

ANNEXURE-III
METHODOLOGY FOR SAMPLING AND ANALYSIS

1.0 Meteorology

The methodology adopted for monitoring surface observations is as per the standard norms laid down by Bureau of Indian Standards (IS:8829) and India Meteorological Department (IMD).

1.1 Methodology of Data Generation

The Central Monitoring Station (CMS) equipped with continuous monitoring equipment was installed at site at a height of about 10-m above ground level to record wind speed, direction, relative humidity and temperature. The meteorological monitoring station was located in such a way that it is free from any obstructions and as per the guidelines specified under IS:8829. Cloud cover was recorded by visual observation. Rainfall was monitored by rain gauge.

The continuous recording meteorological instrument of Dynalab, Pune (Model No.WDL1002) has been used for recording the met data. The sensitivity of the equipment is as given in **Table-1**.

TABLE-1
SENSITIVITY OF METEOROLOGY MONITORING STATION

Sr. No.	Sensor	Sensitivity
1	Wind speed Sensor	± 0.02 m/s
2	Wind direction Sensor	± 3 degrees
3	Temperature Sensor	± 0.2°C

Hourly maximum, minimum and average values of wind speed, direction and temperature were recorded continuously with continuous monitoring equipment. All the sensors were connected to filter and then logged on to datalogger. The readings were recorded in a memory module, which was attached to datalogger. The memory module was downloaded in computer through Dynalab software. The storage capacity of memory module was 256 KB. Data was downloaded every fortnight into the computer. The data was recorded continuously. The recovery of data was about 98%. The rest of 2 % data gaps were filled by referring to IMD data and daily weather reports in the local newspapers. However, Relative Humidity and Rainfall were recorded manually.

1.2 Ambient Air Quality

1.2.1 Method of Analysis

The air samples were analyzed as per standard methods specified by Central Pollution Control Board (CPCB), IS: 5184 and American Public Health Association (APHA).

1.2.2 Instruments used for Sampling

Respirable Dust Samplers APM-451 instruments have been used for monitoring Total Suspended Particulate Matter (TSPM), Respirable fraction (<10 microns) and gaseous pollutants like SO₂ and NO_x. Charcoal filled glass tubes were deployed for collection of carbon monoxide. Gas Chromatography techniques have been used for

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the estimation of CO. VOC's were collected in specially designed glass tubes called VOC tubes and analyzed on Gas Chromatograph.

1.2.3 Instruments used for Analysis

The make and model of the instruments used at Vimta Labs Limited for analysis of the samples collected during the field monitoring are given in **Table-2**.

TABLE-2
INSTRUMENTS USED FOR ANALYSIS OF SAMPLES

Sr. No	Instrument Name	Make	Model	Parameters
1	Spectrophotometer	HACH	DR 2000; Sl. No. 911016344	SO ₂ , NO _x
2	Electronic Balance	Metler	AE 200S; Sl. No M10774	TSPM, SPM, RPM
3	Gas Chromatograph With FID, pFPD, ECD	GC-3, VARIAN	CP- 3800-44; Sl. No. 8094	CO, HC, VOC

1.2.4 Sampling and Analytical Techniques

1] Particulate Matter PM₁₀, PM_{2.5}, SO₂ and NO_x

PM₁₀ and PM_{2.5} present in ambient air is drawn through the cyclone. Coarse and non-respirable dust (>10 μ) is separated from the air stream by centrifugal forces acting on the solid particles. These separated particulates fall through the cyclone's conical hopper and collect in the sampling cup placed at the bottom of the cyclone. The fine dust (<10 microns) forming the respirable fraction passes the cyclone and is retained by the filter paper.

A tapping is provided on the suction side of the blower to provide suction for sampling air through a set of impingers. Samples of gases are drawn at a flow rate of 0.2 Liters Per Minute (LPM).

PM₁₀ and PM_{2.5} have been estimated by Gravimetric method (IS: 5182, Part IV). Modified West and Gaeke method (IS-5182 Part-II, 1969) has been adopted for estimation of SO₂. Jacobs-Hochheiser method (IS-5182 Part-VI, 1975) has been adopted for the estimation of NO_x.

Calibration:

Calibration charts have been prepared for all gaseous pollutants. The calibration is carried out whenever new absorbing solutions are prepared. All the Respirable Dust Samplers are calibrated as per ASTM D-4096. The rotameter is calibrated using soap bubble meter.

2] Carbon Monoxide, Hydrocarbon and VOC

A sample of the air containing carbon monoxide and hydrocarbons is adsorbed on Charcoal plugged into a glass tube. The adsorbed charcoal is eluted using the solvent, which in turn is projected into the gas chromatograph where it is carried from one end of the column to the other. During its movement, the constituents of the sample undergo distribution at different rates and ultimately get separated

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from one another. The separated constituents emerge from the end of the column one after the other and are detected by suitable means whose response is related to the amount of a specific component leaving the column [CO- IS: 5182 (Part-XVII; HC-IS: 5182 (Part-X)]. VOC's were collected in specially designed glass tubes called VOC tubes and analyzed on Gas Chromatograph.

The techniques used for ambient air quality monitoring and minimum detectable level are given in **Table-3**.

TABLE-3
TECHNIQUES USED FOR AMBIENT AIR QUALITY MONITORING

Sr. No.	Parameter	Technique	Minimum Detectable Limit ($\mu\text{g}/\text{m}^3$)
1	PM ₁₀	Fine Dust Sampler (Gravimetric method)	5.0
2	PM _{2.5}	Fine Dust Sampler (Gravimetric method)	2.0
3	Sulphur dioxide	Modified West and Gaeke	4.0
4	Oxide of Nitrogen	Jacob & Hochheiser	9.0
5	Carbon Monoxide	Gas Chromatography	12.5
6	VOC's and HC	Gas Chromatograph	0.5 to 25 ppb

1.3 Water Analysis

Samples for chemical analysis were collected in polyethylene carboys. Samples collected for metal content were acidified with 1 ml HNO₃. Samples for bacteriological analysis were collected in sterilized glass bottles. Selected physico-chemical and bacteriological parameters have been analyzed for projecting the existing water quality status in the study area. Parameters like temperature, Dissolved Oxygen (DO) and pH were analyzed at the time of sample collection.

The methodology for sample collection and preservation techniques was followed as per the Standard Operating Procedures (SOP) mentioned in **Table-4**.

TABLE-4
STANDARD OPERATING PROCEDURES (SOP)
FOR WATER AND WASTEWATER SAMPLING

Parameter	Sample Collection	Sample Size	Storage/ Preservation
pH	Grab sampling Plastic /glass container	50 ml	On site analysis
Electrical Conductivity	Grab sampling Plastic /glass container	50 ml	On site parameter
Total suspended solids	Grab sampling Plastic /glass container	100 ml	Refrigeration, can be stored for 7 days
Total Dissolved Solids	Grab sampling Plastic /glass container	100 ml	Refrigeration, can be stored for 7 days
BOD	Grab sampling Plastic /glass container	500 ml	Refrigeration, 48 hrs
Hardness	Grab sampling Plastic /glass container	100 ml	Add HNO ₃ to pH<2, refrigeration; 6 months
Chlorides	Grab sampling Plastic /glass container	50 ml	Not required; 28 days
Sulphates	Grab sampling Plastic /glass container	100 ml	Refrigeration; 28 days
Sodium, Potassium	Plastic container	100 ml	Not required; 6 months
Nitrates	Plastic containers	100 ml	Refrigeration; 48 hrs

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Parameter	Sample Collection	Sample Size	Storage/ Preservation
Fluorides	Plastic containers only	100 ml	Not required; 28 days
Alkalinity	Plastic/ glass containers	100 ml	Refrigeration; 14 days
Ammonia	Plastic/ glass containers	100 ml	Add H ₂ SO ₄ to pH>2, refrigeration, 28 days
Hexavalent Chromium, Cr ⁺⁶	Plastic/ Glass rinse with HNO ₃	100 ml	Grab sample; refrigeration; 24 hrs
Heavy Metals (Hg, Cd, Cr, Cu, Fe, Zn, Pb etc.)	Plastic/ Glass rinse with HNO ₃	500 ml	Filter, add HNO ₃ to pH>2; Grab sample; 6 months

Source: *Standard Methods for the Examination of Water and Wastewater, Published By APHA, AWWA, WEF 19th Edition, 1995*

1.3.1 Analytical Techniques

The analytical techniques used for water and wastewater analysis is given in the **Table-5**.

TABLE-5
ANALYTICAL TECHNIQUES
FOR WATER AND WASTEWATER ANALYSIS

Parameter	Method
pH	APHA-4500-H ⁺
Colour	APHA-2120 C
Odour	IS: 3025, Part-4
Temperature	APHA-2550 B
Dissolved Oxygen	APHA-4500 O
BOD	APHA-5210 B
Electrical conductivity	APHA-2510 B
Turbidity	APHA-2130 B
Chlorides	APHA-4500 Cl ⁻
Fluorides	APHA-4500 F ⁻
Total dissolved solids	APHA-2540 C
Total suspended solids	APHA-2540 D
Total hardness	APHA-2340 C
Sulphates	APHA-4500 SO ₄ ⁻²
Arsenic	APHA-3120 B/ APHA-3114 B/ APHA-3500 As
Calcium	APHA-3120 B/ APHA-3500 Ca
Magnesium	APHA-3120 B/ APHA-3500 Mg
Sodium	APHA-3120 B/ APHA-3500 Na
Potassium	APHA-3120 B/ APHA-3500 K
Manganese	APHA-3120 B/ APHA-3500 Mn
Mercury	APHA-3112 B/ APHA-3500 Hg
Selenium	APHA-3120 B/ APHA-3114 B/ APHA-3500 Se
Lead	APHA-3120 B/ APHA-3500 Pb
Copper	APHA-3120 B/ APHA-3500 Cu
Cadmium	APHA-3120 B/ APHA-3500 Cd
Iron	APHA-3120 B/ APHA-3500 Fe
Zinc	APHA-3120 B/ APHA-3500 Zn
Boron	APHA-4500 B
Coliform organisms	APHA-9215 D
Alkalinity	APHA-2320 B

1.4 Soil Quality

At each location, soil samples were collected from three different depths viz. 30 cm, 60 cm and 90 cm below the surface and are homogenized. This is in line with IS: 2720 & Methods of Soil Analysis, Part-1, 2nd edition, 1986 of (American Society for Agronomy and Soil Science Society of America). The homogenized samples were analyzed for physical and chemical characteristics. The soil samples were collected and analyzed once in each season.

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The samples have been analyzed as per the established scientific methods for physico-chemical parameters. The heavy metals have been analyzed by using Atomic Absorption Spectrophotometer and Inductive Coupled Plasma Analyzer.

The methodology adopted for each parameter is described in **Table-6**.

TABLE-6
ANALYTICAL TECHNIQUES FOR SOIL ANALYSIS

Parameter	Method (ASTM number)
Grain size distribution	Sieve analysis (D 422 - 63)
Textural classification	Chart developed by Public Roads Administration
Infiltration capacity	Infiltrometer
Bulk density	Sand replacement, core cutter
Porosity	Void ratio
Sodium absorption ratio	Flame colourimetric (D 1428-82)
PH	pH meter (D 1293-84)
Electrical conductivity	Conductivity meter (D 1125-82)
Nitrogen	Kjeldahl distillation (D 3590-84)
Phosphorus	Molybdenum blue, colourimetric (D 515-82)
Potassium	Flame photometric (D 1428-82)
Copper	AAS (D 1688-84)
Iron	AAS (D 1068-84)
Zinc	AAS (D 1691-84)
Boron	Surcumin, colourimetric (D 3082-79)
Chlorides	Argentometric (D 512-81 Rev 85)
Fluorides	Fusion followed by distillation and estimation by Ion selective electrode.

1.5 Noise Levels

1.5.1 Method of Monitoring

Noise level monitoring was carried out continuously for 24-hours with one hour interval starting at 0030 hrs to 0030 hrs next day. The noise levels were monitored on working days only and Saturdays, Sundays and public holidays were not monitored. During each hour L_{eq} were directly computed by the instrument based on the sound pressure levels. L_{day} (L_d), L_{night} (L_n) and L_{dn} values were computed using corresponding hourly L_{eq} of day and night respectively. Monitoring was carried out at 'A' response and fast mode.

Parameters Measured During Monitoring

For noise levels measured over a given period of time interval, it is possible to describe important features of noise using statistical quantities. This is calculated using the percent of the time certain noise levels exceeds the time interval. The notation for the statistical quantities of noise levels is described below:

- Hourly L_{eq} values have been computed by integrating sound level meter.
- L_{day} : As per the CPCB guidelines the day time limit is between 07:00 hours to 22.00 hours as outlined in Ministry of Environment and Forest Notification S.O. 123 (E) dated 14/02/2000.

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- L_{night} : As per the CPCB guidelines the night time limit is between 22:00 hours to 07.00 hours as outlined in Ministry of Environment and Forest Notification S.O. 123 (E) dated 14/02/2000.

A rating developed by Environmental Protection Agency, (US-EPA) for specification of community noise from all the sources is the Day-Night Sound Level, (L_{dn}).

L_{dn} : It is similar to a 24 hr equivalent sound level except that during night time period (10 PM to 07 AM) a 10 dB (A) weighting penalty is added to the instantaneous sound level before computing the 24 hr average. This nighttime penalty is added to account for the fact that noise during night when people usually sleep is judged as more annoying than the same noise during the daytime.

The L_{dn} for a given location in a community may be calculated from the hourly L_{eq} 's, by the following equation.

$$L_{dn} = 10 \text{Log} \frac{[\sum_{i=1}^{15} 10^{(L_{eq}i/10)} + \sum_{i=1}^9 10^{(L_{eq}i+10/10)}]}{24}$$