PROJECT: INDORAMA FERTILIZER PLANT
COUNTRY: NIGERIA

ENVIRONMENT & SOCIAL IMPACT ASSESSMENT SUMMARY

Date: JANUARY 2012

<table>
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<tr>
<th>Team</th>
<th>Team Leader</th>
<th>Snr. Investment Officer OPSM 2</th>
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<td>Team</td>
<td>Ousmane Fall</td>
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<td>Sector Manager:</td>
<td>Mouhamadou Niang</td>
<td>Division Manager OPSM 2</td>
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<td>Res. Rep:</td>
<td>Ousmane Dore</td>
<td>NGFO</td>
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<td>Sector Director:</td>
<td>Timothy Turner</td>
<td>OPSM</td>
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<td>Regional Director:</td>
<td>Janvier Litse</td>
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1. Introduction:

Indorama Eleme Petrochemicals Company Limited is the current Management of Eleme Petrochemicals Company Ltd (EPCL), having taken over management/ownership of the company from Nigerian National Petroleum Company (NNPC) in 2006. This major Olefins Plant (Eleme Petrochemical complex) situated on a site approximately 9km² is located some 15 km north-east of Port Harcourt, the capital of Rivers State. EPCL is the parent company of Indorama Eleme Fertilizer and Chemicals Ltd (IEFCL), proponent of the proposed fertilizer plant. The existing complex is made up of four major process facilities, namely: Olefins, Butene, Polyethylene and Polypropylene plants. Related utilities units are made up of Power, Water, Air plants and off-site facilities for intermediate product storage, effluent treatment, waste management etc. The proposed nitrogenous fertilizer project is planned to be set up within the existing Eleme Petrochemicals Complex. The complex will consist of Ammonia / Urea trains with a total capacity of 2,300 metric tons per day (MTPD) of ammonia and 4,000 MTPD of granulated urea. Among others, this summary briefly discusses the socio-economic reasons which led to this project, the environmental impacts, mitigation and monitoring aspects including stakeholder consultation and management.

2. Project Description and Justification

The Project entails (i) construction and operation of a 1.4M metric TPA Nitrogenous Fertilizer Complex comprising a 2,300 metric TPD ammonia plant and a 4,000 metric TPD granulated urea plant and supporting infrastructure and utilities (the Plant) at the Eleme petrochemicals complex site, Eleme, Port Harcourt, Nigeria; (ii) construction of a 84 km pipeline from the gas supplier’s processing facilities to the plant (the pipeline) for supply of the feedstock gas that will run adjacent to two existing pipelines within an existing right of way (RoW); and the third last component though not part of the AfDB transaction will be the (iii) construction of a multipurpose jetty inclusive of material handling facility (jetty) located 16 kms from the site within the operational Onne Federal Ocean Terminal Zone. Due to the difference in activities, impacts and locality of the three components, their environment and social studies have been separated also because they don’t fall in the same category as per national legislation.

2.1 The natural gas feedstock pipeline covered in this summary and expected to have a less stringent category, will be 84 km long and 35 cm in diameter. It will connect the gas supplier (Nigerian Azienda Generale Italiana Petroli (Agip) Pipeline Company (NAOC) from Obrikom (OBOB) within the Ogba-Egbema Local Government Area (LGA) and will cross two further LGAs before terminating at Eleme LGA. All four LGAs are within the Rivers State of Nigeria. The pipeline will run within a right of way (RoW) managed by NAOC which has been in existence since 1992. The RoW is 15 m wide and is currently utilised by two other pipelines with sufficient space for a third pipeline.

2.2 The jetty will be situated approximately 16 km south east of the fertilizer complex within the operational Onne Federal Ocean Terminal (FOT) Zone. The multipurpose jetty will have a section for handling urea loading to vessels capable of handling 30-35,000 MT DWT; and another for containerized and break bulk cargo vessels capable of handling 6-8,000 MT DWT. The total cargo envisaged to be handled at the jetty will be 1 Million MT (MMT) of urea per annum and other cargoes (such as containerized loads, pipes and dry chemicals) are anticipated to be approximately 400,000 MT per annum.

2.3 The fertilizer plant will be located within the existing IEPL Complex, within which there currently exist four major process facilities, namely: olefins, butene, polyethylene and polypropylene plants. The IEPL Complex is approximately 9 km³. The existing facilities are self-sufficient in terms of power which is presently
generated by gas turbines. The final product (urea) will be stored in new warehouses to be constructed within the IEPL Complex with approximately 60-70% of the product transported by road to the jetty for the export market. The remaining 30-40% of urea produced will be bagged in 50 kg bags for onward distribution in the domestic market.

FIGURE 1: Pipeline Route Map

2.4 Justification:
Agriculture in Nigeria is a dominant sector that engages about 70% of the population and provides more than 75% of non-oil foreign exchange earnings with the largest share of about 41.84% of overall GDP in 2009 (IEFCL Market Survey, 2010). The agriculture sector contributes significantly to rural employment and food security. At the moment the majority of population dependent on agriculture currently lives below the poverty line due to very poor land yields. Provision of fertilizers at affordable prices will help to get higher yields to meet the demands of growing population as well as to uplift large part of the population out of poverty. The project will help to reach the objectives of the federal gas revolution programme providing necessary infrastructure for natural gas based industries.

3. Policy, Legal and Administrative Framework

The ESIA was carried out in line with national legislation with the most relevant ones being shown in Table 1 below. The ESIA process also conforms to the AfDB’s ESAP. The field work in one season supported by Secondary data was approved by FMENV through its correspondence referenced FMENV/EIA/123.2156/VOL.1/176 dated 27th September, 212.

<table>
<thead>
<tr>
<th>REGULATORY INSTRUMENT</th>
<th>OBJECTIVE</th>
<th>RELEVANT PROVISION</th>
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<tr>
<td>African Convention on the Conservation of Nature and Natural</td>
<td>To encourage, individual and joint actions for the conservation, utilization and</td>
<td>: Contracting States to adopt measures necessary to ensure conservation, utilization and development of natural resources in accordance with scientific</td>
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<td>Resources, Algiers, 1968, ratified by Nigeria on 16 June 1969</td>
<td>development of soil, water, flora and fauna for the present and future welfare of mankind, from an economic, nutritional, scientific, educational, cultural and aesthetic point of view.</td>
<td>Parties to establish policies to conserve, utilize and develop water resources prevent pollution and control water use. Parties to protect flora and ensure its best utilization, the management of forests and control of burning, land clearance and overgrazing. etc.</td>
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<tr>
<td>Convention on Occupational Safety and Health and the Working Environment, Geneva, 1981.</td>
<td>To prevent accidents and injury to health by minimizing the causes of hazards inherent in the working environment.</td>
<td>The enforcement of laws and regulations concerning occupational safety and health and the working environment to be secured by an adequate and appropriate system of inspection. The enforcement system to provide for adequate penalties for violations of laws and regulations.</td>
</tr>
<tr>
<td>Convention Concerning Safety in the use of Chemicals at work, Geneva, 1990.</td>
<td>Enhancement of the existing legal frame-work for occupational safety regulating the management of chemicals in the workplace, with the broad purpose of protecting the environment and the public, and with the specific objective of protecting workers from harmful effects of chemicals.</td>
<td>Parties signatory to the convention to establish policies to prevent importation and use of listed dangerous chemicals Parties to develop and implement tracking programme to monitor and control the management of these substances from “cradle to grave”.</td>
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<tr>
<td>Convention concerning the protection of the world cultural and national Heritage (World Heritage Convention), Paris, 16 November 1972, ratified by Nigeria on 17 December 1975.</td>
<td>To prevent the loss of cultural heritage with respect to project development</td>
<td>Measures to be taken for the Prevention and Control of lost of cultural heritage against project development.</td>
</tr>
<tr>
<td>Convention on biological diversity, Nairobi, 22 May 1992, ratified by Nigeria on 27 November 1994.</td>
<td>To prevent the destruction of biodiversity against development projects</td>
<td>Measures to be taken for the protection of biodiversity against project development.</td>
</tr>
<tr>
<td>United Nations Framework Convention on Climate Change (UNFCCC or FCCC) 1992.</td>
<td>To reduce atmospheric concentrations of greenhouse gases with the goal of preventing dangerous anthropogenic interference with Earth's climate system.</td>
<td>Actions were aimed primarily at industrialized countries, with the intention of stabilizing their emissions of greenhouse gases at 1990 levels by the year 2000. The parties agreed in general that they would recognize &quot;common but differentiated responsibilities&quot;, with greater responsibility for reducing greenhouse gas emissions in the near term on the part of developed/industrialized countries.</td>
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<td>Environmental Impact Assessment Act, 86 of 1992</td>
<td>To ensure that before any decision is taken to undertake or authorize the commencement of any activity likely to impact on the environment by any person, authority, corporate body or unincorporated body including the Government, Federal, State or Local, that the environmental effects of such activity shall first be taken into account.</td>
<td>□ The public or private sector of the economy is forbidden from undertaking, embarking or authorizing projects or activities without prior consideration, at an early stage, of their environmental effects. □ Where the extent, nature or location of a proposed project or activity is such that it is likely to cause significant effect on the environment, its Environmental Impact Assessment shall be undertaken in accordance with the provision of the Act. □ Non-compliance with the Act will attract a fine of One Hundred Thousand Naira (N100,000.00) or five years imprisonment in the case of an individual and in the case of a corporation a fine of not less than fifty thousand Naira (N50,000.00) and not more than one hundred thousand Naira (N100,000.00).</td>
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<td>S. I. 8 National Environmental Protection (Effluent Limitation) Regulations 1991.</td>
<td>Regulation of effluents discharged into the environment by Industries in Nigeria.</td>
<td>□ Every industry is to install anti-pollution equipment for the detoxification of effluent and chemical discharges emanating from industries. □ The anti-Pollution equipment should be based on the Best Available Technology (BAT), the Best Practicable/technology (BPT) or the Uniform Effluent Standards (UES). □ Waste Water parameters to be monitored are as follows: – Ammonia, Chloride, Chromium, Nitrate, Sulphate, Suspended Solids, Urea, Organic Nitrogen Compounds, Zinc, Calcium, COD, Gas purification Chemicals, Iron, Oil &amp; Grease, pH, Phosphate, Sodium, Temperature and Total Dissolved Solids.</td>
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<tr>
<td>S. I. 9 National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations 1991.</td>
<td>Prohibition of industry or facility from the release of hazardous or toxic substances into the air, water or land of Nigeria’s ecosystem beyond limits approved by FMENV.</td>
<td>An industry or facility shall; (a) have a pollution-monitoring unit within its premises; (b) have on site a pollution control; or (c) assign the responsibility for pollution control to a person or body corporate accredited by FMENV. • A discharge, including solid, gaseous and liquid waste from any industry or facility shall be analysed and reported to the nearest office of FMENV every month, through a discharge Monitoring Report. • An industry or a facility shall setup machinery for combating pollution hazard and maintain equipment in the event of an emergency. • Engaging in the storage, treatment and transportation of harmful toxic wastes within Nigeria without a permit issued by FMENV prohibited. • An industry or a facility which is likely to release gaseous, particulate, liquid or solid untreated discharge shall install, into its system, appropriate abatement equipment in such manner as may be determined by FMENV.</td>
</tr>
<tr>
<td>S. I. 9 National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations 1991.</td>
<td>Prohibition of industry or facility from the release of hazardous or toxic substances into the air, water or land of Nigeria’s ecosystem beyond limits approved by FMENV.</td>
<td>• No effluent with constituents beyond permissible limits shall be discharged into public drains, rivers, lakes, sea or underground injection without permit issued by FMENV. • Industry forbidden from exposing an employee to any hazardous condition in his workplace. • FMENV shall demand environmental audits from existing industries and Environmental Impact Assessment from new industries and major development projects</td>
</tr>
<tr>
<td>S. I. 15 National Environmental Protection Management of Solid and Hazardous Wastes Regulations 1991.</td>
<td>Management of solid and Hazardous Wastes in Nigeria.</td>
<td>□ All industries or facility to inform the FMENV of all toxic, hazardous and radioactive substances, which they discharge during their production processes.</td>
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<td>Harmful Waste (Special Criminal Provisions, etc) Act 1988. L.F.N. 1990.</td>
<td>Prohibition of the carrying, depositing and dumping of harmful waste on any land or territorial waters.</td>
<td>□ All activities relating to the purchase, sale, importation, transportation, deposit, storage of harmful waste prohibited and declared unlawful. □ The carrying on of the above activity without lawful authority is criminal and shall attract an imprisonment for life and forfeiture of carrier object etc. □ Harmful Waste means any injurious, poisonous, toxic or noxious substance and, particular, includes nuclear waste emitting any radioactive substance if the waste is in such quantity, whether with any other consignment or the same or different substances, as to subject any person to the risk of death, fatal injury or incurable impairment of physical and mental health; and the fact that the harmful waste is placed in a container shall not by itself be taken to exclude any risk which might be expected to arise from the harmful waste.</td>
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<tr>
<td>Factories Act, 1990.</td>
<td>To provide for the registration of factories. To make adequate provisions regarding the safety of workers.</td>
<td>□ Factory to provide healthy facilities for workers and ensure the health of workers. □ Workers welfare should be priority of factory. □ Director of Factories to be informed of accidents and industrial diseases.</td>
</tr>
<tr>
<td>Criminal Code, 1990</td>
<td>Prevention of environmental crime</td>
<td>□ Contamination of water, Stream, Spring, Well, Tank, Reservoir prohibited and punishable with an imprisonment for six (6) months. □ Vitiation of atmosphere and spread of infectious disease prohibited and punishable</td>
</tr>
<tr>
<td>Landuse Act Cap 202, 1978.</td>
<td>Land administered for the use and common benefit of all Nigerians.</td>
<td>□ All land in urban areas shall be under the control and management of the Governor of each State.</td>
</tr>
<tr>
<td>Federal government green revolution programme, 1980</td>
<td>To provide enabling environment for improved agriculture. To provide necessary chemical inputs &amp; mechanical equipment to farmers.</td>
<td>□ Create agricultural extension services in all state ministries of agricultural. □ Establish a division in the ministry to support state agricultural development program. □ Establish a division of ministry to coordinate funding from donor agencies.</td>
</tr>
<tr>
<td>Federal gas revolution programme, 2011</td>
<td>To optimize the advantage of the abundance of natural gas to positively impact on the lives of present and future generations of the Nigerian citizens</td>
<td>□ To provide the necessary infrastructures development for capitalizing the nation’s gas resources □ To ensure sustainable electricity delivery for domestic and industrial uses. □ Accelerate industrialization by providing cheaper, safer, cleaner and environmentally friendly fuel to industries in the region. □ By 2014 to position Nigeria firmly as the undisputed regional hub for natural gas-based industries as fertiliser, petrochemicals and methanol.</td>
</tr>
<tr>
<td>National Environmental Standards And Regulation Enforcement Agency (NESREA) Act And Regulations: 2009 -2011</td>
<td>Regulations focused on the protection and sustainable development of the environment and its natural resources.</td>
<td>□ Section 7 provides authority to ensure compliance with environmental laws, local and international, on environment sanitation and pollution prevention and control through monitor and regulatory measures; □ Section 8(1) (k) empowers the agency to make and review regulations on air and water quality, effluent limitations, control of harmful substances and other forms of environmental pollution and sanitation; □ Section 27 prohibits, without lawful authority, the discharge of hazardous substance into the environment. This offence is punishable under this section, with a fine not exceeding One Million Naira (1,000,000) and an imprisonments term of five (5) years. In the case of a company, there is an additional N 50,000 for every day the offence persists.</td>
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<tr>
<td>National Environmental Standards And Regulation Enforcement Agency (NESREA) Act And Regulations: 2009 -2011</td>
<td>• National Environmental (Permitting and Licensing Systems) Regulations, 2009</td>
<td>Issuance of permits and licenses to protect the environment from degradation and pollution.</td>
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<td></td>
<td>• National Environmental (Construction Sector Regulations), 2011</td>
<td>To ensure construction activities conducted in an environmental friendly manner.</td>
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<td>• National Environmental (Control of Vehicular Emissions from petrol and Diesel Engines) Regulations, 2011</td>
<td>To ensure prevention and control of vehicular emission.</td>
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<td>• National Environmental (Surface and Ground Water Quality Control) Regulations, 2011</td>
<td>To ensure protection and pollution of surface and ground water quality.</td>
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<td>• National Environmental (Sanitation and Waste Control) regulation 2009</td>
<td>To ensure protection of the environment against house-keeping, waste generation and disposal.</td>
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<td></td>
<td>• National Environmental (Ozone Layer Protection) Regulations 2009</td>
<td>To protect the environment against Ozone depleting substances. To prevent the production, use, importation or sale of Ozone depleting substances.</td>
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<td></td>
<td>• National Environmental (Wetlands, River Banks and Lake Shores Protection) Regulations, 2009</td>
<td>To provide for the wise use of wetlands and their resources;</td>
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<td>• National Environmental (Noise Standards and Control) Regulations, 2009</td>
<td>Prescribe maximum permissible noise levels. Provide for the control of noise and mitigation measures for the reduction of noise. Ensure maintenance of healthy environment and psychological well-being of the people.</td>
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<td><strong>STATE LAWS</strong></td>
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<tr>
<td>Rivers State Environmental Protection Agency Edict Number 2 1994</td>
<td>• Environmental Protection, biodiversity conservation and sustainable development of Rivers State’s Natural Resources.</td>
<td>□ Power to establish specific environmental standards and guidelines.</td>
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<td>• Establishment of standards and guidelines.</td>
<td>□ Power to inspect Industries.</td>
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<td>• Technology Development.</td>
<td>□ ‘Polluter pays’ principles.</td>
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<td>• Monitor and Control Industrial and hazardous Wastes.</td>
<td>□ Any actor that pollutes must report within 48 hours to the Ministry.</td>
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<td>• Collect effluent discharge fee.</td>
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<td>• Enforcement of Industrial and domestic sewage treatment.</td>
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<td>• Control of Noise Pollution in the Port Harcourt Metropolis, and elsewhere in the State.</td>
<td>□ Power to set noise standards for residential and industrial areas.</td>
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<td>□ Power to prosecute violators of noise limits.</td>
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4. **Description of the Project Environment**

4.1 **Pipeline Description**

The project consists of a 16” x 83km long Gas Pipeline that will run from Obrikom/Obiafu (OBOB) Gas plant to IEFCL. The gas pipeline will supply Natural Gas (170 mmscfd) as the primary fuel for feed stock of fertilizer plant at Indorama Petrochemical complex, Eleme. The pipeline will be designed according to API 5L X65 latest Edition and class 600-pressure rating. The maximum gas volume to be transported is expected to be 170MMscf with an average upstream pressure of 80 bar at an average temperature of 15-25°C and delivered at the IEFCL at about 50 bar. The pipeline materials will be based on API 5L carbon steel not less than X65 and polyethylene externally coated for corrosion protection. Cathodic protection of the pipeline shall be provided by impressed current system. For pigging purposes, the pipeline will be provided with launching and receiving scraper traps which shall be located at the tie-in manifold and Metering station at Ob/Ob.

The Ob/Ob Gas supply and IEFCL gas receiving facilities shall comprise the following facilities:

- Emergency shut down (ESD) valves
- Metering system
- Pressure relief/vent/flare and blowdown system
- Control room
- VSAT/Telecom facilities
- Pigging facilities

Furthermore there will be OFC (Optical Fiber Cable) throughout all along pipeline for multiple utilization like fast information receiving, control and to sensor any abnormality etc and the “SCADA” (Supervisory Control and Data Acquisition) system for acquisition of all information and control along with OFC.

4.2 **Hydrogeology/Geology**

A total of twenty nine (29) groundwater samples were collected from boreholes in communities along the pipeline. Results of analyses of these samples compared to environmental standards showed no trace of contamination of the groundwater and therefore formed part of the baseline data for the area. The total and faecal coliforms ranged from 3 to 7MPN/100ml and 0 MPN/100ml in the study area; and 4 to 11MPN/100ml and 0MPN/100ml respectively in the control station. Similarly, the heterotrophic bacterial and total fungal counts ranged from 3.9 x 102 to 5.1 x 102cfu/ml and 2.4 x 101 to 3.0 x 101cfu/ml respectively. Also, the counts in the control stations were within the range of the study area as the counts varied from 3.1 x 102 to 3.9 x 102 for the heterotrophic bacterial and 7.8 x 101 to 9.2 x 101cfu/ml for the total fungi.
4.3 Surface Water
The pH of the surface water ranged from (6.91 – 8.31). However, temperature ranged from (25.7 to 30.8°C); the TDS concentrations range from (11.0 to 22.0mg/l), Electrical conductivity, which is a measure of the ionic richness of the river course, ranged from (20.0 to 40.0 μS/cm) Dissolved oxygen (DO) varied from (2.49 to 2.81mg/l), Biochemical oxygen demand ranged from (1.97 to 2.44mg/l), Chemical Oxygen Demand ranged from (7.48 to 38.4mg/l), Total Suspended Solids concentrations range from ((5.10 to 26.1mg/l), turbidity of the water samples observed a range of (0.47 to 44.2NTU) The nutrient were within acceptable limits, sulphate concentrations range from (32.2 to 43.5mg/l) Nitrate concentration ranged from (<0.001 to 0.05mg/l) and phosphate concentrations range from (5.03 to 15.13mg/l). The Total hydrocarbon content levels were generally low and values was <0.001mg/l. The concentrations for heavy metal like Copper concentrations for the water bodies within the pipeline route range from (0.0048 to 0.914mg/kg), Lead (0.002 to 0.005mg/kg), Cadmium (<0.001 to 0.002mg/kg), Chromium (<0.001 to 0.0002mg/kg), Iron (0.031 to 0.315mg/kg). Mercury and Arsenic were below the detection limit of <0.01mg/l throughout the various surface water sample across the different water bodies along the project route, The Total coliforms and faecal coliforms ranged from 39 to 150MPN/100ml and 21 to 64MPN/100ml respectively. The hydrocarbon utilizing microbes, recorded very low counts as the hydrocarbon utilizing bacterial counts ranged from 7.7 x 101 to 9.3 x 101cfu/ml and the hydrocarbon utilizing fungal counts from 4.9x101 to 6.1x101cfu/ml.

4.4 Sediment
The colour of the sediment samples ranged from dark grey to black colouration. The silt fraction was higher than the sand and clay content making the sediment silty in texture. Sulphate concentrations varied from 4.40 to 6.20mg/kg, nitrate content for the sampling sites had the lowest concentration of 6.38mg/kg and highest of 6.80mg/kg. The phosphorus contents ranged from 0.43 to 1.80mg/kg. The ranges of concentration of anions (Magnesium, and Calcium) of the study area were 13.5 – 14.8mg/kg and 34.1 – 39.4mg/kg respectively. The concentrations ranges of the different heavy metals; Mercury and Arsenic were below detection limit in the sediment samples. Copper (0.641 – 0.914mg/kg), lead (1.007 to 3.051mg/kg), zinc (0.901 – 1.990mg/kg), iron (117.1 to 132.5mg/kg), cadmium (0.301 – 1.005 mg/kg), Nickel (<0.001 – 1.90mg/kg) and Chromium (3.210 to 9.050mg/kg). Total Hydrocarbon Content was low for all samples taken (<0.01mg/kg). The Total heterotrophic bacterial and total fungal counts ranged from 6.8x104 to 9.7x104cfu/g and 2.1 x 103 to 3.9 x 103cfu/g respectively. The counts from the control station were within the range of counts obtained in the control station as the hydrocarbon utilizing bacterial and fungal counts were 3.4 x 102 to 4.9 x 102cfu/g and 5.5 x 101 to 7.1 x 101cfu/g respectively.

4.4 Phytoplankton Abundance and Distribution
Six (6) major algal phyla were represented in the micro flora of the study area. These were Bacillariophyta, Chlorophyta, Cyanophyta, Pyrrhophyta, Euglenophyta and Rhodophyta. A total of ninety (90) species were identified and each differing in their cellular structure, pigment arrays and the presence or absence of motile structures. In decreasing order, the dominance pattern of the phyla were Bacillariophyta>Chlorophyta>Cyanophyta>Pyrrhophyta>Euglenophyta>Rhodophyta. The species density was generally high and showed consistent trend in taxa number in all the sampling stations. The correlation values between different phylum of phytoplankton and physicochemical parameters of the surface water showed a significant positive correlation (p<0.05) between Bacillariophyceae, Cyanophyceae, Chlorophyceae, Euglenophyceae, Pyrrhophyceae and Rhodophyceae with Dissolved oxygen. Therefore, it can be asserted that the increase or decrease of phytoplankton populations and the replacement of one form by another throughout in the study area is controlled by varying environmental parameters such as Dissolved oxygen.

4.5 Zooplanktons
The Zooplankton community was dominated by the Arthropoda with twenty-seven (27) species which constituted about 56.35%; the Ciliophora had ten (10) species (9.50%, Rotifera recorded twenty (20) species constituting about 29.48%; Rhizopoda had six (6) species (4.0%) and the Pisces recorded two (2) species
In decreasing order, the dominance pattern of the zooplanktons were Arthropoda>Rotifera>Rhizopoda>Pisces. Generally, the species density showed consistent trend in taxa number in all the sampling stations, however the control stations showed optimum secondary productivity and proper ecological stabilization (i.e. food web dynamics). The result of the correlation analysis between the physicochemical parameters and the zooplankton phyla showed the influence of pH and dissolved oxygen ($p<0.05$) on the Arthropods, Ciliophora, Rotifers, Rhizopods and Pisces.

4.6 **Benthic fauna**

A total of thirty-seven (37) species of benthic invertebrates belonging to four (4) taxonomic groups were identified. In decreasing order, the dominance pattern of the Benthic fauna were Insecta>Polychaetes>Oligochaetes>Gastropoda. Generally, the species density showed consistent trend in taxa number in all the sampling stations. The correlation values between different phylum of Benthic invertebrates and some physicochemical parameters showed a significant positive correlation ($p<0.05$) between Gastropoda, Polychaetes, Insecta and Oligochaetes with heavy metals and sulphates. Thus, these abiotic indicators have predominant influence on the increase or decrease in benthic population.

4.7 **Fishery**

Fishing activities in the study area is generally subsistent in nature as many fisherfolks have lost this once lucrative income generating occupation to pollution from domestic wastes from communities, illegal sand mining, change in occupation etc and the aquatic ecosystem is simply getting less productive as the years go by. The fishery is generally a multi-species stock largely exploited by artisanal fishers operating dug-out wooden canoes of various sizes. The major fish communities exploited by the artisanal fisher folks include but not limited to the following: Claridae, Distichodontidae, Characidae, Channidae, Cichlidae, etc. A total of Seventy-six (76) fishery resources were recorded from the study area using various fishing gears such as Gill net, Fish fence, Cast net, Hook and line, Drag net, Wire mesh basket and basket trap. The maximum safe limits of heavy metals acceptable in the tissues of fish as stipulated by the World Health Organization, Food and Agricultural Organization and US Food and Drug Administration were used for comparison. All heavy metals analysed were within acceptable limits and thus considered safe for human consumption.

4.8 **Air Quality/Odour**

The air quality study exercise was conducted using air monitoring equipment, while noise levels were measured using portable noise instrument. The parameters measured during ambient air study are: CO, SO2, NO2, H2S, VOCs, SPM, PM10, and heavy Metals (Fe, Cu, Zn, Mn, Cr, and Cd). Baseline results obtained during the period of this study showed that sulphur dioxide (SO2) ranged in value from $<0.1 \mu g/m^3$ to 8.6$\mu g/m^3$; NO2 ranged from $<0.1 \mu g/m^3$ to 19.1$\mu g/m^3$; CO values in the field ranged from $<0.1$ to 5.6ppm; Concentrations of H2S measured in the field ranged from $<0.01$ to 0.05ppm; VOCs concentrations measured in the project area ranged from $<0.1$ to 6.8ppm; Values of SPM obtained ranged from 7.69$\mu g/m^3$ to 64.8$\mu g/m^3$ with mean value of 24.56$\mu g/m^3$ and standard deviation of 11.11$\mu g/m^3$; The concentration of PM10 obtained in this study ranged from 4.53$\mu g/m^3$ to 46.5$\mu g/m^3$ with mean value of 15.98$\mu g/m^3$ and standard deviation of 6.98$\mu g/m^3$. These values are significantly lower than FMEnv and IFC limits. These results confirm with similar study carried out by Greater Port Harcourt for Phase 1A Area (GPHC, 2010 & 2011). The concentrations of heavy metals in the air environment of the project area were generally low ($<0.001 ppm$). The air-borne metals concentrations therefore represent baseline background values and indicate that the region traversed by the gas pipeline is free from man-made and vehicular contributions. The Air Quality Indices (AQI) computed for all the communities in the region traversed by the gas pipeline indicate that the baseline air quality condition of the area is good according to the Rating Scale for AQI (Rao & Rao, 2002 & Wikipedia, 2012). Thus, the baseline ambient air quality condition of region can be described as Good and of Acceptable quality. This represents baseline air quality condition of the project area. The Exceedance Factors (EF) for the four criteria pollutants computed for the region indicates that the concentrations of all pollutants are within FMEnv and IFC limits. Some reasons for the low levels of pollutants in the project area
may be because the gas pipeline traversed mainly rural areas that are covered by vegetation and there is no commercial and industrial activities taking place.

4.9 Ambient Noise Level
Noise levels in the proposed project routes were low and mostly within natural background status of 30dB to 58dB. Baseline noise levels measure along the length of the proposed gas pipeline project ranged from 30.1dB at Ikwerre/Awara valve station to 58.0dB at Rumuokwurusi, averaging 40.13dB with a standard deviation of ±5.74dB. The expected noise level at site during construction phase is predicted to be 102.7dB. This is higher than FMEnv/WHO limit of 90dB with an Exceedance factor of 1.14. Workers exposure to welding and cutting fumes as well as noise will be a major issue during construction of the gas pipeline. Impact of gaseous emissions on public health would be very minimal or low. Noise will be a major concern, especially as a number of sensitive receptors (wildlife) have been identified to be quite close to the pipeline route in the project area. Based on predicted noise levels in the catchment communities, noise impact on public health will be very minimal (not significant) during construction. The negative perturbations and impacts would be low, reversible and short-term. A number of mitigation measures are recommended against negative impacts during the construction phase of the project. These include use of earplugs by site workers, low-CO2 content shielding gases, noise suppressors or mufflers for heavy equipment, control of air pollution from construction works and movement of vehicles through proper inspection and maintenance to reduce exhaust emissions. Availability of medical services and health monitoring of site workers are also recommended.

4.10 Meteorology
Five microclimatic variables were monitored for both axis at Omoku and Port Harcourt. The mean measurements obtained for ambient temperature, relative humidity, wind speed, pressure and cloud cover for Omoku station were 26.7oC, 87.5%, 3.69m/s, 1031.9mbar and 6 oktas. That obtained from the Port Harcourt axis were 27.7oC, 84.5, 3.71, 1009.4 and 5 oktas. The prevailing wind direction for Omoku was south-easterly, while that for Port Harcourt was south-westerly. The dispersive potential of the atmosphere within the study areas based on the wind profile is moderate. The weather stations were set up in areas representative of the totality and monitored for 24 hours, while long term data were acquired from the Nigerian Meteorological Agency. The weather condition during the course of field measurements indicated mostly cloudy, slightly sunny and moderately windy conditions. The study areas feature a coastal climatic condition that is similar to the rest of the Niger-Delta. Although rainfall is observed throughout the year, there are two periods, with the heaviest rains falling from March to September and a weaker rainy season in October to early December. There is a brief relatively dry period in August and a longer dry season from December to early February. Monthly rainfall between May and September averages over 240 mm, while in December it is down to 18.6mm. The main dry season is accompanied by harmattan winds from the Sahara Desert, which between December and early February can be quite strong. The average temperature in January is 33°C and for July it is 29°C. On average the hottest month is February; with a mean temperature of 34°C; while July to September are the coolest months.

4.11 Land Use
By Information obtained from the satellite imagery and during the field work exercise revealed that the project area is covered by a mixture of Urban 20% and Agriculture 80% (farmlands, plantations (palm & rubber) primary and secondary forests). The ecologically sensitive areas include the river systems and tidal flooded plains. Land use is a description of how people utilize the land and socio-economic activity - urban and agricultural land uses are two of the most commonly known land use classes. The physical material at the surface of the earth (land cover) within the study area was urban surface 22%, Asphalt 1%, water 7% and fields at 70%.
4.12 Soil
A total of 57 soil sample stations and 2 control stations (one at each end of the RoW) were sampled. A total of 118 soil samples were analyzed, recorded and reported. The dominant textural group was sandy Loamy constituting 73.84%, while the clay loam texture was 16.86 % of the entire 83km route of the pipeline. The percentage sand content generally decreased with depth at any particular sampling point. The soils were generally acidic with pH ranging from 4.18 to 6.54 in the topsoil layer and the bottom layer, pH ranged from 3.75 to 6.40. The soils showed slight decrease in pH from the topsoil layers to the bottom layers. The values for the soil electrical conductivity recorded within the sampling areas are in the range of 0.01 to 0.11 mS/m and 0.01 to 0.10 mS/m for top and bottom soils respectively indicating that the study area is within the fresh water zone. The porosity of the top soils in the wetland areas ranged from 45-56% and from 43 to 58 % for the sub-surface layer while the porosity of the top soils in the upland areas ranged from 45-56% and from 43 to 58 % for the sub-surface The carbon concentrations (0.34 – 2.50% and 0.25-2.61% for top and sub soil respectively) were adequate to high compared to the critical level of 1%. The total nitrogen of the soils were low to adequate and ranged from 0.01 to 1.10% compared to 0.15 to 0.20% for moderate ranges in soil.

The phosphorus concentrations ranged from 2.40 – 113.8ppm for top soil and 0.64-111.3ppm and most of the values fall within the accepted range of 7.0-20.00ppm for agricultural purposes. The soil macro-fauna encountered within the study area includes various arthropods (insects, millipedes, mites termites), molluscs (snails), annelids (earthworms) and nematodes. The Total heterotrophic bacteria ranged from 3.1 x 105 to 5.9 x 105cfu/g and 6.2 x 104 to 7.4 x 104cfu/g in the top and bottom soil strata respectively. Similarly, the total fungi ranged from 4.1 x104 to 6.8x104cfu/g in the top soil strata and 7.3 x 103 to 8.2 x 103cfu/g in the bottom soil strata. The fungi counts also varied from 1.2x104 to 2.8x104cfu/g and 1.6x103 to 6.4x103cfu/g in the top and bottom soil strata respectively. The hydrocarbonoclastis were in relatively low numbers with bacterial counts ranging from 7.1x101 to 9.3x101cfu/g and 0cfu/g in the top and bottom soil strata respectively.

4.13 Vegetation
Transect were laid for the analysis of distribution pattern of plant in the project area of study. The data on vegetation were quantitatively analysed for abundance, and frequency. Species diversity in terms of richness and evenness is calculated using the Shannon-Wiener Diversity Index. Since observation of wildlife takes long time, survey was limited to field visit and direct and indirect sighting of animals. The health status of the vegetation recorded a less significant and non-significant disease conditions in the wet seasons respectively. Despite the variation in metal content among the species, the plants are said to be in their natural state with a tolerable metal accumulation to normal concentration standards of metal (mg/kg). Generally there is a complete view of a rich vegetation profile with plant species high in diversity and abundance reflecting an original state of undisturbed ecosystem.

4.14 Wildlife
Species diversity in terms of richness and evenness is calculated using the Shannon-Wiener Diversity Index. Since observation of wildlife takes long time, survey was limited to field visit and direct and indirect sighting of animals. The presence of wildlife was also confirmed from the local inhabitant depending on the animal sightings. The result of the study has recorded some levels of heterogeneity and discrete homogeneity as a result of imbalances in the local environmental conditions emanating from both natural and human factors.

4.15 Socio Economic and Cultural Environment
4.15.1 Despite the diversities in cultural beliefs, the people freely move between their traditional - religious and cultural practices and Christianity as situation demand. However, Christianity is still the dominant and covenanted religion with a few traditional worshippers and Muslims. People worshipped the goddess called mini Ojio, Ahiale, Odo, Nkesa, Uzuzuand many others. They were originally Pagans, serving many gods like; Obiora, Amadioha, Ihuani etc. They involve in culture of Wrestling, Masquerade, Dancing, Football as well as fish and yam festivals. The festivals of Eyiam, Oyibo and Nehaka among others are usually
celebrated before planting for a good harvest. The head or Chief of each extended family or the kindred holds the land in trust for every member of the group, who enjoy traditional rights. The Chief lacks the power to alienate any portion of the land without the knowledge and approval of the council of Chiefs and consultation with the community at large.

4.15.2 They study used a participatory review approach which involves the traditional rulers, community development associations, youth and women groups. The study made use of both primary as well as secondary data sources. The instrument used for quantitative data collection was structured questionnaire while focused group discussion, in-depth interview, personal observation/interview etc. were used as qualitative data collection tools. Simple statistical tools such as frequency distribution, percentages, ratios and tables were used to analyze the data. The study estimated a population size of about 845,687 people in the study area. This value is not in variance from the nationally published data by National Population Commission, 2006. Result has shown that, majority of the people met during public forum were men (59%) while 41% were female. Result that, 78.82%, 14.72% and 6.46% represented those who are married (male and female), single and the widows respectively. Majority (58%) of the people have attended at least secondary education, while those with no formal education are represented with 7.12% and 3.4%. About 52% of the people earn between 6000 to 9000 per month. The highest household size was 8 persons per household (84%) while majority of the people are within the age limit of 31 to 50 years representing 84%. The major income activities of the people are farming and trading. Result shows that, majority preferred drying (ranked as 1) to other methods of preservation. Peeling, shelling, depodding and threshing were ranked as 2, 3, 4, and 5 respectively. Over 87% of the communities have these institutions provided for by the government or the community. Result shows that, majority preferred drying (ranked as 1) to other methods of preservation. Peeling, shelling, depodding and threshing were ranked as 2, 3, 4, and 5 respectively. 35.08% of income is spent on food items especially carbohydrates, protein, beverages etc. 10.3% spent on clothing, 10.53% on education, and transportation.

4.15.3 The likely felt impacts on the project are as follows: taking over of cultivable land, destruction of shrines, pollution, may causes ill-health, reduced fishing activities among others. Despite the anticipated negative impacts, the people believe that, the project will enhance employment of the youths, provide additional physical and social infrastructures to the community etc. The study recommend the following; that, IEFCL should carry the people along during planning and implementation of the project, that appropriate compensation measures be put in place, appropriate safety measures should be considered in case of uncertainty situation.

4.16 Health Assessment

Health Hazards: The health hazard in the study area according to field data and observations indicated that the health hazards included physical, chemical and biological hazards while the health outcomes hazards included communicable and non-communicable diseases as shown by analysis of our structured questionnaire, focus group discussion, key informant discussions, on the spot observation and clinical examinations. It was observed that the major factors influencing health status in the area included poverty, infections (Communicable and Non-communicable diseases) inadequate social and health infrastructures, poor housing, unsanitary environment conditions and high abundance of disease vectors with little or no capacity to control them. In the project communities the respondents agreed that the major cause of ill health included malaria, diarrhoea, respiratory tracts infection etc. others included hypertension, diabetes, malnutrition and eye problems. Morbidity and mortality rates are very high with high infant and maternal mortality.

Environmental health: In the project area, access to safe/potable water which is very critical to life is very poor with poor refuse and sewage disposal methods and their attendant consequences on health. Nutritional status: Nutritional status of the people was very low probably due to poverty, ignorance and illiteracy. Women and children are most susceptible to the effect of nutrition and is a risk factor in many diseases. The result of
the analysis on the nutritional status of some children showed underweight stunting and wasting. Knowledge about STI, lifestyle and habit: Many of the community members have heard about HIV/AIDS but have wrong knowledge of the cause and mode of transmission of HIV/AIDS. About 25% of the respondents will not sit, shake hands or share anything with HIV/AIDS patients According to information from our key informants, about 40% of the community members smoke cigarettes, 5% hard drugs though nobody openly admitted taking hard drugs, while over 75% drink Alcohol especially their local gin and beer with the attendant health implications. The EIA studies and other similar studies conducted in and around the area, it is apparent/obvious that the health care delivery service was inadequate, rudimentary and less than basic in standard operation. However, a few Model Health facilities with modern equipment and trained personnel offered satisfactory services.

Health facilities: There are few Orthodox health facilities that lacked equipment and qualified personnel in most of the project affected areas. However, there are some communities that had the Model Health Centres and General Hospitals that are fairly equipped and well-staffed. There are so many disease vectors in the communities because environmental conditions favour their vector biology, with little no local capacity to control them hence high disease prevalence. The health care facilities and services in many of these communities are inadequate, poor and rudimentary hence the system is characterized by high infant and maternal mortality. There is therefore urgent and compelling need to review existing health laws and regulations. Because this is a government role that requires budget and personnel, IEFCL will instead arrange periodic health camp for communities and will also undertake distribution of medicines periodically in order to alleviate the current challenges. These measures if carefully implemented will certainly reduce morbidity and mortality and will in the long run improve the health status of the people.

5. Project Alternatives
A range of alternatives are evaluated to facilitate identification of the most appropriate means of meeting the purpose and need for this project. The benefits of evaluating alternatives are for the selection of the best project design, selection of the best project location, most efficient use of resources; avoidance of adverse impacts; and achievement of sustainable development goals only achievable through consideration of new ways of doing business. Bearing on the above factors, the following alternatives were appraised: no project alternative; delayed project alternative; alternative location or site; and alternative technology.

Alternatives were also considered in terms of raw materials. The usage of natural gas as major feed for the production of Ammonia and Urea was considered more cost beneficial and environmentally friendly than the usage of other raw materials, such as coal and biomass. Alternatives were also considered in terms of location, the EPCL complex already has power, water, wastewater treatment facilities, storage facilities, adequate and available manpower and technology; therefore it was more environmentally friendly to consider it rather than virgin land.

6. Potential Impacts and Mitigation/Enhancement Measures
By the virtue of the identified impacts, prior the beginning of each project phase, the proponent is committed to implement dedicated mitigation/compensation measures to ensure that the project will be sustainable. A dedicated action plan has been prepared in this regard.

6.1 Impacts
6.1.1 Construction Stage - Site Preparation
Site preparation shall involve removal of limited amount of vegetation to provide path for trenching. The removal of wildlife habitat (vegetation) will lead to temporal migration of wildlife.
Trenching
Trenching would involve the use of trenching machines and excavator. There may be changes in water quality at river crossing. Increase in SPM, (dust content) when the trenching is carried out during the dry season is anticipated. There shall be temporary road and railway obstruction/diversion during trenching activities.

Backfilling
The backfilling may affect the drainage pattern of the area if not properly carried out. The back-filling may induce erosion, if soil is not properly re-instated. The effect is non significant, reversible and has short-term duration. Transportation of Personnel, Equipment, and Materials
Increase in traffic may increase the rate of exposure to accidents. Roads and railways may temporally be obstructed or diverted to allow for movement of heavy equipment and materials.

6.1.2 Operation & Maintenance Stage
Changes in air quality may occur as a result of emissions from leaks during pipeline operation and maintenance. Influx of workers during the construction phase will significantly affect the demography of the communities, not just in terms of population numbers but also in terms of population structure. The project will bring about increase in employment and improve income level especially during the construction phase. The project will lead to an influx of nonlocals into predominantly rural, traditional and conservative communities which will have an influence on the lifestyles of the people. The most common impact on lifestyles may be informed by sexual and other forms of behaviour, as well as modes of dressing. Sexual laxity/prostitution and alcoholism are the most vexatious and are associated with migrant workers living alone, away from their families. There are no cultural properties of note in the host communities. The possible exceptions religious sites/shrines. However, traditional worship is no longer very significant in the areas because of the influence of Islam and Christianity. Therefore, the impact of construction on cultural properties and practices will be very minimal, if any.

The most common social infrastructures in the host communities are primary and secondary schools, healthcare facilities and water supply systems. The project will engender population growth due to the influx of workers. The capacity of local infrastructures in some of the communities is very limited and so cannot cope with the increased demand that will result from population growth during the construction of the pipeline. Ordinarily, a major impact on natural resources will be occasioned by land-uptake and destruction of vegetation along the pipeline and transmission line. The beneficial health impacts from the activities of the pipeline project include availability of more job opportunities, which will improve income and make healthcare affordable, probable introduction of immigrants with new skills and perspectives, and the introduction of improved waste management/sanitation methods. The non-beneficial impacts include: increase in communicable diseases especially sexually transmitted diseases as a result of influx of casual labour force, injury from fire outbreaks that may result from pipeline damage and pressure on health facilities in clinics/hospitals as a result of increase in population.

6.2 Mitigation/Control Measures
6.2.1 Planning Phase
The Propone
t shall:
- Compensate communities for any extra land take other than the existing RoW and farmlands in line with Federal Government Land use decree and the African Development Bank’s requirements.

6.2.2 Site Preparation
- Use environmental route/path for site survey.
- Enforce “no hunting of game animals” during site preparatory activities.
- Avoid excess land take and minimize bush clearing during site survey.

6.2.3 Construction Phase
• Use equipment, which emit low levels of noise with acceptable exhaust gases, which conform to national standards and specifications.
• Enforce proper waste management practices and good in-house sanitary practices for base camp workforce.
• Use existing access/right of way if available.
• Carry out major construction/civil works during dry season or provide silt curtains to control the suspended particles in the run-offs. Wet grounds to reduce dust.
• Reduce water and road crossing for pipeline, plan for run-off during wet season.
• Reduce time frame between clearing trenching, pipe laying, and backfilling/revegetation.
• Prevent intruders/from inquisitive onlookers from work site to protect them against welding radiations
• Re-vegetate all bare areas and restore site where construction activities are completed

6.2.4 Pre-commissioning Phase
• Enforce the installation of cathodic protection devices on the pipes to maintain their integrity/prevent corrosion
• Use fresh water for hydrotesting.
• Use proper PPE including ear defenders at high noise zones.
• Place/caution signs.

6.2.5 Operation Phase
• Ensure regular maintenance of right of way for pipeline.
• Provide security to prevent vandalism at key critical points along the 85 km long pipeline

6.3 Decommissioning and Abandonment phase
• Re-vegetate all bare areas and restore site to original land use.
• Restore land to original form as much as possible and return to indigenes.
• Return ROW to indigenes for other land-use.
• Educate/guide road users on days of movement of dismantled parts.

In the event of abandoning the project or at the end of its lifespan a Decommissioning/Abandonment plan will be developed by the Proponent and fully discussed with the Regulatory Agencies. Any commitments relating to abandonment had with the stakeholders (especially the communities) will be visited during this process. The abandonment plan will be approved by the Regulatory Agencies before implementation of the plan.

7. Environmental Management Plan
The EMP for the OB/OB-Eleme Gas Pipeline Project has been developed to meet long term objectives of the project activities and operations. The EMP is designed to guarantee and achieve the implementations of the EIA findings highlighted in this report through the provision of project execution and maintenance guidelines, audit procedures, waste management plan, monitoring programme, resource requirements, responsibilities and training procedures. The project execution guidelines cover areas such as waste management, base camp operation, and contingency and monitoring plans. The overall cost for mitigation measures and cost of monitoring the ESMP will be Naira 189 million (US$ 1.2 million).

8. Public Consultations and Public Disclosure
8.1 Stakeholders:
There is a guideline for community / stakeholder management that outlines the EPC Contractor and subcontractor’s responsibilities for those employed in the construction of the pipeline with regards to community engagement and community social responsibility projects. The framework for stakeholder and community engagement that currently exists for IEPL will be extended to the pipeline element of the Project. The Guidelines set out the requirements for the engagement of manpower and also state that EPC Contractors and sub-contractors must comply with the Sponsor’s community affairs policies, including a Memorandum of
Understanding (MOU) with local communities (as discussed in Section 4.3.7). All community engagement is organised by the Sponsor’s Community Liaison Officer (CLO).

8.2 Consultation
The title of the project was explained to the audience and the purpose of the public fora was to enlighten host communities along the ROW and other stakeholders on the scope of the EIA studies. The audience was also made to understand that the public forum was in compliance with the environmental impact assessment act 86 of 1982 and IEFCL policy on environment.
The 27 communities identified as communities along the ROW were now grouped into manageable groups of five (5) representing communities in the six Local Government areas traversed by the pipeline.

9 Conclusion:
The EIA has demonstrated that the overall impacts associated with the OB/OB-Eleme Gas Pipeline Project can be managed within reasonable and acceptable limits by applying all identified mitigation measures contained in the ESIA report. Residual issues associated with the project are expected to be minor and not likely to have long-term significance on the environment.

10. References and Contacts
10.2 Final EIA Report by Foster Wheeler.

10.3 Contacts:
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