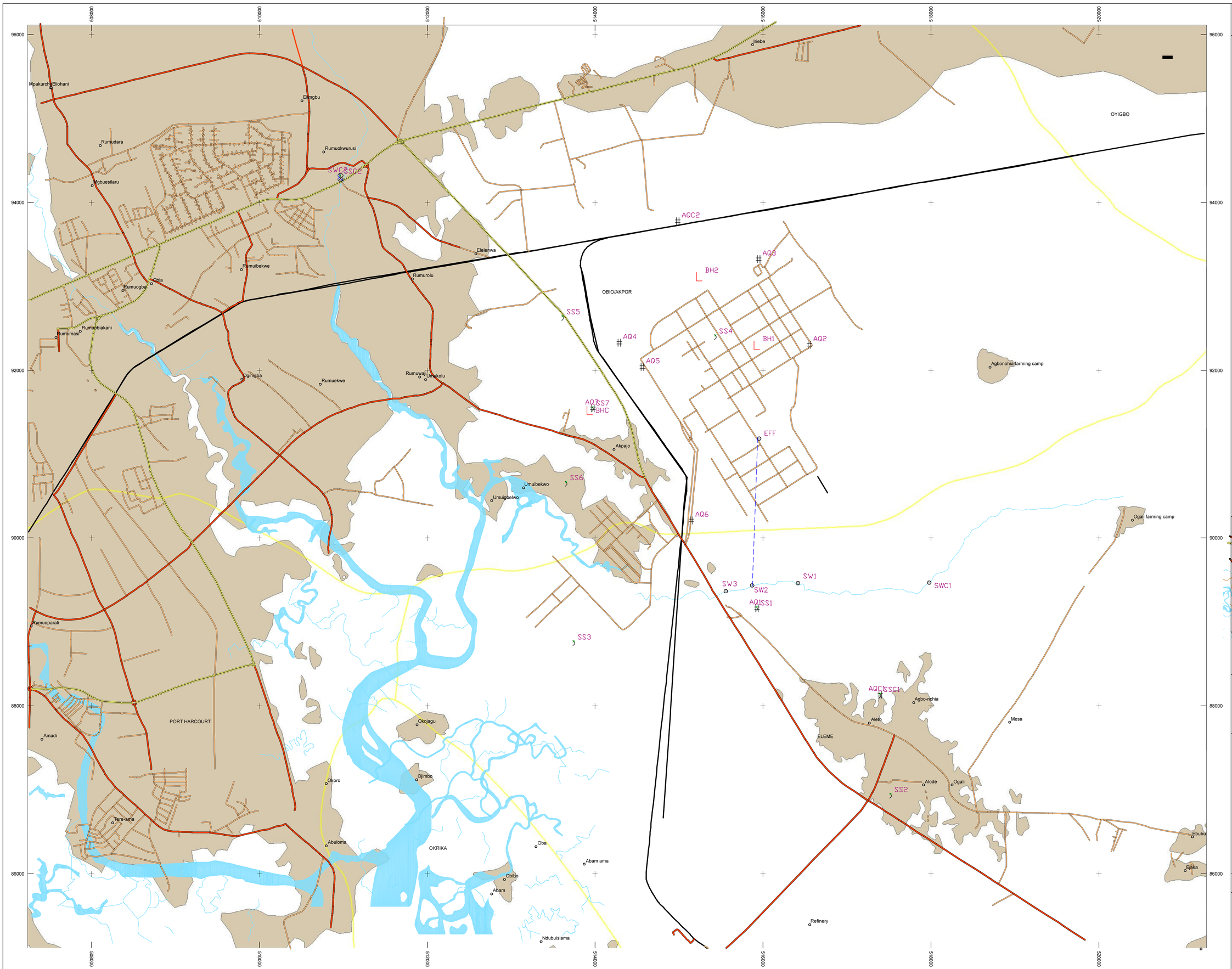


MAP PRODUCED BY:

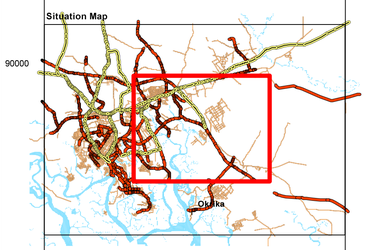
NANDERK GLOBAL LIMITED

TEL: 09081423095

Legend

- AIR QUALITY (AQ)
- BOREHOLE POINTS (BH)
- SOIL SAMPLES (SS)
- SURFACE WATER/SEDIMENT/HYDROBIOLOGY (SW)
- Cities and Major Towns
- Towns and Villages
- Roads - Expressway
- Roads - Major
- Roads - Minor
- Rail Network
- Stream
- Major Rivers
- Minor Rivers
- Sea
- Local Governments Boundary

Situation Map



CONSULTANT:

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SCALE: 1:20,000

0 — 1 Km

NTM MID BELT PROJECTION

CLIENT:

ELEME PETROCHEMICAL LTD

THEMATIC MAP OF IEFCL-TRAIN II PROJECT SHOWING SAMPLING STATIONS, LAND USE AND NATURAL FEATURES

Appendix - 4.2

METHODOLOGY

AMBIENT AIR/NOISE/METEOROLOGY AND MODELLING

Ambient Air Quality Study

Field study for the proposed IEFCL-Train2 project was conducted in September 2017 for rainy season data collection. Secondary data from previous studies conducted in the area (IEPL & IEFCL, Jan/Feb/March' 2017) were used for the dry season analysis. The ambient air quality survey was carried out in compliance with statutory requirements and in line with national and international policy on the protection and conservation of the environment. Ambient air quality monitoring is required to determine the existing quality of air in the project area. The ambient air quality objectives/standards are pre-requisite for developing management programme for effective management of ambient air quality and to reduce the damaging effects of air pollution. Measured baseline data were compared with Federal Ministry of Environment (FMEnv) standards and International Finance Corporation Standards. Concentrations of PM_{10} and $PM_{2.5}$ were compared with International Finance Corporation Standards. Air emission levels for fertilizer manufacturing (IFC, 2007); Nigerian Ambient air quality standards and International Finance Corporation (IFC) limits are presented in Appendix.

The ambient air quality monitoring survey was carried out at 9 locations (Table 1) within the proposed project geographical zone. Measurement of the real concentration levels of sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), hydrogen sulphide (H_2S), total hydrocarbon (THC), volatile organic compounds (VOCs), ammonia (NH_3), total suspended particulate matter (TSP), particulate matter (PM_{10}), & particulate matter ($PM_{2.5}$) are expressed in microgram per cubic meter ($\mu g/m^3$) and gives an understanding of the baseline existing environmental setting and condition of the project area. Statistical descriptors were used to compute the geometric mean, standard deviation and the 75th percentile (3rdquantile) concentrations of generated data during sampling at all locations.

Secondary historical data on meteorological parameters played an important role in identifying the general meteorological status of the project area. Site specific data was compared with secondary historical data in order to identify changes which may have taken

place due to the various developments in the area. Data obtained from field survey was supplemented by baseline assessment of secondary historical data from various locations. Historical data used are sourced from the monthly air quality monitoring reports by IEPL environmental consultant. Monitoring survey results are reported and discussed in detail in chapter 4. Collated secondary data was used to understand the ambient air quality scenario of the project area in the dry season.

Air Quality Sampling Procedure

Air quality sampling within the project area and its environs was done for a period of eight hours per day for each location and readings of all the parameters taken every hour. The eight hour monitoring period was carried out from day to day so that reading could be taken from early morning to late at night over the monitoring period. Sampling methodology adopted for this study was in compliance with Environmental Standards and Guidelines (FMENV 1991).

Table 1: Monitoring Location

Code	Location	Coordinates	
		N	E
AQ1	Aleto Community	N 04^0 49'12.64"	E 07^o 05'41.66
AQ2	Flare Area	N $04^0$50'03.42"	E $07^0$06'39.80"
AQ3	NG Receipt facility Area	N 04^o50'.33.33"	E 07^o06'21.70"
AQ4	Urea bagging Plant	N 04^0 50'27.04"	E $07^0$05'58.76"
AQ5	Weigh Bridge	N 04^o49'58.80"	E 07^o05'35.20"
AQ6	Main Gate	N 04^o48'54.48"	E 07^o05'54.10"
AQ7	Akpajo Community	N $04^0$49'37.90''	E $07^0$05'15.80''
AQC1	Agbonchia Njuru (Control 1)	N $04^0$47'64.40''	E $07^0$06'98.10''
AQC2	Rumukrushi Town (Control 1)	N $04^0$51'07.60''	E $07^0$03'38.00'

Measurement of Gaseous Pollutants

Madur GA-21 plus multi-gas analyser equipment was used for ambient air quality measurement. The multi-gas analyser automatically extracts atmospheric air and sent through the analyser gas sensors for the determination of pollutant gases of interest (SO_X,

VOC, O_3, NO_X, CO, H_2S, and THC). Instrument measurement principles and ranges of parameters are shown in Tables 2 and 3 respectively.

Measurement of Suspended Particulate Matter (TSP, PM_{10} and $PM_{2.5}$)

A mini-volume portable air sampler (Airmetrics ®) with a pre-weighed membrane filter (45µm) is used to collect particulate matter. After sampling, the membrane filter was dried in a desiccator and weighed to the nearest milligram. Measuring the mass of particulate matter and dividing by the volume of air calculated the mass concentration (gravimetric).

Table2: Gas components and suitable measuring principles

Parameter	Recommended method of determination
Particulate matters/Dust	Laboratory analysis method
H_2S	Electrochemical method
NO_2	FTIR / NDIR (cold) and converter / Calculation
SO_2	NDIR (cold and hot) / FTIR / DOAS-UV
VOC	FID (Flame Ionization Detector)
THC	IR sensor

Table3: Measurement range for parameters

Parameter	Range	Accuracy	Resolution
CO	0 to 10,000 ppm H2 comp.	< 5 ppm, 0 to 99 ppm, < 5% of m.v., 100 to 2,000 ppm < 10% of m.v., 2,001 to 10,000 ppm	1 ppm
NO_2	0 to 500ppm	< 5 ppm, 0 to 99 ppm, < 5% of m.v., 500 ppm	0.1 ppm
SO_2	0 to 5,000ppm	< 5 ppm, 0 to 99 ppm, < 5% of m.v, 100 to 2,000 ppm < 10% of m.v., 2,001 to 5,000 ppm	1 ppm
H_2S	0 to 300ppm	< 2 ppm, 0 to 39.9 ppm, < 5% of m.v., 40 to 300 ppm	0.1 ppm
THC	0 – 100ppm	±0.5ppm	0.01ppm
Noise	30 – 130dB (A)	±1.5dB	0.1dB

Noise Study

Noise levels were monitored at the nine locations within the project zone alongside air quality monitoring.

Noise Measurement Instrument

Smart Sensors (models AR844 and AR854) and TES (model 1352H) digital sound level meters were used. The Smart Sensors and TES digital sound level meters measure sound pressure level and are commonly used in noise studies.

The digital sound level meters are designed according to following standards:

- International electrician committee standard: IEC PUB 651 TYPE2
- US national standard: ANSI S 1. 4 TYPE2

The sound level meters were in-field calibrated by means of calibrator (piston-phone or other approved calibrator conforming to ANSIS1.4.

Methods of Noise Measurement

Field measurement of noise levels at different locations in project area and its environs was conducted in the month of September for the wet season period. A systematic monitoring of noise levels was carried out at pre-determined locations within and outside the project boundary area using Smart Sensor (models AR854) and TES (model 1352H) sound pressure level meters which give instant, real time readings according to regulatory noise measurement standards. The instruments were set on the A-weighting scale and fast response. Measurement of sound pressure levels were carried out at 15minutes intervals in an eight (8) hour working day. The instruments were placed 3 to 10 meters above ground level in accordance with ISO 9613 noise measurement procedure (Ugbebor et al., (2017).

Method of Noise Analysis

Measured noise levels were statistically analysed to determine baseline scenario around the project zone. The following noise level descriptors were determined and evaluated from measured data.

- Equivalent continuous equal energy level (L_{eq})
- The maximum A-weighted and fast time noise leveln (L_{max})
- A-weighted sound pressure level exceeded 10% of a given measurement interval (L_{10})
- A-weighted noise level exceeded for 50% of a given measurement period (L_{50})
- A-weighted sound pressure level exceeded 90% of a given measurement interval (L_{90})

Statistical Descriptors (ISO 1996-1:2003 & ISO 9613-2)

(a) Average Noise levels

Average values of noise levels obtained during field measurement was computed using the following Equation (Davis and Cornwell, 2008)

$$L_{avg} = 20\log\frac{1}{N}\sum_{j=1}^{N} 10^{\left(L_j/20\right)}$$

where

L_{avg} = average noise level (in dB ref : 20 mPa)

N = number of measurements

L_j = the jth noise level (in dB ref : 20 mPa)

j = 1,2,3,.....N

- **L_{90}** The level exceeded for 90% of the time during a specified period. This value was considered the background level.
- **L_{50}** The level exceeded for 50% of the time. This value was considered the median noise level.
- **L_{10}** The level exceeded for 10% of the time. This value was to represent maximum noise level.
- **L_1** The level exceeded for 1% of the time. This value was considered the peak noise level

(b) Equivalent Noise level (Leq)

The Leq is the equivalent continuous equal sound pressure level, which is equivalent to the same sound energy as the actual fluctuating sound measured in the same period. This is a cumulative metric that provides a more accurate quantification of noise exposure for a specified period and it is calculated to determine the steady-state noise level over a specified time period.

Leq is computed as defined by ISO 9613-2 using the following equation (Keily, 1996)

$$Leq = 10 * Log\left(\frac{1}{T}\int_0^T \frac{P^2(t)}{P_0{}^2}dt\right)$$

where:

T is the total time

P is the instantaneous A - weighted sound pressure in pascals

P_0 is the reference sound pressure (= 20 mPa)

t is the specified time interval, in seconds

For discrete sampling employed in this study the following formula was used to compute the values of Leq for both the wet and dry seasons.

$$L_{eq} = 10Log\left(\frac{1}{T}\sum_{i=1}^{i=n} 10^{L_t/10}(t_i)\right)$$

where:

$$Li = \text{the noise level in dB(A) of the ith measurement}$$

$$T = \text{total time}$$

$$n = \text{the total number of measurements taken}$$

$$t_i = \text{fraction of total measurement time}$$

Modeling Methodology

The mathematical simulation of the dispersion of air pollutants emissions from the new ammonia/urea plant is presented and discussed in this section. Two modelling approaches were employed in the modelling - Level 1 assessment and Level 2 assessment (IFC, 2007). A screen view model was applied for first level assessment (IFC, 2007), while ISC-AERMOD View model was used for second level assessment. Both models are approved by the United States Environmental Protection Agency (USEPA) for air pollutants dispersion modelling.

A screening model was applied for first level assessment to provide the worst-case pollutant concentrations, while ISC- AERMOD was used for second assessment to provide an in-depth modeling approach to determine long-range (24-hour) scenarios.

Screen view version 4.0 is a screening-level air quality model approved by the United States Environmental Protection Agency (USEPA) and International Finance Corporation (IFC) for the **estimation of worst-case ground level concentrations** for a single source as well as concentrations in the cavity zone, and concentrations due to inversion break-up and shoreline fumigation (Lake Environmental, 2011).

The screen view model has a built-in, meteorological data matrix that represents a spectrum of different combinations of meteorological conditions that could possibly occur in the area. It calculates concentrations under these different combinations of meteorological

conditions. From this output, the highest (worst-case) concentration is selected. Screening models are generally limited to providing the worst-case one-hour concentrations at a receptor. Screening models are considered to provide conservative concentration estimates, and as such are used as a flagging device that indicates the potential for unacceptable air quality (British Columbia Ministry of Environment, 2008).

Although Level 1 assessments are useful in many situations, often the complete distribution of concentrations in time and space are of interest. This distribution provides the spatial pattern of maximum concentrations at different time averages surrounding the source area, and/or the identification of areas where certain specified concentration thresholds are exceeded as well as their exceedance frequencies (British Columbia Ministry of Environment, 2008).

The ISC-AERMOD View model was used at the second level modelling assessment to determine long range air pollutants transport and their impacts on surrounding receptors. Mathematical simulations of emissions air dispersion from new stationary sources on long term basis was achieved by the modelling code AERMOD using the graphical user interface (GUI) AERMOD View. AERMOD View is a steady-state Gaussian Plume Air Dispersion Model developed by the Atmospheric Studies Group (ASG) scientists. The model incorporates Industrial Source Complex Model (ISCST3), AERMOD model and Plume Rise Enhancements (ISC-PRIME).

ISC-AERMOD View is a USEPA Regulatory, refined, steady-state, multiple source, Gaussian plume air Dispersion Model. ISC- AERMOD View is widely accepted as the preferred model to use for industrial sources in air quality analysis. The model was used to simulate pollutant concentrations emitted from the proposed ammonia/urea plant. Therefore, using ISC-AERMOD View for cumulative impacts modelling gives conservatively high impacts from a distance point source**.** Results are compared with Federal Ministry of Environment (FMEnv) and International Finance Corporation (IFC) standards and guidelines.

Point source Emission data

In below table 4, indicated the summary of emission factors, and stack characteristics, adopted in the model for plant's stacks.

Modelling Data for IEFCL Train-2 EIA

Emission Rate Nm3/hr.

Boiler stack emission	– 124,938 Nm3/hr.
Reformer stack emission	– 295,326 Nm3/hr.
Granulator 1	– 11, 86, 000 Nm3/hr.
Granulator 2	– 180,900 Nm3/hr.

Reformer stack Flue Gas Emissions

Effluent	Flow / Conditions	Components	Discharge
101-B Reformer Flue Gas	363,700 kg/hr (wet basis) 120 deg.C MW 27.55	N2 = 71.0 mol% H2O = 18.50 mol% CO2 = 7.30 mol% O2 = 2.10 mol% Ar = 1.10 mol% SO_2:1.02ppm based on 10 ppm H2S in NG fuel NOx : 40 ppmv @ 3%O2	Vented to Atmosphere

Package Boiler stack Flue Gas Emissions

Source	Flow / Condition	Components	Discharge
Flue Gas from Package Boiler B-BF1301	Max case: 124,938 Nm3/h (153,674 kg/hr) (wet basis) For 125 t/h steam production 160°C Mol Wt 27.55 Nor case: 44,554 Nm3/h (55,295 kg/hr) (wet basis) 150°C Mol wt 27.8	Max case: SOx ≤ 30 mg/Nm3 (at 3% O2 vol. dry basis) NOx < 150 mg/Nm3 (at 3% O2 vol. dry basis) CO = 100 mg/Nm3 (at 3% O2 vol. dry basis) Particulate < 50 mg/Nm3 Matter (at 3% O2 vol. dry basis) H2O = 19.65 wet vol.% CO2 = 8.61 wet vol.% O2 = 1.84 wet vol.% N2 = 69.9 wet vol.% Nor case: NOx < 150 mg/Nm3 (at 3% O2 vol. dry basis) CO = 100 mg/Nm3 (at 3% O2 vol. dry basis) Particulate < 50 mg/Nm3 Matter (at 3% O2 vol. dry basis) H2O = 16.6 wet vol.% CO2 = 6.9 wet vol.% O2 = 5.4 wet vol.% N2 = 71.1 wet vol.%	Vented to Atmosphere

Table 4: Summary of emission factors

Stack	No of Stack	Stack height (m)	Exit Temp (oC)	Exit Temp (ok)	Stack Diameter (m)	Maximum Concentration (mg/Nm3)			
						NOx	SOx	PM	NH3
Ammonia Reformer	1	35	120	413	3.65	150	2.90	50	N/A
Boiler Stack	1	40.6	160	433	2.2	@100% 150	@100% 30	@100% 50	N/A
Urea Granulation 1	1	55	50	323	5.5	N/A	N/A	50	50
Urea Granulator 2	1	55	50	323	2.1	N/A	N/A	50	50

N.A. = Not applicable

In the definition of emission factors, following assumptions have been made:

- All pollutants emissions emitted by the plant's stacks have been cautiously merged using the M parameter.
- In second level simulation, all plants stacks have been considered as a single stack with a total emission given by the emission of a single stack times the number of stacks at site.
- All NO_x emitted by plants have been cautiously considered NO_2;
- All SO_x emitted by plants have been conservatively considered SO_2;

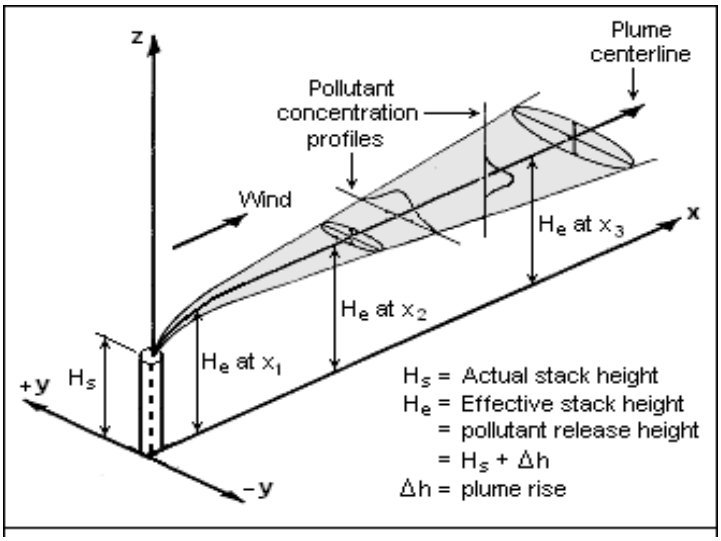
In order to estimate the impact the stationary sources on the air quality of the area, the following characteristic of the emission sources were applied:

- Pollutants emission rate;
- Stack height;
- Stack gas temperature, stack inside diameter, and stack gas exit velocity (for plume rise computation);
- Location of the point of emission with respect to the surrounding topology characteristics;
- Full meteorology and stability class.

In this modelling the emissions from each source was fully and accurately characterized. Material balance computation was based on engineering knowledge of the process.

Further Assumptions

- 1 Kmol of any gas occupies 22.4m^3 at 101.3kN/m^2 at 273K
- Density of Air at STP (ρ) = 1.29kg/m^3
- Pollutants molecular weight: NO_2 = 46, SO_2 = 64, CO = 28, VOC (as C_2H_6)= 30
- Fuel type: Natural gas liquid (NGL)
- Modelling is based on dry gas, 11 percent O_2



Visualization of a Buoyant Gaussian Air Pollution Dispersion Plume.

Effective Release Height above Ground (Hs_1).

The effective release height is calculated (Beychok, 2005). This is the plume height (h_e) that will occur during each wind speed and is given as:

$$h_e = h_s + \Delta h$$

$$H_{s1} = H_s + 4.56\times10^{-3}\left(\frac{H_r}{4.1868}\right)^{0.478}$$

Where: 4.1868 is a conversion factor (Joules to calories). Plume rise for the combusted gas is calculated in the SCREEN model for this effective release height (EPA, 1995).

Normalized plume rise: Estimate the normalized plume rise (uΔh) under neutral and unstable atmospheric conditions.

$$F_b = \frac{g}{4} v_s d_s^2 \left[\frac{T_s - T_a}{T_s}\right] = 3.12V \left[\frac{T_s - T_a}{T_s}\right]$$

where:

g = acceleration due to gravity (9.806 m/s²)

v_s = stack gas exit velocity (m/s)*

d_s = stack inside diameter (m)

T_s = stack gas exit temperature (K)*

T_a = ambient air temperature (K) (If no ambient temperature data are available, assume that T_a = 293K.)

$V = (\pi/4) d_s^2 v_s$ = actual stack gas volume flow rate (m³/s)

Normalized plume rise ($u\Delta h$) is then given by:

$u\Delta h = 21.4 F_b^{3/4}$ when $F_b < 55$ m⁴/s³

$u\Delta h = 38.7 F_b^{3/5}$ when $F_b \geq 55$ m⁴/s³

Merged parameters for Thermal Desorption Unit stacks

The two thermal desorption units have similar parameters and are located the same area close to each other. Therefore, all the emissions are analyzed as though coming from a single representative stack using the M parameter. The M parameter is hereby applied the TDU and scaled to represent the two stacks as follows:

$$M = \frac{h_s V T_s}{Q}$$

where:

M = merged stack parameter which accounts for the relative influence of stack height, plume rise, and emission rate on concentrations

h_s = stack height (m)

$V = (\pi/4) d_s^2 v_s$ = stack gas volumetric flow rate (m³/s)

d_s = inside stack diameter (m)

v_s = stack gas exit velocity (m/s)

T_s = stack gas exit temperature (K)

Q = pollutant emission rate (g/s)

The stack that has the lowest value of M is used as a "representative" stack. Then the sum of the emissions from all stacks is assumed to be emitted from the representative stack; i.e., the equivalent source is characterized by h_{s_1}, V_1, T_{s_1} and Q, where subscript 1 indicates the representative stack and $Q = Q_1 + Q_2 + \ldots + Q_n$.

Meteorology

The computational procedures given here for estimating the impact of a stationary source on air quality utilize information on the following meteorological parameters:

- Wind speed and direction
- Stability class
- Mixing height
- Temperature

Full Meteorology (All Stability Classes and Wind Speeds)

All the meteorological combinations between stability classes and their associated wind speeds are considered to identify the "worst case" meteorological conditions, that is, the combination of wind speed and stability that results in the maximum ground level concentrations. The wind speed and class combinations used by the SCREEN View model are given below

Stability Classes and Wind Speeds

Pasquill-Gifford Stability Class	10-Meter Wind Speed (m/s)											
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	8.0	10.0	15.0	20.0
A	√	√	√	√	√								
B	√	√	√	√	√	√	√	√	√				
C	√	√	√	√	√	√	√	√	√	√	√		
D	√	√	√	√	√	√	√	√	√	√	√	√	√
E	√	√	√	√	√	√	√	√	√				
F	√	√	√	√	√	√	√						

Pasquill-Gifford Stability Classes

The Pasquill-Gifford stability classes represent six levels of atmospheric stability. Atmospheric stability is important as it influences the rate of dispersion of pollutants. Increased amounts of turbulence will cause pollutants to disperse more rapidly than with more stable atmospheric conditions. The Pasquill-Gifford stability classes range from A to F (1.0 to 6.0) and describe the ambient atmospheric stability as show in Table 5.

Pasquill-Gifford Stability Classes

Class	Value	Description
A	1.0	Very unstable
B	2.0	Unstable
C	3.0	Slightly unstable
D	4.0	Neutral
E	5.0	Slightly stable
F	6.0	Stable

CLIMATE AND METEOROLOGY

Data for this study was acquired via field work measurement (microclimatic data) for a period of 24 hours. Further data have been acquired for the development of the air dispersion study. During the course of fieldwork, a weather station was set up in an open ground, Latitude N04^{o} 48' 57.6" Longitude E007^{o} 05' 52.8" and allowed to run for a minimum of 24 hours in order to establish a microclimatic baseline of the study area. All precautions usually taken when setting up a weather station were observed for the onsite measurements according to the World Meteorological Organization (WMO) standard. These include setting up the weather station away from obstacles like buildings and tall vegetation, using an instrument shelter to display all temperature sensitive gadgets, orienting the instrument shelter so that the sun's radiation does not fall directly on the instrument during reading and setting up the weather station in an area representative of the study area's totality.

SOIL SAMPLING

Systematic sampling design (systematic line transect, reference for the Fertilizer plants site area) was employed to collect soil by establishing plots across the sampled area. Stratified sampling applied was simply the process of identifying portions within the overall area. Transects samples were taken at particular points along lines. Samples were evenly/regularly distributed in a spatial context at every 20 x 20 meters (Quadrant) along transect lines. This method was used since sampling area is made up of sub-sets of known size. These sub-sets make up different proportions of the total, and therefore sampling was stratified to ensure that results are proportional and representative of the whole.

Soil samples were collected at depths of 0-15cm and 15-30cm, representing top and bottom samples, with the aid of the following main equipment: a Dutch Hand Auger, Hand gloves, a spool and hammer. The first 30cm from the ground level is the soil depths at which most (>80%) of the plants feeder roots & soil micro-organisms are concentrated, most affected by erosion and most exposed to spills/pollution.

At each sampling station, three (3) samples were taken for each depth and mixed to give one representative sample. 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 and stored in ice – packed coolers;
- Samples for hydrocarbon and microbiological analysis, collected in McCartney bottles and stored in ice-packed coolers.

A soil profiling is carried out to obtain a representative image of the various types of soils and of the soil horizons present on the site using the bucket auger boring method.
Soil samples were taken in two ways, according to the kind of tests to be performed.
They are:

- Disturbed samples which do not represent exactly how the soil was in its natural state before sampling;
- Undisturbed samples which represent exactly how the soil was in its natural state before sampling.

Disturbed samples are used for the more simple tests that will be performed and particularly for those tests which are performed in the field. Undisturbed samples are necessary for the more geotechnical tests which must be performed in the laboratory for more detailed physical and chemical analyses. Undisturbed samples are collected with greater care for the represent exactly the nature of the soil. For a complete study of the soils disturbed and undisturbed samples are needed.

The auger boring method is a way to obtain soil samples from different depths by drilling, without having to dig a pit. This way, a continuous series of soil samples is taken which

makes it possible to assemble a core showing the soil horizons. The auger boring method is fast and provides only disturbed samples. An auger is used in most soils above the water table and in cohesive soils below the water table.

The basic steps to follow when sampling with an auger are:

- Drill the auger into the soil to a depth of 30 cm;
- Pull the auger up carefully to keep the soil in place, just as it was in the ground, and place the soil sample on a sheet of plastic or newspaper;
- Continue drilling 30 cm at a time; place the successive sections one after the other to assemble a core showing the soil horizons;
- Make a drawing of the core; measure and write the depths at which you observe the various horizons;
- If you reach water, drill more carefully but try to continue drilling for another 30 to 40 cm.

A standard bucket auger is a metal cylinder about 30 cm long and 18 cm in diameter. It has a cutting edge on the bottom surface which enables it to cut through most soils easily. Generally, bucket augers are equipped with an extension shaft and handle which allow you to take samples at greater depths, usually down to 2.4 m. A sample taken with a bucket auger is slightly disturbed but it is acceptable for most sampling purposes and it provides a sample large enough for further laboratory analysis.

Soil Sampling Locations and Sample ID

ID	Sample Description/Location	Coordinates	
SS1	SS1 (Aleto) ; Top and Bottom	E07º06'19.52"	N04º48'20.46"
SS2	SS2 (Agbonchia); Top and Bottom	E07^0 07'07.17"	N04^0 47'46.94"
SS3	SS3 (Flare Area); Top and Bottom	E07^0 06'19.94"	N04^0 50'02.66"
SS4	SS4 (Agip Metering); Top and Bottom	E07^0 06'19.93"	N04^0 50'35.96"
SS5	SS5 (IRC); Top and Bottom	E07^0 05'25.98"	N04^0 50'03.31"
SS6	SS6 (Weigh Bridge); Top and Bottom	E07^0 05'34.90"	N04^0 49'53.97"
SS7	SS7 (Akpajo); Top and Bottom	E07^{0}05'15.80"	N04^{0}49'37.92"
SSC1	SSC1 Oyigbo Road; Top and Bottom	E07^0 07'07.17"	N04^0 47'46.90"
SSC2	SSC2 Rumukrushi; Top and Bottom	E07^0 03'38.40"	N04^0 51'07.68''

VEGETATION STUDIES

Plant Identification is a basic activity and one of the primary objectives of systematics. Although identification is a separate activity or process, in practice it involves both classification and nomenclature.

The methods of plants identification used include ***(***1).visual Observation (2) Polyclaves (3). Taxa, Characters and Data Matrices (4) Comparison (5) Construction of Identification Keys (habit, leaf arrangement, petal, Locule, stamen, Fruit)

The University of Port Harcourt herbarium (Library for the collection of preserved plants stored, catalogued, and arranged systematically for study) was used as a critical resource for biodiversity, ecological and evolutionary research studies.

WILDLIFE

This involved a survey/census of mammals, birds' reptiles and amphibians around the study area. Direct count method, using a pair of binoculars, was employed for the census of reptiles, birds and other animals sighted during the study. The presence of some of the animals were ascertained by probing such humid habitant like logs, heaps of dead decaying leaves, forest undergrowths, ponds and burrows. Thus all sighted, captured or dislodged animals were identified often on the spot to possible taxonomic levels using field guides and keys (Walkey et al 1968; Elgood 1960; Happold 1987; Brach 1988).

The indirect method which makes use of evidence of animal's presence (Dasmann 1963) was used for species which do not offer themselves readily for observation. Interviews with hunters also provided further information on the wildlife diversity abundance and use in the area.

LAND USE AND LAND COVER

The land use pattern of a region is an outcome of natural and socio –economic factors and their utilization by man in time and space. Land is becoming a scarce resource due to immense agricultural and demographic pressures.

The land use types found in the proposed project environments were measured and observed directly from the field (See Appendix 2.1 - thematic land use map).

Land cover is the physical material at the surface of the earth. Land covers include grass, asphalt, trees, bare ground, water, etc. The two primary methods used for capturing information on land cover are field survey and analysis of remotely sensed imagery. At any one point or place, there may be multiple and alternate land uses, the specification of which may have a political dimension

HYDROGEOLOGY & GEOLOGY SURVEYS

Geologic Site Characterization

Conventional boring method, which consists of the use of the light shell and auger hand rig, were used in the boring operation. During the boring operations, disturbed samples were regularly collected at depths of 0.75 m intervals and also when change of soil type is noticed. Undisturbed cohesive soil samples will be retrieved from the boreholes with conventional open-tube sampler 100 mm in diameter and 450 mm in length. The open-tube sampler consists essentially of a lower end and upper end screwed into a drive head which is attached to the rods of the rig. The head has an overdrive space and incorporates a non-return valve to permit the escape of air or water as the samples enters the tube. The sampler is driven into the soil by dynamic means using a drop hammer. On withdrawal of the sampler, the non-return valve assists in retaining the sample in the tube. All samples recovered from the boreholes were examined, identified and roughly classified in the field.

Standard Penetration Tests (SPT) was performed at every 1.5 m advance through cohesion-less soils. The main objective of this test is to assess the relative densities of the cohesion-less soils penetrated. In this test, a 50mm diameter split spoon sampler is driven 450mm into the soil with a 63.5 kg hammer falling freely a distance of 760 mm. The sampler is driven into the soil in two stages. The initial 150 mm penetration of the sampler is the seating drive and the last 300 mm penetration, the test drive.

Cone Penetration Testing (CPT)

Hydraulically operated, GMF type, static penetrometer of 50KN capacity was used in the cone resistance soundings. Mechanical mantle cone with friction jacket was used in the operation. Discontinuous sounding procedure was adopted in the test. The cone in its retracted position is first forced into the ground a distance of 10cm by the application of

force to the outer sounding tubes. The cone is then pushed out a distance of about 4cm by the application of force to the inner rods only and the magnitude of the force required to achieve this, is measured on the pressure gauges and recorded. This is the cone resistance.

Borehole Drilling

Three boreholes were drilled in the area in a triangular array. This is to capture the water flow direction and the heterogeneity of the subsurface across the area.

Design and construction of the monitoring borehole.

The drilling involve the boring of 5" diameter hole from surface to about 14-20m respectively or to the bottom of identified portable water productive aquifer, for screen and casing installation. Verticality of the hole was maintained while drilling cuttings were sampled and collected at every 3.05m interval and at any charge in lithology.

Casing/screen installation

Polyvinyl chloride (PVC) 4" 8bar casing pipe and screen slot of 1mm (machine slotted) were used for installation. The screen was coupled to the blinded casing shoe and lowered from the surface downward into the aquifer zone using conventional method. The casing pipe were incorporate to the screen head to form a continuous length of intake structure. The pipe were incorporated using suitable adaptors, jointing kits, centralizers, bottom bunk/casing shoe etc. That were required for proper casing installation.

Well construction (gravel packing / cement grouting)

And artificial filter park (rice gravel) was placed around the length of the well screen annulus. Well-sorted, rounded river washed gravel about 10mm – 15mm was placed from bottom to above the screen zone and sealed off by filter sand and finally by cement grouting.

Water Chemistry

Water samplings were done with relevant water sampler for Physico-chemistry, BOD and micro-biological analyses. All field samples both soil and water were properly labelled and stored in appropriate condition (ice chest for water) before sending to the laboratory for analyses. Laboratory microbial analyses were done using various media and microbiological techniques. GPS was also used to capture the coordinates of the various sampling locations.

ID	Sample description/location	Coordinates	
BH1	Indorama complex, Flare area	N4^0 50'02.65"	E07^0 06'19.93"
BH2	Indorama complex, water treatment plant	N04^{0}50'29.20''	E07^{0}05'57.60'
BHC	Akpajo	N04^{0}49'37.24"	E007^{0}05'15.30"

AQUATIC STUDIES

Sampling Protocol

The hydrology of the project area consists of Okulu stream, which is the only water body close to the project area. To be able to predict the present status of the environment, sampling stations were established in such a manner as to adequately represent the present condition of the various water body sampled. This informs the choice of five (5) surface water distributed thus, three (Upstream, Midstream and Downstream) stations were located on the Okulu Stream (Indorama treated effluent recipient water body), while control station were cited in Agbonchia and Rumukrushi to enable comparison of both water chemistry. The same stations were adopted for the assessment of sediment and hydrobiology in the cause of this study. The table below present sampling locations and coordinate for each station.

Surface Water/Sediment/Hydrobiology

Sample code	Sampling location	Coordinates	
		North	East
SW1	Up Stream	N04^{0}48'43.70''	E07^{0}06'42.60''
SW2	Midstream	N04°48'43.70"	E07°06'42.60"
SW3	Down Stream	N04^{0}48'27.40''	E07^{0}06'04.30''
SWC1	Agbonchia Stream	N04^{0}48'33.80''	E07^{0}07'27.50''
SWC2	Rumukrushi	N04^{0}51'07.60''	E07^{0}03'38.00''

Treated Effluent Stream

Effluent Stream	Sampling location	Coordinates	
		North	East
Eff.	Indorama Sluice Gate	N04^{0}49'25.70''	E07^{0}06'20.50''

Surface water

Physico chemical

A total of five (5) stations were sampled for water. A water sampler was used to collect water samples at designated locations. Standard field methods were used in the sample collection at the site as recommended by FMENV. To ensure the integrity of some unstable physicochemical parameters *in-situ* measurements of temperature, pH, electrical conductivity (EC), dissolved oxygen (DO), turbidity, salinity and total dissolved solids (TDS)

were carried out in the field using water quality checker Horiba U-10. To maintain analytical accuracy duplicate and blank samples were included in the analyses. Distilled water used for analysis conforms to ASTM D 1193 Type 1. Only qualified and trained personnel were employed in the laboratory work.

Samples for BOD measurement were collected in Winkler's bottles, while water samples for heavy metals analyses were collected in glass containers and acidified with concentrated nitric acid to avoid precipitation.

Sample Preservation and Storage

The water samples collected were stored in ice-packed coolers and preserved in accordance with Federal Ministry of Environment Guidelines and Standards. All water samples for heavy metals were preserved by the addition of concentrated HNO_3, while concentrated HCl was added to the samples for the analyses of total hydrocarbon.

Microbiology

Methods of Sample Collection

(a) Water samples were collected in accordance with the procedures described in standard methods for water and wastewater analysis (APHA, 2005 21st Edition). The same is accepted and adopted by FMENV as standards for Nigeria. According to the procedure, 200 ml of sterilized sample bottle was used for collecting water sample under the watch of FMENV supervisor.

(b) The samples were preserved in an ice-cooled container and transported to the laboratory for analysis.

Quality Control Measures

i) Clean sterile containers were used for sample collection to avoid external contamination of the sample.

ii) Sample was transported in an ice packed cooler to the laboratory and analysed within 2 hours of collection or stored in refrigerator for analysis at other days.

iii) Procedures for sample collection were done aseptically and in accordance with standard procedures.

iv) Only adequately trained personnel were used for the sampling.

v) The personnel to be involved in the project were briefed on the scope of work.

vii) Equipment used for *in situ* measurements were adequately calibrated prior to use and checked by the supervising officer.

viii) Blank samples were taken to determine the measure of contamination introduced from sampling procedure.

ix) Sampling equipment was washed with sterilized water after use to prevent cross contamination.

x) Pre-rinsing and overfilling of sample containers are avoided to prevent loss of preservative, dilution of preservative and loss of air space.

Methods of Sample Analysis

(a) Enumeration of Bacteria

Serial dilution procedure as described by Obire and Wemedo (1996); Ofunne (1999) was employed for cultivation and enumeration of bacteria and fungi in the water samples. The ten-fold serial dilution was used to obtain appropriate dilutions of the samples. Aliquots of the required dilutions were plated in duplicates onto the surface of dried sterile nutrient agar (for total heterotrophic bacteria). In case of total/Feacal coliform bacteria, the most probable number (MPN) technique described by Collins and Lyne, (1980) was employed for estimation of their numbers in water. Appropriate volumes of undiluted water samples were inoculated into test tubes of MacConkey broth medium. All inoculated media were incubated at 37^0C for 24 hours or 3-7 days except for fecal coli form bacterial set up incubated at 44.5^0C.

(b) Enumeration of microorganisms

(i) Nutrient agar medium used for enumeration of total heterotrophic bacteria prepared according to manufacturer's specifications.

(ii) MacConkey broth medium for estimation of total/faecal coli form bacteria in water.

(c) Quality Control Measures

(i) Samples were analyzed in FMEnv accredited standard microbiological laboratory in accordance with standard procedures.

(ii) Procedures for cultivation and enumeration of bacteria were carried out aseptically to avoid contamination from external sources.

(iii) All media and glass wares used were sterilized in an autoclave at 121°C for 15 minutes.

Sediment

Sediment Samples were collected at the water sampling points using an Eckman grab sampler. Sediment samples for physiochemical analysis were collected in polythene bags, while those for microbiology analysis were collected in Aluminium foil.

Similarly all the sediment samples were temporarily stored in ice packed coolers prior to transfer to the laboratory.

Hydrobiology

Plankton & Zooplankton

Phytoplankton and Zooplankton composite samples were collected quantitatively by filtering 100litres of water through 55mm Hydrobios plankton net. All samples (concentrated to 100ml) collected for phytoplankton analysis were preserved in Lugol's iodine, while samples collected for Zooplankton analysis were preserved in 4% buffered formaldehyde in 250ml polyethylene bottles. In the laboratory, the phytoplankton and zooplankton were identified and counted using a Wild-Lietz Stereo Zoom dissecting microscope and a Nikon Compound Research microscope. Representative species of zooplankton were mounted in polyvinyl lactophenol tinted with lignin pink after dissecting the relevant taxonomic parts. Individuals of each identified taxon in each sample were enumerated using a Petri dish and Sedgwick – Rafter counting cell. Density computations were expressed in numbers of cells per 1000l based on number of each species observed per 100 liters of samples filtered. Enumeration of numbers of cells per 1000l was computed using the following formula:

$$\text{Number of cells/ 1000l} = \frac{[N \times 1000]}{\text{Initial volume of water filtered}}$$

Where N = Cells counted per sample i.e.

$$\frac{\text{Counts x fraction}}{\text{No of fields counted}} \times \frac{1}{\text{Vol of chamber x 100}} \times \frac{100}{1}$$

Where subsamples from the original 100ml concentrated samples were used, N was first computed from the original sample before estimating the density. Identifications were made to the lowest possible taxonomic level using relevant identification keys (Nwankwo, 2004, Witkowski*et al*., (2000), Rosowski, (2003), Siver, (2003), and Iain and David (2009).

Benthic Fauna

Quantitative samples for benthic fauna were collected at each station using the Ekman Grab (0.0225m^2) and sieved in the field using 250 and 500mm Tyler sieves. All samples were preserved in wide mouthed plastic containers by adding some quantities of 40% formaldehyde and stained with Rose Bengal solution (0.1 sensitivity) (Zabbey, 2002; Idowu and Ugwumba, 2005).

Laboratory analysis was carried out by using the binocular dissecting microscope and Nikon compound microscope for sorting, dissection of relevant taxonomic parts, and preparation of slides. Specimens were identified to the lowest possible taxonomic level using reliable identification keys and texts (Pennak, 1978; Barnes, 1980). Faunal densities were computed in numbers per m^2.

In addition to determining the relative abundance by direct count of the individuals' encountered, basic statistical measurement of diversity indices were used to describe the plankton community structure. PAST (Paleontological Statistics) software package for data analysis was used to compute the diversity (Hammer *et al*. 2001). Four diversity indices namely, Shannon-Wiener (H'), Dominance index (D) Evenness (E) or Equitability (J) and Margalef (d) each representing a different aspect of the faunal diversity were used (Green, 1971; Shannon and Weaver,1963; Robinson and Robinson 1971, Ogbeibu 2014).

Socio-Economic

Approach

It is assumed that the socio-economic context to be considered for this study is constituted by the communities closest to the proposed Fertilizer Plant, which are likely to be the most affected by the project from a socio-economic point of view. The proposed project is arousing a lot of interest and expectations are high, albeit with uncertainties also over its social and environmental consequences. There are a number of instruments that can be used to collect data in this circumstance; for this survey, the questionnaire and focused group interviews were the primary means of data collection.

In social research, both the objective and subjective data are required to adequately assess respondents and their situation. In this survey, the objective data include age, function in the community, and expected impacts. The subjective data include specific questions

through which the respondents were able to express their opinions and preferences as regards themselves and their environment.

Design of the Survey

This is a one-shot cross sectional study of the affected settlements. The impact assessment will put in perspective a project whose effects on the social well-being of settlements should be evaluated. This survey is predicated on household behavior pattern and characteristics. A household is a group of people who live in one house, use the same kitchen (i.e., eat from the same table). They contribute their resources and share the burden of group members together. Usually, there is a head who is often a man. A minority of cases may exist where a woman, presides over the household because she is a widow or was never married. The household was the basic unit of inquiry in this study.

The questionnaire was structured into several sub-sections to address issues like, demography, economic activities, social environment, perception of project operations, living conditions and quality of life, utilities and infrastructure, community relations, security, conflict and conflict resolution. The questions were both structured and unstructured. The unstructured ones were more, because of the preponderance of qualitative variables in the survey – the approach being to maximize an understanding of the respondents' state of mind on the issues of concern. The questionnaire is reproduced as enclosed appendix of this report.

Data Management and Analysis

Pertinent activities were divided into three phases: database design and implementation phase, statistical analysis phase, and qualitative/descriptive data analysis phase. The data analysis' strategy was to capture both qualitative and quantitative information and present them in an electronically managed form. The software used is the Statistical Package for Social Sciences (SPSS) version 17.0. The SPSS is a versatile statistical package with the capability of analysing numerical data tied to variable names.

The outputs are in the form of frequencies, percentages, graphs, descriptive and advanced statistics, if required. The analysis using SPSS was carried out at two levels: the individual community member and his household, and the study community as a whole. In this

analysis, simple frequency tables and percentages were developed. To have achieved this, almost all the information had to be coded into numerical terms. Qualitative responses were tackled by looking at the broad classes of response and numerals awarded. The code book was a modification of the original questionnaire with numerical values.

Health-Impact

An integrated descriptive, cross-sectional study design was adopted for the community health survey. It involved community-based households and facility-based surveys. Quantitative data was complemented by qualitative information by way of key informant interviews of opinion leaders of the community to understand other socio-cultural and economic characteristics of the people that influenced their health statutes. Specifically, in depth interviews of the nurses in private and government medical centers were conducted.

The Health Impact Assessment of the project area was conducted in and around the facilities, the communities to determine the baseline characteristics of the health status of the project area against which future impacts of the project can be compared. Secondly to determine the probable/potential impacts of the project on the health of the workers within the IEPL facility and of the people around the communities (Agbonchia, Aleto, Akpajo, and Elelenwo) so as to determine the type of intervention/s needed to ameliorate these negative potential impacts.

These communities were sampled by the health personnel to obtain information regarding mortality and morbidity rates, demographic or population

Structures, types of health outcome hazards, most prevalent diseases, less prevalent diseases, disease vectors, nutrition, health facility infrastructure capability and usage, service delivery, average family size, sexual reproductive health, immunization status and coverage, sewage and waste management system, air quality, water quality, radiation sources and levels were considered.

Data collection

From each of the communities, a total of Four Hundred respondents were randomly selected using village listing as the main frame.

A total of 81 respondents were used in the study.

- The study instruments consisted of Structured Questionnaires;

- Physical and clinical examinations and observation carried out to the extent of the suitability of the environment and availability of the facilities. Invasive techniques were not used;
- Informal discussions with the respondents;
- Group focus discussion (GFD) sessions;
- Key informant interview;
- Health facility survey.

Secondary data was generated from Health Centers, Hospitals records. Information was also sought from traditional Birth attendants and numerous chemist/patent medicine shops. Traditional medicine practitioners and spiritual healing homes/churches which played significant roles because they complemented orthodox health care delivery services in all the communities. The data were generated by medical personnel who administered the questionnaire, conducted the group focus discussion session (GFD) and key informant discussion sessions. The respondents were mainly adults and opinion moulders who are resident in the communities. There were a preponderance of male respondents (about 75-80%) than females. About 60% had formal education.

Appendix- 4.3

EIA Study Team - Qualification/Experience

NAME	QUALIFICATION	DESIGNATION/POSITION	EXPERIENCE (Highlights)
Olu Andah Wai-Ogosu	· B.Sc Biological Science · M.Sc Environmental Systems Management (Engineering Option) · Registered Environmental Manager (REM-USA) · Fellow Nigerian Environmental Society (FNES) · Member American Air Pollution Association	Principal Environmental Consultant Environmental and Chemical Services Ltd	· First Nigerian to produce World Bank Approved Environmental Impact Assessment (EIA) 1990 · Lead Consultant/Team Leader for several Environmental Assessment projects for the Oil and Gas, Manufacturing and Infrastructural sectors of the Nigerian economy · Produced Eight World Bank approved EIA reports · Environmental and Social Impact Assessments (EIA, PIA, EA etc) · Stakeholder Engagement · Social Action Plan · Development of Environmental Management Systems and Implementation · Project management · Capacity development · Thirty four (34) years in active Environmental consultancy · Delegate to 2014 National Conference (represented the Nigeria Environmental Society) · Environmental Advisor to many companies

Yorkor, Banaadornwi	· B. Tech (Elect.) · M.Eng (Environmental) · M.Eng (Engineering Management) · M. Eng (Public Health Engineering) · Ph.D (In view)	Registered Environmental Manager (REM) Environmental Modelling Specialist Air Quality Consultant Meteorology Consultant Noise Study Specialist	· **Project Manager:** Soil and groundwater assessment of Eleme Petrochemical Company Limited. · **Assist. Project Manager:** Environmental impact assessment of shoreline protection works at Atimagbene, Delta State. · Cumulative impact assessment of fertilizer project Indorama Eleme Fertilizer Company. · Design and construction of oil water separators in ITS and Atlas Companies, Onne.
Adeyemi Adewale	· B.Tech Agronomy · Mphil Environmental Management · Registered Environmental Manager (REM) · QMS Lead Auditor · EMS Lead Auditor · Environmental Consultant	Soil and water Consultant, Remediation Analytical QAQC Evaluator	· Have participated in over 40 EIA project as Team Leader, coordinator and as soil and water quality consultant

R. Tombari Sibe	· B. Tech Computer Engineering M. Eng Electrical/Electronic Engineering (Telecoms) · PhD Geomatics (in View) · Member Nigerian Society of Engineers · COREN Registered Engineer · Member Institute of Electrical and Electronic Engineers (IEEE)	Computer Engineer System Analyst Application Developer Mapping and Geospatial Consultant Remote Sensing Database Management Data Management ICT Consultant	· Lead Consultant and Project Manager for several ICT Projects for the Rivers State Government (ICT Department, RIWAMA, RSSDA, etc) · Lead Consultant for E-Library Application for the Presidency (OSSAP-MDGs) · Mapping and Geospatial Analyst for Several Environmental Projects for clients such as Mobil, BLNG, Total, PHCN, RIWAMA, etc. · Lead Consultant for the Geospatial Application for the Presidential Committee on the North-East Initiative (PCNI) · Project Manager for Geospatial and Mobile Application for the Rivers State Road Maintenance and Rehabilitation Agency. · Project Manager for Several Projects, such as: Public Health Management System, Power Infrastructure Management System, etc.

Alwell Nteegah	· Ph.D Economics · M.Sc Economics · B.Sc Economics	Economics and Socio-economics Analyst	· Lecturer, Department of Economics, University of Port Harcourt. · Consultant, SIMAS Ventures · Human Development Expert · Environmental Impact Assessment (EIA) Consultant
Shola A	· PhD Hydrobiology · M.Sc Environmental Science	Hydrobiology Consultant	· Have been several EIA Project as a Hydrobiology consultant
Iniabe Eezor	· B.Sc Chemistry · MPhil Environmental mgt (inview)	Waste management Consultant	· Have participated in over 20 EIA Project as waste management consultant
Dr. Chris Anaynwu	· B. Sc Biochemistry · M.Sc Epidemiology · PhD Public Health	Health Impact Assessment Consultant	· Have participated in over 30 EIA project as a HIA Consultant
Dr. Raphael Offiong	· B.Sc Geography/Regional Planning · M.Sc Environmental Mgt/Planning · PhD Bio-Geography	Ecology Consultant	· Senior Lecturer Department of Geography University of Calabar · Ecology consultant for over 30 EIA project.
Dr. David O	· B.Sc Meteorology · M.Phil Environmental Management · PhD Climatology	Climate/Meteorology Consultant	· Have participated in over 32 EIAs as a Climate/Meteorology Consultant
Ifeanyi Anasonya	· B.Sc Geology	Geology/Hydrogeology Consultant	· Have participated in over 35 EIAs as a Hydrogeology/Geology Consultant

Nwachukwu Solomon	· B.Sc Maths/Computer Science · PGD Environmental Soil science · HSE Level 1-3 from British Safety Council	Soil Quality Assessment/Routine environmental monitoring of Indorama Complex	· Have participated in over 30 EIA projects with keen interest in soil quality assessment.
Legborsi N	· B.Sc Environmental Management · PGD Education	Air Quality Assessment/ Routine environmental sampling of Indorama complex	· Have participated in over 10 EIA sampling, as well environmental routine monitoring for so many facilities
Barikpoa John	· OND Science Laboratory · HND Environmental Microbiology (inview)	Air Quality Assessment/ Routine environmental sampling of Indorama complex	· Have participated in over 10 EIA sampling, as well environmental routine monitoring for so many facilities

Appendix – 4.4

Wet season Baseline Air Quality of Project Area

Location / Parameter		SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	CO ($\mu g/m^3$)	H_2S ($\mu g/m^3$)	THC ($\mu g/m^3$)	VOCs ($\mu g/m^3$)	NH_3 ($\mu g/m^3$)	TSP ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)
X1	Aleto Community	0.00	0.00	0.00	0.00	0.00	15.00	0.32	11.00	10.00	1.00
X2	Flare Area	0.00	0.00	0.00	0.00	20.00	9.00	0.20	27.00	18.00	9.00
X3	NG Receipt facility Area	0.00	2.00	1.30	0.00	0.00	25.00	0.30	15.00	10.00	5.00
X4	Urea bagging Plant	0.00	0.00	0.00	0.00	10.00	15.00	0.01	8.00	5.00	3.00
X5	Weigh Bridge	2.60	2.00	0.00	0.00	20.00	3.50	0.04	59.00	39.00	20.00
X6	Main Gate	0.00	0.00	2.60	0.00	10.00	10.00	0.03	47.00	31.00	16.00
X7	Akpajo Community	5.40	0.00	3.80	0.00	0.00	5.00	0.00	30.00	19.00	11.00
Control 1	Agbonchia Njuru	0.00	0.00	1.30	0.00	0.00	10.00	0.18	20.30	13.80	6.50
Control 2	Rumukrushi Town	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.00	15.00	8.00
	Range	**0.0-5.4**	**0.0-2.0**	**0.0-3.8**	**0.0**	**0.0-20.0**	**0.0-25.0**	**0.0-0.32**	**8.0-59.0**	**5.0-39.0**	**1.0-20.0**
	Mean	**0.9**	**0.4**	**1.0**	**0.0**	**6.7**	**10.3**	**0.1**	**26.7**	**17.9**	**8.8**
	Std. dev.	**1.90**	**0.88**	**1.40**	**0.00**	**8.66**	**7.44**	**0.13**	**16.79**	**10.81**	**6.09**
	FMEnv limit	**26**	**75-113**	**22.8**	**N/A**	**160**	**6000**	**0.5-1.0**	**250**	**N/A**	**N/A**
	IFC limit	**20**	**200**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**50**	**25**

Dry season Baseline Air Quality of Project Area

Location / Parameter		SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	CO ($\mu g/m^3$)	H_2S ($\mu g/m^3$)	THC ($\mu g/m^3$)	VOCs ($\mu g/m^3$)	NH_3 ($\mu g/m^3$)	TSP ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)
X1	Aleto Community	5.58	2.89	3.51	1.17	13.98	0.19	10.83	74.9	39.3	18.9
X2	Flare Area	8.32	4.70	4.40	0.63	14.57	0.45	7.92	90.5	44.0	19.8
X3	NG Receipt facility Area	8.55	4.76	4.46	3.47	18.74	0.38	11.04	98.0	43.4	21.1
X4	Urea bagging Plant	7.49	6.18	4.15	2.33	16.96	0.44	10.83	90.7	37.9	18.4
X5	Weigh Bridge	7.95	5.17	5.42	2.30	18.75	0.19	8.54	106.6	43.5	19.5
X6	Main Gate	7.83	7.59	5.89	2.09	15.77	0.32	11.67	93.3	45.3	19.5
X7	Akpajo Community	4.37	4.28	4.04	0.70	13.68	0.35	4.80	78.2	41.8	16.5
Control 1	Agbonchia Njuru	6.30	4.08	5.24	0.48	10.70	0.16	7.94	61.5	33.7	13.5
	Range	**4.37-8.55**	**2.89-7.59**	**3.51-5.89**	**0.48-3.47**	**10.70-18.75**	**0.16-0.45**	**4.80-11.67**	**61.5-106.6**	**33.7-45.3**	**13.5-21.1**
	Mean	**7.0**	**5.0**	**4.6**	**1.6**	**15.4**	**0.3**	**9.2**	**86.7**	**41.1**	**18.4**
	Std. dev.	**1.48**	**1.42**	**0.80**	**1.06**	**2.74**	**0.12**	**2.33**	**14.37**	**3.88**	**2.39**
	FMEnv limit	**26**	**75-113**	**22.8**	**N/A**	**160**	**6000**	**0.5-1.0**	**250**	**N/A**	**N/A**
	IFC limit	**20**	**200**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**50**	**25**

Dry Session data monitored during Month of January, February & March' 2017

	Location	SO_2 (µg/m3)				NO_2 (µg/m3)				CO (µg/m3)			
		Jan	Feb	Mar	Ave	Jan	Feb	Mar	Ave	Jan	Feb	Mar	Ave
X1	Aleto Community	6.06	4.98	5.70	5.58	3.10	3.58	2.00	2.89	1.56	5.33	3.65	3.51
X2	Flare Area	10.70	8.91	5.36	8.32	6.40	4.56	3.15	4.70	4.69	4.56	3.94	4.40
X3	NG Receipt facility Area	8.90	7.13	9.63	8.55	6.40	5.13	2.75	4.76	5.46	5.13	2.79	4.46
X4	Urea bagging Plant	3.58	8.19	10.69	7.49	4.10	4.20	10.25	6.18	2.16	5.60	4.69	4.15
X5	Weigh Bridge	9.63	7.11	7.11	7.95	4.86	7.68	2.98	5.17	4.68	7.68	3.90	5.42
X6	Main Gate	6.05	6.76	10.68	7.83	4.86	6.40	11.51	7.59	6.72	6.25	4.69	5.89
X7	Akpajo Community	5.08	4.98	3.05	4.37	2.73	4.98	5.13	4.28	3.89	5.11	3.13	4.04
Control 1	Agbonchia Njuru	6.41	6.06	6.43	6.30	3.59	6.06	2.60	4.08	3.78	7.68	4.26	5.24
	Range				**4.37-8.55**				**2.89-7.59**				**3.51-5.89**
	Mean				**7.0**				**5.0**				**4.6**
	Std. dev.				**1.48**				**1.42**				**0.80**

Continue……

	Location	H_2S (µg/m3)				THC (µg/m3)				TSPM (µg/m3)			
		Jan	Feb	Mar	Ave	Jan	Feb	Mar	Ave	Jan	Feb	Mar	Ave
X1	Aleto Community	1.60	1.90	0.00	1.17	14.28	16.96	10.69	13.98	83.4	80.3	61.0	74.9
X2	Flare Area	1.90	0.00	0.00	0.63	13.38	18.74	11.6	14.57	85.4	120.1	66.0	90.5
X3	NG Receipt facility Area	3.80	3.80	2.80	3.47	18.74	21.42	16.07	18.74	65.1	101.6	127.4	98.0
X4	Urea bagging Plant	0.00	2.53	4.45	2.33	16.07	16.07	18.74	16.96	65.5	94.3	112.4	90.7
X5	Weigh Bridge	2.48	1.90	2.53	2.30	16.07	20.53	19.64	18.75	81.0	121.3	117.5	106.6
X6	Main Gate	6.28	0.00	0.00	2.09	15.17	19.64	12.50	15.77	80.4	95.1	104.4	93.3
X7	Akpajo Community	2.10	0.00	0.00	0.70	15.17	10.70	15.17	13.68	93.8	65.5	75.4	78.2
Control 1	Agbonchia Njuru	1.43	0.00	0.00	0.48	9.82	10.68	11.60	10.70	72.6	49.0	62.9	61.5
	Range				**0.48-3.47**				**10.70-18.75**				**61.5-106.6**
	Mean				**1.6**				**15.4**				**86.7**
	Std. dev.				**1.06**				**2.74**				**14.37**

Continue……

	Location	VOC (µg/m3)				NH_3 (µg/m3)				PM_{10} (µg/m3)				$PM_{2.5}$ (µg/m3)			
		Jan	Feb	Mar	Ave	Jan	Feb	Mar	Ave	Jan	Feb	Mar	Ave	Jan	Feb	Mar	Ave
X1	Aleto Community	13.75	18.75	0.00	10.83	0.29	0.29	0	0.19	42.3	40.5	35.2	39.33	21.1	19.8	15.8	18.90
X2	Flare Area	7.50	11.25	5.00	7.92	0.19	0.48	0.67	0.45	46.0	47.5	38.5	44.00	19.4	22.6	17.5	19.83
X3	NG Receipt facility Area	10.00	12.50	10.63	11.04	0.29	0.29	0.57	0.38	38.2	44.2	47.9	43.43	16.9	22.4	23.9	21.07
X4	Urea bagging Plant	13.75	10.00	8.75	10.83	0.57	0.57	0.19	0.44	30.7	36.4	46.5	37.87	14.8	17.9	22.6	18.43
X5	Weigh Bridge	7.50	10.63	7.50	8.54	0.10	0.08	0.38	0.19	37.9	47.3	45.2	43.47	16.5	22.4	19.6	19.50
X6	Main Gate	16.25	8.75	10.00	11.67	0.48	0.29	0.19	0.32	41.7	45.9	48.2	45.27	18.7	19.2	20.7	19.53
X7	Akpajo Community	3.13	5.63	5.63	4.80	0.00	0.85	0.19	0.35	44.3	42.3	38.7	41.77	19.5	13.2	16.7	16.47
Control 1	Agbonchia Njuru	11.25	3.81	8.75	7.94	0.19	0.00	0.29	0.16	36.7	27.6	36.8	33.70	15.9	11.4	13.1	13.47
	Range				**4.80-11.67**				**0.16-0.45**				**33.7-45.3**				**13.5-21.1**
	Mean				**9.2**				**0.3**				**41.1**				**18.4**
	Std. dev.				**2.33**				**0.12**				**3.88**				**2.39**

MODELLING OUTPUT RESULTS
AMMONIA REFORMER NOX

SIMPLE TERRAIN INPUTS:
SOURCE TYPE = POINT
EMISSION RATE (G/S) = 12.3000
STACK HEIGHT (M) = 35.0000
STK INSIDE DIAM (M) = 4.3500
STK EXIT VELOCITY (M/S)= 11.9400
STK GAS EXIT TEMP (K) = 413.0000
AMBIENT AIR TEMP (K) = 303.0000
RECEPTOR HEIGHT (M) = 0.0000
URBAN/RURAL OPTION = RURAL
BUILDING HEIGHT (M) = 0.0000
MIN HORIZ BLDG DIM (M) = 0.0000
MAX HORIZ BLDG DIM (M) = 0.0000

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

BUOY. FLUX = 147.525 M**4/S**3; MOM. FLUX = 494.789 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****
Atmospheric condition category:
1 = Very unstable; 2 = Unstable; 3 = Slightly unstable; 4 = Neutral; 5 = Slightly stable; 6 = Stable
*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	0.4870E-02	5	1.0	1.6	10000.0	172.22	34.12	33.75	NO
200.	0.1274	5	1.0	1.6	10000.0	172.22	40.89	39.70	NO
300.	0.1495	5	1.0	1.6	10000.0	172.22	42.69	40.16	NO
400.	0.6852	3	10.0	11.3	3200.0	99.46	46.12	28.87	NO
500.	5.131	1	3.0	3.3	960.0	271.56	122.21	114.50	NO
600.	12.76	1	3.0	3.3	960.0	271.56	142.86	162.63	NO
700.	15.60	1	3.0	3.3	960.0	271.56	163.03	221.11	NO
800.	18.79	1	1.5	1.6	509.1	508.11	213.39	310.24	NO
900.	22.33	1	1.5	1.6	509.1	508.11	233.33	387.47	NO
1000.	23.01	1	1.5	1.6	509.1	508.11	248.66	473.55	NO
1100.	22.19	1	1.5	1.6	509.1	508.11	264.19	571.51	NO
1200.	21.03	1	1.5	1.6	509.1	508.11	279.87	681.13	NO
1300.	19.91	1	1.5	1.6	509.1	508.11	295.65	802.30	NO
1400.	18.90	1	1.5	1.6	509.1	508.11	311.49	934.96	NO
1500.	17.98	1	1.5	1.6	509.1	508.11	327.36	1079.10	NO
1600.	17.15	1	1.5	1.6	509.1	508.11	343.26	1234.73	NO
1700.	16.39	1	1.5	1.6	509.1	508.11	359.15	1401.87	NO

```
 1800.   15.69      1    1.5   1.6  509.1  508.11  375.04 1580.58   NO
 1900.   15.06      1    1.5   1.6  509.1  508.11  390.90 1770.89   NO
 2000.   14.47      1    1.5   1.6  509.1  508.11  406.74 1972.85   NO
 2100.   13.93      1    1.5   1.6  509.1  508.11  422.54 2186.52   NO
 2200.   13.43      1    1.5   1.6  509.1  508.11  438.31 2411.94   NO
 2300.   12.96      1    1.5   1.6  509.1  508.11  454.03 2649.18   NO
 2400.   12.53      1    1.5   1.6  509.1  508.11  469.72 2898.28   NO
 2500.   12.13      1    1.5   1.6  509.1  508.11  485.36 3159.29   NO
 2600.   11.90      2    1.5   1.6  509.1  508.11  385.10  339.85   NO
 2700.   12.04      2    1.5   1.6  509.1  508.11  396.59  351.98   NO
 2800.   12.12      2    1.5   1.6  509.1  508.11  408.06  364.23   NO
 2900.   12.15      2    1.5   1.6  509.1  508.11  419.52  376.59   NO
 3000.   12.13      2    1.5   1.6  509.1  508.11  430.97  389.05   NO
 3500.   11.58      2    1.5   1.6  509.1  508.11  487.92  452.69   NO
 4000.   10.68      2    1.5   1.6  509.1  508.11  544.36  518.14   NO
 4500.   9.777      2    1.5   1.6  509.1  508.11  600.24  585.02   NO
 5000.   8.973      2    1.5   1.6  509.1  508.11  655.56  653.08   NO
 5500.   8.818      3    1.5   1.7  491.7  490.66  498.32  318.56   NO
 6000.   8.904      3    1.5   1.7  491.7  490.66  536.03  340.68   NO
 6500.   8.844      3    1.5   1.7  491.7  490.66  573.54  362.89   NO
 7000.   8.910      5    1.0   1.6 10000.0  172.22  298.52   76.79   NO
 7500.   9.281      5    1.0   1.6 10000.0  172.22  317.21   78.82   NO
 8000.   9.598      5    1.0   1.6 10000.0  172.22  335.76   80.79   NO
 8500.   9.467      5    1.0   1.6 10000.0  172.22  354.20   82.72   NO
 9000.   9.409      5    1.0   1.6 10000.0  172.22  372.51   84.60   NO
 9500.   9.385      5    1.0   1.6 10000.0  172.22  390.71   86.45   NO
10000.   8.879      5    1.0   1.6 10000.0  172.22  408.81   88.26   NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
  980.   23.04      1    1.5   1.6  509.1  508.11  245.73  456.27   NO

 DWASH=   MEANS NO CALC MADE (CONC = 0.0)
 DWASH=NO MEANS NO BUILDING DOWNWASH USED
 DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
 DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

 *** INVERSION BREAK-UP FUMIGATION CALC. ***
 CONC (UG/M**3)   =   25.91
 DIST TO MAX (M)  = 10943.74

    ***************************************
    *** SUMMARY OF SCREEN MODEL RESULTS ***
    ***************************************
 CALCULATION       MAX CONC    DIST TO   TERRAIN
 PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
--------------   -----------  ---------  -------
SIMPLE TERRAIN      23.04         980.       0.

INV BREAKUP FUMI    25.91        10944.      --
**************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
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AMMONIA REFORMER PM

SIMPLE TERRAIN INPUTS:
SOURCE TYPE = POINT
EMISSION RATE (G/S) = 4.10000
STACK HEIGHT (M) = 35.0000
STK INSIDE DIAM (M) = 4.3500
STK EXIT VELOCITY (M/S)= 11.9400
STK GAS EXIT TEMP (K) = 413.0000
AMBIENT AIR TEMP (K) = 303.0000
RECEPTOR HEIGHT (M) = 0.0000
URBAN/RURAL OPTION = RURAL
BUILDING HEIGHT (M) = 0.0000
MIN HORIZ BLDG DIM (M) = 0.0000
MAX HORIZ BLDG DIM (M) = 0.0000

THE NON-REGULATORY BUT CONSERVATIVE BRODE 2 MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

BUOY. FLUX = 147.525 M**4/S**3; MOM. FLUX = 494.789 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****
Atmospheric condition category:
1 = Very unstable; 2 = Unstable; 3 = Slightly unstable; 4 = Neutral; 5 = Slightly stable; 6 = Stable
*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	0.1623E-02	5	1.0	1.6	10000.0	172.22	34.12	33.75	NO
200.	0.4248E-01	5	1.0	1.6	10000.0	172.22	40.89	39.70	NO
300.	0.4984E-01	5	1.0	1.6	10000.0	172.22	42.69	40.16	NO
400.	0.2284	3	10.0	11.3	129.3	99.46	46.12	28.87	NO
500.	2.176	1	3.0	3.3	300.0	271.56	122.21	114.50	NO
600.	6.487	1	3.0	3.3	300.0	271.56	142.86	162.63	NO
700.	8.874	1	3.0	3.3	300.0	271.56	163.03	221.11	NO
800.	9.406	1	2.5	2.7	326.8	318.87	187.60	293.10	NO
900.	8.840	1	2.5	2.7	326.8	318.87	206.76	372.08	NO
1000.	8.189	1	2.5	2.7	326.8	318.87	223.91	461.04	NO
1100.	7.607	1	2.5	2.7	326.8	318.87	241.05	561.19	NO
1200.	7.104	1	2.0	2.2	397.6	389.84	265.20	675.24	NO
1300.	6.985	2	5.0	5.5	194.6	176.93	198.99	151.29	NO
1400.	6.828	2	5.0	5.5	194.6	176.93	212.03	163.22	NO
1500.	6.604	2	5.0	5.5	194.6	176.93	224.99	175.29	NO
1600.	6.400	2	4.5	4.9	210.0	192.70	238.68	188.51	NO
1700.	6.193	2	4.0	4.4	229.4	212.42	252.52	202.10	NO
1800.	6.075	3	8.0	9.1	147.4	118.84	177.53	107.48	NO
1900.	5.968	3	8.0	9.1	147.4	118.84	186.28	112.65	NO

2000.	5.838	3	8.0	9.1	147.4	118.84	194.98	117.81	NO
2100.	5.693	3	8.0	9.1	147.4	118.84	203.64	122.96	NO
2200.	5.539	3	8.0	9.1	147.4	118.84	212.27	128.10	NO
2300.	5.426	3	5.0	5.7	197.5	171.70	222.96	136.67	NO
2400.	5.402	3	5.0	5.7	197.5	171.70	231.43	141.66	NO
2500.	5.359	3	5.0	5.7	197.5	171.70	239.88	146.65	NO
2600.	5.299	3	5.0	5.7	197.5	171.70	248.30	151.63	NO
2700.	5.226	3	5.0	5.7	197.5	171.70	256.70	156.61	NO
2800.	5.143	3	5.0	5.7	197.5	171.70	265.07	161.58	NO
2900.	5.053	3	5.0	5.7	197.5	171.70	273.41	166.55	NO
3000.	4.974	3	4.5	5.1	212.1	186.89	282.36	172.55	NO
3500.	4.589	3	4.0	4.5	230.6	205.87	324.26	198.39	NO
4000.	4.247	3	3.5	4.0	254.5	230.28	365.75	224.32	NO
4500.	3.942	3	3.0	3.4	286.5	262.83	407.04	250.59	NO
5000.	3.682	3	3.0	3.4	286.5	262.83	446.41	274.30	NO
5500.	3.454	3	2.5	2.8	331.5	308.40	487.32	301.05	NO
6000.	3.254	3	2.5	2.8	331.5	308.40	525.82	324.37	NO
6500.	3.061	3	2.5	2.8	331.5	308.40	564.00	347.63	NO
7000.	2.970	5	1.0	1.6	10000.0	172.22	298.52	76.79	NO
7500.	3.094	5	1.0	1.6	10000.0	172.22	317.21	78.82	NO
8000.	3.199	5	1.0	1.6	10000.0	172.22	335.76	80.79	NO
8500.	3.289	5	1.0	1.6	10000.0	172.22	354.20	82.72	NO
9000.	3.364	5	1.0	1.6	10000.0	172.22	372.51	84.60	NO
9500.	3.426	5	1.0	1.6	10000.0	172.22	390.71	86.45	NO
10000.	3.476	5	1.0	1.6	10000.0	172.22	408.81	88.26	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

780.	9.434	1	2.5	2.7	326.8	318.87	183.82	279.24	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

*** INVERSION BREAK-UP FUMIGATION CALC. ***
CONC (UG/M**3) = 8.638
DIST TO MAX (M) = 10943.74

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	9.434	780.	0.
INV BREAKUP FUMI	8.638	10944.	--

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **

AMMONIA REFORMER SOX

SIMPLE TERRAIN INPUTS:
SOURCE TYPE = POINT
EMISSION RATE (G/S) = 0.238000
STACK HEIGHT (M) = 35.0000
STK INSIDE DIAM (M) = 4.3500
STK EXIT VELOCITY (M/S)= 11.9400
STK GAS EXIT TEMP (K) = 413.0000
AMBIENT AIR TEMP (K) = 303.0000
RECEPTOR HEIGHT (M) = 0.0000
URBAN/RURAL OPTION = RURAL
BUILDING HEIGHT (M) = 0.0000
MIN HORIZ BLDG DIM (M) = 0.0000
MAX HORIZ BLDG DIM (M) = 0.0000

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

BUOY. FLUX = 147.525 M**4/S**3; MOM. FLUX = 494.789 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****
Atmospheric condition category:
1 = Very unstable; 2 = Unstable; 3 = Slightly unstable; 4 = Neutral; 5 = Slightly stable; 6 = Stable
*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	U10M STAB	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	0.9424E-04	5	1.0	1.6	10000.0	172.22	34.12	33.75	NO
200.	0.2466E-02	5	1.0	1.6	10000.0	172.22	40.89	39.70	NO
300.	0.2893E-02	5	1.0	1.6	10000.0	172.22	42.69	40.16	NO
400.	0.1326E-01	3	10.0	11.3	3200.0	99.46	46.12	28.87	NO
500.	0.9929E-01	1	3.0	3.3	960.0	271.56	122.21	114.50	NO
600.	0.2470	1	3.0	3.3	960.0	271.56	142.86	162.63	NO
700.	0.3019	1	3.0	3.3	960.0	271.56	163.03	221.11	NO
800.	0.3636	1	1.5	1.6	509.1	508.11	213.39	310.24	NO
900.	0.4321	1	1.5	1.6	509.1	508.11	233.33	387.47	NO
1000.	0.4452	1	1.5	1.6	509.1	508.11	248.66	473.55	NO
1100.	0.4294	1	1.5	1.6	509.1	508.11	264.19	571.51	NO
1200.	0.4068	1	1.5	1.6	509.1	508.11	279.87	681.13	NO
1300.	0.3852	1	1.5	1.6	509.1	508.11	295.65	802.30	NO
1400.	0.3656	1	1.5	1.6	509.1	508.11	311.49	934.96	NO
1500.	0.3479	1	1.5	1.6	509.1	508.11	327.36	1079.10	NO
1600.	0.3318	1	1.5	1.6	509.1	508.11	343.26	1234.73	NO
1700.	0.3171	1	1.5	1.6	509.1	508.11	359.15	1401.87	NO
1800.	0.3037	1	1.5	1.6	509.1	508.11	375.04	1580.58	NO
1900.	0.2914	1	1.5	1.6	509.1	508.11	390.90	1770.89	NO
2000.	0.2800	1	1.5	1.6	509.1	508.11	406.74	1972.85	NO

2100.	0.2695	1	1.5	1.6	509.1	508.11	422.54	2186.52	NO
2200.	0.2598	1	1.5	1.6	509.1	508.11	438.31	2411.94	NO
2300.	0.2508	1	1.5	1.6	509.1	508.11	454.03	2649.18	NO
2400.	0.2425	1	1.5	1.6	509.1	508.11	469.72	2898.28	NO
2500.	0.2347	1	1.5	1.6	509.1	508.11	485.36	3159.29	NO
2600.	0.2302	2	1.5	1.6	509.1	508.11	385.10	339.85	NO
2700.	0.2329	2	1.5	1.6	509.1	508.11	396.59	351.98	NO
2800.	0.2345	2	1.5	1.6	509.1	508.11	408.06	364.23	NO
2900.	0.2350	2	1.5	1.6	509.1	508.11	419.52	376.59	NO
3000.	0.2347	2	1.5	1.6	509.1	508.11	430.97	389.05	NO
3500.	0.2240	2	1.5	1.6	509.1	508.11	487.92	452.69	NO
4000.	0.2067	2	1.5	1.6	509.1	508.11	544.36	518.14	NO
4500.	0.1892	2	1.5	1.6	509.1	508.11	600.24	585.02	NO
5000.	0.1736	2	1.5	1.6	509.1	508.11	655.56	653.08	NO
5500.	0.1706	3	1.5	1.7	491.7	490.66	498.32	318.56	NO
6000.	0.1723	3	1.5	1.7	491.7	490.66	536.03	340.68	NO
6500.	0.1711	3	1.5	1.7	491.7	490.66	573.54	362.89	NO
7000.	0.1724	5	1.0	1.6	10000.0	172.22	298.52	76.79	NO
7500.	0.1796	5	1.0	1.6	10000.0	172.22	317.21	78.82	NO
8000.	0.1857	5	1.0	1.6	10000.0	172.22	335.76	80.79	NO
8500.	0.1909	5	1.0	1.6	10000.0	172.22	354.20	82.72	NO
9000.	0.1953	5	1.0	1.6	10000.0	172.22	372.51	84.60	NO
9500.	0.1989	5	1.0	1.6	10000.0	172.22	390.71	86.45	NO
10000.	0.2018	5	1.0	1.6	10000.0	172.22	408.81	88.26	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

980.	0.4459	1	1.5	1.6	509.1	508.11	245.73	456.27	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

*** INVERSION BREAK-UP FUMIGATION CALC. ***
CONC (UG/M**3) = 0.5014
DIST TO MAX (M) = 10943.74

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	0.4459	980.	0.
INV BREAKUP FUMI	0.5014	10944.	--

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

BOILER STACK NOX

SIMPLE TERRAIN INPUTS:
SOURCE TYPE = POINT
EMISSION RATE (G/S) = 5.20000
STACK HEIGHT (M) = 40.0000
STK INSIDE DIAM (M) = 2.9000
STK EXIT VELOCITY (M/S)= 13.0600
STK GAS EXIT TEMP (K) = 448.0000
AMBIENT AIR TEMP (K) = 303.0000
RECEPTOR HEIGHT (M) = 0.0000
URBAN/RURAL OPTION = RURAL
BUILDING HEIGHT (M) = 0.0000
MIN HORIZ BLDG DIM (M) = 0.0000
MAX HORIZ BLDG DIM (M) = 0.0000

THE NON-REGULATORY BUT CONSERVATIVE BRODE 2 MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

BUOY. FLUX = 87.150 M**4/S**3; MOM. FLUX = 242.542 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****
Atmospheric condition category:
1 = Very unstable; 2 = Unstable; 3 = Slightly unstable; 4 = Neutral; 5 = Slightly stable; 6 = Stable
*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	0.1535E-03	5	1.0	1.6	10000.0	153.36	27.57	27.11	NO
200.	0.1815E-01	5	1.0	1.6	10000.0	153.36	34.41	32.98	NO
300.	0.7274E-01	1	3.0	3.3	300.0	210.89	76.84	54.82	NO
400.	1.763	1	3.0	3.3	300.0	210.89	98.50	78.56	NO
500.	6.378	1	3.0	3.3	300.0	210.89	119.45	111.55	NO
600.	11.86	1	2.0	2.2	302.3	296.34	148.11	167.26	NO
700.	16.09	1	2.0	2.2	302.3	296.34	168.68	225.31	NO
800.	16.38	1	2.0	2.2	302.3	296.34	186.39	292.33	NO
900.	15.26	1	2.0	2.2	302.3	296.34	203.80	370.44	NO
1000.	14.08	1	2.0	2.2	302.3	296.34	221.18	459.72	NO
1100.	13.11	1	1.5	1.7	387.5	381.78	247.11	563.82	NO
1200.	12.58	2	4.5	5.0	167.8	153.93	184.28	137.41	NO
1300.	12.21	2	4.0	4.4	181.6	168.17	198.22	150.29	NO
1400.	11.80	2	4.0	4.4	181.6	168.17	211.31	162.29	NO
1500.	11.46	2	3.5	3.9	199.5	186.48	225.23	175.59	NO
1600.	11.06	2	3.0	3.3	223.5	210.89	239.42	189.45	NO
1700.	10.74	2	3.0	3.3	223.5	210.89	252.15	201.64	NO
1800.	10.38	3	5.0	5.7	159.1	138.36	178.08	108.38	NO
1900.	10.34	3	5.0	5.7	159.1	138.36	186.80	113.51	NO
2000.	10.24	3	5.0	5.7	159.1	138.36	195.48	118.63	NO

2100.	10.09	3	5.0	5.7	159.1	138.36	204.12	123.75	NO
2200.	9.957	3	4.5	5.2	169.4	149.29	213.16	129.57	NO
2300.	9.801	3	4.5	5.2	169.4	149.29	221.72	134.65	NO
2400.	9.639	3	4.0	4.6	182.5	162.95	230.80	140.63	NO
2500.	9.497	3	4.0	4.6	182.5	162.95	239.27	145.65	NO
2600.	9.334	3	4.0	4.6	182.5	162.95	247.72	150.67	NO
2700.	9.162	3	3.5	4.0	199.5	180.51	256.87	156.89	NO
2800.	9.030	3	3.5	4.0	199.5	180.51	265.23	161.85	NO
2900.	8.883	3	3.5	4.0	199.5	180.51	273.56	166.81	NO
3000.	8.726	3	3.5	4.0	199.5	180.51	281.88	171.76	NO
3500.	8.036	3	3.0	3.4	222.3	203.93	323.96	197.92	NO
4000.	7.434	3	2.5	2.9	254.5	236.72	365.81	224.43	NO
4500.	6.873	3	2.5	2.9	254.5	236.72	405.72	248.43	NO
5000.	6.441	3	2.0	2.3	303.0	285.89	447.19	275.57	NO
5500.	6.031	3	2.0	2.3	303.0	285.89	486.12	299.11	NO
6000.	5.637	3	2.0	2.3	303.0	285.89	524.71	322.57	NO
6500.	5.353	3	1.5	1.7	384.4	367.86	566.37	351.45	NO
7000.	5.292	5	1.0	1.6	10000.0	153.36	297.70	73.55	NO
7500.	5.455	5	1.0	1.6	10000.0	153.36	316.44	75.66	NO
8000.	5.583	5	1.0	1.6	10000.0	153.36	335.04	77.71	NO
8500.	5.682	5	1.0	1.6	10000.0	153.36	353.51	79.71	NO
9000.	5.654	5	1.0	1.6	10000.0	153.36	371.86	81.67	NO
9500.	5.623	5	1.0	1.6	10000.0	153.36	390.09	83.58	NO
10000.	5.578	5	1.0	1.6	10000.0	153.36	408.21	85.45	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

758.	16.56	1	2.0	2.2	302.3	296.34	179.25	263.56	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

*** INVERSION BREAK-UP FUMIGATION CALC. ***
CONC (UG/M**3) = 14.28
DIST TO MAX (M) = 8974.19

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	16.56	758.	0.
INV BREAKUP FUMI	14.28	8974.	--

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

BOILER STACK PM

SIMPLE TERRAIN INPUTS:
SOURCE TYPE = POINT
EMISSION RATE (G/S) = 1.73500
STACK HEIGHT (M) = 40.0000
STK INSIDE DIAM (M) = 2.9000
STK EXIT VELOCITY (M/S)= 13.0600
STK GAS EXIT TEMP (K) = 448.0000
AMBIENT AIR TEMP (K) = 303.0000
RECEPTOR HEIGHT (M) = 0.0000
URBAN/RURAL OPTION = RURAL
BUILDING HEIGHT (M) = 0.0000
MIN HORIZ BLDG DIM (M) = 0.0000
MAX HORIZ BLDG DIM (M) = 0.0000

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

BUOY. FLUX = 87.150 M**4/S**3; MOM. FLUX = 242.542 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****
Atmospheric condition category:
1 = Very unstable; 2 = Unstable; 3 = Slightly unstable; 4 = Neutral; 5 = Slightly stable; 6 = Stable
*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	0.5120E-04	5	1.0	1.6	10000.0	153.36	27.57	27.11	NO
200.	0.6055E-02	5	1.0	1.6	10000.0	153.36	34.41	32.98	NO
300.	0.2427E-01	1	3.0	3.3	960.0	210.89	76.84	54.82	NO
400.	0.5882	1	3.0	3.3	960.0	210.89	98.50	78.56	NO
500.	2.099	1	3.0	3.3	960.0	210.89	119.45	111.55	NO
600.	3.132	1	3.0	3.3	960.0	210.89	139.85	160.00	NO
700.	3.010	1	2.5	2.8	800.0	245.07	162.98	221.07	NO
800.	3.386	1	1.5	1.7	480.0	381.78	197.26	299.38	NO
900.	3.926	1	1.0	1.1	553.7	552.67	240.05	391.56	NO
1000.	4.221	1	1.0	1.1	553.7	552.67	254.98	476.90	NO
1100.	4.158	1	1.0	1.1	553.7	552.67	270.15	574.29	NO
1200.	3.969	1	1.0	1.1	553.7	552.67	285.50	683.47	NO
1300.	3.769	1	1.0	1.1	553.7	552.67	300.98	804.28	NO
1400.	3.584	1	1.0	1.1	553.7	552.67	316.56	936.66	NO
1500.	3.415	1	1.0	1.1	553.7	552.67	332.19	1080.57	NO
1600.	3.261	1	1.0	1.1	553.7	552.67	347.86	1236.02	NO
1700.	3.121	1	1.0	1.1	553.7	552.67	363.56	1403.01	NO
1800.	2.991	1	1.0	1.1	553.7	552.67	379.26	1581.59	NO
1900.	2.873	1	1.0	1.1	553.7	552.67	394.95	1771.79	NO

2000.	2.763	1	1.0	1.1	553.7	552.67	410.63	1973.66	NO
2100.	2.661	1	1.0	1.1	553.7	552.67	426.29	2187.25	NO
2200.	2.567	1	1.0	1.1	553.7	552.67	441.92	2412.60	NO
2300.	2.480	1	1.0	1.1	553.7	552.67	457.53	2649.78	NO
2400.	2.398	1	1.0	1.1	553.7	552.67	473.09	2898.83	NO
2500.	2.322	1	1.0	1.1	553.7	552.67	488.62	3159.80	NO
2600.	2.251	1	1.0	1.1	553.7	552.67	504.11	3432.74	NO
2700.	2.184	1	1.0	1.1	553.7	552.67	519.57	3717.70	NO
2800.	2.137	2	1.0	1.1	553.7	552.67	411.94	368.57	NO
2900.	2.161	2	1.0	1.1	553.7	552.67	423.30	380.79	NO
3000.	2.177	2	1.0	1.1	553.7	552.67	434.64	393.12	NO
3500.	2.148	2	1.0	1.1	553.7	552.67	491.17	456.19	NO
4000.	2.021	2	1.0	1.1	553.7	552.67	547.28	521.20	NO
4500.	1.867	2	1.0	1.1	553.7	552.67	602.89	587.74	NO
5000.	1.721	2	1.0	1.1	553.7	552.67	657.98	655.52	NO
5500.	1.592	2	1.0	1.1	553.7	552.67	712.56	724.33	NO
6000.	1.617	5	1.0	1.6	10000.0	153.36	259.80	69.14	NO
6500.	1.699	5	1.0	1.6	10000.0	153.36	278.83	71.38	NO
7000.	1.766	5	1.0	1.6	10000.0	153.36	297.70	73.55	NO
7500.	1.820	5	1.0	1.6	10000.0	153.36	316.44	75.66	NO
8000.	1.813	5	1.0	1.6	10000.0	153.36	335.04	77.71	NO
8500.	1.796	5	1.0	1.6	10000.0	153.36	353.51	79.71	NO
9000.	1.792	5	1.0	1.6	10000.0	153.36	371.86	81.67	NO
9500.	1.799	5	1.0	1.6	10000.0	153.36	390.09	83.58	NO
10000.	1.747	5	1.0	1.6	10000.0	153.36	408.21	85.45	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

1022.	4.228	1	1.0	1.1	553.7	552.67	258.45	498.25	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

*** INVERSION BREAK-UP FUMIGATION CALC. ***
CONC (UG/M**3) = 4.763
DIST TO MAX (M) = 8974.19

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	4.228	1022.	0.
INV BREAKUP FUMI	4.763	8974.	--

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

BOILER STACK SOX

SIMPLE TERRAIN INPUTS**:**
SOURCE TYPE = POINT
EMISSION RATE (G/S) = 1.04000
STACK HEIGHT (M) = 40.0000
STK INSIDE DIAM (M) = 2.9000
STK EXIT VELOCITY (M/S)= 13.0600
STK GAS EXIT TEMP (K) = 448.0000
AMBIENT AIR TEMP (K) = 303.0000
RECEPTOR HEIGHT (M) = 0.0000
URBAN/RURAL OPTION = RURAL
BUILDING HEIGHT (M) = 0.0000
MIN HORIZ BLDG DIM (M) = 0.0000
MAX HORIZ BLDG DIM (M) = 0.0000

THE NON-REGULATORY BUT CONSERVATIVE BRODE 2 MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

BUOY. FLUX = 87.150 M**4/S**3; MOM. FLUX = 242.542 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****
Atmospheric condition category:
1 = Very unstable; 2 = Unstable; 3 = Slightly unstable; 4 = Neutral; 5 = Slightly stable; 6 = Stable
*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	0.3069E-04	5	1.0	1.6	10000.0	153.36	27.57	27.11	NO
200.	0.3629E-02	5	1.0	1.6	10000.0	153.36	34.41	32.98	NO
300.	0.1455E-01	1	3.0	3.3	300.0	210.89	76.84	54.82	NO
400.	0.3526	1	3.0	3.3	300.0	210.89	98.50	78.56	NO
500.	1.276	1	3.0	3.3	300.0	210.89	119.45	111.55	NO
600.	2.373	1	2.0	2.2	302.3	296.34	148.11	167.26	NO
700.	3.218	1	2.0	2.2	302.3	296.34	168.68	225.31	NO
800.	3.276	1	2.0	2.2	302.3	296.34	186.39	292.33	NO
900.	3.053	1	2.0	2.2	302.3	296.34	203.80	370.44	NO
1000.	2.816	1	2.0	2.2	302.3	296.34	221.18	459.72	NO
1100.	2.621	1	1.5	1.7	387.5	381.78	247.11	563.82	NO
1200.	2.515	2	4.5	5.0	167.8	153.93	184.28	137.41	NO
1300.	2.441	2	4.0	4.4	181.6	168.17	198.22	150.29	NO
1400.	2.360	2	4.0	4.4	181.6	168.17	211.31	162.29	NO
1500.	2.291	2	3.5	3.9	199.5	186.48	225.23	175.59	NO
1600.	2.212	2	3.0	3.3	223.5	210.89	239.42	189.45	NO
1700.	2.148	2	3.0	3.3	223.5	210.89	252.15	201.64	NO
1800.	2.076	3	5.0	5.7	159.1	138.36	178.08	108.38	NO

1900.	2.069	3	5.0	5.7	159.1	138.36	186.80	113.51	NO
2000.	2.048	3	5.0	5.7	159.1	138.36	195.48	118.63	NO
2100.	2.018	3	5.0	5.7	159.1	138.36	204.12	123.75	NO
2200.	1.991	3	4.5	5.2	169.4	149.29	213.16	129.57	NO
2300.	1.960	3	4.5	5.2	169.4	149.29	221.72	134.65	NO
2400.	1.928	3	4.0	4.6	182.5	162.95	230.80	140.63	NO
2500.	1.899	3	4.0	4.6	182.5	162.95	239.27	145.65	NO
2600.	1.867	3	4.0	4.6	182.5	162.95	247.72	150.67	NO
2700.	1.832	3	3.5	4.0	199.5	180.51	256.87	156.89	NO
2800.	1.806	3	3.5	4.0	199.5	180.51	265.23	161.85	NO
2900.	1.777	3	3.5	4.0	199.5	180.51	273.56	166.81	NO
3000.	1.745	3	3.5	4.0	199.5	180.51	281.88	171.76	NO
3500.	1.607	3	3.0	3.4	222.3	203.93	323.96	197.92	NO
4000.	1.487	3	2.5	2.9	254.5	236.72	365.81	224.43	NO
4500.	1.375	3	2.5	2.9	254.5	236.72	405.72	248.43	NO
5000.	1.288	3	2.0	2.3	303.0	285.89	447.19	275.57	NO
5500.	1.206	3	2.0	2.3	303.0	285.89	486.12	299.11	NO
6000.	1.127	3	2.0	2.3	303.0	285.89	524.71	322.57	NO
6500.	1.071	3	1.5	1.7	384.4	367.86	566.37	351.45	NO
7000.	1.058	5	1.0	1.6	10000.0	153.36	297.70	73.55	NO
7500.	1.091	5	1.0	1.6	10000.0	153.36	316.44	75.66	NO
8000.	1.117	5	1.0	1.6	10000.0	153.36	335.04	77.71	NO
8500.	1.112	5	1.0	1.6	10000.0	153.36	353.51	79.71	NO
9000.	1.109	5	1.0	1.6	10000.0	153.36	371.86	81.67	NO
9500.	1.104	5	1.0	1.6	10000.0	153.36	390.09	83.58	NO
10000.	1.103	5	1.0	1.6	10000.0	153.36	408.21	85.45	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

758.	3.312	1	2.0	2.2	302.3	296.34	179.25	263.56	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

*** INVERSION BREAK-UP FUMIGATION CALC. ***
CONC (UG/M**3) = 2.855
DIST TO MAX (M) = 8974.19

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	3.312	758.	0.
INV BREAKUP FUMI	2.855	8974.	--

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

UREA GRANULATOR-1 NH3

SIMPLE TERRAIN INPUTS:
SOURCE TYPE = POINT
EMISSION RATE (G/S) = 0.502500E-01
STACK HEIGHT (M) = 55.0000
STK INSIDE DIAM (M) = 2.1000
STK EXIT VELOCITY (M/S)= 14.5080
STK GAS EXIT TEMP (K) = 323.0000
AMBIENT AIR TEMP (K) = 303.0000
RECEPTOR HEIGHT (M) = 0.0000
URBAN/RURAL OPTION = RURAL
BUILDING HEIGHT (M) = 0.0000
MIN HORIZ BLDG DIM (M) = 0.0000
MAX HORIZ BLDG DIM (M) = 0.0000

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

BUOY. FLUX = 9.712 M**4/S**3; MOM. FLUX = 217.688 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****
Atmospheric condition category:
1 = Very unstable; 2 = Unstable; 3 = Slightly unstable; 4 = Neutral; 5 = Slightly stable; 6 = Stable
*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	0.1051E-05	1	3.0	3.4	960.0	89.87	27.87	15.82	NO
200.	0.4397E-01	1	3.0	3.4	960.0	89.87	50.94	30.92	NO
300.	0.2416	1	3.0	3.4	960.0	89.87	72.45	48.48	NO
400.	0.3499	1	2.0	2.3	640.0	107.31	93.91	72.72	NO
500.	0.3899	1	1.5	1.7	480.0	124.74	114.78	106.53	NO
600.	0.4021	1	1.0	1.1	320.0	159.61	136.20	156.81	NO
700.	0.3584	1	1.0	1.1	320.0	159.61	155.21	215.41	NO
800.	0.3196	1	1.0	1.1	320.0	159.61	173.98	284.58	NO
900.	0.3058	2	1.5	1.7	480.0	124.74	141.66	99.39	NO
1000.	0.2960	2	1.0	1.1	320.0	159.61	156.99	113.31	NO
1100.	0.2952	2	1.0	1.1	320.0	159.61	170.46	124.97	NO
1200.	0.2870	2	1.0	1.1	320.0	159.61	183.83	136.81	NO
1300.	0.2749	2	1.0	1.1	320.0	159.61	197.09	148.79	NO
1400.	0.2716	3	1.5	1.8	480.0	121.26	141.28	85.30	NO
1500.	0.2697	3	1.5	1.8	480.0	121.26	150.25	90.59	NO
1600.	0.2648	3	1.5	1.8	480.0	121.26	159.17	95.87	NO
1700.	0.2578	3	1.5	1.8	480.0	121.26	168.04	101.13	NO
1800.	0.2535	3	1.0	1.2	320.0	154.40	178.12	108.45	NO
1900.	0.2524	3	1.0	1.2	320.0	154.40	186.84	113.58	NO
2000.	0.2496	3	1.0	1.2	320.0	154.40	195.52	118.70	NO

```
 2100.  0.2455      3    1.0   1.2  320.0  154.40  204.16  123.82   NO
 2200.  0.2404      3    1.0   1.2  320.0  154.40  212.77  128.92   NO
 2300.  0.2348      3    1.0   1.2  320.0  154.40  221.34  134.02   NO
 2400.  0.2288      3    1.0   1.2  320.0  154.40  229.88  139.10   NO
 2500.  0.2225      3    1.0   1.2  320.0  154.40  238.38  144.18   NO
 2600.  0.2162      3    1.0   1.2  320.0  154.40  246.85  149.24   NO
 2700.  0.2100      3    1.0   1.2  320.0  154.40  255.29  154.30   NO
 2800.  0.2038      3    1.0   1.2  320.0  154.40  263.71  159.34   NO
 2900.  0.1979      3    1.0   1.2  320.0  154.40  272.09  164.38   NO
 3000.  0.1921      3    1.0   1.2  320.0  154.40  280.44  169.40   NO
 3500.  0.1669      3    1.0   1.2  320.0  154.40  321.81  194.38   NO
 4000.  0.1495      4    1.5   1.9  480.0  115.85  239.94   79.42   NO
 4500.  0.1439      4    1.5   1.9  480.0  115.85  266.62   85.01   NO
 5000.  0.1371      4    1.5   1.9  480.0  115.85  292.99   90.38   NO
 5500.  0.1299      4    1.5   1.9  480.0  115.85  319.06   95.55   NO
 6000.  0.1262      4    1.0   1.3  320.0  146.27  345.42  102.41   NO
 6500.  0.1254      5    1.0   1.8 10000.0  107.56  277.35   65.35   NO
 7000.  0.1243      5    1.0   1.8 10000.0  107.56  296.32   67.72   NO
 7500.  0.1226      5    1.0   1.8 10000.0  107.56  315.13   70.00   NO
 8000.  0.1205      5    1.0   1.8 10000.0  107.56  333.81   72.22   NO
 8500.  0.1181      5    1.0   1.8 10000.0  107.56  352.34   74.37   NO
 9000.  0.1155      5    1.0   1.8 10000.0  107.56  370.75   76.46   NO
 9500.  0.1128      5    1.0   1.8 10000.0  107.56  389.03   78.50   NO
10000.  0.1100      5    1.0   1.8 10000.0  107.56  407.20   80.48   NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
  560.  0.4099      1    1.0   1.1  320.0  159.61  128.71  136.83   NO

 DWASH=   MEANS NO CALC MADE (CONC = 0.0)
 DWASH=NO MEANS NO BUILDING DOWNWASH USED
 DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
 DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

 *** INVERSION BREAK-UP FUMIGATION CALC. ***
 CONC (UG/M**3)  =  0.3452
 DIST TO MAX (M)  =  4427.79

    ****************************************
    *** SUMMARY OF SCREEN MODEL RESULTS ***
    ****************************************

 CALCULATION       MAX CONC    DIST TO   TERRAIN
  PROCEDURE       (UG/M**3)    MAX (M)    HT (M)
--------------   -----------   ---------   -------
SIMPLE TERRAIN     0.4099         560.       0.

INV BREAKUP FUMI   0.3452        4428.      --


**************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
**************************************************
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UREA GRANULATOR-1 PM

SIMPLE TERRAIN INPUTS:
SOURCE TYPE = POINT
EMISSION RATE (G/S) = 0.502500E-01
STACK HEIGHT (M) = 55.0000
STK INSIDE DIAM (M) = 2.1000
STK EXIT VELOCITY (M/S)= 14.5080
STK GAS EXIT TEMP (K) = 323.0000
AMBIENT AIR TEMP (K) = 303.0000
RECEPTOR HEIGHT (M) = 0.0000
URBAN/RURAL OPTION = RURAL
BUILDING HEIGHT (M) = 0.0000
MIN HORIZ BLDG DIM (M) = 0.0000
MAX HORIZ BLDG DIM (M) = 0.0000

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

BUOY. FLUX = 9.712 M**4/S**3; MOM. FLUX = 217.688 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****
Atmospheric condition category:
1 = Very unstable; 2 = Unstable; 3 = Slightly unstable; 4 = Neutral; 5 = Slightly stable; 6 = Stable
*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	0.1051E-05	1	3.0	3.4	960.0	89.87	27.87	15.82	NO
200.	0.4397E-01	1	3.0	3.4	960.0	89.87	50.94	30.92	NO
300.	0.2416	1	3.0	3.4	960.0	89.87	72.45	48.48	NO
400.	0.3499	1	2.0	2.3	640.0	107.31	93.91	72.72	NO
500.	0.3899	1	1.5	1.7	480.0	124.74	114.78	106.53	NO
600.	0.4021	1	1.0	1.1	320.0	159.61	136.20	156.81	NO
700.	0.3584	1	1.0	1.1	320.0	159.61	155.21	215.41	NO
800.	0.3196	1	1.0	1.1	320.0	159.61	173.98	284.58	NO
900.	0.3058	2	1.5	1.7	480.0	124.74	141.66	99.39	NO
1000.	0.2960	2	1.0	1.1	320.0	159.61	156.99	113.31	NO
1100.	0.2952	2	1.0	1.1	320.0	159.61	170.46	124.97	NO
1200.	0.2870	2	1.0	1.1	320.0	159.61	183.83	136.81	NO
1300.	0.2749	2	1.0	1.1	320.0	159.61	197.09	148.79	NO
1400.	0.2716	3	1.5	1.8	480.0	121.26	141.28	85.30	NO
1500.	0.2697	3	1.5	1.8	480.0	121.26	150.25	90.59	NO
1600.	0.2648	3	1.5	1.8	480.0	121.26	159.17	95.87	NO
1700.	0.2578	3	1.5	1.8	480.0	121.26	168.04	101.13	NO
1800.	0.2535	3	1.0	1.2	320.0	154.40	178.12	108.45	NO
1900.	0.2524	3	1.0	1.2	320.0	154.40	186.84	113.58	NO
2000.	0.2496	3	1.0	1.2	320.0	154.40	195.52	118.70	NO

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 2100.  0.2455      3    1.0   1.2  320.0  154.40  204.16  123.82   NO
 2200.  0.2404      3    1.0   1.2  320.0  154.40  212.77  128.92   NO
 2300.  0.2348      3    1.0   1.2  320.0  154.40  221.34  134.02   NO
 2400.  0.2288      3    1.0   1.2  320.0  154.40  229.88  139.10   NO
 2500.  0.2225      3    1.0   1.2  320.0  154.40  238.38  144.18   NO
 2600.  0.2162      3    1.0   1.2  320.0  154.40  246.85  149.24   NO
 2700.  0.2100      3    1.0   1.2  320.0  154.40  255.29  154.30   NO
 2800.  0.2038      3    1.0   1.2  320.0  154.40  263.71  159.34   NO
 2900.  0.1979      3    1.0   1.2  320.0  154.40  272.09  164.38   NO
 3000.  0.1921      3    1.0   1.2  320.0  154.40  280.44  169.40   NO
 3500.  0.1669      3    1.0   1.2  320.0  154.40  321.81  194.38   NO
 4000.  0.1495      4    1.5   1.9  480.0  115.85  239.94   79.42   NO
 4500.  0.1439      4    1.5   1.9  480.0  115.85  266.62   85.01   NO
 5000.  0.1371      4    1.5   1.9  480.0  115.85  292.99   90.38   NO
 5500.  0.1299      4    1.5   1.9  480.0  115.85  319.06   95.55   NO
 6000.  0.1262      4    1.0   1.3  320.0  146.27  345.42  102.41   NO
 6500.  0.1254      5    1.0   1.8 10000.0  107.56  277.35   65.35   NO
 7000.  0.1243      5    1.0   1.8 10000.0  107.56  296.32   67.72   NO
 7500.  0.1226      5    1.0   1.8 10000.0  107.56  315.13   70.00   NO
 8000.  0.1205      5    1.0   1.8 10000.0  107.56  333.81   72.22   NO
 8500.  0.1181      5    1.0   1.8 10000.0  107.56  352.34   74.37   NO
 9000.  0.1155      5    1.0   1.8 10000.0  107.56  370.75   76.46   NO
 9500.  0.1128      5    1.0   1.8 10000.0  107.56  389.03   78.50   NO
10000.  0.1100      5    1.0   1.8 10000.0  107.56  407.20   80.48   NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
  560.  0.4099      1    1.0   1.1  320.0  159.61  128.71  136.83   NO

 DWASH=   MEANS NO CALC MADE (CONC = 0.0)
 DWASH=NO MEANS NO BUILDING DOWNWASH USED
 DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
 DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

 *** INVERSION BREAK-UP FUMIGATION CALC. ***
 CONC (UG/M**3)  =  0.3452
 DIST TO MAX (M)  =  4427.79

    ****************************************
    *** SUMMARY OF SCREEN MODEL RESULTS ***
    ****************************************

 CALCULATION       MAX CONC    DIST TO   TERRAIN
  PROCEDURE       (UG/M**3)    MAX (M)    HT (M)
--------------   -----------   ---------   -------
SIMPLE TERRAIN     0.4099         560.       0.

INV BREAKUP FUMI   0.3452        4428.      --


**************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
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UREA GRANULATOR-2 NH3

SIMPLE TERRAIN INPUTS:
SOURCE TYPE = POINT
EMISSION RATE (G/S) = 0.329000E-01
STACK HEIGHT (M) = 55.0000
STK INSIDE DIAM (M) = 5.5000
STK EXIT VELOCITY (M/S)= 13.8670
STK GAS EXIT TEMP (K) = 323.0000
AMBIENT AIR TEMP (K) = 303.0000
RECEPTOR HEIGHT (M) = 0.0000
URBAN/RURAL OPTION = RURAL
BUILDING HEIGHT (M) = 0.0000
MIN HORIZ BLDG DIM (M) = 0.0000
MAX HORIZ BLDG DIM (M) = 0.0000

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

BUOY. FLUX = 63.676 M**4/S**3; MOM. FLUX = 1364.176 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****
Atmospheric condition category:
1 = Very unstable; 2 = Unstable; 3 = Slightly unstable; 4 = Neutral; 5 = Slightly stable; 6 = Stable
*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	U10M STAB	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	0.2870E-09	5	1.0	1.8	10000.0	153.38	22.51	21.94	NO
200.	0.4532E-05	5	1.0	1.8	10000.0	153.38	30.42	28.79	NO
300.	0.1049E-02	1	3.0	3.4	960.0	193.44	75.73	53.26	NO
400.	0.1759E-01	1	3.0	3.4	960.0	193.44	97.24	76.97	NO
500.	0.5087E-01	1	3.0	3.4	960.0	193.44	118.05	110.04	NO
600.	0.6714E-01	1	3.0	3.4	960.0	193.44	138.32	158.66	NO
700.	0.6391E-01	1	2.5	2.8	800.0	221.13	159.53	218.54	NO
800.	0.8934E-01	1	1.0	1.1	471.3	470.32	208.46	306.87	NO
900.	0.1016	1	1.0	1.1	471.3	470.32	224.17	382.03	NO
1000.	0.1014	1	1.0	1.1	471.3	470.32	240.08	469.11	NO
1100.	0.9634E-01	1	1.0	1.1	471.3	470.32	256.14	567.83	NO
1200.	0.9076E-01	1	1.0	1.1	471.3	470.32	272.28	678.05	NO
1300.	0.8568E-01	1	1.0	1.1	471.3	470.32	288.47	799.69	NO
1400.	0.8112E-01	1	1.0	1.1	471.3	470.32	304.68	932.72	NO
1500.	0.7702E-01	1	1.0	1.1	471.3	470.32	320.90	1077.16	NO
1600.	0.7332E-01	1	1.0	1.1	471.3	470.32	337.10	1233.03	NO
1700.	0.6996E-01	1	1.0	1.1	471.3	470.32	353.27	1400.38	NO
1800.	0.6691E-01	1	1.0	1.1	471.3	470.32	369.41	1579.25	NO
1900.	0.6411E-01	1	1.0	1.1	471.3	470.32	385.50	1769.70	NO
2000.	0.6155E-01	1	1.0	1.1	471.3	470.32	401.55	1971.79	NO

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 2100.  0.5919E-01   1   1.0   1.1  471.3  470.32  417.55 2185.56   NO
 2200.  0.5701E-01   1   1.0   1.1  471.3  470.32  433.50 2411.08   NO
 2300.  0.5500E-01   1   1.0   1.1  471.3  470.32  449.39 2648.39   NO
 2400.  0.5312E-01   1   1.0   1.1  471.3  470.32  465.23 2897.56   NO
 2500.  0.5364E-01   2   1.0   1.1  471.3  470.32  367.96  321.38   NO
 2600.  0.5413E-01   2   1.0   1.1  471.3  470.32  379.62  333.62   NO
 2700.  0.5433E-01   2   1.0   1.1  471.3  470.32  391.27  345.98   NO
 2800.  0.5428E-01   2   1.0   1.1  471.3  470.32  402.89  358.43   NO
 2900.  0.5402E-01   2   1.0   1.1  471.3  470.32  414.49  370.98   NO
 3000.  0.5359E-01   2   1.0   1.1  471.3  470.32  426.07  383.63   NO
 3500.  0.4992E-01   2   1.0   1.1  471.3  470.32  483.61  448.03   NO
 4000.  0.4547E-01   2   1.0   1.1  471.3  470.32  540.50  514.08   NO
 4500.  0.4137E-01   2   1.0   1.1  471.3  470.32  596.74  581.43   NO
 5000.  0.3983E-01   3   1.0   1.2  450.6  449.61  455.80  289.34   NO
 5500.  0.4037E-01   3   1.0   1.2  450.6  449.61  494.05  311.84   NO
 6000.  0.4007E-01   3   1.0   1.2  450.6  449.61  532.06  334.40   NO
 6500.  0.3921E-01   3   1.0   1.2  450.6  449.61  569.83  357.01   NO
 7000.  0.3800E-01   3   1.0   1.2  450.6  449.61  607.37  379.62   NO
 7500.  0.3661E-01   3   1.0   1.2  450.6  449.61  644.66  402.23   NO
 8000.  0.3513E-01   3   1.0   1.2  450.6  449.61  681.73  424.82   NO
 8500.  0.3365E-01   3   1.0   1.2  450.6  449.61  718.57  447.38   NO
 9000.  0.3222E-01   3   1.0   1.2  450.6  449.61  755.20  469.90   NO
 9500.  0.3139E-01   5   1.0   1.8 10000.0  153.38  389.76   82.02   NO
10000.  0.3171E-01   5   1.0   1.8 10000.0  153.38  407.89   83.92   NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
  943.  0.1026       1   1.0   1.1  471.3  470.32  231.15  418.89   NO

 DWASH=   MEANS NO CALC MADE (CONC = 0.0)
 DWASH=NO MEANS NO BUILDING DOWNWASH USED
 DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
 DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

 *** INVERSION BREAK-UP FUMIGATION CALC. ***
 CONC (UG/M**3)   =   0.8621E-01
 DIST TO MAX (M)  =  9182.35

    ****************************************
    *** SUMMARY OF SCREEN MODEL RESULTS ***
    ****************************************

 CALCULATION       MAX CONC    DIST TO   TERRAIN
  PROCEDURE       (UG/M**3)    MAX (M)    HT (M)
--------------   -----------  ---------  -------
SIMPLE TERRAIN     0.1026         943.       0.

INV BREAKUP FUMI   0.8621E-01    9182.      --


**************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
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UREA GRANULATOR-2 PM

SIMPLE TERRAIN INPUTS:
SOURCE TYPE = POINT
EMISSION RATE (G/S) = 0.329000E-01
STACK HEIGHT (M) = 55.0000
STK INSIDE DIAM (M) = 5.5000
STK EXIT VELOCITY (M/S)= 13.8670
STK GAS EXIT TEMP (K) = 323.0000
AMBIENT AIR TEMP (K) = 303.0000
RECEPTOR HEIGHT (M) = 0.0000
URBAN/RURAL OPTION = RURAL
BUILDING HEIGHT (M) = 0.0000
MIN HORIZ BLDG DIM (M) = 0.0000
MAX HORIZ BLDG DIM (M) = 0.0000

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

BUOY. FLUX = 63.676 M**4/S**3; MOM. FLUX = 1364.176 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****
Atmospheric condition category:
1 = Very unstable; 2 = Unstable; 3 = Slightly unstable; 4 = Neutral; 5 = Slightly stable; 6 = Stable
*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	0.2870E-09	5	1.0	1.8	10000.0	153.38	22.51	21.94	NO
200.	0.4532E-05	5	1.0	1.8	10000.0	153.38	30.42	28.79	NO
300.	0.1049E-02	1	3.0	3.4	960.0	193.44	75.73	53.26	NO
400.	0.1759E-01	1	3.0	3.4	960.0	193.44	97.24	76.97	NO
500.	0.5087E-01	1	3.0	3.4	960.0	193.44	118.05	110.04	NO
600.	0.6714E-01	1	3.0	3.4	960.0	193.44	138.32	158.66	NO
700.	0.6391E-01	1	2.5	2.8	800.0	221.13	159.53	218.54	NO
800.	0.8934E-01	1	1.0	1.1	471.3	470.32	208.46	306.87	NO
900.	0.1016	1	1.0	1.1	471.3	470.32	224.17	382.03	NO
1000.	0.1014	1	1.0	1.1	471.3	470.32	240.08	469.11	NO
1100.	0.9634E-01	1	1.0	1.1	471.3	470.32	256.14	567.83	NO
1200.	0.9076E-01	1	1.0	1.1	471.3	470.32	272.28	678.05	NO
1300.	0.8568E-01	1	1.0	1.1	471.3	470.32	288.47	799.69	NO
1400.	0.8112E-01	1	1.0	1.1	471.3	470.32	304.68	932.72	NO
1500.	0.7702E-01	1	1.0	1.1	471.3	470.32	320.90	1077.16	NO
1600.	0.7332E-01	1	1.0	1.1	471.3	470.32	337.10	1233.03	NO
1700.	0.6996E-01	1	1.0	1.1	471.3	470.32	353.27	1400.38	NO
1800.	0.6691E-01	1	1.0	1.1	471.3	470.32	369.41	1579.25	NO
1900.	0.6411E-01	1	1.0	1.1	471.3	470.32	385.50	1769.70	NO
2000.	0.6155E-01	1	1.0	1.1	471.3	470.32	401.55	1971.79	NO

```
 2100.  0.5919E-01   1   1.0   1.1  471.3  470.32  417.55 2185.56   NO
 2200.  0.5701E-01   1   1.0   1.1  471.3  470.32  433.50 2411.08   NO
 2300.  0.5500E-01   1   1.0   1.1  471.3  470.32  449.39 2648.39   NO
 2400.  0.5312E-01   1   1.0   1.1  471.3  470.32  465.23 2897.56   NO
 2500.  0.5364E-01   2   1.0   1.1  471.3  470.32  367.96  321.38   NO
 2600.  0.5413E-01   2   1.0   1.1  471.3  470.32  379.62  333.62   NO
 2700.  0.5433E-01   2   1.0   1.1  471.3  470.32  391.27  345.98   NO
 2800.  0.5428E-01   2   1.0   1.1  471.3  470.32  402.89  358.43   NO
 2900.  0.5402E-01   2   1.0   1.1  471.3  470.32  414.49  370.98   NO
 3000.  0.5359E-01   2   1.0   1.1  471.3  470.32  426.07  383.63   NO
 3500.  0.4992E-01   2   1.0   1.1  471.3  470.32  483.61  448.03   NO
 4000.  0.4547E-01   2   1.0   1.1  471.3  470.32  540.50  514.08   NO
 4500.  0.4137E-01   2   1.0   1.1  471.3  470.32  596.74  581.43   NO
 5000.  0.3983E-01   3   1.0   1.2  450.6  449.61  455.80  289.34   NO
 5500.  0.4037E-01   3   1.0   1.2  450.6  449.61  494.05  311.84   NO
 6000.  0.4007E-01   3   1.0   1.2  450.6  449.61  532.06  334.40   NO
 6500.  0.3921E-01   3   1.0   1.2  450.6  449.61  569.83  357.01   NO
 7000.  0.3800E-01   3   1.0   1.2  450.6  449.61  607.37  379.62   NO
 7500.  0.3661E-01   3   1.0   1.2  450.6  449.61  644.66  402.23   NO
 8000.  0.3513E-01   3   1.0   1.2  450.6  449.61  681.73  424.82   NO
 8500.  0.3365E-01   3   1.0   1.2  450.6  449.61  718.57  447.38   NO
 9000.  0.3222E-01   3   1.0   1.2  450.6  449.61  755.20  469.90   NO
 9500.  0.3139E-01   5   1.0   1.8 10000.0  153.38  389.76   82.02   NO
10000.  0.3171E-01   5   1.0   1.8 10000.0  153.38  407.89   83.92   NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
  943.  0.1026       1   1.0   1.1  471.3  470.32  231.15  418.89   NO

 DWASH=   MEANS NO CALC MADE (CONC = 0.0)
 DWASH=NO MEANS NO BUILDING DOWNWASH USED
 DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
 DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

 *** INVERSION BREAK-UP FUMIGATION CALC. ***
 CONC (UG/M**3)   =   0.8621E-01
 DIST TO MAX (M)  =  9182.35

    ****************************************
    *** SUMMARY OF SCREEN MODEL RESULTS ***
    ****************************************

 CALCULATION       MAX CONC    DIST TO   TERRAIN
  PROCEDURE       (UG/M**3)    MAX (M)    HT (M)
---------------   -----------  ---------  -------
SIMPLE TERRAIN     0.1026         943.       0.

INV BREAKUP FUMI   0.8621E-01    9182.      --


**************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
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Appendix - 4.5

MONITORING OF NOISE LEVEL
DAY AND NIGHT FOR BOTH INTERNAL AND EXTERNAL (CLOSEST) RECEPTOR

INTERNAL STATIONS			
Sr. No.	**AREA/ LOCATION/POINT**	**Field Survey Noise L_{Aeq} (dBA)**	
		DAY	**NIGHT**
1	Entrance of Indorama Complex	69.3	65.2
2	2nd GATE	60.7	44.1
3	CAR PARK	62.1	42.7
4.	ETP Near Fire pump house	61.3	51.2
5.	ETP before incinerators	66.0	63.7
6.	ETP by incinerators	65.1	61.8
7.	ETP operational area	67.5	62.9
8.	Sluice Gate	51.8	43.7
9.	Flare area 1	63.6	61.4
10.	Flare area 2	72.8	75.3
11.	Flare area 3	51.5	47.4
12.	Flare area 4	69.4	55.9
13.	Plot by Retention pond	50.9	45.5
14.	Plot opposite Retention pond	58.6	52.3
15.	New Air Compressor House	69.3	58.6
16.	Water Treatment Plant	61.7	58.6
17.	New Water Treatment &DM Unit	56.8	53.4
18.	Urea Cooling Tower	69.2	68.2
19.	Ammonia Cooling Tower	69.8	68.7
20.	IEPL Cooling Tower	68.5	68.8
21.	Open field behind power plant	67.7	62.3
22.	Power Plant	74.6	72.3
		66.7	64.8
23.	Ammonia-1 Plant	69.5	65.8
24.	Polypropylene Plant	85.5	82.2
		84.3	79.5

25.	Urea-1 Plant	66.2	63.4
		61.7	59.8
26.	PP Warehouse Inside	56.2	55.1
27.	PP Warehouse Outside	69.3	67.4
28.	Olefins	84.9	83.2
		80.2	79.8
		86.0	81.2
29.	Polyethylene Plant	76.8	71.3
		73.9	70.0
30.	Weigh Bridge	69.5	55.4
31.	MMD	64.1	59.5
32.	Workshop	65.8	61.0
33.	Ethylene Storage	54.2	52.6
34.	Butane-1 Storage	59.4	49.4
35.	Propylene Storage	58.6	46.7
36.	VC5- Storage	53.8	47.9
37.	PRF Storage	67.4	62.9
38.	NGL Storage	57.5	48.8
		55.8	47.3
39.	Chemical Warehouse	56.9	44.7
40.	Gas Receiving	64.0	61.1
41	Urea warehouse	67.2	64.8
42	Urea bagging area	69.8	66.2
43	Urea Bulk loading	72.4	67.8
44	Near IRC	62.2	44.2
	Min	**50.9**	**45.7**
	Max	**86.0**	**83.2**
	LAeq	**75.3**	**72.2**
	LeqDN	**73.9**	
	IFC Limit (Industrial/commercial receptor) LAeq dB(A)	**70**	**70**
	NESREA Limit (Industrial outside perimeter) LAeq dB(A)	**70**	**70**
	NESREA Limit (For a factory/workshop)	**85**	**85**
	FMEnv Limit	**90**	**90**

EXTERNAL STATIONS			
Sr. No.	**AREA/ LOCATION/POINT**	**Field Survey Noise L_{Aeq} (dBA)**	
		DAY	**NIGHT**
1	Akpajo Residential community	54.6	42.2
2	Theological Institute Akpajo	52.5	47.5
3	Police Check Point Akpajo	72.8	70.4
	Min	**52.5**	**42.2**
	Max	**72.8**	**70.4**
	LAeq	**68.1**	**65.6**
	LeqDN (dBA)	**67.1**	
	IFC Limit (Residential/Institution/Education)	**55**	**45**
	FMEnv Limit	**90**	**90**

Noise survey – conducted in Oct'2017

Table 1.7.1 Noise Level Guidelines

Receptor	*One Hour LAeq (dBA)*	
	Day (0700-2200)	*Night (2200-0700)*
Residential / Institutional /educational	*55*	*45*
Industrial / Commercial	*70*	*70*

Dry Season -2017

	Location	**NOISE dB(A)**			
		17-Jan	**17-Feb**	**17-Mar**	**Average**
AQ1	Aleto Community	54.9	52.1	48.9	52.0
AQ2	Flare Area	47.8	48.4	49.5	48.6
AQ3	NG Receipt facility Area	80.5	70.4	72.3	74.4
AQ4	Urea bagging Plant	57.1	54.5	56.5	56.0
AQ5	Weigh Bridge	62.8	69.7	55.0	62.5
AQ6	Main Gate	64.1	67.7	63.9	65.2
AQ7	Akpajo Community	49.3	49.5	49.2	49.3
AQC 1	Agbonchia Njuru (Control 1)	49.1	48.2	48.6	48.6

Physiochemical properties of soil 0-15cm (Top Soil)

Appendix-4.6

PARAMETERS	UNIT	IND/SS1	IND/SS2	IND/SS3	IND/SS4	IND/SS5	IND/SS6	IND/SS7	IND/CTRL 1	IND/CTRL 2
Depth	Cm	0 - 15	0 - 15	0 - 15	0 - 15	0 - 15	0 - 15	0 - 15	0 - 15	0 - 15
pH		5.20	4.70	5.60	5.40	5.60	4.80	5.20	4.80	5.30
Porosity	% pore space	51.40	50.40	43.80	49.20	52.40	53.20	50.40	42.80	50.90
Permeability	(K-4 cm/hr)	2.1	1.7	1.7	2.1	2.1	1.7	1.7	1.9	1.6
Bulk Density	(g/cm)	0.25	0.25	0.28	0.20	0.25	0.15	0.25	0.22	0.20
Moisture Content	%	0.55	1.15	0.71	0.5	0.24	0.45	0.71	0.72	0.42
Electrical conductivity	(µS/cm)	83	128.2	172.2	101.8	117.1	48.2	128.2	124.60	39.40
Phosphorous	(%)	0.13	0.16	0.16	0.28	0.19	0.17	0.16	0.14	0.12
Total nitrogen	(%)	0.248	0.152	0.14	0.08	0.139	0.389	0.24	0.126	0.163
CEC	(Cmol/kg)	1.06	1.32	1.04	0.87	0.81	1.14	1.06	1.21	1.04
SO_4^{2-}	(ppm)	2.703	3.306	3.525	7.254	5.335	4.677	3.606	8.661	2.757
NO_3 - N	(ppm)	0.074	0.048	0.152	0.182	0.16	0.074	0.074	0.065	0.048
NH_4 - N	(ppm)	0.306	0.239	0.476	0.519	0.523	0.158	0.158	0.178	0.189
O & G	(ppm)	1.62	1.28	1.38	1.55	1.35	6.16	1.38	2.31	0.68
TOC	%	0.12	0.11	0.08	0.13	0.04	0.11	0.13	0.25	0.26
OM	%	0.19	0.18	0.16	0.21	0.09	0.18	0.09	0.39	0.33
Exc. Acidity	(meq/100g)	1.00	1.20	0.90	0.80	0.70	1.10	0.70	1.1	1.0
Base Saturation	%	5.96	9.30	13.79	8.42	13.12	3.85	13.79	9.40	3.44
Total sand	%	77.0	70.1	68.6	64.5	67.2	66.9	67.2	76.5	66.7
Total silt	%	9.2	6.4	7.7	9.1	5.8	10.1	5.8	1.3	21.4
Total clay	%	13.8	23.5	23.7	26.4	27.0	23.0	23.5	22.2	11.9
TEXTURE		LOAMY SAND	SANDY LOAM	SANDY LOAM	SANDY LOAM	SANDY LOAM	SANDY LOAM	SANDY LOAM	LOAMY SAND	SANDY LOAM

PARAMETERS	UNIT	IND/SS1	IND/SS2	IND/SS3	IND/SS4	IND/SS5	IND/SS6	IND/SS7	IND/CTRL 1	IND/CTRL 2
CATIONS										
Ca	(mg/kg)	0.794	0.671	1.076	0.945	1.295	0.631	0.671	0.859	0.719
Mg	(mg/kg)	0.497	1.881	3.613	0.355	3.258	2.213	1.881	1.631	0.120
Na	(mg/kg)	10.707	21.769	22.505	14.410	14.456	4.611	10.707	21.264	6.314
K	(mg/kg)	3.404	3.650	4.151	1.251	3.601	0.952	4.151	1.501	1.400
HEAVY METALS										
V	(mg/kg)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ni	(mg/kg)	14.418	13.295	12.134	7.812	14.652	17.324	13.295	13.569	13.377
Fe	(mg/kg)	6112.01	5931.95	6459.12	6625.18	8592.83	7362.42	6459.12	3709.22	4468.47
Pb	(mg/kg)	38.68	43.63	42.94	38.14	51.16	46.01	38.14	38.92	38.17
Cu	(mg/kg)	11.311	7.708	7.057	9.760	8.809	8.409	7.057	5.906	5.806
Zn	(mg/kg)	61.564	74.977	69.772	80.383	70.673	60.663	70.673	72.275	70.973
Cd	(mg/kg)	5.313	8.595	7.423	8.234	8.895	8.835	7.423	8.925	2.675
Cr	(mg/kg)	0.658	1.183	0.562	1.252	0.609	0.398	0.658	0.119	0.619
Hg	(mg/kg)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
MICROBIOLOGY										
THB	cfu/g X 10^4	1.88	3.80	3.26	4.50	1.88	0.52	3.80	1.00	1.61
THF	cfu/g X 10^4	0.92	0.27	1.15	1.05	1.59	0.15	0.92	0.45	0.23
HUB	cfu/g X 10^4	0.42	0.62	1.96	0.40	0.81	0.25	0.40	0.20	1.45
HUF	cfu/g X 10^3	1.06	1.50	1.80	3.00	0.64	1.00	0.64	2.00	0.38
Total Coliform	cfu/g X 10^4	1.2	1.24	1.1	1.31	1.23	0.95	0.85	1.34	1.26

Physiochemical properties of soil 15-30cm (Sub-Soil)

PARAMETERS	UNIT	IND/SS1	IND/SS2	IND/SS3	IND/SS4	IND/SS5	IND/SS6	IND/SS7	IND/CTRL 1	IND/CTRL 2
Depth	Cm	15 - 30	15 - 30	15 - 30	15 - 30	15 - 30	15 - 30	15 - 30	15 - 30	15 - 30
pH		4.90	4.30	6.10	5.80	6.80	4.30	6.10	5.50	5.50
Porosity	% pore space	53.80	47.50	44.00	51.50	51.30	56.08	47.50	52.30	57.40
Permeability	(K-4 cm/hr)	1.9	1.6	1.9	2.0	1.8	1.7	1.6	2	1.9
Bulk Density	(g/cm)	0.33	0.28	0.33	0.20	0.20	0.18	0.33	0.28	0.26
Moisture Content	%	0.44	0.26	0.45	0.45	0.51	0.34	0.44	0.16	0.15
Electrical Conductivity	(µS/cm)	41.1	116.6	121.7	43	103.9	44.50	43	38.30	34.50
Phosphorous	(%)	0.16	0.32	0.28	0.18	0.2	0.14	0.16	0.22	0.19
Total Nitrogen	(%)	0.156	0.082	0.145	0.274	0.208	0.152	0.082	0.068	0.120
CEC	(Cmol/kg)	1.23	1.49	0.8	0.74	0.7	1.24	0.74	1.04	0.93
SO_4^{2-}	(ppm)	2.922	5.445	6.651	7.309	6.103	5.554	6.651	1.648	2.432
NO_3 - N	(ppm)	0.095	0.043	0.087	0.056	0.217	0.078	0.087	0.056	0.087
NH_4 - N	(ppm)	0.33	0.281	0.456	0.34	0.466	0.117	0.281	0.176	0.268
O & G	(ppm)	<0.01	<0.01	0.92	<0.01	0.98	1.52	0.92	<0.01	<0.01
TOC	%	0.05	0.09	0.06	0.05	0.03	0.08	0.03	0.04	0.07
OM	%	0.16	0.15	0.11	0.08	0.09	0.12	0.11	0.07	0.12
Exc. Acidity	(meq/100g)	1.20	1.40	0.70	0.70	0.60	1.2	0.60	1	0.9
Base Saturation	%	2.64	6.16	11.97	4.80	13.85	3.40	2.64	3.39	2.88
TOTAL SAND	%	72.2	70.1	59.5	58.8	64.4	65.9	59.5	71.1	75.9
Total silt	%	7.0	6.1	7.9	6.8	7.0	7.6	6.1	5.4	5.7
Total clay	%	20.8	23.8	32.6	34.4	28.6	26.5	20.8	23.5	18.4
Texture		LOAMY SAND	SANDY LOAM	SANDY CLAY LOAM	SANDY CLAY LOAM	SANDY LOAM	SANDY LOAM	SANDY CLAY LOAM	LOAMY SAND	LOAMY SAND

PARAMETERS	UNIT	IND/SS1	IND/SS2	IND/SS3	IND/SS4	IND/SS5	IND/SS6	IND/SS7	IND/CTRL 1	IND/CTRL 2
CATIONS										
Ca	(mg/kg)	0.599	0.497	0.707	1.212	0.608	0.670	0.497	0.881	0.530
Mg	(mg/kg)	0.337	0.417	1.549	0.761	2.272	1.472	0.417	0.592	0.167
Na	(mg/kg)	5.460	18.059	17.462	4.460	15.662	5.655	4.460	5.063	4.657
K	(mg/kg)	1.153	2.901	1.101	1.351	2.502	0.801	1.101	1.451	0.933
HEAVY METALS										
V	(mg/kg)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ni	(mg/kg)	14.791	14.184	17.273	10.917	13.543	13.349	14.910	17.283	15.621
Fe	(mg/kg)	7827.580	6306.070	6106.010	8401.760	7466.460	4003.320	8401.760	2915.960	2023.670
Pb	(mg/kg)	46.210	45.110	44.730	31.030	32.050	48.740	45.110	40.590	38.280
Cu	(mg/kg)	10.411	7.808	7.408	8.609	7.958	5.155	7.408	3.954	5.005
Zn	(mg/kg)	66.469	55.457	67.470	78.581	63.165	52.955	67.470	52.254	62.765
Cd	(mg/kg)	8.595	8.564	8.564	6.281	8.354	8.564	8.354	4.838	2.825
Cr	(mg/kg)	0.116	1.993	1.066	3.781	0.669	0.817	1.066	0.189	0.561
Hg	(mg/kg)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
MICROBIOLOGY										
THB	cfu/g X 10^4	1.50	3.94	3.95	2.45	2.50	1.54	3.94	2.03	0.85
THF	cfu/g X 10^4	0.87	0.83	1.20	0.61	2.00	0.45	1.20	0.94	0.12
HUB	cfu/g X 10^4	0.37	1.34	0.50	1.99	1.25	1.20	0.37	0.27	NIL
HUF	cfu/g X 10^3	2.00	1.12	3.50	0.35	2.50	0.22	1.12	1.21	0.5
Total Coliform	cfu/g X 10^4	0.5	0.31	0.41	0.39	0.45	0.42	0.36	0.41	0.46

Appendix 4.7

TABLE 1 ***VES 1 @ BH 1. INDORAMA COMPLEX ELEME, RIVERS STATE***

VES 1

COMPANY:	***PROJECT:*** ***Environmental Impact Assessment*** ***CLIENT:*** ***INDORAMA UREA FERTILIZER*** ***DATE : 29-09-2017*** ***CONTRACTOR:*** ***ENVIRON & CHEM. SER.*** ***WEATHER : SUNNY***					
	SUBSOIL AVERAGE ELECTRIC RESISTIVITY MEASUREMENT					
CO ORDINATE	**ELECTRODE SPACING**		**CONSTANT**	**MEASURED RESISTANCE**	**RESISTIVITY**	**Depth**
	C1C2 (m)	**P1P2 (m)**	**K**	**(ohm)**	**(ohm.m)**	**(m)**
N 04^0 49'49.864" E 007^{0}06'.352"	**3**	**0.5**	**13.744**	**51**	**700.944**	1
	4.5		**31.416**	**31**	**973.896**	1.5
	6		**56.156**	**10**	**561.56**	2
	9		**126.842**	**4**	**507.368**	3
	12	**1**	**112.312**	**3**	**336.936**	4
	15		**175.929**	**1.2**	**211.115**	5
	21		**345.575**	**0.8**	**276.46**	7
	30	**2**	**351.858**	**1.5**	**527.787**	10
	45		**793.643**	**0.7**	**555.550**	15
	60		**1412.146**	**0.6**	**847.2876**	20
	90	**10**	**623.319**	**0.8**	**498.6552**	30

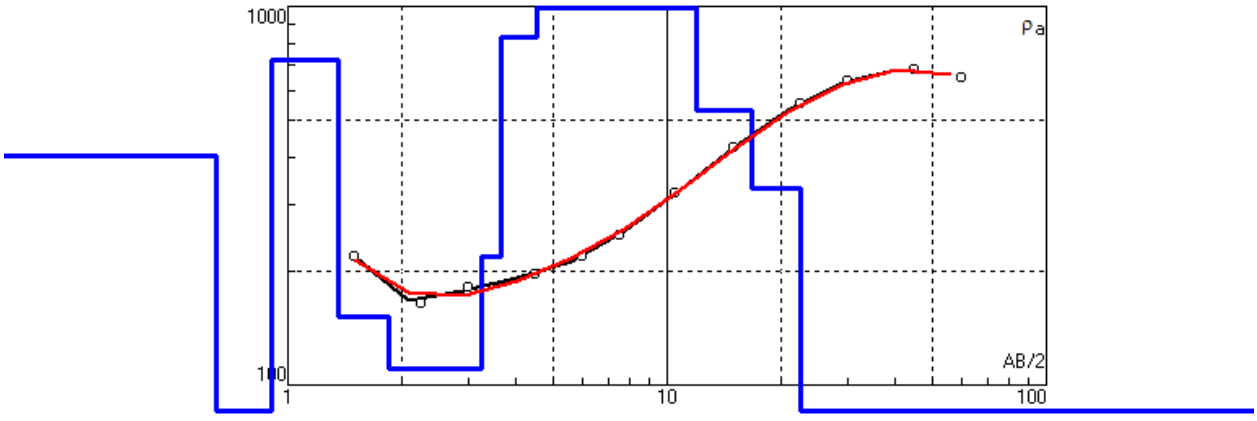


Fig. 1 Schlumberger VES Curve @ VES 1, ***INDORAMA COMPLEX, ELEME, RIVERS STATE***

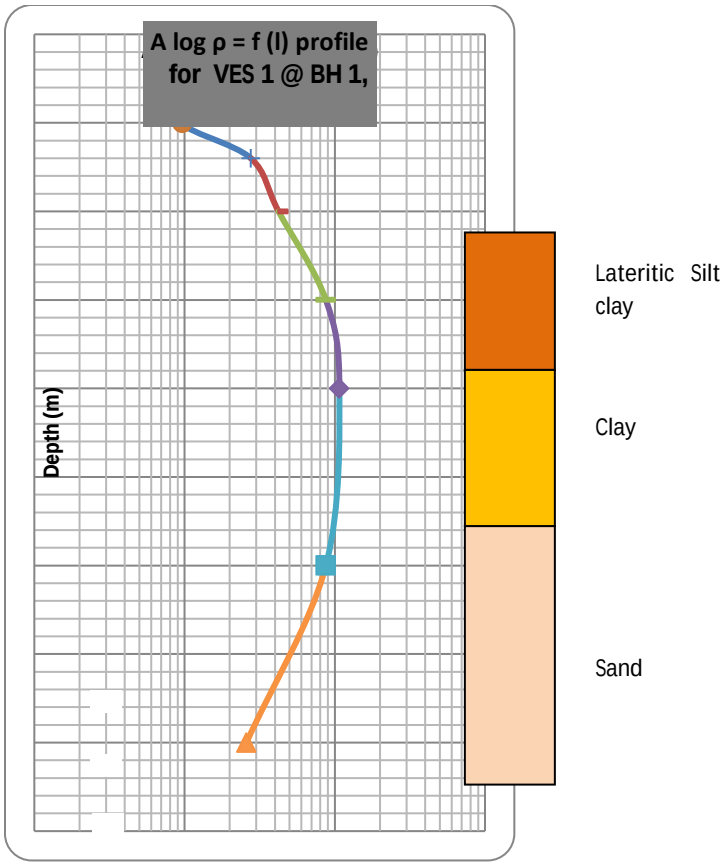


Fig. 2, VES 1; A log ρ = f (I) ***Profile*** ***INDORAMA COMPLEX, ELEME, RIVERS STATE***

TABLE 2 ***VES 2 @ BH 2, INDORAMA COMPLEX ELEME*, RIVERS STATE**

VES 2

COMPANY:	***PROJECT:*** ***Environmental Impact Assessment***
	CLIENT: ***INDORAMA UREA FERTILIZER*** ***DATE : 29-09-2017***
	CONTRACTOR: ENVIRON.&CHEM. SER. ***WEATHER : SUNNY***

SUBSOIL AVERAGE ELECTRIC RESISTIVITY MEASUREMENT

CO ORDINATE	ELECTRODE SPACING		CONSTANT	MEASURED RESISTANCE	RESISTIVITY	Depth
	C1C2 (m)	P1P2 (m)	K	(ohm)	(ohm.m)	(m)
N 04^0 50'.038" E 007$^+$06.587"	3	0.5	13.744	61	838.384	1
	4.5		31.416	35	1099.56	1.5
	6		56.156	15	842.34	2
	9		126.842	7	887.894	3
	12	1	112.312	6	673.872	4
	15		175.929	2.5	439.823	5
	21		345.575	1.2	414.69	7
	30	2	351.858	1.8	633.344	10
	45		793.643	1.1	873.007	15
	60		1412.146	0.7	988.5022	20
	90	10	623.319	0.9	560.9871	30

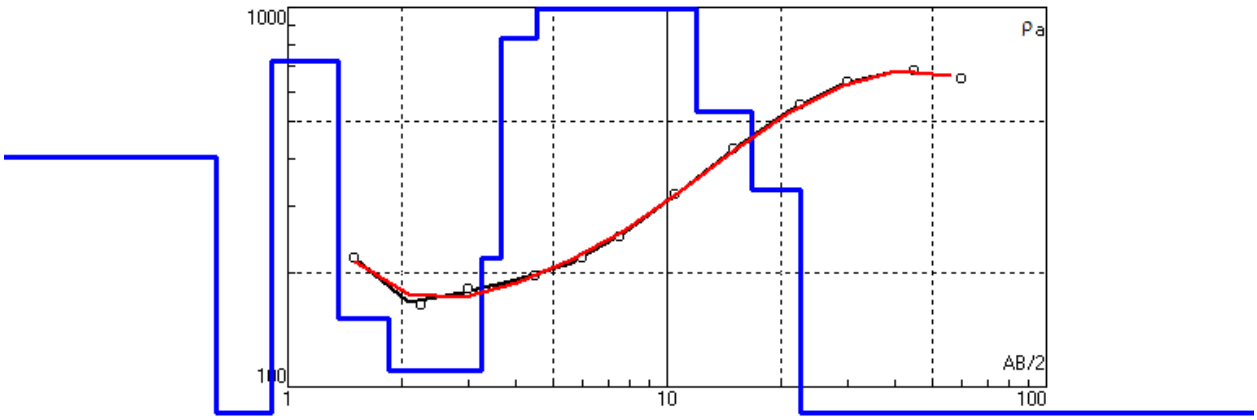


Fig. 3 Schlumberger VES Curve @ VES 2, ***INDORAMA COMPLEX, ELEME, RIVERS STATE***

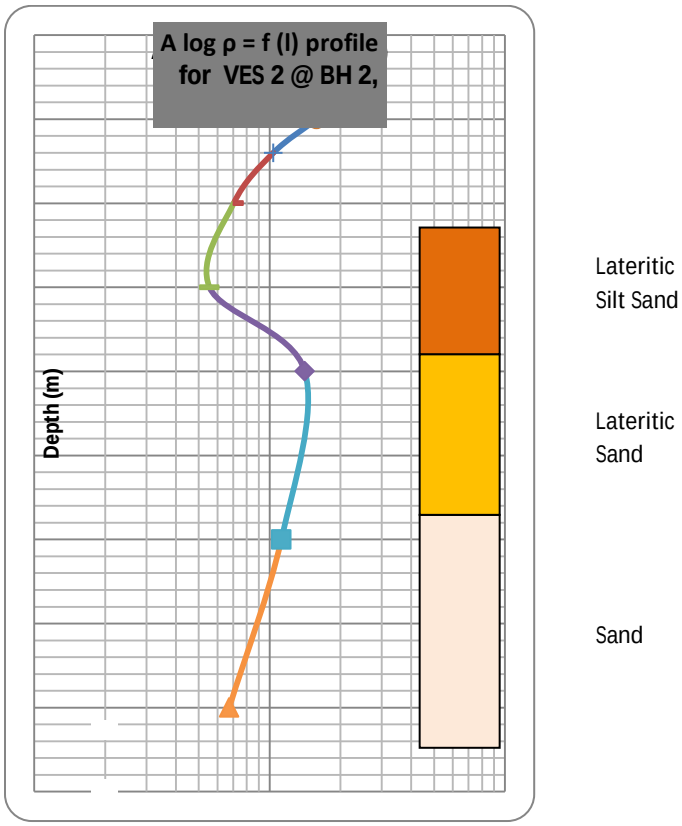


Fig. 4, VES 2; A log ρ = f (l) profile, ***INDORAMA COMPLEX ELEME, RIVERS STATE***

TABLE 3 ***VES 3 @ BH 3, INDORAMA COMPLEX, ELEME, RIVERS STATE***

VES 2

COMPANY:	***PROJECT:*** ***Environmental Impact Assessment***
	CLIENT: ***INDORAMA UREA FERTILIZER*** ***DATE : 29-09-2017***
	CONTRACTOR: ENVIRON. & CHEM.SER. ***WEATHER : SUNNY***

SUBSOIL AVERAGE ELECTRIC RESISTIVITY MEASUREMENT

CO ORDINATE	ELECTRODE SPACING		CONSTANT	MEASURED RESISTANCE	RESISTIVITY	Depth
	C1C2 (m)	P1P2 (m)	K	(ohm)	(ohm.m)	(m)
N 04^{0} 50''.038" E 007^{+}06.226"	**3**	**0.5**	**13.744**	**84**	**1154.496**	1
	4.5		**31.416**	**34**	**1068.144**	1.5
	6		**56.156**	**14**	**786.184**	2
	9		**126.842**	**9**	**1141.578**	3
	12	**1**	**112.312**	**4.5**	**505.404**	4
	15		**175.929**	**2.1**	**369.451**	5
	21		**345.575**	**1.8**	**622.035**	7
	30	**2**	**351.858**	**1.2**	**422.230**	10
	45		**793.643**	**0.9**	**714.2797**	15
	60		**1412.146**	**0.7**	**988.5022**	20
	90	**10**	**623.319**	**1.1**	**685.6509**	30

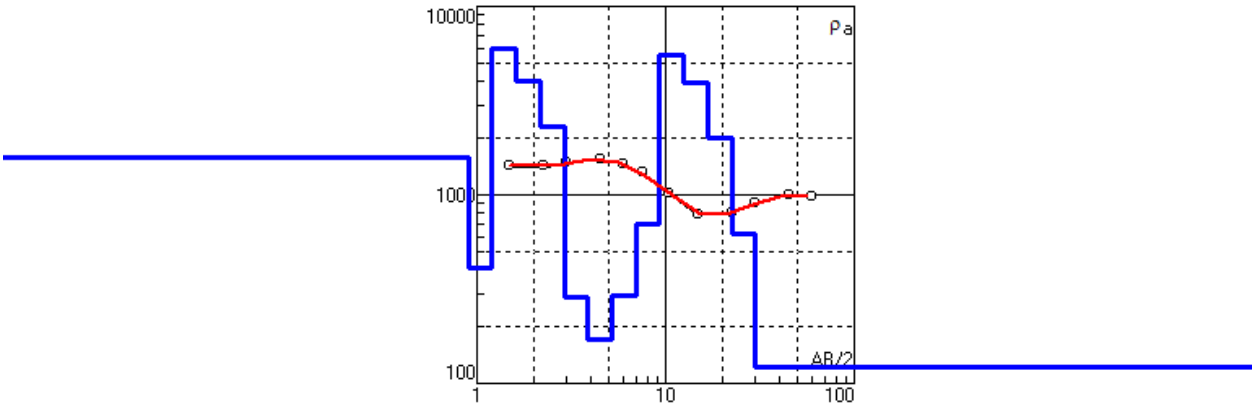


Fig. 5 Schlumberger VES Curve @ VES 3, ***INDORAMA COMPLEX, ELEME, RIVERS STATE***

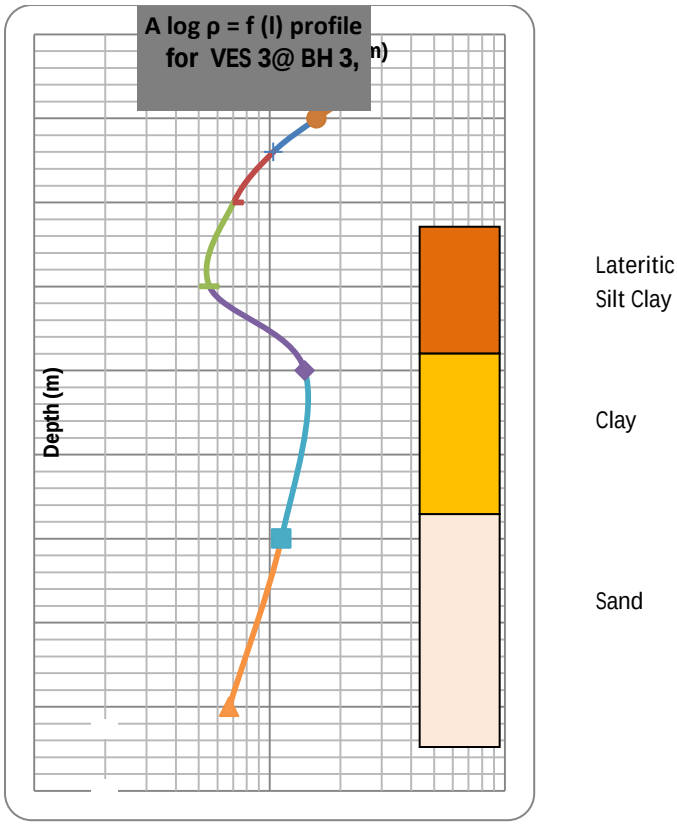


Fig. 6, VES 2; A log ρ = f (l) profile, ***INDORAMA COMPLEX, ELEME, RIVERS STATE***

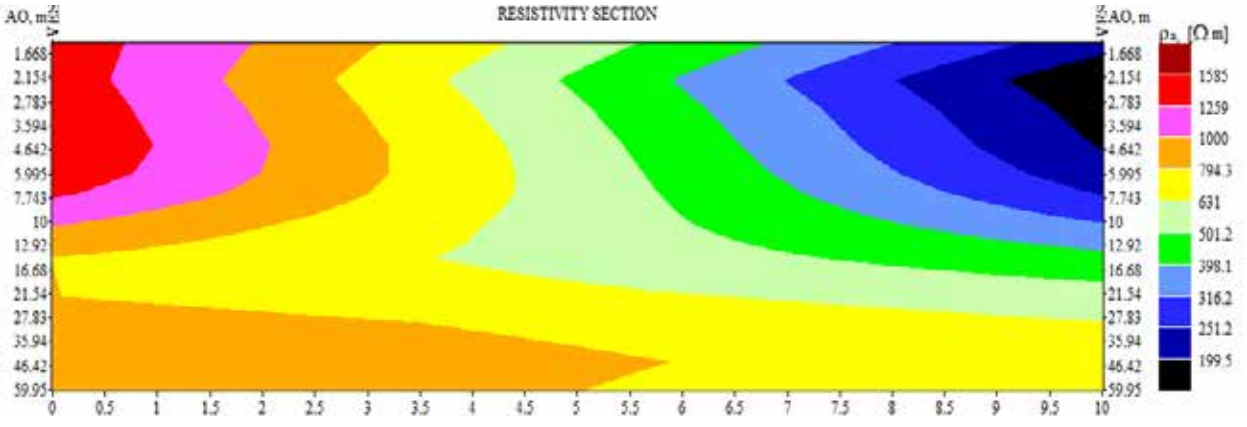


Fig. 7, Pseudo cross section for VES 1 & 3, ***INDORAMA COMPLEX, ELEME, RIVERS STATE***

TABLE 4 ***RESISTIVITY RANGE OF SELECTED GEOLOGICAL MATERIAL***

S/N	Geological and Moisture Characteristics	Resistivity given in ohm.m at 20^0C
1	Graphites	0.0001
2	Conducting mineral	0.01 – 0.1
3	Wet Graphic Schists	0.5 – 1
4	Dry Graphic Schists	3.5
5	Brine	2-6
6	Ferrous Clay – Wet marls – Wet clays	4 – 10
7	Wet clay sand – Wet gypsum	50
8	Sand + clay in alternate layers	20 – 100
9	Dry humus – clayey schists	20 – 100
10	Clayey soils	100 – 600
11	Sandy Soils (dry)	700 – 2000
12	Wet sand + gravel	100 – 1500
13	Clays mixed with dry sand	80 – 200
14	Dry peats	150 – 300
15	Wet Peat	10 - 50
16	Wet sand	200 – 500
17	Loose Sands	1000 - 90000
18	Dry gypsum, dry sand, dry gravel	1000
19	Alluvium	10 - 800
20	Petroleum, halite	10^5 - 10^7

Modified from Reynolds J.M (1998)

Table. 5:

SOIL ELECTRICAL RESISTIVITY CLASSIFICATION

ACCORDING TO THE BRITISH STANDARD BS – 1377

Soil Resistivity (ohm –m)	Soil corrosivity
Under 10	Severe
10 – 50	Corrosive
50 – 100	Moderately corrosive
Above 100	Slightly corrosive

APPENDIX

LABORATORY TEST RESULTS

UNDRAINED TRIAXIAL COMPRESSION TESTS

LOCATION:

Bore-Hole No	**Depth Sample(m)**	**Natural Moisture Content (%)**	**Undrained Cohesion (KN/m^2)**	**Friction angle f (Degree)**	**Description of Sample**
1	1.5	25	22	2	Soft Grayish sandy clay

CLASSIFICATION TEST

ATTERBERG LIMIT
LOCATION:

Borehole No.	Depth(m)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	Bulk Unit Weight\ g (KN/m^3)
3	2	43.8	20	23.8	19.6
2	4.0	35.9	17.4	18.5	

CONSOLIDATION (ONE –DIMENSIONAL)

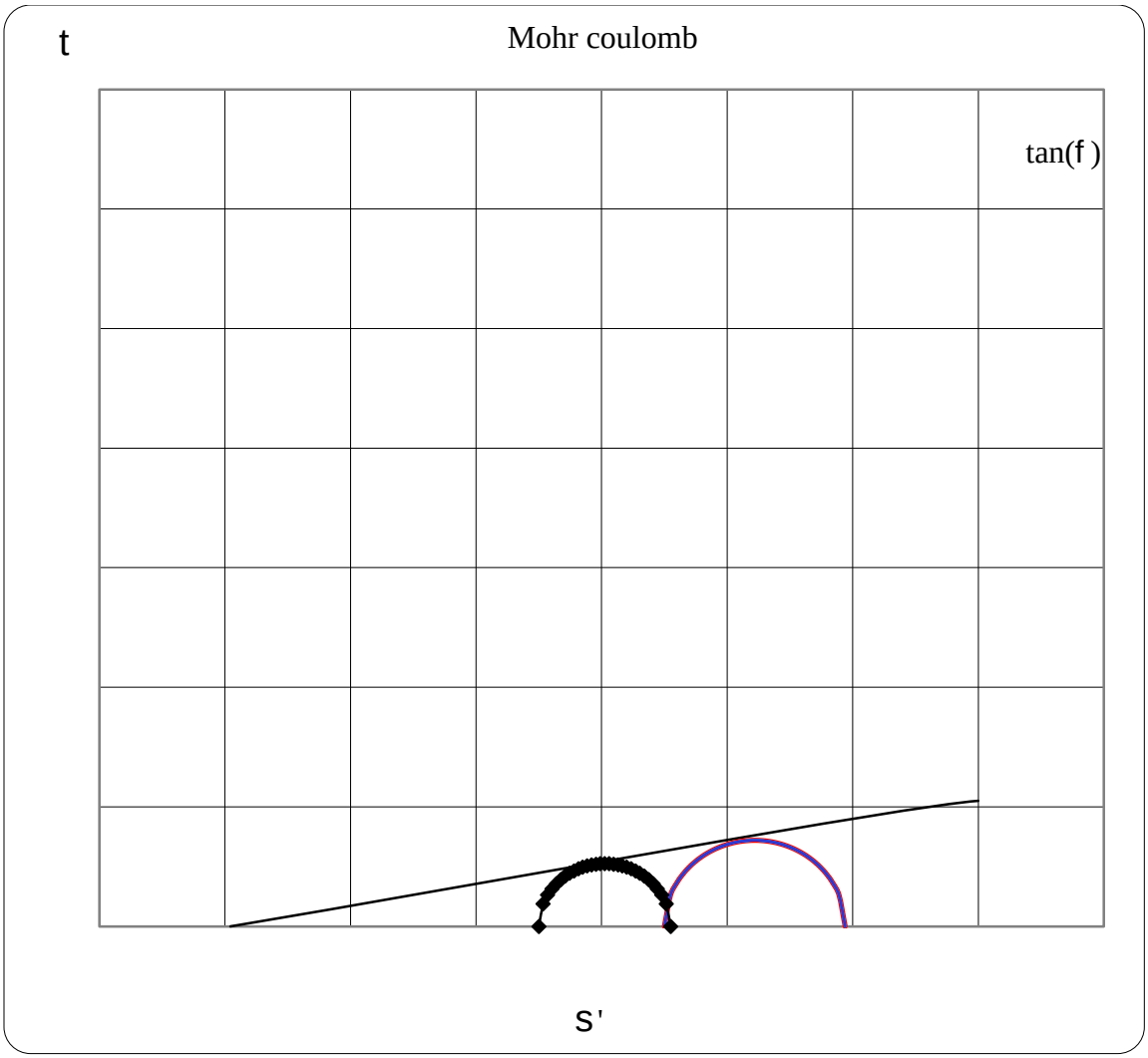
COMPRESSIBILITY PARAMETER.

Bore-Hole Nos	**Depth (m)**	**Pressure Range (Kpa)**	**Coefficient of Consolidation Cv(m^2/yr)**	**Coefficient of Volume Compressibility Mv 10^{-4}**	**Coefficient of Permeabilty K 10^{-8}cm/s**
2	4.0	0-25 25-50 50-100 100-200 200-400 400-800	**Error! Not a valid link.**	**Error! Not a valid link.**	**Error! Not a valid link.**

Triaxial

BH 2, 4.0m

Minor Principal Stress	100KN/m^2	300KN/m^2
Deviator Stress	201KN/m^2	288KN/m^2
Major Principal Stress	301KN/m^2	588KN/m^2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Appendix – 4.8

Physico-chemical properties of Surface water (Okulu Stream) – Up Stream

Parameters	Jan'17	Feb'17	Mar'17	Average	FMEnv Limit Aquatic Life	IFC LIMITS
pH	7.27	6.54	6.39	6.73	6.0-9.0	6-9
EC us/cm	478.0	446.0	852.0	592.0	-	-
Temperature ºC	24	24.4	28.7	25.7	20-33	-
TDS (mg/l)	240	228	426	298.0	-	-
Turbidity NTU	24.2	27.8	13.1	21.7	-	-
D.O (mg/l)	6.50	6.30	6.09	6.30	6.8	-
TSS (mg/l)	10.5	11.5	9.1	10.4	NS	-
COD (mg/l)	16.00	19.00	17.00	17.33	40*	150
BOD_5 (mg/l)	2.40	2.40	2.40	2.40	4.0	30
Total Hardness (mg/l)	4.0	4.0	2.0	3.3	NS	-
Nitrate (mg/l)	1.17	0.22	<0.10	0.46	NS	-
Sulphate (mg/l)	1.08	17.51	15.14	11.24	NS	-
Phosphate (mg/l)	2.04	<0.001	<0.001	0.68	NS	-
Ammonia (mg/l)	<0.10	<0.10	<0.10	<0.10	-	-
Chloride Cl- (mg/l)	21.98	27.08	25.08	24.71	-	-
Alkalinity (mg/l)	60.0	70.0	70.0	66.7	-	-
Calcium (mg/l)	10.20	10.21	11.00	10.47	-	-
Iron (mg/l)	0.98	1.99	0.64	1.20	1.0	-
Lead (mg/l)	0.050	0.070	0.042	0.054	0.05	-
Zinc (mg/l)	0.160	1.126	0.624	0.637	50	-
Cadmium (mg/l)	<0.001	<0.001	<0.001	<0.001	0.002	<0.1
Manganese (mg/l)	0.050	0.050	0.008	0.036	-	-
Chromium, (mg/l)	0.016	0.216	0.209	0.147	0.03	<0.1
Mercury (mg/l)	<0.001	<0.001	<0.001	<0.001	0.001	-
Silver (mg/l)	<0.001	<0.001	<0.001	<0.001	0.1	-
Copper (mg/l)	0.004	0.005	0.015	0.008	1.0	-
Oil and grease (mg/l)	<1.00	<1.00	<1.00	<1.00	NS	10

Physico-chemical properties of Surface water (Okulu Stream) – Mid Stream

Parameters	Jan'17	Feb'17	Mar'17	Average	FMEnv Limit Aquatic Life	IFC LIMITS
pH	8.24	8.17	8.31	8.24	6.0-9.0	6-9
EC us/cm	448.0	283.8	162.5	298.1	-	-
Temperature ºC	23.8	24.5	28.7	25.7	20-33	-
TDS (mg/l)	225	142	81	149	-	-
Turbidity NTU	19.2	27.8	13.8	20.3	-	-
D.O (mg/l)	6.40	6.41	6.27	6.36	6.8	-
TSS (mg/l)	11.0	12.0	11.5	11.5	NS	-
COD (mg/l)	16.00	14.00	11.00	13.67	40*	150
BOD_5 (mg/l)	2.40	2.20	2.10	2.23	4.0	30
Total Hardness (mg/l)	4.0	4.0	4.0	4.0	NS	-
Nitrate (mg/l)	0.62	1.79	1.89	1.43	NS	-
Sulphate (mg/l)	2.32	14.85	15.88	11.02	NS	-
Phosphate (mg/l)	<0.001	<0.001	<0.001	<0.001	NS	-
Ammonia (mg/l)	<0.10	<0.10	<0.10	<0.10	-	-
Chloride Cl- (mg/l)	19.14	20.02	18.04	19.07	-	-
Alkalinity (mg/l)	110.0	70.0	50.0	76.7	-	-
Calcium (mg/l)	9.42	9.44	5.47	8.11	-	-
Iron (mg/l)	1.72	0.87	1.05	1.21	1.0	-
Lead (mg/l)	0.040	0.080	0.040	0.053	0.05	-
Zinc (mg/l)	0.070	0.190	0.447	0.236	50	-
Cadmium (mg/l)	<0.001	<0.001	<0.001	<0.001	0.002	<0.1
Manganese (mg/l)	0.018	0.010	0.001	0.010	-	-
Chromium, (mg/l)	0.030	0.090	0.002	0.041	0.03	<0.1
Mercury (mg/l)	<0.001	<0.001	<0.001	<0.001	0.001	-
Silver (mg/l)	<0.001	<0.001	<0.001	<0.001	0.1	-
Copper (mg/l)	<0.001	<0.001	<0.001	<0.001	1.0	-
Oil and grease (mg/l)	<1.00	<1.00	<1.00	<1.00	NS	10

Physico-chemical properties of Surface water (Okulu Stream) – Down Stream

Parameters	Jan'17	Feb'17	Mar'17	Average	FMEnv Limit Aquatic Life	IFC LIMITS
pH	6.59	6.35	7.29	6.74	6.0-9.0	6-9
EC us/cm	208.4	153.9	152.7	171.7	-	-
Temperature ºC	23.7	24.4	28.7	25.6	20-33	-
TDS (mg/l)	104	77	76	85.7	-	-
Turbidity NTU	32.1	28.2	26.1	28.8	-	-
D.O (mg/l)	6.40	6.20	6.06	6.22	6.8	-
TSS (mg/l)	9.8	8.8	8.2	8.9	NS	-
COD (mg/l)	18.00	17.00	15.00	16.67	40*	150
BOD_5 (mg/l)	2.30	2.30	2.30	2.30	4.0	30
Total Hardness (mg/l)	4.0	4.0	2.0	3.3	NS	-
Nitrate (mg/l)	3.14	<0.001	<0.001	3.14	NS	-
Sulphate (mg/l)	0.80	12.30	11.40	8.17	NS	-
Phosphate (mg/l)	<0.001	<0.001	<0.001	<0.001	NS	-
Ammonia (mg/l)	<0.10	<0.10	<0.10	<0.10	-	-
Chloride Cl- (mg/l)	16.31	20.31	20.30	18.97	-	-
Alkalinity (mg/l)	90.0	80.0	60.0	76.7	-	-
Calcium (mg/l)	12.05	12.00	12.09	12.05	-	-
Iron (mg/l)	2.40	2.72	0.54	1.89	1.0	-
Lead (mg/l)	0.070	2.170	0.031	0.757	0.05	-
Zinc (mg/l)	0.240	1.024	0.478	0.581	50	-
Cadmium (mg/l)	<0.001	<0.001	<0.001	<0.001	0.002	<0.1
Manganese (mg/l)	0.050	0.050	0.004	0.035	-	-
Chromium, (mg/l)	0.017	0.117	0.107	0.080	0.03	<0.1
Mercury (mg/l)	<0.001	<0.001	<0.001	<0.001	0.001	-
Silver (mg/l)	<0.001	<0.001	<0.001	<0.001	0.1	-
Copper (mg/l)	0.007	0.010	0.018	0.012	1.0	-
Oil and grease (mg/l)	<1.00	<1.00	<1.00	<1.00	NS	10

Appendix 4.9

Phytoplankton species composition and distribution in the study area (Dry season)

Taxa	SW1	SW2	SW3	SWC1	SWC2	Total	%Total
Bacillariophyta							
Navicula spp	0	0	0	0	13	**13**	
Nitzschia spp	1	0	0	0	7	**8**	
Fragilaria crotonensis	0	0	0	0	4	**4**	
Cyclotella spp	0	2	75	2	2	**81**	
Melosira spp	0	0	0	0	17	**17**	
Synedra spp	1	1	0	0	0	**2**	
Subtotal	**2**	**3**	**75**	**2**	**43**	**125**	29.83
Chlorophyta							
Chlorella spp	0	3	12	0	0	**15**	
Rhizoclonium spp	0	0	0	0	37	**37**	
Subtotal	**0**	**3**	**12**	**0**	**37**	**52**	12.41
Cyanophyta							
Coelosphyaerium spp	0	22	48	172	0	242	
Subtotal	**0**	**22**	**48**	**172**	**0**	**242**	57.76
Taxa_S	2	4	3	2	6		
Individuals (cells/1000L)	2	28	135	174	80		
Shannon_H	0.69	0.74	0.91	0.06	1.44		
Evenness_e^H/S	1	0.50	0.82	0.08	0.80		
Margalef	1.44	0.90	0.41	0.19	1.14		
Dominance_D	1	0.38	0.56	0.02	0.71		

Source: Field survey, 2011

Phytoplankton species composition and distribution in the study area (Wet season)

Taxa	SW1	SW2	SW3	SWC1	SWC2	Total	%Total
Class: Bacillariophyceae							
Amphora ovalis	1	5	1	0	1	**8**	
Amphora spiroides	0	0	0	1	0	**1**	
Nitzschia frigida	5	0	1	0	1	**7**	
Nitzschia gracilis	0	1	5	1	1	**8**	
Nitzschia clausii	1	0	0	1	1	**3**	
Nitzschia closterium	0	7	1	1	0	**9**	
Cyclotella stigmata	0	1	0	0	5	**6**	
C. operculata	1	0	1	0	1	**3**	
C. centralis	0	1	0	1	0	**2**	
Melosira varians	1	0	1	0	1	**3**	
Navicula gracilis	1	5	0	0	0	**6**	
N. cuspidate	3	1	1	5	1	**11**	
N. ovalis	1	0	0	0	1	**2**	
Synedra ulna	2	0	0	0	3	**5**	
Tabellaria fenestrata	1	3	1	2	1	**8**	
SUBTOTAL	**17**	**24**	**12**	**12**	**17**	**82**	**42.27**
Class: Cyanophyceae							
Oscillatoria indica	3	0	1	0	1	**5**	
O. limnosa	0	1	1	2	1	**5**	
O. major	1	0	3	1	0	**5**	
O. obscura	0	1	0	0	1	**2**	
O. miniata	1	1	1	2	0	**5**	
Anabaena affinis	0	1	0	0	1	**2**	
A. flos-aquae	1	0	1	0	0	**2**	
A. laxa	1	1	0	1	1	**4**	
A. limnetica	0	3	1	0	1	**5**	
A. affinis	1	0	1	1	0	**3**	
SUBTOTAL	**8**	**8**	**9**	**7**	**6**	**38**	**19.59**
Class: Chlorophyceae							
Closterium gracile	0	2	0	2	2	**6**	
C. littorale	6	0	0	0	0	**6**	
C. navicula	0	3	0	0	3	**6**	
C.lineatum	3	0	6	1	1	**11**	
C. parvulum	0	6	0	0	0	**6**	
C. kuetzingii	4	0	0	2	0	**6**	
Eudorina elegans	0	1	0	0	1	**2**	
E. cylindrica	0	0	3	1	0	**4**	
Scenedesmus acuminatus	0	0	0	0	0	**0**	
S. quadricauda	3	1	0	0	0	**4**	

Taxa	**SW1**	**SW2**	**SW3**	**SWC1**	**SWC2**	**Total**	**%Total**
Cosmarium sp	1	3	0	0	0	**4**	
Micrasterias apiculata	0	1	0	0	1	**2**	
Micrasterias radiata	3	2	2	0	2	**9**	
SUBTOTAL	**20**	**19**	**11**	**6**	**10**	**66**	**34.02**
Class: Euglenophyceae							
Euglena caudata	1	0	5	1	1	**8**	
SUBTOTAL	**1**	**0**	**5**	**1**	**1**	**8**	**4.12**
SUMMARY							
Taxa_S	23	22	19	17	24		
Individuals (cells/1000L)	46	51	37	26	34		
Shannon_H	2.91	2.83	2.67	2.68	3.01		
Evenness_e^H/S	0.93	0.92	0.91	0.96	0.97		
Margalef	5.75	5.34	4.98	4.91	6.52		
Dominance_D	0.95	0.95	0.94	0.95	0.97		

Source: Field survey, 2017

Zooplankton species composition and distribution in the study area (Dry season)

Taxa	SW1	SW2	SW3	SWC1	SWC2	Total	%Total
Order: Copepoda							
Copepod nauplius	0	0	0	2	4	6	
Subtotal	**0**	**0**	**0**	**2**	**4**	**6**	**20.69**
Rotifera							
Keratella cochlearis	0	0	0	9	11	20	
Kellicotia spp	0	0	0	1	0	1	
Subtotal	**0**	**0**	**0**	**10**	**11**	**21**	**72.41**
Tintinidae							
Tintinid larva	0	0	0	0	2	2	
Subtotal	0	0	0	0	2	2	**6.90**
Taxa_S	0	0	0	3	3		
Individuals (cells/100L)	0	0	0	12	17		
Shannon_H	0	0	0	0.72	0.87		
Evenness_e^H/S	0	0	0	0.62	0.78		
Margalef	0	0	0	0.80	0.71		
Dominance_D	0	0	0	0.44	0.54		

Source: Field survey, 2011

Zooplankton species composition and distribution in the study area (Wet season)

Taxa	SW1	SW2	SW3	SWC1	SWC2	Total	%Total
Order: Cladocera							
Alona sp	0	0	0	1	0	1	
Bosmina affinis	1	0	1	0	1	3	
Bosmina diaphana	1	1	0	1	0	3	
Polyphemus sp	5	0	1	0	1	7	
Moina sp	1	0	0	1	0	2	
SUBTOTAL	**8**	**1**	**2**	**3**	**2**	16	**22.86**
Order: Copepoda							
Mesocyclops sp	1	0	0	0	3	4	
Diaptomus sp	1	5	1	0	0	7	
Eucyclops sp	0	0	0	1	0	1	
Metacyclops sp	1	5	0	0	1	7	
SUBTOTAL	**3**	**10**	**1**	**1**	**4**	**19**	**27.14**
Order: Rotifera							
Lecane sp	0	5	1	1	1	8	
Euchlanis sp	0	4	1	0	1	6	
Collotheca sp	5	0	0	1	0	6	
Keratella sp	1	0	1	1	1	4	
Asplanchna sp	3	1	0	1	1	6	
SUBTOTAL	**9**	**10**	**3**	**4**	**4**	**30**	**42.86**
Cichlidae							
Tilapia sp (fry)	0	1	3	0	1	5	
SUBTOTAL	**0**	**1**	**3**	**0**	**1**	**5**	**7.14**
Taxa_S	10	7	7	8	9		
Individuals (cells/100L)	20	22	9	8	11		
Shannon_H	2.03	1.74	1.83	2.08	2.10		
Evenness_e^H/S	0.87	0.90	0.96	1	0.97		
Margalef	3.00	1.94	2.73	3.37	3.34		
Dominance_D	0.88	0.84	0.92	1	0.95		

Benthic invertebrates composition and distribution in the study area (Dry season)

Taxa	SW1	SW2	SW3	SWC1	SWC2	Total	%Total
CLASS: OLIGOCHAETA							
Oligochaete worm	0	0	0	3	0	3	
SUBTOTAL	0	0	0	3	0	3	25
CLASS: INSECTA							
Chaoborus larvae	0	0	0	0	2	2	
Chironomus larvae	0	0	0	0	6	6	
Simulium larvae	0	0	0	0	1	1	
SUBTOTAL	0	0	0	0	9	9	75
Taxa_S	0	0	0	1	3		
Individuals (cells/m^2)	0	0	0	3	9		
Shannon_H	0	0	0	0	0.85		
Evenness_e^H/S	0	0	0	0	0.74		
Margalef	0	0	0	0	0.91		
Dominance_D	0	0	0	0	0.56		

Source: Field survey, 2011

Benthic invertebrates composition and distribution in the study area (Wet season)

Taxa	Up-Stream	Mid-Stream	Down Stream	Agbonchia Control1	Rumukrushi Control2	Total	%Total
CLASS: OLIGOCHAETA							
Dero obtusa	2	0	0	0	1	3	
Ophidonias sp	0	0	1	0	0	1	
Dugesia polychroa	1	0	0	0	1	2	
Lumbricus sp	1	0	1	0	0	2	
SUBTOTAL	4	0	2	0	2	8	**38.10**
CLASS: INSECTA							
Chironomous sp	0	1	0	0	1	2	
Cordulia sp	0	2	0	0	0	2	
Donacia sp	1	0	0	1	1	3	
Dytiscus sp	0	0	1	0	0	1	
Poissonia sp	1	0	0	1	1	3	
SUBTOTAL	2	3	1	2	3	11	**52.38**
Nauplii	0	1	0	0	1	2	
SUBTOTAL	0	1	0	0	1	2	**9.52**
Taxa_S	5	3	3	2	6		
Individuals (cells/m^2)	6	4	3	2	6		
Shannon_H	1.56	1.04	1.10	0.69	1.79		
Evenness_e^H/S	1	1	1	1	1		
Margalef	2.23	1.44	1.82	1.44	2.79		
Dominance_D	0.93	0.83	1	1	1		

Source: Field survey, 2017

Appendix – 4.10

SOCIO-ECONOMIC IMPACT ASSESSMENT QUESTIONNAIRE

FOR IEFCL - TRAIN2 PROJECT

FOCUS ON GROUP DISCUSSION

SECTION A: GENERAL INFORMATION

I. Respondent Information

1. Age: 0-18 yrs = 1; 18-35yrs = 2; 35-65yrs = 3; 65yrs and above = 4 _____

2. Gender: Female = 1; Male = 2 ____

3. Marital Status: Single = 1; Married = 2; Widow/Widower = 3; Divorced = 4 _____

4. Level of education:

1=no formal education, 2= adult literacy training, 3=some primary education, 4 = completed primary education, 5=some secondary education (incl. junior secondary school), 6=completed secondary education,7=post-secondary education _____

5. Do you live or engage in economic activity in a community close to Indorama Fertilizer Plant? Yes=1 No=2_____

6. What type of economic activity are you engaged in? A. Agriculture? Yes=1 No=2_____ B. Local Craft? Yes=1 No=2_____C. Trading? Yes=1 No=2_____D. Vendor/Contractor? Yes=1 No=2_____E. Civil Service? Yes=1 No=2. F. Hospitality? Yes=1 No=2. Others? Yes=1 No=2.

SECTION B: SOCIAL IMPACT OF INDORAMA FERTILIZER PLANT

Instruction: Kindly tick the appropriate box that corresponds with your response to respective items.

SA = Strongly Agree ; A = Agree ; U = Undecided ; D = Disagree ; SD = Strongly Disagree

S/N	**Social Indicators**	**SA**	**A**	**U**	**D**	**SD**
1	The operations of the Indorama Fertilizer Plant have not impacted negatively on individual and population health.					
2	Unity among community and cultural groups has not been battered due to the operations of the Indorama Fertilizer Plant.					
3	Family unity has not been negatively affected by the operations of the Indorama Fertilizer Plant.					

4	Since the take-off of the Indorama Fertilizer Plant, scholarships and other educational support programmes for students have been provided.					
5	The operations of the Indorama Fertilizer Plant have not increased the pressure on social services such as hospitals and schools.					
6	The operations of the Indorama Fertilizer Plant have not made housing unaffordable and scarce in our community.					
7	Traffic and road safety has not deteriorated due to the operations of the Indorama Fertilizer Plant.					
8	The operations of the Indorama Fertilizer Plant have not led to a negative "in and out" migration effect.					
9	Social makeup of my community has not changed due to the operations of the Indorama Fertilizer Plant.					
10	Recreational life in my community has not been negatively affected due to the operations of the Indorama Fertilizer Plant					

SECTION C: CULTURAL IMPACT OF INDORAMA FERTILIZER PLANT

Instruction: Kindly tick the appropriate box that corresponds with your response to the following items.

SA = Strongly Agree ; A = Agree ; U = Undecided ; D = Disagree ; SD = Strongly Disagree

S/N	**Cultural Indicators**	**SA**	**A**	**U**	**D**	**SD**
1	The operations of the Indorama Fertilizer Plant have not made the maintenance of our culture difficult.					
2	The aesthetic value of my community has not depreciated due to the operations of the Indorama Fertilizer Plant.					
3	The archaeological value of my community has not depreciated due to the operations of the Indorama Fertilizer Plant.					
4	The spiritual value of my community has not depreciated due to the operations of the Indorama Fertilizer Plant.					

5	The Maintenance of traditional language, education, laws and traditions has not been affected negatively by the operations of the Indorama Fertilizer Plant.					

SECTION C: ECONOMIC IMPACT OF INDORAMA FERTILIZER PLANT

Instruction: Kindly tick the appropriate box that corresponds with your response to respective items.

SA = Strongly Agree ; A = Agree ; U = Undecided ; D = Disagree ; SD = Strongly Disagree

S/N	Economic Indicators	**SA**	**A**	**U**	**D**	**SD**
1	The operations of the Indorama Fertilizer Plant have increased business competitiveness in my community.					
2	The operations of the Indorama Fertilizer Plant have increased employment opportunities for residents of my community.					
3	The operations of the Indorama Fertilizer Plant have increased opportunities for training and career development for residents of my community.					
4	The operations of the Indorama Fertilizer Plant have led to improvement in economic activities in my community through economic diversification.					
5	The operations of the Indorama Fertilizer Plant have improved income level in my community.					
6	The operations of the Indorama Fertilizer Plant have increased the level of disposable income in my community.					
7	The operations of the Indorama Fertilizer Plant have not increased local cost of living in my community.					
8	The cost and benefit of the operations of the Indorama Fertilizer Plant have been equally distributed in my community.					
9	The operations of the Indorama Fertilizer Plant have not led to adverse economic lifestyle like gambling and crime.					
10	The operations of the Indorama Fertilizer Plant have not affected the traditional economy (i.e. hunting, trapping, gathering, and farming) of my community negatively.					

Appendix – 4.11

HEALTH IMPACT ASSESSMENT QUESTIONNAIRE
FOR IEFCL - TRAIN2 PROJECT
FOCUS ON GROUP DISCUSSION

Name of the Town/Village.....

Lifestyle/habits

1. What are the common types of food eaten in the community.....
2. Is there any food taboos Yes/No
3. What is the average life span (expectancy) in your community? .....
   a. Male ..... (b) Female
4. Do you drink alcohol? Yes/No. If yes, how often (1) Everyday (2) At least once a week (3) Occasionally
5. Do you smoke? Yes/No. If yes, how many sticks per day.....
6. When are those health problems common during the year?.....

S/NO	DISEASE	RAINY SEASON	DRY SEASON

7. Which of those health problems pose the greatest threat to your community?
8. (5 diseases to be listed in order of frequency.....
   .....
   .....
   .....
9. What are the most important causes of death in your community among:
10. Children under 5 years .....
11. Adults.....
12. How many deaths in the last one year among:
    i. Whole community.....
       a. Children under 5 years
       b. Adults (Women of child bearing age)
13. What refuse do you generate?.....

How do you store your refuse?
.....

14. How do you dispose your refuse?
.....

15. What is your method of sewage dispose?
.....

16. Do you have drainage in your community?
.....

17. Does your community get flooded or water logged?
.....

18. What is the source of the flooding?
.....

19. What is the source of your drinking water?
.....

20. Do you treat your water before drinking?
.....

21. Do you wash your hands before eating?
.....

22. Do you wash your hands after defecating?
(Toileting) .....

23. What are health facilities in your communities?
.....

24. What are the common environmental problems in your community?
.....

25. Did you think this project would cause any health problem in your community? Yes: No: ☐ ☐
If yes, what are the problems .....

26. How do you think these problems can be minimized?
.....

27. What do you think are the most important five health needs of your community? .....

28. Do you have the followings in your community?
(a) House fly/cockroach/mosquito/Lice/Black fly/Tsetse fly/and rats.
(b) What diseases could these insects cause/transmit?

29. Do you have sexual partners not married to you? Yes/No
(1) How many are they?
(2) Have you heard of sexual transmissible infection Yes/No?
(3) Have you ever had/contacted sexually transmissible infection? Yes/No
(4) What symptom (Complaints) did you have?

Appendix – 4.12

BRIEFING DOCUMENT FOR THE STAKEHOLDER ENGAGMENTS/PUBLIC FORUM

EIA OF PROPOSED IEFCL- TRAIN 2

PROPONENT: INDORAMA ELEME FERTILIZER AND CHEMICALS LTD (IEFCL)

PURPOSE OF THE PUBLIC FORUM

This forum is organized by management of IEFCL to enlighten the communities and other interested Stakeholders that may be directly or indirectly benefited / affected by the proposed project.

In line with Federal Governments Policy on Environment, including Environmental Impact Assessment (EIA) Decree 86 of 1992 guideline on Environment, this project will be executed in compliance with all relevant statutory regulations.

This forum is a part of a series of consultations with all the benefited / affected communities and other stakeholders. It will offer the opportunity to hear their views while soliciting for their support in the execution of the project.

BACKGROUND TO THE PROJECT

Nigeria is a major producer and exporter of crude oil and natural gas. In response to the abundant petroleum resources in the Niger Delta region and Federal Government's Policies on natural gas utilization, in 2012 Indorama management had decided to key in, to enhance Federal Government Policies on:

1. Clean methods for effective natural gas utilization for the production of Urea Fertilizer
2. Effective Fertilizer utilization per hectare of arable land
3. Enhanced Agricultural production for food security

In-line with above, Indorama management built a world class Urea manufacturing facility, IEFCL. After commissioning, the plants are operating on 100% installed capacity, nourishing the agricultural sector and national economy as well.

With the successful operation of IEFCL-train1 and looking forward to meet the agricultural demand, the IEFCL Management identified the following project. This project will place Nigeria as one of the major fertilizer producer, sustainably nourishing agricultural sector, which will increase food production resulting in actualizing the objective of food security.

PROJECT DESCRIPTION

The proposed fertilizer plant will utilize natural gas as its basic raw material and will be sited on free land space totaling approx. 26 hectares within the Indorama Eleme complex.
Other utilities (water, power and infrastructure) needed by this new plant are available within the complex.

The new fertilizer plant will have the following production capacities:

Ammonia 2,300MT/Day

Urea 4,000MT/Day

BENEFITS OF THE PROJECT

During Project Execution (construction):

- There will be employment opportunities for skilled, semi-skilled and unskilled manpower.
- The Federal Government Policy on local content will be implemented which will benefit the host communities.
- Construction contractors will be encouraged and required to employ (as many as possible) skilled, semi-skilled and unskilled man power and technicians from the local communities.
- The project will encourage sub-contractors and vendors from the host communities through patronage.

During Operations

- Commerce and economic activities will generally be enhanced, as Agricultural sector in the Niger Delta, as well as Nigeria at large, will have reliable and alternative source of fertilizer for their farming.

- Also alternative and reliable source for fertilizer as well as Urea for NPK blending plants will improve agriculture production which will reflect on food security.
- This project will provide suitable ground for skill acquisition, technology transfer, human empowerment etc.
- The plant processes involves effective energy/water use in a closed loop and having minimal emissions and discharge into the environment. This is an improved phenomenon in latest technology over the old generation fertilizer plants.
- This project will positively increase the nation's cumulative foreign exchange thus improving the nation's GDP and brand reputation.
- The new project will further cumulatively increase the economic activities in Eleme LGA and Rivers State.

NEGATIVE EFFECTS

During construction

The only foreseeable negative impacts will include:

- Increase vehicular transport (especially commercial trucks) that will visit the site to deliver goods/services.
- Increase in-house solid waste stream within IEFCL complex.
- Short term impact on air quality as a result of increased vehicular emissions.
- Increase population into the host communities may have some negative impacts.

During operations

- Increase traffic volume in the area.
- Increase in migrant workers.
- Impact on air quality in the event of gaseous emissions.
- Increase solid waste stream (plastic, metal, wood) within IEFCL complex.

ENVIRONMENTAL MANAGEMENT

The environmental risk management for the project will be implemented through a structured Cause and Effect Management Process (CEMP). This involves the identification of the potential environmental and social impacts, risks and hazards. The CEMP provide the opportunity for effective management of identified potential impacts proactively.

To this end, Environmental Impact Assessment (EIA) Studies has been commissioned for the project and in-fact field data gathering is conducted with FMEnv officers and community representatives' participation. Issues addressed in the study include socio-economy, health status of the study area, soil, surface water quality, ground water quality, air quality, noise, construction and operational wastes, etc.

The results of the EIA will contain an Environmental Management Plan (EMP) for the implementation by IEFCL, the proponent of the project.

ENGINEERING DESIGN

The potential environmental effects associated with the project will occur generally during project construction, as a result of minimal earth movement, machinery movement and noise. These will occur during the first half of the construction phase. This short-term phenomena is restricted to construction site only and hence public at large have no adverse impact.

The second half of construction which involves equipment installation will pose a localized and temporary environmental impact as a result of numerous welding work. This temporary insignificant environmental impact is limited to construction site only and have no effect on surroundings.

Several control/mitigative measures are built into the Engineering design to reduce environmental pollution, risks and hazards during construction as well as when the plants will be functional. For example, all calculations and drawings required for fabrication, welding and sourcing of materials shall conform to National and International Standards / Codes. The project management procedures will include specified HSE procedures and safety workshops etc.

COMMUNITY AFFAIRS/COMMUNITY RELATIONS

The project team will promote mutually beneficial relationships with all the host communities through close, prompt contacts, and regular discussions. Effort will be made to identify and proactively deal with community issues arising from the execution of the

work. The project team and Community Relations Department will interact and ensure that all stakeholders are adequately and routinely briefed on the operations.

The Proponent, in conjunction with its Consulting Engineers, will maintain a policy of high engineering proficiency, and compliance with the requirements of the relevant Government regulations, laws and statutes in the execution of this project.

Thank you for your attention, and we are willing to take questions.

INDORAMA ELEME FERTILISER AND CHEMICALS LIMITED

EIA PUBLIC FORUM FOR FERTILISER TRAIN 2

AT

BEST PREMIER HOTEL AND RESORT, ELELENWO RIVERS STATE

17/11/2017

s/n	Name	Community/Organization	Phone number	Signature
1	CONFIDENCE N. NGOFA	ALETO	08075552696	[signature]
2	RAMATU C. NGOFA	ALETO	08068128190	[signature]
3	OLAKA Samuel Eppie	Agbaelu	~~0803~~ 080309[illegible]487	[signature]
4	CHINDA NYEBUCHI G.	ELELENWO	07038832951	[signature]
5	Dudu Dudu	ALETO	07063142244	[signature]
6	ROBINSON AMIGOV	ALETO	09080383885	[signature]
7	SAIKA DUDU	ALETO	09092158650	[signature]
8	OBUZOR T. OBUZOR	AGBONCHIA	08037104965	[signature]
9	Hon. Obele Ekee	Agbonchia	09082223777	[signature]
10	Hon. Joseph (Testal) Ekee	Agbonchia	08033806718	[signature]
11	Mr. Johnson Goya	Agbonchia	07035611500	[signature]
12	HON NWOSU NLOWA, JP	ALETO	08038798079	[signature]
13	Mrs Ngiate B. Olaka	Aleto	09059098444	[signature]
14	Dame Cecilia Egbe	Aleto	08106441646	[signature]
15	Emmanuel Obefeo	Aleto	08036739878	[signature]
16	Kanwatoh O Dudu	Aleto	08064231119	[signature]
17	Comrade Edward .K.	AKPAJO.	08036700304	[signature]
18	Ohaka Goya	ALETO	08038982698	[signature]
19	BRIAN GOKPA	ELEME YOUTH	07035018004	[signature]
20	Princewill david olaka	Aleto	07067853741	[signature]
21	Rufus OSARO	ALETO	0803549625	[signature]
22	Gomba Dickson	Aleto, Eleme	08034350121	[signature]
23	NWIDAA GOMBA NWOKOLU	AKPAJO. ELEME	08033730319	[signature]
24	OKOSUN FELIX	INDORAMA	08056118766	[signature]
25	Dr JOSSY NKWOCHA	INDORAMA	08055[illegible]	[signature]
26	[illegible] Igwe	Njuru	08037736427	[signature]
27	Hon. Ignatius Kattey	ELEME L.G.A	08063540964	[signature]
28	Comr. Jacob Wuwu	ELEME L.G.A	08034652059	[signature]
29	Sunny Opara	Aleto	08091952044	[signature]
30	Mrs Ngozi Wodi	Nwakohu family	07035377078	[signature]
31	Beatrice Wodi	Nwakohu " "	08062663906	[signature]
32	ODUM GLORY QUEEN	~~ALETO~~ UNIPORT	08068610954	[signature]
33	ALENDU [illegible]	Agaleme[illegible]	08086980385	[signature]
34	Atwell Nteegah	Uniport	08069214958	[signature]
35	PHILEMON.O. NGOFA	ALETO	08038896697	[signature]
36	NWOLU NWOLU	AGBONCHIA	08086121653	[signature]
37	(Emere) Osaro A. [illegible] for Akpakpan		08033391185	

S/N	Name	Community/organization	Phone number	Signature
38	Com. CHRISTIAN OKOCHI	AKPAJO	07030138558	
39	Kenneth O. Sanu	Aleto	08054087519	
40	IKODIE AUGUSTINE	OKEREWA	08036876224	
41	Ayeleme Wale	E&CS/Consultant	08137203981	
42	Ugwuoke Chuka	Agborchia	08057088788	
43	Ibifas KW	RIVERS	08033401062	
44	Dr. Emmanuel Ibaing	IMO N ENV RIVERS	08033961744	
45	Richard S Yagbas	Okerewa	08037329932	
46	Nwajama GODA	Okerewa	08089335854	
47	Peter Amadi	ALETO	08037896057	
48	Obele Obe Eson	Aleto	08033361866	
49	TiTi Sunday Gwia	Aleto	08038988854	
50	Mercy Gimbert	Aleto	08051977092	
51	Grace E. Egbe	Aleto	08060762644	
52	Igwe Obey Ngwe	Aleto	08185757898	
53	Oliver N. Nwidaa	Akpajo	08035518874	
54	OLAKA GODDAY WUWU	AKPAJO	08065832929	
55	CADDA O. OCHEN	ALETO	08036677626	
56	Cappa felicia Osis	Aleto	08065575286	
57	Ogbonna Ugofa	Aleto	08030888638	
58	Nwagbara Ugofa	Aleto	08137167067	
59	Blessing Wuwuobe	Aleto	08067197071	
60	Evang Salome Nnamu Nwolu	Aleto	08063503736	
61	Obele Besinee	Agbonchia	08131032939	
	PHILIP OKPARAZA	CIVIL SOCIETY	08037099197	
65	VICTOR NWOKU	AGBONCHIA	08191875411	
66	Owate Victor	AGBONCHIA	08102791816	
67	OTAKI JIMA GOMBA	AGBONCHIA	07060753515	
68	DAVID EJIRE	AGBONCHIA	08034221713	
69	Chuma Daniel Jima	Aleto	07066828717	
70	George O. Nkoi Obe	Aleto	08135621168	
71	Gowba Obanjima	Agbonchia	07060753515	
72	Fortune Sabbe	Agbonchia	08030447943	
73	Agba NWAJI	ALETO	08036636557	
74	Chinedu Jochi	Aleto	07035797145	
75	JOHN MICAH	AKPAJO	08037524365	
76	ANITA JOHN MICAH	AKPAJO	08035079273	
77	PERFECT EBIE NWOSU	AKPAJO	08030953333	
78	ELIJAH OLUKA-NWAFOR	ALOBE	08167500078	
79	NTEANA OLUKA	AGBONCHIA	07063082062	
80	JAKA GOD'SPOWER-K	AKPAJO INDORAMA	08171476692	
81	Kendrick Oluka	INDORAMA	08055266268	

INDORAMA ELEME FERTILISER AND CHEMICALS LIMITED

EIA PUBLIC FORUM FOR FERTILISER TRAIN 2

AT

BEST PREMIER HOTEL AND RESORT, ELELENWO RIVERS STATE

17/11/2017

s/n	Name	Community/Organization	Phone number	Signature
1	NGAH VICTORY EZINNE	E&CS LTD	07068617796	
2.	ADETAYO. O. ALICE	E&CS LTD	07088579848	
3	NWACHUKWU SOLOMON	E&CS LTD	08032906028	
4	INIABE EEZOR	E&CS LTD	08095314007	
5	DR. MAHENDRA JAIN	IEFCL	08070324523	
6.	UCHE O DAVID	FMENV	08137487070	
7.	OBI AUGUSTA	FMENV	08032658246	
8	DALJIT SINGH	IEFCL	08150864361	
9.	S. MURALI MOHAN	IEFCL	08057575697	
10	OKORI, OBARIJUMA	IEFCL	08034439532	
11	EBISIKE, OBIOMA	IEFCL	08128328809	
12	Pradeep ERKO	Indorama	08052294360	
13	IKUE JOHN N.	UNIPORT	08036658036	
14	Lagbdam Dorcas	Uniport	09055114249	
15.	DAOFA EFUKA	RPCL	08099932762	
16	Chf. Oluka Koida	Ayolanchie	08033127527	
17	VINCENT, M.O.	UNIPORT	08091959491	
18	OGO RISI	ELELENWO	08036656824	
19	K. TOMBARI SIBE	E&CS LTD	08037089277	
20	OSAROGODA AJI	OKERENA	08039323698	
21	Chief (Mrs) Grace Aji	✓	✓	
22	Mrs. Blessing Kanwi	✓	✓	
23	Bish. Stephen Wodi JP	Wokoma Elelenwo	08032485530	
24	Nyebuchi Nwakolu	✓	08038958740	
25	OBE-MBIEH J.J.	HUMAN RIGHT	08037799414	
26	BENSON OLUKA	ALETO	08035077629	
27	Temple Lolo Lala	Aleto	08035512578	
28	O G WILLIAMS	ALETO	08135137112	
29	OSARUWATAR CHUKA	AGBONCHIA	08068439539	
30	Maxwell Losan	Aleto	08066906514	
31	Gomba nwoji	Aleto	09094511224	
32	Andrew ochon	✓	07039171425	
33	Godwin Wmade	✓	08037483521	
34	Osaro Uke	✓	07068115980	
35	Sir C C Ochijndo	Akpajo	08058479960	
36	Joshua Omofe	Okerenkoko	07035834935	
37	Er. Chris Ayi			

	Name	Community/organization	Phone number	Signature
38	Ngofa Ezekiel	Aleto	08034838080	[signature]
39	Twenty Afunji	Aleto	08187020230	[signature]
40				
41				
42	fortune Abeknike	Aleto	08069309211	[signature]
43	timothy Lyime	ALETO	08057445835	[signature]
44	Obele Ngoke Dick	AKPAJO	08037452953	[signature]
45	Osamoluka Godwin	Akpajo	08037070505	[signature]
46	Chief Blessing U.S	[illegible]	08060369214	[signature]
47	MERCY FIDAY	[illegible]		
48	Amenga Ngofa	Aleto	08131923660	[signature]
49	HRH CHIEF WELLINGTON	AKPAJO.	08134416692	[signature]
50	SIR SUNDAY OSARO LUJI	AKPAJO.	-	[signature]
51	GODPOWER TEKARA	AGBONCHIA	08089101616	[signature]
52	CHF. DAILY NWAKPOLU	AKPAJO	08033393138	[signature]
53	RUFUS NWAFOR	AKPAJO	08057923670	[signature]
54	ALENTU IKE WAI	Agbonchia	08086880385	[signature]
55	Moses Atale	Akpajo	08057526543	[signature]
56	ABBEY OBO ABBEY	ALETO	08038700342	[signature]
57	FRANCIS EJEEF	Agbonchia	08037922456	[signature]
60	Ngolaka Dickson	Akpajo-Eleme	08027299922	[signature]
61	Meshack Oluka	Akpajo-Eleme	08088799998	[signature]
62	Prince Friday Y.	OKERENKOKO	08037964371	[signature]
63	Ngei Sob	Agbonchia	08037639417	[signature]
64	Obele Ceh Ossom	Nyu-u	08031570955	[signature]
65	Meshack Oluka	Akpajo	08032544225	[signature]
66	Aruji Igwe	INDORAMA	08033405190	[signature]
67	RUZZEL NGOFA	ALETO	08063345585	[signature]
~~68~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	[signature]

STAKEHOLDER ENGAGEMENT / PUBLIC FORUM MEETING FOR THE EIA ON "IEFCL-TRAIN2 PROJECT" BY INDORMA ELEME FERTILIZER & CHEMICALS LIMITED,

PROCEEDINGS

Date : 17th November' 2017

Venue : Best Premier Hotels, Opposite Intel's Camp, KM16, Aba Road, Elelenwo

Indorama Team: Pradeep Ekka, Murali Mohan, Daljit Singh, Dr. Mahendra K. Jain, Kendrick Oluka, Dr. Jossy Nkwocha, Felix Okosun, Obarijima Okori, Ebiseke Obioma, Engr. Olu Andah Wai-Ogosu

Observers : Representatives from Eleme LG, FMEnv Zonal Office PHC, RSMENV PHC

Participants : From Host communities and other stakeholders signed in on Attendance sheet.

Introduction

The meeting started at about 10.10am after accreditation of participants with the recognition of the special adviser to the Managing Director, Indorama, Nigeria by the MC of the day, Mr. Jossy Nkwocha. Thereafter an Opening prayer was said by Mrs. Risi of Elelenwo community. This was followed by the introduction and welcome of Regulators and Indorama team by Dr. Jossy Nkwocha (SA to MD on Corporate Communications), introduction and welcome of the representative of the paramount ruler of Eleme and Honorable Chiefs from the communities by Mr. Kendrick Oluka (Head of Communality relations), Safety briefing by Engr. Raymond (Safety Officer) of Best Premier Hotels, Opening remarks by Head HR & IR, Mr. Pradeep Ekka, presentation of briefing document by IEFCL Env. Consultant Engr. Olu Andah Wai-Ogosu. Highlighting project background, process description, engineering design, environment and social impacts of proposed IEFCL-Train2 project on host communities. The next session was open session for questions and comments.

Question and Answer Session

Name : **Hon. Joseph Ekee**

Community : Agbonchia

Question : Can two (2) fertilizer companies be sited in same location

Response :

Yes, two fertilizer plants can be sited in a place when the design and engineering compliments each other. Also if source of energy, water and other ancillary facilities etc. are shared. In the Indorama case above consideration, and most importantly both plants uses the latest technology in the Fertilizer world which makes it impossible for ammonia to be emitted into the atmosphere unless there is a major disaster. On related inference made about the soot issue which was experienced in Port Harcourt from October 2016. Engr Wai-Ogosu replied that Indorama as a responsible corporate body assembled its Environment group and swung into action, carrying out pilot studies in November 2016 and April 2017 to help determine the sources and origin of the soot. A preliminary report revealed that old and worn out trucks, the artisnary refineries and some other source of incomplete combustion may be responsible for the soot problem. On a related question on what Indorama is doing to reduce traffic congestion on its axis of the highway. The environmental Consultant replied that Indorama conducted a Traffic management study for the first project to determine traffic peak periods in terms of hours and days. This is used to determine the time the Indorama trucks, are out of the facility.

Name : **Hon. Obele Ekee**

Community : Agbonchia

Question : Petrochemicals & Fertilizer Plant situated in one (1) location contributes to traffic gridlock covering the entire road between Akpajo junction and Aleto Bridge. They also emit air pollutants into the atmosphere

Can alternative routes be constructed for truck usage via Agbonchia through Oyigbo link road in order to decongest Akpajo axis

Response:

Alternative road can form a mitigation measure. We noticed that the poor condition of the Federal East-West Highway was responsible for the frequent traffic gridlock on that section of the highway. That informed intervention by Indorama to help the government repair the damaged portion of the Eleme section of the east west road. Whatever arrangement will reduce pressure on the East-West Road Indorama will look at it.

Response from HRH Chief Philip of Aleto: My questions and worry was solved by my visit to India with Eng Ogosu. The volume of vehicles accessing our road is not only for Indorama, it passes to Onne, to Oron and to other places. Eleme has a lot of companies and it is not only petrochemical that should be asked to do an alternative road. Petrochemical has acquired a land for the park and they should develop it. Indorama should try to maintain the portion they are using. The Eleme area has over 200 companies and two refineries at Alesa, the government should encourage these actors to join hands with Indorama in the good work that it's is doing.

Name	:	**Barr. Francis Obe-Mbieh**
Organization	:	Society for Environment, Development & Services (NGO)
Question	:	Have you got plans for Long term and short term risk management plans as regards upcoming project What possible environment effects on human health and vegetation

Response:

Engr Ogosu: There is no need to come here and read data from 2007 to date because we are here to talk about a new project that is yet to be constructed. Before any of new project commences, a risk analysis is carried out. It was carried out for the first fertilizer project and the risk analysis for the second one will involve the cumulative impact. This shall be done.

HRH Chief Philip of Aleto added by saying that the only question Francis should ask is where the body of water that can carry the volume is of what is coming out of Indorama. The commander of operation 'crocodile smile' said they destroyed about 1000 (one thousand) illegal refineries. The Governor of Rivers State saw some people burning tyres and arrested them. They are the source of soot. There is a community in China that they do not live up to 55 years because of pollution and the people die of cancer. Eleme community should be

declared an emergency area by the federal government. For a very long time we deserved a state emergency.

Name : **Commrade. Ngei Job** (Indorama Host Communities Youth President)

Organization : Indorama Host Communities Youth Body

Question : We understand you are building another Fertilizer Plant, and we are also aware that our people are under-employed in the existing Fertilizer/Petrochemical system. Will our percentage quota in terms of staff employment be filled up in the upcoming set-up.

What about our signature bonus for train 1 project; will this signature bonus be paid for train 2 project?

Is this Public forum supposed to hold at Best Premier hotels or at suitable location within the host community so that aggrieved ones can express themselves? If it's not the ideal location,

I understand Indorama Management is building a new gas turbine … Are you ready to provide electricity with our communities?

Name : **Mr. Nwosu Ngofa**

Community : Aleto

Question : OKULU stream is polluted. What is our benefit? Okulu water, a drinking water source is no more portable. Therefore, we request Indorama to provide portable water within its host communities.

IEFCL should also take into consideration the provision of light (Electricity) to its host communities

Response:

In the briefing document, I did mention that the study of surface water is a major aspect of the EIA scope of work. Presently Indorama conducts monthly physiochemical and microbiology studies of the Okulu stream which takes its head from Agbonchia (Host community) and empties into the Amadi creek in south. During this course some materials of anthropogenic and industrial characteristic are introduced into the water body. One major hazardous activity on this surface water is the continuous sand mining which is helping to make the water body unhealthy for aquatic life forms and also destroying its utility value (fishing, recreation etc.) Indorama in attempt to find out the effects of these

activities carried out a study on the stream carrying capacity. The report has been submitted to the Federal Ministry of Environment. Most important is the fact that Indorama is willing to work with state and local government to find out how best to resuscitate the Okulu stream.

Name : **Mr. Fortune S. Nyimeobari**

Community : Agbonchia

Question : This EIA process is not people friendly. How many communities were considered in the study? Who and who was questionnaire's administered to? I did not receive neither did any of my younger one's receive. What were the criteria for administering health questionnaires if there was any distributed at all.

Response

Your comments are well taken but please remember that the EIA process does not set time for public consultation and questionnaire administration. Consultation in a continuous process in the life of a project.

Name : **Chief Philip Obele** (Paramount ruler – Aleto Clan)

Organization : Representing Eleme Council of Chiefs

Comments :

- I have keenly followed up environmental studies in Rivers State. I also visited India to inspect similar facilities located there.
- IEPL acquired truck park that is already fenced, we urge Indorama to develop the park in order to mitigate traffic impact on road users
- FG's neglect on Eleme in comparison to revenue generated from over 200 companies situated within this axis is not encouraging.
- Carrying capacity of Okulu as regards effluents from IEPL, IEFCL trains 1 & 2 is considered in the design process
- Black soot was blamed on Indorama but a chat with NNS Pathfinder commander confirmed that over 1000 illegal refineries

have been destroyed in the creeks. This is a major contributor to black soot within Rivers State.

- Inadequate medical facilities within Eleme; reference to a particular city in China which the average life span is 55yrs old as a result of air pollution. We request for befitting medical facilities for our people
- What about our signature bonus for train 1 project; will this signature bonus be paid for train 2 project
- I personally sponsored researchers from Institute of Pollution Studies in Uniport and Rivers State University to investigate the level of pollution at Okulu River. We need to contest results provided by Indorama's Environmental consultant and at the appropriate time, I will confront Indorama to clarify results on Okulu River.

Head, HR & IR response: all concerns are noted and we are open and we will embrace the new youth body and work with everyone at large.

EIA public forum was wrapped up by goodwill messages from the following:

1) President of Eleme youth council Comrade Prince Gokpa: On behalf of Eleme youth council, I felicitate with Indorama. You are a practical example of privatization and government should give private company a chance. We are happy for the skill transfer to the host communities and hope the project will influence the socio-economic of the host communities.

2) The representative of the caretaker committee chairman of Eleme Local Government Area, Robert Ogosu apologized for the unavoidable absence the Chairman. Robert congratulated Indorama for making Eleme popular. NAFCON made Eleme people popular when we were small and Indorama as Eleme grows socio-economically is what makes Eleme popular now. As a council, we will make bridge and the council will not take side. We have to see Eleme first and not play politics and sentiment

with development. There is no way they will build the plant without creating employment. Let us see this opportunity as a means to grow our community.

3) The Permanent Secretary RSMENV, Dr. Emmanuel Uruang congratulated the host community and said that they should be proud to be the host community to a multinational as Indorama. Issues has been noted, amendment has to be made. The duty of the government is to ensure that this project is a success. No part of the representative of the stakeholder will want to be blamed for the failure of this project. There is the need to think of how to mitigate all adverse effect. Indorama should be ready to do mitigation. The state government will not fold its hands but will watch as developments unfold.

4) The representative of the Hon. Minister for Environment Ogbonnaya Uche commends Indorama for this wonderful opportunity to gather us here. He said the consultation process is an ongoing process and runs through the life of the project. Take the project as your project and as you take it, every benefit will accrue to you. Indorama has tapped into the program of the FG to utlise natural gas. Indorama should look at the comments, the traffic. The FMENV and the FG is behind this process. He employs Indorama to continue the good works.

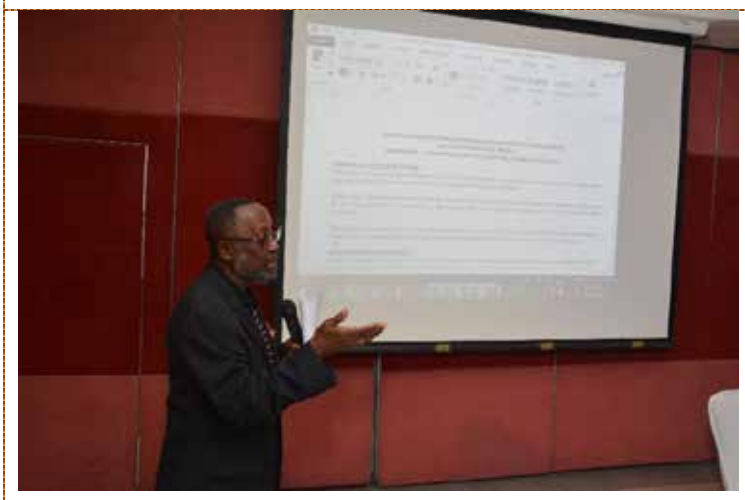
Vote of thanks by Mr. Kendrick Oluka (Community Relations & Development)

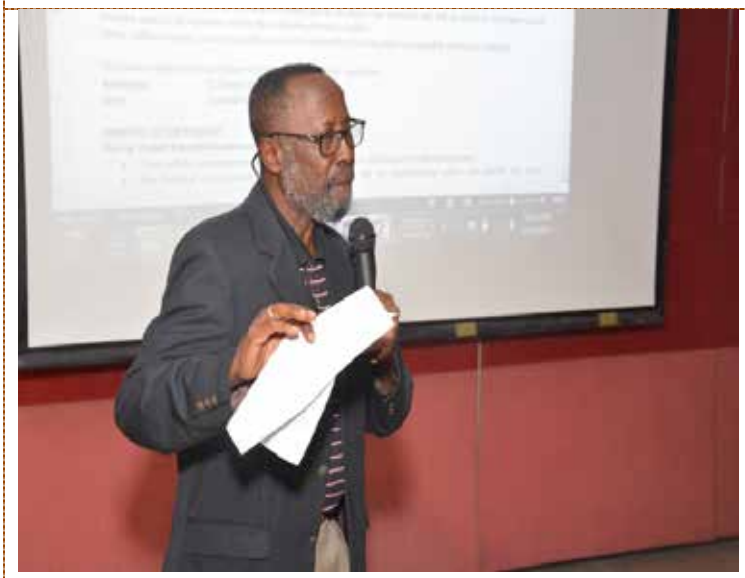
After which, program was finalized with closing prayer by Mrs. Evelyn Gokpa (Eleme Women Chief).

Photographs of Stakeholder Engagement/Public Forum

Arrival of Stakeholders

Stakeholder Engagement Meeting






IEFCL
Welcomes
Honourable Stakeholders
Date: 17th Nov' 2017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Community Development Programmes

www.indorama.com

Budgetary Support for Community Development Programmes

Ø Host Communities (6 No's)

Fig. in Naira

MOU Period	Duration (Years)	No of Communities	Budget / Host Comm.	Total Budget
2007 - 2010	3	6	10,000,000	180,000,000
2010 - 2013	3	6	15,000,000	270,000,000
2013 - 2016	2	6	17,500,000	330,000,000
2013 - 2016	1	6	20,000,000	
2016 - 2019	3	6	30,000,000	540,000,000

Ø Pipeline Transit Communities (30 No's)

Fig. in Naira

Project Period	Duration (Years)	No of Communities	Budget / Host Comm.	CSR Budget
2014 - 2015	1	30	5,000,000	150,000,000

Community development programmes:
Akpajo Community

S. Nos.	Project	Phase	Amount	Status
1	Electricity Project	I	N 10M	Completed
2	440 Meters Road Project	IV	N 20M	Completed
3	33MVA Substation	III	N 15M	Completed
4	33MVA Substation	II	N 15M	Completed
5	14 Classrooms Block	V-IX	N 90 M	In Progress

Community development programmes:
Agbonchia Community

S. Nos.	Project	Phase	Amount	Status
1	266Meters Road Project	I	N10M	Completed
2	340 Meters Road Project	II	N15M	Completed
3	366 Meters Road Project	III	N15M	Completed
4	360 Meters Road Project	IV	N15M	Completed
5	440 Meters Road Project	V	N20M	Completed
6	365 Meter 2 sides Drainage Projects	VI	N17.5M	Completed
7	365 Meter 2 sides Drainage Projects	VII	N17.5M	Completed

Community development programmes:
Njuru Community

S. No.	Project	Phase	Amount	Status
1	Electricity Project	I	N10M	Completed
2	Palace Road Project	II	N15M	Completed
3	Drainage/ Road Project	III	N15M	Completed
4	Drainage Project	IV	N20M	Completed

Community development programmes:
Okerewa Community

S. No.	Project	Phase	Amount	Status
1	Electrification Project	I	N10M	Completed
2	600mtrs drainage Project	II	N15M	Completed
3	366 Meters Road Project	III	N15M	Completed
4	360 Meters Road Project	IV	N20M (1st MoU)	Completed
5	440 Meters Road Project	V	N15M (2nd MoU)	Completed
6	Health Centre	VI-VIII	N55M	In Progress

Community development programmes:
Aleto Community

S. Nos.	Project	Phase	Amount	Status
1	Purchase of Land for	I	N10.0M	Completed
2	Construction of 12 Class room Block	II	N15.0M	Completed
3	Continuation of School Project	III	N15.0M	Completed
4	Continuation of School Project	IV	N15.0M	Completed
5	Continuation of School Project	V	N17.5M	Completed
6	Finishing of School Project	VI	N20.0M	Completed
7	Finishing of School Project	VII	N17.5M	Completed
8	Finishing of School Project	VIII	N20.0M	Completed

Community development programmes:
Elelenwo Community

S. Nos.	Project	Phase	Amount	Status
1	266Meters Road Project	I	N10M	Completed
2	340 Meters Road Project	II	N15M	Completed
3	366 Meters Road Project	III	N15M	Completed
4	360 Meters Road Project	IV	N15M	Completed
5	440 Meters Road Project	V	N20M	Completed
6	Interlocking of Road network	VI	N17.5M	Completed
7	Construction of 9 Classrooms Block	VII-IX	N57.5M	In Progress

Merit Scholarship for Indigenes, studying in Tertiary Institutions

- Eleme has instituted scholarship program for the meritorious students from Eleme's Host Communities for engineering and physical sciences streams
- Scholarship is being given for graduates in university and polytechnic
- Scholarship has been progressively improved upon

	2009	2010	2011	2012	2013	2014	Total
Batch I	18	18	18	18			72
Batch II		18	18	18	18		72
Batch III			*	18	18	18	54
Batch IV					18	18	36
Batch V						18	18
Total	**18**	**36**	**36**	**54**	**54**	**54**	**252**

*PAC could not submit list of applicants for the year 2011

Photo gallery

Renovation of Hospital

Renovated Nchia General Hospital Eleme

Commissioning of the New Roads at Nchia Hospital

Photo gallery

Donation of notebooks to schools in Eleme and Excited pupils

Federal Highway -- N530 million donated

Appendix – 4.14

Field Activity/Survey Photographs

Kick-Off Meeting with Regulators

Consultants

Moving to Up-stream – Okulu Stream

Surface water / Sediment / Hydrobiology Sampling

In-Site measurement Equipments

Okulu Stream

Soil Sampling

Soil Sampling and In-site measurement


Soil Sampling and In-site measurement


Soil Sampling and In-site measurement


Ambient Air Quality Monitoring

Ambient Air Quality Monitoring

Ambient Air Quality and Noise Monitoring

Field Data Recording