

1.11.1.2 Operation
During operation it is essential to ensure that the environmental requirements stipulated in the ESMP
are being implemented effectively. TCN will compile monthly reports and report 6 monthly on EHS issues to World Bank. Annual reports on EHS will be submitted to FMEnv.

In addition the TCN in-house Environment Health and Safety staff will carry out Environmental Audits every three years on the installation. These results will be forwarded to FMEnv. In the event of non compliance with the legislation FMEnv will require TCN to rectify the situation as soon as reasonably possible.

1.11.2 The CESMP

The ESMP is of necessity a general document. The contractor must prepare a detailed ESMP giving site specific details of construction activities. This is a Contractor Environmental Social Management Plan (CESMP). This must be done within one (1) month of contract signing. The CESMP must be submitted and approved before construction activity may commence.

A CESMP is a dynamic document and may be changed and updated at any time during implementation of the Project. Environmental monitoring results shall be documented and reviewed at least monthly to ensure that signs of adverse impacts are detected at an early stage and that actions for mitigation are taken.

Compliance with the ESMP is contractually binding. Failure by the contractor to comply with the ESMP may result in financial penalties.

A generic sample is given in Annex 8 and an example of a CESMP is given in Annex 9.

1.11.3 Cost of implementing ESMP.

The main part of the ESMP relates to construction which will be by a contractor. The ESMP is to be included in the Tender Documents against which the contractor will submit a bid. All contractors bidding for the project must include costs for environmental management in their bid price.

Construction - The cost to the contractor of meeting the requirements of the ESMP should be included in the tender as a budget line. The contractor must demonstrate that he is implementing the measures such as spill control, control of run off and stormwater, drainage, stockpile of materials, storage of fuels and health and safety issues such as issuing of PPEs (Personal Protective Equipment) such as high vis jackets, safety helmets, and boots, and also ear plugs goggles, if required. This will equate to about $150,000.

Operationally - The baseline should be repeated every three years in accordance with TCN Standard Practices for Environmental Audits. The cost of this is estimated to be $40,000.

Details of cost calculation are given in Section 14.32.
1.11.4 Monitoring

Monitoring should be carried out on a regular basis. The following list is for guidance and is indicative only. More regular monitoring or spot checks may be required in response to a complaint.

- Liquid emissions from sites must be checked every three months or after heavy rain if overflowing is reported. Measurements in streams and water courses must be made.
- Groundwater monitoring wells should be established and checked at least annually (A minimum of one upstream and one downstream of the site is recommended). Samples should be checked for heavy metals and organics.
- Dust emissions on site must be checked weekly by visual inspection and monthly by examining records of water spraying. Ambient air quality must be checked over a 24 hour continuous period at sensitive receptors in the event of complaints.
- Noise levels must be checked every three months at site perimeters, or in the event of a complaint, at night as well as during the daytime.
- Correct removal and disposal of food waste and waste engine oil and grease must be checked weekly by visual inspection of the camps and checking of records from the waste disposal contractors.
- Noise and vibration must be checked at sensitive receptors when blasting first occurs or in the event of complaint. Before blasting commences warning notices must be posted to local residents.
- Reinstatement of borrow-pits and quarries must be checked after closure of the facility.

In addition to regular monitoring, unannounced spot-checks must be made by TCN-PMU on contractors operations. All of the above procedures should be carried out by the site CSC inspectors, in conjunction with PMU and where appropriate, FMEnv. The results should be formally recorded every week and compiled into a monthly report. This should be submitted to TCN and the contractors as necessary but at a minimum on a monthly basis. Monthly reports should be compiled into quarterly and annual reports to be submitted to WB.

1.12 Decommissioning

At some point in the future the site may be decommissioned. At such a time the baseline environmental survey and analysis should be repeated to ensure that no deterioration in soil or groundwater conditions has occurred.

Prior to decommissioning, a decommissioning plan will be prepared, according to final monitoring and the decommissioning impacts listed in Table 14.1. Generic Decommissioning plan is given as a guide in
Annex 10.

Although closure of the site is unlikely, it is conceivable that transfer of ownership of the site may occur, in the event of say, privatisation. In that event the new owner will insist on a Due Diligence and a lack of reliable data on site conditions may jeopardise the transaction.

1.13 Going Beyond Compliance
It will be necessary to carry out measurements to establish if the regulations are being met. As a matter of fact simple compliance with the standards is not necessarily the final objective. There is no harm in the contractor or the operator “going beyond compliance” and running an operation better than that required by the FMEnv and World Bank standards. This is the CSR objective of TCN.

1.14 Capacity Building and Institutional Strengthening
In order to implement the project, various stakeholders will have a part to play. Their roles and responsibilities as well as appropriate capacity building are discussed in Section 14.37.

1.15 Development of the Site
No key issues have been identified that will preclude the development of the sites as intended.

2 Introduction

2.1 Background
The Federal Government of Nigeria is taking steps to improve the quality and reliability of electricity supply while ensuring sustainability of the power provision industry. By bridging the gap between the available electricity supply, and the demand required for industry, commercial businesses and homes, the project will support domestic economic development, improve lifestyles, provide revenue for government and create employment opportunities in the target states. There are also ongoing discussions with neighboring countries on the foreign export and import of electricity in the future.

2.2 Location
Nigeria is located in western Africa on the Gulf of Guinea and occupies a total area of 923,768 km\(^2\) making it the world’s 32nd-largest country. It has a 4,047km border which it shares with Benin (773 km), Niger (1497 km), Chad (87 km), Cameroon (1690 km), and it has a coastline of 853 km. Nigeria lies between latitudes 4°and 14°N, and longitudes 2° and 15°E.
Nigeria has a varied landscape. The far south is defined by its tropical rainforest climate, where annual rainfall is 1,500 to 2,000 mm a year. Coastal plains are found in both the southwest and the southeast. This forest zone's most southerly portion is defined as "salt water swamp," or mangrove swamp. North of this is fresh water swamp, with different vegetation and north of that is rain forest. ¹

The highest point in Nigeria is Chappal Waddi at 2,419 m. The main rivers are the Niger and the Benue which converge and empty into the Niger Delta. This is one of the world's largest river deltas, and the location of a large area of Central African mangroves. To the southwest of the Niger is highland. To the southeast of the Benue are hills and mountains, which form the Mambilla Plateau, the highest plateau in Nigeria. This plateau extends through the border with Cameroon.²

The area near the border with Cameroon close to the coast is rich rainforest and part of the Cross-Sanaga-Bioko coastal forests ecoregion, an area with high biodiversity. Most of Nigeria

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² Ibid
is savannah with insignificant tree cover, grasses and flowers. Rainfall is limited to between 500 and 1,500 millimetres per year. The savannah zone's three categories are Guinean forest-savanna mosaic, Sudan savannah, and Sahel savannah. Guinean forest-savanna mosaic is plains of tall grass interrupted by trees. Sudan savannah is similar but with shorter grasses and shorter trees. Sahel savannah consists of patches of grass and sand, found in the northeast. In the dry north-east corner of the country lies Lake Chad, which Nigeria shares with Niger, Chad and Cameroon.  

2.3 Registration

The Government received an additional credit from the International Development Association (IDA) under the World Bank for the implementation of Nigeria Electricity and Gas Improvement Project (NEGIP). Some of this financing is allocated to the Transmission Company of Nigeria (TCN) for the construction of four proposed transmission substations at New Kano in Kano State, Biliri in Gombe State, Kabba in Kogi State, and Abor (9th Mile) in Enugu State. However, this ESIA refers only to Biliri in Gombe State.

The physical location of the proposed project site is shown below. 

\[\text{Image: Map of Nigeria showing the location of Biliri in Gombe State.}\]

\[\text{Image: Map of Africa showing the location of Lake Chad.}\]

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\(^3\) Ibid

\(^4\) TCN PMU TOR
This project will be carried out on unoccupied land designated “greenfield” site. The project has been submitted for registration with the Federal Ministry of Environment.

2.4 ESIA Procedure

2.4.1 Federal Ministry of Environment (FMEnv)
The offices of the FMEnv in Abuja were visited by the Team Leader and helpful and cooperative discussions held. The EIA process has been updated and this ESIA complies with these requirements.

2.4.2 World Bank
This project is financed by World Bank and they have their own Due Process for Environmental and Social Assessment. These procedures have been followed.

2.4.3 ESMP
This Environmental and Social Assessment contains an ESMP as an integral chapter. The ESMP can be extracted and used as a stand-alone document when appointing contractors.

2.5 Screening and Scoping
A preliminary part of the ESIA process is screening and scoping of the proposed 132/33kV transmission substations at Biliri for potential adverse environmental and social impacts. This exercise defines the scope and depth of the technical issues to be addressed during the preparation of the ESIA and these are subject to confirmation by FMEnv. This requires site reconnaissance and this process was completed.

2.6 Primary Data
Primary data was obtained by taking samples from the sites for subsequent analysis and taking measurements. The results were compared with National and International standards and this established the baseline conditions on the sites before any activity commences. The baseline is used to assess the impacts of project activities on the surroundings. Also if at some time in the future the sites are decommissioned then the sites must be returned to their original condition. The baseline establishes the nature of that condition. The site visits were made in August and September 2015.
2.7 Secondary Data
In addition to primary data collected by the consultants secondary data were also collected. These were obtained from other agencies such as meteorological information, as is regularly collected by airports, or previous environmental reports in similar locations. These were identified during the literature review. The consultants have been involved in many previous studies and material gathered in these activities was accessed and used when relevant.

2.8 Constraints Mapping and GIS

2.8.1 Constraints Mapping
In accordance with FMEnv requirements the spatial boundaries of the study are 2kms for bio-physical impacts and 4 kms for socio-economic impacts. These are reflected in the boundaries of the constraint mapping. Anything beyond 4kms is considered to be outside the zone of influence of the project.

2.8.2 High Definition Remote Sensing Imagery
The consultants have obtained high definition remote sensing satellite imagery for the site. The information is stored in layered PDF files so that specific details such as roads, rivers etc can be switched in and out. This makes identifying impacts simpler. These maps have also been printed up in A0 size for illustrative use in public consultations.

2.8.3 Digital Terrain Mapping (DTM)
The consultants have obtained Digital Terrain maps for the site location. Standard topographical maps printed on paper are two dimensional and give height data by numbers on the maps. DTM files are three dimensional and include vertical height data embedded in the file. They can be used directly for determining catchment areas and calculating rainfall run off.

2.9 Layout of ESIA Report

2.9.1 Format of Report
The format of the report is in accordance with the requirements of FMEnv ESIA Procedure and World Bank OP4.01.

2.9.2 Objective and Scope of the ESIA
The objectives of the study are to prepare ESIAs and ESMPs for each of the proposed substations. The scope of services includes the following key steps:
• Project Definition
• Project registration
• Project Description
• Environment description
• Impact assessment
• Analysis of Alternatives
• Environmental and Social Impact Assessment (ESIA)
• Environmental and Social Management Plans (ESMPs)
• Stakeholder consultation
• Monitoring plan
• Quality assurance and quality control

These steps have all been completed and are described in this document.
3 Legal and Institutional Framework

The following sections give details on the legal and institutional framework within which the ESIA has been prepared.

3.1 Legal and Regulatory Requirements

The ESIA is prepared in accordance with the current legal regime and regulatory framework. The ESIA complies with all existing legislation but also takes cognizance of any forthcoming regulatory requirements that may be related to the project development and operation.


The constitution recognizes the importance of improving and protecting the environment and makes provision for this. Relevant sections are:

- Section 20 makes it an objective of the Nigerian State to improve and protect the air, land, water, forest and wildlife of Nigeria.
- Section 12 establishes that international environmental treaties ratified by the National Assembly should be implemented as law in Nigeria.
- Section 33 and 34 which guarantee fundamental human rights to life and human dignity respectively, have also being argued to be linked to the need for a healthy and safe environment to give these rights effect.

3.1.2 National Environmental Standards & Regulations Enforcement Agency (NESREA)


FEPA was charged with the overall responsibility for environmental management and protection. It is on record that by the establishment of FEPA, Nigeria became the first African country to establish a national institutional mechanism for environmental protection.

FEPA and Departments in other Ministries were merged to form the Federal Ministry of Environment in 1999, but lacked appropriate enabling laws on enforcement. To address this omission, the Federal Government followed section 20 of the 1999 Constitution of the Federal Republic of Nigeria, and established the National Environmental Standards and Regulations Enforcement Agency (NESREA), a parastatal of the Federal Ministry of Environment.

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

3.1.3 Nigerian Statutory Requirements
The NESREA Act empowers the Agency to be responsible for enforcing all environmental laws, guidelines, policies, standards and regulations in Nigeria, as well as enforcing compliance with provisions of international agreements, protocols, conventions and treaties on the environment to which Nigeria is a signatory.

The Federal Government through NESREA has developed 24 Environmental Regulations which have been published in the Federal Republic of Nigeria Official Gazette and are now in force. These regulations are given in Annex A. All of these regulations will be taken into account when preparing the ESIA.

3.1.4 EIA requirements
Under the Environmental Impact Assessment (EIA) Act CAP E12, LFN 2004 an Environmental Impact Assessment can be required in respect of public and private projects. Sections relevant to this ESIA include:

- Section 2 (1) requires an assessment of public or private projects likely to have a significant (negative) impact on the environment.
- Section 2 (4) requires an application in writing to the Agency before embarking on projects for their environmental assessment to determine approval.
- Section 13 establishes cases where an EIA is required and
- Section 60 creates a legal liability for contravention of any provision.

3.1.5 Planning Requirements
The Nigerian Urban and Regional Planning Act CAP N138, LFN 2004 oversees purposeful planning of the country to avoid overcrowding and poor environmental conditions. The following sections are relevant to this ESIA:
• Section 30 (3) requires a building plan to be drawn by a registered architect or town planner.
• Section 39 (7) establishes that an application for land development would be rejected if such development would harm the environment or constitute a nuisance to the community.
• Section 59 makes it an offence to disobey a stop-work order. The punishment under this section, is a fine not exceeding N10,000 (Ten thousand naira) and in the case of a company, a fine not exceeding N50,000.
• Section 72 provides for the preservation and planting of trees for environmental conservation.

The Land Use Act CAP 202, LFN 2004 places the ownership, management and control of land in each state of the federation in the Governor. Land is therefore allocated with his authority for commercial, agricultural and other purposes.

3.1.6 Criminal Acts
The Harmful Waste (Special Criminal Provisions) Act CAP H1, LFN 2004 prohibits, without lawful authority, the carrying, dumping or depositing of harmful waste in the air, land or waters of Nigeria. The following sections are notable:
• Section 6 provides for a punishment of life imprisonment for offenders as well as the forfeiture of land or anything used to commit the offence.
• Section 7 makes provision for the punishment accordingly, of any conniving, consenting or negligent officer where the offence is committed by a company.
• Section 12 defines the civil liability of any offender. He would be liable to persons who have suffered injury as a result of his offending act.

3.1.7 ESIA regulatory requirements
Some of the relevant legislation have been described above. The ESIA will ensure that the project complies with all of these.

3.1.8 EIA Procedure
Subsequent to UNCED Nigeria promulgated the main EIA legislation. The EIA Act 86 (1992) makes EIA mandatory for development projects likely to have adverse impacts on the environment. The EIA must be prepared and approved prior to implementation. The office of the FMEnv in Abuja was visited on 11th August, 2015 and discussions held with the Environment Officers responsible for the site. They were helpful and provided the EIA Process Flow Chart given below which has been recently updated. (Figure 2-1)
ESIA for the Proposed 132/33kV Transmission Substation at Biliri, Gombe State | 40
3.2 International Conventions

Nigeria has acceded to several international conventions and protocols as given below.

Table 3-1 International Environmental Agreements

- Environment Related International Conventions And Protocol Signed And Ratified By Nigeria
  - International Convention for the Prevention of Pollution of the Sea by Oil, 1954-62
  - Convention on Fishing and Conservation of the living resources of the High Sea, 1985
  - Convention on the Prevention of Marine Pollution by Dump of Wastes and Other Matters, 1972
  - Equal Remuneration Convention, 1951
  - Abolition of Forced Labour Convention, 1957
  - Discrimination (Employment and Occupation) Convention, 1958
  - Minimum Age Convention, 1973
  - Worst Forms of Child Labour Convention, 1999
  - The RAMSAR Convention on the Conservation of Wetlands of International Importance,
especially as Water Fowl Habitat, 1971

- The Convention concerning the Protection of the World Culture and Natural Heritage, 1972
- Convention on International Trade in Endangered Species of Fauna and Flora (CITES) 1973
- Convention on the Conservation of Migratory Species of Wild Animals, 1973
- Framework Convention on Climate Change, 1992
- Convention to Combat Desertification, 1994
- Convention on Biological Diversity 1992

As there are no international transboundary issues associated with the site it is not considered likely that any agreements made under these conventions will be breached.

3.3 World Bank Safeguard Policies

3.3.1 OP/BP 4.01 Environmental Assessment

The proposed activities triggered OP/BP 4.01 and the ESIA is expected to meet the requirements of this policy in terms of content and structure. Under Environmental Assessment (OP 4.01) the Bank requires environmental and social impact assessment (ESIA) of sub-projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable.

The environmental assessment is a process that is conducted to identify the negative impacts that a project may have on aspects of the biophysical and social environment. It analyses the impacts of project alternatives, and provides mitigation measures to be undertaken to eliminate or minimize the impacts identified. The ESIA does follow this policy in terms of content and structure.

3.3.2 OP/BP 4.12 – Involuntary Resettlement.

The proposed activities triggered OP/BP 4.12 – Involuntary Resettlement. However, in terms of involuntary resettlement it was established that there were no persons found to be resident on or around the immediate vicinity of proposed site. Some informal growing of crops was taking place and compensation has been paid for this by the State Government who were responsible for the land acquisition. Other than this there are no resettlement issues.

3.3.3 World Bank Environmental, Health, and Safety Guidelines (EHS)

The World Bank Group Environmental, Health, and Safety Guidelines (known as the "EHS Guidelines") contain the performance levels and measures that are normally acceptable and that are generally
considered to be achievable in new facilities at reasonable costs by existing technology. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets with an appropriate timetable for achieving them. The environmental assessment process may recommend alternative (higher or lower) levels or measures, which, if acceptable, become project- or site-specific requirements.

The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP).

When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects will be required to achieve whichever is more stringent. If less stringent levels or measures than those provided in the EHS Guidelines are appropriate in view of specific project circumstances, a full and detailed justification must be provided for any proposed alternatives through the environmental and social risks and impacts identification and assessment process. This justification must demonstrate that the choice for any alternate performance levels is consistent with the objectives of Performance Standard 3.

3.4 TCN Environmental and Social Management Framework (ESMF)

4  The Project

4.1  Project Description
The Transmission Company of Nigeria (TCN) proposes to build and operate a transmission substation situated at Biliri, in Gombe State. The project will be carried out on unoccupied land designated as a “greenfield” site. The construction during this project is limited to the transformer substation site only. Transmission lines already exist and distribution lines will be constructed later. Transmission and distribution are outside the scope of this report and are not included in this ESIA.

4.2  Project Objectives
The Project intends to achieve the following objectives:
• Provide a readily available electricity supply,
• Improve transmission and supply of electricity statewide,
• Promote industrial growth,
• Create job opportunities,
• Increase revenue for TCN.
TCN will adopt all steps necessary to ensure responsible engagement with Affected Persons and Project Beneficiaries throughout the process.

4.3  Electricity Supply in Nigeria
In order to place this project in the correct context an over view of the electricity supply industry in Nigeria is given below. This is for the benefit of non-technical readers who may not be totally familiar with the history and culture of TCN.

4.3.1  Generation
Any electricity supply system consists of three basic stages:
• Generation
• Transmission
• Distribution

The two mains types of generation are thermal and hydro. Thermal can be by burning of coal, oil, or gas. Natural gas is a by-product of petroleum recovery (“crude oil”) and so is available to be used in Nigeria.
Hydropower generation translates the natural potential energy of water stored in reservoirs into electricity by the use of large dams. Also small dams known as “run of river” systems translate kinetic energy of running water into electricity, and due to the small size are known as mini or micro hydel systems. A major significant difference is that thermal plants require fuel and hydro do not. There are many other pros and cons for each type of plant. Generation can be supplemented by renewable energy such as solar, geothermal, wind power, tidal and biogas.  

4.3.2 Transmission
It is conventional to split generation, transmission and distribution between separate operators. The responsibility of the transmission company is to take power from the generator and deliver it to

\[\text{Figure 4-1} \quad \text{Generation, Transmission, Distribution and Consumers}\]

distributors, who provide power to the consumers. Every effort is made to do this efficiently with as little loss of power as possible. Currents flowing in transmission lines lose power through heat, which is proportional to current, so to avoid this, power is transmitted at very high voltages and low current.

The high voltage is then transmitted down the familiar large towers.⁶

![High Voltage Transmission Towers](image)

**Figure 4-2**  High Voltage Transmission Towers

In Nigeria this voltage is 330,000 volts (330kV). The power coming from the generator must be

---

increased in voltage and this requires a **step-up transformer** whereby the voltage is increased. For distribution the voltage must be reduced and this requires a **step down transformer**. The 330kV is reduced to 132 kV and again to 33kV. The responsibility for delivery of power then shifts from the transmission company to the delivery company ("DISCO").
4.3.3 Distribution
There are 11 DISCOs in Nigeria. Power can be distributed by them to industries and utilities at lower voltages such as 11kV. To increase efficiency power is transmitted in 3 phases. Factories such as steelworks with arc furnaces can require large currents and other industries may take 3 phases at 450 volts. Households use the common single phase 240 volts. Utilities such as railways require lower voltage but often direct current (D.C.) as opposed to alternating current (A.C.) produced in the generating power station. The Nigerian nominal frequency is 50 Hz.

4.4 Project Justification
Nigeria as a country has the largest population in Africa and accounts for over 47% of the population of West Africa. It is the biggest oil exporter in Africa, with the largest natural gas reserves in the continent. The GoN “Roadmap 2010” outlined the government’s strategy for power sector reform to expand supply, attract private investment and tackle issues hampering service delivery. The

---


8 Ibid
population continues to grow and is estimated currently to be around 180 million. If the current
growth rate continues, by 2050 Nigeria will be the third most populous country in the world.  
(Figure 3-4)  

![Population Graph](image)

**Figure 4-4**  
Nigeria Populations in Millions

The economy of Nigeria continues to grow with GDP per capita increasing. It currently stands around
US$2,700 per person. The expanding population will expect electric power supplies to be available to
improve their lifestyle and they will have the ability and willingness to pay for it. This will place a heavy
demand growth on TCN.  

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9 Ibid

10 [http://www.indexmundi.com/nigeria/](http://www.indexmundi.com/nigeria/)

11 [http://www.indexmundi.com/nigeria/](http://www.indexmundi.com/nigeria/)
In Nigeria, electricity production is mainly based on gas-fired thermal power stations and hydroelectric plants. The production in kilowatt hours (kWh) is shown below (Figure 3-6); current capacity is slightly below 5,000 MW. Interruptions in gas supply, and low water levels in summer, limit the ability to increase generation capacity. (Figure 3-6)\textsuperscript{12}

The amount actually consumed is shown below in kWh. The discrepancy between the amount of electricity generated, 24 billion kwhrs\textsuperscript{13}, and the amount consumed, 20kWh, is due to loss in

---

\textsuperscript{12} http://nigeria.opendataforafrica.org/skikh/nigeria-electricity-consumption-export-import-1980-2013

\textsuperscript{13} http://www.indexmundi.com/nigeria/
transmission and distribution. (Figure 3-7)  

![Electricity Consumption Graph]

**Figure 4-7 Electricity Consumption**

As a member of the West African Power Pool Nigeria does have agreements to export electricity from hydroelectric power plants in return for riparian rights on water usage. Transmission lines were constructed for this purpose. Recently these exports have reduced to low power levels. In the past Nigeria did import electricity but recently this has ceased.  

The “Road Map for Power Sector Reform” in Nigeria specifies a rule of thumb of at least 1GW (1,000 megawatts) of electricity generation and consumption for every 1 million head of population for any developed industrial nation. Based on Nigeria’s population of nearly 180 million people, the target should be 180 GW for Nigeria to be ranked as a developed country. Current targets are around 50GW. The ultimate target would give around 1kW/person. At present in Nigeria the supply is around 0.03kW/person.

There are currently 23 power generating plants in total.  As can be seen in Figure 3-8 the majority of the power generation capacity is in the south of the country with few in the north.  

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14 CIA World Factbook - Unless otherwise noted, information in this page is accurate as of June 30, 2015

15 http://www.indexmundi.com/nigeria/

Figure 4-8  Power Generation in Nigeria
In 2013 less than 50% of Nigeria's population had access to electricity.\textsuperscript{17} The peak demand forecast in 2015 is 12,800 MW.\textsuperscript{18} Nigeria plans to increase generation from fossil fuel to 20,000 MW by 2020 and increase hydroelectricity capacity to 5,690 MW by 2020. The ultimate target is 50,000MW by 2050. Independent Power Projects (IPP's) currently contribute 1,600 MW to the national grid and more investment is being encouraged. The National Policy on Renewable Energy and Energy Efficiency is intended to boost power supply and will make use of Nigeria's natural gas reserves helping to eliminate gas flaring in the country. There is a significant shortage of power availability in Nigeria both now and in the future. Major generation and distribution is in the south of the country with less in the north. This imbalance needs to be rectified. The Transmission Development Project proposed by TCN will help to ease immediate power supply constraints and assist in economic growth. Based on the above discussion the project is considered justified.

4.5 The Project Proponent - TCN

The Government owned electricity system currently comprises\textsuperscript{19}:

- Three hydro and seven thermal generating stations total installed capacity 6,852MW, available capacity 3,542MW.
- A radial transmission grid (330kV and 132kV), owned and managed by TCN
- Eleven distribution companies at 33kV and below

TCN was incorporated in November 2005. It was one of the 18 unbundled Business Units previously under the Power Holding Company of Nigeria (PHCN). TCN licensed activities include electricity transmission, system operation and electricity trading which is ring fenced.

TCN carries out the functions of Transmission Service Provider, System Operations and Market

\textsuperscript{17} National Population Commission 2013

\textsuperscript{18} Presidential Task Force on Power 2015

\textsuperscript{19} POWER SECTOR OUTLOOK IN NIGERIA: Governments Renewed Priorities, Prof. Bart Nnaji CON, Chairman, Presidential Task Force on Power, Securities and Exchange Commission June, 2011
Operations. The TCN system comprises 330 kV and 132 kV circuits on overhead lines and substations (Figure 3-9.) A 700kV supergrid is planned. (Figure 3-10.) Distribution is split into 11 zones and the distribution networks comprise 33 kV, 11 kV and low voltage circuits. 20

Figure 4-9   Existing Power Transmission in Nigeria

4.6 Project Location- Biliri (Gombe State)

The proposed 132/33kV Transmission sub-station is to be situated at Biliri, in Gombe State which is located in the north-eastern part of Nigeria and shares borders with Borno, Yobe, Taraba, Adamawa and Bauchi. Its boundaries correspond, roughly with that of the Gombe Emirate and was created in October 1996 from the old Bauchi State by the Sani Abacha military government.

4.7 Role of Transformer Substations

4.7.1 Operation of a Substation

Electricity is generated in a thermal power plant, hydroelectric power plant, or by renewable energy. This electricity is then supplied to a transmission substation. In the transmission substation the voltage
is increased substantially using step up transformers. The voltage is increased to reduce the transmission losses over long distances. This electricity is then supplied to a power distribution injection substation where it is stepped down using step down transformers and then supplied to a distribution grid. In the distribution grid there are additional distribution transformers and voltage is further reduced for distributing further down the grid. From here the electricity is supplied to residences, Industries, etc at 220 volts as per requirement.

The transformer substation is the component of the electricity supply network that is the subject of this project. The substation is where the voltages are increased to high values by using step up transformers, and after the transmission, they are again stepped down for distribution. In addition to changing the voltages the substations have a variety of protective devices like circuit breakers and fuses to protect the distribution networks. These are designed in such a way that various distribution circuits can be isolated for repairs and load shedding.\endnote{21}

### 4.7.2 Function of Transformer Substations

Apart from the distribution of electricity the substations have many other functions as follows:

- **Step up and step down of the voltage for transmission and distribution.** This lowers transmission losses.
- **Switching and isolating the circuits for maintenance:** Switching is also an important function of substations. Closing down a feeder circuit when the load demands are high needs to be done for the safety of the generating plants. Switching high voltages is a dangerous work, and special circuit breakers like air circuit breakers and oil circuit breakers for quenching the arcs have to be used.
- **Load shedding:** When the power demand is more than the supply, the substations do load shedding on distribution circuits to maintain balance.
- **Correction of power factors circuits:** The power factor has to be kept at the correct value when reactive loads are there to protect the generating plant and increase efficiency.

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• Safety devices like circuit breakers and fuses: These safety devices are provided for protecting the machineries on the distribution circuit as well as in the substation against high short circuit currents.
• Bus bars for splitting the power for distribution: These are thick bars of copper to which various distributing circuits are connected by nuts and bolts.

Substations are normally outdoors and are enclosed by a wire fence. However, in residential or high density areas, the substation may be indoors and even housed inside a building to restrict the humming noise of the large transformers. The elements of a substation are shown below.  

![Elements of a substation](image)

Figure 4-12 Elements of a substation

A: Primary power lines' side  
B: Secondary power lines' side


The first substations were connected to only one power station, where the generators were housed, and were subsidiaries of that power station. Hence the name “sub-station”.  

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22 Ibid  
23 Ibid
4.7.3 Reactors

Efficiency and safety are key considerations in a substation. For transmission lines, the space between the overhead line and the ground forms a capacitor parallel to the transmission line, which causes an increase in voltage as the distance increases. When a network becomes larger, sometimes the short-circuit current on the transmission line exceeds the short-circuit rating of the equipment. To offset the capacitive effect of the transmission line and to regulate the voltage and reactive power of the power system, reactors are connected either at line terminals or at the middle, thereby improving the voltage profile of transmission line. Reactors are current-limiting devices and oppose rapid changes in current. They hold down any spikes of current and limit any peak currents.

Variable Shunt Reactors are used in high voltage energy transmission systems to stabilize the voltage during load variations. The variability brings several benefits compared to traditional fixed reactors. The VSR can continuously compensate reactive power as the load varies so ensuring voltage stability.²⁴

4.7.4 Local Control Kiosk

All substations contain a local control kiosk. This is manned and used for controlling power allocation but also as a communications hub in case of accident or power outage. The new 132kV and 33kV diaries will be equipped with control kiosk.

Figure 4-13 Substation Transformers

²⁴ Ibid
4.7.5 **Equipment**

The project covers the design, manufacture, delivery, construction, installation and commissioning of 132/33kV Transformers at Biliri. It includes all works that may be needed to deliver the new substation as specified in the bidding document. It includes the works in Table 3-1 below.
### Table 4-1 Sub-station Works

<table>
<thead>
<tr>
<th>132kV Equipment</th>
<th>33kV Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Supply and installation of 2x60MVA 132/33kV transformers, double bus bar switchyard, complete with all associated equipment. The Double busbar shall be designed and constructed for the connection to the bays such as detailed below.</td>
<td></td>
</tr>
<tr>
<td>- Supply and installation of 33 kV double bus bar outdoor switchyard together with all associated equipment.</td>
<td></td>
</tr>
<tr>
<td>- Poles circuit-breakers,</td>
<td></td>
</tr>
<tr>
<td>- Current transformers</td>
<td></td>
</tr>
<tr>
<td>- Voltage transformers</td>
<td></td>
</tr>
<tr>
<td>- poles isolators and isolators with earthing switches</td>
<td></td>
</tr>
<tr>
<td>- Surge arresters</td>
<td></td>
</tr>
<tr>
<td>- Supporting steel structures and gantries,</td>
<td></td>
</tr>
<tr>
<td>- Post insulators,</td>
<td></td>
</tr>
<tr>
<td>- Overhead conductors, string insulators and hardware,</td>
<td></td>
</tr>
<tr>
<td>- Earthing materials,</td>
<td></td>
</tr>
<tr>
<td>- Other fittings and their accessories.</td>
<td></td>
</tr>
<tr>
<td>- Control and Protection Equipment/ Panels</td>
<td></td>
</tr>
<tr>
<td>- Equipment for the new 33kV Double busbar shall comprise the following:</td>
<td></td>
</tr>
<tr>
<td>- Earthing transformers</td>
<td></td>
</tr>
<tr>
<td>- Poles circuit-breakers,</td>
<td></td>
</tr>
<tr>
<td>- Poles isolators and isolators with earthing switches</td>
<td></td>
</tr>
<tr>
<td>- Current transformers (one per phase),</td>
<td></td>
</tr>
<tr>
<td>- Voltage Transformers (one per phase)</td>
<td></td>
</tr>
</tbody>
</table>
4.8 Project Implementation

The project will be implemented by PMU of TCN and is intended to commence in January / February 2016. Construction time is estimated at 18 months. Allowing for commissioning the substations should be online within 2 years.

4.9 Alternatives

4.9.1 Renewable Energy

Renewable energy is also called “clean” or “green” energy because it has little to no emissions and can be replenished in a short period of time. The four renewable sources used most often are wind, solar photovoltaics, geothermal and biomass. Hydropower is also a renewable resource and is already used in Nigeria where sufficient head of water and flow is available. The first consideration with “green” energy is whether they are economically feasible when compared with more traditional options.

4.9.1.1 Wind

Wind turbines use blades to collect the wind’s kinetic energy. When the wind blows, it flows over the blades creating lift, like the effect on airplane wings, which causes them to turn. The blades are
connected to a drive shaft that turns an electric generator.\textsuperscript{25}

The cost of the commercial wind turbines varies from $1 to $2 million per mega watt (MW) of capacity installed. A single 1 MW turbine operating at a 45\% production rate will generate about 3.9 million kilowatts (KW) of electricity in a year, meeting the needs of about 500 households annually. However, the average wind turbine turns at approximately 25\%. \textsuperscript{26}

The major challenge of using wind as a source of power is that the wind is intermittent and does not always blow when electricity is needed. Wind energy cannot be stored and not all winds can be harnessed to meet the timing of electricity demands. Wind farms producing energy on a large scale often need to be in locations far removed from the populated areas where the energy is needed. This puts wind energy at a major disadvantage in terms of costs of new substations and transmission lines. \textsuperscript{27}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{wind_turbines_solar_panels.png}
\caption{Wind Turbines and Solar Panels}
\end{figure}

\textsuperscript{25} Renewable Energy: Technology and Systems, Jäger, Olindo, Delft University of Technology, 2014

\textsuperscript{26} Ibid

\textsuperscript{27} Ibid
4.9.1.2 Solar

Solar energy can be converted directly to electricity by utilizing Photovoltaic (PV) devices, or “solar cells.” Concentrated Solar Plants (CSP) uses solar energy as heat to boils water; the steam drives a turbine; the turbine turns an ordinary generator, which then generates electric power. A 500 megawatt (MW) plant solar power plant could cost about $5 billion to build and would require 4,000 acres whereas a 500 MW natural gas plant would require 40 acres and a coal plant 300 acres. The obvious limitation is that during hours of darkness another fuel source is required. The advantage is that generation can take place next to the consumer, if solar insolation is adequate. 28

4.9.1.3 Geothermal

Figure 4-15  Geothermal Plant and Landfill Gas Extraction

28 Photovoltaic Solar Energy, Miro Zeman Delft University of Technology 2015
Geothermal power plants use earth’s heat to generate steam accessed by wells. It is a closed circuit system so there are no liquid or gaseous emissions. Since geothermal plants use smaller land areas, the cost of land is usually less expensive than other power plants. Geothermal is a baseload resource, available 24 hours per day, every day of the year. It is independent of weather conditions and has no associated fuel costs. Drilling and finding geothermal reservoirs can be expensive. The initial cost can be $5M per installed MW and more for a small scale (<1 MW) power plant. The drilling needed can vary greatly depending on geological conditions and generation is very site specific. Consequently, transmission costs can be considerable.  

4.9.1.4 Biomass

Biomass energy includes landfill methane gas, wood waste, farm by-products and ethanol. The majority of biomass electricity today is generated using a steam cycle. In this process, biomass is burned in a boiler to make steam. The steam then turns a turbine, which is connected to a generator that produces electricity. Landfill methane gas is collected from decomposing waste by a series of wells strategically placed throughout the landfill. The wells are connected by a series of pipes under a vacuum created by blowers. Once blowers deliver the gas to the plant, internal combustion engines use the gas as fuel and spin generators to produce electricity. Converting landfill gas (LFG) to electricity reduces emissions of methane, a greenhouse gas 23 times more potent than carbon dioxide. It can be a source of carbon credits.

4.9.1.5 Base Load Demand

All renewable energy sources face the same problem that is they are not capable of covering the base load demand. Nigeria is currently exploring a secure and reliable energy future based on a combination of natural gas, hydro and renewable energy sources.

4.9.2 Transmission Alternatives

Transmission in Nigeria is by means of overhead transmission lines. These have significant visual

29 Geothermal Energy, Copenhagen Technology University, 2015
30 Landfill Gas Extraction and Usage, Copenhagen Technology University, 2015
impacts and often placing the cable underground is suggested as an alternative in areas of high scenic value such as national parks. Such a decision needs to take into account a comparison of the cost of installation, maintenance, vulnerability to damage and service provision to the public.

Placing a cable underground rather than overhead can incur costs ranging from 4 to 20 times more expensive depending on location. 31 Underground co-axial cables cause capacitive losses whereas overhead lines can cause inductive losses, so changing from overhead lines to underground cables can require modifications to the reactor settings in the substation. The costs vary with voltage but indicative overall total costs are given in Table 4-2 below.

Table 4-2  Cost Ratio of U/G cable to O/H Line

<table>
<thead>
<tr>
<th>Voltage in KV</th>
<th>Operating and Maintenance: Cost Ratio of U/G cable to O/H Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>18</td>
</tr>
<tr>
<td>220</td>
<td>13</td>
</tr>
<tr>
<td>132</td>
<td>8</td>
</tr>
</tbody>
</table>

The use of underground cables is only justified in extreme cases.  

4.9.3 Site Alternatives

According to the Nigeria Land Use Act of 1978, all lands in the state is vested in the Governor of the State but the Act categorically states that the land is to be held in trust for the citizens (Sections 34 and 36) and the means of enforcing such rights are provided in sections 39 and 41. With the Land Use Act, Access to land by investors and individuals for various uses is easy, every part of the country has a common Land Tenure System, government controls the use of land and the issue of acquisition of land, compensation and resettlement is made easy.

In each case TCN approached the State Government and requested land to be made available. The general location and need for proximity to overhead transmission lines was stated. The Local Government then nominated sites and held all discussions with local land owners and residents. Compensation was agreed and paid. Confirmation of this was then sent from the LGA to TCN.

Biliri is located 60km from Gombe 132/33kV Substation where the supply comes from on 33kV line.

The Town Biliri is a full-fledged Business Unit and is supplied on a 33kV feeder emanating from Gombe 132/33kV Substation. The feeder travels over 500km with multiple T-offs and is believed to be the longest 33kV feeder in Jos Electricity Distribution Company. This long 33kVfeeder supplies four local Government Headquarters and some parts of Taraba state resulting in a very low voltage profile. Since there is already an existing line from Gombe to Yola passing through the location, there are no issues of Right-Of way as the line will only be turn –in- and out at the proposed station. The station is also centrally located and will make it easy for the radiation of 33kV feeders into the town and its

The new 2x60MVA, 132/33kV Substation will supply these local Government Headquarters (namely Biliri, Akko, Kaltungo, Shongom and their surrounding villages) including Federal University at Kashere and College of Education Kumo. It is believed that all the six 33kV feeders that will radiate from the new station will be optimally utilized.

Biliri and some of the local Government Headquarters have a lot of potential and need for future expansion.

TCN did not examine alternative sites themselves because the sites were identified and made available by the respective state governments.

TCN specified the general area where the substation was to be located based on the proximity to high voltage transmission lines and the necessary size of the substations. This information was passed to the state government who reviewed possibilities, consulted with landowners, and arrived at a decision on the site which was then conveyed to TCN.

As the site was suitable TCN accepted the proposed location. The State Government then transferred to TCN the Site Plan, Survey Plan and Change of Ownership letters. This transaction was confirmed through the various community stakeholders meetings subsequently organised by TCN.
5 Preliminaries

The preliminaries included Screening, Scoping, Primary and Secondary Data collection and GIS Mapping.

5.1 Screening

The site was visited by the consultants and an initial reconnaissance carried out. The proposed sites were assessed based on the following check-list:

- Administrative and Legal Framework
- Nature of site
- project type
- location
  - Visibility – Is the Site generally visible?
  - Dwellings- Is there a high density of dwellings?
  - Archaeology/Historical site- Is there a high density of archaeological features?
  - Topography- Nature of the topography?
  - Ecology-Is there any ecological potential on the site?
- scale (size)
- significance or environmental sensitivity of the receiving environment

This was a screening exercise to confirm that an ESIA was required.

5.2 Biliri: Gombe State (north-eastern Nigeria) Reconnaissance visit

The reconnaissance field visit was conducted by the Environmental consultants (SMEC/Metaspec) and the proponent (TCN-PMU Abuja staff and TCN Regional office at Gombe, Gombe State). The schedule of site visit is shown in the table below.

<table>
<thead>
<tr>
<th>S/N</th>
<th>DATE</th>
<th>LOCATION</th>
<th>TEAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>18th-19th June 2015</td>
<td>Biliri (Gombe State)</td>
<td>TCN-PMU &amp; SMEC/Metaspec</td>
</tr>
</tbody>
</table>
Figure 5-2 Nearby settlement to site

Figure 5-3 Proposed site with Transmission lines at

Figure 5-4 Nearby settlement to site

Figure 5-5 Nearby settlement to site

Figure 5-6 The proposed Project site

Figure 5-7 Stakeholders being lead to proposed site
### 5.2.1.1 Screening Results

The following results were concluded on screening.

<table>
<thead>
<tr>
<th>S/N</th>
<th>CRITERIA</th>
<th>RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Administrative and Legal Framework</td>
<td>Federal Ministry of Environment (Nigeria) EIA sectoral guidelines for Electrification projects</td>
</tr>
<tr>
<td>2.</td>
<td>Nature of site</td>
<td>Greenfield-Undeveloped parcel of land used for agriculture.</td>
</tr>
<tr>
<td>3.</td>
<td>Project type</td>
<td>132/33kV Transmission substation</td>
</tr>
<tr>
<td>4.</td>
<td>Location</td>
<td>Proposed site is located off Gombe – Yola road to the west and Gombe –Talese Road to the North in Biliri community of Biliri Local Government Area of Gombe State</td>
</tr>
<tr>
<td>5.</td>
<td>Scale (size)</td>
<td>8.80 ha</td>
</tr>
<tr>
<td>6.</td>
<td>Site Description</td>
<td>Proposed site is visible with no vegetation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Site located off two major roads</td>
</tr>
</tbody>
</table>

Figure 5-8 Flat topography of proposed project site with high lands in background

Figure 5-9 Tilling using beast of burden in the proposed project environment
### 5.3 Scoping

#### 5.3.1 Notification

It is a requirement of the Federal Ministry of Environment that all Project Proponents make known to any residents living in close proximity to a proposed development of their intentions to develop that site. Consequently, during the Reconnaissance Visits public consultations were held. These were to State authorities, local councils and selected groups of host communities. These are considered to be focus group discussions (FGD). In addition to this well advertised open public forum meetings were also held later in October 2015. Minutes of the meetings are given in Annex 2. Details of attendees and their contact details are available from TCN.

#### 5.3.2 Comments from Stakeholders Consulted

The state and local authorities applauded the project and promised their full cooperation in executing the ESIA for the Project to commence. The communities expressed disappointment that the project is yet to commence despite the fact the parcel of land had been offered to the proponent a long time ago. They urged for speedy conclusion of the ESIA to pave way for the commencement of the construction works. The communities promised to support and assist the Environmental consultant in every way possible whenever they return for the field data gathering exercise.

#### 5.3.3 Spatial boundary

A comprehensive description of the biophysical, social and health components of the environment to be studied was recorded. The Spatial Boundary for the study was based on regulatory requirements
and stakeholder’s concerns. As required by Ministry of Environment, spatial boundaries were established of 2 km radius from the perimeter of proposed project site for biophysical assessment and 4km radius for socioeconomics and health studies.

5.3.4 Sampling Locations

Professional judgment was applied in the selection of sampling stations, taking into account ecological features, geographical location of communities and control points in apparently undisturbed areas. Socio-economic & health studies structured questionnaires were administered to a probabilistic sample of households. The sampling locations for the site is given below as agreed after the Scoping Exercise.

Table 5-3 Sampling Locations

<table>
<thead>
<tr>
<th>S/N</th>
<th>Environmental Components</th>
<th>No. of Sampling Stations</th>
<th>Description of sample Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Climate/Meteorology</td>
<td>1</td>
<td>Project site</td>
</tr>
<tr>
<td>2.</td>
<td>Air Quality &amp; Noise</td>
<td>11</td>
<td>10 stations and 1 control</td>
</tr>
<tr>
<td>3.</td>
<td>Surface Water</td>
<td>2</td>
<td>1 station and 1 Control</td>
</tr>
<tr>
<td>4.</td>
<td>Sediment</td>
<td>2</td>
<td>1 station and 1 Control</td>
</tr>
<tr>
<td>5.</td>
<td>Ground Water</td>
<td>3</td>
<td>2 existing boreholes and 1 Control</td>
</tr>
<tr>
<td>6.</td>
<td>Soil</td>
<td>15 (30 samples)</td>
<td>10 stations (site) 4 stations (communities) 1 station (Control)</td>
</tr>
<tr>
<td>7.</td>
<td>Vegetation</td>
<td>5 transects</td>
<td>2km radius</td>
</tr>
<tr>
<td>8.</td>
<td>Wildlife</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>9.</td>
<td>Socio economics and Health</td>
<td>2</td>
<td>Communities</td>
</tr>
</tbody>
</table>

5.3.5 Sampling Procedure

The sampling procedure was established during Scoping. These measurements were made in situ to
establish the Environmental Baseline:

- Meteorology
- Air Quality and Noise
- Soil, Land use and land cover
- Vegetation and Wildlife
- Geology/Hydrogeology
- Surface water
- Socio-economics
- Health

The Sampling Specifications are given below.

<table>
<thead>
<tr>
<th>S/N</th>
<th>SAMPLE</th>
<th>SAMPLE TYPE/DURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Soil</td>
<td>Composite: Surface (0-15cm) and Subsurface (15-30cm)</td>
</tr>
<tr>
<td>2.</td>
<td>Sediment</td>
<td>Grab</td>
</tr>
<tr>
<td>3.</td>
<td>Surface Water</td>
<td>Grab</td>
</tr>
<tr>
<td>4.</td>
<td>Groundwater</td>
<td>Grab</td>
</tr>
<tr>
<td>5.</td>
<td>Vegetation</td>
<td>Transect area</td>
</tr>
<tr>
<td>6.</td>
<td>Wildlife</td>
<td>Transect/Visual Observation/Interviews</td>
</tr>
<tr>
<td>7.</td>
<td>Air Quality</td>
<td>Spot Measurement: Twenty-five (25) minutes per station</td>
</tr>
</tbody>
</table>

The Federal Ministry of Environment representatives were present during the sampling to ensure that environmental samples are collected and preserved (where necessary) according to recommended procedures and practices for environmental data collection in Nigeria.

The environmental components and indices for the Biophysical Baseline Assessment were as given below.
<table>
<thead>
<tr>
<th>Environmental Component</th>
<th>Environmental Aspect</th>
<th>Data Acquisition</th>
<th>Potential Environmental Impact Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate/ Meteorology</td>
<td>Microclimate/Regional Climatic features</td>
<td>In situ measurement, secondary data</td>
<td>Temperature, Rainfall, Relative humidity, Wind direction and speed, visibility.</td>
</tr>
<tr>
<td>Air Quality</td>
<td>Local and Regional</td>
<td>In situ / laboratory analysis</td>
<td>Particulate, NOx, SOx, CO2, CO, VOC, H2S  Heavy metals (Fe, Cd, Cr, Pb, Ni, Vn, Zn)</td>
</tr>
<tr>
<td>Noise</td>
<td>Local</td>
<td>In situ measurement</td>
<td>Ambient noise level dB (A).</td>
</tr>
<tr>
<td>Surface Water</td>
<td>Hydrology/</td>
<td>In situ /secondary data</td>
<td>Flow direction, flow rate, Drainage characteristic, erosion pattern</td>
</tr>
<tr>
<td>(storm water) / Sediment Characteristics</td>
<td>Hydrodynamics</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Physicochemical Features</td>
<td>In situ measurements, Composite samples for laboratory analysis</td>
<td>Colour, alkalinity, TDS, TSS, Turbidity, EC, THC, pH, DO, Redox potential, BOD5, COD, Oil &amp; Grease, PCB, Anions/Cations, NH4+, NO3, NO2, PO4, SO4, SiO2, Na, K, Ca, Mn, Mg, Heavy metals (Fe, Cd, Cr, Ni, V, Pb, Zn, Hg).</td>
</tr>
<tr>
<td></td>
<td>Hydrobiology</td>
<td>Composite samples for laboratory analysis</td>
<td>Species composition, distribution, diversity and abundance and seasonality of Phytoplankton, Zooplankton, Benthos</td>
</tr>
<tr>
<td>Environmental Component</td>
<td>Environmental Aspect</td>
<td>Data Acquisition</td>
<td>Potential Environmental Impact Indicator</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------------</td>
<td>-----------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>Surface Water</td>
<td>Fisheries</td>
<td>Direct observations/interaction, In situ measurements, composite samples for laboratory analysis</td>
<td><strong>Fishery activities</strong></td>
</tr>
<tr>
<td>(storm water) / Sediment Characteristics</td>
<td>Microbiology (surface water)</td>
<td>Composite samples for laboratory analysis</td>
<td>Total heterotrophic bacteria, fungi, Total hydrocarbon bacteria and fungi, total and faecal coliforms.</td>
</tr>
<tr>
<td></td>
<td>Sediments</td>
<td>Composite grab samples for laboratory analysis</td>
<td>Colour, Texture, Temperature, pH, Redox potential, THC, Oil &amp; Grease, PCB, Sediment geochemistry (Fe, Ni, V, Cd, Cr, Pb, Zn, Hg), Sediment microbiology</td>
</tr>
<tr>
<td></td>
<td>Water Use</td>
<td>Direct observation/interviews</td>
<td>Traditional use of rivers and water bodies (navigation, sand mining, food processing, aquaculture, domestic etc)</td>
</tr>
<tr>
<td>Ground Water Characteristics</td>
<td>Physicochemical Features</td>
<td>In situ / laboratory analysis</td>
<td>Colour, odour, alkalinity, TDS, TSS, Turbidity, EC, THC, DO, pH, Redox potential, BOD5, COD, Oil &amp; Grease, Anions/Cations, NH4+, NO3, NO2, PO4, SO4, SiO2, Na, K, Ca, Mn, Mg, Heavy metals (Fe, Cd, Cr, Ni, V, Pb, Zn, Hg).</td>
</tr>
<tr>
<td>Environmental Component</td>
<td>Environmental Aspect</td>
<td>Data Acquisition</td>
<td>Potential Environmental Impact Indicator</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------------</td>
<td>-----------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>• Microbiology</td>
<td>• Composite samples</td>
<td>• Total heterotrophic bacteria, fungi, Total hydrocarbon utilizing bacteria and fungi, total and faecal coliforms.</td>
<td></td>
</tr>
<tr>
<td>• Groundwater dynamics</td>
<td>• In situ</td>
<td>• Static Water Level (SWL), Flow direction/ Flow Rate.</td>
<td></td>
</tr>
<tr>
<td>• Groundwater dynamics</td>
<td>• Laboratory analysis, secondary data sources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Hydrogeology</td>
<td>• Stratigraphy, Aquifer characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Geology</td>
<td>• Local and Regional</td>
<td>• Regional geology, Stratigraphic/Lithologic properties etc</td>
<td></td>
</tr>
<tr>
<td>• Soil</td>
<td>• Physical characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Soil</td>
<td>• In situ/ composite auger samples for lab analysis, Soil profile pits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Chemical characteristics</td>
<td>• Composite samples for laboratory analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Soil microbiology</td>
<td>• Composite samples for laboratory analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Total heterotrophic bacteria, fungi, Total hydrocarbon bacteria and fungi.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental Component</td>
<td>Environmental Aspect</td>
<td>Data Acquisition</td>
<td>Potential Environmental Impact Indicator</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------------</td>
<td>-----------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>• Land Use/Cover</td>
<td>• Satellite Imagery of Land use/Land cover</td>
<td>• Secondary data sources</td>
<td>• Land Use types: Recreational, agricultural, forestry, industrial, residential, institutional, commercial. Trends and time-lapse mapping.</td>
</tr>
<tr>
<td></td>
<td>• Wildlife</td>
<td>• Transect, direct observation, interviews, secondary data sources</td>
<td>• Species composition/distribution (vegetation map of locality), seasonality, exploitation methods/level (kill rates/month/year, estimates of wildlife population etc). IUCN categorization</td>
</tr>
<tr>
<td></td>
<td>• Vegetation</td>
<td>• Transect, herbarium studies, tissue analysis</td>
<td>• Habitat status, floral composition, density and distribution, vegetation structure, plant pathology</td>
</tr>
<tr>
<td>• Biodiversity Status &amp; issues relevant to biodiversity</td>
<td>• Conservation</td>
<td>• In situ observation, interviews, secondary data</td>
<td>• Conservation status (rare, threatened and endangered species), conservation areas (forest reserves etc), environmentally sensitive areas – wetlands and swamps), local conservation practices.</td>
</tr>
</tbody>
</table>

Source: FMEnv Standard ESIA Parameters (Nigeria)

** Note: Surface water was not sighted as at the time of the reconnaissance visit close to any of the proposed project sites; however it is expected during the peak of the raining season (July-September) storm water will gather at depressions to form surface water.
5.4 Primary Data Site Assessments

5.4.1 Field Sampling Program

The field sampling program took place in August and September 2015 as shown below.

Table 5-6 Field Sampling Program

<table>
<thead>
<tr>
<th>S/N</th>
<th>Assignment Description</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Mobilization of ESIA Team</td>
<td>23rd August</td>
</tr>
<tr>
<td>4.</td>
<td>Team Re-organization at Abuja Base Office</td>
<td>28th August</td>
</tr>
<tr>
<td>7.</td>
<td>Demobilization of Team</td>
<td>4th September</td>
</tr>
<tr>
<td>8.</td>
<td>Laboratory Analysis of collected biophysical samples</td>
<td>26th August – 10th September</td>
</tr>
<tr>
<td>9.</td>
<td>Draft Report Submission to SMEC</td>
<td>15th September</td>
</tr>
</tbody>
</table>

5.4.2 Field Sampling Plan

Parameters such as temperature, pH, turbidity, electrical conductivity and dissolved oxygen are to be determined in situ because of their rapid change on storage. For other parameters samples which could be subject to microbial degradation and transformation were preserved, stored and analysed at minimum time after collection.

A radial pattern of sampling, in web like structure around the site was applied. The distance of influence is:

- 2 km radius from proposed project site for biophysical
- 4km radius for socioeconomic from proposed project site

This combined Work Plan/Field Sampling and Analysis Plan (FSAP) addressed the field sampling, analytical, quality control, and data review procedures for the collection and analysis of samples.
Table 5-7  Field Sampling and Analysis Plan (FSAP)

<table>
<thead>
<tr>
<th>ENVIRONMENTAL COMPONENT</th>
<th>PARAMETER</th>
<th>EQUIPMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>METEOROLOGY</td>
<td>Temperature</td>
<td>Traceable Thermometer</td>
</tr>
<tr>
<td></td>
<td>Wind speed &amp; Direction</td>
<td>Skye Master Anemometer &amp; wind Vane</td>
</tr>
<tr>
<td></td>
<td>Humidity, Atmospheric Pressure</td>
<td>Skye Master Mini Weather Station</td>
</tr>
<tr>
<td>AIR QUALITY</td>
<td>Suspended Particulate Matter</td>
<td>Met One Instrument Aerosol Mass Monitor</td>
</tr>
<tr>
<td></td>
<td>Nitrogen Oxides</td>
<td>Testo 350 XL Gas Analyser</td>
</tr>
<tr>
<td></td>
<td>Sulphur Oxides</td>
<td>Testo 350 XL Gas Analyser</td>
</tr>
<tr>
<td></td>
<td>Carbon Monoxides</td>
<td>Testo 350 XL Gas Analyser</td>
</tr>
<tr>
<td></td>
<td>VOC/HC</td>
<td>Testo 350 XL Gas Analyser</td>
</tr>
<tr>
<td>NOISE</td>
<td>Sound level</td>
<td>Tecman Sound Meter</td>
</tr>
<tr>
<td>SOIL</td>
<td>Sampling</td>
<td>Stainless steel auger</td>
</tr>
<tr>
<td></td>
<td>pH</td>
<td>Hannah pH meter</td>
</tr>
<tr>
<td></td>
<td>Electrical conductivity</td>
<td>Hannah conductivity meter.</td>
</tr>
<tr>
<td></td>
<td>Soil Texture</td>
<td>Particle Size Matrix</td>
</tr>
<tr>
<td></td>
<td>Heavy metals</td>
<td>Digestion/AA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spectrophotometry</td>
</tr>
<tr>
<td>------------------------------</td>
<td>--------------------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>Vegetation</td>
<td></td>
<td>Extraction / IR Spectrophotometry</td>
</tr>
<tr>
<td>SURFACE/GROUND WATER</td>
<td>Temperature</td>
<td>Eco Testr pH/temperature Meter</td>
</tr>
<tr>
<td></td>
<td>pH</td>
<td>Eco Testr pH meter</td>
</tr>
<tr>
<td></td>
<td>Total, Dissolved and Suspended Solid</td>
<td>ExTech Conductivity/TDS Meter</td>
</tr>
<tr>
<td></td>
<td>Total Alkalinity</td>
<td>HACH Digital Titration method</td>
</tr>
<tr>
<td></td>
<td>Dissolved Oxygen</td>
<td>ExTech DO Meter</td>
</tr>
<tr>
<td></td>
<td>Biological oxygen Demand (BOD5)</td>
<td>Winkler method</td>
</tr>
<tr>
<td></td>
<td>Total Hydrocarbon Content (THC)</td>
<td>Extraction / Spectrophotometer</td>
</tr>
<tr>
<td></td>
<td>Conductivity</td>
<td>Ex Tech Conductivity Meter.</td>
</tr>
<tr>
<td></td>
<td>Heavy metals</td>
<td>Flame Atomic Absorption Spectrophotometry</td>
</tr>
<tr>
<td>SEDIMENTS</td>
<td>Sampling</td>
<td>Ekman Grab</td>
</tr>
<tr>
<td>MICROBIOLOGY</td>
<td>Total heterotrophic bacteria, fungi, hydrocarbon Utilizing bacteria and fungi,</td>
<td>Composite samples for laboratory analysis</td>
</tr>
<tr>
<td>Category</td>
<td>Methodology</td>
<td>Data Collection</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>WILDLIFE</td>
<td>Conservation status (rare, threatened and endangered species), conservation areas (forest reserves etc.), environmentally sensitive areas – wetlands and swamps), local conservation practices.</td>
<td>In situ observation, interviews, secondary data</td>
</tr>
<tr>
<td>GEOLOGY</td>
<td>Profile, type and composition</td>
<td>In situ observation, drilling, laboratory analysis, reporting</td>
</tr>
<tr>
<td>SOCIO-ECONOMIC STUDIES</td>
<td>Social Infrastructure Cultural Properties, Natural Resources and Land Use, Perception of the project, The role of women and children, Physically Challenged, Social Structure and Organization, Vehicular Traffic Analysis, Sex Trade</td>
<td>Key informant interviews, Focus Group Discussion (FGD), direct observation, Administration of structured questionnaires and Collection of secondary data.</td>
</tr>
<tr>
<td>HEALTH STUDIES</td>
<td>Demographic profile of the Communities, Morbidity/Mortality Patterns, Healthcare</td>
<td>Key informant interviews, FGD, Administration of structured</td>
</tr>
</tbody>
</table>
5.5 **Secondary Data**

In addition to primary data collected by the site sampling, information was obtained from other agencies such as meteorological information, as is regularly collected by airports, or previous environmental reports in similar locations.

5.6 **GIS Mapping**

5.6.1 **Constraints Mapping**

The spatial boundaries of 2kms for bio-physical impacts and 4 kms for socio-economic impacts were also adopted for the GIS evaluation. These were reflected in the boundaries of the constraint mapping. The mapping identified the site, roads, watercourses, and nearby development. The information is used in the Baseline Evaluations to show gradient and catchment areas.
5.6.2 GIS Ground Truthing

It has been stressed continually during the preparation of the ESIA that although GIS information is extremely valuable there is no substitute for visiting the site and these two activities must be combined. In order to visually check that the GIS data is correct site inspections were made and this is known as “Ground Truthing”.

The GIS team member visited the site and took GPS measurements in order to ground truth the information gained from remote sensing satellite imagery.

5.6.3 Biliri: Gombe State (north-eastern Nigeria)

Biliri site had already been visited by FMEnv officials with TCN staff so a separate visit was organised by the Team Leader and PMU. State TCN officials arranged a meeting with the Governor of the State and then guided the team to the site.

The site is flat with no pronounced gradient. There is some farming for agricultural produce by local residents. The approach to the site is through several residential properties. The nearest is 75 m from the perimeter of the site. A structure has been built at 10m from the eastern perimeter (near the centre of the site) but is as yet unoccupied.

A high voltage transmission line passes near to the site. A watercourse indicated on the maps is in fact nearly dry.

![Figure 5-10](image)

Figure 5-10 Nearest occupied residential property, 75m from perimeter, and dried up watercourse

5.6.4 Validation of GIS Data

The site visits have validated the GIS data so it can be used with confidence in the ESIA.

5.6.5 Use of A0 Maps

The maps produced from downloaded remote sensing data were printed in A0 size and used in the
public consultations. These proved very effective in generating lively comments and discussions.
6 Description of the Environment – Biliri

6.1 Baseline
The purpose of the baseline data acquisition was to establish the status of the various environmental components that are likely to be affected by the proposed project. In order to achieve this, environmental parameters were determined from literature survey, fieldwork, laboratory and data analyses. The components of the environment evaluated covered biophysical, social and health. The ESIA study of the project incorporated data from already approved Environmental Impact Assessment reports as secondary data amongst others.

6.2 Baseline Data Acquisition Methods
The approach adopted was to obtain ecological baseline data from desktop, field and laboratory studies, interviews and consultations with individuals/representatives of the communities of the project area.

6.3 Study Location
Biliri in Gombe State is located in the north-eastern part of Nigeria. Billiri is a Local Government Area of Gombe State, Nigeria. Its headquarters are in the town of Billiri in the northeast of the area on A345 highway. The geographical coordinates of the town are 9°51’ 53” N to 11°13’ 31” E occupying an approximate area of 737km².
The proposed Transmission Substation site lies about 300 metres off the Biliri - Yola highway. The size of the proposed site is 8.80 hectares.

### 6.4 Description of Sampling Locations

The map showing the study area with the sampling stations is shown below. The Sampling points were geo-referenced by means of Global Positioning System (GPS) in the field. Judgment was applied in the selection of study stations, taking into account ecological features, geographical location of communities and control points in apparently undisturbed areas.

#### Table 6-1 Geographical Reference of Sampling Stations

<table>
<thead>
<tr>
<th>Station</th>
<th>Easting</th>
<th>Northing</th>
</tr>
</thead>
<tbody>
<tr>
<td>MET1</td>
<td>11°13'46.718&quot;</td>
<td>9°53'38.392&quot;</td>
</tr>
<tr>
<td>AQ1/SS1</td>
<td>11°13'47.38&quot;</td>
<td>9°53'29.51&quot;</td>
</tr>
<tr>
<td>AQ2/SS2</td>
<td>11°13'56.20&quot;</td>
<td>9°53'22.77&quot;</td>
</tr>
<tr>
<td>AQ3/SS3</td>
<td>11°13'43.02&quot;</td>
<td>9°53'22.37&quot;</td>
</tr>
<tr>
<td>AQ4/SS4</td>
<td>11°13'44.10&quot;</td>
<td>9°54'01.03&quot;</td>
</tr>
</tbody>
</table>
6.5 Spatial Boundary

A radial pattern of sampling, in web like structure around the site shall was applied. The spatial boundary is:

- 2 km radius from proposed project site for biophysical
- 4 km radius for socioeconomic from proposed project site
Socio-economic and health studies structured questionnaires were administered to a probability sample of households. The universe of households was obtained from listing by guides and assigned field assistants. The communities in Table 6-2 were identified within the defined study boundary.

<table>
<thead>
<tr>
<th>STATE (1)</th>
<th>LOCAL GOVERNMENT AREA (1)</th>
<th>COMMUNITY (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gombe</td>
<td>Biliri</td>
<td>Biliri</td>
</tr>
</tbody>
</table>

6.6 Environmental Parameters

A comprehensive description of the baseline conditions of the proposed project area was undertaken. The scope covered:

- Meteorology
- Air Quality and Noise
- Soil, Land Use and Land Cover
• Vegetation and Wildlife
• Geology/Hydrogeology
• Surface Water
• Human Health
• Socio-economics

The sampling protocol for each of these parameters is given in Annex 3.

6.7 Quality Assurance / Quality Control Measures
The QA/QC procedure covered sample collection and handling, laboratory analyses, generation of data and coding, data storage and treatment as well as report preparation. The quality assurance programme used required:

- Only experienced and qualified personnel used in the study
- Carrying out field calibrations of equipment and running distilled water blanks to reduce errors that could arise from field measurements.
- Replicate samples were collected and used as checks of instrument performance.
- Field analytical operations were carried out in a defined sequence to avoid cross contamination of instruments.
- Chain of custody protocols were followed

Parameters such as temperature and dissolved oxygen were determined in situ because of their rapid change on storage. As samples could experience microbial degradation they were analysed as quickly as possible after collection.

6.8 Timing of Field Work
Field work for this study was carried out on the basis of approval received from the Federal Ministry of Environment (FMEnv). The fieldwork was carried out from 26th to 27th August, 2015 (Wet Season). Laboratory analysis of field samples was conducted at Research and Development Laboratory Ministry of Science and Technology, Uyo, Akwa Ibom State.

6.9 Physical

6.9.1 Climate
Gombe has two distinct climates, the dry season (November-March) and the rainy season (April-October) with an annual average rainfall of 850mm. The project area is dominated by two seasonal reverse winds, the dry tropical wind or the north-easterly winds from January to March and the tropical maritime wind or the south-westerly winds from April to December. The climate is classified
as a tropical savanna (winter dry season) with a tropical dry forest biozone.

6.9.2 Rainfall
The wet season has a rainfall peak around August, the dry season peaks around the month of December. Biliri has a dry sub-humid (0.5-0.65p/pet) climate. The landscape is mostly covered with rain fed croplands. The average monthly amount of precipitation has been recorded at 87mm.

6.9.3 Temperature
March is warmest with an average temperature of 36.2°C at noon. December is coldest with an average temperature of 13.6°C at night. Biliri has no distinct temperature seasons as the temperature is relatively constant during the year. Temperatures drop sharply at night. December is on average, the month with most sunshine.

6.9.4 Wind Speed and Directions
The average daily wind speed in September has been around 4km/h, which is the equivalent to about 3mph, or 2 knots. In recent years the maximum sustained wind speed has reached 81 km/h, which is the equivalent of around 51 mph, or 44 knots.
The prevailing wind direction in the area is southwest at an average speed of 9.2m/s. The dominant wind direction places the major communities upwind relative to potential emission sources from the project.

6.9.5 Humidity (Relative Humidity)
The average daily relative humidity for September is around 67%.

6.9.6 Air Quality Assessment
The baseline in-situ ambient air quality data was captured using direct reading portable gas analyzers. The measured ambient air quality data are shown in Table 7-3.
<table>
<thead>
<tr>
<th>Stations</th>
<th>AQ1</th>
<th>AQ2</th>
<th>AQ3</th>
<th>AQ4</th>
<th>AQ5</th>
<th>AQ6</th>
<th>AQ7</th>
<th>AQ8</th>
<th>AQ9</th>
<th>AQ10</th>
<th>AQC</th>
<th>Range</th>
<th>FME/ WHO Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL PPM</td>
<td>20.8</td>
<td>20.9</td>
<td>20.8</td>
<td>20.8</td>
<td>20.8</td>
<td>21.8</td>
<td>21.0</td>
<td>20.8</td>
<td>20.8</td>
<td>21.0</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Oxygen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>10.0</td>
</tr>
<tr>
<td>Hydrogen Sulphide</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>0.008</td>
</tr>
<tr>
<td>Sulphur oxide</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>0.1 / 125 µg/m3</td>
</tr>
<tr>
<td>Nitrogen oxide</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>0.06 200 µg/m3</td>
</tr>
<tr>
<td>Hydro carbon</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>N/A</td>
</tr>
<tr>
<td>ALL µg/m3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pm 2.5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>N/A</td>
<td>1-3</td>
<td>75</td>
</tr>
<tr>
<td>Pm 10</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>N/A</td>
<td>1-5</td>
<td>150</td>
</tr>
<tr>
<td>TSPM</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>2.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>2.5</td>
<td>4.0</td>
<td>3.0</td>
<td>1.0–4.0</td>
<td>250 N/A</td>
</tr>
</tbody>
</table>
Source: Field Survey 2015

Carbon monoxide was below 0.1ppm. Hydrogen sulphide, sulphur oxide, nitrogen oxides and hydrocarbons were all below detection limits. The levels of total suspended particulate matters were low, ranging from 1.0µg/m³ – 4.0µg/m³ probably as a result of rainfall and the values are below the threshold limits set by the FMEnv and WHO.
### 6.9.7 Field Work Meteorological Measurements

A summary of meteorological measurements taken during the field work is given below.

Table 6-4  Meteorological measurements during field work

<table>
<thead>
<tr>
<th>Location</th>
<th>AQ1</th>
<th>AQ2</th>
<th>AQ3</th>
<th>AQ4</th>
<th>AQ5</th>
<th>AQ6</th>
<th>AQ7</th>
<th>AQC</th>
<th>AQ8</th>
<th>AQ9</th>
<th>AQ10</th>
<th>AQ10</th>
<th>AQC</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure (mbar)</td>
<td>968</td>
<td>967</td>
<td>968</td>
<td>970</td>
<td>967</td>
<td>967</td>
<td>968</td>
<td>967</td>
<td>968</td>
<td>967</td>
<td>967</td>
<td>967</td>
<td>967 - 970</td>
<td></td>
</tr>
<tr>
<td>Temp (0C)</td>
<td>29</td>
<td>30.0</td>
<td>32</td>
<td>33</td>
<td>37</td>
<td>37</td>
<td>38</td>
<td>38</td>
<td>35</td>
<td>34.0</td>
<td>29.0</td>
<td>38.0</td>
<td>29.0 - 38.0</td>
<td></td>
</tr>
<tr>
<td>Relative Humidity (%)</td>
<td>74</td>
<td>63</td>
<td>59</td>
<td>58</td>
<td>41</td>
<td>48</td>
<td>47</td>
<td>42</td>
<td>41</td>
<td>56</td>
<td>78.0</td>
<td>41.0 - 78.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed (m/s)</td>
<td>1.6</td>
<td>1.3</td>
<td>2.7</td>
<td>2.4</td>
<td>2.6</td>
<td>1.2</td>
<td>1.6</td>
<td>1.8</td>
<td>1.9</td>
<td>1.2</td>
<td>3.0</td>
<td>1.2 - 3.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind Direction</td>
<td>S</td>
<td>SW</td>
<td>SW</td>
<td>SW</td>
<td>SW</td>
<td>S</td>
<td>SW</td>
<td>S</td>
<td>SW</td>
<td>SE</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Field survey 2015
The detailed historical monthly average weather conditions for September has been calculated using data collected over the past two decades. The climate profile is taken from closest available data source to Gombe. Throughout the month of September daytime temperatures will generally reach highs of around 34°C. At night the average minimum temperature drops down to around 22°C. In recent times the highest recorded temperature in September has been 41°C, with the lowest recorded temperature 16°C.

6.9.8 Noise Level Assessment

The background noise levels at the proposed site were measured between 0900 and 1800h. Levels ranged from 36.8 to 46.9 dB (A) for the minimum noise level and 38.7 to 52.4dB(A) for the maximum noise level. The levels were within the NESREA and WHO limits for residential areas of 50dB (A) and 55dB (A) respectively.
### Table 6-5 Noise Level Measurements

<table>
<thead>
<tr>
<th>Sampling Stations</th>
<th>AQ1</th>
<th>AQ2</th>
<th>AQ3</th>
<th>AQ4</th>
<th>AQ5</th>
<th>AQ6</th>
<th>AQ7</th>
<th>AQ8</th>
<th>AQ9</th>
<th>AQ 10</th>
<th>AQC</th>
<th>Range</th>
<th>NES REA</th>
<th>WHO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise (dBA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Lowest)</td>
<td>36.8</td>
<td>37.3</td>
<td>39.2</td>
<td>40.1</td>
<td>39.1</td>
<td>38.4</td>
<td>36.7</td>
<td>39.3</td>
<td>46.9</td>
<td>36.4</td>
<td>43.9</td>
<td>36.7-46.9</td>
<td>50</td>
<td>55</td>
</tr>
<tr>
<td>Noise (dBA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Highest)</td>
<td>48.7</td>
<td>44.2</td>
<td>47.2</td>
<td>43.2</td>
<td>41.0</td>
<td>42.3</td>
<td>41.8</td>
<td>42.0</td>
<td>52.4</td>
<td>38.7</td>
<td>48.9</td>
<td>38.7-52.4</td>
<td>50</td>
<td>55</td>
</tr>
</tbody>
</table>

Source: Field survey 2015

### Table 6-6 Maximum Permissible Noise Levels for General Environment (NESREA)

<table>
<thead>
<tr>
<th>Facility</th>
<th>Maximum permissible Noise Limits dB (A) (Leq)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DAY</td>
</tr>
<tr>
<td>Any building use as hospital, convalescence home, home for the aged, sanatorium and institutes of higher learning, conference rooms, public library, environmental or recreational sites.</td>
<td>45</td>
</tr>
<tr>
<td>Residential buildings</td>
<td>50</td>
</tr>
<tr>
<td>Mixed residential (with some commercial and entertainment)</td>
<td>55</td>
</tr>
<tr>
<td>Residential+ industry or small scale production + commerce</td>
<td>60</td>
</tr>
</tbody>
</table>
### Table 6-7  IFC Noise Limits

<table>
<thead>
<tr>
<th>Noise Level Guidelines</th>
<th>One Hour LAeq (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receptors</td>
<td>Daytime 07:00-22:00</td>
</tr>
<tr>
<td>Residential, Institutional, Educational</td>
<td>55</td>
</tr>
<tr>
<td>Industrial; Commercial</td>
<td>70</td>
</tr>
</tbody>
</table>

Source: IFC General Guidelines
6.9.9 Land Use and Land Cover

The land uses in the project area and their spatial coverage were ascertained by physical observation and studying topographic maps of the area.

Despite being utilized for agriculture since the earliest times of European settlement, the land uses of the study area do not appear to have seriously diminished the status of the original vegetation community. The dominant land uses are intensive such as row crops and minor grazing, small scale agriculture, disturbed forest and minor urban development.

![Land Use Map of Gombe State](source: National Bureau of Statistics)

The land-cover types in the study area were Forest I (undisturbed), Forest II (disturbed), water and built up/bare soil with 0%, 1%, 1% and 98% respectively. The Land cover types within study area are shown in Figure 6-7.
6.9.10 Soils

The soil in the area is high in lixisols (lx), soil with clay-enriched lower horizon and high saturation of bases. The topsoil from 0-1m was salty clay; from 1-1.5m was clayey sand (plastic greyish colour) and a depth of 1.5-2.3m consisted of weathered rock properties.

The majority of the soils were slightly acidic to neutral with medium amount of organic matter content while most of the soils were clay in texture. The soil pH ranged from 6.2 to 7.6 (mean 6.9); organic carbon contents ranged from 10.7 to 13.9g/Kg (mean 12.39 g/Kg). The soil pH influences the oxidation reaction and the solubility of several constituents and the ionic form of several elements.

Soil samples from each of the top (0-15cm deep) and bottom (15 – 30cm deep) were collected with the aid of an auger from ten stations of the quadrant specified in the sampling protocol within the proposed site. The results of the analysis are shown below. (Table 6-8)
Table 6-8  
Soil Characteristics

<table>
<thead>
<tr>
<th>Parameters</th>
<th>SS 1</th>
<th>SS 2</th>
<th>SS 3</th>
<th>SS 4</th>
<th>SS 5</th>
<th>SS 6</th>
<th>SS 7</th>
<th>SS 8</th>
<th>SS 9</th>
<th>SS 10</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.4</td>
<td>6.65</td>
<td>5.8</td>
<td>5.2</td>
<td>6.53</td>
<td>7.3</td>
<td>8.38</td>
<td>6.29</td>
<td>5.7</td>
<td>5.71</td>
<td>6.40</td>
<td>5.5-8.38</td>
</tr>
<tr>
<td>Electric Conductivity, ( \mu \text{s/cm} )</td>
<td>251</td>
<td>216</td>
<td>168.8</td>
<td>201.00</td>
<td>220</td>
<td>193</td>
<td>1864</td>
<td>201</td>
<td>136</td>
<td>137.9</td>
<td>136-251</td>
<td>376.4</td>
</tr>
<tr>
<td>TOC, mg/kg</td>
<td>38.4</td>
<td>18</td>
<td>25.8</td>
<td>6.5</td>
<td>10.36</td>
<td>6.24</td>
<td>1.42</td>
<td>0.81</td>
<td>1.96</td>
<td>1.38</td>
<td>11.09</td>
<td>0.81-38.4</td>
</tr>
<tr>
<td>PO43, mg/kg</td>
<td>1.28</td>
<td>1.03</td>
<td>1.28</td>
<td>0.89</td>
<td>0.88</td>
<td>0.84</td>
<td>0.8</td>
<td>0.71</td>
<td>1.69</td>
<td>0.7</td>
<td>1.01</td>
<td>0.7-1.69</td>
</tr>
<tr>
<td>Ca, mg/kg</td>
<td>6.89</td>
<td>7.54</td>
<td>4.35</td>
<td>6.71</td>
<td>6.62</td>
<td>5.34</td>
<td>7.21</td>
<td>3.85</td>
<td>6.34</td>
<td>3.75</td>
<td>5.86</td>
<td>3.75-7.54</td>
</tr>
<tr>
<td>NO3, mg/kg</td>
<td>0.4</td>
<td>0.2</td>
<td>1.5</td>
<td>0.3</td>
<td>0.6</td>
<td>0.2</td>
<td>0.4</td>
<td>0.3</td>
<td>1.6</td>
<td>0.2</td>
<td>0.57</td>
<td>0.2-1.6</td>
</tr>
<tr>
<td>Mg, mg/kg</td>
<td>0.82</td>
<td>0.47</td>
<td>0.89</td>
<td>1.06</td>
<td>0.86</td>
<td>0.36</td>
<td>0.57</td>
<td>0.73</td>
<td>1.12</td>
<td>1.39</td>
<td>0.827</td>
<td>0.36-1.12</td>
</tr>
<tr>
<td>Vanadium, mg/kg</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Ni, mg/kg</td>
<td>1.282</td>
<td>1.43</td>
<td>2.64</td>
<td>1.12</td>
<td>0.945</td>
<td>0.478</td>
<td>1.21</td>
<td>0.583</td>
<td>2.01</td>
<td>1.743</td>
<td>1.344</td>
<td>0.583-2.64</td>
</tr>
<tr>
<td>Lead, mg/kg</td>
<td>0.006</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>0.124</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>0.065</td>
<td>0.0124</td>
<td>0-0.124</td>
</tr>
</tbody>
</table>
Table 6-9  Soil Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>SS 1</th>
<th>SS 2</th>
<th>SS 3</th>
<th>SS 4</th>
<th>SS 5</th>
<th>SS 6</th>
<th>SS 7</th>
<th>SS 8</th>
<th>SS 9</th>
<th>SS 10</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chromium, mg/kg</td>
<td>0.026</td>
<td>0.045</td>
<td>0.013</td>
<td>0.027</td>
<td>0.018</td>
<td>0.007</td>
<td>0.024</td>
<td>0.036</td>
<td>0.052</td>
<td>0.012</td>
<td>0.026</td>
<td>0.007-0.052</td>
</tr>
<tr>
<td>Zinc, mg/kg</td>
<td>0.42</td>
<td>2.35</td>
<td>1.264</td>
<td>0.602</td>
<td>3.42</td>
<td>9.4</td>
<td>5.39</td>
<td>2.59</td>
<td>1.42</td>
<td>1.37</td>
<td>2.822</td>
<td>0.42-9.4</td>
</tr>
<tr>
<td>Cadmium, mg/kg</td>
<td>0.42</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>0.468</td>
<td>&lt;0.01</td>
<td>0.518</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>0.469</td>
<td>0.0-0.518</td>
</tr>
<tr>
<td>Fe, mg/kg</td>
<td>16.4</td>
<td>18.7</td>
<td>21.2</td>
<td>12.2</td>
<td>1.295</td>
<td>15.4</td>
<td>1.206</td>
<td>14.1</td>
<td>24.3</td>
<td>74.4</td>
<td>19.92</td>
<td>1.206-74.4</td>
</tr>
<tr>
<td>Arsenic, mg/kg</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.011</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Cu, mg/kg</td>
<td>0.012</td>
<td>0.017</td>
<td>0.006</td>
<td>0.013</td>
<td>0.024</td>
<td>0.112</td>
<td>0.018</td>
<td>0.005</td>
<td>0.015</td>
<td>0.01</td>
<td>0.023</td>
<td>0.005-0.112</td>
</tr>
<tr>
<td>Manganese, mg/kg</td>
<td>0.5</td>
<td>0.6</td>
<td>2.3</td>
<td>3.5</td>
<td>2.3</td>
<td>2.33</td>
<td>1.46</td>
<td>1.4</td>
<td>1.42</td>
<td>3.3</td>
<td>1.911</td>
<td>0.5-3.3</td>
</tr>
<tr>
<td>PCB, mg/kg</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Source: Field Survey 2015
<table>
<thead>
<tr>
<th></th>
<th>7.69</th>
<th>7.84</th>
<th>4.8</th>
<th>5.2</th>
<th>6.65</th>
<th>7.2</th>
<th>8.38</th>
<th>6.19</th>
<th>5.6</th>
<th>5.53</th>
<th>6.50</th>
<th>4.8-8.38</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Electric Conductivity, $\mu$s/cm</td>
<td>24</td>
<td>21</td>
<td>16.8</td>
<td>201.00</td>
<td>11</td>
<td>93</td>
<td>1863</td>
<td>200</td>
<td>146</td>
<td>137.2</td>
<td>279.11</td>
</tr>
<tr>
<td>TOC, mg/kg</td>
<td>45</td>
<td>27</td>
<td>25.2</td>
<td>6.6</td>
<td>38.4</td>
<td>6.22</td>
<td>1.72</td>
<td>0.94</td>
<td>1.99</td>
<td>1.38</td>
<td>15.4</td>
<td>45</td>
</tr>
<tr>
<td>PO43, mg/kg</td>
<td>2.6</td>
<td>2.8</td>
<td>4.2</td>
<td>2.7</td>
<td>2.7</td>
<td>4.5</td>
<td>6.8</td>
<td>1.9</td>
<td>3.8</td>
<td>2.5</td>
<td>3.38</td>
<td>1.9-6.8</td>
</tr>
<tr>
<td>Ca, mg/kg</td>
<td>6.51</td>
<td>9.84</td>
<td>4.35</td>
<td>6.71</td>
<td>6.22</td>
<td>5.34</td>
<td>7.21</td>
<td>3.85</td>
<td>6.34</td>
<td>3.75</td>
<td>6.01</td>
<td>3.75-7.21</td>
</tr>
<tr>
<td>NO3, mg/kg</td>
<td>0.2</td>
<td>0.3</td>
<td>1.5</td>
<td>0.3</td>
<td>0.6</td>
<td>0.2</td>
<td>0.4</td>
<td>0.3</td>
<td>1.6</td>
<td>0.2</td>
<td>0.56</td>
<td>0.2-1.6</td>
</tr>
<tr>
<td>Mg, mg/kg</td>
<td>0.48</td>
<td>0.76</td>
<td>0.89</td>
<td>1.06</td>
<td>0.86</td>
<td>0.36</td>
<td>0.57</td>
<td>0.73</td>
<td>1.12</td>
<td>1.39</td>
<td>0.82</td>
<td>0.36-1.39</td>
</tr>
<tr>
<td>Vanadium, mg/kg</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ni, mg/kg</td>
<td>1.21</td>
<td>1.262</td>
<td>2.64</td>
<td>1.12</td>
<td>1.126</td>
<td>0.478</td>
<td>1.21</td>
<td>0.583</td>
<td>2.01</td>
<td>1.743</td>
<td>1.33</td>
<td>0.583-</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.001</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>0.02</td>
<td>0.012-0.072</td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>------</td>
<td>------</td>
<td>-------</td>
<td>--------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
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</tr>
<tr>
<td>Lead, mg/kg</td>
<td>&lt;0.00</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.001</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Chromium, mg/kg</td>
<td>0.024</td>
<td>0.016</td>
<td>0.023</td>
<td>0.027</td>
<td>0.012</td>
<td>0.017</td>
<td>0.024</td>
<td>0.056</td>
<td>0.072</td>
<td>0.022</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>Zinc, mg/kg</td>
<td>0.602</td>
<td>0.624</td>
<td>1.264</td>
<td>0.602</td>
<td>0.526</td>
<td>9.4</td>
<td>5.39</td>
<td>2.79</td>
<td>1.42</td>
<td>1.37</td>
<td>2.39-88</td>
<td></td>
</tr>
<tr>
<td>Cadmium, mg/kg</td>
<td>0.518</td>
<td>0.412</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>0.52</td>
<td>&lt;0.01</td>
<td>0.518</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>0.49-0.52</td>
<td></td>
</tr>
<tr>
<td>Fe, mg/kg</td>
<td>1.206</td>
<td>1.242</td>
<td>21.2</td>
<td>12.2</td>
<td>1.218</td>
<td>15.4</td>
<td>1.206</td>
<td>13.1</td>
<td>25.3</td>
<td>77.4</td>
<td>16.9-472</td>
<td></td>
</tr>
<tr>
<td>Arsenic, mg/kg</td>
<td>&lt;0.00</td>
<td>0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Cu, mg/kg</td>
<td>0.018</td>
<td>0.012</td>
<td>0.006</td>
<td>0.013</td>
<td>0.016</td>
<td>0.112</td>
<td>0.018</td>
<td>0.015</td>
<td>0.025</td>
<td>0.01</td>
<td>0.02-0.112</td>
<td></td>
</tr>
<tr>
<td>N, mg/kg</td>
<td>1.05</td>
<td>1.66</td>
<td>0.68</td>
<td>1.24</td>
<td>0.8</td>
<td>0.46</td>
<td>0.72</td>
<td>0.84</td>
<td>1.26</td>
<td>1.29</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Manganese, mg/kg</td>
<td>0.5</td>
<td>0.6</td>
<td>2.8</td>
<td>3.5</td>
<td>2.3</td>
<td>2.33</td>
<td>1.46</td>
<td>1.2</td>
<td>1.46</td>
<td>3.5</td>
<td>1.96-5</td>
<td></td>
</tr>
<tr>
<td>PCB, mg/kg</td>
<td>&lt;0.00</td>
<td>&lt;0.01</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td></td>
</tr>
</tbody>
</table>
6.9.11 Geology
The northern Nigerian basement complex comprises three groups of rock namely migmatites and (high grade) gneisses derived from birrimain sedimentary rocks through high grade metamorphism and granitization. The younger meta sediments of upper Proterozoic age which are low grade metamorphic rock that were folded along with the migmatite and gneisses during the pan African orogeny and the older granite series which were intruded during the pan African orogeny (McCurry, 1989). In the study area, Hazel et al, 1988 also reports the occurrence of rocks of younger granite series (Falconer, 1911) so termed because they are Jurassic in age as well as volcanic and occasional younger dykes and flows Agricultural and Rural Development Authority in Gombe identifies the individual members of the older granite suite, but rocks of the younger meta-sediments and those of the migmatite-gneiss complex were simply grouped as migmatite-gneiss complex in some place. The investigation uncovered, within the depths explored, the existence of sandy clay overlying a sandy layer up to the depth investigated.

6.9.12 Hydrology
The hydrogeology indicates that the aquifer is of basement complex in the study area are the weathered and fractured rocks in which ground water exist under water table condition and also in sedimentary hydrogeological zones (depression and old river channels). The depth of wells is highest in the migmatite-gneiss complex and schist and it is lowest in areas underlain by rocks of the younger granite. Static water level in wells is deepest in the migmatite-gneiss complex and schist and shallowest in areas underlain by rocks of the younger granite yield is lowest in migmatite-gneiss and schist, and it is highest in the porphyritic granite and drawdown, is highest in the migmatite-gneiss complex and schist while it is lowest in the regolith of the younger granite.

6.9.13 Ground Water
The ground water flow is highly dependent of nature of the underlying fractured rock and the degree of weathering. Water is abstracted by pumping from boreholes, hand dug wells and mono pumps.
Hand dug well for domestic water source

Stream along Talese road
Two sites were sampled at the locations shown in Figure 6-8. The results are given in Table 6-10 below.

**Table 6-10  Groundwater Analysis**

<table>
<thead>
<tr>
<th></th>
<th>GW1</th>
<th>GW2</th>
<th>Mean</th>
<th>Range</th>
<th>FMEnv Limit</th>
<th>WHO limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.3</td>
<td>7.4</td>
<td>7.35</td>
<td>7.3 - 7.4</td>
<td>6.5 - 8.5</td>
<td>6.5 - 8.5</td>
</tr>
<tr>
<td>Temperature (oC)</td>
<td>32.7</td>
<td>30.4</td>
<td>31.55</td>
<td>30.4 - 32.7</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>DO (mg/l)</td>
<td>4.12</td>
<td>4.32</td>
<td>4.22</td>
<td>4.12 - 4.32</td>
<td>7.5</td>
<td>NA</td>
</tr>
<tr>
<td>TDS (mg/l)</td>
<td>132</td>
<td>178</td>
<td>155</td>
<td>132 - 178</td>
<td>500</td>
<td>600</td>
</tr>
<tr>
<td>Conductivity (µs/cm)</td>
<td>264</td>
<td>256</td>
<td>260</td>
<td>256 - 264</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td>3.58</td>
<td>4.46</td>
<td>4.02</td>
<td>3.58 - 4.46</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Hardness (mg/l)</td>
<td>580</td>
<td>440</td>
<td>510</td>
<td>440 - 580</td>
<td>200</td>
<td>500</td>
</tr>
<tr>
<td>BOD (mg/l)</td>
<td>2.16</td>
<td>1.89</td>
<td>2.025</td>
<td>1.89 - 2.16</td>
<td>0</td>
<td>N/A</td>
</tr>
<tr>
<td>COD (mg/l)</td>
<td>3.05</td>
<td>3.68</td>
<td>3.365</td>
<td>3.05 - 3.68</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>TSS(mg/l)</td>
<td>0.4</td>
<td>0.3</td>
<td>0.35</td>
<td>0.3 - 0.4</td>
<td>10</td>
<td>N/A</td>
</tr>
<tr>
<td>Sulphates (mg/l)</td>
<td>&lt;0.001</td>
<td>0.01</td>
<td>0.005</td>
<td>&lt;0.001 - 0.01</td>
<td>500</td>
<td>250</td>
</tr>
<tr>
<td>Nitrates (mg/l)</td>
<td>&lt;0.001</td>
<td>0.002</td>
<td>0.001</td>
<td>&lt;0.001 - 0.001</td>
<td>10</td>
<td>N/A</td>
</tr>
<tr>
<td>Phosphate (mg/l)</td>
<td>0.64</td>
<td>0.89</td>
<td>0.765</td>
<td>0.64 -0.89</td>
<td>&gt;5.0</td>
<td>N/A</td>
</tr>
<tr>
<td>Lead (mg/l)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0</td>
<td>&lt;0.001</td>
<td>0.05</td>
<td>N/A</td>
</tr>
<tr>
<td>Cadmium (mg/l)</td>
<td>0.32</td>
<td>0.18</td>
<td>0.25</td>
<td>0.18 - 0.32</td>
<td>0.01</td>
<td>N/A</td>
</tr>
<tr>
<td>Chromium (mg/l)</td>
<td>0.018</td>
<td>0.013</td>
<td>0.0155</td>
<td>0.013 - 0.018</td>
<td>0.05</td>
<td>N/A</td>
</tr>
<tr>
<td>Arsenic (mg/l)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0</td>
<td>&lt;0.001</td>
<td>0.2</td>
<td>N/A</td>
</tr>
</tbody>
</table>
### 6.9.14 Surface Water

The water samples were taken from two surface water bodies within the radius of influence of the project. The first is the Takenno stream which runs parallel to the project site and Biliri community from east to west. The second is a stream flowing from Talese community about 1 km from the project site.

The quality of the surface water was typical of surface water exposed to anthropogenic activities. As a result of the shallowness and in flow from streamlets, runoff and soil erosion the colour was deep brownish colour and clarity was extremely turbid.

The results are shown in Table 6-11.

Table 6-11 Surface Water Analysis

<table>
<thead>
<tr>
<th>Parameters</th>
<th>(Surface Water)</th>
<th></th>
<th></th>
<th>FMEnv Limit for Surface Water (Aquatic Life)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SW1 Takenno stream</td>
<td>SW2 Takenno stream</td>
<td>SW3</td>
<td></td>
</tr>
<tr>
<td>Copper (mg/l)</td>
<td>0.012</td>
<td>0.004</td>
<td>0.008</td>
<td>0.004 - 0.012</td>
</tr>
<tr>
<td>Iron (mg/l)</td>
<td>0.926</td>
<td>0.31</td>
<td>0.618</td>
<td>0.31 - 0.926</td>
</tr>
<tr>
<td>Zinc (mg/l)</td>
<td>0.424</td>
<td>0.51</td>
<td>0.467</td>
<td>0.424 - 0.51</td>
</tr>
<tr>
<td>Nickel (mg/l)</td>
<td>0.426</td>
<td>0.39</td>
<td>0.408</td>
<td>0.39 - 0.426</td>
</tr>
<tr>
<td>Mercury (mg/l)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>PCB (mg/l)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mineral oil (mg/l)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total Coliform cfu/100ml</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Faecal Coliform, cfu/100ml</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: Field survey 2015
<table>
<thead>
<tr>
<th></th>
<th>pH</th>
<th>7.3</th>
<th>7.8</th>
<th>7.9</th>
<th>6.8</th>
<th>6.0 – 9.0</th>
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</thead>
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<tr>
<td>Temperature (°C)</td>
<td>30.4</td>
<td>34.2</td>
<td>31.6</td>
<td>334</td>
<td>20 - 33</td>
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<tr>
<td>DO (mg/l)</td>
<td>5.86</td>
<td>6.52</td>
<td>6.23</td>
<td>6.12</td>
<td>6.8</td>
<td></td>
</tr>
<tr>
<td>TDS (mg/l)</td>
<td>48</td>
<td>53</td>
<td>66</td>
<td>30</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Conductivity (µs/cm)</td>
<td>96</td>
<td>106</td>
<td>132</td>
<td>60</td>
<td>NS</td>
<td></td>
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<tr>
<td>Turbidity (NTU)</td>
<td>18.2</td>
<td>31</td>
<td>5.82</td>
<td>15.8</td>
<td>NS</td>
<td></td>
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<tr>
<td>BOD (mg/l)</td>
<td>1.41</td>
<td>1.62</td>
<td>2.16</td>
<td>2.121</td>
<td>4.0</td>
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<tr>
<td>COD (mg/l)</td>
<td>13.2</td>
<td>12</td>
<td>15</td>
<td>11.2</td>
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<td>TSS(mg/l)</td>
<td>0.024</td>
<td>0.168</td>
<td>1</td>
<td>0.86</td>
<td>4.0</td>
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<tr>
<td>Sulphate (mg/l)</td>
<td>0.62</td>
<td>0.34</td>
<td>0.297</td>
<td>0.24</td>
<td>NS</td>
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</tr>
<tr>
<td>Nitrates (mg/l)</td>
<td>0.12</td>
<td>0.58</td>
<td>0.558</td>
<td>0.48</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Phosphate (mg/l)</td>
<td>2.1</td>
<td>1.6</td>
<td>1.4</td>
<td>3</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Pb (mg/l)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.0017**</td>
<td></td>
</tr>
<tr>
<td>Cd (mg/l)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.0002 – 0.0018**</td>
<td></td>
</tr>
<tr>
<td>Cr (mg/l)</td>
<td>0.028</td>
<td>0.042</td>
<td>0.02</td>
<td>0.032</td>
<td>0.02 – 2.0</td>
<td></td>
</tr>
<tr>
<td>As (mg/l)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Parameters</td>
<td>SD1</td>
<td>SD2</td>
<td>SD3</td>
<td>SDC</td>
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<td>------</td>
<td>------</td>
<td>------</td>
<td>-------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hg (mg/l)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cu (mg/l)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.002</td>
<td>0.004</td>
<td>0.002 – 0.004**</td>
<td></td>
</tr>
<tr>
<td>Fe (mg/l)</td>
<td>1.209</td>
<td>1.162</td>
<td>1.128</td>
<td>1.118</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Zn (mg/l)</td>
<td>0.382</td>
<td>0.346</td>
<td>0.324</td>
<td>0.418</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>Ni (mg/l)</td>
<td>1.026</td>
<td>1.184</td>
<td>1.265</td>
<td>1.346</td>
<td>0.025 – 0.150***</td>
<td></td>
</tr>
<tr>
<td>PCB (mg/l)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>Nil</td>
<td></td>
</tr>
<tr>
<td>Mineral oil (mg/l)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>Nil</td>
<td></td>
</tr>
<tr>
<td>Total Coliform cfu/100ml</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Faecal Coliform, cfu/100ml</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Speed, m/s</td>
<td>1.20</td>
<td>0.90</td>
<td>1.30</td>
<td>0.50</td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>

Source: Field Survey 2015   ** Converted from µg/l to mg/l

The distance of 50 meters was used to judge the velocity of the stream. The speed was calculated using distance over time travelled of the floater. The width of the stream was not definite due to undulating topography, sedimentation and erosion. However a width of 5 - 7 meters and a depth of 50cm were roughly estimated.

Sediment sample were taken and the results are given in Table 6-12 below.

Table 6-12    Sediment Results
<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>pH</td>
<td>8.61</td>
<td>8.39</td>
<td>7.89</td>
<td>8.13</td>
</tr>
<tr>
<td>2</td>
<td>TOC (mg/kg)</td>
<td>28.3</td>
<td>21.2</td>
<td>19.3</td>
<td>31.4</td>
</tr>
<tr>
<td>3</td>
<td>EC (mg/kg)</td>
<td>163</td>
<td>72</td>
<td>133</td>
<td>162</td>
</tr>
<tr>
<td>4</td>
<td>Ca (mg/kg)</td>
<td>7.34</td>
<td>6.19</td>
<td>5.43</td>
<td>5.8</td>
</tr>
<tr>
<td>5</td>
<td>Mg (mg/kg)</td>
<td>0.62</td>
<td>4.58</td>
<td>6.72</td>
<td>5.1</td>
</tr>
<tr>
<td>6</td>
<td>Na (mg/kg)</td>
<td>9.16</td>
<td>8.47</td>
<td>7.89</td>
<td>8.29</td>
</tr>
<tr>
<td>7</td>
<td>K (mg/kg)</td>
<td>5.92</td>
<td>4.39</td>
<td>6.2</td>
<td>5.51</td>
</tr>
<tr>
<td>8</td>
<td>NO3 (mg/kg)</td>
<td>0.4</td>
<td>1.1</td>
<td>0.56</td>
<td>0.92</td>
</tr>
<tr>
<td>9</td>
<td>PO4 (mg/kg)</td>
<td>5.2</td>
<td>6.9</td>
<td>7.3</td>
<td>5.9</td>
</tr>
<tr>
<td>10</td>
<td>NO2 (mg/kg)</td>
<td>0.003</td>
<td>0.012</td>
<td>0.1</td>
<td>0.02</td>
</tr>
<tr>
<td>11</td>
<td>N (mg/kg)</td>
<td>0.68</td>
<td>0.01</td>
<td>0.03</td>
<td>0.14</td>
</tr>
<tr>
<td>12</td>
<td>NH4 (mg/kg)</td>
<td>0.12</td>
<td>0.23</td>
<td>0.19</td>
<td>0.38</td>
</tr>
<tr>
<td>13</td>
<td>Cr (mg/kg)</td>
<td>0.01</td>
<td>&lt;0.001</td>
<td>0.01</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>14</td>
<td>Cu (mg/kg)</td>
<td>0.024</td>
<td>0.13</td>
<td>0.21</td>
<td>0.19</td>
</tr>
<tr>
<td>15</td>
<td>Fe (mg/kg)</td>
<td>1.214</td>
<td>2.14</td>
<td>1.67</td>
<td>3.32</td>
</tr>
<tr>
<td>16</td>
<td>As (mg/kg)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>17</td>
<td>Cd (mg/kg)</td>
<td>0.426</td>
<td>0.31</td>
<td>0.24</td>
<td>0.39</td>
</tr>
<tr>
<td>18</td>
<td>Ni (mg/kg)</td>
<td>1.124</td>
<td>1.43</td>
<td>0.93</td>
<td>1.82</td>
</tr>
<tr>
<td>19</td>
<td>Pb (mg/kg)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>20</td>
<td>Zn (mg/kg)</td>
<td>0.716</td>
<td>0.68</td>
<td>0.89</td>
<td>0.73</td>
</tr>
<tr>
<td>21</td>
<td>Total Coliform (cfu/100ml)</td>
<td>8.0</td>
<td>12</td>
<td>3</td>
<td>Nil</td>
</tr>
<tr>
<td>22</td>
<td>Faecal Coliform (cfu/100ml)</td>
<td>15</td>
<td>21</td>
<td>2</td>
<td>Nil</td>
</tr>
<tr>
<td>23</td>
<td>PCB (mg/l)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>24</td>
<td>Total Hydrocarbon Content (mg/l)</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Source: Field Survey 2015
6.10 Biological

6.10.1 Vegetation

Much of the biodiversity originally present has been retained to a high degree over the majority of the study area over a long period of time. The project site is completely green and covered with vegetation. In Billiri community, the project site was composed of eight tree/shrubs species within six families.

Two species were abundant namely, Azadirachta indica and Danieli oliveri. Three species namely Phoenix dactylifera, Parkiabiglobosa and Cinnamomum cassia were commonly found in the area. Also Adansonia digitata and Alchornea sp were occasional species while Senegaliagreggi was the only rare species in the area. The tree/shrub species families in the area were Malvaceae, Arecaceae, Meliaceae, Fabaceae, Lauraceae and Euphorbiaceae with Fabaceae being the dominant family.

<table>
<thead>
<tr>
<th>S/N</th>
<th>Tree/shrubs species</th>
<th>Family</th>
<th>Ecological system</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Adansonia digitata</td>
<td>Malvaceae</td>
<td>A</td>
</tr>
<tr>
<td>2</td>
<td>Phoenix dactylifera</td>
<td>Arecaceae</td>
<td>C</td>
</tr>
<tr>
<td>3</td>
<td>Azadirachta indica</td>
<td>Meliaceae</td>
<td>O</td>
</tr>
<tr>
<td>4</td>
<td>Parkiabiglobosa</td>
<td>Fabaceae</td>
<td>X</td>
</tr>
<tr>
<td>5</td>
<td>Senegaliagreggi</td>
<td>Fabaceae</td>
<td>R</td>
</tr>
<tr>
<td>6</td>
<td>Cinnamomum cassia</td>
<td>Lauraceae</td>
<td>A</td>
</tr>
<tr>
<td>7</td>
<td>Alchornea spp</td>
<td>Euphorbiaceae</td>
<td>X</td>
</tr>
<tr>
<td>8</td>
<td>Danieli oliveri</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>2 3 2 1</td>
</tr>
</tbody>
</table>

Source: Field Survey 2015  
Key: A-Abundant; C-Common; O-Occasional; R-Rare
6.10.1 Herbaceous Species Composition

A total of fifteen herbaceous species within seven families were observed in the project area. Three species namely *Mimosa pudica*, *Ipomea asarifolia* and *Indigofera* sp were abundant. Five species were commonly encountered. These were *Sida acuta*, *Ipomea involucrata*, *Elusine indica*, *Kyllinga erecta* and *Digitaria sanguinalis* (common) while *Azonopus compressus*, *Aspilla africana*, *Tridax precumbens*, *Boerhavia diffusa* and *Paspalum scrobiculatum* were occasional. Only *Calapogonium mucunoides* was rarely seen in the area. The species families were Fabaceae, Malvaceae, Convolvulaceae, Poaceae, Cyperaceae, Asteraceae and Nyctaginaceae with Poaceae being the abundant family.
Table 6-14  Herbaceous species composition

<table>
<thead>
<tr>
<th>S/N</th>
<th>Tree/shrubs species</th>
<th>Family</th>
<th>Ecological system</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>1</td>
<td>Mimosa pudica</td>
<td>Fabaceae</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>Sida acuta</td>
<td>Molvaceae</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Ipomea involucrate</td>
<td>Convolvulaceae</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Iponea asarifolia</td>
<td>Convolvulaceae</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Elusine indica</td>
<td>Poaceae</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Indigofera spp</td>
<td>Fabaceae</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Kyllinga erecta</td>
<td>Cyperaceae</td>
<td>X</td>
</tr>
<tr>
<td>8</td>
<td>Azonopus compressus</td>
<td>Poaceae</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Aspilia Africana</td>
<td>Asteraceae</td>
<td>X</td>
</tr>
<tr>
<td>10</td>
<td>Calapogonium mucunoides</td>
<td>Fabaceae</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Tridax precumbens</td>
<td>Asteraceae</td>
<td>X</td>
</tr>
<tr>
<td>12</td>
<td>Boerhavia diffusa</td>
<td>Nyctaginaceae</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Paspalum probiculatum</td>
<td>Poaceae</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Digitaria sangainalis</td>
<td>Poaceae</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

Source: Field survey 2015  Key: A-Abundant; C-Common; O-Occasional; R-Rare

6.10.1.2 Crop Species Composition

Six crop species were observed to be present in the area namely Vigna unguiculata, Arachis hypogea, Zea mays, Pennisetum purpureum, Sorghum bicolor and Oryza sativa.

Table 6-15  Crops in the area

<table>
<thead>
<tr>
<th>s/n</th>
<th>Scientific name</th>
<th>Common name</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vigna unguiculata</td>
<td>Cowpea</td>
<td>Food</td>
</tr>
<tr>
<td>2</td>
<td>Arachis hypogea</td>
<td>Groundnut</td>
<td>Food</td>
</tr>
<tr>
<td>3</td>
<td>Zea mays</td>
<td>Maize</td>
<td>Food</td>
</tr>
<tr>
<td>4</td>
<td>Pennisetum glaucum</td>
<td>Millet</td>
<td>Food</td>
</tr>
<tr>
<td>5</td>
<td>Sorghum bicolor</td>
<td>Sorghum</td>
<td>Food</td>
</tr>
</tbody>
</table>
6.10.1.3 Plant Diseases Symptoms and Isolated Pathogens

In the study area, plant disease symptoms and isolated pathogens of some plants were observed. Tissue analysis from the herbarium showed that four of the plant species sampled namely *Ipomea involucrate*, *Chromoleanaodorata*, *Aspilia africana*, and *Arachis hypogeal* had one form of disease symptoms.

Specifically, *Ipomea involucrate* had common symptoms like leaf spot, mold and blight and necrotic lesions which were caused by *Botrylislinerea*. *Chromoleanaodorata* had dead streaks, black colorations and wilting of leaves which was believed to be caused by *Oedecephallum spp*. The same *oedecephallum* was responsible for the symptoms and diseases witnessed on *Aspilia africana* such as sooty molds, yellow molting and cassava mosaic. *Thielaviopsis mosaic* was the pathogen that caused yellow molting and wilting of leaves of *Arachis hypogeal*.

Three isolated pathogens were the major causes of disease in the study area. In spite of the few observed disease and symptoms on plants species, this was not a serious issue as the disease range and impacts were minor. In general the vegetation of the area was healthy.

Table 6-16 Plant Diseases Symptoms and Isolated Pathogens

<table>
<thead>
<tr>
<th>S/N</th>
<th>Plant Species</th>
<th>Disease symptoms</th>
<th>Isolated pathogens</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Ipomea involucrate</em></td>
<td>Leaf spot, mold and blight, necrotic lesions</td>
<td><em>Botrylislinerea</em></td>
</tr>
<tr>
<td>2</td>
<td><em>Chromoleanaodorata</em></td>
<td>Dead streaks. Black colouration and wilting</td>
<td><em>Oedecephallum spp</em></td>
</tr>
<tr>
<td>3</td>
<td><em>Aspilia Africana</em></td>
<td>Sootymolds, yellow molting and cassava mosaic</td>
<td><em>Oedecephallum spp</em></td>
</tr>
<tr>
<td>4</td>
<td><em>Arachis hypogeal</em></td>
<td>Yellow molting of leaves and molting</td>
<td><em>Thielaviopsis mosaic</em></td>
</tr>
</tbody>
</table>

Source: Field Survey 2015

6.10.2 Wildlife

In the study area, ten wildlife species were encountered of which three species were abundant namely
Agama agama, Rattus fuscipes and Cricetomys ganbianus. Python regius, Python sebae, Opheodrys vernalis and Ploceidae were the four common species in the area. Boa constrictor, Naja nigricollis and bubulcus ibis were the occasionally observed species in the area.
Table 6-17  Wildlife species composition

<table>
<thead>
<tr>
<th>s/n</th>
<th>Common name</th>
<th>Scientific name</th>
<th>Ecological station</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>A    C   O   R</td>
</tr>
<tr>
<td>1</td>
<td>Royal python</td>
<td>Python regius</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>African rock python</td>
<td>Python sebae</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Boa</td>
<td>Boa constrictor</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Olive green snake</td>
<td>Opheodrysvernatis</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Black cobra</td>
<td>Nojanigricollin</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Agama lizard</td>
<td>Agama agama</td>
<td>X</td>
</tr>
<tr>
<td>7</td>
<td>Bush rat</td>
<td>Rattusfuscipes</td>
<td>X</td>
</tr>
<tr>
<td>8</td>
<td>African giant rat</td>
<td>Cricetomysganbianus</td>
<td>X</td>
</tr>
<tr>
<td>9</td>
<td>Weaver bird</td>
<td>Ploceidae</td>
<td>X</td>
</tr>
<tr>
<td>10</td>
<td>Cattle egret</td>
<td>Bubulcus ibis</td>
<td></td>
</tr>
</tbody>
</table>

Total 3 4 3 0

Source: Field Survey 2015  Key: A-Abundant; C-Common; O-Occasional; R-Rare

6.10.3  Soil fauna

The soil macro-fauna encountered within the study area include various arthropods (insects, millipedes, mites), molluscs (snails), annelids (earthworms) and nematodes. These organisms are primary consumers; decomposers, mixers and utilizers of energy stored in plants and plant residues, and contribute to the re-cycling of nutrients. Others were secondary consumers such as centipedes and spiders. These animals consume smaller sized animals and they may also serve as food for organisms occupying higher levels of the food chain.

6.11  Social Indicators

6.11.1  Health Status Assessment

This section presents the baseline health data of communities near to the project site. It is based on information obtained from sampled groups around the project site and members of the communities.

6.11.1.1  Common Health Symptoms Experienced by Respondents

Climatic conditions in Gombe are typical of the Sudan savannah zone characterized by long dry and short rainy seasons. Gombe is a predominantly agrarian state with vast arable land and a wide variety
of livestock. This influences water and food supply, basic sanitation and hygiene, transmission of water and air borne diseases like gastro-enteritis, meningitis, and pulmonary tuberculosis. Being a state that is traversed by tributaries of the upper Benue River, onchocerciasis is endemic in the State.

6.11.1.2 Health Profile

The most frequent diseases in Billiri community is respiratory problem, malaria, typhoid and waterborne diseases due to the lack of piped water in the community. The principal causes of morbidity and mortality are malaria, pneumonia, vaccine preventable diseases, snake bite, road traffic accidents, and Acquired Immune Deficiency Syndrome (AIDS). Immunization coverage in 2008 is 68% for yellow fever, 92% for BCG, 86% for pertussis, 81% for tetanus, 75% for polio and 110% for measles.

6.11.1.3 Respondents Opinion on Causes of Health

Billiri community has various health institutions. About 43% of respondents visit the maternity clinic, while only 3% visit the General Hospital. About 14% believed in getting treatment from patent medicinal store, often situated “around the corner”, while 23% prefers to put their faith in the hand of the native doctors.

Most of the respondents admitted to finding easy cures from the herbs prepared by the experienced local doctors. Their nutrition habits are good as respondents have access to food that constitutes a balanced diet which promotes healthy living.

6.11.1.4 Availability of Health Care Facility

There are 57 health facilities in Biliri LGA: General Hospital (1), Community Health centre (5), Maternity (6) and Dispensary (45).

6.11.2 Socio-Economic Characteristics

6.11.2.1 Socio Economic Status Assessment

Agriculture and carving are the two major traditional occupations of the Tangales. The urban sector, with its concentration of informal sector activities, plays a growing role in the economy of the Northern region. Trading services and miscellaneous activities are the most important areas of employment, after agriculture.

Table 6-18 Summary of status of social amenities in the study Communities
The level of infrastructure and amenities available and functional in any area or community has direct implications on the quality of life in that area, and therefore the willingness of people to live and remain there. It also influences other socio-cultural and economic variables in the area. The field study and observations of humanities/settlements study area reveal availability of basic amenities for quality living. It was observed that governments at both the local and state level have shown concern in the study area especially in the communities of the project area. Also at the local government headquarters some basic amenities provided by government.

Amenities include Education, Health and communications facilities. The host community is connected to the national grid but the supply is unreliable and when the project 132/33kV transmission substation is completed, power supply will certainly improve and more businesses will thrive,
especially those requiring power.

### 6.11.2.2 Population Characteristics and Settlement Pattern

Gombe has an estimated population of 2,768,452 in 2011 based on projections from the 2006 census (Male : Female ratio 1:033).

Biliri, with an average elevation of 564 meter above sea level is mildly densely populated with 148 people per km$^2$.

The study area is characterized by nucleated compound system settlement patterns. The settlements are located close to each other. The settlement is linear on both sides of the road. Some of the community’s initial status as reflected in layout and housing types and structure was that of farming settlement. However, many of the houses are designed and built with block/brick walls with corrugated galvanized aluminum sheet at the main town and at the local government headquarters. All the settlements exhibited similar housing patterns and local architecture. About 15-25% is makeshift while the rest exhibit modern architecture.

### 6.11.2.3 Occupation and Livelihood

Farming was common in the study area. The major crops are cassava, maize, millet, sorghum, groundnuts, and vegetables. The people of Biliri are primarily farmers with farming activities accounting for more than 80% of occupations while trading is next with 10%, the rest being artisans and civil servants. The major crops produced are food and cash crops like Cereals: Maize, Sorghum, Rice and wheats: Legumes: Cowpeas, groundnuts, soya beans and bambara nuts. Fruits: Orange, Lemon, Mango, Guava, Paw-paw and grapes. Vegetables: Tomatoes, pepper, onions, okro, pumpkin and melon. Tree Crops: Gum Arabic, Kenaf, sugar cane, sunflower and ginger. Both subsistence and commercial farming are practiced in Biliri. Subsistence farming is approximately (70%) while Commercial farming is about (30%).

### 6.11.2.4 Education

More than 55% of respondents had primary level education followed by those with secondary level education (40.5%) and 5% had no form of formal education. There are 94 primary school and 63 community and government secondary schools in Biliri District. Primary and secondary schools are available in all the villages and communities of the project area. About 42% of the respondents in Billiri Community have up to secondary school level of education.
About 3% have NCE/diploma certificate, while only 2% graduates. The level of basic literacy is very low judging from the fact that about 22% are non-literate, 26% have no formal education and only 7% with primary education.

The introduction of the Universal Basic Education scheme has increased the number of primary and post primary schools but the girl child has a lower probability of school enrolment. The drop-out rate is higher than boys with early marriage resulting in a low female completion of the high school curriculum. In the final year, girls account for 26.7% of the student population.

6.11.2.5 Age and Family

In Billiri Community, about 14%, 41%, 22% and 18% of the respondents fall within 18-25, 26-40, 41-55 and 56-65 age brackets, respectively. In addition, majority of respondents are male, representing about 76% of the population sampled.

There are about 57.5% respondents who were married. About 2.5% were widowed and 42.5% single. Married people were more careful, rigid and suspicious in assessing the environmental effects of the project probably because of the likely social and health effects on their children.

During the field work a number of physically challenged people, although few in number, were seen in the community carrying about their normal business. According to our key informant and some elders of the community, there is no form of social exclusion of the physically challenged persons but all are completely absorbed / assimilated into the system in the kingdom. According to the elders, the foundation of the kingdom is built on justice, equity and fairplay; therefore physically challenged people are accorded equal rights and opportunities.

Children assist parents in domestic work and farming and also play very significant roles in church and traditional cultural activities.

Land ownership right is by family inheritance. Land could also be acquired through outright sale, gift, transfer of ownership through lease, so conflicts relating to land is very rare. Women are not given land unless there is no male child in the family but she can buy land from the original owner.

6.11.3 History and Culture

6.11.3.1 Gombe History

Tangale district covers an estimated area of 720 square kilometers. Altogether, there are eight main towns that make Tangele chiefdom. These are Biliri, Bare, Kalmai, Banganje, Tanglang, Tal, Todi, and Kwaya. All these towns have their respective village heads.
There are nine districts under Tangale, Biliri which is one of the districts is the host to the project. Other districts include, Bara, Kalorica, Banganje North, Banganje South, Tadi, Tudun Kwange, Tanglag and Tal. The Tangale people live in the western part of the former Tangela-Waja local Government area around a hill called Ballin or Pandi Biliri (A name given to the hill by the Tangale). They have a common boundary with Akko in the North, Kamo, and Kaltungo chiefdom in the East, Pero (in Kaltungo district) and part of Alkaleri Local Government in the West.

The Tangale people believe they came from a place called Yemel (Yemen) and from there they came through Cushite Land in Northern Sudan to Nzanzargamu in the present Bornu state. From there they journeyed to a place called Kupto in the present Funakaye LGA. They were to be in the company of their kingsmen the Tera, Bolewa, Waja and Longuda who later went to their present settlement. Tangale people then came and settled at present settlement Kumana around Biliri Hill.

Tangale is surrounded by neighbouring communities such as Shongon (Katungun chiefdom, Kamo, Awak, Waja and Tula in the Eastern part. All these tribes live in peace with Tangale especially the Jukuns who are related to Tangale. In the West and South, there are the Jukuns and Pero communities respectively who also live in peace with the Tangale.

The Tangale believe that they have been in their present settlement for more than three hundred years. Tangale as a community has seven Tangale clans: Tangaltong, Tal, Kalmai, Banganje, Tanglang, Todi and Nathi. The Tangalton comprises Biliri and Baro each with a clan head.

6.11.3.2 Cultural Environment

Field studies revealed that there are several traditional sites of local cultural importance to the
communities. These are mainly small shrines and deities, sacred groves/bushes, and burial ground. Tangale people, like any other ethnic group, depended wholly on their culture and arts for passing on of knowledge, which is still being encouraged today. The Tangale people are known for farming, hunting, weaving and carving, blacksmithing, pottery, and leather works.

Cultural dances are important aspect of social life in Tangale. Cultural dances are held at fixed times and for different purposes.

Tangale refers not only to the language spoken by the inhabitants of Biliri District of Gombe State, it also refers to the people themselves, the land on which they live and their government. In recent times, the language has been introduced into the primary and secondary schools curricula and many books have been written in Tangale language for the purpose of promoting the language, arts and culture of the people.

6.11.3.3 Religion

Before the advent of Christianity, Tangale people were adherents of traditional religion. All the deities have different forms of worship led by respective chief priests. After the advent of Christianity, Islam emerged. About two thirds of the total population is either Christians or Muslims leaving one-third as traditional religious worshippers.

In case of burials special ceremonies are held because Christians, Muslims and Traditionalists co-exist together in the districts. Usually, there are three days of mourning following the death and burial of a community member.

6.11.4 Governance

6.11.4.1 Structure

The political administration is well structured with the paramount ruler/community leader at the apex of authority. The paramount ruler is called or addressed as the HRH, Mai Tangale of Biliri, The present Mai Tangale is Dr. Abdu Buba Maisheru 2 of Biliri Kingdom.

Tangale as a name and union emerged probably in the 13th century AD. From that time till date, Tangale has a list of fifteen rulers who hail from Biliri clan called Miyen-ma-Mai. The incumbent, Mai Abdu Buba Maisheru 2 received the mantle of leadership of the kingdom in 2001 from the 14th Mai-Mai Mohammed Iliyasa Maiyamba who died in 1997.
6.11.4.2 Conflict Resolution Mechanisms

Field observations indicate a peaceful co-existence among the numerous tribes and ethnic nationalities that live in the communities. There were also cordial relationships among the various groups - youth, elders, and the women organization. There have been no conflicts in the bid for succession to the throne among the different ruling houses.

Conflicts and contentious issues are resolved in the communities and settlement is by collaboration among the village chiefs/heads, the Executives, the council of Chiefs, youth and women wing. The rungs of power are well established and guided by unwritten byelaws.

The following are regarded as taboos to any member of the community:

- Stealing
- Killing/Murder
- Getting close to a corpse
- Killing of a Python, a symbol of Power in the land.
- Witchcraft.
- Food taboos in Biliri community are eating vulture and pork

There are procedural guidelines for conflict resolution and management in these communities. These include:

- Adjudication by the traditional customary process
- Dialogue
- Reaching of consensus
- Proclamation of sanctions
- Administration of fines such as payment of fines with such things like wines/drink, goat and of cash depending on the adjudged magnitude of the offence
- Administration of oath of sincerity and allegiance to the interest of the community
- Use of law enforcement agents e.g. Police, local police or vigilante.
- Use of court

If a matter is not resolved it is handed over to the family heads then the council of chiefs and council of elders. The King HRH Mai Tangale has a final say and punishment is given according to the gravity of the offence. In most cases disputes were amicably settled without resort to the police or court proceedings.

The youth groups of the area are quite active. They are responsible for swift coordination of activities in
the day to day running of the community affairs especially when confrontational actions are involved. The youths are a formidable pressure group. They maintain law, order and security in their communities. For example in 1991, the youth protested when a neighboring community trespassed on their land and government of Gombe responded by appointing a commission that delineated the boundary between them.

Women groups have a woman leader and are usually welfare oriented rendering financial and moral assistance to members that are in need. They have carried out renovation of schools, hospitals and youth empowerment by buying and distributing motor cycles to members of the community. They pursue peace in the land and also carry out sanitation exercises to keep the environments clean. Women also play major role during ceremonial functions such as festivals, marriage ceremonies and burials.

Joint meetings between the various bodies including various social groups are held from time to time to discuss various issues affecting the communities.

6.12 Community Consultations

6.12.1 Consultations

Consultation was conducted in the course of the preparation of this ESIA. It is recognized that one key factor that exists in all successful approaches to project development and implementation is participation by relevant stakeholders. The more direct involvement of the local level people in the planning and management processes, the greater the likelihood that resource use and protection problems will be solved as well as the likelihood of development opportunities occurring in a balanced way and to the broad benefit of all communities in the project area.

Community Participation was considered in the entire process as a fundamental tool for: managing two-way communication between the proponent and the public, building understanding and improving decision-making by actively involving relevant stakeholders, especially the project affected persons and organizations with a stake and reducing the likelihood for conflicts.

The objectives of Community Consultations were:

- Canvass the inputs, views and concerns; and take account of the information and views of the public in the project design and in decision making.
- Obtain local and traditional knowledge that may be useful for decision-making;
- Facilitate consideration of alternatives, mitigation measures and trade-offs and ensure that important impacts are not overlooked and benefits maximized;
• Reduce conflict through the early identification of contentious issues;
• Provide an opportunity for the public to influence the designs and implementation in a positive manner;
• Improve transparency and accountability in decision-making; and Increase public confidence in the project.

The key stakeholders identified and consulted in the area include leaders in the communities, individual people who own properties that will be directly or indirectly affected, and business owners, etc.

Figure 6-13 Team with HRH, palace council and LG Heads of Department

Figure 6-14 Entrance to Palace

At the meeting, the overview of the proposed project and appreciation of ESIA were presented. Furthermore, the challenges that could impede the implementation of the project and the support needed from all parties to ensure effective project and successful implementation were also discussed with the stakeholders.

The primary concern of the people was how quickly the construction of this project could be completed and improve their socioeconomic conditions.

Community members were appreciative of the project but gave several instances of how they have remained under-developed despite numerous promises by various governments that were never fulfilled. But all have high expectations that the project will turn things around for them. The need for development is therefore, imperative. It is against this backdrop that communities that are stakeholders and hosts to the Project come with a long list of suggestions, some usually outside the scope and budget of companies that are put in place to maximize opportunities available.
6.12.2 **The Stakeholders Concerns**

The main issues raised by the stakeholders during consultation were as given in Table 6-19. These concerns were taken on notice by the ESIA Team.

<table>
<thead>
<tr>
<th>Communities and Settlements</th>
<th>Needs/Demands and Expectations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biliri</td>
<td>• Provision of electricity to improve from the present poor state of supply</td>
</tr>
<tr>
<td></td>
<td>• Provision of employment and youth empowerment</td>
</tr>
<tr>
<td></td>
<td>• Construction of road to the transmission substation</td>
</tr>
</tbody>
</table>

Source: Field Survey 2015

Response from the ESIA team and other Stakeholders such as State & local Government authorities and Power companies include the following:

- Casual workers during construction would be selected from the community
- Retail business shall improve during construction and wholesale business after the completion of the project
- Non-technical staff such as security, cleaners etc to be sourced from the host communities
- The project be completed with the funding pattern

See minutes of Public forum with stakeholders in Annex 2.

6.13 **GIS Data**

Maps were produced showing the following:

- Dimensions of site with distance to nearest development
- Location of site relative to 2 kms for biophysical effects and 4kms for socio-economic effect.
- Composite map showing 10m contours, waterbodies, streams, roads, development and site location
- Terrain map showing direction of gradient across slope
- Watershed map showing catchment areas and direction of flow
Figure 6-15 Dimensions of site with nearest development
Figure 6-16 Location of site relative to 2 kms and 4kms effects.
Figure 6-17 Composite map showing 10m contours and features
Figure 6-18 Terrain map showing gradient
Figure 6-19 Watershed map showing catchment and flow direction
7 Climate Change

7.1 Historical Data
Rainfall data from 28 stations for the period of 1941 – 1970 and 1970 – 2002 from the Nigeria Meteorological Station, Lagos was analysed.  

The results show that rainfall decreases from 1350 mm (1941–1970) to 1276 mm (1970–2002). While there is a decrease in rainfall in Nigeria in general, the coastal area is experiencing a slight increase. Apart from the general southward shift in rainfall patterns, the duration of rainy days per year has also reduced from a range of 80-360 days (1941-1970) to a range of 40-280 days (1970-2002).

Climate data from Bauchi meteorological station Research conducted by ATBU revealed that northern states in Nigeria have experienced major drought episodes causing massive famine in 1882-86, 1913-16, 1942-45, 1971-73, 1983-84, 1987-88 and 1997-98. The most severe drought years were 1973, 1983, 1987 and 1997-98, which coincided with El Niño years (NIMET, 2006). Analysis of rainfall data at Bauchi demonstrates that there has been sustained reduction in rainfall from 1955 onwards. Also, there has

33 Global Journal of Environmental Sciences Vol. 4(2) 2005: 139-145
been more year-to-year variability in rainfall since the 1970s.  

According to the vegetation map of Nigeria (1973 and 1995) the pattern of the vegetation belt especially in the northern fringes of the country has altered. The rainfall pattern has enhanced wind erosion/desertification in the north, soil erosion in the east and coastal flooding in the coastal areas of Nigeria.

Figure 7-2 Change in Rainfall for Nigeria 1905-2009

34 NEST and Woodley, E. (2012). Learning from Experience - Community-based Adaptation to Climate Change in Nigeria. (Building Nigeria's Response to Climate Change project). Ibadan, Nigeria: Nigerian Environmental Study/Action Team (NEST).

7.2 Climate Change Projections

Historically Nigeria has two peaks of temperature in April with a lesser one in October, and a peak in rain fall in August. According to the World Bank Climate Change Portal for the time period 2046-2065 the average rainfall maximum will shift to later in the year to September.
Projections have also been made for spatial distribution of rainfall and temperature.

Figure 7-5 Projected Maximum Temperatures across Nigeria

Figure 7-6 Projected Liability to Flood and Drought

There is a general shift in decreasing rainfall and loss of vegetation from north moving southwards towards the coast. Temperatures in the north will be higher than in the south. The north will be more liable to drought and the south will be more liable to floods.
8 Impacts due to Location

8.1 General Location
The general location of a substation is initially determined by distribution requirements and transmission line routing. The selection of a substation site involves the consideration of many factors. Sufficient land area is required for installation of equipment with necessary clearances for electrical safety and for access to maintain large apparatus, such as transformers. The site should have room for expansion due to load growth or planned transmission additions. Potential environmental effects such as stormwater drainage, noise, and road traffic must also be considered.

The impacts related to the construction and operation of a new electric substation will depend on its size as well as the topography, land cover, and existing land use of the selected site. Some impacts are temporary; however, most of the community and environmental impacts are permanent. The extensive land clearing and excavation activities required for the substation foundation creates permanent changes to the land cover of the site. A permanent access road is needed to allow for maintenance.

8.2 Cultural Resources
No cultural or archaeological sites or graves were discovered or identified near the site. No intangible cultural resources such as traditional uses of land, verbal agreements or unwritten spiritual values associated with the land were identified by local residents.

8.3 Land Use and Habitat Loss
New substations located within residential neighborhoods or subdivisions may be perceived as an industrial land use, inconsistent with the aesthetics of the community. They have the potential to affect the character and desirability of the residential area unless adequately landscaped or designed to be less obtrusive. Some examples of substation landscaping or design include surrounding the substation with tree-covered berms, attractive wood fencing, or the use of low-profile facility designs. Locating a substation in a rural area that is primarily agricultural could result in the loss of productive farmland. Utilities may purchase more land than is needed for the substation footprint. In these situations, once the substation and required infrastructures, like storm water ponds or access roads are constructed, the surrounding acreage is usually leased to a farm operator and returned to agricultural use.

The site is a green-field site and productive farm land has been purchased from owners. Ongoing crops
will be allowed to be harvested before the site is occupied.

8.4 Public Safety
The installation of equipment within substations must meet the requirements of the Nigerian Electrical Code. There are also strict safety requirements for personnel assigned to work in substations. To maintain safe conditions for the general public, all substations are fenced and have gates that must be locked at all times. Appropriate signage must also be posted that shows the owner of the substation, the hazardous nature of the substation, and contact information.

8.5 Storage of Hazardous Materials
There may be hazardous material stored on site for use in the normal operation of the substations. This is discussed in detail below.

8.6 Threatened, Endangered, or Rare Species
Construction and operation of a substation could have direct impacts on rare species or their habitat if the substation is sited in an area with high-quality habitat suitable for protected species. Field surveys were carried out and no rare or endangered species were identified. There will be no loss of important habitats and no impacts on active breeding seasons, or loss of grassland or woodland habitats for listed birds, mammals, reptiles and other wildlife.

8.7 Wetlands/Waterways
Because of the need for a stable, level ground surface, new substations are rarely constructed within wetlands. No wetlands have been identified within 5 kms of the site.

8.8 Drainage
There is a small watercourse running across the site but at the time of the site investigation this was dry. It is a rainwater runoff channel and should be redirected during site formation. There are no drainage issues on the site. There are no main rivers within 2kms of the site.

8.9 Site Access
The site is located near residential development and the existing access is through a restricted narrow roadway crossing a steep sided small stream.
It is recommended that a new access road be constructed linking the site with the main road to the north of the site at a distance of about 900m from the site. This will avoid a stream crossing and significantly reduce the risk of traffic accidents.

It is recommended that the contractor be instructed to make a temporary access road to the site from the north off the main road. The GIS maps show two streams running off the site from south to north and then crossing under the main road. If the contractor constructed a turn out on the main road he would be between the 2 streams and no bridge would be needed. This would save money on a bridge.

The access road would be about 1 km. There is an access path but it has some tight turns unsuited to
an articulated lorry carrying the transformers. A new access would remove the road safety hazard.

Figure 8-3  Recommended New Access Route to Biliri Site

The land would have to be obtained from the local people and returned to the same standard afterwards unless they wanted to keep a road.

8.10  Involuntary Resettlement

No involuntary resettlement of persons is required for the proposed project at this site.

8.11  Potential Positive Socio-economic Impacts

The proposed projects will provide short term, local employment opportunities during the construction phase for community members in terms of site clearance, excavation, loading and offloading of materials. Other short term opportunities may arise from the provision of security services where temporary camps or stores are erected and from opportunities to provide goods and services to construction workers e.g. food kiosks and other shops.

The long term impact is provision of power to the area with associated improvement in standard of living and economic development.
8.12 Key Aspects

Those aspects which have been discarded above will not be discussed further. The key aspects are now discussed below.
9 Impacts due to Project Design

9.1 Noise

9.1.1 Noise Sources
The noise emitted by energized transformers consists of no-load noise, load current induced noise, cooling equipment noise and switchgear noise. In a 50 Hz transformer the current is reversing twice a cycle and the generated magnetic field causes the core to vibrate at 100Hz giving the well-known “mains hum”. The noise level varies with load and is generally constant if the load is constant. There may be harmonics of the supply frequency at 100 and 200Hz. The transformer cooling fans generate more broadband noise, although they are not in continual operation. Fans generate a tonal component linked to the rotational speed of the fan and the air flow gives a broadband “hiss” or “white noise”. Switchgear noise is generated by the operation of circuit breakers and is “impulsive” in character and of short duration often described as a “crackle”.

Noise levels for the proposed transformers has been obtained from three sources:

- TCN Procurement Technical Specifications
- First Principles based on the load
- Field measurements of operating substation

The results are compared below.

9.1.2 Transformer Specifications
The TCN Technical Specifications as given in the BOQ follows international rules. In the EU the relevant guideline is IEC 60076-10:2001 Power transformers - Part 10: Determination of sound levels. In the USA the relevant guideline is IEEE STANDARD C57.12.90-2010 - IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers.

These standards give the test procedures for establishing noise levels. Noise level, or more correctly Sound Pressure Level (SPL), must be qualified by giving the distance at which the measurement is made, or the SPL predicted. The values below are taken from section 2.20 of the BOQ and show the noise level at the IEC standard distance of 0.3 m from the face of the transformer when it is running at 105% of full rated voltage.
Table 9-1  Noise Levels of 150 MVA Transformer from TCN BOQ

<table>
<thead>
<tr>
<th>2.20</th>
<th>Audible noise level</th>
<th>%</th>
<th>105</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Voltage in percent of rated value</td>
<td>- ONAN rating</td>
<td>dB(A)</td>
<td>83 max</td>
</tr>
<tr>
<td>- ONAF maximum rating</td>
<td></td>
<td>dB(A)</td>
<td>86 max</td>
</tr>
</tbody>
</table>

The ONAN/ONAF terminologies describe the transformer cooling system types. ONAN designates an oil filled unit that has natural convection flow in the tank and utilizes natural air convection cooling externally. When fans are added for external forced air ventilation the designation is ONAF. A transformer that has natural convection cooling as a base rating and an elevated rating when fans are added is designated as ONAN/ONAF.

9.1.3 Near Field and Far Field

The values above show that when the transformer is running at full load the noise level at 0.3 m from the face of the transformer is 86dB(A). The distance 0.3 m is the IEC standard distance at which all transformers are tested.

However, close to a sound source, the sound intensity is affected by constructive and destructive interference of the multiple waves which originate from the radiator face. This is called the “Near Field”, and it is difficult to calculate the attenuation with distance of a sound level based on measurements taken in the near field. One needs to establish the distance at which the radiator starts acting as a single point source. This is known as the “Far Field” and depends on the dimension of the radiator and the frequency. If one takes a sound level measurement in the far field then once can apply the Inverse Square Law to this measurement to extrapolate to the noise level at a set distance. The far


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field can be calculated from the following formula:

$$N = \frac{D^2}{4\lambda}$$

where: $N =$ Length of Transition from Near Field to Far Field  
$D =$ Largest dimension of transformer  
$\lambda =$ Wavelength, in this case 3.3m at 100hz

The dimensions of the transformer as measured in Abuja are length 7m, width 4m and height 6m. This gives a Far Field distance of 3.7m. Therefore, although the IEC sound level at 0.3m is very useful for occupational noise exposure assessment, where operatives are in close proximity to the transformer, in order to calculate the possible intrusion off-site at nearby residences, one must determine noise levels at distances greater than 3.7 metres.\(^{37}\) This is discussed further below.

### 9.1.4 Noise Level Variation with Load Capacity

Noise levels are given by manufacturers. Typical noise levels of a Siemens 420 MVA transformer is shown below. As shown a 420 MVA transformer at full load with cooling fans operating gives 76.3dB(A) at 0.3 m.

![Figure 9-1 Typical noise levels of a Siemens 420 MVA transformer](image)

Noise levels increase with load and the theoretical noise level can be calculated based on the MVA

\(^{37}\) As a cross check an industry “rule of thumb” is that the near field is limited to a distance from the source equal to about a wavelength of the sound which in this case, for 100Hz, is 3.3m under normal atmospheric conditions.
rating of the transformer assuming it is operating at full load.

The formula is \( \text{SPLdB(A)} @ 0.3\text{m} = 45+12\log\text{MVA} \). So for example, as shown above, a 150 MVA transformer at full load gives 70 dB(A) at 0.3 m.

Low noise power transformers are available. A low noise design can cut noise emission by up to 24dB(A) when compared with a standard design transformer. In this case as there are no noise sensitive receptors in the immediate vicinity, low noise transformers are not required nor economically justified.

### 9.1.5 IEC 60076

Actual data on noise emission levels from transformers was collected by the consultants. A procedure to be followed when taking site noise measurements around transformers was written and is included in an Annex for future reference. This is in accordance with International Standard IEC 60076-10, Power transformers Part 10: Determination of sound levels, First edition 2001-05.

### 9.1.6 Noise Measurements, Abuja

To support the theoretical calculations noise measurements were taken on a similar installation in Abuja that was typical of the intended plant installations. This was at Katampe, a 330KV and 2x150MVA installation on Thursday 13\(^{th}\) August, 2015. The name plate details were Mitsubishi, ABB, ONAN / ONAF 150MVA.
These noise data have been used in the impact assessment for the ESIA.

**9.1.7 Results of Noise Measurements**

The noise measurements were taken on a clear dry day with little wind. The sound level meter was IEC Type 2 calibrated before and after measurements in accordance with the manufacturer’s instructions. A windshield was used and measurements taken with the microphone in a vertical position. (Figure 9-3)

In order for sound level measurements to be valid the measured noise should be 10 dBs above the ambient. A measurement was taken within the substation but well removed from the transformers. The ambient was assessed at 55dB(A). Traffic noise was occasionally audible. There were no other extraneous noise sources.

Measurements were then taken around the transformer in accordance with IEC 60076-10 at distances of 5m and 10m. The transformer had 8 cooling fans and measurements were taken with the fans on and off. At the time the substation staff reported that the transformer was operating at Full Load. Full load plus all fans represents worst case conditions.
MEASURING WITH FANS OFF
SPL in dB(A)

TRANSFORMER 150 MVA

10 m

5 m

10 m

SPL MEASURING POINTS

Figure 9-4 Noise measurements at Katampe, Abuja

MEASURING WITH FANS ON
SPL in dB(A)

TRANSFORMER 150 MVA

10 m

5 m

2 FANS ON

SPL dB(A) MEASURING POINTS

Figure 9-5 Noise measurements at Katampe, Abuja
9.1.8 Analysis of Noise Measurements

Measurements were taken at 4 locations in concentric circles around the transformer at distances of 5m and 10m giving 8 measurements in total. As the previous calculation gave the near field as ending at 3.7m, these measurements were taken in the far field. This means as one moves away from the transformer the sound level should theoretically drop by 6dBs for every doubling of distance. As the transformer is mounted in a concrete yard there may be some reflections from the ground which will reduce this reduction slightly. This is the case, with noise levels typically dropping from 69dB(A) to 65(A) as one moves from 5m to 10 m distance.

It was noted that there was a brick wall facing one end of the transformer. Reflection from this wall may increase the measured noise level by 3dBs so these noise levels are not typical of a free standing transformer in an open space, as will be the case at the project sites.

The results show that the noise emitted is basically omnidirectional with no pronounced directivity.

A typical noise level at 10m with the fans on is 64dB(A). A typical noise level at 10m with the fans off is 56dB(A). The fans are adding 8dB(A) to the emitted noise levels.

9.1.9 Impact of Noise Levels

If one assumes the worst case scenario that is a noise level of 64dB(A) at 10 metres then the attenuation with distance is as shown in Table 9-2.

<table>
<thead>
<tr>
<th>Distance from Source in m.</th>
<th>10</th>
<th>20</th>
<th>40</th>
<th>80</th>
<th>160</th>
<th>320</th>
<th>640</th>
<th>&gt;1km</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound Level in dB(A)</td>
<td>64</td>
<td>58</td>
<td>52</td>
<td>46</td>
<td>40</td>
<td>34</td>
<td>28</td>
<td>~20</td>
</tr>
</tbody>
</table>

This is attenuation with distance based purely on the Inverse Square Law. If one includes for ground scrubbing and atmospheric absorption the sound levels will be much lower. However, ground scrubbing will not occur immediately next to the transformer as it is located in a concrete paved or gravel yard with no vegetation.

To be detectable the noise level needs to be comparable with the ambient, and to be intrusive noise level needs to be 10dB(A) higher than the ambient.

The International Finance Cooperation (IFC) Environmental Noise Management Standard states that noise impacts should not increase background levels by 3 dBs at the nearest receptor location off-site. IFC also gives standards for different Land Uses. (Table 9-3)
Table 9-3  IFC Guidelines

<table>
<thead>
<tr>
<th>Noise Level Guidelines</th>
<th>One Hour LAeq (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daytime 07:00-22:00</td>
</tr>
<tr>
<td>Residential, Institutional, Educational</td>
<td>55</td>
</tr>
<tr>
<td>Industrial, Commercial</td>
<td>70</td>
</tr>
</tbody>
</table>

The WHO guidelines for nighttime noise recommend less than 40 dB(A) outside of bedrooms to prevent adverse health effects from noise. The FMEnv standard is given below: 
Table 9-4  Maximum Permissible Noise Levels for General Environment

<table>
<thead>
<tr>
<th>FACILITY</th>
<th>Maximum permissible Noise Limits dB (A) (Leq)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DAY</td>
</tr>
<tr>
<td>Any building use as hospital, convalescence home, home for the aged, sanatorium and institutes of higher learning, conference rooms, public library, environmental or recreational sites.</td>
<td>45</td>
</tr>
<tr>
<td>Residential buildings</td>
<td>50</td>
</tr>
<tr>
<td>Mixed residential (with some commercial and entertainment)</td>
<td>55</td>
</tr>
<tr>
<td>Residential+ industry or small scale production + commerce</td>
<td>60</td>
</tr>
<tr>
<td>Industrial (outside perimeter fence)</td>
<td>70</td>
</tr>
</tbody>
</table>


The FMEnv standards are given in Leq dB(A). Noise may be classified as steady, non-steady or impulsive. Steady noise is a noise with negligibly small fluctuations within the period of observation. A non-steady noise is when sound levels shift significantly. This can be intermittent noise. Fluctuating noise changes continuously. Tonal noise is characterised by one or two single frequencies. This noise is more intrusive than than broadband noise. In order accommodate the changes the descriptor Leq is used which is the single value equivalent to the weighted average of the period of observation. FMEnv stipulate standards in Leq. As transformers emit tonal and broadband steady noise and transformer noise is continuous the short term SPL is the same as the Leq. Ambients were measured on site and were typically 55dB(A) daytime. One can assume that nighttime ambients are 10dB less than daytime so a target noise level of 45dB(A) at the perimeter of the site would be a good standard.

ISO 12001
The noise standard for operation should assume that development may take place in the future and buildings may be constructed right up to the TCN boundary. One would hope that the local government planners would discourage noise sensitive dwellings, or residential properties, immediately adjacent to the site.

Transformers are usually located next to the access road to allow transfer of oil and access for fire engines. This means they are close to the perimeter but TCN activities should not cause noise intrusion beyond the perimeter of their site.

Taking a target noise level of 45dB(A) at the perimeter of the site, based on the Technical Specification and measured levels, it is recommended that transformers should not be located within 80m of the boundary of the site. This is a worst case scenario. Following this recommendation would ensure no complaints over noise intrusion both during the night time and during daytime during operation. It also allows a margin for intensification of use in the future.

9.1.10 Corona Discharge

One of the phenomena associated with all energized electrical devices, including high-voltage transmission lines, is corona. The localized electric field near a conductor can be sufficiently concentrated to ionize air close to the conductors. This can result in a partial discharge of electrical energy called a corona discharge, or corona.

Corona occurs on all types of transmission lines, but it becomes more noticeable at higher voltages (345 kV and higher). Under fair weather conditions, the audible noise from corona is minor and rarely noticed.

During wet and humid conditions, water drops collect on the conductors and increase corona activity. Under these conditions, a crackling or humming sound may be heard in the immediate vicinity of the line. Corona results in a power loss. Power losses like corona result in operating inefficiencies and a major concern is reduction of losses. TCN will take all practical steps to reduce corona discharge and the noise impacts are not considered to be significant.

9.2 Electromagnetic Fields (EMF)

9.2.1 Sources of EMF

There are various naturally occurring magnetic fields in the environment such as the Earth’s magnetic field. Every live conductor or piece of equipment, from high-power electric lines to domestic appliances, generates electrical and magnetic fields around itself.
Electric and magnetic fields act independently of each other and are measured separately. Voltage generates electrical fields, and the higher the voltage, the stronger the resulting field. Electrical field strength is measured in volts per metre (V/m), or kilovolts per metre (kV/m).

Magnetic fields are caused by current, the higher the current, the stronger the magnetic field. Magnetic field strength is usually given as the density of the magnetic field, for which the measurement unit is Tesla (T), millitesla (MT) or more usually micro-Tesla (μT).

Powerlines come in different configurations. The highest power ones (>400kV) are the long-distance lines from the generating power station to the places where the power is needed. The pylons supporting these power cables are large, metal structures, which have long strings of insulators from which the cables hang. The smallest 230 volt lines start from local substations and supply the power needs for a relatively small area. In between these two extremes are a variety of other types of lines carrying different voltages.

The strength of the fields around overhead power lines depends on the voltage and on how much current is passing through the line at a given time. The field is stronger in the immediate vicinity of the line, and further away decreases significantly. The strength of the electrical field is affected by the height of the mast, the layout of the wires on the mast, and the number of sections of the mast.

There are two types of electromagnetic fields (EMFs) associated with powerlines; electric fields and magnetic fields. These are at their highest to either side of the central cable of large lines, and underneath the cables of smaller lines. The EMFs come from the cables, not the pylons as the pylons are insulated from the fields generated. As one moves away from the line, the fields begin to drop away. How far they extend depends on the line voltage for the electric field, and the power being supplied for the magnetic field. This is shown on Figure 9-6 below.
The ICNIRP (International Commission of Non ionizing Radiation Protection) recommends that in places where there is regular human presence, the electrical fields from power lines may not under normal circumstances exceed 5 kV/m and the magnetic field must not exceed 100 μT. The same limits are also given in the recommendations of the Council of the European Union. This means there is no reason to restrict activities such as fruit picking, farming or forestry near or under overhead lines. The same limits apply to domestic situations. This is shown on Figure 9-7 below.
There are limits set for the maximum strength of electromagnetic fields in residential areas. If the electrical and magnetic fields strengths remain within the limits, there is no negative impact on human health.

### 9.2.2 Induced Effects
The electromagnetic fields caused by overhead lines can induce currents and voltage in conductive objects near the line. Induction is also possible in long metal structures such as communications equipment, fences, pipes, or lines near the power lines, or in large objects such as roofs, tanks or large trucks.

### 9.2.3 Earthing
Most of the effects of induced voltage are found in metal structures and objects that are not well earthed and every conducting part of such structures needs to be properly earthed. Long metal structures which are earthed in one or several places and stand parallel to electrical wires, must be repeatedly earthed at appropriate intervals, or interspersed with insulating elements in order to reduce the size of the possible electrical flows.

### 9.2.4 Screening
Electric fields from substation equipment are unlikely to extend beyond the equipment housing, as they are screened by practically all building materials. For all practical purposes magnetic fields cannot be stopped and will travel through walls. Buildings and some trees reduce electric fields, but magnetic fields travel through most materials.

### 9.2.5 EMF and Health
The issue of EMF and health effects has been extensively reviewed over the past 30 years by Australian and international inquiries and expert panels established for the purpose of trying to determine whether or not human exposure to EMF is related to adverse health effects. Consistently, there is no scientific evidence to conclude that EMF causes cancer or any other disease.

There has been a lot of research on whether exposure to ELF (Extremely Low Frequency) EMF from electrical sources below the exposure limits causes any health effects. Most of the research indicates that ELF EMF exposure normally encountered in the environment, including in the vicinity of powerlines, does not pose a risk to human health.
However, there are some epidemiological (population) studies that have reported a possible association between prolonged exposure to ELF magnetic fields at levels below the exposure limits but higher than what is typically encountered and increased rates of childhood leukaemia. Based largely on this limited evidence the International Agency for Research on Cancer has classified ELF magnetic fields as possibly carcinogenic to humans. (The term "extremely low" is described as any frequency below 300 hertz as opposed to high frequency such as microwave.)

EMF contain both electric and magnetic field at 90 degree phase difference. The electric field can cause oscillations in human cells at high frequency, causing them to heat up. Similarly, the varying magnetic field induces an electric current in human cells and tissues. Thus high-power EMF can damage body cells. (This of course is the principle behind a microwave oven)

Studies have been done on people that live within 300 meters of a substation.\textsuperscript{39} There is some evidence to suggest an increased risk of some type of cancer. However, the evidence has not been conclusive.\textsuperscript{40} The IARC classification of ELF magnetic fields reflects the fact that some limited evidence exists that ELF magnetic fields might be a risk factor for childhood leukemia.\textsuperscript{41} However, the vast majority of scientific research to date does not support a link between ELF magnetic field exposure and human cancers. The IARC\textsuperscript{42} has classified ELF magnetic fields as "possibly carcinogenic to humans". At present, the evidence of a possible link between ELF magnetic field exposure and cancer risk is far from conclusive and more research is needed to clarify this "possible" link. Health Canada is in agreement with both the World Health Organization and IARC that additional research in this area is warranted.

The relevant Australian regulatory authority, the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), concludes that “On balance, the scientific evidence does not indicate that exposure

\textsuperscript{39} Australian Radiation Protection and Nuclear Safety Agency, 2015
\textsuperscript{40} “Current standards used for radiation protection remain primarily based on acute high-dose exposures, derived from studies based on atomic bomb survivors in Japan,” IARC Director, 2015
\textsuperscript{41} Risk of Leukaemia in Nuclear Workers, International Agency for Research on Cancer , WHO, June 2015
\textsuperscript{42} “Electric and magnetic fields from power lines and electrical appliances”, http://www.canada.ca, 2015
\textsuperscript{43} Risk of Leukaemia in Nuclear Workers, International Agency for Research on Cancer , WHO, June 2015
to 50 Hz EMFs found around the home, the office or near power lines is a hazard to human health” (Australian Radiation Protection and Nuclear Safety Agency 2003).

There are currently no Australian standards regulating exposure to these fields. The National Health and Medical Research Council issued Interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields. These guidelines are aimed at preventing immediate health effects resulting from exposure to these fields. The recommended magnetic field exposure limit for members of the public (24-hour exposure) is 100 uT and for occupational exposure whole working day is 500 uT. EnergyAustralia operates its powerlines, substations and other electrical infrastructure well within these interim guideline limits.

As the typical level underneath a power line is 10uT, adverse health impacts from EMF are not anticipated. Magnetic fields can also interfere with computers but this is not considered a likely problem on these sites.

The scientific evidence does not establish that exposure to ELF EMF around near powerlines or another electrical source is a hazard to human health.44

9.3 Chemical Hazards

9.3.1 Hazardous Materials Storage

The typical chemicals found in substations include dielectric fluid, transformer oil, capacitor oil, sulphur hexafluoride and sulphuric acid. These are used to insulate and cool electrical conductors, apart from sulphuric acid which is battery acid.

Dielectric fluid is a mineral oil used to cool and insulate underground transmission feeders. It is a non-polychlorinated biphenyl (Non-PCB) oil and can possibly be ignited by electric arcs which have very high temperatures, up to 5,000°C.

Transformer oil is the generic name given to the oil used to insulate and cool transformers. Its flash point is approximately 150°C. Historically; this is where PCBs have been found. Utility companies systematically remove carcinogenic PCBs from their old equipment by “retrofilling.” The transformers on the TCN site in this project are new and the procurement specification states they must be free of

44 Australian Radiation Protection and Nuclear Safety Agency, 2015
PCBs.

Capacitor oil is a viscous insulating oil used in capacitor banks. It is Non-PCB oil and has a flash point of 140°C. Older capacitor cans may contain PCBs but the new ones for these sites will not be allowed to do so.

Sulphuric acid is contained in the lead/acid batteries used in the backup power source. According to the TCN technical specification the batteries will be 110 volts DC. Substations typically have two battery rooms, each containing 30 to 40 car-type batteries. Each battery can hold up to 50 litres of acid at 40% concentration. Exposure to liquid sulphuric acid is a skin hazard, but acid mist can produce respiratory injuries. Spills must be contained and treated. The TCN technical specification includes battery chargers. When batteries are charged hydrogen is released. In the event of a fire in a battery room Carbon Monoxide detectors are often used for safety checks. CO sensors are cross-sensitive to hydrogen and this can lead to false readings. Caution must be observed in interpreting readings as they may be false.

Sulfur hexafluoride gas is used to insulate and extinguish arcs in circuit breakers and other electrical components. For higher voltages, gas-insulated switch gear reduces the space required around live bus. Instead of bare conductors, bus and apparatus are built into pressurized tubular containers filled with sulfur hexafluoride (SF₆) gas. This gas has a higher insulating value than air, allowing the dimensions of the apparatus to be reduced. In addition to air or SF₆ gas, apparatus will use other insulation materials such as transformer oil, paper, porcelain, and polymer insulators.

Under normal conditions, SF₆ is an odorless and colorless gas that is five times heavier than air and presents an asphyxiation hazard in below-grade confined spaces. If exposed to high heat, thermal decomposition produces two hazardous by-products, hydrogen fluoride gas and metal fluorides. Hydrogen fluoride gas (HF) gives off a rotten egg smell and desensitizes the sense of smell, so continuing exposure may make it seem as if it has dissipated. It is a respiratory hazard because in the lungs it mixes with water and produces hydrofluoric acid. Metal fluoride is a white powder which produces a sunburn type effect on the skin.

All of these materials will be stored in a Hazardous Material store with strict inventory control.

9.3.2 PCBs

Polychlorinated biphenyls (PCBs) were used in transformers as dielectric insulating fluids to solve the problem of high flammability for installations in and near buildings. As their negative aspects began to be fully appreciated (high toxicity), other fluids such as silicone oils, high-temperature hydrocarbons,
tetrachloroethylenes, and synthetic esters started to be used in transformers located in many of the locations where PCBs were formerly used. These fluids possessed superior fire resistance properties compared to mineral oils, although they were not as fire resistant as PCBs with the exception maybe of tetrachloroethylenes. They did not, however, with the possible exception of synthetic esters, possess biodegradability characteristics that were markedly superior to mineral oils. In the late 1990s, natural esters, a new class of fully biodegradable dielectric insulating fluids, were developed for transformer applications. These vegetable-oil-based fluids meet all the requirements for a high-temperature insulating fluid with the addition of being manufactured from renewable raw materials. There are, today, a number of published industry standards and guides that cover the use of natural ester fluids in transformer applications, such as the American Society for Testing and Materials standard D6871 and the IEEE guide C57.147 in North America, and the IEC Standard 62770. Polychlorinated biphenyl (PCB) is a concern where transformer oils are used. It is reported that some old transformers in Nigeria still contain PCBs. All transformers on these sites are new and are free of PCBs. The procurement specification stipulates that they must use oils free of PCBs. There will be no use of old used transformers. All new transformers are specified as being free of PCBs. No PCBs will be present on the sites.

10 Impacts due to Construction Works

10.1 Air Quality Impacts

Air quality impacts during construction are likely to result from the following sources:

- Dust from movement of haulage trucks and haulage of spoil for disposal
- Dust from stripping of vegetation and site formation pavement during road rehabilitation
- Dust from earthworks such as use of borrow pits, embankments and cut and fill
- Dust from loading, unloading and construction materials from borrow pits particularly in areas where receptors (people) are present such as in villages;
- Dust from concrete batching plants
- Dust entrained by wind from uncovered surfaces

Minor increases in NOx and SOx from construction machinery and vehicles

Air quality issues will be localized and could affect residential areas in Biliri.

10.2 Mitigation

The mitigation measures to protect sensitive receptors from air quality issues are:
• Concrete batching plants to be located at least 300 m downwind or as far as practicable from the nearest dwellings in order to reduce the impact of fumes on humans and to be fitted with necessary equipment such as bag house filters to reduce fugitive dust emissions.

• Stockpiles of materials such as sand must be managed to reduce dust emissions. The location of the stockpile must be downwind of sensitive receptors. The stockpile must be sprayed with water before material is moved. If the stockpile is within 300 m of dwellings the stockpile should be covered with tarpaulins and fenced in to form a high barrier and prevent wind lifting and dispersing the materials.

• Water will be sprayed on construction sites and approach roads to suppress dust in dry weather.

• Trucks transporting materials will be covered with automatically closing covers or tarpaulins to avoid spilling material on roads.

• Construction vehicles and machinery will be maintained to minimize emissions of fuel fumes.

• During construction the contractors will immediately clean up any mud or dusty materials left on public roads. Wheel cleaning facilities will be installed at site access points to stop carry over of materials onto roads.

Air quality monitoring will take place to confirm the impact of the project on air quality and identify corrective actions if needed.

10.3 Water Quality

10.3.1 Impacts

Water quality impacts during construction are likely to result from the following sources:

• Increased sedimentation of water courses

• Accidental spills contaminating wells with oils, lubricants, paint wastes etc

• Sanitation facilities such as toilets leaking into potable water source

On Biliri there is a small water course adjacent to the western edge of the site.

10.3.2 Mitigation

The mitigation measures to protect from water quality issues are:

• Wells will be identified in advance of construction and demarcated to ensure vehicles and machinery does not encroach on them. Identification will require consultation with community members.
• No materials will be stored within 50 m of a water course, including soil, spoil, aggregates, chemicals or other materials used during construction.

• Temporary drainage provision will be made during construction to ensure that any rain storm water running off the construction areas will be controlled. It will be lead to silt traps before discharge into the natural drainage system.

• Any toilet or personal washing facilities on site will have prefabricated septic tanks installed on site which discharge to a subsurface soakaway, to avoid soil contamination and smell.

• Chemical and oils storage areas will be laid on a hard concrete base. Overhead protection from rain and severe weather will be provided. A perimeter kerb will be provided leading to a spill collection sump.

• Fuel storage for site vehicles must be in an elevated skid mounted tank placed on a hard area with a kerb built up around it that is capable of holding 110% of the contents of the tank volume. It may have a drainage plug to allow rain water to be discharged but this must have a tap which is Normally Closed and be kept closed at all times.

• Vehicle maintenance workshops, vehicle parking areas and vehicle cleaning areas must be placed at least 300 m away from the nearest water body and have surrounding drainage to ensure contaminated water does not enter a watercourse. Maintenance and cleaning activities must be on hard standing surface.

• Contingency plans for control of spills of oil and other hazardous substances will be formulated and spill collection kits kept readily available.

Water quality monitoring will take place to confirm the impact of the project on water resources and identify corrective actions if needed.

10.4 Solid and Liquid Waste

10.4.1 Impacts

Waste impacts during construction are likely to result from the following sources:

• Clearance of site vegetation. Biliri has open land. This vegetation will be cleared and removed to a municipal dump site approved by local authorities.

• The potential impacts arising from solid and liquid waste production and disposal will be mitigated through a number of activities defined in the EMP, and which will be incorporated in the bid documents and construction contracts.

As regards removal of topsoil and underlying materials a mass balance “cut and fill budget” will be
prepared so that cut material from an embankment can be reused on site to fill in low lying areas. This will minimize vehicle movement and save money in purchasing fill material. The cut and fill budget will be subject to approval by the materials engineer to confirm the materials are of suitable load bearing integrity.

10.4.2 Mitigation

The mitigation measures to protect from waste contamination issues are:

- Waste removal and disposal will be subject to the waste hierarchy of reduce / reuse / recycle. Where waste materials can be reused they will be, but not if this leads to pollution.
- Vegetation will be cleared and removed to a municipal dump site approved by local authorities.
- Waste storage containers for worker’s general waste will be provided and emptied regularly
- Hazardous liquid wastes will be kept in a dedicated store. Hazardous waste such as oily rags, old oil filters or chemical containers will be disposed of in plastic bags or sealed bins to an approved contractor.
- Mud on roads will be avoided by wheel cleaning facilities at entry and exit points
- Soil and overburden will be removed, stored and reused as far as possible in accordance with a cut and fill mass balance plan
- Spoil will not be disposed of where it may impact on any vegetation
- Topsoil will be stockpiled and used for later landscaping
- Municipal type waste such as foodwastes, paper, cardboard, clean wood and other materials will be collected in bins and emptied regularly to a municipal waste tip to avoid encouraging vermin and rodents.
- Temporary waste storage will be in an area kept as dry as possible with a lightweight roof to keep off rain.
- Burning of waste will be prohibited at all times.
- It has been noted on some sites that wastes are dumped by residents. The contractor will not be responsible for this in the future and this process will have to be terminated. However existing wastes on site will be removed by the contractor.

Waste disposal monitoring will take place by visual inspections of the sites on a regular basis by the construction supervision inspectors.
10.5 Noise

10.5.1 Impacts
The major sources of noise pollution during construction are removal of existing surface vegetation and overburden and site formation. In sites with no pronounced slope, such as Gombe, no site leveling will be required. Consequently, there should be no need for impact piling. No rock will be extracted other than by excavators so no blasting will take place. The general movement of construction vehicles for haulage of removed over burden and delivery of construction materials will create noise and vibration.

As regards removal of topsoil and underlying materials a mass balance “cut and fill budget” will be prepared so that cut material from an embankment can be reused on site to fill in low lying areas. This will minimize vehicle movement and save money in purchasing fill material. The cut and fill budget will be subject to approval by the materials engineer to confirm the materials are of suitable load bearing integrity.

Table 10-1 indicates noise levels for construction machinery.\(^{45}\) Construction activities could reasonably be expected to produce noise levels up to 90 dB(A) within 5 m of machinery. For the project, no receptors other than construction workers will be this close to the machinery, and they will be required to wear appropriate PPE. Other receptors have been identified with the closest being 75m (Biliri). This is the distance from the edge of the site. If vehicles were to operate at the far edge of the site they would be about 400 m distance from the nearest noise sensitive receptor.

Table 10-1   Construction Machinery Noise

The loudest piece of equipment is the jack hammer with a noise level of 90dBA at 15m. The Inverse Square Law (ISL) states that sound levels drop at the rate of 6dBs / doubling of distance which would give the Table 10-2 below.

### Table 10-2  Sound attenuation with Distance

<table>
<thead>
<tr>
<th>Distance from Source in m.</th>
<th>15</th>
<th>30</th>
<th>60</th>
<th>120</th>
<th>240</th>
<th>480</th>
<th>960</th>
<th>~1km</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound Level in dBA</td>
<td>90</td>
<td>84</td>
<td>78</td>
<td>72</td>
<td>64</td>
<td>58</td>
<td>52</td>
<td>~50</td>
</tr>
</tbody>
</table>

This is attenuation with distance based purely on the ISL. If one includes for ground scrubbing and atmospheric absorption the sound levels will be much lower.

To be detectable the noise level needs to be comparable with the ambient, and to be intrusive noise level needs to be 10dBA higher than the ambient. Given a daytime ambient of typically 55dBA activities that are more than 200 metres from noise sensitive dwellings should not be intrusive. This comment relates to the noisiest activity. Other activities will be quieter than this.

The site at Biliri, Gombe is adjacent to a village which has residential dwellings at a distance of 75m from the perimeter of the site. Also site vehicles may have to access the site through this village. There are no schools or hospitals in the vicinity and although site activities are not expected to be
significantly intrusive, there needs to be a strong community relationship building exercise between
the contractor and the villagers.
Noisy activities will not be continuous and the sources will move around the site. Also noisy activities
will be limited to daytime hours 0700 to 1900 so there should be no sleep disturbance. Sometimes it is
necessary to carry out activities on site which cannot be interrupted, such as concrete pouring. If it
should be necessary to work at night, or in close proximity to the site boundary, then a public
information campaign is essential. Sound levels are only considered intrusive if residents object, and if
they are advised in advance in a respectful manner, told how long the activity will take and their
indulgence requested, they are likely to agree without protest. This issue is dealt with in more detail in
the CEMP.
In connection with vehicle movement is safety to residents, particularly
children. Noise is an issue here
because often audible warning devices are fitted to vehicles particularly when reversing and residents
should be made aware of the safety considerations.
There will be no impact piling. Ground surface vibration may be caused from the use of heavy
construction machinery. Tracked plant such as bulldozers and vibratory rollers may cause
vibration, more so than rubber wheeled plant such as dumper trucks. However it is anticipated that
the receptors are unlikely to be significantly adversely affected by vibration as generally over 20 m
from the construction, the vibrations in buildings are beyond human perception.

10.5.2 Mitigation
The potential noise impacts will be mitigated through a number of activities which will be defined in the
ESMP. These will be incorporated in the bid documents and construction contracts and are:

- **Source Control**

Maintain all exhaust systems in good working order; undertake regular equipment maintenance,
enclose stationary equipment such as generators where practicable and reduce vehicle speeds around
sensitive receptors such as dwellings and schools.

\[\text{\textsuperscript{46} Martin, D (1977) Transport and Road Research Laboratory, UK. . Ground vibrations caused by road construction.}\]
• Siting
Locate sites for concrete-mixing, batching plants and similar activities at least 500 m away from sensitive areas.

• Timing
Operate between 7am-7pm only and reach an agreement with nearby residents regarding the timing of heavy machinery work, to avoid unnecessary disturbances.

• Community notification
In advance of construction, representatives from religious buildings, schools and village leaders will be consulted on the timing of construction so key ceremonies, exam times, or other significant events so that impacted upon them are as little as possible.

• Consultation and engagement
Set up procedure for handling of noise complaints through the Grievance Redress Mechanism and continually seek suggestions from community members to reduce noise intrusion.

Potential sensitive receptors in residential areas, businesses, religious buildings and schools may be exposed to short term impacts. With the above mitigation measures in place, potential noise impacts during the construction stage are anticipated to be acceptable. In addition, during construction, noise monitoring will be undertaken near sensitive receptors in order to identify corrective action if needed.

10.6 Fauna

10.6.1 Impacts
No endangered species or animals of special scientific interest have been detected on the sites during the baseline studies. Removal of the vegetation will not impact on the habitats of any animals. None the less steps will be taken to protect endemic commonly appearing species on the site. The project will not have any impacts on fish.

10.6.2 Mitigation
Contractors will issue instructions to their staff and workers that no capturing or animals particularly birds is allowed on site for eating or any other purposes. Anyone caught doing so can face dismissal.

10.7 Flora

10.7.1 Impacts
No rare plant species or flowers, shrubs and trees of special scientific interest have been detected on
the sites during the baseline studies. However, controls will be exerted on the site over taking vegetation.

10.7.2 Mitigation
No open burning will be allowed on site. Workers will not be allowed to use local wood for cooking. Cooking services will be provided in the canteen facilities.

10.8 Cultural Resources

10.8.1 Impacts
There are no religious buildings or cultural monuments in the vicinity of the sites. No archaeological remains have been identified during the baseline study but should any be found during construction steps will be taken to preserve them.

10.8.2 Mitigation
If any archaeological remains are uncovered during construction the “chance find” procedure will be invoked. All excavations must stop immediately and the nearest representative of the department of antiquities be notified. Further instructions will be taken from them. This will be considered as a valid claim from the contractor for an extension of time.

10.9 Occupational Health and Safety

10.9.1 Impacts
The contractors may be exposed to occupational risks during construction work. Risks will arise from a range of hazards such as the use of heavy plant and working with rotating tools. These issues are dealt with in detail in the ESMP

10.9.2 Mitigation
The civil works contractors must implement adequate precautions to protect the health and safety of construction workers. The occupational health and safety risks will be minimized by not only providing adequate personal protective equipment (PPE) but ensuring workers wear it. In addition, the contractors will undertake the following activities:

- An Environment Health and Safety Officer (EHSO) will be appointed to prepare a Health and Safety Management Plan, to implement the HSMP and ensure that the requirements of the EMP are met.
The EHSO will ensure that the HSMP is submitted to TCN prior to construction for approval, that accurate records and reports of any occupational health and safety incidents are kept, and reviewing the distribution and use of appropriate PPE.

The EHSO will also encourage awareness building on safety through activities such as “Toolbox Briefings” and reporting “Near Misses.”

10.10 Community

10.10.1 Impact

In public consultations anxieties were expressed over the following issues:

- Influx of foreign workers and clashes with local residents
- Complaints being made but ignored
- Risks to the public from heavy machinery and traffic

10.10.2 Mitigation

The following activities will be undertaken in order to minimize impacts on the community during construction:

- To minimize the number of foreign workers being brought to the site, the contractor will be required to hire unskilled labor from local people if they wish to be hired. It is accepted that the contractor may insist in using his own labor for skilled jobs. He must offer employment to women if they are agreeable. He must be able to show from his records that he has done this. This will be a contract condition and so is enforceable.
- A “Complaints Mechanism” will be set up and a complaints officer appointed so that any complaints are responded to within 24 hours in a polite and respectful way.
- The contractor will be required to prepare a traffic management scheme and submit to the client for approval before occupancy of the site is given to them.
- To ensure safety warning signs and fencing will be erected at the construction sites and around borrow pits, in full view of the public, warning people of potential dangers such as moving vehicles, and excavation to raise awareness on safety issues.
- Heavy machinery will not be used after day light and all such equipment will be returned to its overnight storage area/position before night.
• All sites including storage areas will be made secure, discouraging access by members of the public by fencing when appropriate. In particular children will be warned not play on the sites, especially after dark.

10.11 Pedestrian Road Safety

10.11.1 Impacts
During construction, there may be a risk to members of the public from hazards such as the use of heavy machinery, excavations, and changes in traffic priorities. The access to Biliri passes through a village.

10.11.2 Mitigation
A traffic management plan will set out safe access during construction. Clear signs will guide and advise other road users. Road control staff will be deployed if necessary when heavy vehicle are turning across traffic particularly where approaching traffic may be travelling fast downhill. At Biliri an alternative access point will be investigated to avoid heavy vehicles passing through the existing village. The community will be involved in road safety with requests for schools, churches and mosques to reinforce the message on safety throughout the communities. In particular children will be warned not play near the access roads when vehicles are passing, especially if it is after dark.

10.12 Utilities Provision

10.12.1 Impacts
The project may require the relocation of electricity cables which may lead to interruption of electricity supplies for local residents.

10.12.2 Mitigation
Any disruption will be discussed with utility operators and the community beforehand. People affected will be informed in advance of any power cuts and the duration of the cut will be made clear in order that they can plan around the lack of power.

10.13 General House keeping

10.13.1 Impacts
When dealing with environmental controls on a construction site it is not possible to detail in writing
every possible occurrence. Therefore, as a general rule contractor should practice “good housekeeping”. The site should be kept clean and tidy, spills should be mopped up as soon as they occur, rubbish should be collected and removed promptly and tools and equipment stored away neatly when not in use. More details will be given in the ESMP

10.13.2 Mitigation
The concept of “good housekeeping” is easy for anyone to understand, even those of a non-technical nature. The contractor’s staff are expected to behave in a responsible way and not wait to be told what to do on every occasion. They will benefit from Good Housekeeping as a clean well run site is less likely to have industrial accidents. Monitoring will be by visual inspection by the construction supervision consultants.

10.14 Potential Socio-economic Benefits

10.14.1 Impacts
During the construction phase there may be positive impacts. The projects may provide short term local employment opportunities for community members in terms of site clearance, excavation, loading and offloading of materials. Other short term opportunities are likely to arise from the provision of security services where temporary camps or stores are erected and from opportunities to provide goods and services to construction workers e.g. food kiosks and other shops.

10.14.2 Mitigation
If impacts are positive mitigation is not required.

11 Impacts due to Commissioning Phase

11.1 Commissioning Activities
The commissioning process is a critical phase in the project development. The assembly of transformers, circuit breakers, CCVTs, circuit switchers, capacitors, and disconnect switches must be closely watched and tested to ensure proper assembly. This is especially true for transformers since their future trouble-free operation is very dependent on proper handling during assembly. The process involves the following tasks related to transformers:

- Perform transformer inspection when received
- Observe transformer assembly (dress out)
- Carry out oil filling procedure
• Check operation
• Check pumps, fans and heaters
• Confirm operation of gauges, relays, controls and alarms
• Acceptance testing

The site in general must have the following items checked:

• Earth grid in yard
• Earthing for fences
• Central oil pit for transformers
• Control building inside works (air conditioning units, water/ sewage supply, electrical installation, painting, building furniture)
• Supplying fire extinguisher
• Installation of emergency lights system
• Battery rooms
• Civil works roads, side-walks, fences, guard towers
• Installation of water pumps
• Installation of water supply and sewage connection
• Padlocks for all outdoor cubicles e.g. circuit breaker cubicles)
• Ensure all wastes removed from site
• Sanitation facilities such as toilets should be checked

When the plant is operating tests of noise levels should be carried out.

Transmission line structures and equipment are attractive to birds for roosting and building nests. This may occur after the structures are erected but before they are commissioned. Steps should be taken to minimize the risk of electrocution or injury to birds, of damage to electrical equipment, and of outages that may result when birds come in contact with power lines and structures. Checks should be made that there are no birds nesting before switching on.

It is useful to have a final public hearing. Local people can be advised about availability of temporary work for low income residents such as drain cleaning and grass cutting. Any grievances received can be finalised.

11.2 Spill Control

Transformers are filled with oil during commissioning and a spill control procedure must be in place before this activity takes place. Staff must be instructed in what actions to take and what PPE to wear.
If necessary temporary spill containment such as flexible kerbs should be placed around the possible, spill area. Spill collection materials such as absorbent mats should be readily available and containers designated as hazardous waste bins kept nearby. If a spill does occur and is contained and collected the bins must be disposed of to a toxic waste landfill not a municipal dump. If no such facility is available, then the spilled oils can be returned to the supplier.

11.3 Fires
There is an inherent risk of fire during commissioning as this is the time that damaged components will be tested under real field conditions. The local fire department should be notified of the intention to activate the facility and may agree to have an appliance (fire engine) standing by at the site.
Small scale fires should be tackled on site. The choice of fire retardant and flame suppressant should already have been made and suitable fire extinguishers provided. Transformers are provided with a rock filled fire trap which will allow any oil to burn out.
In the event of a major fire and large volumes of water being sprayed on the site fire fighting water may become contaminated with oil. This should not be allowed to runoff into neighboring drains. Retention basins to catch oil and a collection system should have been provided.
All firefighters at the scene must be aware of the potential dangers and act to safeguard themselves. If there is a fire or hazard in a TCN substation, then policy is to let it burn until a TCN representative arrives and advises on appropriate actions.
The attitude “Let it burn” may sound brutal but burning electrical equipment is ruined anyway. To stop further damage water should be sprayed on adjoining plant to protect it but NOT on electrical equipment.
Basic rules for enforcing electrical safety at substations are:

- Evacuate the area. Keep people at least 100m away. Protect nearby dwellings to prevent fire spreading.
- Avoid bringing metal or partially metal tools into the substation, and tools should not be carried over the shoulder. This will breach the allotted safe-clearance distances.
- Responders should not climb but stay on the ground. Raising ladders outside the substation may not be safe.

The response time of the fire appliance to reach the site should also be established for future reference.
12 Impacts due to Operation

12.1 Air Quality
High electric fields around power cables attract airborne pollutants, such as occur near a main road, chemical factory, sprayed fields, etc. These are then deposited downwind or in rain.
Ozone may be generated around transmission lines but in low concentrations and there is no evidence of it being harmful to health.

12.2 Electro-Magnetic Fields (EMF)
Electric overhead lines are considered a source of power frequency, electric and magnetic fields, which may have a perceived health effect. The strength of both electric and magnetic fields is a function of the voltage, distance from the conductors to the ground and the lateral distance from the line to the receptor. Many studies published during the last decade on occupational exposure to Electro-Magnetic Fields (EMF) have exhibited a number of inconsistencies and no clear, convincing evidence exists to show that residential exposures to electric and magnetic fields are a threat to human health.

12.3 Electrical and Magnetic Fields Safety

12.3.1 Overhead Electrical Safety
It is common to think that one has to touch an electrical conductor to get hurt. This is not true when dealing with high voltages. Substations use a high-voltage, open-air conductor — called “bus” — which resembles a 75mm conduit pipe. The metal pipes running through the overhead areas of a substation are the conductors of electricity. There are no wires inside the pipe. The electricity is carried on the pipe’s outside skin.
Because of the high voltages involved, one need not touch an electrical conductor to be harmed. If close enough, the electricity will contact the person in the form of a high-temperature electrical arc. The potential for an electrical arc becomes greater as voltage increases. For this reason, the safety distances must be observed. The proper clearance from the overhead bus is calculated for each station, and conductors are positioned accordingly, using a conservative distance to ensure the safety of anyone walking through a station. For 333kV, a safe distance of 6m has been established. For 11kV to 132kV a safe distance of 4m has been established. To stay safe from the electric bus inside a substation, one should not climb nor carry tools above the shoulder.
12.3.2 Ground-Level Electrical Safety

The overhead bus is not the only electrical hazard present in a substation. Many electrical hazards are found at ground level also. Safety from these hazards is maintained by restricting access to them and by placing the hazard behind locked doors, cages, and fenced-in areas. Capacitor banks reside in cages, providing a buffer zone between persons and the exposed electrical conductors. Circuit breakers are housed in locked cubicles to eliminate the chance of casual entry into these areas. Lightning arrestors and various other electrical components are placed behind fences. All such areas should have warning signs.

Where a substation has a metallic fence, it must be properly grounded to protect people from high voltages that may occur during a fault in the network. Earth faults at a substation can cause a ground potential rise. Currents flowing in the Earth's surface during a fault can cause metal objects to have a significantly different voltage than the ground under a person's feet; this touch potential presents a hazard of electrocution.

12.3.3 Underground-Level Electrical Safety

Power cables can be undergrounded. Electric fields will be absorbed by the earth above a buried cable. Magnetic fields will be higher immediately above an underground cable than they will be below an overhead line, because one is are closer, but the fields reduce much more quickly from an underground cable. It should be remembered that the cost of putting cables underground can be twenty times higher than allowing them to go overhead, although less for lower voltage lines.

12.4 Vegetation Management

Buried beneath the gravel in a substation yard is a grid of wires that functions as the grounding for the high voltage equipment. In order to ensure safety for utility employees and the public, it is important to prevent this ground grid from being compromised by vegetation growth. For this reason, substation yards are regularly maintained by using a variety of herbicides.

12.5 Pesticides

Herbicides are one branch of pesticides. Any pesticides stored on site for control of weeds, rodents or vectors (such as mosquitoes) should be kept in a secure storage and application should be made under controlled conditions. Technical staff and residents should be advised and workers wear PPE.
12.6 Migratory Birds
The project area does not contain any natural habitats considered to be either critical or fragile. The project area does not have any wetlands or forested areas nearby or International Bird areas (IBAs) and there are no international migratory bird Flyways.

12.7 Noise
If the noise produced by an operating substation is considered intrusive to adjacent property owners a barrier of mature trees or tall soil berms between the substation and nearby residences can be helpful in partially reducing the perception of noise impacts, although trees do very little in reality. Earth berms can reduce up to 7dBs but as the sound is low frequency barriers are not very effective.

12.8 Visual Appearance
Light pollution may present a nuisance in residential areas. Substations may have lights that operate all night long to discourage vandalism and unauthorized individuals. New downward-focused security lighting can help to avoid or reduce light pollution.

12.9 Spills
Transformers may occasionally need oil replacement or replenishment but this is usually very infrequent. In the event of a spill the same procedure as given under Commissioning in Section 13 should be followed.

12.10 Fires
Mineral-oil-filled transformer explosions and fires causing heavy collateral damage have raised major safety concerns. There have also been major environmental concerns over the toxic effects of uncontained mineral oil spills. This has given rise to a new class of alternative dielectric insulating fluids that have historically been developed to answer these specific concerns. Transformers are fitted with fire traps to allow oil burn out. In the event of a major fire the same fire response procedure as given under Commissioning should be followed.

12.11 HSE
There must be adequate precautions to protect the health and safety of plant workers. All staff must be provided with personal protective equipment (PPE) and made to wear it. The details are given in the ESMP but in addition, the facility operators should undertake the following activities:
• An Environment Health and Safety Officer (EHSO) should be appointed to ensure that the EMP is implemented
• The EHSO will ensure that accurate records and reports of any occupational health and safety incidents are kept, and reviewing the distribution and use of appropriate PPE.
• The EHSO will also encourage awareness building on safety through activities such as “Toolbox Briefings” and reporting “Near Misses.”
• Site briefings for visitors on restricted areas and emergency evacuation procedure
• Induction EHS briefings for new staff
• Follow NERC procedures
• Implement Corrective Action Reporting (CAR)

12.11.1 Tool box briefings
Tool box briefings should be held every morning during roll call and a “safety moment” held. This need only last 2-3 minutes and a specific item can be stated, for example when hot work permits are needed, or when safety equipment is needed if working at a height. The essence of Tool Box meetings is repetition. Staff becomes complacent if not continually reminded of safety procedures. Topics can be repeated every few weeks. The topics addressed should be recorded and reported in the monthly management reports.

12.11.2 Near Misses
Near Misses are situations that arise that could have led to a safety incident but which were spotted by vigilant staff and avoided by swift action. This may be something as simple as spotting a gas cylinder propped upright without support that may fall and injure someone and insisting that it be held in a cradle on a trolley. (For example see Figures 12-1 and 12-2 below)
Staff may be reluctant to report “Near Misses” as they fear a reprimand but this reluctance must be overcome. The target should be “Zero Incidents” and many “Near Misses” reported and avoided. An EHS annual report that states No Incidents and No Near Misses will not be believed.

12.11.3 Induction Briefings

New staff should be given an Induction Briefing at the start of their employment. They should be trained to identify and eliminate, isolate or minimize potential hazards in their working environment. Persons entering the site facility should be issued with personal protective equipment (PPE) and be required to wear it. This applies to workers and visitors. Any person found not wearing full PPE should be ordered to wear it and if they refuse they should be ordered off the site. Site supervisors and security guards have the authority to do this. All staff and visitors should be briefed on and follow emergency and evacuation procedures in particular firefighting.

12.11.4 NERC

As part of normal Occupational Hygiene, Health, Safety and Environment the Nigerian Electricity Regulatory Commission Health and Safety Standards must be followed. The standards are organized into five Parts:

- Part I. How to Evaluate Safety Programs;
- Part II. Safety and Best Industry Practices;
- Part III. Worker Safety Rules;
- Part IV. Recordkeeping, Training, Inspections, Accident Investigation and Reporting;
- Part V. Risk and Vulnerability Assessments

As stated by The Nigerian Electric Regulatory Commission “These Standards are designed to save lives”. The practices defined are legal obligations. Each employer has a legal obligation to ensure that a safe work environment is provided to all employees, both regular and non-regular. Contractors working at substations, transmission stations, power plants or engaging in any work activities involving power generation, transmission, distribution and servicing are also required to follow the best practices and safety standards as defined by NERC.

**12.11.5 Corrective Action Reporting (CAR)**

If an incident takes place, then it is not enough simply to report it. Steps must be taken to abate the nuisance, end the problem and to avoid it happening again. These steps should be included in Corrective Action Reporting (CAR) which is an iterative process whereby checks are made that the situation has actually been resolved in a prompt manner.
13 Impacts due to Decommissioning

13.1 Impacts
The transmission lines and substations are likely to remain in place for many years and therefore any decommissioning works could be a long time in the future. Towers and substations would be dismantled and removed and materials recycled/re-used as far as possible. Any areas disturbed must be restored to pre-project conditions or to conditions acceptable to FMEnv.
After decommissioning the site may be handed over to a new owner and developed for another purpose. In order to avoid any contingent liability to TCN on handover, the site must be free of all encumbrances. After removal of all ancillary equipment the main issue will be potential soil contamination. This is why the soil sediments samples during the baseline are important.
During the life of the installation all efforts should be made to avoid or minimize spills of potentially contaminating materials and to make strenuous efforts to clean up after any spills. After removal of all site equipment soil samples should be taken and compared with the baseline results. If the post-operative soil samples show similar or lower concentrations of parameters measured in the baseline, then the site is deemed clean and can be handed over. If the concentrations are higher, then it may be necessary to excavate contaminated soils, dispose of the contaminated material and backfill with clean soils. Therefore, it is important to store the baseline soils analysis in a secure place.
Potential negative impacts during decommissioning could include

- Spillages of transformer oils on ground and into groundwater as equipment is removed.
- Solid wastes such as brick, concrete and rubble from substation site demolition
- Metals and cables from towers dismantling can become an eyesore if not taken off site either for re-use or recycling.
- Invasive flora species could colonise former substation sites and the way-leave on decommissioning following removal of structures, buildings and hardcover.
- Local residents could be subject to noise and air impacts during demolition.

13.2 Mitigation
Environmental impacts associated with decommissioning can minimised through the implementation of an environmental and social management plan (ESMP). If the ESMP is followed faithfully then there should not be any residual environmental impacts during decommissioning. Therefore, it is imperative that the ESMP is followed during Operation so that Decommissioning is not onerous. If the ESMP is not
followed, then remedial works or payment of compensation may have to be paid.
14 ESMP - Environmental and Social Management Plan

14.1 Impacts and Mitigation

The following issues have been addressed in this ESIA:

- Noise
- Air Pollution
- Solid Waste
- Liquid Wastes
- Ground Water Quality
- River Water Quality
- Soils
- Health from Electric Fields
- Ecology
- Habitats
- Flora and Fauna
- Endangered Species
- Socio Economic – positive and negative
- Construction
- Operation
  - Decommissioning
- Cultural Heritage
- Religious & Traditions
- Baselines and Seasonal Variations
- ESMP
- CESMP
- Toxic Wastes
- Oil spills
- Maximum Credible Event
- ALARP Events

No issues have been identified that preclude this project proceeding if the following mitigation measures given in the ESMP are implemented.
14.2 Environmental Management & Monitoring

TCN will be the executing agency for projects. The supervision and monitoring of Project-related social and environmental activities during the pre-construction, construction and operation phases are the responsibility of TCN. They may also be responsible for decommissioning. The PMU set up within TCN is responsible for supervision of environmental management and for environmental monitoring.

World Bank environmental requirements and all applicable GoN environmental laws, regulations and standards, must be met prior to the commencement of construction, during construction and operation of the Project.

14.3 EMP Environmental Management Plan

An Environmental Management Plan (EMP) has been prepared for pre-construction, construction, operation and decommissioning phases. The EMP includes a text description below and a table. This EMP is written as a stand-alone document. It can be extracted and used as an independent guide. Therefore, there is of necessity some repetition of some items mentioned earlier under the ESIA.

The EMP will be the guiding document for environmental management and monitoring during construction of the projects. It will guide the contractor in determining whether the recommended mitigation measures prior to site occupancy and during construction are being implemented effectively.

The main part of the EMP relates to construction which will be by a contractor. The EMP is to be included in the Tender Documents against which the contractor will submit a bid. All contractors bidding for the project must include costs for environmental management in their bid price.

14.4 CESMP Contractors Environmental Social Management Plan

The responsibility for Environmental Management and Monitoring during project construction lies with the main contractor and his sub-contractors. Compliance with the EMP is contractually binding. Failure by the contractor to comply with the EMP may result in financial penalties.

The EMP is of necessity a general document. The contractor must prepare a detailed EMP giving site specific details of construction activities. This is a Contractor Environmental Social Management Plan (CESMP). This must be done within one (1) month of contract signing. The CESMP must be submitted and approved before construction activity may commence. A CESMP is a dynamic document and may be changed and updated at any time during implementation of the Project. Environmental monitoring results shall be documented and reviewed at least monthly to ensure that signs of adverse impacts are
detected at an early stage and that actions for mitigation are taken.

14.5 Pre-Construction Phase

14.5.1 Permits and Plans
TCN will issue a permit to occupy the site to the successful contractor. Prior to this all outstanding issues on compensation must be resolved so that conflicts with local villagers do not hinder the contractor’s activities.

To ensure that construction works are environmentally sound mitigation requirements are included in the construction contract provisions. The project will follow the standard specifications and General Conditions of Contract for construction contract purposes, as will be decided in the detailed design stage of the project.

Appropriate environmental mitigation and monitoring measures are included in the EMP. The proposed environmental mitigation measures will form part of the design documents for the components, and be included in the contracts for procurement of goods and services. All contractors AND subcontractors will be required to comply with the EMP.

14.5.2 Contractor Management Plans.
Before the construction starts, the Contractor will prepare a number of mitigation plans and method statements consistent with the ESMP for review and approval by the construction supervision consultant (CSC). Approval will be required one month prior to construction commencing. Contract documents shall explicitly indicate the requirement of these plans that construction cannot start until all documents are approved and also state that all environmental protection measures will be included in the bid price. These management plans are needed in order to address the following issues:

- Soil Erosion Management Plan
- Borrow Pits and Spoil Management Plan
- Spill Management Plan
- Construction Camp Management Plan
- Waste Management Plan for operation of construction camp and work sites
- Health and Safety Management Plan (HSMP).

The HSMP will give details of Occupational Health and Safety for the construction workers based on the ESMP. It will be submitted to the PMU for review. The detailed HSMP will include the following
provisions:

Clean water. Provide a clean and sufficient supply of fresh water, for construction and for all houses, camps, offices and other relevant sites such as workshops.

Sewage and wastewater. Provide an adequate number of latrines and other sanitary arrangements at the site and work areas, and ensure that they are cleaned and maintained in a hygienic state.

Solid waste. Provide garbage receptacles at construction site and camps, which will be periodically cleared.

Liquid chemical waste. Provide receptacles in suitably bunded areas for the storage of liquid chemical waste prior to disposal. Include clear warnings with health risks.

Personal protection. Provide personal protection equipment (PPE), such as safety boots, helmets, gloves, protective clothing, goggles, and ear protection for workers ensuring accordance with all national health and safety legislation if appropriate.

Emergency Preparedness and Response. An emergency response plan to take actions on accidents and emergencies, including public health emergencies associated with hazardous material spills and similar events will be prepared. Emergency phone contacts with hospital in the nearest township will be established. A fully equipped first-aid base in each construction camp will be organized.

Records Management. A Records Management System that will store and maintain easily retrievable records protected against loss or damage will be established. It will include documenting and reporting occupational accidents, diseases, and incidents. The records will be reviewed during compliance monitoring and audits.

Safety communication. Ensure that safety, rescue and health matters are given a high degree of publicity to all persons regularly or occasionally at active construction sites. Posters in all appropriate languages for the contractors will be displayed prominently at the site drawing attention to relevant health regulations and safety issues.

Training, awareness and competence. Train all construction workers in basic sanitation and health care issues, general health and safety matters, and on the specific hazards of their work. Implement HIV/AIDS and other communicable diseases awareness and prevention program to target the local community and construction workers.

All of the above plans must be prepared by the contractor and be submitted to PMU for review and approval.

An example of a Contractors Environmental and Social Management Plan is given in Annex 8.
14.6 Construction Phase

14.6.1 Air Quality Impacts

During construction, air pollution sources are dust due to earthworks and stockpiling, extraction of fill materials and transport of construction materials such as earth, stone, gravel, sand, and cement; as well as gaseous emissions from construction equipment, vehicles and concrete mixing plants; and removal of surface materials; etc. These impacts, however, are temporary and localized. The following mitigation measures shall be implemented by the contractors to minimize impacts to air quality:

- Construction equipment will be maintained to a good standard. Immediate repairs of any malfunctioning construction vehicles and equipment shall be undertaken.
- Equipment and vehicles not in use shall be switched off.
- Machinery and vehicles causing excessive pollution (e.g., visible black smoke) will be banned from construction sites.
- All construction equipment and vehicles shall have valid certifications indicating compliance to vehicle emission standards.
- Siting of bitumen plants, concrete mixing plants, crushing plants and other facilities that cause high dust and/or gaseous emissions should be at least 500 m from settlements and other sensitive receptors (schools, hospitals, etc.)
- Necessary environmental clearance/approval shall be obtained prior to establishment and operation of asphalt mixing plants, crushing plants and other facilities.
- On rainless day undertake watering, at least twice per day, on dusty and exposed areas at construction yards, materials stockpile, construction sites, access roads, quarry areas, borrow sites and other project areas where residential sites and other sensitive receptors are located nearby.
- Tightly cover trucks transporting construction materials (sand, soil, cement, gravel, etc.) to avoid spills onto roads and dust emission.
- Impose speed limits on construction vehicles to minimize dust emission along areas where sensitive receptors are located (houses, schools, churches, mosques, etc.).
- Position any stationary emission sources (e.g., portable diesel generators, compressors, etc.) as far as is practical from sensitive receptors;
- Burning on site of wastes generated at the construction sites, at work camps and by other project related activities shall be strictly prohibited.
- Provide temporary covers (e.g., tarpaulins, grassing) on long term materials and spoils stockpiles.
• Clean road surfaces of debris/spills from construction equipment and vehicles.
• Install temporary fencing or barriers around particularly dusty activities in vicinity of sensitive receivers.
• Locations for stockpiling spoils, fill and other materials with high dust content shall be at least 500 m from the nearest residential areas and other sensitive receivers.

14.7 Water Quality

14.7.1 Water Quality and Drainage
Stockpiling of construction materials and spoils and earthworks if not properly managed may affect surface water quality by obstruction flow of watercourses and flooding. These impacts shall be minimized through implementation by the contractor of the following measures:
• Firmly consolidate banks of any streams being crossed using stones, concrete and other suitable retaining measures and ensure that water courses are kept free of excavation spoil and construction debris, floating and submerged.
• Spoils, construction wastes and construction materials stockpile area shall be located away from water bodies and under no circumstances will these materials be dumped into watercourses.
• Do not fill up watercourse even if dry at the construction site. In case filling of local drainage system is necessary, consult with local authorities and get their permission beforehand. An alternative drainage shall be put in place before the existing watercourse is filled in. (This particularly applies at Biliri)
• Discharge of oily wastewater, fuel, hazardous substances and wastes, and untreated sewage to watercourses/canals and on the ground/soil is prohibited.
• Provide drainage at the construction sites around the perimeter to avoid flooding of surrounding areas and minimize flow obstruction of existing watercourses.
• Regularly inspect and maintain all drainage channels to keep these free of obstructions. This should be at least once a week and after heavy rain.
• Slope stabilization measures (e.g., planting of fast growing native species of grass and shrubs, etc.) shall be implemented on exposed surfaces along to reduce material wash-away.
• Do not wash vehicles in streams
14.8 Solid and Liquid Wastes

14.8.1 Workers Camps

There may be a need to establish worker’s camps during construction. The operation of these facilities will generate wastes and if improperly handled, these could cause health problems and pollution. The following mitigation measures shall be implemented by the contractor to minimize impacts that may arise from operation of construction/workers camps:

- Workers camp location and facilities shall be located at least 500 m from settlements and agreed with local communities and local officials.
- Drainage shall be provided to facilitate the rapid removal of surface water from all areas and prevent flooding and accumulation of stagnant water.
- Provide adequate housing for all workers at the construction camps and establish clean canteen/eating and cooking areas.
- Portable lavatories (or at least pit latrines in remote areas) shall be installed and open defecation shall be prohibited and prevented by cleaning lavatories daily and by keeping lavatory facilities clean at all times.
- Provide separate hygienic sanitation facilities/toilets and bathing areas with sufficient water supply for male and female workers.
- Wastewater from contractors’ workshops and equipment washing-yards will be passed through gravel/sand beds and all oil/grease contaminants will be removed before wastewater is discharged. Oil and grease residues shall be stored in tightly covered drums. Such wastes shall be disposed consistent with national and local regulations.
- Construction/workers camps shall be cleaned up after use to the satisfaction of FMEnv and local community. All waste materials shall be removed and disposed to disposal sites approved by local authorities.
- Land used for campsites shall be restored to the original condition as soon as practicable after it is vacated and cleaned.

14.8.2 Construction and Domestic Waste

Various construction activities and operation of workers camps will generate solid wastes. Poor waste management can cause odor and vermin problems and negatively impact the landscape. The following mitigation measures to minimize impacts due to waste generation shall be implemented by the contractor:
• Segregate and regularly collect wastes at worker camps and offices.
• Construction/workers’ camps shall be provided with garbage bins.
• Prohibit disposal of solid wastes into canals, rivers, other watercourses, agricultural field and public areas.
• There will be no on site landfills established by the contractors. All solid waste will be regularly collected and removed from the work camps and disposed to areas approved by local authorities.
• Prohibit burning of construction and domestic wastes.
• Recyclables shall be recovered and sold to recyclers.
• Residual and hazardous wastes shall be disposed of in disposal sites approved by local authorities.
• Ensure that wastes are not haphazardly dumped within the project site and adjacent areas

14.8.3 Excavation Spoils
The sites will require removal of vegetation and grading on flat sites like Biliri. Improper spoils disposal could cause deterioration of water quality and flow obstruction of water courses. The following measures shall be implemented by the contractor to avoid or minimize such impacts.
• Provide grass cover and other suitable slope stabilization measures on embankment slopes and on long term stockpile of spoils.
• Spoil disposal shall not cause sedimentation and obstruct natural drainage or cause damage to agricultural land and densely vegetated areas.
• Spoils shall only be disposed to areas approved by local authority.
• Excavated materials shall be reused into low elevation depressions for construction.
• On steep slopes plant appropriate native vegetation that retards erosion.
• Long term stockpiles such as topsoil is to be covered with native species of grass or other suitable materials to prevent wind erosion.

14.8.4 Use of Hazardous Substances
Pollution and safety risks due to use of hazardous materials and disposal of hazardous wastes shall be prevented through implementation of the following mitigation measures by the contractor:
• Store fuel and hazardous substances and wastes in paved areas with roof and surrounding kerb. If spills or leaks do occur, undertake immediate clean up.
• Train relevant construction personnel in handling of fuels and other hazardous substances as well as spill control procedures.
• Ensure availability of spill cleanup materials (e.g., absorbent pads, etc.) specifically designed for petroleum products and other hazardous substances where such materials are being stored.

• Segregate hazardous wastes (oily wastes, used batteries, fuel drums) and ensure that storage, transport and disposal shall not cause pollution and shall be undertaken consistent with national and local regulations.

• Store waste oil, lubricant and other hazardous materials and wastes in tightly sealed containers to avoid contamination of soil and water resources.

• Ensure all storage containers of hazardous substances and wastes are in good condition with proper labeling.

• Regularly check containers for leakage and undertake necessary repair or replacement. If necessary store oversize drums to contain leaking drums.

• Store hazardous materials above any levels likely to flood during heavy rain.

• Storage areas for fuel, oil, lubricant, bitumen and other hazardous substance will be located at least 100 m away from any watercourses.

• Storage areas will be bunded and provided with interceptor traps so that accidental spills do not contaminate the environment.

• Vehicle maintenance and refueling will be confined to areas in construction sites designed to contain spilled lubricants and fuel.

• Bitumen for internal roads shall not be allowed to enter either running or dry streambeds and nor will be disposed of in ditches or small waste disposal sites prepared by the contractor.

14.8.5 Fuel Storage and Vehicle Maintenance

It is expected that vehicles will be stored at construction sites. Fuel stored on site must follow good industry practice. Fuel suppliers must provide skid mounted tanks with a metered off take and pump, mounted on a concrete hard standing. The concrete base must have a perimeter curb to catch and retain any minor leaks or spills from the main tank manifold. Some vehicle maintenance may take place at commercial garages. This will have no impact on the project area. If maintenance takes place on site, measures must be implemented to control oily water runoff. (See Figure 14-1 below)

• Wherever possible, refueling will be carried out at a commercial garage.

• Refuelling shall not be permitted within or adjacent to watercourses.

• Fuel storage areas must be provided with concrete flooring and surrounded by an embankment to readily contain and clean-up spills.
14.8.6 Waste Oil

Waste oil can be sold to local waste subcontractors. This process is endorsed. The project contractor is at liberty to subcontract with any one he chooses. This approach has several advantages:

- It allows the contractor to avoid a cost of disposal and brings in revenue to the contractor
- The subcontractor will have paid for the waste oil. It is now a valuable commodity to him. Therefore, he is extremely unlikely to illegally dump the waste oil or allow any spillage on the road.

Figure 14-1 Spill Protection for Fuel Oil Storage / Rain Proofing for Waste Oil Storage
Notwithstanding this practical point, it is preferable if licensed contractors are commissioned to ensure legal accountability.

Any waste oil must be stored in drums which are clearly marked “waste material”. The drums must be of sound structural integrity and not leak, or be covered on the outside with dirty oil. Drums must be stored on a concrete hard standing with a perimeter curb to catch and retain any minor leaks or spills from the drums. The base must be covered with a lightweight rain proof shelter. Simple inclined corrugated lightweight material is sufficient. This must stop rain falling on the drums.

14.8.7 Bitumen Use for Asphalt for Approach Roads

Bitumen may be used for internal roads. This should be heated by kerosene or gas or as an alternative, cold mix bitumen can be employed. Fuel wood must not be used for heating. Asphalt must not be applied during rain so as to avoid it being washed into watercourses.

14.9 Noise

14.9.1 Noise and Vibration Impacts

Elevated noise and vibration levels are likely to be experienced during construction phase due to site works and operation of various equipment and vehicles. To minimize noise and vibration impacts, the following measures shall be implemented by the contractor:

- Noisy activities such as pile driving or hammering will not be allowed during the nighttime which is designated as being between 7.00 pm to 7.00 am.
- Noisy construction activities will be avoided during religious or cultural events in close proximity to the roadside such as Friday prayers attended by Muslims or Sunday mornings near churches or during temple festivals or weddings, etc.
- All construction equipment and vehicles shall be well maintained, regularly inspected for noise emissions, and shall be fitted with effective muffler and other appropriate noise suppression equipment consistent with applicable national and local regulations.
- Truck drivers and equipment operators shall avoid, as much as possible, the use of horns in densely populated areas and where schools, hospital, etc. are located.
- Impose speed limits on construction vehicles to minimize noise emission along areas where there are houses, schools, temples, hospitals, etc.
- If noise complaints are received from residents contractors can construct temporary noise barriers. Raw materials such as sand or soil can be used to block noise from noisy equipment.
• Avoid noisy construction activities during exams in vicinity of schools
• Truck drivers and equipment operators shall avoid, the use of horns
• In accordance with the FMEnv standard construction noise levels when measured at the boundary of the site should not exceed 75dB(A) daytime and 65dB(A) nighttime.

145. The environmental monitoring program will be incorporated into the overall project design to ensure that environmental impacts are closely monitored and the construction and operating activities are closely supervised against the approved ESMP and the implementation of the GRM will be monitored.

14.9.2 Blasting

Blasting is not anticipated to be undertaken for the project. However, in case this becomes necessary, the following measures shall be implemented by the contractor to ensure safety of workers and the public:

• Blasting will be carried out only with permission of the concerned authority, using a pre-established schedule.
• All the statutory laws, regulations, rules etc., pertaining to acquisition, transport, storage, handling and use of explosives will be strictly followed.
• The timing will be made available to the local people within 500 m of the blasting site in all directions, depending on the total charge used.
• Blasting will be held only during day time. Under no circumstance will blasting be undertaken at night.
• Where possible, blasting mats will be used to reduce flying rock.
• No blasting will take place without a condition survey of any buildings within 500 m
• People living near blasting sites will be informed of blasting times prior to the blasting.
• Warning sirens will be sounded before blasting.
• Where the vibration from blasting is exceeding the maximum permissible level, or damage occurs to local property information from the blasting shall be used to modify blasting patterns and calculate a reduced charge for future blasts.
• Blasting shall be under careful and strict management/supervision of properly trained and licensed personnel. Workers at blasting sites will be trained prior to blast operations and provided with safety equipment and earplugs.
• Blasting shall be initiated by 20 millisecond delays to minimise vibration.
• Observe proper warning and precautionary measures to ensure safety of residents, pedestrians, motorists and structures during blasting.

• All expenses/costs to address injuries, damage to properties, accidents, etc. due to blasting shall be assigned to the contractor.

14.9.3 Quarry and Borrow Sites
For the sites with steep gradients it may be necessary to bring fill material in to the site. This will be brought from quarries or borrow areas where soils can be extracted, The following measures shall be implemented at quarry and borrow sites to minimize impacts on water quality, reduce dust emission during transport, minimize erosion and siltation of nearby water courses and avoid damage to productive land and ecologically sensitive areas:

• Sourcing of quarry and borrow materials from existing sites shall be preferred over establishment of new sites, as much as possible.

• In case the project will involve new quarry/borrow sites, necessary approvals from environmental authorities shall be obtained prior to operation of such sites. Such sites shall be located over 500 m away from residential, school, hospital and other sensitive receptors.

• Dust control during excavation and transport (e.g., water spraying on access roads and provision of truck cover) shall be undertaken in areas where there are sensitive receptors such as residential areas, school, hospital, etc.

• Long-term material stockpiles shall be covered to prevent wind erosion.

• The use of river bed sources shall be avoided, as much as possible. Alluvial deposits which lie on the river beds but are not covered by water in normal hydrological conditions shall be preferred.

• Upon completion of extraction activities, borrow pits shall be dewatered and fences shall be installed, as appropriate, to minimize health and safety risks.

• To avoid drowning when pits become water-filled, measures such as fencing, shall be implemented.

• It is possible that villagers may request borrow pits to be left excavated so that they may be used as water reservoirs or fishponds. If this were to be agreed between the contractors and the villagers, all the full safety measures detailed above must be observed. Such agreements would be formalized in writing between the contractors and the villagers after full discussion with all concerned parties.
14.10 Flora and Fauna

Only minimal vegetation clearing is required so loss of habitats is not expected. However, hunting of wildlife and cutting of trees for fuel may not be undertaken by workers and strict prohibitions should be imposed by the contractor. The following conditions shall apply:

- Spoils and all types of wastes shall not be dumped into forested areas, agricultural land, densely vegetated areas, and water courses.
- Workers shall be prohibited from collecting firewood and construction materials from surrounding forests, and from hunting wild animals.
- The contractor shall prohibit cutting of trees for firewood and for use in for construction-related activities.
- The contractor will not use or permit the use of wood as a fuel for the execution of any part of the Works, including but not limited to the heating of bitumen and bitumen mixtures, and to the extent practicable shall ensure that fuels other than wood are used for cooking, and water heating in all his camps and living accommodations.
- Contractor shall not buy or use wood from the illegal sources that come from the illegal logging.
- Contractor will take all precautions necessary to ensure that damage to vegetation is avoided due to fires resulting from execution of the works.
- As much as possible, construction works will be scheduled in dry season to minimize adverse impacts to fishery, river water quality and other aquatic resources.

14.11 Damage to Culturally Significant Areas

To ensure that site works and other project-related activities shall not adversely affect culturally significant sites in the event of any construction work uncovering or revealing archaeological relics these shall be deemed a “chance find” and reported as such to the appropriate Local Government Authority. All work on the site must stop until they issue a statement that work may be resumed.

14.12 Occupational Health and Safety

The main risks during the construction stage may arise from: (a) inadequate sanitation facilities in work camps; (b) failure to implement measures to avoid accidents and injuries involving workers and the public; (c) introduction of sexually transmitted or other diseases by non-local workers, and; (d) outbreaks of diseases such as malaria, diarrhea, etc. in the labor force. In order to minimize these risks, the following measures shall be implemented by the contractor:
• Conduct orientation for construction workers regarding emergency response procedures and equipment in case of accidents e.g., head injury from falling, burns from hot bitumen, spills of hazardous substances, fire; health and safety measures, such as on the use of rotating machines; prevention of HIV/AIDS, malaria, diarrhea, and other related diseases.

• Provide drainage at construction sites and workers camps to prevent water logging/accumulation of stagnant water and formation of breeding sites for mosquitoes.

• Provide fire extinguish equipment and appropriate emergency response equipment based on on-going construction activities at the work areas and at construction and workers camps.

• Provide first aid kits at each camps and working sites that are readily accessible by workers.

• At the workers camps, provide adequate housing for all workers at the construction camps, provide reliable supply of potable water, install separate hygienic sanitation facilities/toilets and bathing areas with sufficient water supply for male and female workers and establish clean eating areas and kitchen.

• Provide workers with appropriate safety equipment/devices (PPE) such as dust mask, safety helmets, safety shoes or boots, goggles, ear plugs, etc. and strictly require them to use these as necessary.

• Install warning sign boards showing hazardous areas where PPE must be warn such as noisy areas or where googles are needed.

• Instruct Security Guards to deny entry to persons not wearing PPE.

• Strictly impose speed limits on construction vehicles along residential areas and where other sensitive receptors such as schools, churches, hospitals, and other populated areas are located.

• Educate drivers on safe driving practices to minimize accidents and to prevent spill of hazardous substances and other construction materials by providing covers over transporting dump trucks.

• Install lighting systems at places which are badly lit where accidents may happen.

• The general public/local residents shall not be allowed in high-risk areas, e.g., excavation sites and areas where heavy equipment is in operation.

• Ensure proper collection and disposal of solid wastes within the construction camps consistent with local regulations.

• Provide fencing on all areas of excavation greater than 2 m deep.

• Ensure reversing signals are installed on all construction vehicles.
• Measures to prevent malaria shall be implemented e.g., provision of insecticide treated mosquito nets to workers, spraying of insecticides, installation of proper drainage to avoid formation of stagnant water, etc.
• Discharge of untreated sewage shall be prohibited.

The civil works contractors must implement adequate precautions to protect the health and safety of construction workers. The occupational health and safety risks will be minimized by not only providing adequate personal protective equipment (PPE) but ensuring workers wear it. In addition, the contractors will undertake the following activities:

• An Environment Health and Safety Officer (EHSO) will be appointed to prepare a Health and Safety Management Plan, to implement the HSMP and ensure that the requirements of the EMP are met.
• The EHSO will ensure that the HSMP is submitted to TCN prior to construction for approval, that accurate records and reports of any occupational health and safety incidents are kept, and reviewing the distribution and use of appropriate PPE.
• The EHSO will also encourage awareness building on safety through activities such as “Toolbox Briefings” and reporting “Near Misses.”

14.13 Community

14.13.1 Social Conflicts

The presence of workers could cause conflicts with local communities. These can be avoided by implementing the following measures:

• Regularly inform in advance the local officials and local residents on the location and schedule of construction activities which may cause impacts on the environment and life of people e.g., roads used for transport of materials, locations of worker camps etc.
• Locate construction camps away from communities (at least 500 m away) in order to avoid social conflict in using resources and basic amenities such as water supply.
• Maximize number of local people employed in construction works.
• Maximize goods and services sourced from local commercial enterprises.

14.13.2 Damage to Community Facilities

Transport of materials and spoils, operation of construction equipment and various construction activities may damage community utilities. The contractor shall implement the following measures to address this impact:
• The contractor shall not allow overloading of trucks used for all project-related activities.
• The contractor shall immediately repair any damage caused by the project to community facilities such as water supply, power supply, drainage and the like. If compensation is to be paid to affected parties, the contractor will be held responsible for damages.

14.13.3 Complaints Mechanism
A Grievance Redress Mechanism (GRM) must be set up by the contractor and a complaints officer appointed. A sign board should be placed outside the construction site giving contact names and mobile phone numbers. These phone numbers should be manned 24/7. Any complaints received should be responded to within 24 hours in a polite and respectful way. Complaints and remedial works should be reported at least once a month to the client under CAR – Corrective Action Reporting. Details of the GRM are given in Section 14.34.

14.14 Traffic Disruption and Access Obstruction
The construction works may cause traffic disruption and congestion near roadside properties particularly at Biliri. Lack of proper traffic warning signs could cause accidents. The following measures shall be implemented by the contractor to minimize such impacts:
• Set up clear traffic signal boards and traffic advisory signs at the roads going in and out the construction sites to minimize traffic build-up.
• Regularly monitor traffic conditions along access roads so that vehicles do not cause congestion.
• Provide sufficient lighting at night within and in the vicinity of construction sites.
• Provide temporary accesses to properties and establishments affected by disruption to their permanent accesses.
• Reinstate good quality permanent accesses following completion of construction.
• Provide safe pedestrian access around construction areas.
• Provide adequate signage. The signs should be bold and clearly visible at night.

14.15 Utilities
In the event of contractor damaging or disrupting utilities such as pipes or cables the contractor will be liable. To avoid this the utility companies should be contacted to ensure there are underground and unmarked facilities in the area. As the site is a green-field site this is unlikely but it is still the contractors responsibility to check.
14.16 General House Keeping
Contractors should practice “good housekeeping”. The concept of “good housekeeping” is easy for anyone to understand, even those of a non-technical nature. The contractor’s staff are expected to behave in a responsible way and not wait to be told what to do on every occasion. The site should be kept clean and tidy, spills should be mopped up as soon as they occur, rubbish should be collected and removed promptly and tools and equipment stored away neatly when not in use. More details will be given in the EMP.

The staff will benefit from Good Housekeeping as a clean well run site is less likely to have industrial accidents. Monitoring will be by visual inspection by the construction supervision consultants. The contractors must use only vehicles and equipment that are registered and have necessary documentation and permits. All drivers must have valid and current HGV driving licences.

14.17 Positive Impacts
The contractor should attempt to create positive impacts. Employment opportunities should be offered to local community members for unskilled labor. Other short term opportunities such as providing food should be encouraged as long as high standards of food hygiene and sanitation are observed.

14.18 Operation Phase

14.18.1 NERC HSE Standards
During operations a key concern is operator safety. The Nigerian Electricity Regulatory Commission Health and Safety Standards developed industry-specific health and safety (H&S) standards. These are a technical reference document and guidelines of International Industry Best Practice (IIBP).

The power sector is critical infrastructure needed for the economic, industrial, technological and social development of Nigeria. The World Bank have long recognized that electricity consumption is one of the indices for measuring the standard of living of any country. The backbone of the industry is the labor force. The industry sector employs approximately 34,000 people. The population is of more than 150 million, with about 40% of the population serviced by electricity. The need to protect workers and the general public from the hazards resulting from power generation, transmission, distribution and supply is a matter of protecting human life.

Workplaces include all places of work; all non-electrical workers and members of the public in public places. Major causes of fatalities in workplaces include plug in appliances and flexible cords and fixed wiring, and maintenance related activities that are specific to the industry sector. Contact with power...
lines is a significant causative factor of electrical deaths across several of the electrical safety priorities such as workplaces and public places, but it is not the only one. Workplaces even within the industry sector represent a very diverse group of locations, with very different levels of electrical risk. Prioritization of high risk areas needs to be determined based on data, but is likely to include:

- the rural sector
- the construction sector
- workplaces where water is significantly involved

The standards focus on all electrical and non-electrical workers engaged to perform work by electricity entities, involved in the generation, transmission or distribution of power in Nigeria. A review of numerous industry reported studies from the sector support that fatalities occurred which could have been prevented by the use of recognized electricity industry safe systems of work. The procedures are essentially adopted from the U.S. Occupational Safety and Health Act of 1970.

14.19 Air Quality
High electric fields around power cables attract airborne pollutants, such as occur near a main road, chemical factory, sprayed fields, etc. These are then deposited downwind or in rain. Ozone may be generated around transmission lines but in low concentrations and there is no evidence of it being harmful to health.

14.20 Electro-Magnetic Fields (EMF)
Electric overhead lines are considered a source of power frequency, electric and magnetic fields, which may have a perceived health effect. The strength of both electric and magnetic fields is a function of the voltage, distance from the conductors to the ground and the lateral distance from the line to the receptor. Many studies published during the last decade on occupational exposure to Electro-Magnetic Fields (EMF) have exhibited a number of inconsistencies and no clear, convincing evidence exists to show that residential exposures to electric and magnetic fields are a threat to human health.

14.21 Electrical and Magnetic Fields Safety

14.21.1 Overhead Electrical Safety
It is common to think that one has to touch an electrical conductor to get hurt. This is not true when dealing with high voltages. Substations use a high-voltage, open-air conductor —called “bus”— which resembles a 75mm conduit pipe. The metal pipes running through the overhead areas of a substation
are the conductors of electricity. There are no wires inside the pipe. The electricity is carried on the pipe’s outside skin.
Because of the high voltages involved, one need not touch an electrical conductor to be harmed. If close enough, the electricity will contact the person in the form of a high-temperature electrical arc. The potential for an electrical arc becomes greater as voltage increases. For this reason the safety distances must be observed. The proper clearance from the overhead bus is calculated for each station, and conductors are positioned accordingly, using a conservative distance to ensure the safety of anyone walking through a station. For 333kV, a safe distance of 6m has been established. For 11kV to 132kV a safe distance of 4m has been established. To stay safe from the electric bus inside a substation, one should not climb nor carry tools above the shoulder.

14.21.2 Ground-Level Electrical Safety
The overhead bus is not the only electrical hazard present in a substation. Many electrical hazards are found at ground level also. Safety from these hazards is maintained by restricting access to them and by placing the hazard behind locked doors, cages, and fenced-in areas. Capacitor banks reside in cages, providing a buffer zone between persons and the exposed electrical conductors. Circuit breakers are housed in locked cubicles to eliminate the chance of casual entry into these areas. Lightning arrestors and various other electrical components are placed behind fences. All such areas should have warning signs.
Where a substation has a metallic fence, it must be properly grounded to protect people from high voltages that may occur during a fault in the network. Earth faults at a substation can cause a ground potential rise. Currents flowing in the Earth’s surface during a fault can cause metal objects to have a significantly different voltage than the ground under a person’s feet; this touch potential presents a hazard of electrocution.

14.21.3 Underground-Level Electrical Safety
Power cables can be undergrounded. Electric fields will be absorbed by the earth above a buried cable. Magnetic fields will be higher immediately above an underground cable than they will be below an overhead line, because one is are closer, but the fields reduce much more quickly from an underground cable. It should be remembered that the cost of putting cables underground can be twenty times higher than allowing them to go overhead, although less for lower voltage lines.
14.22 Vegetation Management
Buried beneath the gravel in a substation yard is a grid of wires that functions as the grounding for the high voltage equipment. In order to ensure safety for utility employees and the public, it is important to prevent this ground grid from being compromised by vegetation growth. For this reason substation yards are regularly maintained by using a variety of herbicides.

14.23 Pesticides
Herbicides are one branch of pesticides. Any pesticides stored on site for control of weeds, rodents or vectors (such as mosquitoes) should be kept in a secure storage and application should be made under controlled conditions. Technical staff and residents should be advised and workers wear PPE.

14.24 Migratory Birds
The project area does not contain any natural habitats considered to be either critical or fragile. The project area does not have any wetlands or forested areas nearby or International Bird areas (IBAs) and there are no international migratory bird Flyways.

14.25 Noise
If the noise produced by an operating substation is considered intrusive to adjacent property owners a barrier of mature trees or tall soil berms between the substation and nearby residences can be helpful in partially reducing the perception of noise impacts, although trees do very little in reality. Earth berms can reduce up to 7dBs but as the sound is low frequency barriers are not very effective.

14.26 Visual Appearance
Light pollution may present a nuisance in residential areas. Substations may have lights that operate all night long to discourage vandalism and unauthorized individuals. New downward-focused security lighting can help to avoid or reduce light pollution.

14.27 Spills
Transformers may occasionally need oil replacement or replenishment but this is usually very infrequent. In the event of a spill the same procedure as given under Commissioning should be followed.
14.28 Fires
Mineral-oil-filled transformer explosions and fires causing heavy collateral damage have raised major safety concerns. There have also been major environmental concerns over the toxic effects of uncontained mineral oil spills. This has given rise to a new class of alternative dielectric insulating fluids that have historically been developed to answer these specific concerns.
Transformers are fitted with fire traps to allow oil burn out. In the event of a major fire the same fire response procedure as given under Commissioning should be followed.

14.29 HSE
There must be adequate precautions to protect the health and safety of plant workers. All staff must be provided with personal protective equipment (PPE) and made to wear it. The facility operators should undertake the following activities:

- An Environment Health and Safety Officer (EHSO) should be appointed to ensure that the EMP is implemented
- The EHSO will ensure that accurate records and reports of any occupational health and safety incidents are kept, and reviewing the distribution and use of appropriate PPE.
- The EHSO will also encourage awareness building on safety through activities such as “Toolbox Briefings” and reporting “Near Misses.”
- Site briefings for visitors on restricted areas and emergency evacuation procedure
- Induction EHS briefings for new staff
- Follow NERC procedures
- Implement Corrective Action Reporting (CAR)

14.29.1 Tool box briefings
Tool box briefings should be held every morning during roll call and a “safety moment” held. This need only last 2-3 minutes and a specific item can be stated, for example when hot work permits are needed, or when safety equipment is needed if working at a height. The essence of Tool Box meetings is repetition. Staff becomes complacent if not continually reminded of safety procedures. Topics can be repeated every few weeks. The topics addressed should be recorded and reported in the monthly management reports.
14.29.2 Near Misses
Near Misses are situations that arise that could have led to a safety incident but which were spotted by vigilant staff and avoided by swift action. This may be something as simple as spotting a gas cylinder propped upright without support that may fall and injure someone and insisting that it be held in a cradle on a trolley. (For example see figure below)

![Example of Near Misses - Gas cylinders incorrectly stored and handled](image)

Figure 14-2 Examples of Near Misses - Gas cylinders incorrectly stored and handled

![Example of Near Misses - Gas cylinders correctly stored and handled](image)

Figure 14-3 Examples of Near Misses - Gas cylinders correctly stored and handled

Staff may be reluctant to report “Near Misses” as they fear a reprimand but this reluctance must be overcome. The target should be “Zero Incidents” and many “Near Misses” reported and avoided. An EHS annual report that states No Incidents and No Near Misses will not be believed.

14.29.3 Induction Briefings
New staff should be given an Induction Briefing at the start of their employment. They should be trained to identify and eliminate, isolate or minimize potential hazards in their working environment.
Persons entering the site facility should be issued with personal protective equipment (PPE) and be required to wear it. This applies to workers and visitors. Any person found not wearing full PPE should be ordered to wear it and if they refuse they should be ordered off the site. Site supervisors and security guards have the authority to do this.

All staff and visitors should be briefed on and follow emergency and evacuation procedures in particular firefighting.

14.29.4 NERC

As part of normal Occupational Hygiene, Health, Safety and Environment the Nigerian Electricity Regulatory Commission Health and Safety Standards must be followed. The standards are organized into five Parts:

- Part I. How to Evaluate Safety Programs;
- Part II. Safety and Best Industry Practices;
- Part III. Worker Safety Rules;
- Part IV. Recordkeeping, Training, Inspections, Accident Investigation and Reporting;
- Part V. Risk and Vulnerability Assessments

As stated by The Nigerian Electric Regulatory Commission “**These Standards are designed to save lives**”. The practices defined are legal obligations. Each employer has a legal obligation to ensure that a safe work environment is provided to all employees, both regular and non-regular. Contractors working at substations, transmission stations, power plants or engaging in any work activities involving power generation, transmission, distribution and servicing are also required to follow the best practices and safety standards as defined by NERC.

14.29.5 Corrective Action Reporting (CAR)

If an incident takes place, then it is not enough simply to report it. Steps must be taken to abate the nuisance, end the problem and to avoid it happening again. These steps should be included in Corrective Action Reporting (CAR) which is an iterative process whereby checks are made that the situation has actually been resolved in a prompt manner.

14.30 Decommissioning Phase

The transmission lines and substations are likely to remain in place for many years and therefore any decommissioning works could be a long time in the future. Towers and substations would be dismantled and removed and materials recycled/re-used as far as possible. Any areas disturbed must
be restored to pre-project conditions or to conditions acceptable to FMEnv.

After decommissioning the site may be handed over to a new owner and developed for another purpose. In order to avoid any contingent liability to TCN on handover, the site must be free of all encumbrances. After removal of all ancillary equipment the main issue will be potential soil contamination. This is why the soil sediments samples during the baseline are important.

During the life of the installation all efforts should be made to avoid or minimize spills of potentially contaminating materials and to make strenuous efforts to clean up after any spills. After removal of all site equipment soil samples should be taken and compared with the baseline results. If the post-operative soil samples show similar or lower concentrations of parameters measured in the baseline, then the site is deemed clean and can be handed over. If the concentrations are higher, then it may be necessary to excavate contaminated soils, dispose of the contaminated material and backfill with clean soils. Therefore, it is important to store the baseline soils analysis in a secure place.

Potential negative impacts during decommissioning could include:

- Spillages of transformer oils on ground and into groundwater as equipment is removed.
- Solid wastes such as brick, concrete and rubble from substation site demolition.
- Metals and cables from towers dismantling can become an eyesore if not taken off site either for reuse or recycling.
- Invasive flora species could colonise former substation sites and the way-leave on decommissioning following removal of structures, buildings and hardcover.
- Local residents could be subject to noise and air impacts during demolition.

Environmental impacts associated with decommissioning can minimised through the implementation of an environmental and social management plan (ESMP). If the ESMP is followed faithfully then there should not be any residual environmental impacts during decommissioning. Therefore, it is imperative that the ESMP is followed during Operation so that Decommissioning is not onerous. If the ESMP is not followed then remedial works or payment of compensation may have to be paid.

An example of a generic Decommissioning Plan is given in Annex 9.

14.31 Environmental and Social Management Plan

The Environmental and Social Management Plan (ESMP) is given below.
# Table 14-1  Environmental Impacts and Mitigation Measures

<table>
<thead>
<tr>
<th>Project Activity</th>
<th>Potential Environmental Impacts/Concerns</th>
<th>Proposed Mitigation Measures</th>
<th>Location</th>
<th>Estimated Cost</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-construction Phase</td>
<td>Lack of mechanism to address environmental complaints</td>
<td>Establish a grievance redress mechanism (GRM)</td>
<td>At TCN after contract signing</td>
<td>No additional cost</td>
<td>TCN PMU, WB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Make well known the existence of the GRM through public awareness campaigns.</td>
<td>At village residences and in communities</td>
<td>No additional cost</td>
<td>TCN PMU, WB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ensure that names and contact numbers of representatives of TCN-PMU and contractors are placed on notice boards outside the construction site and at local government offices.</td>
<td>At site entrance and in local community</td>
<td>No additional cost</td>
<td>Contractor/TCN PMU, WB</td>
</tr>
<tr>
<td>Location of quarry and borrow areas</td>
<td>Siting of quarry and borrow areas could cause damage to ecologically sensitive sites, productive land</td>
<td>Use existing sites rather than new sites, as much as possible.</td>
<td>Quarry and borrow sites</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor, TCN PMU</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quarries and borrow pits shall not be established in national,</td>
<td>Quarry and borrow sites</td>
<td>No additional cost</td>
<td>Contractor, TCN PMU</td>
</tr>
<tr>
<td>Project Activity</td>
<td>Potential Environmental Impacts/Concerns</td>
<td>Proposed Mitigation Measures</td>
<td>Location</td>
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<tr>
<td>and nuisance to sensitive receptors (residential areas, schools, etc.)</td>
<td>provincial, district and village conservation forests and other ecologically sensitive and protected areas.</td>
<td>Borrow/quarry sites shall not be located in productive land.</td>
<td>Quarry and borrow sites</td>
<td>No additional cost</td>
<td>Contractor TCN PMU</td>
</tr>
<tr>
<td>and nuisance to sensitive receptors (residential areas, schools, etc.)</td>
<td></td>
<td>In case the Project will involve new quarry/borrow sites, necessary approvals from environmental authorities shall be obtained prior to operation of such sites. Such sites shall be located over 500 m away from residential, school, hospital and other noise sensitive receptors.</td>
<td>Quarry and borrow sites</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor FMEnv</td>
</tr>
<tr>
<td>Location of construction workers camps and other project facilities</td>
<td>Siting of various project facilities could adversely affect sensitive receptors (residential areas, etc.) due to dust</td>
<td>Workers camp location and facilities shall be located at least 500 m from settlements and agreed with local communities and local officials.</td>
<td>At site</td>
<td>No additional Cost</td>
<td>Contractor CSC / PMU</td>
</tr>
<tr>
<td>Project Activity</td>
<td>Potential Environmental Impacts/Concerns</td>
<td>Proposed Mitigation Measures</td>
<td>Location</td>
<td>Estimated Cost</td>
<td>Responsibility</td>
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<tr>
<td></td>
<td>emission, wastewater generation, etc.</td>
<td>Siting of asphalt plants, concrete mixing plants, crushing plants and other facilities that cause high dust and/or gaseous emissions will be at least 500 m from settlements and other sensitive receptors (schools, hospitals, etc.)</td>
<td>At site</td>
<td>No additional Cost</td>
<td>Contractor</td>
</tr>
<tr>
<td></td>
<td>Necessary environmental clearance/approval shall be obtained prior to establishment and operation of asphalt mixing plants, crushing plants and other facilities.</td>
<td>At site</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor</td>
<td>FMEnv</td>
</tr>
<tr>
<td>Site preparation</td>
<td>Disruption to utilities</td>
<td>Prior to commencement of site works, relocate or re-provision water supply pipelines, electricity supplies and other facilities that may be affected by construction works. This will be done in agreement with the local</td>
<td>At site</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor</td>
</tr>
</tbody>
</table>

CSC / PMU

FMEnv

Contractor

Part of contractor’s bid cost

FMEnv
<table>
<thead>
<tr>
<th>Project Activity</th>
<th>Potential Environmental Impacts/Concerns</th>
<th>Proposed Mitigation Measures</th>
<th>Location</th>
<th>Estimated Cost</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Management Plans</td>
<td>Site activities to be controlled</td>
<td>Site Management Plans must be prepared by the contractor and must be approved by PMU before construction starts.</td>
<td>At site</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor / CSC / PMU</td>
</tr>
<tr>
<td>Construction Phase</td>
<td></td>
<td></td>
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<tr>
<td>Earthworks &amp; excavations</td>
<td>Encroachment/ damage to historically / culturally significant areas</td>
<td>Upon discovery of any objects of possible archaeological significance that may be uncovered during construction, the site supervisor shall immediately suspend construction activities affecting the area and shall alert Local Government district offices to inspect the site. Work will remain suspended until a site assessment has been made</td>
<td>At site</td>
<td>No additional cost</td>
<td>Contractor / CSC / PMU / Department of Antiquities, Ministry of Culture</td>
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<tr>
<td>Project Activity</td>
<td>Potential Environmental Impacts/Concerns</td>
<td>Proposed Mitigation Measures</td>
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<td>Transport of materials, operation of construction equipment</td>
<td>Air pollution due to elevated levels of dust and gaseous emissions</td>
<td>Construction equipment will be maintained to a good standard. Immediate repairs of any malfunctioning construction vehicles and equipment shall be undertaken.</td>
<td>All site access roads and borrow roads.</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor CSC / PMU</td>
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<td></td>
<td></td>
<td>Equipment and vehicles not in use shall be switched off.</td>
<td>All site access roads and borrow roads.</td>
<td>No additional cost</td>
<td>Contractor CSC / PMU</td>
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<td>Machinery and vehicles causing excessive pollution e.g., visible dark smoke will be banned from construction sites.</td>
<td>All site access roads and borrow roads.</td>
<td>No additional cost</td>
<td>Contractor CSC / PMU</td>
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<td>All construction equipment and</td>
<td>All site access</td>
<td>No additional</td>
<td>Contractor FMEnv</td>
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<td>Project Activity</td>
<td>Potential Environmental Impacts/Concerns</td>
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<tr>
<td>Operation of construction equipment and vehicles</td>
<td>Elevated noise and vibration levels that could cause nuisance and damage to properties</td>
<td>Vehicles shall have valid certifications indicating compliance to vehicle emission standards.</td>
<td>Throughout project site</td>
<td>No additional cost</td>
<td>Contractor CSC / PMU</td>
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<td>Roads and borrow roads.</td>
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<td>No noisy construction-related activities e.g., transport of materials along residential areas and other sensitive receptors, piling, use of jackhammer, etc. will be carried out from 1900 hrs to 0700 hrs near sensitive receptors.</td>
<td>Throughout project site</td>
<td>No additional cost</td>
<td>Contractor CSC / PMU</td>
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<td>Noisy construction activities will be avoided during religious or cultural events in close proximity to the roadside such as Muslim Friday prayers, religious festivals or weddings, etc.</td>
<td>Throughout project site</td>
<td>No additional cost</td>
<td>Contractor CSC / PMU</td>
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<td></td>
<td></td>
<td>All construction equipment and vehicles shall have valid certifications indicating compliance to vehicle emission standards.</td>
<td>Construction</td>
<td>Part of</td>
<td>Contractor CSC / PMU</td>
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<td>Project Activity</td>
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<td>Vehicles shall be well maintained, regularly inspected for noise emissions, and be fitted with effective muffler and other appropriate noise suppression equipment consistent with applicable national and local regulations.</td>
<td>Site</td>
<td>Contractor's bid cost</td>
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<td>Use only vehicles and equipment that are registered and have necessary permits.</td>
<td>Construction site</td>
<td>No additional cost</td>
<td>Contractor</td>
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<td>Truck drivers and equipment operators shall avoid, as much as possible, the use of horns in densely populated areas and where there other sensitive receptors are found such as schools, temples, hospital, etc. are located.</td>
<td>Construction site</td>
<td>No additional cost</td>
<td>Contractor</td>
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<td>Impose speed limits on Construction site.</td>
<td>Construction site</td>
<td>No additional cost</td>
<td>Contractor</td>
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<td>Project Activity</td>
<td>Potential Environmental Impacts/Concerns</td>
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<td>construction vehicles to minimize noise emission along areas where sensitive receptors are located (houses, schools, temples, hospitals, etc.).</td>
<td>site</td>
<td>cost</td>
<td>Implementation</td>
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<td>Provide temporary noise barriers (3-5 meter high barrier can reduce 5-10 dB(A), as necessary, if site works will generate high noise levels that could disturb nearby households, hospital, school and other sensitive receptors)</td>
<td>Construction site</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor</td>
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<td>Avoid noisy construction activities in vicinity of sensitive receivers during night time or other sensitive periods (e.g. during school hours in vicinity of schools)</td>
<td>On approaches to construction site</td>
<td>No additional cost</td>
<td>Contractor</td>
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<td>Truck drivers and equipment operators shall avoid the use of</td>
<td>On approaches</td>
<td>No additional cost</td>
<td>Contractor</td>
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CSC / PMU
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<th>Project Activity</th>
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<th>Implementation</th>
<th>Monitoring</th>
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<tbody>
<tr>
<td>Waste from workers camps</td>
<td>Improper handling of wastes could cause odor and vermin problems</td>
<td>Segregate and regularly collect wastes at worker camps and offices.</td>
<td>Construction site and workers camps</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor’s EHS Office</td>
<td>CSC / PMU</td>
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<td>Construction/workers’ camps shall be provided with garbage bins.</td>
<td>Construction site and workers camps</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor’s EHS Office</td>
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<tr>
<td>Waste from construction</td>
<td>Improper disposal of wastes could cause pollution and obstruction of nearby watercourses.</td>
<td>Prohibit disposal of solid wastes into rivers, watercourses, agricultural field and public areas.</td>
<td>Construction site</td>
<td>No additional cost</td>
<td>Contractor</td>
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<td>There will be no site-specific landfills established by the contractors. All solid waste will be regularly collected and removed from the work camps and disposed to areas approved by</td>
<td>Construction site</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor</td>
<td>CSC / PMU</td>
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<td>Prohibit burning of wooden</td>
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<td>construction and domestic</td>
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<td>Recyclables shall be</td>
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<td>Residual and hazardous</td>
<td>Construction site</td>
<td>Part of contractor’s bid cost</td>
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<td>Ensure that wastes are not</td>
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<td>Drainage shall be provided</td>
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<td>Operation of</td>
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<td>Provide adequate housing</td>
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<td>construction and</td>
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<td>workers camps</td>
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CSC / PMU / State Env
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<th>Location</th>
<th>Estimated Cost</th>
<th>Responsibility</th>
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<tr>
<td></td>
<td>and pollution.</td>
<td>workers at the construction camps and establish clean canteen/eating and cooking areas.</td>
<td>Workers camps</td>
<td>contractor’s bid cost</td>
<td>EHS Office</td>
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<td>Portable lavatories (or at least pit latrines in remote areas) shall be installed and open defecation shall be prohibited and prevented by cleaning lavatories daily and by keeping lavatory facilities clean at all times.</td>
<td>Construction Workers camps</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor’s EHS Office</td>
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<td>Provide separate hygienic sanitation facilities/toilets and bathing areas with sufficient water supply for male and female workers.</td>
<td>Construction Workers camps</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor’s EHS Office</td>
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<td>Wastewater effluents from contractors’ workshops and equipment washing- yards will be passed through gravel/sand beds</td>
<td>Construction Workers camps</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor</td>
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<td>and all oil/grease contaminants will be removed before wastewater is discharged. Oil and grease residues shall be stored in tightly covered drums. Such wastes shall be disposed consistent with national and local regulations.</td>
<td>Construction Workers camps</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor’s EHS Office / CSC / PMU / State Env</td>
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<td>Construction/workers camps shall be cleaned up after use to the satisfaction of FMEnv and local community. All waste materials shall be removed and disposed to disposal sites approved by local authorities.</td>
<td>Construction Workers camps</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor / CSC / PMU</td>
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<td>Land used for workers camps shall be restored to the original condition as far as practicable and the area shall be planted with appropriate trees/shrubs as soon</td>
<td>Construction Workers camps</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor / CSC / PMU</td>
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<tr>
<td>Quarry and borrow site operation</td>
<td>Quarry left as open excavation.</td>
<td>Prior to extraction, topsoil (about 15 cm) shall be stockpiled, preserved and then refilled after completion of quarry/borrow pit operation for rehabilitation purposes after excavation is over.</td>
<td>All quarries and borrow areas</td>
<td>No additional cost</td>
<td>Contractor</td>
</tr>
<tr>
<td>Quarry and borrow site operation</td>
<td>Dust entrainment by wind.</td>
<td>Dust control during transport e.g., water spraying on access roads and provision of truck cover and excavation shall be undertaken in areas where there are sensitive receptors such as residential areas, school, hospital, etc.</td>
<td>All quarries and borrow areas</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor</td>
</tr>
<tr>
<td>Quarry and borrow site operation</td>
<td>Stagnant water</td>
<td>During quarry and borrow site operation, provide adequate</td>
<td>All quarries and borrow areas</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor</td>
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<td>Project Activity</td>
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<tr>
<td>Operation</td>
<td>Safety concerns</td>
<td>Drainage to avoid accumulation of stagnant water.</td>
<td>Areas</td>
<td>Bid cost</td>
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<tr>
<td>After quarry finished</td>
<td>Safety concerns</td>
<td>Upon completion of extraction activities, borrow pits shall be dewatered and fences shall be installed, as appropriate, to minimize health and safety risks.</td>
<td>All quarries and borrow areas</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor / CSC / PMU / State Env</td>
</tr>
<tr>
<td>After quarry finished</td>
<td>Safety concerns</td>
<td>Borrow pits will be left in a tidy state with stable side slopes and proper drainage in order to minimize soil erosion, siltation of nearby bodies of water and to avoid creation of water bodies favorable for mosquito breeding.</td>
<td>All quarries and borrow areas</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor / CSC / PMU / State Env</td>
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<tr>
<td>After quarry finished</td>
<td>Safety concerns</td>
<td>To avoid drowning when pits become water-filled, measures such as fencing shall be implemented.</td>
<td>All quarries and borrow areas</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor / CSC / PMU / State Env</td>
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<td>After quarry finished</td>
<td>Water supplies</td>
<td>It is possible that villagers may request borrow pits to be left</td>
<td>All quarries and borrow</td>
<td>Part of contractor’s</td>
<td>Contractor / EHS Office / CSC / PMU / State Env</td>
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<td>Project Activity</td>
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<td>Use of hazardous substances such as fuel, oil, lubricants, etc.</td>
<td>Pollution and safety risks due to use of hazardous materials and disposal of hazardous wastes</td>
<td>excavated so that they may be used as water reservoirs or fishponds. If this were to be agreed between the contractors and the villagers, all the full safety measures detailed above must be observed. Such agreements would be formalized in writing between the contractors and the villagers after full discussion with all concerned parties.</td>
<td>areas</td>
<td>bid cost</td>
<td>Implementation Monitoring</td>
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<td>Train relevant construction personnel in handling of fuels and other hazardous substances as</td>
<td>Construction site</td>
<td>Contractor’s bid cost = $10,000</td>
<td>Contractor’s EHS Office</td>
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<td>Store fuel and hazardous substances and wastes in paved areas with roof and embankment. If spills or leaks do occur, undertake immediate clean up.</td>
<td>Construction site</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor</td>
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<td>Project Activity</td>
<td>Potential Environmental Impacts/Concerns</td>
<td>Proposed Mitigation Measures</td>
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<td>Well as spill control procedures.</td>
<td>Construction site</td>
<td>Part of contractor’s bid cost = $2,000</td>
<td>Contractor’s EHS Officer</td>
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<td>Ensure availability of spill clean up materials (e.g., absorbent pads, etc.) specifically designed for petroleum products and other hazardous substances where such materials are being stored.</td>
<td>Designated storage sites</td>
<td>No additional cost</td>
<td>CSC / PMU</td>
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<td></td>
<td>Segregate hazardous wastes (oily wastes, used batteries, fuel drums) and ensure that storage, transport and disposal shall not cause pollution and shall be undertaken consistent with national and local regulations.</td>
<td>Designated storage sites</td>
<td>Part of contractor’s bid cost = $4,000</td>
<td>CSC / PMU / State Env</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Store waste oil, lubricant and other hazardous materials and wastes in tightly sealed containers to avoid contamination of soil and water resources.</td>
<td>Designated storage sites</td>
<td></td>
<td>CSC / PMU / State Env</td>
</tr>
<tr>
<td>Project Activity</td>
<td>Potential Environmental Impacts/Concerns</td>
<td>Proposed Mitigation Measures</td>
<td>Location</td>
<td>Estimated Cost</td>
<td>Responsibility</td>
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<tr>
<td>Refuelling and vehicle maintenance</td>
<td></td>
<td>Ensure all storage containers of hazardous substances and wastes are in good condition with proper labeling. NOTE. It is illegal to carry a waste drum on the highway without labelling!</td>
<td>Designated storage sites</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor’s EHS Officer / CSC / PMU / State Env</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Regularly check containers for leakage and undertake necessary repair or replacement.</td>
<td>Designated storage sites</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor’s EHS Officer / CSC / PMU / State Env</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Store hazardous materials above flood level. Note Biliri has a drainage channel running through the site.</td>
<td>Designated storage sites</td>
<td>No additional cost</td>
<td>Contractor’s EHS Officer / CSC / PMU / State Env</td>
</tr>
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<td></td>
<td></td>
<td>Storage areas for fuel, oil, lubricant, bitumen and other hazardous substance will be located at least 100 m away from any watercourses.</td>
<td>Designated storage sites</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor’s EHS Officer / CSC / PMU / State Env</td>
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<tr>
<td></td>
<td></td>
<td>Storage areas will be bunded and provided with interceptor traps</td>
<td>Designated storage sites</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor’s EHS Officer / CSC / PMU / State Env</td>
</tr>
<tr>
<td>Project Activity</td>
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<td>so that accidental spills do not contaminate the environment.</td>
<td>Construction site</td>
<td>bid cost</td>
<td>Contractor’s EHS Officer</td>
<td>CSC / PMU / State Env</td>
</tr>
<tr>
<td></td>
<td>Storage, transport and disposal of hazardous wastes, including spill wastes, shall be consistent with national and local regulations.</td>
<td>Construction site</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor’s EHS Officer</td>
<td>CSC / PMU / State Env</td>
</tr>
<tr>
<td></td>
<td>Wherever possible, refueling will be carried out at a garage, gas station or fuel storage area.</td>
<td>Construction site</td>
<td>No additional cost</td>
<td>Contractor’s EHS Officer</td>
<td>CSC / PMU / State Env</td>
</tr>
<tr>
<td></td>
<td>Refuelling shall not be permitted within or adjacent to watercourses.</td>
<td>Construction site</td>
<td>No additional cost</td>
<td>Contractor’s EHS Officer</td>
<td>CSC / PMU / State Env</td>
</tr>
<tr>
<td></td>
<td>All areas intended for storage of hazardous materials will be quarantined and provided with adequate facilities (e.g., fire fighting equipment, sorbent pads, etc.) to combat emergency situations complying with all the applicable statutory stipulation.</td>
<td>Designated storage sites</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor’s EHS Officer</td>
<td>CSC / PMU / State Env</td>
</tr>
<tr>
<td>Project Activity</td>
<td>Potential Environmental Impacts/Concerns</td>
<td>Proposed Mitigation Measures</td>
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<tr>
<td>Blasting of rocks in quarries or on site.</td>
<td>Safety risks to workers and the public</td>
<td>Vehicle maintenance and refueling will be confined to areas in construction sites designed to contain spilled lubricants and fuel.</td>
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<td>Implementation</td>
</tr>
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<td></td>
<td></td>
<td>Blasting will be carried out only with permission of the concerned authority, using a pre-established schedule.</td>
<td>All areas where blasting will occur</td>
<td>No additional cost</td>
<td>Contractor</td>
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<tr>
<td></td>
<td></td>
<td>All the statutory laws, regulation, rules etc., pertaining to acquisition, transport, storage, handling and use of explosives.</td>
<td>All areas where blasting will occur</td>
<td>No additional cost</td>
<td>Contractor’s EHS Officer</td>
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<tr>
<td></td>
<td></td>
<td>The timing will be made available to the local people within 500 m of the blasting site in all directions, depending on the total charge used.</td>
<td>All areas where blasting will occur</td>
<td>No additional cost</td>
<td>Contractor’s EHS Officer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blasting will be held only during day time and shall be carried out</td>
<td>All areas where blasting will occur</td>
<td>No additional cost</td>
<td>Contractor</td>
</tr>
<tr>
<td>Project Activity</td>
<td>Potential Environmental Impacts/Concerns</td>
<td>Proposed Mitigation Measures</td>
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<tr>
<td>Earthworks / excavation</td>
<td>Improper spoils disposal could cause deterioration of water quality, damage to</td>
<td>The spoils disposal site shall be located at least 50 m from surface water courses. Avoid steep slopes in stockpiles. Provide</td>
<td>Construction site.</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor</td>
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<tr>
<td></td>
<td></td>
<td>not using high powered explosives. Under no circumstance will blasting be undertaken at night.</td>
<td>blasting will occur</td>
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<td>Where possible blasting mats will be used to reduce noise levels when blasting is carried out to reduce flying rock.</td>
<td>All areas where blasting will occur</td>
<td>bid cost</td>
<td>Contractor</td>
</tr>
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<td></td>
<td></td>
<td>No blasting will take place without condition survey of the buildings within 500 m.</td>
<td>All areas where blasting will occur</td>
<td>No additional cost</td>
<td>Contractor</td>
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<td></td>
<td></td>
<td>People living near blasting sites will be informed of blasting times prior to the blasting.</td>
<td>All areas where blasting will occur</td>
<td>No additional cost</td>
<td>Contractor’s EHS Officer</td>
</tr>
<tr>
<td>Project Activity</td>
<td>Potential Environmental Impacts/Concerns</td>
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<tr>
<td>Transport of materials and spoils, operation of construction equipment and various construction activities</td>
<td>productive land and flow obstruction of water courses. Damage to community utilities such as water supply pipes, irrigation canals, drainage, etc. may occur during construction activities.</td>
<td>grass cover and other suitable slope stabilization measures on long term stockpile of spoils to prevent runoff in heavy rain. Spoils shall only be disposed to areas approved by local authority. Under no circumstances will removed spoil materials be dumped into watercourses. The contractor shall not allow overloading of trucks used for all project-related activities. The contractor shall immediately repair any damage caused by the project to community facilities such as water supply, power supply, irrigation canals, drainage and the like. Adequate compensation shall be paid to</td>
<td>Construction site.</td>
<td>No additional cost</td>
<td>Contractor’s EHS Officer / State Env</td>
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<td></td>
<td></td>
<td>Construction site.</td>
<td>Construction site.</td>
<td>No additional cost</td>
<td>Contractor’s EHS Officer / State Env</td>
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<td></td>
<td></td>
<td>Construction site. Part of contractor’s bid cost</td>
<td>Construction site.</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor / CSC / PMU / State Env</td>
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<tr>
<td>Road traffic and access to sites</td>
<td>Traffic disruption and obstruction of access to roadside properties</td>
<td>Set up clear traffic signal boards and traffic advisory signs at the road going in and out the construction site to minimize traffic build-up outside the houses. Check vehicles are not causing congestion</td>
<td>Road access to construction site</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor / CSC / PMU / State Env / Police</td>
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<td></td>
<td></td>
<td>Provide sufficient lighting at night within and in the vicinity of construction sites.</td>
<td>Road access to construction site</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor / CSC / PMU / State Env / Police</td>
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<td></td>
<td></td>
<td>Provide safe temporary accesses to properties and establishments</td>
<td>Road access to</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor / CSC / PMU / State Env / Police</td>
</tr>
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**ESIA for the Proposed 132/33kV Transmission Substation at Biliri, Gombe State | 225**
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<tr>
<th>Project Activity</th>
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<th>Estimated Cost</th>
<th>Responsibility</th>
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<tbody>
<tr>
<td></td>
<td>affected by disruption to their permanent accesses.</td>
<td>construction site</td>
<td>bid cost</td>
<td>/ Police</td>
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<td></td>
<td>Provide adequate signage and flag persons for traffic control. Traffic control should be installed to prevent traffic accidents. Vehicles on the main road should be given right of way and site vehicles made to wait. Warning signs should be posted uphill of the sites warning oncoming traffic to slow down.</td>
<td>Road access to construction site</td>
<td>Part of contractor’s bid cost</td>
<td>Contractor / CSC / PMU / State Env / Police</td>
<td></td>
</tr>
<tr>
<td>Operation of construction site</td>
<td>Impacts to flora and fauna</td>
<td>Spoils and all types of wastes shall not be dumped into forested areas, agricultural land, densely</td>
<td>Around construction site and near no additional cost</td>
<td>Contractor / CSC / PMU / State Env</td>
<td></td>
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<td>Project Activity</td>
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<tr>
<td>Presence of workers</td>
<td>Impacts to flora and fauna</td>
<td>Workers shall be prohibited from collecting firewood from surrounding forests, and from hunting wild animals.</td>
<td>construction site and near workers camps</td>
<td>No additional cost</td>
<td>Contractor / CSC / PMU / State Env</td>
</tr>
<tr>
<td>Construction</td>
<td>Health and safety risks</td>
<td>Conduct orientation for Construction</td>
<td>Construction</td>
<td>Part of</td>
<td>Contractor’s / CSC / PMU</td>
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<tr>
<td>Project Activity</td>
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<td>workers camps</td>
<td>to workers and the public</td>
<td>construction workers regarding emergency response procedures and equipment in case of accidents (e.g., burns, spills of hazardous substances, etc.), fire, etc.; health and safety measures, prevention of HIV/AIDS, malaria, diarrhea, and other related diseases.</td>
<td>site and workers camps</td>
<td>contractor’s bid cost = $5,000</td>
<td>EHS Officer</td>
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<td></td>
<td></td>
<td>Provide drainage at construction sites and workers camps to prevent water logging/accumulation of stagnant water and formation of breeding sites for mosquitoes.</td>
<td>Construction site and workers camps</td>
<td>Part of contractor’s bid cost = $5,000</td>
<td>Contractor</td>
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<tr>
<td></td>
<td></td>
<td>Provide fire fighting equipment and appropriate emergency response equipment (based on on-going construction activities) at the work areas and at</td>
<td>Construction site and workers camps</td>
<td>Part of contractor’s bid cost = $5,000</td>
<td>Contractor</td>
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<tr>
<td>Project Activity</td>
<td>Potential Environmental Impacts/Concerns</td>
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<td>construction and workers camps.</td>
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<td></td>
<td>Provide first aid facilities that are readily accessible by workers.</td>
<td>Construction site and workers camps</td>
<td>Part of contractor’s bid cost = $5,000</td>
<td>Contractor’s EHS Officer</td>
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<td>At the workers camps, provide adequate housing for all workers at the construction camps, provide reliable supply of potable water, install separate hygienic sanitation facilities/toilets and bathing areas with sufficient water supply for male and female workers and establish clean eating areas and kitchen.</td>
<td>Construction site and workers camps</td>
<td>Part of contractor’s bid cost = $25,000</td>
<td>Contractor</td>
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<td></td>
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<td>Provide workers with appropriate safety equipment/devices PPE such as dust mask, hard hats, safety shoes, goggles, ear plugs, etc. and strictly require them to</td>
<td>Construction site and workers camps</td>
<td>Part of contractor’s bid cost = $15,000</td>
<td>CSC / PMU</td>
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Responsibility: Implementation Monitoring
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<tbody>
<tr>
<td>Use these as necessary.</td>
<td></td>
<td>Install warning sign boards and lighting systems at the construction sites, borrow pits, or places which may cause accidents for people and workers</td>
<td>Construction site and workers camps</td>
<td>Part of contractor’s bid cost = $5,000</td>
<td>Contractor</td>
</tr>
<tr>
<td>Strictly impose speed limits on construction vehicles along residential areas and where other sensitive receptors such as schools, hospitals, and other populated areas are located.</td>
<td></td>
<td></td>
<td>Construction site and workers camps</td>
<td>No additional cost</td>
<td>Contractor’s EHS Officer</td>
</tr>
<tr>
<td>Educate drivers on safe driving practices to minimize accidents and to prevent spill of hazardous substances and other construction materials during transport.</td>
<td></td>
<td></td>
<td>Construction site and workers camps</td>
<td>No additional cost</td>
<td>Contractor’s EHS Officer</td>
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<tr>
<td>Barriers (e.g., temporary fence) shall be installed at construction site</td>
<td></td>
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<td>Construction site</td>
<td>Part of contractor’s</td>
<td>Contractor</td>
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<td>Project Activity</td>
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<td>areas to deter pedestrian access to these areas. Do not allow people particularly children to cross the site.</td>
<td></td>
<td>workers camps</td>
<td></td>
<td>bid cost</td>
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<tr>
<td>Sufficient lighting at night as well as warning signs shall be provided in the periphery of the construction site.</td>
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<td>Construction site and workers camps</td>
<td></td>
<td>Part of contractor’s bid cost</td>
<td>Contractor</td>
</tr>
<tr>
<td>The general public/local residents shall not be allowed in high – risk areas, e.g., excavation sites and areas where heavy equipment is in operation. Hire Security officers.</td>
<td></td>
<td>Construction site and workers camps</td>
<td></td>
<td>Cost = $25,000</td>
<td>Contractor</td>
</tr>
<tr>
<td>Ensure proper collection and disposal of solid wastes within the construction camps consistent with local regulations.</td>
<td></td>
<td>Construction site and workers camps</td>
<td></td>
<td>Part of contractor’s bid cost</td>
<td>Contractor</td>
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<tr>
<td>Provide fencing on all areas of excavation greater than 2 m</td>
<td></td>
<td>Construction site and workers camps</td>
<td></td>
<td>Part of contractor’s</td>
<td>Contractor</td>
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Implementation | Monitoring |
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<tr>
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<td></td>
<td>deep.</td>
<td>workers camps</td>
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<td>bid cost</td>
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<td></td>
<td>Ensure audible reversing signals are installed on all construction vehicles.</td>
<td>Construction site and workers camps</td>
<td></td>
<td>Part of contractor’s bid cost</td>
<td>Contractor / CSC / PMU</td>
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<td></td>
<td>Measures to prevent malaria shall be implemented (e.g., provision of insecticide treated mosquito nets to workers, spraying of insecticides, installation of proper drainage to avoid formation of stagnant water, etc.).</td>
<td>Construction site and workers camps</td>
<td></td>
<td>Part of contractor’s bid cost</td>
<td>Contractor’s EHS Officer / CSC / PMU</td>
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<td></td>
<td>Discharge of untreated sewage shall be prohibited.</td>
<td>Construction site and workers camps</td>
<td></td>
<td>Part of contractor’s bid cost</td>
<td>Contractor / CSC / PMU</td>
</tr>
<tr>
<td>Operation of construction sites</td>
<td>Social conflicts</td>
<td>Locate construction camps away from communities (at least 500 m)</td>
<td>Construction workers</td>
<td>No additional cost</td>
<td>Contractor’s EHS Officer / CSC / PMU / WB</td>
</tr>
<tr>
<td>Project Activity</td>
<td>Potential Environmental Impacts/Concerns</td>
<td>Proposed Mitigation Measures</td>
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<td>and workers camps</td>
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<td>away) in order to avoid social conflict in using resources and basic amenities such as water supply.</td>
<td>camps</td>
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<td>Local community</td>
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<td></td>
<td></td>
<td>Maximize number of local people employed in construction works.</td>
<td>Local community</td>
<td>No additional cost</td>
<td>Contractor’s EHS Officer / Local community</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximize goods and services sourced from local commercial enterprises.</td>
<td>Local community</td>
<td>No additional cost</td>
<td>Contractor’s EHS Officer / Local community</td>
</tr>
<tr>
<td>Commissioning Phase</td>
<td></td>
<td>Spillages while loading oils.</td>
<td>Transformer substation</td>
<td>Part of commissioning contractors bid price</td>
<td>Contractor’s EHS Officer / Local Fire Department</td>
</tr>
<tr>
<td>Installing transformers</td>
<td></td>
<td>Spillages of transformer oils may occur during loading. Use containment around the transformers and have spill mop kits nearby.</td>
<td>Transformer substation</td>
<td>Part of commissioning contractors bid price</td>
<td>Contractor’s EHS Officer / Local Fire Department</td>
</tr>
<tr>
<td>Testing switch gear and Fire</td>
<td></td>
<td>Have fires extinguishers handy. Notify fire department and</td>
<td>Transformer substation</td>
<td>Part of commissioning contractors bid price</td>
<td>Contractor’s EHS Officer / Local Fire Department</td>
</tr>
<tr>
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<td>capacitors</td>
<td></td>
<td>request an appliance on be on standby or preferably at the site.</td>
<td></td>
<td>g contractors bid price</td>
<td>Local Fire Department</td>
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<td>Operation Phase</td>
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<td>High voltages</td>
<td>Air quality</td>
<td>High electric fields around power cables attract airborne pollutants, such as occur near a main road, chemical factory, sprayed fields, etc. These are then deposited downwind or in rain. Anticipate dust down wind of HV lines.</td>
<td>Transformer substation</td>
<td>Operational expenses</td>
<td>TCN Site Staff</td>
</tr>
<tr>
<td>Overhead Safety</td>
<td>Electric overhead lines are a source of electric and magnetic fields. Safety distances must be observed. The proper clearance from the overhead bus is calculated for each station, and conductors are positioned accordingly, using a conservative distance to ensure the safety of anyone walking through a station.</td>
<td>Transformer substation</td>
<td>Operational expenses</td>
<td>TCN Site Staff</td>
<td>TCN PMU / WB</td>
</tr>
<tr>
<td>Project Activity</td>
<td>Potential Environmental Impacts/Concerns</td>
<td>Proposed Mitigation Measures</td>
<td>Location</td>
<td>Estimated Cost</td>
<td>Responsibility</td>
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<tr>
<td>Ground level Safety</td>
<td>Maintain safety by locked doors on cages, and fenced-in areas for capacitor banks, exposed electrical conductors, circuit breakers and lightning arrestors. All such areas should have warning signs.</td>
<td>For 333kV, a safe distance of 6m has been established. For 11kV to 132kV a safe distance of 4m has been established. To stay safe from the electric bus inside a substation, one should not climb nor carry tools above the shoulder.</td>
<td>Transformer substation</td>
<td>Operational expenses</td>
<td>TCN Site Staff</td>
</tr>
<tr>
<td>Underground Safety</td>
<td>Ground all electrical conductors. Place warning signs above underground cables and earth grids.</td>
<td>Transformer substation</td>
<td>Operational expenses</td>
<td>TCN Site Staff</td>
<td>TCN PMU / WB</td>
</tr>
<tr>
<td>Hot work permits</td>
<td>Ensure all maintenance works</td>
<td>Transformer substation</td>
<td>Operational expenses</td>
<td>TCN Site Staff</td>
<td>TCN PMU / WB</td>
</tr>
<tr>
<td>Project Activity</td>
<td>Potential Environmental Impacts/Concerns</td>
<td>Proposed Mitigation Measures</td>
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<td>Estimated Cost</td>
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<tr>
<td></td>
<td></td>
<td>near HV cables and equipment is subject to Hot work permits. No work must be allowed without Possession Orders and Isolation procedures.</td>
<td>substation</td>
<td></td>
<td>WB</td>
</tr>
<tr>
<td>Pesticides</td>
<td>Water contamination</td>
<td>Substation yards are regularly maintained by using a variety of herbicides. Ensure pesticides are applied at ground level if possible. If elevated sprays are used do not apply during strong winds. Warn staff to close windows. Ensure workers wear appropriate PPE such as masks. Handle drums cautiously and avoid spills on gravel areas where it is difficult to mop up.</td>
<td>Transformer substation</td>
<td>Operational expenses</td>
<td>TCN Site Staff</td>
</tr>
<tr>
<td>Elevated structures</td>
<td>Birds</td>
<td>Birds may nest in tower and high level structures. Thus can lead to power outages. Check for bird</td>
<td>Transformer substation</td>
<td>Operational expenses</td>
<td>TCN Site Staff</td>
</tr>
<tr>
<td>Project Activity</td>
<td>Potential Environmental Impacts/Concerns</td>
<td>Proposed Mitigation Measures</td>
<td>Location</td>
<td>Estimated Cost</td>
<td>Responsibility</td>
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<tr>
<td>Transformer operation</td>
<td>Noise</td>
<td>If the noise produced by an operating substation is considered intrusive to adjacent property owners a barrier of mature trees or tall soil berms between the substation and nearby residences can be helpful in partially reducing the perception of noise impacts, although trees do very little in reality. Earth berms can reduce up to 7dBs but as the sound is low frequency barriers are not very effective. Carr</td>
<td>Transformer substation</td>
<td>Operational expenses</td>
<td>TCN Site Staff</td>
</tr>
<tr>
<td>Security lighting</td>
<td>Light pollution</td>
<td>Lighting may be considered a nuisance in some residential areas. Substations may have lights that operate all night long</td>
<td>Transformer substation</td>
<td>Operational expenses</td>
<td>TCN Site Staff</td>
</tr>
<tr>
<td>Project Activity</td>
<td>Potential Environmental Impacts/Concerns</td>
<td>Proposed Mitigation Measures</td>
<td>Location</td>
<td>Estimated Cost</td>
<td>Responsibility</td>
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</tr>
<tr>
<td>Transformer maintenance</td>
<td>Spillages of oils.</td>
<td>to discourage vandalism and unauthorized individuals. Downward-focused security lighting can help to avoid or reduce light pollution.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Operation</td>
<td>Health and Safety</td>
<td>An Environment Health and Safety Officer (EHSO) should be appointed to ensure that the EMP is implemented. The EHSO will ensure that accurate records and reports of any occupational health and safety incidents are kept, and reviewing the distribution and use of appropriate PPE.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Transformer substation Operational expenses TCN Site Staff TCN PMU / WB</td>
<td></td>
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<td></td>
<td></td>
<td>Transformer substation Operational expenses TCN Site Staff TCN PMU / WB</td>
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<tr>
<td>Project Activity</td>
<td>Potential Environmental Impacts/Concerns</td>
<td>Proposed Mitigation Measures</td>
<td>Location</td>
<td>Estimated Cost</td>
<td>Responsibility</td>
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<tr>
<td></td>
<td></td>
<td>The EHSO will also encourage awareness building on safety through activities such as “Toolbox Briefings” and reporting “Near Misses.”</td>
<td>Transformer substation</td>
<td>Operational expenses</td>
<td>TCN Site Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conduct site briefings for visitors on restricted areas and emergency evacuation procedure. Hold Induction EHS briefings for new staff.</td>
<td>Transformer substation</td>
<td>Operational expenses</td>
<td>TCN Site Staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Follow NERC procedures as laid down in: • Part I. How to Evaluate Safety Programs; • Part II. Safety and Best Industry Practices; • Part III. Worker Safety Rules; • Part IV. Recordkeeping,</td>
<td>Transformer substation</td>
<td>Operational expenses</td>
<td>TCN Site Staff</td>
</tr>
<tr>
<td>Project Activity</td>
<td>Potential Environmental Impacts/Concerns</td>
<td>Proposed Mitigation Measures</td>
<td>Location</td>
<td>Estimated Cost</td>
<td>Responsibility</td>
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</tr>
<tr>
<td>Decommissioning</td>
<td></td>
<td>Training, Inspections, Accident Investigation and Reporting; Part V. Risk and Vulnerability Assessments</td>
<td>Transformer substation</td>
<td>Operational expenses</td>
<td>TCN Site Staff / TCN PMU / WB</td>
</tr>
<tr>
<td>Removing transformers</td>
<td>Spillages of oils.</td>
<td>Spillages of transformer oils may occur as equipment is removed. Use containment around the transformers and have spill mop kits nearby.</td>
<td>Transformer substation</td>
<td>Part of Contractors costs</td>
<td>Contractors / TCN PMU / WB</td>
</tr>
<tr>
<td>Demolishing buildings</td>
<td>Solid wastes</td>
<td>Solid wastes such as brick, concrete and rubble from substation site demolition will need removal. Hire licensed waste contractor and remove to LGA approved landfill. Recycling of construction rubble may be</td>
<td>Part of Contractors costs</td>
<td>Contractors / TCN PMU / WB</td>
<td></td>
</tr>
<tr>
<td>Project Activity</td>
<td>Potential Environmental Impacts/Concerns</td>
<td>Proposed Mitigation Measures</td>
<td>Location</td>
<td>Estimated Cost</td>
<td>Responsibility</td>
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</tr>
<tr>
<td>Dismantling towers</td>
<td>Scrap metal</td>
<td>Metals and cables from towers dismantling can become an eyesore if not taken off site either for re-use or recycling. They can be sold to an approved scrap metal dealer.</td>
<td>Transformer substation</td>
<td>Part of Contractors costs</td>
<td>Contractors</td>
</tr>
<tr>
<td>Site abandoned</td>
<td>Ecology changes</td>
<td>Invasive flora species could colonise former substation sites and the way-leave on decommissioning following removal of structures, buildings and hardcover. Arrange for maintenance of site after closure until handover.</td>
<td>Transformer substation</td>
<td>Part of Contractors costs</td>
<td>Contractors</td>
</tr>
<tr>
<td>Use of noisy machinery</td>
<td>Excessive noise levels</td>
<td>Local residents could be subject to noise impacts during demolition. Maintain perimeter noise levels below 75dB(A) to meet industrial</td>
<td>Transformer substation</td>
<td>Part of Contractors costs</td>
<td>Contractors</td>
</tr>
<tr>
<td>Project Activity</td>
<td>Potential Environmental Impacts/Concerns</td>
<td>Proposed Mitigation Measures</td>
<td>Location</td>
<td>Estimated Cost</td>
<td>Responsibility</td>
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</tr>
<tr>
<td>Spillages of oil</td>
<td>Soil contamination</td>
<td>standard and only work between 0700 and 1900.</td>
<td></td>
<td></td>
<td>Implementation  Monitoring</td>
</tr>
<tr>
<td>Groundwater contamination</td>
<td></td>
<td>It is necessary to establish if deterioration has taken place between site occupation and site decommissioning. Repeat sampling of soils in same locations as were sampled in the original baseline. Take to lab for analysis of all parameters recorded in baseline. Then compare results with baseline conditions to give Before and After comparison.</td>
<td>Transformer substation</td>
<td>$20,000</td>
<td>Contractors TCN PMU / FMEnv / WB</td>
</tr>
<tr>
<td>Groundwater contamination</td>
<td></td>
<td>It is necessary to establish if deterioration has taken place between site occupation and site decommissioning. Repeat sampling of groundwater in same locations as were sampled in the original baseline.</td>
<td>Transformer substation</td>
<td>$20,000</td>
<td>Contractors TCN PMU / FMEnv / WB</td>
</tr>
<tr>
<td>Project Activity</td>
<td>Potential Environmental Impacts/Concerns</td>
<td>Proposed Mitigation Measures</td>
<td>Location</td>
<td>Estimated Cost</td>
<td>Responsibility</td>
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<tr>
<td></td>
<td>original baseline. Take to lab for analysis of all parameters recorded in baseline. Then compare results with baseline conditions to give Before and After comparison.</td>
<td></td>
<td></td>
<td></td>
<td>Implementation, Monitoring</td>
</tr>
</tbody>
</table>
14.32 Costs of Implementing the ESMP

The requirements of the ESMP are mainly related to Occupational Health and Safety and compliance with the environmental regulations pertaining in Nigeria at the present time. This is the law of the land and it can be argued that the contractors should be meeting these legal requirements as a matter of course. However contractors often protest that they have not allowed for environmental compliance in their bid prices. Although this is a spurious argument it can be helpful to include a budget line for environmental compliance in the tender documents. This can include, among others, things like appointing an EHO, providing PPE for workers and installing fuel stores correctly.

The contractor should be required to show these costs in his bid. The information below is a guide:

Table 14-2: Costs of Implementing the ESMP

<table>
<thead>
<tr>
<th>Environmental Control Item</th>
<th>Timing</th>
<th>Cost US$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction of hard standing for fuel storage tank and kerbing around perimeter with provision of lightweight roof to prevent ingress of rain. Any oil storage facilities on site must have kerb high enough to contain 110% of tank volume.</td>
<td>Before any fuel oils stored on site</td>
<td>$10,000</td>
</tr>
<tr>
<td>Provision of spill control materials to mop up any oil spills on site.</td>
<td>Before any fuel oils stored on site</td>
<td>$2,000</td>
</tr>
<tr>
<td>Provision of closed containers on site for waste oil, engine oil, used engine oil filters and other oily waste hazardous waste. Contract with licensed hazardous waste collector for removal of skips for duration of site works.</td>
<td>Before any vehicles access the site.</td>
<td>$4,000</td>
</tr>
<tr>
<td>Provision of cooking area for site staff with enclosed food storage area and clean canteen facilities for staff.</td>
<td>Before any workers enter the site.</td>
<td>$10,000</td>
</tr>
<tr>
<td>Provision of separate toilets for men and women. Toilets must have underground septic tanks or be chemical toilets.</td>
<td>Before any workers enter the site.</td>
<td>$10,000</td>
</tr>
<tr>
<td>Provision of sanitary facilities with showers and washing areas if workers sleep on site.</td>
<td>Before any workers enter the site.</td>
<td>$5,000</td>
</tr>
<tr>
<td>Provision of garbage skips on site for food</td>
<td>Before any workers</td>
<td>$5,000</td>
</tr>
<tr>
<td>Activity</td>
<td>Requirement</td>
<td>Cost</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Waste and other non hazardous waste.</td>
<td>Contract with licensed waste collector or municipality for removal of skips for duration of site works.</td>
<td></td>
</tr>
<tr>
<td>Construction of temporary stormwater drainage channels.</td>
<td>Before any vegetation is removed from site.</td>
<td>$5,000</td>
</tr>
<tr>
<td>Covering of stockpiled materials by tarpaulins or other covering materials to prevent raw materials such as sand or soil from being carried away into nearby drains by rain water runoff.</td>
<td></td>
<td>$2,000</td>
</tr>
<tr>
<td>Issuing of PPE (Personal Protective Equipment) such as high visibility jackets, safety helmets, boots, and also ear plugs if using noisy equipment, and protective goggles where using cutting saws or rotating machines.</td>
<td>Before any workers start work.</td>
<td>$15,000</td>
</tr>
<tr>
<td>Induction course for all new workers on environment health and safety.</td>
<td>Before any workers start work.</td>
<td>$5,000</td>
</tr>
<tr>
<td>Hiring of security officers with instructions not to allow any workers onto the site who are not wearing all the correct PPE.</td>
<td>Before work commences.</td>
<td>$25,000</td>
</tr>
<tr>
<td>Noise level measurements at four locations around the site, or if response to complaints, at complainants house or premises.</td>
<td>Every 6 months or in response to complaints.</td>
<td>$12,000</td>
</tr>
<tr>
<td>Repeat of baseline environmental survey in accordance with TCN Standard Practices for Environmental Audits.</td>
<td>After construction finishes.</td>
<td>$40,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>$150,000.00</td>
</tr>
</tbody>
</table>

As a general rule 1% to 1.5% of the total contract value should be allocated to environmental compliance. As the contract value is typically US$10M this will equate to about $100,000-$150,000. Operationally -The baseline should be repeated every three years in accordance with TCN Standard Practices for Environmental Audits. Based on information from TCN the cost of this is estimated to be $40,000.
14.33 Environmental Monitoring

14.33.1 Measurements

The essence of monitoring is to ensure Compliance with Environmental Legislation. The contractors have a duty to comply with the relevant legislation. The supervising consultant must check their activities and report to TCN. In the event of noncompliance TCN can exert pressure on the contractor to comply.

The measurements to be made and standards to be met are given below. There will be a “hierarchy” of monitoring and measurements. This would be based on:

- Contractors
- Construction Supervising Consultant Inspector
- TCN PMU
- FMEnv

Initially, contractors should check daily that all operations are being conducted correctly. In general “good housekeeping” must be employed. Overflowing of septic tanks must be checked by visual inspection. Dust must be controlled by covering of stockpiles and water sprays. Solid waste, engine oil and grease, must be taken away by waste removal contractors and records kept.

Construction supervision inspectors must make daily spot checks and weekly formal checks on site operations. They must cross check all of the above and view records for waste disposal. They must also investigate any pollution incidents or complaints. They must use the checklists for record purposes and make sure that the complaint or incident is brought to the notice of the contractor immediately, verbally and with a follow up written notice.

FMEnv staff will have access to noise and water quality monitoring equipment. When requested by TCN-PMU FMEnv inspectors must visit the site and make measurements. The equipment for noise and water will give direct results so data will be available immediately. In the event that more detailed information is required on water quality samples can be taken of water and delivered to a commercial laboratory for analysis. In addition PMU staff should make monthly visits to site to check the veracity of reporting. They should also review the reports submitted by the CSC to TCN and report to the TCN project manager.

If vibration measurements or dust measurements are required then specialized equipment will be needed. If dust measurements are needed than a two stage process must be adopted. A High Volume Sampler (HVS) will be deployed by FMEnv or a private local consultant. After a suitable period, usually 24 hours, the filter in the HVS will be retrieved and transported to the laboratory for the second stage which is analysis. This requires highly specialized equipment. The Lab will charge for this service. These charges must be covered by the contractor.

The results must be submitted to PMU who will interpret them with respect to the relevant regulations.
Discussions must then be held with the contractor to determine how to resolve any problems. After extraction from borrow areas is finished, revegetation and reinstatement must be carried out. Warning signs must be erected to avoid drowning if deep ponds are left. CSC Inspectors staff must make regular checks by visual inspection.

14.33.2 Timing of Monitoring
The timing of the monitoring is important. The following list is for guidance and is indicative only.

- Liquid emissions from sites must be checked every three months or after heavy rain if overflowing is reported. Measurements in streams and water courses must be made.
- Dust emissions on site must be checked weekly by visual inspection and monthly by examining records of water spraying. Ambient air quality must be checked over a 24 hour continuous period at sensitive receptors in the event of complaints.
- Noise levels must be checked every three months at site perimeters, or in the event of a complaint, at night as well as during the daytime.
- Correct removal and disposal of food waste and waste engine oil and grease must be checked weekly by visual inspection of the camps and checking of records from the waste disposal contractors.
- Noise and vibration must be checked at sensitive receptors when blasting first occurs or in the event of complaint. Before blasting commences warning notices must be posted to local residents.
- Reinstatement of borrow pits and quarries must be checked after closure of the facility.

In addition to regular monitoring, unannounced spot checks must be made by TCN-PMU on contractors operations. All of the above procedures should be carried out by the site CSC inspectors, in conjunction with PMU, and where appropriate FMEnv. The results should be formally recorded every week and compiled into a monthly report. This should be submitted to TCN and the contractors as necessary but at a minimum on a monthly basis. Monthly reports should be compiled into quarterly and annual reports to be submitted to WB.

14.33.3 Beyond Compliance
It will be necessary to carry out measurements to establish if the regulations are being met. In fact, simple compliance with the standards is not necessarily the final objective. There is no harm in the contractor “going beyond compliance” and running an operation better than that required by the standards.
Table 14-3: Measurement of Environmental Parameters during Construction

<table>
<thead>
<tr>
<th>Environmental Issue</th>
<th>Parameter</th>
<th>Standard</th>
<th>Timing</th>
<th>Equipment</th>
<th>Institutional Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Quality</td>
<td>BOD</td>
<td>&lt; 50mg/L</td>
<td>every 3 months or after heavy rain</td>
<td>Water Sampler</td>
<td>Contractor</td>
</tr>
<tr>
<td></td>
<td>SS</td>
<td>&lt; 50mg/L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Temperature</td>
<td>&lt;45°C</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>pH</td>
<td>6-9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oil &amp; Grease</td>
<td>&lt; 5mg/L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dissolved Oxygen</td>
<td>&gt; 5mg/L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air Quality</td>
<td>TSP</td>
<td>&lt; 0.33 mg/m³</td>
<td>24 hours</td>
<td>H.V.S + Lab</td>
<td>FMEnv</td>
</tr>
<tr>
<td>Noise Quality</td>
<td>Leq Site Boundary</td>
<td>75dB(A)</td>
<td>(daytime 07-19)</td>
<td>Noise Meter</td>
<td>Contractor</td>
</tr>
<tr>
<td></td>
<td>Leq Site Boundary</td>
<td>65dB(A)</td>
<td>(nighttime, 19-07)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vibration</td>
<td>PPV</td>
<td>&lt; 1mm/sec</td>
<td>During blasting</td>
<td>Vibration meter</td>
<td>Contractor</td>
</tr>
<tr>
<td>Solid Waste</td>
<td>Food Waste</td>
<td>Properly Removed</td>
<td>Daily</td>
<td>Visual Inspection</td>
<td>Contractor</td>
</tr>
<tr>
<td>Liquid Waste</td>
<td>Waste Oil, Grease</td>
<td>Properly Controlled After Removed by Subcontractor</td>
<td>Weekly</td>
<td>Visual Inspection</td>
<td>Contractor</td>
</tr>
<tr>
<td>Septic Tank</td>
<td>Smell, Sewage</td>
<td>No Smell, No Overflowing</td>
<td>During Operation</td>
<td>Visual Inspection</td>
<td>CSC Inspector</td>
</tr>
<tr>
<td>Borrow Pits</td>
<td>Condition of</td>
<td>Filled after Project</td>
<td>After Closure</td>
<td>Visual Inspection</td>
<td>CSC Inspector</td>
</tr>
<tr>
<td>Borrow Pits</td>
<td>Completion, Topsoil resurfaced</td>
<td>No Drowning Hazard</td>
<td>After Closure</td>
<td>Visual Inspection</td>
<td>CSC Inspector</td>
</tr>
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</tr>
<tr>
<td>Borrow Pits</td>
<td>Depth of Borrow pits</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Borrow Road</td>
<td>Location for Borrow Road</td>
<td>Meet the Engineer Demand</td>
<td>After Closure</td>
<td>Visual Inspection</td>
<td>CSC Inspector</td>
</tr>
<tr>
<td>Quarries</td>
<td>Condition of Quarries</td>
<td>Quarries reinstated</td>
<td>After Closure</td>
<td>Visual Inspection</td>
<td>CSC Inspector</td>
</tr>
</tbody>
</table>
14.34 Grievance Redress Mechanism

Villagers and APs are encouraged to voice complaints and these are to be duly investigated and reported through the contractor to PMU and so to TCN. As a consultative procedure has been established through public consultation it is recommended that this procedure be maintained and extended to include environmental issues.

Environmental monitoring must be carried out by the construction supervision inspectors, all of whom must have previous experience of environmental issues on similar projects. Response to complaints will be based on the following schedule:

- Complaint made to contractor
- Response by contractor or construction supervision consultants’ inspectors.
- Weekly compiling of checklists by inspectors. Copies of checklists to be given to contractors as official notification of action being required, confirmation of receipt obtained by contractor signing copy, and joint inspection carried out if necessary.
- Monthly progress reports by inspectors by consolidating weekly reports.
- Corrective Action Reports (CARs) from contractors, as soon as action taken.
- Monthly progress meetings with contractors at which CARs from previous month examined and checked.
- Three monthly progress reports to WB detailing problems and Corrective Actions taken.
- Checks with complainants that they are satisfied

Review of progress must be checked on a daily basis by the inspectors. Any urgent issues must be drawn to the contractors’ attention immediately. Failure by the contractor to respond in a timely or adequate manner must be raised with them at the monthly progress meetings. The procedure is shown below.
14.35 Corrective Action Reporting

In the event of an incident or complaint Corrective Action Reporting must be implemented. This is an iterative process whereby reported incident cannot be left unattended.

In the event of an incident the contractor will be informed verbally to be followed up by a formal instruction, which can be handwritten. This would then be followed by a letter. The contractor will be expected to take action immediately or as soon as reasonably possible. There is no reason to delay.

In monthly progress meetings between contractor and client’s representative the incident report will be reviewed. If the incident has been dealt with and the situation is now satisfactory this will be recorded. If the situation is still not acceptable then a CAR will be issued. This warns the contractor that unless action is taken financial penalties may be applied. The situation is then formally reviewed at the next monthly meeting (See Figure 14-5 below). This procedure is intended to ensure that incidents and remedial measure are not overlooked. It does not mean the contractor can wait a month to take action. A prompt response to any situation is expected.
14.36 Institutional Roles and Responsibilities

14.36.1 Institutional Arrangements

In order to implement the project various stakeholders will have a part to play. Their roles and responsibilities are described below. Where appropriate, capacity building and enhancement is recommended.

14.36.2 Federal Ministry of Environment

The Federal Ministry of Environment is the Agency of government responsible for the formulation and enforcement of policies/regulations on environment in Nigeria. Under this project the Federal Ministry of Environment will perform supervisory functions at the government level during construction and even during operation of the facility. This will involve taking measurements and collecting relevant samples. Experience, though, has shown that the Ministry lacks the budgetary provisions required to enable it carry out its role in ensuring safeguards compliance. The Ministry lacks the equipment required to carry out basic sampling and even had to be rescued by TCN-PMU through NEGIP for the provision of internet services, a functional website, office equipment, project vehicles and a stand-by generator. It is necessary that the TCN-PMU extend this goodwill to this project by providing basic sampling equipment.

14.36.3 TCN management

Following the implementation of previous World Bank assisted energy projects like the Nigeria Transmission Development Project (NTDP) and the National Energy Development Project (NEDP) the management of TCN established an Environment, Resettlement and Social Unit (ERSU) at the corporate headquarters. There are plans to extend this structure to the regional offices with the presence of two (2) ERSU personnel at the Regional offices and one (1) in each substation. TCN needs to ensure swift implementation of this ERSU structure and provide appropriate training and equipment for the ERSU staff to enable them carry out their role as stated in this ESIA.
14.36.4 TCN-PMU & ERSU-PMU
The ERSU-PMU has been managing safeguards compliance of all World Bank financed power projects since the inception of the TCN-PMU. This Unit is made up of well trained personnel that have been involved in safeguards monitoring and preparation of safeguards instruments required by the World Bank for Electric Power Projects. The ERSU will assign specific personnel that will be responsible for monthly safeguards monitoring of the execution of the contract. They will produce monthly reports that will be used in assessing the level of compliance of the contractor with the provisions of this ESIA. The ERSU personnel will also be responsible for raising quarries and penalties in the event of a default on the part of the Contractor to avoid a complete deterioration of the safeguards conditions of the project site.

The TCN-PMU has in the past provided capacity building and training assistance to the Federal Ministry of Environment and the TCN-ERSU. A lot still needs to be done in this area to ensure safeguards compliance at the project sites considering the non-availability of resources for both agencies to accomplish this task.

14.36.5 TCN on-site personnel
The TCN on-site personnel will be responsible for the day-to-day safeguards supervision of the execution of the contract. They will alert the regional TCN office and the ERSU PMU of any serious safeguards breaches or accidents for immediate follow-up actions. They will also compile their weekly safeguards monitoring reports and send to the ERSU-PMU and TCN regional offices for any further necessary actions.

14.36.6 The Supervising Engineer
Besides ensuring strict compliance with the engineering specifications the Supervising Engineer is also expected to ensure compliance with all other aspects of the contract by the Contactor like environmental and social safeguards. Consequently, the supervising Engineer is expected to have a suitably qualified HSE personnel on site on a daily basis. This HSE personnel will grant work permits, enforce use of PPEs, ensure that only suitably qualified and properly trained persons are used by the Contractor for any particular jobs, enforce ‘stop work’ orders in the event of safeguards breach by the Contractor and recommend appropriate punitive measures to prevent re-occurrence of same.
**14.36.7 Construction Contractor**

The civil works contractors must implement adequate precautions to protect the environment, avoid disturbance to residents, deterioration of the amenity of the area, and ensure the health and safety of construction workers.

The contractors will undertake the following activities:

- An Environment Health and Safety Officer (EHSO) will be appointed who must prepare an Environment Health and Safety Management Plan (EHSMP).
- The EHSO will ensure that the EHSMP is submitted to TCN prior to construction for approval.
- The EHSO will ensure that accurate records and reports of any occupational health and safety incidents are kept.
- The occupational health and safety risks will be minimized by providing adequate personal protective equipment (PPE) and ensuring workers wear it. The EHSO will review the distribution and use of appropriate PPE.
- The EHSO will also encourage awareness building on safety through activities such as “Toolbox Briefings” and reporting “Near Misses.”

Contractors should check daily that all operations are being conducted correctly. In general, “good housekeeping” must be employed.

Contractor must report on a monthly basis to the CSC on implementation of the ESMP. Notwithstanding monthly reporting they must react promptly to any incidents occurring and respond quickly to any complaints received.

All monthly reports will be compiled into 3 monthly, 6 monthly and annual reports.

**14.36.8 World Bank**

All monthly, 3 monthly and 6 monthly reports will be compiled into an annual report to be submitted by TCN to World Bank. An annual review and environmental and social audit may be carried out by WB at their discretion.

**14.36.9 Plant Operator**

After construction the site will be taken over by the plant operator. This will probably be TCN but could be a third party in the event of a transfer such as occurs in privatisation. The operator will be required to observe and comply with the requirements of the ESMP and follow the reporting schedule described above.
15 Public Consultation

15.1 Consultation with Stakeholders
Consultations were held with regulatory agencies and other relevant stakeholders as shown below:
- Federal Ministry of Environment
- State of Gombe Ministries of Environment,
- State of Gombe Ministries of Lands/Surveyor General’s offices,
- Community Based Organizations,
- TCN Regional Offices
- ERSU - PMU - TCN
- Project-affected persons (PAPs)

During the Initial Site reconnaissance consultations were held with PAPs. Then during the Baseline Site Sampling Focus Group discussions were held.
Public consultations were then held in Abuja as an Interagency Meeting and in each the state.

15.2 Interagency
The Interagency Meeting was held at TCN offices in Abuja on September 15\textsuperscript{th} 2015. It was well attended with 30 people present and several presentations were made by TCN, consultants and World Bank.

TCN emphasized its approach to Corporate Social Responsibility (CSR) through which it wants to implement a good neighbor policy and will achieve this through preparation and use of good Environmental and Social Impact Assessment (ESIA) and Environmental and Social Management Plan (ESMP).

TCN GM PMU Engr. Ciroma Joseph stated that the stakeholder meeting was the first stage of stakeholder engagement. He explained that the Environmental and Social Impact Assessment study is a requirement by the World Bank and must be done before the project can be carried out. He explained that the forum must be an open and interactive session

A goodwill message was delivered by Mr. Biodun representative of the Permanent Secretary, Federal Ministry of Finance (FMF). He commended the efforts of the PMU in organizing the forum and the efforts of World Bank in providing funding for the project. He stated that sustainable development is hinged on three pillars- economic viability, social and environmental safety. He stressed that we must ensure that the project does not have adverse impact on the health, livelihood and safety of the communities and the general public.

World Bank stressed the need for an effective Grievance Redress Mechanism. FMEnv emphasized the need for site visits to establish the real situation on the ground. SMEC concurred with this
approach and stated that the Team Leader had visited all sites so that all GIS data could be ground truthed. Metaspec confirmed that their staff were in the field carrying out baseline sampling at that moment.

No objections were raised to the project. Further details were requested as the project progresses.

15.3 Biliri Gombe

The Public Consultation was held in the Palace of the Mai Tangle of Biliri on the 15th of October 2015. Previously letters of invitation had been sent out and adverts placed in two newspapers. The language of communication was English and Hausa.

The chairman was His Excellency, the governor of Gombe State represented by the Biliri local government caretaker chairman Mr Jubrin Dawa. All the Traditional rulers and members of the traditional ruling council were present.

The session was well attended with 99 people present and presentations were made by TCN and the consultants. A question and answer session followed.

A member of the Biliri ruling council applauded the federal government of Nigeria for choosing Biliri for the establishment of the substation.

He emphasized the fact that the micro businesses are driven by power and therefore needed to be factored in before electricity pricing in Nigeria. He explained that micro businesses that are likely to grow in Gombe as a result of quality electricity will require some level of rebate to be able to stay in business. Price of food items are affected by the price of electricity. He encouraged the project owners TCN to improve on their social responsibility to the Host communities.

Federal ministry of environment represented by Mr Celestine Gonwalk said that a detailed engineering design of the project ought to have been presented. He equally said that there is need to put in place a system to check the influx of foreigners that will come into Biliri as a result of the project to seek greener pastures. It was noted that the police and immigration cooperate to control the influx of foreigners.

A question was asked if Biliri benefit from carbon credits. The response was that Nigeria as a nation can assess their carbon credit from the World Bank through the Department of Climate Change in the Federal Ministry of Environment.

Queries were made about effects of EMF from high electrical fields. TCN stated that local residents would be discouraged from constructing dwellings underneath the power lines. Workers would follow strict Health and Safety procedures within the plant.

A resident noted that access to the site was restricted. TCN said that a new access road was budgeted for in the contract.

The chairman summed up by saying that no serious disturbance was envisaged during this project.
execution since the communities, industries, LGA officials, state government now see themselves as partners in the development of their areas.
16 Conclusions

16.1 Potential Adverse Impacts and Mitigation

16.1.1 Drainage
There is a small watercourse running across the site but at the time of the site investigation this was dry. It is a rainwater runoff channel and should be redirected during site formation. There are no drainage issues on the site. There are no main rivers within 2kms of the site.

16.1.2 Site Access
The site is located near residential development and the existing access is through a restricted narrow roadway crossing a steep sided small stream. It is recommended that a new access road be constructed linking the site with the main road to the north of the site at a distance of about 900m from the site. This will avoid a stream crossing and significantly reduce the risk of traffic accidents. It is recommended that the contractor be instructed to make a temporary access road to the site from the north off the main road. A new access would remove the road safety hazard.

16.1.3 Noise Levels
The Nigeria National Environmental Noise Standards and Control Regulation (2009) require noise levels of 50dB(A) $\text{Leq}_{(12 \text{ hours})}$ during the daytime and 35 dB(A) $\text{Leq}_{(12 \text{ hours})}$ during nighttime at the perimeter of the site to preclude noise nuisance to residential property that may be built adjacent to the site in the future. Based on the Technical Specification for transformers and measured noise levels, it is recommended that transformers should not be located within 80m of the boundary of the site. This is a worst case scenario. Following this recommendation would ensure no complaints over noise intrusion both during the night time and during daytime during operation. It also allows a margin for intensification of use in the future.

16.1.4 Climate Change
Climate change projections show that there will be significant differences between sites in the north and sites in the south, with the north being more subject to droughts and the south being more subject to floods. This may impact on the demand load imposed on the transmission system but will not impact on the site of this project.

16.2 Positive Impacts
- The proposed projects will provide short term, local employment opportunities during the construction phase for community members in terms of site clearance, excavation, loading...
and offloading of materials. Other short term opportunities may arise from the provision of security services where temporary camps or stores are erected and from opportunities to provide goods and services to construction workers e.g. food kiosks and other shops.

- The long term impact is provision of power to the area with associated improvement in standard of living and economic development.
- All new transformers are specified as being free of PCBs. No PCBs will be present on the sites and there is no need for concern on this issue.
16.3 Matrix of Significant Impacts

The Matrix of Significant Impacts is given below. This site is one of four under consideration for project development. The matrix refers to all four although this ESIA refers only to Biliri in Gombe.

<table>
<thead>
<tr>
<th>ENVIRONMENTAL IMPACTS</th>
<th>Biliri</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction</strong></td>
<td><strong>Operations</strong></td>
</tr>
<tr>
<td>Water Quality</td>
<td>✅ ✅ ✅</td>
</tr>
<tr>
<td>Flooding from sleep gradient</td>
<td>✅</td>
</tr>
<tr>
<td>Soil Contamination from spills</td>
<td>✅</td>
</tr>
<tr>
<td>Air Quality</td>
<td>✅ ✅ ✅</td>
</tr>
<tr>
<td>Waste solid and liquid</td>
<td>✅ ✅</td>
</tr>
<tr>
<td>Noise</td>
<td>✅ ✅</td>
</tr>
<tr>
<td>Visual impact</td>
<td>✗</td>
</tr>
<tr>
<td><strong>Physical</strong></td>
<td></td>
</tr>
<tr>
<td>Fauna</td>
<td>✗</td>
</tr>
<tr>
<td>Flora</td>
<td>✗</td>
</tr>
<tr>
<td><strong>Biological</strong></td>
<td></td>
</tr>
<tr>
<td>Resettlement</td>
<td>✅</td>
</tr>
<tr>
<td>Cultural</td>
<td>✗</td>
</tr>
<tr>
<td>Occupational Health and Safety</td>
<td>✅ ✅</td>
</tr>
<tr>
<td>Community</td>
<td>✅ ✅</td>
</tr>
<tr>
<td>Utilities</td>
<td>✅ ✅</td>
</tr>
<tr>
<td>None</td>
<td>✗</td>
</tr>
<tr>
<td>Minor</td>
<td>✗</td>
</tr>
<tr>
<td>Moderate</td>
<td>✅ ✅</td>
</tr>
<tr>
<td>Significant</td>
<td>✅ ✅ ✅</td>
</tr>
</tbody>
</table>

Figure 16-1 Matrix of Significant Impacts

Prior to decommissioning, a decommissioning plan will be prepared, according to final monitoring and the decommissioning impacts listed in Table 14.1. A generic Decommissioning plan is given as a guide in Annex 10.

16.4 Site Development

No key issues have been identified that will preclude the development of the site as intended.
17 Annexes

17.1 Annex 1 Environmental Regulations Gazetted

The Federal Government through NESREA has developed 24 Environmental Regulations which have been published in the Federal Republic of Nigeria Official Gazette and are now in force. The Regulations are:


3. National Environmental (Sanitation and Wastes Control) Regulations, 2009. S. I. No. 28. The purpose of this Regulation is to provide the legal framework for the adoption of sustainable and environment friendly practices in environmental sanitation and waste management to minimize pollution.


5. National Environmental (Access to Generic Resources and Benefit Sharing) Regulations, 2009. S. I. No. 30. The overall purpose of these Regulations is to regulate the access to and use of generic resources to ensure the regeneration and sustainability of threatened species.


8. National Environmental (Food, Beverages and Tobacco Sector) Regulations, 2009. S. I. No. 33. These provides to prevent and minimise pollution from all operations and ancillary activities of food, beverages and tobacco sector to the Nigerian environment.

9. National Environmental (Textile, Wearing Apparel, Leather and Footwear Industry) Regulations, 2009. S. I. No. 34. The main thrust of this Regulation is to prevent and
minimize pollution from all operations and ancillary activities from the sector to the Nigeria environment.

10. National Environmental (Noise Standards and Control) Regulations, 2009. S. I. No. 35. The main objective of the provisions of this Regulation is to ensure tranquility of the human environment or surrounding and their psychological well-being by regulating noise levels.

11. National Environmental (Chemicals, Pharmaceuticals, Soap and Detergent Manufacturing Industries) Regulations, 2009. S. I. No. 36. This Regulation is to prevent and minimize pollution from all operations and ancillary activities from this Sector in order to protect Nigeria environment.

12. National Environmental (Standards for Telecommunications/Broadcasting Facilities) Regulations, 2010. S. I. No. 11. The main objective of these regulations is to protect the environment and human health, ensure safety and general welfare, eliminate or minimize public and private losses due to activities of the telecommunications and broadcast industry.

13. National Environmental (Soil Erosion and Flood Control) Regulations, 2010. S. I. No. 12. The overall objective of these Regulations is to check all earth-disturbing activities, practices or developments for non-agricultural, commercial, industrial and residential purposes.

14. National Environmental (Desertification Control and Drought Mitigation) Regulations, 2010. S. I. No. 13. This Regulation seeks to provide an effective and pragmatic regulatory framework for the sustainable use of all areas already affected by desertification and the protection of vulnerable lands.


16. National Environmental (Control of Bush/Forest Fire and Open Burning) Regulations, 2010. S. I. No. 15. The principal thrust of these Regulations is to prevent and minimize the destruction of ecosystem through fire outbreak and burning of any material that may affect the health of the ecosystem through the emission of hazardous air pollutants.

17. National Environmental (Protection of Endangered Species in International Trade) Regulations, 2010. S. I. No. 16. The major objective of this Regulation is to protect species of endangered wildlife from extinction through the prohibition of trade, importation, etc.

18. National Environmental (Domestic and Industrial Plastic, Rubber and Foam Sector) Regulations, 2010. S. I. No. 17. The principal thrust of this Regulation is to prevent
and minimize pollution from all operations and ancillary activities of the Domestic and Industrial Plastic, Rubber and Foam Sector to the Nigerian environment.

19. National Environmental (Coastal and Marine Area Protection) Regulations, 2010. S. I. No 18. This Regulation provides for the regulatory framework for the application of preventive, precautionary and anticipatory approaches so as to avoid degradation of the coastal and marine environment.


21. National Environmental (Control of Vehicular Emissions from Petrol and Diesel Engines) Regulations, 2010. S. I. No. 20. The purpose of these regulations is to restore, preserve and improve the quality of air. The standards contained herein provide for the protection of the air from pollutants from vehicular emission.


23. National Environmental (Surface and Groundwater Quality Control) Regulations, 2010. S. I. No. 22. The purpose of this Regulation is to restore, enhance and preserve the physical, chemical and biological integrity of the nation’s surface waters, and to maintain existing water uses.

24. National Environmental (Electrical/Electronic Sector) Regulations, 2010. S. I. No 23. The principal thrust of this Regulation is to prevent and minimize pollution from all operations and ancillary activities of the Electrical/Electronic Sector. This Regulation covers both new and used Electrical/Electronic Equipment (EEE/UEEE)

These Regulations are to ensure that the national development agenda is not at variance with the carrying capacity of the environment.
17.2 Annex 2 Biliri: Gombe State (north-eastern Nigeria) Stakeholder Public Consultations

Public Consultation took place with local stakeholders. Details are given below.

STAKEHOLDER’S FORUM FOR THE ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR THE PROPOSED CONSTRUCTION OF 330/132KV and 132/33KV TRANSMISSION SUB-STATION AT BILIRI GOMBE STATE

PURPOSE
Stakeholder’s forum for the Environmental and Social Impact Assessment (ESIA) for the proposed construction of 330/132KV and 132/33KV Transmission Sub-Station at Biliri, Gombe State.

DATE:
Thursday 15th October 2015

VENUE:
Palace of the Mai Tangle of Biliri

LANGUAGE OF COMMUNICATION:
English and Hausa

PROGRAMME:
The meeting which was earlier slated for 11am was actually flagged off by 12pm with the introduction of the chairman of the programme, His Excellency, the governor of Gombe State ably represented by his Deputy who was also represented by the Biliri local government caretaker chairman Mr Jubrin Dawa. The caretaker chairman and other dignitaries from Gombe State were introduced by Mrs Asabe Baba Nahaya who served as the Master of ceremony for the occasion. All the Traditional rulers and member of the traditional ruling council, other members present were introduced.

Mr. John Curtis of the transmission company of Nigeria (TCN) introduced all the members present and the consultants from SMEC PTY international.

The forum was officially opened with a prayer by the representative of the Mai Tangle of Biliri, the breaking of kola nuts by one of the traditional rulers followed.
Chairman’s Remarks

The chairman in his opening remarks stated that the forum held in the palace of Mai tangle was very informative and thanked the organizers for a beautiful job done. He said the government of Gombe state freely endorsed the project. He continued by stressing the importance and benefits to be deserved from the project which included, employment opportunities for the locals bringing more economic developments to the community.

- The project will provide suitable ground for skills acquisition, technology transfer, human empowerment
- The new project will increase revenue base of Biliri LGA and Gombe State Government. The chairman promised to report back to his Excellency, the executive Governor of Gombe state. He placed the responsibility of protecting the facility on the local chiefs and also solicited support from the youths. A stern warning was handed down to the people who many sabotage by vandalizing the facility.

Biliri Ruling Council

A member of the Biliri ruling council applauded the federal government of Nigeria for choosing Biliri for the establishment of the substation.

He emphasized the fact that the micro businesses are driven by power and therefore needed to be factored in before electricity pricing in Nigeria. He explained that micro businesses that are likely to grow in Gombe as a result of quality electricity will require some level of rebate to be able to stay in business. Price of food items are affected by the price of electricity. He encouraged the project owners TCN to improve on their social responsibility to the Host communities.

Federal ministry of environment represented by Mr Celestine Gonwalk said that a detailed engineering design of the project ought to have been presented. He equally said that there is need to put in place a system to check the influx of foreigners that will come into Biliri as a result of the project to seek greener pastures.

Question and answer session commenced immediately after the presentations

Question: Why does distribution section put fixed charges even when there is no power?

Answer: Mr. Bechila B.R. of TCN Gombe explained that Transmission Company of Nigeria (TCN) only transmitting power, not distributing/ selling.

NERC had on several occasions and several fora explained that when a product is being promoted, some charges are incurred in the process, Equally some damages occur while transmitting power.
over a distance, Vandalizations do occur. There are other unforeseen challenges that will put cost of transmission and even distribution unit. These are the reasons why fixed charges are placed on customers. Transmission must buy from Generation. Besides, Transmission does not collect money, it is the distribution that does that. The TCN representative continued by suggesting that distribution (Jos Electricity Distribution Company) could employ the use of jingles to explain certain grey areas or issues to customers as a kind of sensitization exercise.

**Question:** How the issue of criminality that are likely to result from influx of foreigners who may come to seek greener pastures.

**Answer:** During the data gathering exercise and forum also held at the palace of the Mai Tangle, this same question arose. The community said that they operate internal security checks organized by the youths who are supported by the community people. They cited a case where a neighboring community killed some Biliri indigenes over community land conflict. He explained that the youth provided security that successfully rebuffed the invaders.

**Answer:** Biliri has internal security networks. They are also advised to work and cooperate with the police and immigration section to be able to deal with the issue of sudden influx of foreigners.

**Question:** How do you deal with the issue of soil erosion and desert encroachment in Biliri?

**Answer:** The soil erosion and desert encroachment, there is a programme of the federal government of Nigeria that takes care of both erosion and desert encroachment, the fund is called Ecological fund, disbursed by Federal Government and managed by the state government.

**Answer:** Tree planting project that takes care of desert encroachment or a forestation.

**Question:** How can Biliri benefit from carbon credit?

**Answer:** Nigeria as a nation can assess their carbon credit from the World Bank through the Department of climate change in the Federal Ministry of Environment.

**Question:** Is there any way the Federal Government and World Bank could assist Biliri local government to develop its own private university since many of our children are denied admission/placement in both state and federal universities?

**Answer:** Mr. Bechila B.R advised the good people of Biliri who are very lucky to parade many
professors and other professionals in all works of life to use them to reach out to various arms of government, national universities commission, politicians in and out of power to help lobby the appropriate people in authority to assist Biliri to obtain the license to develop and operate private university in Biliri. The World Bank may not come in directly but can help to establish other projects that may help in university establishment. A typical example in the power project 132/33KV power substation. University facilities require quality power to operate successfully.

**Question:** How would TCN/World bank handle the issue of electromagnetic radiation from the project?

**Answer:** The community has been advised not to build houses under high tension cable because of radiation fallout which could be injurious to health.

In the case of staff who will work in the switch yard, the exposure limit of eight hours will not be exceeded. Staff will be rotated to avoid exposure of more than eight hours per day. Besides, special aprons (PPE) to prevents the penetration of radiation into the body will be used by staff who work in the switch yard.

Finally standard operation procedures (SOPs) will be prepared to guide workers in the facility. HSE department will be strengthened to supervise all work procedures with safety measures put in place, safety caricatures, safety handouts, poster pasted at the right places. Equally hazardous areas will be marked out or access restricted or limited except authorized personnels.

**Question:** What will TCN do to improve access to the project site since the project site is not presently accessible?

**Answer:** TCN representative Said that construction of a standard access road to the facility was captured in the contract. There is a plan to construct an access road to the site to enable heavy trucks that will carry materials to the site to do that without difficulty.

**Question:** What is the capacity of the project?

**Answer:** There is going to be installed, a 2 x 60mVA transformers in the substation. These transformers are capable of supplying electricity to the whole of North Eastern part of Nigeria. The coverage is enormous considering the fact as at now only one feeder supplies Kumo, Biliri and even part of Taraba, then, six of such feeders from this 2 x 60 MVA transformer can supply many towns and communities. There are however other factors to be considered. The aim actually is to radiate a lot of energy/power to supply quality electricity.
**Question:** Will the youths be allowed to supervise and monitor the project?

**Answer:** Engineer Femi Abiola of TCN-PMU said that youths are not the ones that should monitor the project but are rather expected to cooperate and liaise with the contractors to ensure work is going on smoothly without issues.

**Answer:** Mr Bechila B.R of TCN added that the police and local vigilante groups should help to serve and protect materials and properties of the facility and that of contractors. He reminded the youths to shun corruption and forget anything material gains, rather the youths should be organized to extend the community good public relation and protect the facilities on ground.

The business unit manager of Jos Electricity Distribution Company informed the forum that Biliri LGA pays the highest bill in Gombe and for that reason the unit is considering bringing back the business unit that was removed due to downsizing carried out by the new owners of the facility. He also explained that the variation is also due to cost implications of the new owners arising from the privatization exercise and running costs.

**General comments on the effectiveness of the stakeholder’s consultation.**

- News of the project was gladly received and approved by the community more especially the benefits of gainful employment for their wards from present and future industries in the area.
- Industrialists especially cottage ones and private business people were eager to have the project completed due to the reliability/cost effectiveness, of electricity/power over erratic/expensive fuel supply for alternative power source with generator.
- The power project will further attract more invertors to the area.
- No serious disturbance is envisaged during this project execution since the communities, industries, LGA officials, state government now see themselves as partners in the development of their areas.
A signed attendance sheet was filled in and proof of occupancy provided.
THE DAILYTRUST AND DAILYSUN NEWSPAPERS ADVERT FOR THE PUBLIC FORUM
ESIA for the Proposed 132/33kV Transmission Substation at Biliri, Gombe State | 272
17.3 Annex 3 Field Sampling and Analysis Plan (FSAP)

17.3.1 Materials and Methods

A.1 Background
The fieldwork for data gathering was embarked upon in August and September 2015 (Rainy season) by a multi-disciplinary team. A reconnaissance visit was carried out to crosscheck potential sampling locations proposed on the location map of this study area with the actual situation on ground. Sampling was then commenced following the conclusion of this exercise. The actual locations where samples of different types were collected are indicated in study sampling Map. Sampling locations were identified using a Global Positioning System (GPSmap 76) Garmin GPS Receiver instrument configured in the Nigerian Minna datum with the geodetic co-ordinates of the points already imputed into the system. In the navigation mode, this equipment provides a compass of the target position, elevation above sea level and the UTM Coordinates of this target position.

A.2 Statutory Regulators
A representative from the Federal Ministry of Environment and some personnel from Transmission Company of Nigeria (TCN) were present throughout the duration of the fieldwork. Their function was to ensure that environmental samples were collected and preserved (where necessary) according to recommended procedures and practices for environmental data collection in Nigeria.

A.3 Quality Control/Quality Assurance (QC/QA)
The QC/QA programme covered all aspects of the study, including sample collection and handling, laboratory analyses, generation of data and coding, data storage and treatment as well as report preparation. The quality assurance programme used in the fieldwork and laboratory analyses is in accordance with recommendations by National and International Regulations.

17.3.2 Sample Collection and Handling
This was done as stipulated in National and International guidelines and standards. In preparation for fieldwork, glassware to be used were washed with detergent solutions, rinsed with tap water, then soaked in 1:3 nitric acid solutions for 24 hours to remove organic materials, washed again with tap water and rinsed with distilled water. Plastic containers were washed with detergents, rinsed with tap water, followed by distilled water.

After drying, all the containers were rinsed with acetone to remove organic materials, and rinsed with distilled water. Aluminium foils were obtained for soil and sediment samples. Water sampling equipment was rinsed with portions of the water to be sampled. Composite samples per sampling point were taken with thoroughly cleansed containers. Sterile wide-mouth polypropylene and
Pyrex glass sample bottles were used. Samples for oil and grease were collected in clean and dry glass-stoppered bottles and were usually not completely filled to avoid losing oil when the stopper was inserted.

17.3.3 Sample identification
Specific details on sample identification were entered on a permanent label to reflect project, date, sample matrix, sampling point, sample number, depth, as the case may be.

17.3.4 Storage/Preservation
As samples could be subject to microbial degradation and transformation, they were therefore analysed at minimum time after collection. Since storage may be necessary for water samples for physico-chemical parameters, they were stored in ice-chest as a cooling device and transported to the laboratory where they were refrigerated at 4°C. Samples for heavy metal analyses were preserved with 1:1 nitric acid and oil and grease with 1 ml of 1:1 H₂SO₄ as soon as they were collected as recommended. Adherence to good preservation procedures ensured that errors were not introduced into the analytical process.

17.3.5 Fieldwork
Carrying out field calibrations of equipment and running distilled water blanks reduce errors that could arise from field measurements. Replicate samples were collected and used as checks of instrument performance. Field analytical operations were done in a defined sequence to avoid cross contamination of instruments. (Conductivity was always determined before pH because concentrated electrolyte in the pH reference electrode may get into the sample and affect conductivity measurements) Field data collection procedures used for this fieldwork are discussed below:

A.4.1 Aquatic Environment
Field Sampling procedures

Water Chemistry/Microbiology

A stainless steel grab was used to collect surface water samples at the designated locations at the top (a few cm below surface) of the water bodies. The following parameters were measured in-situ: pH, Temperature, Total Dissolved Solids (TDS), Dissolved Oxygen (DO), Electrical Conductivity (EC) and Turbidity. Amber bottles of 250ml capacity were used to collect water samples for microbiological analysis. Plastic containers of 250 ml was used for heavy and trace metals and the
samples were acidified to pH of 2 in the field using concentrated nitric acid. All the other samples for physico-chemical measurements were transported to the laboratory in ice coolers. Surface water samples were collected at the designated sampling points as in water chemistry. Sterile 1000 ml plastic containers with plastic screw caps were used to transport the samples.

Sediment samples were collected at every site where water samples were obtained. Eckman Grab was used to obtain sediment samples. These samples were transferred into sterile polyethylene ziplock sachets. All sachets were appropriately labelled. The samples were preserved in ice chests and transported to the laboratory for analysis.

Surface water velocity was measured at the various sample locations using a buoy, a meter rule and a timer. The depths of the river were determined using a calibrated pole.

A.4.2 Soil Chemistry/Microbiology

Soil samples were collected from site as indicated in the location map provided for this exercise. Surface (0 – 15cm) and sub-surface (15 – 30cm) soil samples were collected at these locations using an Arts mfg stainless steel Hand Auger. Sampling tools are:

**Soil auger:** Auger was made of stainless steel, and is capable of retrieving a cylindrical plug of soil 3 inches in diameter and 6 inches deep.

**Trowels:** used for extruding soil sample from the auger and the use of chrome plated trowels was avoided because samples were to be analyzed for trace metals, as they may interfere with the analysis.

**Collection containers:** The following sub-samples were taken for each depth, namely;

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

**Gloves:** for personal protection and to prevent cross-contamination of samples. May be plastic or latex; should be disposable and powder less.

A.4.3 Vegetation and Wildlife

The materials used for the field work include secateurs, polythene bags, large jute bags, laundry pen, labelling tapes, specimen bottles, hand lens, improvised hook and measuring/calibrated tapes.

Sampling for diversity and abundance was carried out in blocks of 5 and 50m2 each, which were
selected at random from the proposed project site and locations nearby settlements. Direct species counts were taken within the sampling blocks, which also served as quadrants. Leaf and stem materials were taken in specimen bottles containing 70% ethanol, fixative stain solution and formal acetic acid (FAA) for laboratory histochemical analyses. Plants were examined in vivo for signs and evidence of environmentally induced stress as well as disease conditions. General health condition of the vegetation was visually evaluated. Plant materials that could not be identified in the forest (on-site) were taken for identification with taxonomic keys and flora in the Herbarium.

The wildlife assessment of this study involved a survey of amphibians, reptiles, birds and mammals within the Study Area. Experienced hunters in the area were located through personal contacts and in the first instance, were asked to give account of the variety of local animals using vernacular names. The names given by the hunters are most often generic, covering several similar species or even whole families. As a result, confirmation of the species present was made by presenting to the hunters colour photographs of the skins of some of the animals (Happold, 1987) and photographs of snakes (Cansdale, 1961). A few additional confirmations were made through sighting and vocalization when the Assessment Team went to the bushes within the study area.

A.4.4 Air Quality

A.4.4.1 Sampling Scheme

The primary-Secondary type of schemes for making air pollution measurements was applied to mitigate the problem of air quality sampling which are number of sampling stations, location of the stations, sampling time and the frequency of Sampling (Blokker 1973). The measurements were made with a group of instruments, which are moved from one fixed measuring point to another in a predetermined manner. These measurements are then related to meteorological data made at the same time or obtained from a synoptic meteorological station. An advantage of this scheme is that a large area was covered with a minimum of instruments. The data obtained fulfils the main objectives of characterizing air quality and checking adherence to air quality standards.

A.4.4.2 Sample Collection

At each sampling station one hour measurements was taken to enable us analyse for particulate matter suspended in the air, Carbon monoxide, nitrogen oxides as nitrogen oxide, sulphur dioxide, oxygen and hydrogen sulphide using a Testo 350XL Flue gas Analyser. The group of equipment for air quality sampling was moved from sampling station to sampling
station after each round of sampling was concluded at a particular sampling location. For practical and security reasons, measurements were not taken far into the night. Nocturnal conditions were, therefore, not fully covered. During the sampling, care was taken to avoid undue interference from any ‘external’ gaseous emission source while sampling. (Team Vehicles)

A.4.4.3 Meteorological Measurements

The following supporting measurements were made:

(i) Wind direction and Speed
(ii) Air temperature
(iii) Relative humidity
(iv) Atmospheric Pressure

This information is in addition to the continuous meteorological data which is available from the Nigerian Meteorological Agency (NIMET) and previous studies in the geographic area. The parameters were measured using hand held digital Anemometer.

A.4.4.3 Noise Measurements

Noise levels were measured using a hand-held battery operated noise level meter (TECMAN INSTRUMENTS – Digital Sound Level Meter Model No. TM824) within the proposed site and community respectively after it was calibrated with a digital Multi- Range Sound Acoustical Calibrator. The meter had measuring range of 30 – 130 dB (A), accuracy of ±1.5 dB (A) and Resolution: 0.1 dB. Monitors were located approximately 1.5 m above the ground and no closer than 3 m to any reflecting surface (e.g., wall).

A.4.5 Waste Management

The various sources of an existing transmission substation generated wastes and the local waste disposal techniques in the project area were identified. This included identification of local waste management techniques and/or the ultimate destination of wastes.

A.4.6 Geology / Hydrogeology

Soil profiles were determined through profile pits and coring with Arts mfg Stainless steel auger. During drilling, soil samples were regularly taken at one metre interval, visually described and a field litholog was prepared. The samples were then stored in polythene bags, sealed and transported to laboratory (geotechnical) for further studies. At each boring site, the following field data were collected:

Ground elevation above mean sea level
Depth of boring
Existing hand dug wells and boreholes were sources of hydrological samples for groundwater quality check. Secondary data with primary data recorded during the field work were used for the geotechnical results.

A.5 Laboratory Procedure/Data Analysis

A.5.1 QA/QC for Laboratory analysis and generation of data

Possible sources of error in laboratory analysis include contamination of reagents and materials, lack of sensitivity of equipment, lack of calibrations, poor data entry and interpretation. Glassware and other containers to be used for each analysis were thoroughly cleansed as appropriate for each parameter. All glassware used for oil and grease determination was pre-rinsed with Analar grade xylene. Glassware for determination of metals were pre-soaked in dilute nitric acid and then rinsed well with distilled water. All reagents and chemicals of high purity (mostly Analar grade) were used. Freshly distilled water prepared in the laboratory was used for all dilutions.

The various instruments and equipment for measuring physico-chemical parameters were used while in good working condition. Periodic control checks were usually carried out on such instruments/equipment and performance records maintained. For analytical determination requiring the use of calibration curves, such curves were plotted using standard solutions prepared from analytical grade reagents. Records of such calibration curves were maintained and frequent re-calibration checks were carried out. Analytical blanks are incorporated per specific batches of samples to compensate for the sample preparation and determination steps. All the analyses were replicated and the means reported.

17.3.6 Chain of samples custody procedure

There is a Master register for all samples brought into the laboratory. Following registration of the sample, a Sample Data Sheet containing pertinent information on the sample was opened for the samples. The information includes:

- sample reference number,
- nature or type of sample,
- site of collection,
- date and time of collection,
- mode of preservation (depends on nature of material) and analytical data from the field and results of laboratory analyses of representative samples.

Appropriate methods were used in storing the remaining stock materials and sub samples. Samples for storage were kept in labelled compartments on shelves in a storage room. Samples sent to
cooperating laboratories were recorded in the Master Register, accompanied by essential data pertaining to the sample material and appropriate custody transfer forms were filled.

17.3.7 Evaluation of results
Raw data obtained from the instrumental measurement were used in calculating the concentrations of the various parameters, using standardized formulae. All such calculations were crosschecked. Outlying values were deleted from the replicate data before calculation of mean concentrations. A quick identification of results, which deviate from the normal trend, was usually done. Calculated and observed conductivity measurements and other indicator parameters are compared, to check reliability and accuracy of data.

A.6 Health Aspects
This study was conducted using cross-sectional, descriptive design, consisting of epidemiological and environmental health survey. The tools and techniques of data collection were structured questionnaire, checklists, interviews and focus group discussions. Sample analyses were also carried out on domestic water sources and ambient air by the team.

A.6.1 Document review
This first step of the study included the review of all relevant documents and literature that contribute to the HIA study.

A.6.2 Community Consultations/Entry
Community consultations form a key component, and have indeed been used as a vital tool in this HIA study. This vital process was intended to secure the much-desired social license (permit) to operate in the host communities. The broad objectives of this consultation process were:

- To educate and enlighten the communities on the need for their involvement as partners in progress towards the successful conduct of the health assessment process.
- To build up their trust in the project operators.
- To build trust and enhance the capacities of the host communities in health management, through participation in the identification of the pathways by which the health hazards may be introduced into the population.
- To form and promote partnership with all other stakeholders, such as non-governmental organisations (NGOs), through information exchange and participation in open forum and consultations.

During this study, consultations were carried out with communities and all relevant stakeholders prior to community entry and during each stage of the field work.

A.6.3 Focus Group Discussions and Interviews
Focus group discussions were held in each of the study communities. The following focus groups
were identified:

Teenagers and adolescents

- Adult males
- Adult females and
- Youth

Oral Interviews were also conducted. Those interviewed were mostly health personnel and community opinion leaders. The questions were related to the following;

- The health facilities available in the community,
- The common diseases in the community,
- Their health concerns related to the project.
- Their health expectations from the project

A.6.4 Environmental Health Survey

This consist of walk through surveys using prepared check list of environmental health issues such as general level of sanitation, waste disposal practices, water supply and the availability of health and health related facilities. Photographs of relevant health activities/ facilities were taken. The main issues assessed included:

i. Types and quality of housing
ii. Sources of water
iii. Type of sewage disposal methods/facilities
iv. Methods of refuse disposal/ general physical environmental cleanliness.
v. Health facilities available
vi. Environment- Health interplay
<table>
<thead>
<tr>
<th>ENVIRONMENTAL COMPONENT</th>
<th>PARAMETER</th>
<th>EQUIPMENT</th>
<th>UNIT</th>
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</thead>
<tbody>
<tr>
<td>METEOROLOGY</td>
<td>Temperature</td>
<td>Traceable Thermometer</td>
<td>°C</td>
</tr>
<tr>
<td></td>
<td>Wind speed &amp; Direction</td>
<td>Skye Master Anemometer &amp; wind Vane</td>
<td>m/s</td>
</tr>
<tr>
<td></td>
<td>Humidity, Atmospheric Pressure</td>
<td>Skye Master Mini Weather Station</td>
<td>%</td>
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<td>AIR QUALITY</td>
<td>Suspended Particulate Matter</td>
<td>Met One Instrument Aerosol Mass Monitor</td>
<td>Mg/m³</td>
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<td></td>
<td>Nitrogen Oxides</td>
<td>Testo 350 XL Gas Analyser</td>
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<tr>
<td></td>
<td>Sulphur Oxides</td>
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<tr>
<td></td>
<td>Carbon Monoxides</td>
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<td>ppm</td>
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<tr>
<td></td>
<td>VOC/HC</td>
<td>Testo 350 XL Gas Analyser</td>
<td>ppm</td>
</tr>
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<td>NOISE</td>
<td>Sound level</td>
<td>Tecman Sound Meter</td>
<td>dB(A)</td>
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<tr>
<td>SOIL</td>
<td>Sampling</td>
<td>Stainless steel auger</td>
<td></td>
</tr>
<tr>
<td></td>
<td>pH</td>
<td>Hannah pH meter</td>
<td></td>
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<tr>
<td></td>
<td>Electrical conductivity</td>
<td>Hannah conductivity meter</td>
<td>µS/cm</td>
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<tr>
<td></td>
<td>Soil Texture</td>
<td>Particle Size Matrix</td>
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<td></td>
<td>Heavy metals</td>
<td>Digestion/AA Spectrophotometry</td>
<td>mg/kg</td>
</tr>
<tr>
<td></td>
<td>Total Hydrocarbon Content</td>
<td>Extraction / IR Spectrophotometry</td>
<td>mg/kg</td>
</tr>
<tr>
<td></td>
<td>Vegetation</td>
<td>Quadrant, Binoculars</td>
<td></td>
</tr>
<tr>
<td><strong>SURFACE/GROUNDWATER</strong></td>
<td><strong>Equipment</strong></td>
<td><strong>Method</strong></td>
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<td>------------------------</td>
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<tr>
<td>Temperature</td>
<td>Eco Tester</td>
<td>°C</td>
<td></td>
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<tr>
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<td>pH/temperature Meter</td>
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<td></td>
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<tr>
<td>pH</td>
<td>Eco Tester</td>
<td>pH meter</td>
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<td>Total, Dissolved and Suspended Solid</td>
<td>ExTech Conductivity/TDS Meter</td>
<td>mg/l</td>
<td></td>
</tr>
<tr>
<td>Total Alkalinity</td>
<td>HACH Digital Titration method</td>
<td>mg/l</td>
<td></td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>ExTech DO Meter</td>
<td>mg/l</td>
<td></td>
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<tr>
<td>Biological oxygen Demand (BOD₅)</td>
<td>Winkler method</td>
<td>mg/l</td>
<td></td>
</tr>
<tr>
<td>Total Hydrocarbon Content (THC)</td>
<td>Extraction / Spectrophotometer</td>
<td>mg/l</td>
<td></td>
</tr>
<tr>
<td>Conductivity</td>
<td>Ex Tech Conductivity Meter.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy metals</td>
<td>Flame Atomic Absorption Spectrophotometry</td>
<td>mg/l</td>
<td></td>
</tr>
</tbody>
</table>

| **SEDIMENTS** | **Sampling** | **Ekman Grab** |

| **MICROBIOLOGY** | **Bacteria, fungi, hydrocarbon Utilizing bacteria and fungi, total and faecal coliforms.** | **Composite samples for laboratory analysis** |

<p>| <strong>WILDLIFE</strong> | <strong>Conservation status (rare, threatened and in situ observation, interviews, secondary</strong> |</p>
<table>
<thead>
<tr>
<th>Section</th>
<th>Study Areas</th>
<th>Methodologies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ESIA</strong></td>
<td>Endangered species, conservation areas (forest reserves etc.), environmentally sensitive areas – wetlands and swamps, local conservation practices.</td>
<td>Data</td>
</tr>
<tr>
<td><strong>GEOLOGY</strong></td>
<td>Profile, type and composition</td>
<td>In situ observation, drilling, laboratory analysis, reporting</td>
</tr>
<tr>
<td><strong>SOCIO-ECONOMIC STUDIES</strong></td>
<td>Social Infrastructure Cultural Properties, Natural Resources and Land Use, Perception of the project, The role of women and children, Physically Challenged, Social Structure and Organization, Vehicular Traffic Analysis, Sex Trade</td>
<td>Key informant interviews, Focus Group Discussion (FGD), direct observation, Administration of structured questionnaires and Collection of secondary data.</td>
</tr>
<tr>
<td><strong>HEALTH STUDIES</strong></td>
<td>Demographic profile of the Communities, Morbidity/Mortality Patterns, Healthcare facilities, Nutritional Status of Under-fives and the general population, Maternal and Child Health, Knowledge, Attitude Practice and</td>
<td>Key informant interviews, FGD, Administration of structured questionnaire and interviews, Walk-through survey and Collection of secondary data.</td>
</tr>
</tbody>
</table>
A.7 Socio-Economic Aspects

A.7.1 Research Design

The research design entailed determining the study population, i.e. the population of the communities that are regarded as the host communities of the project. It also involved making decisions as to:

- Whether to obtain information at one or several points in time
- The methods of data collection; and
- Whether questionnaires, if used, should be self-administered, or administered face-to-face, using trained interviewers.

In effect, this study belongs to the class described as “passive-observational” (Cook and Campbell, 1979), in the sense that subjects have been studied in situ, without any form of experimental manipulation. A one-shot study, such as this, can provide important and comprehensive information.

A.7.2 Target Populations and Samples

A sample size of 5% of the total population of the study communities based on the 1991 national census figures was used in the study. These figures have been adjusted to 2015 using a projection of an annual growth rate of 3.4%. All the inhabitants in the selected houses were then administered questionnaires until the required sample size was met. A sample of the questionnaire is attached.

Instrumentation and Data Collection

This study employed both primary and secondary data sources. The latter comprised government records, maps, and information published in journals and books, while the former included pre-coded questionnaires, key informants, focus groups, direct observation, direct measurement, specially prepared data collection formats, and participatory research.

Although the questionnaires largely contained closed-ended questions for easy recording of responses, some open-ended ones were included to allow respondents freedom in structuring their responses. This permitted the researchers to obtain clearer insights into questionnaire items. Trained interviewers administered questionnaires face-to-face to respondents. Furthermore,
trained assistants, using specially designed formats, carried out direct observation.
Environmental and Social Impact Assessment (ESIA) for the Proposed 330/132kv and 132/33kv Transmission Substation

Social Impact Assessment Questionnaire

**Instruction**: Please answer the following questions to the best of your knowledge. Tick or fill in as appropriate.

**LOCATION**
1. Name of Settlement (or Village): ..............................................................................
2. Local Government Area: ..............................................................................................

**PERSONAL/DEMOGRAPHIC PROFILE**
3. How old are you? ..........................................................
   (a) 18 - 25  (b) 25 - 30  (c) 30 - 35  (d) 35 - 40  (e) 40 - 45  (f) > 40

4. Sex of respondent (please tick)
   (a) Male  (b) Female

5. Marital Status (please tick)
   (a) Married  (b) Single  (c) Divorced  (d) Widow  (e) Never married  (f) other

6. Respondent’s position in household (please tick)
   (a) Head  (b) Spouse to Head  (c) Son/daughter  (d) Other relations

7. Please state the number of persons in your household (including yourself) who fall into the following categories.

<table>
<thead>
<tr>
<th>Age cohorts (years)</th>
<th>Gender</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
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<td>Female</td>
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<tr>
<td>0 – 4</td>
<td></td>
<td></td>
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<tr>
<td>5 – 9</td>
<td></td>
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<tr>
<td>10 – 14</td>
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<td>15 – 19</td>
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<tr>
<td>20 – 24</td>
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<td>25 – 29</td>
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<td>30 – 34</td>
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<td></td>
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<tr>
<td>35 – 39</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ESIA for the Proposed 132/33kV Transmission Substation at Biliri, Gombe State | 287

40 – 44
45 – 49
50 – 54
55 – 59
60 – 64
65 and over

ECONOMIC ACTIVITIES, EMPLOYMENT AND INCOME

(8) What is your primary occupation/employment status (please specify the sector)
(a) Public (govt) □ (b) Company □ (c) Self employed □ (d) Not employed □

(9) If you are self employed, please tell us what your occupation is:
(a) Fishing □ (b) Farming □ (c) Hunting □ (d) Trading □ (e) Business □ (f) other □

(10) If you are unemployed, please state what you do for a living..........................

(11) Kindly tick the range of your income in a month:
a □ Less than ₦10,000  g □ ₦60,000 – ₦69,999
b □ ₦10,000 – ₦19,999  h □ ₦70,000 – ₦79,999
c □ ₦20,000 – ₦29,999  i □ ₦80,000 – ₦89,999
d □ ₦30,000 – ₦39,999  j □ ₦90,000 – ₦99,999
e □ ₦40,000 – ₦49,999  k □ ₦100,000 or more
f □ ₦50,000 – ₦49,999

SOCIAL ENVIRONMENT

12. Are (a) Christian □ (b) Muslim □ (c) Pagan □ (e) Free thinker □

13. Name the cultural activities/festivals that your people observe
(a) .....................  (b) .....................
(c) .....................  (d) .....................

14. Educational status of respondent: (please tick/underline)
(a) No formal Education (b) Primary (c) Secondary (d) Post-Secondary

15. How many of the following exist in your settlement (village)?
(a) Nursery Schools .....................  (b) Primary Schools .....................
(c) Secondary Schools .....................  (d) Post Secondary Schools ............
UTILITIES/INFRASTRUCTURE
16. From which of these sources do you obtain your water supply?
(a) Rain  (b) River  (c) Borehole  (d) Well  (e) Stored runoff  (f) Pipe borne

17. How do you dispose your wastes (solid/domestic and farm wastes)?
(a) Burning  (b) Burying  (c) Dumping  (d) Throwing into running water

18. How is human waste (excreta) disposed of?
(a) simple pit latrines  (e) Open public sewer
(b) into water channels  (f) VIP (ventilated) latrine
(c) surrounding bushes  (g) Other means (specify) ..................
(d) pail system

19. Is your community is connected to any public power (electricity) supply system who installed it?

ETHNIC RELATIONS
20. Which of these projects have been initiated and / or completed in your community?
(a) Roads/bridges  (e) Electricity  (h) Scholarship
(b) Health centre  (f) Water Supply  (i) Micro-credit facility
(c) Market stalls  (g) School blocks  (j) Other (specify).................

21. Specify which of the following Organizations provided the above facilities
(a) Federal govt.  (c) Local govt.
(b) State govt.  (d) Other (specify).

PERCEPTION OF TCN OPERATIONS
22. Rate between 1 – 10 what you consider the most beneficial aspects of Transmission Substation
presence in your locality

☐ Increased employment  ☐ Others (Specify)......................

☐ Improved Electricity  ☐ Taxes to government

HEALTH IMPACT ASSESSMENT QUESTIONNAIRE

(A) Socio-Demographic Variables

(1) Name of Town / Village.................................................................

(2) Age (Last Birthday).................................................................

(3) Sex: (a) Male ☐ (b) Female ☐

(4) What is your marital status?

<table>
<thead>
<tr>
<th>Status</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td></td>
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<tr>
<td>Married</td>
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<tr>
<td>Divorced</td>
<td></td>
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<tr>
<td>Separated</td>
<td></td>
</tr>
<tr>
<td>Widow/Widower</td>
<td></td>
</tr>
</tbody>
</table>

Reproductive Health Data:

(A) Anthropometric measurements

a. Weight: ......................... kg

b. Height: ......................... cm

c. Body Mass Index: .................

d. Mid Upper Arm Circumference........... cm

e. Skin fold thickness: ................. cm

f. Waist circumference: ................. cm

g. Waist- Height Ratio: .................

(B) Life Style/ Habits

(1) Do you drink alcohol? Yes ☐ No ☐

(2) If yes, How often

   - Every day
   - At least once a week
   - Occasional

(3) Do you smoke? Yes / No

If yes, how many sticks/day ............

(4) Exercise: Yes / No
What type of exercise do you do? ...........................................

Knowledge, Attitudes, Practices and Behaviour on Sexually Transmissible Infections

1. Do you have sexual partners not married to you? Yes  No
2. How many are they? ________________________________
3. Have you heard of sexually Transmissible Infections before? Yes  No
4. Have you ever had any sexually Transmissible Infections? Yes  No
5. What symptoms (complaints) did you have then ______________________

6. Were you treated by a doctor, a nurse or by yourself?
   - Treated by a doctor Yes  No
   - By nurse Yes  No
   - By self Yes  No
7. How many times have you had STIs before? _________________
8. Have you heard of HIV/AIDS before? Yes  No
9. Do you know how HIV/AIDS can infect somebody? Yes  No
10. Name the method by which somebody can get HIV/AIDS ______________

11. Have you checked your HIV status? Yes  No
12. Do you know anybody who has HIV/AIDS? Yes  No
13. How many do you? _______________________
14. Has any member of your family, friend or community had or having tuberculosis?
   Yes  No

Health Seeking Behaviour Data

1. Indicate types/number of health care institutions in your community?

<table>
<thead>
<tr>
<th>Types</th>
<th>Total Number</th>
<th>Total Number of Midwives / Nurses</th>
<th>Total Number of Doctors</th>
<th>Total Number of Medical Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Hospital</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ii) Maternity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(iii) Dispensary</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(iv) Health Center</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(v) Private Clinic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(vi) Patent Medicine Store
(vii) Pharmacy (Chemist)
(viii) Traditional Healing Homes

2. What treatment did/do you employ when sick?
   i) Attended hospital/clinic
   ii) Buys drugs from nearby chemist
   iii) Consult native doctors
   iv) Self medication

3. Where did/you go for child delivery (ies)?
   (ii) Attend hospital/health centre ....
   (iii) Maternity/private clinic .......... 
   (iv) At home alone ...................
   (v) Native Doctor/traditional midwife
   (vi) Any other (specify) ..............

Environmental Health Data:
1. What is the major source of water available to your household? (tick the correct option)
   (i) River/Stream
   (ii) Well
   (iii) Pond
   (iv) Rain Water
   (v) Public pipe-borne water
   (vi) Mono pump
   (vii) Borehole (Commercial)
   (viii) Borehole (private)
   (ix) Commercial tanker

2. What type(s) of residential houses do you have in your community?
(Tick the correct option)

<table>
<thead>
<tr>
<th>Types of Houses (by Nature of construction Materials)</th>
<th>Total Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Wood (Batcher)</td>
<td></td>
</tr>
<tr>
<td>(ii) Mud</td>
<td></td>
</tr>
<tr>
<td>(iii) Corrugated iron sheets (zinc batcher)</td>
<td></td>
</tr>
<tr>
<td>(iv) Cellophane (nylon)</td>
<td></td>
</tr>
<tr>
<td>(v) Thatch</td>
<td></td>
</tr>
</tbody>
</table>
3. How many persons live in a house? ________________

5. What type of toilet facility do you use? Please tick from below.
   (1) Pit
   (2) Bush
   (3) Prier head
   (4) Bucket
   (5) Water closet
   (6) Others (specify) ________________

6. How do you dispose of your household refuse? Please tick from the list below.
   i) Private open dump
   ii) Public open dump
   iii) Organized collection (by Local Government, Community etc)
   iv) Organized collection *by Individual – Commercial
   v) Burning
   vi) Bush
   vii) Burying
   viii) River/Stream
17.4 Annex 4 Secondary Data

Environmental and Social Impact Assessment (ESIA) for the Proposed 330/132kv and 132/33kv Transmission Substations at New Kano in Kano State, Biliri in Gombe State, Kabba in Kogi State and Abor (9th Mile) in Enugu State

<table>
<thead>
<tr>
<th>SOURCE</th>
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<tbody>
<tr>
<td>Nigerian Meteorological Agency (NIMET)</td>
<td>Historical Rainfall, Relative Humidity, Ambient Temperature, Atmospheric Pressure data</td>
</tr>
<tr>
<td>Nigerian Hydrological Services Agency (NIHSA)</td>
<td>Geological Maps and Basement complex information</td>
</tr>
<tr>
<td>National Population Commission (NPC)</td>
<td>1991 and 2006 Census Figures</td>
</tr>
<tr>
<td>Kogi State Government Strategic Health Development Plan (2010-2015) by Kogi State Ministry of Health March 2010</td>
<td>Health Infrastructure in Kabba/Bonu Local Government Area</td>
</tr>
<tr>
<td>Environmental Impact Assessment (EIA) of the Ajaokuta – Obajana Gas Pipeline Project Kogi State February 2004 by Dangote Group</td>
<td>Infrastructural status of kabba/Bonu, settlement Pattern</td>
</tr>
<tr>
<td>National Bureau of Statistics Abuja</td>
<td>Nigerian Socio Economic data, Job creation survey, Labour,</td>
</tr>
<tr>
<td>Project Description</td>
<td>Report Contents</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
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<tr>
<td>Environmental Impact Assessment of the Proposed Transceiver Station (BTS) Project in Enugu State December 2014 by Airtel Networks</td>
<td>NA</td>
</tr>
<tr>
<td>Project Description</td>
<td>Data Types</td>
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<tr>
<td>-------------------------------------------------------------------------------------</td>
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<tr>
<td>Environmental Impact Assessment of EMTS Base Stations in Gombe State November 2012 by Emerging Market Telecommunication Services Limited (Etisalat Nigeria)</td>
<td>Socio Economic and Soil data</td>
</tr>
<tr>
<td>Environmental Impact Assessment of Etisalat Base Stations in Kano State November 2012 by Emerging Market Telecommunication Services Limited (Etisalat Nigeria)</td>
<td>Geotechnical and soil data</td>
</tr>
<tr>
<td>Environmental Impact Assessment (EIA) Study of the proposed Etisalat Base Stations in Seven (7) Local Government Areas of Kogi State, Nigeria November 2012 by Emerging Market Telecommunication Services Limited (Etisalat Nigeria)</td>
<td>Meteorological and Health information</td>
</tr>
<tr>
<td>Environmental And Social Impact Assessment (ESIA) for Gombe-Biu Road Rehabilitation Project 2006 by Prime Consult Limited</td>
<td>Meteorological, Flora and Fauna data</td>
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<tr>
<td>Environmental Liabilities Audit Report of Power Holding Company of Nigeria (PHCN) Successor Companies (Kano Electricity Distribution Company (KEDCO)) November 2014 by Bureau for Public Enterprises (BPE) / EcoConServ Environmental Solutions Egypt &amp; Metaspec Consult Limited Nigeria</td>
<td>Energy supply and Conservation in Kano state</td>
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<tr>
<td>Title</td>
<td>Description</td>
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<td>-----------------------------------------------------------------------------</td>
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<tr>
<td>Environmental Liabilities Audit Report of Power Holding Company of Nigeria (PHCN) Successor Companies (Jos Electricity Distribution Company (JEDC))</td>
<td>Energy Supply and Conservation in Gombe state</td>
</tr>
<tr>
<td>Environmental Liabilities Audit Report of Power Holding Company of Nigeria (PHCN) Successor Companies (Enugu Electricity Distribution Company (EEDC))</td>
<td>Energy Supply and Conservation in Enugu state</td>
</tr>
<tr>
<td>Organization</td>
<td>Data/Information</td>
</tr>
<tr>
<td>--------------</td>
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<tr>
<td>Anambra-Imo River Basin Development Authority</td>
<td>Nigerian Hydrological, flood plain and wetland data, Maps</td>
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<td>Hadejia-Jama’are River Basin Development Authority</td>
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<td>Niger River Basin Development Authority</td>
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</tr>
<tr>
<td>Upper Benue River Basin Development Authority</td>
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<td>Weather Network International (WNI) Nigeria</td>
<td>Meteorological data</td>
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<td>The History and Culture of ABOR by Festus Madukaligwe Okolo</td>
<td>Abor Cultural History</td>
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<td>University of Calabar Herbarium, Botany Department, Faculty of Sciences, University of Calabar, Calabar Cross River State</td>
<td>Vegetative Specie identification data</td>
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<tr>
<td>Nigerian Institute of Social and Economic Research (NISER)</td>
<td>Socio Economic data of Nigerian communities</td>
</tr>
<tr>
<td>Forestry Research Institute of Nigeria (FRIN)</td>
<td>Regional forest belts of Nigeria</td>
</tr>
</tbody>
</table>
17.5 Annex 5 Public Consultation Interagency

REPORT ON THE INTER-GOVERNMENT AGENCY STAKEHOLDERS FORUM AT PMU OFFICE AUDITORIUM,
GROUND FLOOR ON THE 15TH OF SEPTEMBER, 2015

Environmental and Social Impact Assessment (ESIA) for the proposed rehabilitation/reinforcement of
330/132/33kv sub-stations at Abor-9th Mile, Biliri, Kabba and new Kano.

Organizers: TCN-PMU

Participants: World Bank, Ministry of Environment, SMEC International Pty Australia, Ministry of
Finance, PMU Staff, TCN Staff from headquarters and different regions and Non-Governmental
Organization (NGO)

Facilitators: PMU, World Bank and SMEC.

NEGIP STAKEHOLDERS’ FORUM

Facilitators: SMEC, World Bank and PMU

Program of Events:

- Introduction of participants.
- Welcome remarks by the GM PMU.
- Overview of the ESIA by Coordinator ERSU.
- Tea Break
- Presentation by SMEC Team Leader
- World Bank Safeguards Policy on Transmission project.
- Questions and Answers
- Closing remarks/Closing prayers
- Lunch

Presentation 1: Overview of ESIA by Coordinator ERSU

Presenter: ERSU Coordinator

Key Points from presentation:

- ESIA and the ESMP safeguard documents are ongoing now at the proposed rehabilitation/reinforcement transmission sites.
- TCN Policy is concerned with Corporate Social Responsibility (CSR).
- TCN wants to implement a good neighbor policy and wants to achieve this through preparation and use of good Environmental and Social Impact Assessment (ESIA) and Environmental and Social Management Plan (ESMP)

Presentation 2: Presentation by SMEC International Pty

Presenter: Team Leader SMEC for ESIA

Key Points from presentation:
• FG/NEGIP through TCN proposes to develop four (4) new substations at New Kano, Biliri, Abor-9th Mile and Kabba.
• SMEC will prepare ESIAs and ESMPs for each of the substation.
• Characteristics of the sites in the various states visited were mentioned.
• The importance and uses of the digital maps was stated.
• Noise measurements have been done and that the ESMP (Environmental and Social Management Plan) will be prepared to cover the pre-construction, construction, operation and the decommissioning and the ESMP (Environmental and Social Management Plan) does not have to be technical and difficult to understand
• Essential points in an ESIA (Environmental and Social Impact Assessment) includes; simplicity, relevance, site specific, clear and readable and that of ESMP (Environmental and Social Management Plan) includes; simplicity, practical, dynamic, enforceable, contractually binding.
• The final ESIA and ESMP will be submitted by December 2015.

Questions/ Answers on the Session:
The following were the essential points raised during this session
• The World Bank representative said that it will have been nice in the watershed analysis if the flow accumulation and flow direction had been added to show impact and The SMEC team Leader in his reply stated that from the catchment, a flow direction of the stream are in tributaries since one stream flows into another
• Another participant stated that she preferred they do some physical analysis of the location particularly Enugu which is now being used as a dumpsite. The Team Leader in his reply stated that all of the sites were visited and, he was supported by representative of METASPEC who explicitly stated that about fifteen (15) consultants were on ground for all the sites.
• The Federal Ministry of Finance representative stated that they should be able to have some information about the sites. He then complained that the description of the sites were not there completely, that there was a need to know the location, social and economic activities and equally the land use pattern in these sites, he stated that SMEC did not tell the participants if the land were owned by government or private persons. How those land was acquired, because of the social issues that come up from time to time. He then asked if consultations with the primary stakeholders had been done, if it had not been done, it should be so that we can know who we are dealing with and how they feel about the project equally. He stressed on the need to know the land size, land ownership and acquisition issues and land use, the nearby communities that will be affected by the project. In his response, The Team Leader stated that the ESIA must be timely and that there was room for improvement, he complained that the
procedure with the Federal Ministry of Environment is really slow and should be hastened. Then, he suggested that the procedure be quicker by condensing some of the steps to be taken at once when asked the solution by the environmental specialist form World Bank.

- Another participant asked what follows after the baseline has been acquired. He then suggested that a sample be taken from the Ajalli River and analyzed then, the coordinator ERSU and the SMEC representative replied that the samples had been collected and the analysis is ongoing in their respective laboratories.

- The GM PMU further explained the issue about the land stating that most of the issues concerning the land had been settled except in Enugu where there was an issue with the land owners who complained that compensation had not been paid. He also stated that the commitment letter required by the World Bank had been signed and has been given to PMU. He also mentioned the sizes of the land at the different sites.

- Team Leader then stressed that the public consultation is at the preliminary stage and the aim of the meeting is to announce /describe the project not to answer questions about interpretation of any facts especially at the initial meeting. He then stated that data collected are still being analyzed. He reserved the interpretation for another day when the data collection and analysis would have been completed.

- A representative of the GM Enugu region then tried to explain the rationale behind the issue of compensation in Enugu State. He stated that the issue for compensation was with the state government and the community and that the government has agreed to pay but no compensation has been made. He stressed that the community was eager about the project and that Enugu has no issue anymore and also, that the site is no longer being used as a dumpsite.

- The GM PMU then stated that they will be a visit to the sites one after another and asked Engr. Onyigbo to pursue the state government and ensure that there is no issue or else Enugu site may be dropped.

- A representative from Ministry of Environment in addition to what the GM PMU said, pleaded that the participants should try to convince the people that the project is for everyone’s benefit and the generation yet unborn.

**Presentation 3: World Bank Safeguards Policy on Transmission Project**

**Presenter:** World Bank Representative – Environmental Specialist

**Key Points from Presentation:**

- Safe guard policies were mechanisms for the integration of environmental and social issues into decision making and that making informed choices is a fundamental principle of safeguard policies.
• The chance find procedure should be in place before the project commences.
• Consultation is an integral part of the process and the consultation venue, days etc must be delicately balanced.
• There should be a rich and dedicated session on consultation in the report to be submitted by SMEC
• In the disclosure of information, he asked that the executive summary be translated into the three indigenous languages of Nigeria.
• Grievance Redress Mechanism, its importance, principles and value chain.
• There should be an annex for Grievance Redress Mechanism (GRM) in the ESIA.
• Minutes of every meeting should be taken and every key stakeholder present in the meeting should sign on the Minutes.

Questions/ Answers on the Session
The following were the essential points raised during this session
• One of the participants then asked questions on what to do if the land is a communal land and one person believes that he should earn more than others. He also, asked what should be done if one man is paid and he uses the money to marry more wives.
• The presenter in his reply, stated that there was a need to have a system in place for disbursement. He then stressed that there should be no cash payment only bank transfers. He also, stated that trainings on investment be carried out and that people should be taught alternative means of livelihood for adequate and proper investment.
• The GM PMU then asked when they will have the reports for review and the SMEC representative replied 15th October 2015 and that the final disclosure will be in December 2015.
• The GM PMU also, asked if the disclosure could be shorter than twenty-one (21) working days and the representative from the Ministry of Environment said no that it was the standard.
• Coordinator ERSUU then asked the representative from the Ministry of Environment when they will hear from them for the site and he replied that the officers will confirm if the site exists and also, present their comments if anything comes up. He then stressed that the 21 working days disclosure is global and cannot be changed.
• SMEC representative then stated that the next step meeting will be with the local stakeholders and in the next phase/month, more meetings will be done. The GM PMU then asked that they help the TCN PMU get to the local stakeholders, community leaders and so on.

General Discussions:
• Opening remarks was done by the GM PMU. In his opening remarks; he apologized for being almost an hour late and stressed that it was not in the tradition of the organization. He then on behalf of the TCN welcomed everyone and prayed for journey mercies for those still on their way. He introduced SMEC as an organization that is carrying out the Environmental and Social Impact Assessment. He stated that the stakeholder meeting being the first of its kind was the first stage of stakeholder engagement. He then explained that the second level will be more elaborate. He explained that the Environmental and Social Impact Assessment study is a requirement by the World Bank and must be done before the project can be carried out. He explained that the forum must be an open and interactive session and also, explained that the consultant SMEC of Australia has been on board since June and is supposed to last for six (6) months, and is already three (3) months into the assignment. He then said that whatever responses gotten in the forum must be circulated back, so that it can be incorporated into the report. He then stated that he is aware that the Ministry of Environment had visited some of the sites.

• A goodwill message was delivered by the representative of the Permanent Secretary, Federal Ministry of Finance (FMF). In his message, he commended the efforts of the PMU in organizing the forum and the efforts of World Bank in providing funding for the project. He stated that sustainable development is hinged on three pillars- economic viability, social and environmental safety. He stressed that we must ensure that the project does not have adverse impact on the health, livelihood and safety of the communities and the general public. He stated that it was necessary for each agency to see the project from their peculiar perspectives and also, mainstream local knowledge, culture and project communities´ interest and input into the project planning and implementation phases. He then said that through sustained collaboration, PMU should be able to identify at the early stages the adverse effects of the project on the environment as it will help to reduce legal redress, social conflict and so on. He then stressed that stakeholder agencies should carry out their respective monitoring roles as enshrined in the ESIA reports and finally, thanked everyone for their attention.

• After the goodwill message, a participant asked a question on how money borrowed from the World Bank is monitored and the Ministry of Finance Representative then explained that money borrowed is tied to a specific project. In explaining further, he stated whatever borrowing must be along the budgetary provisions of the country and must be tied to a particular project and also, States on their own cannot borrow money independently without the Federal Government signing on their behalf as the borrower is lending money to Nigeria not to any particular state.
• The GM PMU adding to the question of the participant said that TCN have been enjoying good relationship with the Ministry Of Finance and then stated that recently the duty exemption certificates normally given to contractor executing power projects issued by TCN, NIPP, REA is no longer being coordinated by the NIPP but now handled by the Ministry of Finance. He stated that they followed up the issue and were told that the Permanent Secretary was supposed to have signed something to get that approved. He also, mentioned that the budget office was fully aware of that and that his contractors and TCN were also affected, he appealed that the issue of import duty exemption certificate be mentioned to the Permanent Secretary “so as to enable us evacuate most of our containers lying at the port for four, five, six months and we will be following up by next week to see that the issue is resolved”. The representative from the Ministry of Finance then asked if all the necessary documentations have been made and he replied in affirmative. The GM PMU also said that the Permanent Secretary is aware of it. After that, the representative from the ministry of finance left for another meeting

• Closing remarks was done by a representative from TCN and closing prayers was done by the representative from Ministry of Environment at 3.12pm
17.6 Annex 6 Public Consultation Biliri

STAKEHOLDER’S FORUM FOR THE ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR THE PROPOSED CONSTRUCTION OF 330/132KV and 132/33KV TRANSMISSION SUB-STATION AT BILIRI GOMBE STATE

PURPOSE
Stakeholder’s forum for the Environmental and Social Impact Assessment (ESIA) for the proposed construction of 330/132KV and 132/33KV Transmission Sub-Station at Biliri, Gombe State.

DATE:
Thursday 15th October 2015

VENUE:
Palace of the Mai Tangle of Biliri

LANGUAGE OF COMMUNICATION:
English and Hausa

PROGRAMME:
The meeting which was earlier slated for 11am was actually flagged off by 12pm with the introduction of the chairman of the programme, His Excellency, the governor of Gombe State ably represented by his Deputy who was also represented by the Biliri local government caretaker chairman. The caretaker chairman and other dignitaries from Gombe State were introduced by the Master of ceremony for the occasion. All the Traditional rulers and member of the traditional ruling council, other members present were introduced.

The representative from Transmission Company of Nigeria (TCN) introduced all the members present and the consultants from SMEC PTY international.

The forum was officially opened with a prayer by the representative of the Mai Tangle of Biliri, the breaking of kola nuts by one of the traditional rulers followed.

Chairman’s Remarks
The chairman in his opening remarks stated that the forum held in the palace of Mai tangle was very informative and thanked the organizers for a beautiful job done. He said the government of Gombe state freely endorsed the project. He continued by stressing the importance and benefits to be deserved from the project which included, employment opportunities for the locals bringing more economic developments to the community.

- The project will provide suitable ground for skills acquisition, technology transfer, human empowerment
- The new project will increase revenue base of Biliri LGA and Gombe State Government. The chairman promised to report back to his Excellency, the executive Governor of Gombe state.
He placed the responsibility of protecting the facility on the local chiefs and also solicited support from the youths. A stern warning was handed down to the people who many sabotage by vandalizing the facility.

Biliri Ruling Council

A member of the Biliri ruling council applauded the federal government of Nigeria for choosing Biliri for the establishment of the substation. He emphasized the fact that the micro businesses are driven by power and therefore needed to be factored in before electricity pricing in Nigeria. He explained that micro businesses that are likely to grow in Gombe as a result of quality electricity will require some level of rebate to be able to stay in business. Price of food items are affected by the price of electricity. He encouraged the project owners TCN to improve on their social responsibility to the Host communities.

Federal ministry of environment representative said that a detailed engineering design of the project ought to have been presented. He equally said that there is need to put in place a system to check the influx of foreigners that will come into Biliri as a result of the project to seek greener pastures.

Question and answer session commenced immediately after the presentations

**Question:** Why does distribution section put fixed charges even when there is no power?

**Answer:** The representative from TCN Gombe explained that Transmission Company of Nigeria (TCN) only transmitting power, not distributing/ selling.

NERC had on several occasions and several fora explained that when a product is being promoted, some charges are incurred in the process, Equally some damages occur while transmitting power over a distance, Vandalizations do occur. There are other unforeseen challenges that will put cost of transmission and even distribution unit. These are the reasons why fixed charges are placed on customers. Transmission must buy from Generation. Besides, Transmission does not collect money, it is the distribution that does that. The TCN representative continued by suggesting that distribution (Jos Electricity Distribution Company) could employ the use of jingles to explain certain grey areas or issues to customers as a kind of sensitization exercise.

**Question:** How the issue of criminality that are likely to result from influx of foreigners who may come to seek greener pastures.

**Answer:** During the data gathering exercise and forum also held at the palace of the Mai Tangle, this same question arose. The community said that they operate internal security checks organized by the youths who are supported by the community people. They cited a case where a neighboring community killed some Biliri indigenes over community land conflict. He explained that the youth provided security that successfully rebuffed the invaders.

**Answer:** Biliri has internal security networks. They are also advised to work and cooperate with the police and immigration section to be able to deal with the issue of sudden influx of foreigners.
**Question:** How do you deal with the issue of soil erosion and desert encroachment in Biliri?

**Answer:** The soil erosion and desert encroachment, there is a programme of the federal government of Nigeria that takes care of both erosion and desert encroachment, the fund is called Ecological fund, disbursed by Federal Government and managed by the state government.

**Answer:** Tree planting project that takes care of desert encroachment or a forestation.

**Question:** How can Biliri benefit from carbon credit?

**Answer:** Nigeria as a nation can assess their carbon credit from the World Bank through the Department of climate change in the Federal Ministry of Environment.

**Question:** Is there any way the Federal Government and World Bank could assist Biliri local government to develop its own private university since many of our children are denied admission/placement in both state and federal universities?

**Answer:** The TCN advised the good people of Biliri who are very lucky to parade many professors and other professionals in all works of life to use them to reach out to various arms of government, national universities commission, politicians in and out of power to help lobby the appropriate people in authority to assist Biliri to obtain the license to develop and operate private university in Biliri. The World Bank may not come in directly but can help to establish other projects that may help in university establishment. A typical example in the power project 132/33KV power substation. University facilities require quality power to operate successfully.

**Question:** How would TCN/World bank handle the issue of electromagnetic radiation from the project?

**Answer:** The community has been advised not to build houses under high tension cable because of radiation fallout which could be injurious to health.
In the case of staff who will work in the switch yard, the exposure limit of eight hours will not be exceeded. Staff will be rotated to avoid exposure of more than eight hours per day. Besides, special aprons (PPE) to prevent the penetration of radiation into the body will be used by staff who work in the switch yard.
Finally standard operation procedures (SOPs) will be prepared to guide workers in the facility. HSE department will be strengthened to supervise all work procedures with safety measures put in place, safety caricatures, safety handouts, poster pasted at the right places. Equally hazardous areas will be marked out or access restricted or limited except authorized personnels.

**Question:** What will TCN do to improve access to the project site since the project site is not presently accessible?

**Answer:** TCN representative said that construction of a standard access road to the facility was captured in the contract. There is a plan to construct an access road to the site to enable heavy trucks that will carry materials to the site to do that without difficulty.

**Question:** What is the capacity of the project?
**Answer:** There is going to be installed, a 2 x 60mvA transformers in the substation. These transformers are capable of supplying electricity to the whole of North Eastern part of Nigeria. The coverage is enormous considering the fact as at now only one feeder supplies Kumo, Biliri and even part of Taraba, then, six of such feeders from this 2 x 60 MVA transformer can supply many towns and communities. There are however other factors to be considered. The aim actually is to radiate a lot of energy/power to supply quality electricity.

**Question:** Will the youths be allowed to supervise and monitor the project?

**Answer:** The Project Engineer of TCN-PMU said that youths are not the ones that should monitor the project but are rather expected to cooperate and liaise with the contractors to ensure work is going on smoothly without issues.

**Answer:** TCN added that the police and local vigilante groups should help to serve and protect materials and properties of the facility and that of contractors. He reminded the youths to shun corruption and forget anything material gains, rather the youths should be organized to extend the community good public relation and protect the facilities on ground.

The business unit manager of Jos Electricity Distribution Company informed the forum that Biliri LGA pays the highest bill in Gombe and for that reason the unit is considering bringing back the business unit that was removed due to downsizing carried out by the new owners of the facility. He also explained that the variation is also due to cost implications of the new owners arising from the privatization exercise and running costs.

General comments on the effectiveness of the stakeholder’s consultation.

- News of the project was gladly received and approved by the community more especially the benefits of gainful employment for their wards from present and future industries in the area.
- Industrialists especially cottage ones and private business people were eager to have the project completed due to the reliability/cost effectiveness, of electricity/power over erratic / expensive fuel supply for alternative power source with generator
- The power project will further attract more investors to the area
- No serious disturbance is envisaged during this project execution since the communities, industries, LGA officials, state government now see themselves as partners in the development of their areas
TRANSMISSION COMPANY OF NIGERIA
Project Management Unit
No. 7, Hombori Street,
Off Frewtown Street, Wuse II, Abuja, Nigeria
Telephone: 234-9-8705449
Web Site: http://www.tcng.com.ng

NIGERIA ELECTRICITY AND GAS IMPROVEMENT PROJECT (NEGIP): CREDIT NO. 46200-UNI: STAKEHOLDERS’ CONSULTATIVE FORUM FOR THE PROPOSED CONSTRUCTION OF 132/33KV TRANSMISSION SUBSTATIONS AT BILIRI (GOMBE STATE)

The Federal Government of Nigeria has received a credit on behalf of the Transmission Company of Nigeria (TCN) from the International Development Association (IDA) under the World Bank for the implementation of NEGIP, part of which is to be used in funding the above mentioned Project at Biliri (Gombe State), New Kano (Kano State), Abor (9th Mile, Enugu State) and Kabba (Kogi State).

The following jobs will be implemented under the proposed construction project:
- Construction of 330/132/33kV Transmission Substation at Kano and 33/132kV Transmission substations at Biliri (Gombe), Abor (9th Mile, Enugu) and Kabba (Kogi) states.
- Supply and Installation of 2x150MVA Transformer
- Supply and Installation 2x 60MVA transformers;
- Supply and installation of 33kV equipment.

TCN intends to conduct a stakeholders’ Forum at the Project sites (Biliri, New Kano, Abor and Kabba) aimed at achieving the following objectives:
1. Sensitize relevant Stakeholders about the project.
2. Agglomerate various opinions/feedbacks from Stakeholders towards achieving a successful and sustainable project implementation.
3. Affirm necessary socio-environmental considerations towards attaining sustainability are fulfilled.

Representatives of identified Stakeholders (see list below) are kindly requested to attend this important forum as scheduled:

Gombe:
Venue - Mal Tangle’s Palace, Biliri Local Government, Gombe State
Date - Thursday 15th October, 2015.
Time - 11.00am

Kano:
Venue - North-West University, Permanent Site, Kabusga, Kofar Ruwa, Kano.
Date - Thursday 15th October, 2015.
Time - 11.00am

Abor (Enugu): 9th Mile
Venue - 82 Mechanized Division, Dragon Recreational Centre, Independence Roundabout.
Date - Thursday 15th October, 2015.
Time - 11.00am

Kabba:
Venue - St. Augustine’s College Hall, Kabba, Kogi State.
Date - Thursday 15th October, 2015.
Time - 11.00am

List of concerned Stakeholders whose representatives are expected at this Consultative Forum
1. Gombe State Government, Biliri Local Government, Gombe State Ministry of Lands and urban development, Gombe State Ministry of Environment, Biliri Traditional Head, Community, Women, Youth, NGOs, CSOs reps.
2. Kano State Government, Kano Local Government, Kano State Ministry of Lands and urban development, Kano State Ministry of Environment, Emir of Kano, Women, Youth, NGOs, CSOs reps.
3. Enugu Government, Udi Local Government, Enugu State Ministry of Lands and urban development, Enugu State Ministry of Environment, Abor Traditional Head, Community, Women, Youth, NGOs, CSOs reps.
4. Kogi State Government, Kabba Local Government, Kogi State Ministry of Lands and urban development, Kogi State Ministry of Environment, Kabba Traditional Head, Community, Women, Youth, NGOs, CSOs reps.

Signed:
ENGR. A. J. CIROMA
GENERAL MANAGER, (TCN-PMU).
17.7 Annex 7  Measuring Transformer Noise IEC 60076

How to Measure Transformer Noise Using a Sound Level Meter (SLM)


Figure 17-3  Typical Transformer

16 MVA, 50 Hz, 3-phase, 55/11 kV, OFWF/OFAF

Figure 17-4  Typical description of transformer
Figure 17-5  Measuring Positions for one transformer

Procedure

1. Take Photo of transformer (as in Figure 19-25)

2. Get details of transformer  (as in Figure 19-26). Make sure to get the 4 letter series at the end of the description.

3. Measure length and width of transformer

4. Estimate height

5. Make a sketch

6. Take measurements  at 3 distances away from transformer : 0.3 meters ; 2 metres; 5 metres for all 4 sides

7. If access is restricted take measurements just on longest side. Stand in middle of longest side and walk away to 0.3 meters ; 2 metres; 5 metres

8. Take measurements with microphone vertical or horizontal pointing towards the wall of the transformer

9. Ask if the transformer is operating at FULL LOAD or NO LOAD. Write this down
10. Take a steady Sound Pressure Level Reading (not Leq)
11. Use dB(A weighting filter)
12. Record reading
13. Walk away until you cannot hear the transformer. Measure the ambient in Leq dB(A) for 5 minutes.
14. Note ambient noise level, weather conditions, dry sunny raining, windy, time of day and date.
15. Make sure to calibrate SLM before and after measurements and note any drift. USE A WINDSHIELD.
16. If there are several transformers treat them as one group. Count the number. Take measurements at 5, 10 and 20 meters from the 4 sides of the group. (see Figure 19-28)
17.8 Annex 8 GENERIC SAMPLE OF C-ESMP

The following information must be given:

1. Contractors Name and Address:
2. Company Secretary Name and Address:
3. Contract Name:
4. Duration:
5. Value:
6. Project Manager - Name and Contact number and email:
7. Project Director - Name and Contact number and email:
8. Complaints Officer, Name and Contact number and email:
9. Environment Health and Safety Officer (EHSO) - Name and Contact number and email:
10. Emergency contact number 24/7:

NOTE.
The civil works contractors must implement adequate precautions to protect the environment, the amenity of the area and not to disturb local residents. He must also protect the health and safety of construction workers. The occupational health and safety risks will be minimized by providing adequate personal protective equipment (PPE) and ensuring workers wear it.

The contractors will undertake the following activities:

- An Environment Health and Safety Officer (EHSO) will be appointed and will prepare an Environment Health and Safety Management Plan, will implement the EHSMP and ensure that the requirements of the EHSMP are met.
- The EHSO will ensure that the EHSMP is submitted to TCN prior to construction for approval that accurate records and reports of any occupational health and safety incidents are kept, and review the distribution and use of appropriate PPE.
- The EHSO will also encourage awareness building on safety through activities such as “Toolbox Briefings” and reporting “Near Misses.”
- The contractor will establish a procedure for response to complaint which operates 24/7.

The CESMP given below must be completed with site specific details and submitted to TCN within 30 days of contract signing. All matters are contractually binding.
CONTRACTORS
ENVIRONMENTAL MANAGEMENT PLAN

(LAE PORT DEVELOPMENT PROJECT – TIDAL BASIN PHASE 1)
August 2012 (Revision 2)

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47 With Permission of the author
Contractors Environmental Management
Plan
Document No. CHEC/LPDP/EN/CEMP-01

ENGINEER & CONTRACTOR DOCUMENTATION REVIEW:

| Status | Approved as submitted
| Status 2 | Approved subject to implementation of Engineer’s and/or Employer’s comments / notation without re-submission
| Status 3 | Rejected and being subject to full re-submission in response to the Engineer’s and/or Employer’s comments / notation

NOTE:
Consent by the Employer shall not relieve the Contractor of any duty and responsibility under the Contract.
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FOREWORD BY THE PROJECT MANAGER:

China Harbour Engineering Company Limited (CHEC) has prepared this **Contractors Environmental Management Plan (CEMP)** as a practical guide for employees & sub-contractors for the proposed Lae Port Development Project-Tidal Basin Phase 1.

The document is designed to be a reference point for regulatory authority, external and internal audits and general stakeholder interests in environmental practices. The overall custodian of this CEMP is the Project Manager. “Ownership” of the plan, rests with sectional heads, employees, & sub-contractors.

Sectional heads will continuously remind employees of the need to follow the dictates of the CEMP and will carry out checks to enforce environmental controls. Employees are expected to take ownership by adopting and implementing the plan in order to continually maintain and improve environmental performance. They will attend induction sessions, refresher training sessions and have daily reminders on specific topics during daily tool box briefings. Incentives may be offered to staff who demonstrate environmental awareness.

The environmental requirements detailed in the CEMP will be included in sub-contracts. Sub-Contractors will be required to implement the CEMP as a contractual obligation and this will be monitored by site supervisory staff.

The document is a living “organism”. All requests for modification to this document should be submitted to the Deputy Project Manager through Environment, Safety & Health Office. Suggestions would be reviewed and incorporated where necessary.

Together we can create a healthier and safer workplace and protect our environment and assets from harming and ensures continues improvements in our environmental practices.

Mr. Ma Jianhua

Project Manager
CHEC ENVIRONMENTAL POLICY STATEMENT:

A Project Environmental Management Policy is established to demonstrate the Project Team’s commitment in improving our environmental performance. It aims to communicate CHEC’s mission, vision and beliefs towards the environment to the staff and provides a framework for guiding CHEC’s ongoing environmental improvement efforts.

The policy will be reviewed periodically by relevant parties and will be displayed on notice boards in languages suitable for the local workforce. CHEC will modify the CEMP as needed relevant to actual construction work.

As a contractor, the Environmental Policy (See Appendix A) will be implemented and maintained by the project team, until the completion of the project.

CHEC is certified to ISO Standard 14001 - Environmental Management System (See Appendix B). Thus, the project team will continue to implement and maintain these systems for the Lae Port Development Project Tidal Basin Phase I to prevent accidents and minimize adverse environmental impacts from the project.

CHEC ENVIRONMENTAL COMMITMENT

The contractor will comply with all PNG environmental legislation, regulations and PNG government policies and procedures. In addition it will comply with the ADB’s Safeguard Policy Statement 2009.

China Harbour Engineering Company (CHEC) is internationally recognised as having a reputation for safeguarding the environment and has achieved certification to ISO Standard 14001-Environmental Management System (EMS). CHEC acknowledge that it is essential to maintain the annual renewal of this ISO certification and they ensure construction works comply with environmental standards. The steps needed to meet these standards are included in regular staff training plans.

Activities during construction will be constantly monitored on a daily basis to ensure compliance. As part of the continual improvement program, this plan will be reviewed at least once a month, and if necessary amended after discussions with the Supervisory Consultants. It may be amended and updated at any time at the discretion of the Project Management and will be formally reviewed once a year for the life of the project. At completion of the project a Project Completion Report will be submitted confirming that all necessary environmental clean-up measures have been completed.

The basis for amendments, improvements and updates will be environmental inspections, audits and reviews of the contractor’s environmental performance. This will ensure procedures for control of contractors are sufficient to maintain project environmental standards, meet project environmental targets and comply with environmental legislation and regulations relevant to the project.

1.0: INTRODUCTION:

This Contractors Environmental Management Plan (CEMP) covers the Construction Phases of Lae Port
Development Project – Tidal Basin Phase 1. The plan is developed following the findings of the Environmental Impact Assessment (EIA) undertaken by Haskoning Nederland BV in association with Ports & Maritime Consultancy Ltd. Port Moresby, in year 2007. In the EIA, both bio-physical & socio-economic impacts of the project have been identified and mitigation measures recommended. It also follows the requirements and recommendations of the Initial Environmental Examination (IEE) of “PNG: Lae Port Development Project – Additional Works” October 2011, prepared by Independent Public Business Corporation for the Asian Development Bank.

China Harbour Engineering Company (CHEC) is an internationally recognised company and maintains its reputation in safeguarding the environment by meeting regulatory requirements in the country of operation and adopting a “Best Environmental Code of Practice” which is based on CHEC’s certification to ISO Standard 14001-Environmental Management System (EMS). Thus all construction works will comply with acceptable relevant environmental standards and the steps needed to meet these are included in staff training plans.

2.0: DEFINITION:

<table>
<thead>
<tr>
<th>Terms</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Surroundings and conditions in which CHEC’s construction works operates or which it may affect including living systems (human and others) therein.</td>
</tr>
<tr>
<td>Environment Policy</td>
<td>A unique document that shows who does what and when and how to do it. Environment policy does influences all business activities including the selection of people, equipment and materials, the way work is done and how it is designed to provide goods and services. The policy is in compliance with PNG environmental protection laws and ADB’s Safeguard Policy Statement.</td>
</tr>
<tr>
<td>Hazard</td>
<td>Any situation with the potential to cause danger to environment, cause injury or illness to people</td>
</tr>
<tr>
<td>Accident</td>
<td>Any event which result in damage or loss to environment</td>
</tr>
<tr>
<td>Incident</td>
<td>An event which has caused or could have caused damage or loss to environment or injury to personnel on site</td>
</tr>
<tr>
<td>Near-miss</td>
<td>Any event which has the potential to cause damage or loss to environment but avoided by circumstances</td>
</tr>
<tr>
<td>Risk</td>
<td>The potential for a hazard to result in an incident</td>
</tr>
<tr>
<td>Risk Assessment</td>
<td>A careful consideration by competent people of the hazard associated with a task. The potential effect of each hazard, how severe it might be and the likelihood of it occurring</td>
</tr>
<tr>
<td>Risk Management</td>
<td>A management system which eliminates or mitigate the threat from hazard</td>
</tr>
</tbody>
</table>
Environmental Management System | The company structure, responsibilities practices, procedure process and resources for implementing environmental management

Environmental Audit | An independent systematic & documented process of assessing compliance of an Environmental program with legislation

Contractors Environmental Management Plan | A description of the means of achieving environmental objectives during the construction phase in compliance with the EIA and IEE prepared for the project.

3.0: PROJECT BACKGROUND:

Due to the archipelagic nature of Papua New Guinea (PNG) and rugged terrain, which creates widely dispersed population pockets and limits mobility and opportunities to develop the domestic market, the country heavily relies on trade, particularly exports, for economic growth and fiscal revenue. The port sector provides a vital link between PNG and the world market, with more than 80% of PNG exports shipped from ports.

The city of Lae, located in Morobe province, is PNG’s industrial and commercial trade centre. Lae port, the largest port of Papua New Guinea, is centrally located in the country and is on most Pacific shipping routes. It is situated on the coast of the Markham Bay at the north-western corner of the Huon Gulf, approximately 1.5 km east of the mouth of the Markham River.

Over the past decade Lae port has been adapting to the demands of container operations. However, the current five berths of Lae port, with a total length of about 520m and a total storage area of 52,600 m² for cargo marshalling, are aging and insufficient to handle increasing cargo volumes and ship size.

As early as the 1970s a plan to expand port capacity by developing a tidal basin project in the marshland area located to the west of the existing port facilities was formulated. The project did not proceed due to a dispute relating to land ownership. During the following two decades decreased economic growth discouraged not only investment in the tidal basin project, but also adequate maintenance of the existing port facilities. Improved economic performance and steady increase of the cargo throughput at Lae port since 2003 have generated revenues for the Government and PNG Ports Corporation Limited.

4.0: PURPOSE:

The purpose of this CEMP is to;

- Comply with the requirement of PNG Environment Act 2000
- Practically apply CHEC’s Environmental Policy
- Comply with EMS (ISO 14001) Requirements
- Address potential environmental issues pro-actively and systematically in a timely manner
Ensure compliance with PNG’s environmental protection laws and ADB’s Safeguard Policy Statement and agreements between Government and Contractor

5.0: OBJECTIVES & TARGET:

Project environmental objective & target are as follows;

<table>
<thead>
<tr>
<th>No</th>
<th>Objective</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>To comply with legal requirement</td>
<td>Zero conviction</td>
</tr>
<tr>
<td>2</td>
<td>To ensure best environmental performance</td>
<td>Zero non-compliance in environmental practice</td>
</tr>
</tbody>
</table>

6.0: ENVIRONMENTAL LAWS, POLICIES & STANDARDS:

- PNG Environmental Act 2000
- CHEC Environmental Policy
- Environmental Management System
- ADB’s Social Safeguard Policy Statement 2009
- Standards to be adopted for discharges will be in accordance with the PNG Department of Environment and Conservation Permits for Noise, Air, Water and Land Discharges as issued after Minister’s Approval in Principle is given, which has been obtained
- Standards for Mitigation and Monitoring will be as stipulated in the IEE 2011 to include parameters, locations, timing and frequency.

7.0: ENVIRONMENTAL MANAGEMENT STRUCTURE:

The ES&H management structure is shown below. The ES&H Manager is directly responsible and report to the Project Manager/ Project Director.

```
Project Manager
     ↓
Deputy Project Manager
     ↓
ES&H Manager
     ↓
ES&H Engineer
```
8.0: RESPONSIBILITIES:

Respective personnel within the environmental management structure are responsible and accountable for the implementation of this EMP.

8.1: Project Manager (PM);

The Project Manager is responsible for providing support in dealing with all aspects of environmental issues within the project, and reporting to the CHEC Supervisory Board.

8.2: Deputy Project Manager (DPM);

The responsibilities of the Deputy Project Manager are as follows:

a) Ensure works are executed in accordance with the CEMP.
b) Arrange routine joint site inspection with ES&H Manager and ES&H Engineer.
c) Provide necessary guidance & supervision to ES&H Manager and ES&H Engineer in order to implement CEMP.
d) Monitor and control the works including those subcontractor(s) to ensure compliance with specified requirements.
e) Ensure appropriate environmental protection and pollution control mitigation measures are properly implemented in accordance with the relevant procedures.
f) Assist in handling any complaints received from the public.
g) Ensure remedial action is undertaken immediately if there is a non-compliance of statutory or contractual requirements of the environment practices.
h) Liaise with PMU and PMU’s IES as required.

8.3: Environmental, Safety & Health (ES&H) Manager;

ES&H Manager is responsible for;

a) Providing advice to project management in respect of any environmental protection issues such as noise abatement, air & water pollution control, refuse disposal etc.
b) Assuming environmental duty on site with the assistance of Environmental Engineer. Held responsible for any environmental issues arising due to construction activities and in relation to environmental practices adopted on site.
c) Providing necessary guidance & supervision to ES&H engineer in order to implement environmental management plan & program.
d) Ensure works are executed in accordance with this CEMP.
e) Liaise with relevant government department in obtaining required license, permit and test report.
f) Arrange routine joint site inspection with ES&H engineer in consultation with Deputy Project Manager.
g) Prepare, implement and update the Contractors Environmental Management Plan;
h) Arrange and provide the environmental training including the site specific induction training and toolbox talks for the staff and workers on the Site, and to organize environmental promotional activities;  
i) Advise the company on the implementation of an environmental management system;  
j) Attend Site Safety and Environmental Management Committee (SSEMC) Meetings  
k) Liaise with PMU and PMU’s IES as required  
l) Apply for environmental permits and ensure conditions stated therein are complied with during construction activities and site works  
m) Ensure that the elements from the approved CEMP are translated into site inspection forms and monitoring forms.  
n) Ensure that the regularity of the site inspections are followed as per the daily and weekly inspection charts given in the Appendices C and D.  

8.4: Environmental, Safety & Health (ES&H) Engineer;  
Duties and responsibilities of the ES&H Engineer are as follows;  
a) Provide engineering advice to project management in respect of any environmental protection issues such air & water pollution control, refuse disposal etc.  
b) Work in parallel with the design team and project management to ensure environmental issues are fully considered during the design and implementation stages.  
c) Advise on measures to be taken in the interest of environmental protection, and implement such measure;  
d) Liaise on all matters relating to environmental monitoring and auditing;  
e) Carry out inspections of the site for identifying potential hazards to the environmental, and to report findings with recommendations for corrective actions;  
f) Participate in the environmental audit, and monitor the environmental performance on the Site;  
g) Check and ensure that any polluting or potentially polluting situation is promptly rectified as per ES&H Managers advice  
h) Attend Site Safety and Environmental Management Committee (SSEMC) Meetings  
i) Keep a copy of the following documents (including but not limited to):  
   - Any statutory required environmental permits/licenses including construction noise permits, noise levels for compressors and hand held percussive breakers, effluent discharge licenses, dumping permits;  
   - All correspondences with Department of Environment and Conservation. Central Environment Authority and complaints;
• Records regarding the handling of contaminated wastes;
• Records regarding the disposal of all construction and demolition materials to the specific or designated area.
• Record of all trained personnel in the site offices and update the record.

j) Update the monthly summary Waste Flow Table

k) Report to the ES&H Manager regarding non-compliance of any environmental protection issues and ensure any non-compliance is handled

l) Ensure complaints are handled properly

m) Liaise with PMU and PMU’s IES as required

n) Apply for environmental permits and ensure conditions stated therein are complied with during construction activities and site works

o) Ensure that approved CEMP is available at the site office

p) Ensure that the elements form the approved CEMP are translated into site inspection forms and monitoring forms

q) Updating of CEMP based on changes in operating procedures or new issues brought to light. Proposed revisions to the CEMP will be tabled in the monthly progress meetings CHEC/KECC/IPBC. (See Figure 1 below)

r) Carry out site inspections in accordance with the monitoring plan and complete daily and weekly inspection charts as given in the appendices C,D. All findings will be reported including “Near Misses”, not just corrective actions. This relates to potential incidents that were avoided and no actions were required but these must still be reported, as lessons learned can be circulated
8.5: Site Engineers & Assistant Engineers;

The Site Engineers / Assistant Engineers have the following duties in relation to environmental control;

a) Assist the Environmental Manager in implementing the CEMP
b) Monitor and control the works including those of sub-contractors to ensure compliance of both contractual and statutory requirements;
c) Report to the Environmental Manager or Environmental Engineer regarding non-compliance of any environmental protection issues;
d) Investigate and verify the complaint received from public;
e) Ensure the remedial actions or mitigation measures are carried out as planned
f) Carry out noise and vibration monitoring as required.
g) Attend induction and regular meetings on environmental health and safety matters
h) In the event of complaints being received by any staff i.e. site engineers/assistant engineers they must report to ESHE and ESHM and follow the procedure laid down in the Complaints Response Procedure. (Figure 2)

8.6: Technical officers, Foremen, Supervisors;

Technical officers/Foremen/Supervisors are responsible for the following duties in relation to environmental control;

\[ a) \] Assist the Site Engineers/ Assistant Engineers to implement the CEMP
\[ b) \] Control the works, including those of sub-contractors, to fulfil environmental requirements;
\[ c) \] Report to the Site Engineers/ Assistant Engineers any non-compliance of environmental protection and mitigation measures;
\[ d) \] Investigate the complaint received from public,
\[ e) \] Carry out remedial actions or mitigation measures to rectify the non-compliance.
\[ i) \] Attend induction and regular meetings on environmental health and safety matters
\[ j) \] In the event of complaints being received by any staff i.e. site engineers/assistant engineers they must report to ESHE and ESHM and follow the procedure laid down in the Complaints Response Procedure. (Figure 2)

8.7: CHEC Employees;

\[ a) \] to carry out agreed site environmental practices as instructed by ES&H Manager, ES&H Engineer, Site Engineers and Foremen.
\[ b) \] Report promptly to their immediate supervisor who will report to ES&H Manager/ or Engineer on any non-compliance of environmental protection and mitigation measures.
\[ c) \] Participate and co-operate with the Project Management Team to achieve the environmental objectives.

9.0: IMPLEMENTATION AND MONITORING:

It is essential to formulate monitoring system in order to evaluate remedial action taken in respect of water, air, land & waste pollution etc. The CEMP Monitoring Plan is a process of observing the tasks to be carried out on site after identification of environmental risks and hazard events and check whether the actions were executed according to the codes, regulations, and specification requirements. The construction works executed will be observed and checked from time to time through site inspection or Ad-hoc inspection, any non-conformance found will be recorded and collective action will be taken. Thus, work procedures will be setup for controlling and monitoring the construction works to be implemented within the codes and specifications requirements.

The CEMP Monitoring Plan includes the following:

\[ \bullet \] Setup CEMP Monitoring Program.
• Carry out preliminary survey and take necessary records for all elements involved before construction;
• Carry out daily site visit to monitor project construction compliance with codes and regulation requirements (Please refer appendix–C for daily inspection check list)
• Weekly site visit to monitor material production plants such as metal quarry, crusher, asphalt plant and concrete batching plant. (Pls refer appendix –D for weekly inspection check list)
• Carry out CEMP site inspection and audit, issue Non-Conformance Record (NCR)
• Regular communication with local community, and record any complaint regarding to environmental issues;
• Report to the ES&H Manager, Project Manager, Employer and Employer Representative on any non-conformance;
• Documentation of records

9.1: Monitoring Program;
The monitoring program is a detail environmental monitoring work program, it defines each and individual mitigation action which needs to be taken during the construction period. Moreover, the “daily inspection check list” & “weekly inspection check list” (see Appendix C & D) will be main tool for monitoring program since those lists indicate both compliances and non compliances in all relevant aspects of project activities. (See Appendix E).

Within the monitoring period, site inspection, the environmental audit frequency will be planned according to the construction works program. Furthermore, environmental monthly meeting will be assigned as one aspect of monitoring program. The environmental monthly meeting will include Employer, Employer Representative, contractor and sub-contractors (if any).

9.2: Preliminary Survey and Records;
Before commencement of construction, each and individual item listed in the EIA report will be reviewed. Action plan will be prepared for the necessary testing items to be carried out on site.
Finally, the necessary investigation will be carried out to verify of any changes on the existing environmental conditions. Detail records and testing report will be kept and documented, and it will be submitted for review and approval.

9.3: Environmental Inspection and audit;
In the CEMP, the site inspection and audit procedures will be setup.
To enhance the environmental management and control, environmental inspections and audit are the effective mitigation measure to reduce the environmental impact. As a minimum, it will include the following:
1). The environmental site inspection will be carried out according to the program to verify site activities compliance with the project specifications and local codes requirements;
2). The environmental non-conformance records will be listed in the monthly construction progress report to bring the attention to the project team;

3). Non-Conformance Report (NCR) will be issued in an event of non conformity with ES&H aspect and it should be closed after rectifying with given time period. (Pls refer Appendix –E for NCR)

4). Random or Ad-hoc environmental inspection will be carried out to check the site activities without advance notice by senior management staff.

5). The Environmental documentation audit will be carried out periodically and adjust to suit the needs;

6). The anticipated environmental impact will be monitored to provide continuous improvement and maintain at the As Low As Reasonably Practicable level;

7). All NCR, CAR will be reported to Project Manager, Engineer & Employer, and in the monthly meeting.

8). Monitoring report will be prepared and included in the monthly report.

The ES&H Manager and ES&H Engineer will be response to carry out the environmental site inspection and audit.

9.4: Monitoring & Reporting;

The ES&H Manager will be response for the preparation of monitoring report, and the coordination and communication among Engineer, Employer, and CHEC project team. He is also response for reporting to the Engineer, Employer, ES&H Manager, and Project Manager on major environmental issues or non-conformance found.

9.5: Job Hazard;

For those works with high risk or dangerous factors, proper guidance will be provided for safety operational, such as confined space, welding, etc.

In accordance with related law, requirements and regulations of job hazard and risk assessment in PNG, prediction and evaluation of the present or expected hazards/ dangers in the operating environment will be conducted.

To control ES&H risks more effectively, all the engineering activities must comply with the plan, and with the other relevant applicable PNG ES&H directives. In general, the ES&H risks identified as having the most serious impact or consequences must be dealt immediately.

Most of the risks identified have direct repercussions on the construction and operational process; therefore, the continued monitoring of these risks is an important part of Construction Management.

Examples of risk that have been identified include:

- Delivery of major equipment & materials such as caissons, piles, quarry rock.
- Contamination of sea water or accidental dumping of dredge material.
• Environmental impact such as noise and dust during construction
• Weather considerations
• Accidents.
• Precautionary measures with regard to health and safety will be described comprehensively in The Project Health & Safety plan.

9.6: Emergency Response Plan
CHEC will establish, implement and maintain a procedure to identify potential emergency situations and potential accidents that can have an impact on the environment. It will consider the following:
• Accidents, hospital facilities and ambulances
• Fire, distance to fire station, how long does it take a fire engine to get to the site (response time), what on-site fire fighting equipment is maintained on site to fight the fire?
• Fire fighting water tank. Does it hold enough water to fight the fire until the fire brigade responds?
• Marine spill - does the Lae port have an oil spill response plan? What equipment do they have? Do they have boats? What is their response time? Can CHEC participate in their plan? Can this be applied to the dredger?
• UXO - what is the procedure in the event of finding UXO?
This procedure will be prepared and submitted to ADB for approval before works commence.

9.7: Performance Monitoring
The ES&H Manager will be responsible for the monitoring on the environmental management carried out on site. He will check regularly either on site activities or documented records. The performance of the environmental management will be properly monitored through the site activities, inspection records, audit records, and other reports. If any abnormal situations happen action will be taken either informing site staff to take immediate action or report to the Project Manager/ Employer regarding to the issue.

10.0: ENVIRONMENTAL MANAGEMENT & MITIGATION MEASURES;
Summary of the potential hazard events identified in EIA Report are listed below. The initial mitigation measures are proposed for identified impacts. Any other site specific impacts which occur during the construction period will be evaluated and appropriate measures taken accordingly.

11.0: COMPLAINT MANAGEMENT:
CHECL have developed a complaint management program to deal with any complaints raised from the public with regard to environment, health and safety issues as a result of operations. The complaint registers will be maintained and will be regularly monitored.

12.0: ENVIRONMENTAL TRAINING:
All project personnel carrying out activities affecting the environment are sufficiently trained and competent in performing their assigned duties. All employees will receive appropriate training on
environmental and waste management as followings:

a. Environment Training for Site Supervisory Staff

A training session of “Environmental Protection” shall be provided to Site Supervisory Staffs within 14 days from the date of employment of such staff on the Site.

b. Environment Management Training for Site Managerial Staff

A training session of “ISO14001 Environmental Management System on Site” made by Head Office shall be provided to site managerial staff within 3 month from the date of works commencement.

c. Environmental Site Specific Induction Training

All staff and workers employed in the Project directly or in connection with the Project indirectly shall attend the Environmental Site Specific Induction Training delivered by the ES&H Manager/ES&H Engineer. They shall also attend the refresher training per every half-year. The training should cover but not be limited to legislation and regulations, policy, organization structure, duties and responsibilities, mitigation measures, targets in Environmental Management Plan, in-house rules and regulations.

d. Environmental Toolbox Talk

All the workers employed on the Project directly or in connection with the Project indirectly shall attend the Environmental Toolbox Talk regularly regarding the environmental nuisance abatement and waste management. Toolbox meetings will take place daily. The topics of toolbox training shall include but not limited to:

- Air pollution control;
- Wastewater treatment;
- Noise control;
- Waste reduction;
- Waste management;
- Site tidiness;
- Handling of chemical waste; and
- Environmental emergency preparedness.

13.0: ENVIRONMENTAL REPORTING:

Related environmental issues will be included in the monthly report including records from site inspection, environmental accidents, etc.

ESH inspection form and reporting procedure have been developed. This form will be modified relevant to actual work. CHEC is developing relevant forms such as incident investigation form, ESH toolbox forms, incident reporting forms and others with respect to ISO 14001 – EMS.

CHEC has developed non conformance record sheets modified to match this project. ESH issues will be recorded in a register and CHEC management will ensure these issues are addressed in a timely
manner.

The monthly report shall be prepared by the ES&H Engineer containing the following information:

- A list of major forthcoming activities in the next two months which will likely have environmental impacts and nuisances to the surroundings and the control measures in mitigation;
- The training programme for the next month and the records of training arranged/ conducted in the previous month;
- The updated organization chart on environmental management; and
- A summary of defects and deficiencies identified during inspections and weekly environmental walks and the follow-up actions and remedies taken to prevent recurrence.

The ESH Manager will prepare a quarterly ESH performance report and submitted to Project Manager who then report to PMU & IPES.

In addition, the Employer/ Employer’s Representative will be informed immediately if any major environmental incident occurs.

The evaluation and identification of all possible hazard events will follow the procedure as described below.

14.0: MANAGEMENT REVIEW:

Top management of CHEC will review the Environmental Management System, at planned intervals, to ensure its continuing suitability, adequacy and effectiveness. Reviews will include assessing opportunities for improvement and the need for changes to the Environmental Management System, including the environmental objectives and targets. Moreover the ISO14001 Environmental Management System will be followed in implementation of the CEMP.

15.0: SITE SPECIFIC ENVIRONMENTAL PARAMETERS:

Potential site related specific environmental issues identified in the EIA and IEE are listed here under.

a) Noise emission & Vibration
b) Air quality
c) Water quality
d) Ecology & fisheries
e) Solid waste
f) Sewage waste
g) Oil spillage & leakage
h) Littering
i) Vegetation
j) Visual impact
k) Erosion & sedimentation
15.1: Noise & Vibration

Noise emission will come from the following sources:

- Construction works carried out in land,
- Vehicular traffic associated with construction requirement
- Operation of machineries and equipments.
- The construction activities for breaking, piling, excavation, loading/unloading materials, reclamation
- Site formation work

Other major source of noise and vibration includes:

- Quarry, crusher plant
- Asphalt plant operations.

With the proper implementation of all noise & vibration mitigation measure during the construction period, the resultant noise & vibration impacts can be mitigated and minimized to an acceptable level. It is expected that the vibration issue will arise during the breaking of rock profile at a location along the quarry wall foundation. CHEC management will overcome this by using control blasting method under the supervision of qualified engineer. To minimise noise and reduce vibration forces, quarry site will have to be located further away from residential areas to reduce level of vibration and noise reaching them.

Noise emitted from the sources identified poses a threat to the employees working in the site and general public. This noise causes naissance and can cause problems in hearing. However impact level is expected to be a minor medium level. A sound noise survey will be undertaken periodically to establish noise levels within the construction site.

15.2: Air Quality

The potential of air quality impact during construction is limited. Air pollutants will come from the following sources:

- Breaking
- Excavation
- Loading/unloading materials
- Reclamation operations
- Acquiring of construction materials such as metal aggregates and sand etc from outsourcers

Small particles dispersed in the air and ozone sourced from the mentioned areas are air pollutants. When inhaled, these pollutants can aggregate the lungs and can lead to chest pain, coughing, shortness of breath and throat irritation.

Air quality & vibration management plan is being developed to deal with air quality issues at the construction site.

15.3: Water Quality

The major cause of marine water quality impacts will be due to dredging marine sediments and the associated reclamation activities. The dredging works and reclamation are planned to be carried out simultaneously in a marine environment. These will likely to give rise to the following environmental impacts

- Increased turbidity
- Threatened geotechnical stability
- Siltation in the existing harbour
- Sediment transportation
- Change in the current pattern
- Change in adjacent beaches
- Wave disturbance and impact on water quality

It is necessary to note that periodic widespread high turbidity will be common in the project area because of sedimentation processes caused by the Markham River. The surface runoff from construction site may create potential pollution to the sea water during construction period. This will be effectively mitigated through the implementation of standard control measure, such as sediment traps, on-site wastewater collection and treatment systems, chemical toilet etc.

15.4: Ecology & Fisheries

The dredging and reclamation work will cause permanent loss of benthic habitat over about 340 ha of seabed for the reclamation, and temporary loss of 820 ha for the approach channels and basin, the benthic habitat support mollusks, crustaceans, and fishes. Fish and shrimp spawn generally appear on the sandy sea bottom. The ecological value of benthic in these areas is not significant and similar habitats exist elsewhere. There are also two small isolated areas of limestone cap rock at the proposed entrance channel, but they do not provide a habitat for sponges, corals, and echinoderms. There are no protected habitats close to the project area, and therefore dredging and reclamation are not anticipated to have significant impacts on identified habitat in the dredging and reclamation areas.

However, due to the high rock profile at a location along the quay wall foundation, under-water blasting is necessary. This may affect to marine fauna badly if blasting take places without considering possible danger for marine fauna.
15.5: Solid Wastes
Different types of waste will be generated during the construction period. Following are the major construction wastes:

- Construction and dredged materials,
- Chemical waste
- General refuse.

Unsuitable dredged & paving materials, used materials for temporary works such as concrete, off-cut timbers, paving materials, unsuitable metal and glass etc. are unavoidable although the amount can be controlled and minimized at the construction site. It is estimated that there will be a large volume of waste produced every month. CHEC management realizes the importance of proper management of waste arising from the construction works and has developed a Waste Management Plan to minimize environmental impact during the construction period. Waste Management Register will be developed to track down types and classes of wastes produced during the construction activities.

15.6: Sewage
Sewage waste and grey water would be produced from the construction area as the construction works will accumulate construction personnel for the project duration. Such waste would require proper management as this may contribute towards problems of odor, surface and groundwater pollution.

15.7: Oil spillage & leakage
Environmental issue in relation to a spill and leak are expected in the construction area. Leak & spills can escapes into the storm water drainage accelerated by fluvial processes and can pollutes storm & marine water. Hazardous materials such as battery acids can cause significant effect on both health and environment when improperly and or incorrectly used or applied.

Proper storage, handling and usage of both hazardous and non-hazardous chemical at the construction site are required to reduce the risk of spillage and leachate which will have impact on the health and environment when carelessly stored, handled or used.

15.8: Littering
Littering of construction site by the employees and sub-contractors may become an environmental health hazard if trash and other solid wastes are not properly managed. Although impact would be minor and temporary, it requires proper management and therefore specific details of managing littering will be implemented.

15.9: Vegetation Clearance
Portions of the proposed construction area and the surrounds are fully covered by vegetation of mainly short grasses and scattered scrubs.

The terrestrial ecological status is being maintained over time. This means that the area is a bird and
insects friendly environment

15.10: Visual impacts

Visual impact of the proposed construction site due to clearance of vegetation and alteration of landscape is inevitable hence will cause nuisance to the nearby community and the general public. Therefore it is an issue required to be addressed in this EMP.

15.11: Erosion & Sedimentation

The key environmental issue for consideration with respect to topography, geology & soil are erosion & sedimentation control. Proposed construction site clearance will be implemented with respect to design drawing or site plan to maintain the potential of erosion and sedimentation.

15.12: Socio-economic issues:

The Lae Port Development Project would generally have a positive impact on the lives of the locals. This project already provides employment opportunities for the locals who would earn some cash from the project and improve local income generation.

However, with the positive impacts, there are also negative impacts that are anticipated on the social environment. However due to the Resettlement Program the local community now live further away from the project site so negative impacts are expected to be minimal.

15.13: Archaeological & Cultural Heritage

The proposed construction project may uncover some relics of archaeological and cultural significances. Archaeological and cultural heritage management issues are considered during the construction periods.

16.0: ENVIRONMENTAL MANAGEMENT PLAN:

Table 1 below summarizes the environmental monitoring plan, showing the environmental issues, proposed mitigation measures and monitoring plan (locations, parameters, frequency, and responsibility). The monitoring plan for construction operations will be refined after the baseline is completed.
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<tr>
<td>Environmental Issue</td>
<td>Mitigation Measures</td>
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<tr>
<td>DESIGN / PRE-CONSTRUCTION PHASE</td>
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<tr>
<td>Avoidance of sensitive areas for dredge disposal</td>
<td>• Detailed field surveys in consultation with authorities ascertained that proposed dredged material disposal sites are not in sensitive areas. Area is clearly delineated and tipping must remain further than 300m from mouth of Markham River and in at least 50m depth of water.</td>
</tr>
<tr>
<td>Environmentall sound design</td>
<td>• Ensure that final harbor configuration will not cause changes to shoreline, entrance to existing port and dynamics of Adjacent shore line beach and river mouth</td>
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Environmental Management and mitigation monitoring

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<th>Environmental Issue</th>
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adjacent areas.

CONSTRUCTION PHASE

Turbidity (suspended sediment load/sediment plumes) during harbor dredging

- CHEC will identify and map all area where soil disturbances will occur
- For each of these areas identify appropriate sediment control structures (silt fences, bunds, sediment traps, basins and various sediment control drains and install these structures prior to commencement of work
- CHEC will establish which month of the year are likely to

- CHEC will inspect its surrounding to ensure that the erosion and sediment control measures recommended are implemented on site
- If the recommended measures are not implemented, appropriate action will be undertaken immediately to remedy

Weekly during dredging operations

Contractor-CHEC

Daily with direct reading instruments

Contractor-CHEC
### Environmental Management and mitigation

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<tr>
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<tr>
<td>experience higher rainfall</td>
<td>• Site preparation works will be minimised during period of high rainfall</td>
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<td></td>
<td>• Works will be undertaken during dry season so that large quantities of unconsolidated materials are not exposed to rain and run-off.</td>
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<td>• A bund or trench will be constructed to divert runoff to sediment control structures. These bunds and trench will be removed after completion of construction works.</td>
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<td></td>
<td>• All disturbed earthworks sites</td>
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<td></td>
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<tr>
<td>the situation</td>
<td>• Areas that have been re-vegetated will be inspected on a regular basis to ensure that vegetation is re-established.</td>
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<td>for turbidity</td>
<td>• Turbidity will be measured directly at the edge of the construction site where runoff may occur.</td>
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<tr>
<td>and bi-weekly</td>
<td>for suspended sediments</td>
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<td>for suspended sediments</td>
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### Environmental Issue | Mitigation Measures | Locations | monitoring parameter | monitoring frequency | monitoring responsibility |

- All construction will be implemented according to the design plans that are compatible with respect to soil, climate, landform, drainage, vegetation cover and land use factors at the site.
- All drainage on site will be constructed according to design plan so that run-off from outside the construction area does not mix with unfiltered run-off within the works area.
### Environmental Management and Mitigation

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<tr>
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<td></td>
<td>• Earthwork area will be protected as much as possible so that only a smallest area is required to be exposed at any one time. Disturbed soil will be compacted on an artificial slopes</td>
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<td></td>
<td>• Construction spoil materials will not be placed on high grounds where materials can easily be washed off during unexpected rainfall period. Spoil material stockpile will be stored in bunded areas to prevent erosion. If necessary such stockpiles will be covered up</td>
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<td>Environmental Management and mitigation</td>
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<tbody>
<tr>
<td>Excessive noise</td>
<td>All employees working in an environment subject to high ambient noise level would be required to wear hearing protectors, which meets an international noise standard so that excessive noise is limited and minimized.</td>
<td>Construction area</td>
<td>ES&amp;H Manager will carry out visual monitoring within the construction areas. Any workers not wearing full PPE including ear protectors in noisy areas will be disciplined.</td>
<td>Vibration and noise levels will be measured periodically (half yearly intervals) to verify its acceptability as per standards.</td>
<td>Contractor CHEC PMU KECC</td>
</tr>
<tr>
<td>during dredging,</td>
<td>ES&amp;H Manager will provide hearing protectors such as earplug and ear muffs to the employees exposed to noise emitted by machinery within the construction site.</td>
<td></td>
<td>Any noise complaints from residents will be dealt with in a timely an effective manner.</td>
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<td>sheet-piling, and demolition</td>
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<td>Noise measurement</td>
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- The ES&H Manager in liaison with ES&H Engineer will ensure that equipment and machinery utilized in the construction works are well maintained and serviced so that the noise levels are minimized as much as possible.
- Noises sourced from crusher plants & asphalt plant will be minimised by providing adequate buffer zone away from any residential areas.
- Working area will be suitably shielded from surrounding area either by bunding or

s will be made if necessary in response to complaints.
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<td><strong>Mitigation Measures</strong></td>
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- Appropriate noise reflective security fencing.
- Silencers or mufflers will be utilized in all construction equipment and properly maintained.
- Any areas where noise levels are above 85 dB(A) will be highlighted with sign boards and appropriate control measures taken.

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<tr>
<th>Disposal of dredge spoils</th>
<th><strong>Mitigation Measures</strong></th>
<th><strong>Construction site</strong></th>
<th><strong>Direct readings will be made</strong></th>
<th><strong>Daily observation</strong></th>
<th><strong>Contractor</strong></th>
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<tbody>
<tr>
<td>Surface debris will be cleared and disposed of to an approved landfill</td>
<td>Approved dumping ground</td>
<td>of water quality for turbidity near the onshore discharge point and around the dumping zone</td>
<td>Contractor CHEC</td>
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<td>Dredged materials which are unsuitable will be dumped in an approved dumping ground</td>
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<td>PMU KECC</td>
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### Environmental Management and mitigation

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<tr>
<td>approved Disposal Area offshore. Silt curtains will be deployed at the excavation area and at the dumping area. See Dredging Plan in Appendix G for details.</td>
<td>Offshore in &gt; 50m water depth.</td>
<td>300m</td>
<td>Stockpiled materials will be inspected for dust generation.</td>
<td></td>
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<tr>
<td>- Dredged material which is useful will be stockpiled on site for future use in the platform age construction. Stockpiles will be covered with tarpaulins to prevent dust entrainment by winds</td>
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<tr>
<td>- Silt traps will be installed in runoff drains</td>
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<td>- Cutter suction hopper</td>
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- Level of suspended solid, turbidity, dissolved oxygen and PH will be monitored during dredging operation in order to identify changes in marine water. If any significant changes occur, remedial action will be taken promptly.
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- A stable transition region will be established between existing sea bed and the area to be dredged in order to minimize risk of geotechnical instability.
- The dredging will increase turbidity, but the spread of suspended solids is anticipated to be limited. The impacts related to a high level of suspended solids will not significantly reduce
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the primary productivity of these areas.

- Although high level of suspended solids in the water column are not uncommon and localized increase in turbidity are not expected to significantly impact on water quality, the best practice controls in dredging operations will be executed to minimize the risk of
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- uncontrolled release of sediment-laden water.
- All construction plant and equipment will be designed and maintained properly to avoid the risk of silt, sediments, contaminants or other pollutants being released or leaked into the sea.
- Silt curtain will be deployed around the immediate dredging area when there is
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<tbody>
<tr>
<td>Environmental Issue</td>
<td>Mitigation Measures</td>
</tr>
<tr>
<td>Marine ecology and fishery</td>
<td>• To reduce the impact to the marine fauna during blasting at quay wall foundation, control blasting practices and setting up of bubble curtains will be carried out during blasting work.</td>
</tr>
<tr>
<td></td>
<td>• Ensuring that the dredging and reclamation as well as</td>
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- Construction of the permanent and temporary revetments do not extend beyond the designated areas.
- Changes can be identified by benchmarking those results.
- CHEC will monitor marine and fishery impacts by observation of behaviour of marine fauna regularly to help identify any changes in behavioural pattern.
### Environmental Management and mitigation

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</thead>
<tbody>
<tr>
<td>Spills of fuel and other hazardous materials</td>
<td>Material Safety Data Sheet (MSDS) will be made available as a guide for the proper use of a type of chemical.</td>
<td>Work sites</td>
<td>ES&amp;H Manager will undertake regular inspection of fuel storage tanks or drums to ensure that no leach or spill occurs.</td>
<td>Daily</td>
<td>Contractor</td>
</tr>
<tr>
<td></td>
<td>MSDS will be consulted whenever needed to guide the use of hazardous &amp; non hazardous chemicals.</td>
<td></td>
<td>ES&amp;H Manager will undertake daily visual checks around the construction site to detect any leakages or spill of effluents.</td>
<td></td>
<td>CHEC</td>
</tr>
<tr>
<td></td>
<td>The CHEC management will construct a hard surface area with a containment bund for the refuelling facility to contain spills should a refuelling facility be built within the construction site.</td>
<td></td>
<td>ES&amp;H Manager will make Regular checks of containers for any minor leaks where in service or</td>
<td></td>
<td>PMU</td>
</tr>
<tr>
<td></td>
<td>Oil storage containers or drums</td>
<td></td>
<td></td>
<td></td>
<td>KECC</td>
</tr>
</tbody>
</table>
## Environmental Management and mitigation

<table>
<thead>
<tr>
<th>Environmental Issue</th>
<th>Mitigation Measures</th>
<th>Locations</th>
<th>Monitoring parameter</th>
<th>Monitoring frequency</th>
<th>Monitoring responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Drip trays will be used under drums during fuel or solvent transfer</td>
<td>will be placed in the bunded area to contain leach and spill</td>
<td></td>
<td>in storage after being emptied.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Waste oil will be collected and removed from the site by a licensed contractor to an authorised disposable location</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truck / traffic impacts due to hauling of rock from quarry and spoil removal as may interfere</td>
<td>Implementation of hauling schedules that minimize local traffic problems</td>
<td>From port area to land disposal sites and from quarry to port site</td>
<td>Complaints or traffic jams</td>
<td>Daily observation</td>
<td>Contractor CHEC</td>
</tr>
<tr>
<td></td>
<td>Implementation of traffic control scheme to minimize need to cross against existing traffic flows</td>
<td></td>
<td>Reports from local traffic police</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Environmental Management and mitigation

<table>
<thead>
<tr>
<th>Environmental Issue</th>
<th>Mitigation Measures</th>
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<th>Monitoring Frequency</th>
<th>Monitoring Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>with local vehicle traffic.</td>
<td>• All vehicles carrying loads to be covered with tarpaulins</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Falling rocks from vehicles or mud on road.</td>
<td>• Wheel washing facilities and “cattle grids” at access points to site</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disturbance of cultural remains</td>
<td>• Protect and never touch known cultural relic building during working.</td>
<td>Harbor area and surroundings</td>
<td>Reports from site staff, site supervisors</td>
<td>Constant observation</td>
<td>Contractor CHEC</td>
</tr>
<tr>
<td></td>
<td>• Report to the Engineer for instruction when possible cultural relics are found and stop work until getting approval from the Engineer.</td>
<td></td>
<td></td>
<td>Daily reminders to staff during “Tool Box” briefings</td>
<td>PMU KECC</td>
</tr>
<tr>
<td>Archaeological and cultural</td>
<td>• CHEC will raise awareness among</td>
<td></td>
<td></td>
<td></td>
<td>Contractor CHEC’s construction</td>
</tr>
</tbody>
</table>
## Environmental Management and mitigation

<table>
<thead>
<tr>
<th>Environmental Issue</th>
<th>Mitigation Measures</th>
<th>Locations</th>
<th>monitoring parameter</th>
<th>monitoring frequency</th>
<th>monitoring responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>heritage</td>
<td>employees, on the significances of archaeological relics and heritage found on site</td>
<td>personnel are to watch out for any items of cultural significances</td>
<td>CHEC will ensure that personnel on site are aware of or trained in the need to report any sightings of artefacts and relics or heritage remains that are uncovered or disturbed during the excavations activities</td>
<td>CHEC will ensure that the sub-contractors and employees are mindful of cultural heritage when undertaking the works</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Any archaeological employees on the site will carry out</td>
<td>CHEC will ensure that personnel are to watch out for any items of cultural significances</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- CHEC will ensure that personnel on site are aware of or trained in the need to report any sightings of artefacts and relics or heritage remains that are uncovered or disturbed during the excavations activities.

- Any archaeological employees on the site will carry out cultural heritage monitoring.
### Environmental Management and mitigation

<table>
<thead>
<tr>
<th>Environmental Issue</th>
<th>Mitigation Measures</th>
<th>Locations</th>
<th>Monitoring Parameter</th>
<th>Monitoring Frequency</th>
<th>Monitoring Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>finds during works</td>
<td>should be reported</td>
<td>ES&amp;H Manager to have</td>
<td>them salvaged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The National Museum</td>
<td>will be immediately</td>
<td>contacted to undertake</td>
<td>any salvage activity</td>
<td>which cannot be handled by CHEC</td>
<td></td>
</tr>
<tr>
<td>Harbor area and surroundings</td>
<td>Reports from site staff, site supervisors concerning verbal or formal complaints</td>
<td>Daily reminders to staff during “Tool Box” KECC</td>
<td>briefings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reports from site staff, site supervisors concerning verbal or formal complaints</td>
<td>PMU</td>
<td>KECC</td>
<td>briefings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complaints from local Community over construction activities</td>
<td>Report to the Engineer for instruction when complaints received.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Follow complaints procedure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Environmental Management and mitigation

<table>
<thead>
<tr>
<th>Environmental Issue</th>
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<th>Monitoring Frequency</th>
<th>Monitoring Responsibility</th>
</tr>
</thead>
</table>

#### Construction Workers Camp
- **Use of camps for vehicle parking, maintenance and repair**
- **Use of camp for refuelling**
- **HIV Awareness**
- **Gender Issues**
  - CHEC will provide showers, toilets, and clothes washing facilities for use by employees at convenient locations within the construction site.
  - Waste water discharges from general site activities includes waste water treatment units, oil traps, silt traps and settlement tanks will be properly controlled before released to the city sewer system or through any temporary outfall.
  - If connection to the city system is not feasible CHEC will ensure

#### Site area
- CHEC will undertake visual monitoring to ensure the adequate treatment of sewage and grey water before being discharged

#### Daily Observation
- CHEC
- PMU
- KECC
<table>
<thead>
<tr>
<th>Environmental Management and mitigation</th>
<th>monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Issue</td>
<td>Mitigation Measures</td>
</tr>
</tbody>
</table>

that all sewage waste are properly treated prior to discharge into surroundings

- Ensure that sewage treatment units established on site are working adequately
- Ensure that all grey water is also treated prior to discharge
- Provide awareness to all personnel working on site to use the toilet facilities provided and not the bushes
- If alternative pit toilet are used on site, they will be kept hygienic to avoid nuisance
- Any cooking facilities will be
<table>
<thead>
<tr>
<th>Environmental Management and mitigation</th>
<th>monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Issue</td>
<td>Mitigation Measures</td>
</tr>
<tr>
<td>cleaned regularly and maintained in a sanitary condition</td>
<td></td>
</tr>
<tr>
<td>• Any food waste will be stored in closed bins to be bagged and removed from site daily</td>
<td></td>
</tr>
<tr>
<td>• All other waste such as paper, cardboard, plastic bags and bottles, glass bottles, and cans will be segregated for recycling if possible and the removed by an authorised sub-contractor to a government approved sanitary landfill.</td>
<td></td>
</tr>
<tr>
<td>• Scavenging of recyclable solid waste materials by employees</td>
<td></td>
</tr>
</tbody>
</table>
### Environmental Management and mitigation

<table>
<thead>
<tr>
<th>Environmental Issue</th>
<th>Mitigation Measures</th>
<th>Locations</th>
<th>monitoring parameter</th>
<th>monitoring frequency</th>
<th>monitoring responsibility</th>
</tr>
</thead>
</table>

- Forbid unnecessary burning of garbage within the construction site as this will contribute to Green House Effect.
- Vermin control will be implemented. Uncontrolled waste food disposal will not be permitted as it encourages vermin and disease bearing vectors.
- Regular pesticide and insecticide spraying will be implemented to control mosquitoes.
- Stagnant water will not be...
### Environmental Management and mitigation

<table>
<thead>
<tr>
<th>Environmental Issue</th>
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<th>Monitoring Frequency</th>
<th>Monitoring Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Littering</td>
<td>• CHEC will establish a Site area</td>
<td>• ES&amp;H Manager Daily Contractor</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Allowed to accumulate as it provides a haven for mosquito breeding.
- HIV awareness programs will be instituted and all workers required to attend
- Interaction with local populace will be carefully monitored and workers continually reminded to avoid conflict situations
- The Workers Camp will enforce a Zero Tolerance Policy towards possession on site or in the camp of alcohol, drugs, and weapons.
### Environmental Management and mitigation monitoring

<table>
<thead>
<tr>
<th>Environmental Issue</th>
<th>Mitigation Measures</th>
<th>Locations</th>
<th>monitoring parameter</th>
<th>monitoring frequency</th>
<th>monitoring responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>central litter collection centre at the construction area so that all litter at the construction area are collected at the main collection point which will be disposed at the authorised site.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place rubbish bins at the strategic locations within the construction site to store rubbish.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ES&amp;H Manager will notify and encourage all sites personnel to avoid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- will undertake visual monitoring on a regular basis to ensure that littering does not become a problem at the construction area
- CHEC
- PMU
- KECC
<table>
<thead>
<tr>
<th>Environmental Management and mitigation monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Environmental Issue</strong></td>
</tr>
<tr>
<td>Littering and dumping wastes at the central collection points or into the rubbish bins provided.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vegetation</th>
<th>Site area</th>
<th>ES&amp;H Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Any unreasonable removal of the vegetation surrounding the construction area will be avoided as much as possible.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Avoid making fire on the grasses surrounding construction site which may destroy the grassland ecosystems.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site area</td>
<td>Daily</td>
<td>Contractor</td>
</tr>
<tr>
<td>ES&amp;H Manager will monitor by doing spot checks to ensure that an unreasonable removal of vegetation at the surrounding areas do not occur.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daily</td>
<td>Contractor</td>
<td></td>
</tr>
<tr>
<td>CHEC</td>
<td>PMU</td>
<td></td>
</tr>
<tr>
<td>KECC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental Management and mitigation monitoring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Environmental Issue</td>
<td>Mitigation Measures</td>
<td>Locations</td>
</tr>
<tr>
<td>Rock Quarry Operation</td>
<td>• ES&amp;H manager will undertake visual inspection to ensure that the making of fires surrounding area is avoided as much as possible.</td>
<td>• Water sprinkling will be done as required in exposed area of quarry site and transport route to suppress dust generation.</td>
</tr>
</tbody>
</table>
### Environmental Management and mitigation

<table>
<thead>
<tr>
<th>Environmental Issue</th>
<th>Mitigation Measures</th>
<th>Locations</th>
<th>monitoring parameter</th>
<th>monitoring frequency</th>
<th>monitoring responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

- Water sprinkling system will be adopted in crusher plant as applicable in loading point of hopper and other parts of the crusher which emits dust.
- Material transport route is also to be watered to minimize dust emission.
- When transporting dusty material by vehicles, those materials will be
Environmental Management and mitigation

<table>
<thead>
<tr>
<th>Environmental Issue</th>
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<th>Locations</th>
<th>monitoring parameter</th>
<th>monitoring frequency</th>
<th>monitoring responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>covered with tarpaulin cover in order to prevent accidental spillage.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**OPERATION PHASE**

Pollution from port’s sewage and stormwater

- Waste water discharges from port activities includes waste water treatment units, oil traps, silt traps and settlement tanks will be properly controlled before released to the city storm-drainage system or through any temporary outfall.

- Toilet and other sanitary facility for employees will be provided at convenient locations within Harbor area

IPBC will undertake visual monitoring to ensure the adequate treatment of sewage and grey water before being discharged

Monthly

IPBC/ Port Management Authority
Environmental Management and mitigation

<table>
<thead>
<tr>
<th>Environmental Issue</th>
<th>Mitigation Measures</th>
<th>Locations</th>
<th>Monitoring parameter</th>
<th>Monitoring frequency</th>
<th>Monitoring responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>the port</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• All sewage waste will be properly treated prior to discharge into surroundings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Provide awareness to all personnel working on site to use the toilet facilities provided and not the bushes</td>
<td></td>
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</tr>
</tbody>
</table>

Pollution from port’s solid wastes

<table>
<thead>
<tr>
<th>Defense</th>
</tr>
</thead>
<tbody>
<tr>
<td>• All solid wastes will be placed into the rubbish bin drums. When full, they will be removed and disposed of to an authorised dump site for landfill.</td>
</tr>
</tbody>
</table>

Harbor area

• ES&H Manager will watch out for any unacceptable practice of waste disposal within the port by employees and visitors.
• ES&H Manager will ensure that the
<table>
<thead>
<tr>
<th>Environmental Management and mitigation monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Issue</td>
</tr>
<tr>
<td>----------------------</td>
</tr>
</tbody>
</table>

- **Employees and waste collectors are adhering to this solid waste management plan.**

### Pollution from sewage of ships in port

- **Disposal of sewage and bilge water in accordance with MARPOL 73/78.**

### Oil spills and leakage within harbour, or escape the harbour area

- **The sewage and waste oil of vessels should be collected. Applications should be applied before pumping out of tanks. All vessels’ engineers should make**

<table>
<thead>
<tr>
<th>Harbor area</th>
<th>Illegal sewage discharges</th>
<th>Daily when ships are in harbor</th>
<th>Visiting ships and Harbor Master</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port area and offshore water</td>
<td>Illegal waste water discharges</td>
<td>Daily</td>
<td>Harbor Master &amp; Port Management Authority</td>
</tr>
</tbody>
</table>
### Environmental Management and mitigation

<table>
<thead>
<tr>
<th>Environmental Issue</th>
<th>Mitigation Measures</th>
<th>Locations</th>
<th>Monitoring parameter</th>
<th>Monitoring frequency</th>
<th>Monitoring responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil spills from vessels entering, berthing and leaving the harbour</td>
<td>Implementation of the Cook Islands Prevention of Marine Pollution Act (1998) and of existing oil spill contingency plan</td>
<td>Port area and offshore water</td>
<td>Spills of oils</td>
<td>Daily when ships are in harbor</td>
<td>Visiting ships and Harbor Master</td>
</tr>
<tr>
<td>Pollution from sewage and bilge water from ships in harbor areas</td>
<td>Disposal of sewage and bilge water in accordance with MARPOL 73/78.</td>
<td>Harbor area</td>
<td>Illegal sewage and bilge water discharges, presence of oil sleek</td>
<td>Daily when ships are in harbor</td>
<td>Harbor Master</td>
</tr>
<tr>
<td>Pollution from solid wastes of ships in port</td>
<td>With prior notice, CIPA will provide solid waste reception for disposal in</td>
<td>Harbor area</td>
<td>Illegal dumping of solid wastes</td>
<td>Daily when ships are in harbor</td>
<td>Harbor Master</td>
</tr>
<tr>
<td>Environmental Management and mitigation monitoring</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------</td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Environmental Issue</strong></td>
<td><strong>Mitigation Measures</strong></td>
<td><strong>Locations</strong></td>
<td><strong>monitoring parameter</strong></td>
<td><strong>monitoring frequency</strong></td>
<td></td>
</tr>
<tr>
<td>Pollution due to accidents or emergencies</td>
<td>Implementation of a Contingency Plan with the necessary equipment and personnel training.</td>
<td>Harbor area</td>
<td>Release of materials during accidents and emergencies</td>
<td>During accidents and emergencies</td>
<td></td>
</tr>
<tr>
<td>Proactive management of port’s environmental footprint and advance port sustainability</td>
<td>Implement an environmentally responsible port management system (EMS) to achieve and maintain continual environmental quality of the harbor area.</td>
<td>Harbor area</td>
<td>EMS components</td>
<td>Monthly</td>
<td></td>
</tr>
</tbody>
</table>

accordance with MARPOL 73/78.
<table>
<thead>
<tr>
<th>Environmental Issue</th>
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<th>monitoring parameter</th>
<th>monitoring frequency</th>
<th>monitoring responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air quality</td>
<td>• Periodic emission test will be carried out on machineries &amp; equipment in order to identify malfunction areas and possible inefficiency of emission control mechanisms. • Water sprinkling will be applied on exposed excavation areas to suppress dust generation. • Ambient air quality test will be carried out half yearly at the port.</td>
<td>Harbor area</td>
<td>Monthly</td>
<td>IPBC PMU</td>
<td></td>
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<td></td>
<td></td>
<td></td>
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</tbody>
</table>

• Carryout a regular visual inspection around the port to ensure that the does not becomes a problem.
<table>
<thead>
<tr>
<th>Environmental Management and mitigation</th>
<th>Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Issue</td>
<td>Mitigation Measures</td>
</tr>
<tr>
<td>Loading, unloading, transfer, handling or storage of bulk cement will be carried out in an enclosed area and any vent or exhaust will be fitted with air pollution control system.</td>
<td></td>
</tr>
<tr>
<td>Water quality</td>
<td>Refuelling facility will be bunded to prevent spill which when percolated into the soil will pollute the underground water table and when washed down to into the storm</td>
</tr>
<tr>
<td>Harbor area</td>
<td>ES&amp;H Manager will continue to undertake a daily visual monitoring within the facility and surrounds to</td>
</tr>
<tr>
<td>Monthly IPBC PMU</td>
<td></td>
</tr>
</tbody>
</table>
### Environmental Management and mitigation

<table>
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<th>Monitoring Frequency</th>
<th>Monitoring Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water drainage and further into the sea will affect aquatic &amp; marine organisms.</td>
<td>Ensure that all solid wastes are correctly disposed off and spill should not occur and all forms of liquid wastes are being discharged or placed in a designated area.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sewerage water arisen from toilet will driven to sewerage water treatment unit for required purification before disposed to marine environment or city sewer water drainage pipeline.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
## Appendix C - Daily Monitoring check list – Construction area

### DAILY MONITORING CHECK LIST – CONSTRUCTION AREA

<table>
<thead>
<tr>
<th>Key Aspects</th>
<th>Constraints/ Mitigation Measures</th>
<th>Yes</th>
<th>No</th>
<th>NR</th>
<th>Remarks/ Action taken( if any NCR )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dredging</strong></td>
<td>Are TB(dredger name) used for dredging</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Are there any spillage of oil or other hazardous substance from machineries/equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Is level of suspended solid within tolerance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Is level of turbidity within tolerance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Is level of dissolve oxygen within tolerance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Is any complication observed in marine fauna</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Disposal of sewage and waste water from land – based source</strong></td>
<td>Is oil trap/ grease trap working properly</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Is sewer water treatment plant working satisfactory</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Disposal of sewage and waste water from construction Vessels.</strong></td>
<td>Is there any leakage or spillage of waste water</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Surface water runoff from reclamation area</strong></td>
<td>Are silt/sand traps available in required area</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Are de silting done satisfactory</td>
<td></td>
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<tr>
<td></td>
<td>Are manhole covered adequately</td>
<td></td>
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<tr>
<td></td>
<td>Are material stockpiles covered adequately</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Breaking, excavation, loading/unloading</strong></td>
<td>Are emission test available for equipments, machineries &amp; vehicles</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Key Aspects</td>
<td>Constraints/ Mitigation Measures</td>
<td>Yes</td>
<td>No</td>
<td>NR</td>
<td>Remarks/ Action taken( if any NCR )</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>-----</td>
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</tr>
<tr>
<td><strong>Production Process</strong></td>
<td>Is noise/vibration level within standards at the boundary</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Is it necessary to adopt sound proof measure</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Are there any spillage of oil or other hazardous substance from machineries/equipment</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Is waste water generated</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>If “yes”, is there any waste water treatment system</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Is waste water analytical report available</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>If “yes” are tested parameters conformed with standards</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Inspected by:** __________________________  **Approved by:** __________________________

ES&H Engineer  ES&H Manager

Appendix D - Weekly Monitoring Checklist – Plant

Date_____________  Time_____________  Location______________________________
<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is air emission possible</td>
<td></td>
</tr>
<tr>
<td>If “yes” is emission control system / water sprinkling available</td>
<td></td>
</tr>
<tr>
<td>If “yes”, is treatment system satisfied</td>
<td></td>
</tr>
<tr>
<td>Is ambient air quality test report available</td>
<td></td>
</tr>
<tr>
<td>If “Yes”, are tested parameters conformed with standards</td>
<td></td>
</tr>
<tr>
<td>Storage of materials</td>
<td>Are stock piles are covered or applied wet process</td>
</tr>
<tr>
<td>Is chemical waste storage met with CEA requirements</td>
<td></td>
</tr>
<tr>
<td>Surface water runoff</td>
<td>Are silt/sand traps available in required area</td>
</tr>
<tr>
<td>Are de silting done satisfactory</td>
<td></td>
</tr>
<tr>
<td>Are manholes covered adequately</td>
<td></td>
</tr>
<tr>
<td>loading/unloading and transportation of materials</td>
<td>Are emission test available for equipments, machineries &amp; vehicles</td>
</tr>
<tr>
<td>If yes, are they conformed with required standards</td>
<td></td>
</tr>
<tr>
<td>Are silencers or mufflers fixed in machineries</td>
<td></td>
</tr>
<tr>
<td>General refuse disposal</td>
<td>Are disposal bins available for biodegradable waste &amp; non biodegradable waste</td>
</tr>
<tr>
<td>Is previous day waste collection carried out</td>
<td></td>
</tr>
</tbody>
</table>

**Inspected by:** ___________________________  **Approved by:** ___________________________

ES&H Engineer  ES&H Manager
Appendix – E Non Conformance Report

NCR No. ___________ To___________________

Location ______________ Date ______________ Time______________________

Description of non-conformity:

Suggestion for rectification:

________________________

ES&H Manager

TO: ______________________

Please implement above suggestions immediately / within ------ days & report

________________________

ES&H Manager

TO: ES&H manager

Completed/ not completed.

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Head of the department (NCR receiver)

Satisfactory / Unsatisfactory

________________________

☐ ES&H Engineer / ☐ Safety Officer

Approved & recommend for closing

ES&H Manager
17.10 Annex 10 Generic Decommissioning Plan

17.10.1 Reason For Plan
After decommissioning the site may be handed over to a new owner and developed for another purpose. Although decommissioning works could be a long time in the future plans should be drawn up now to restore the site to conditions acceptable to FMEnv. Care must be taken during decommissioning not to cause contamination.

17.10.2 Potential Impacts
Environmental impacts associated with decommissioning can minimised through the implementation of an environmental and social management plan (ESMP). Potential negative impacts during decommissioning could include

- Spillages of transformer oils on ground and into groundwater as equipment is removed.
- Solid wastes such as brick, concrete and rubble from substation site demolition
- Metals and cables from towers dismantling can become an eyesore if not taken off site either for re-use or recycling.
- Invasive flora species could colonise former substation sites and the way-leave on decommissioning following removal of structures, buildings and hardcover.
- Local residents could be subject to noise and air impacts during demolition.

17.10.3 Generic Plan
The following generic plan should be followed:

<table>
<thead>
<tr>
<th>Timing</th>
<th>Action</th>
<th>Impact</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior to</td>
<td>Prepare detailed decommissioning plan and</td>
<td>TCN must review and approve</td>
<td>Ensures that decommissioning plan complies with TCN EHS Policy</td>
</tr>
<tr>
<td>decommissioning</td>
<td>submit to TCN for approval.</td>
<td>decommissioning plan.</td>
<td>and World Bank Safeguard Policies.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prior to</td>
<td>Obtain Possession Order from</td>
<td>Give legal right to enter site</td>
<td>Ensures that Operation has ceased</td>
</tr>
<tr>
<td>decommissioning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decommissioning</td>
<td>TCN</td>
<td>Action</td>
<td>Notes</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----</td>
<td>--------</td>
<td>-------</td>
</tr>
<tr>
<td>Prior to decommissioning</td>
<td>Contact utility companies.</td>
<td>Disconnect all utilities.</td>
<td>Ensures that power water and gas are disconnected and cutting utility supply pipes or lines is not hazardous.</td>
</tr>
<tr>
<td>Prior to decommissioning</td>
<td>Contact TCN Operational staff.</td>
<td>Staff to vacate site</td>
<td>Ensures that all non-essential staff have left the site.</td>
</tr>
<tr>
<td>Prior to decommissioning</td>
<td>Contact TCN EHS Section to obtain any “Hot Work” Permits needed.</td>
<td>Avoids contractors staff working in hazardous areas.</td>
<td>Decommissioning involves entering confined spaces with inherent hazards. Hot Work permitting is an essential mitigation measure.</td>
</tr>
<tr>
<td>Decommissioning</td>
<td>Removing transformers</td>
<td>Spillages of oils.</td>
<td>Spillages of transformer oils may occur as equipment is removed. Use containment around the transformers and have spill mop kits nearby. Place waste oil in a drum within a second containment drum and remove off site to a licensed waste contractor’s premises for recycling or destruction.</td>
</tr>
<tr>
<td>Decommissioning</td>
<td>Demolishing buildings</td>
<td>Solid wastes</td>
<td>Solid wastes such as brick, concrete and rubble from substation site demolition will need removal. Hire licensed waste contractor and remove to LGA approved landfill. Recycling of construction rubble may be approved if carried out in clean manner.</td>
</tr>
<tr>
<td>Decommissioning</td>
<td>Dismantling towers</td>
<td>Scrap metal</td>
<td>Metals and cables from towers dismantling can become an eyesore if not taken off site either for re-use or recycling. They can be sold to an approved scrap metal dealer.</td>
</tr>
<tr>
<td>Decommissioning</td>
<td>Site abandoned</td>
<td>Ecology changes</td>
<td>Invasive flora species could colonise former substation sites and the way-leave on decommissioning following removal of</td>
</tr>
<tr>
<td>Decommissioning</td>
<td>Use of noisy machinery for demolition</td>
<td>Excessive noise levels</td>
<td>Local residents could be subject to noise impacts during demolition. Maintain perimeter noise levels below 75dB(A) to meet industrial standard and only work between 0700 and 1900.</td>
</tr>
<tr>
<td>----------------</td>
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</tr>
<tr>
<td>Decommissioning</td>
<td>Leakage of oil</td>
<td>Soil contamination</td>
<td>It is necessary to establish if deterioration has taken place between site occupation and site decommissioning. Repeat sampling of soils in same locations as were sampled in the original baseline. Take to lab for analysis of all parameters recorded in baseline. Then compare results with baseline conditions to give Before and After comparison.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soil removal</td>
<td>If soil is contaminated then it must be removed off site and disposed of in accordance with Local Government practices.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Groundwater remediation</td>
<td>If groundwater is contaminated then it may be necessary to seal off sampling well and drill new well.</td>
</tr>
<tr>
<td>Decommissioning</td>
<td>FMEnv Approval of remediation</td>
<td>Site declared clean</td>
<td>Final soil and water samples must be submitted to FMEnv for their approval. When their approval is obtained then site can be handed over to next owner as being free of all structures, buildings and hardcover. Arrange for maintenance of site after closure until handover.</td>
</tr>
<tr>
<td>Post Decommissioning</td>
<td>Site handed back to TCN</td>
<td>TCN accept site as being free of all contamination</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Contractor must obtain signed letter of acceptance from TCN. TCN are now at liberty to dispose of the site to a third party without fear of liabilities.</td>
<td>contaminants. FMEnv certificate must be submitted to TCN.</td>
</tr>
</tbody>
</table>