

Environmental Monitoring Report for Kolkata Port Trust – Haldia Dock Complex

**Vth Quarter
Dec 2022 – Feb 2023**



HECS

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ABBREVIATIONS

CPCB	Central Pollution Control Board
HDC	Haldia Dock Complex
HECS	Hubert Enviro Care Systems (P) Ltd
KDS	Kolkata Dock System
SMPK	Syama Prasad Mookerjee Port, Kolkata
MoEF & CC	Ministry of Environment, Forest & Climate Change
WBPCB	West Bengal Pollution Control Board
APHA	American Public Health Association
NAAQ	National Ambient Air Quality
PM	Particulate Matter
NO	Nitrogen Oxide
CO	Carbon Monoxide
SO ₂	Sulfur Dioxide
NO ₂	Nitrogen Dioxide

FOREWORD

M/s. Syama Prasad Mookerjee Port, Kolkata (SMPK) has Port Operation in West Bengal State. Syama Prasad Mookerjee Port, Kolkata comprises two dock systems namely Kolkata Dock System (KDS) and Haldia Dock Complex (HDC). SMP, Kolkata has planned to monitor the current environmental status at the Haldia Dock Complex. They entrusted the work of environmental quality monitoring to M/s. Hubert Enviro Care Systems (P) Ltd., Chennai having an Environmental Laboratory approved by the Central Pollution Control Board (CPCB)/Ministry of Environment, Forest & Climate Change (MoEF & CC) through their Work Order No. I&CF/IZ&R/T/345/1205 dated 25.10.2021.

A comprehensive environmental monitoring program has been planned to monitor data for the Quarter of Dec 2022 – Feb2023. The monitored data on Ambient Air Quality, Ambient Noise Quality, Water Quality, Sediment Quality in river and Green Belt Development are collected and presented in this report.

Our sincere thanks to **Haldia Dock Complex, SMP, Kolkata** for awarding this work and Haldia Dock Authorities for their kind co-operation during the study period.

Date:

Place: Chennai – 600 083




(M.Sivaprakasam)

Laboratory Manager

EXECUTIVE SUMMARY

1.0 M/s. Syama Prasad Mookerjee Port, Kolkata (SMPK) has port operations at Kolkata and Haldia of West Bengal State.

2.0 SMP, Kolkata has planned to monitor the current environmental status of the entire Haldia Dock Complex as a part of regular monitoring. Hence, they entrusted the work of environmental quality monitoring to **M/s. Hubert Enviro Care Systems (P) Ltd., Chennai.**

3.0 Study

The samples were collected from the Haldia Dock Complex with proper preserved condition, after that it was transported to HECS laboratory, Chennai within 48 hours and immediately commenced to analysis process as per letter no. I&CF/IZ&R/T/345/1205 dated 25.10.2021. The data collection programme is given below:

3.1 Ambient Air Quality Monitoring

Ambient air quality was monitored at four locations namely **3rd Oil Jetty office building, Marine House office building, Electrical Maintenance office building at Haldia Township, Chiranjibpur Operational Building.**

The air quality monitoring locations are detailed in **Table 1.**

Table 1. Details of Ambient Air Quality Monitoring Locations

S. No.	Name of Location and Code	Code	Approximate Height (m)
1	3 rd Oil Jetty office building	AAQ 1	6
2	Marine House office building	AAQ 2	3
3	Electrical Maintenance office building at Haldia Township	AAQ 3	8
4	Chiranjibpur Operational Building	AAQ 4	10

Particulate Matter less than 10 μm (PM_{10}), Particulate Matter less than 2.5 μm ($\text{PM}_{2.5}$), Sulphur dioxide (SO_2), Oxides of Nitrogen oxide (NO_x) and Carbon monoxide (CO).

1st AAQM station was set up at a height of 6 meter from BGL (Below Ground Level) at

3rd Oil Jetty. The 2nd and 3rd AAQM station were set up at a height of 3 Meter from BGL at **Marine House** and **8m Electrical Maintenance office building** at Haldia Township. The 4th location was collected at a height of 10 Meter from BGL at **Chiranjibpur Operational Building**. The air quality status is presented in this report. While comparing with NAAQ norms for industrial and mixed-use environment, all PM₁₀, PM_{2.5}, SO₂, NO_x, and CO values were well within the limits.

3.2 Noise Monitoring

Ambient noise monitoring was conducted using Extech sound level meter during day time and night time at twelve locations. Noise level recorded at all locations was within the day time and night time noise criteria as per CPCB (Central Pollution Control Board) norms.

3.3 Water Quality Monitoring

3.3.1 Marine Water:

Marine water samples collected from four locations namely **Near 1st Oil Jetty (Upstream)**, **Near Outer Terminal – II**, **Near Lock Approach** and **Near HFTPL Jetty (Downstream)**. One sample collected at 0.3 meter below from the surface and another sample collected at depth 7 meter at each location and tested as per IS: 3025 and APHA 23rd Edition. In general, Water Quality of 8 samples* were well within the prescribed limits with respect to Primary Water Quality Criteria for Class SW-IV (for Harbour Waters).

3.4 Marine Water Biological Quality

Marine water samples from four locations namely **Near 1st Oil Jetty (Upstream)**, **Near Outer Terminal – II**, **Near Lock Approach** and **Near HFTPL Jetty (Downstream)** were collected and tested as per APHA method and the results recorded. Further, biological parameters such as light penetration, chlorophyll and primary productivity were measured and the results are recorded. Phytoplankton and Zooplankton species were also reported in various locations and results are reported. It is inferred from the test results that all the tested marine water quality parameters from four locations were within the marine water quality standards.

3.5 Sediment Quality

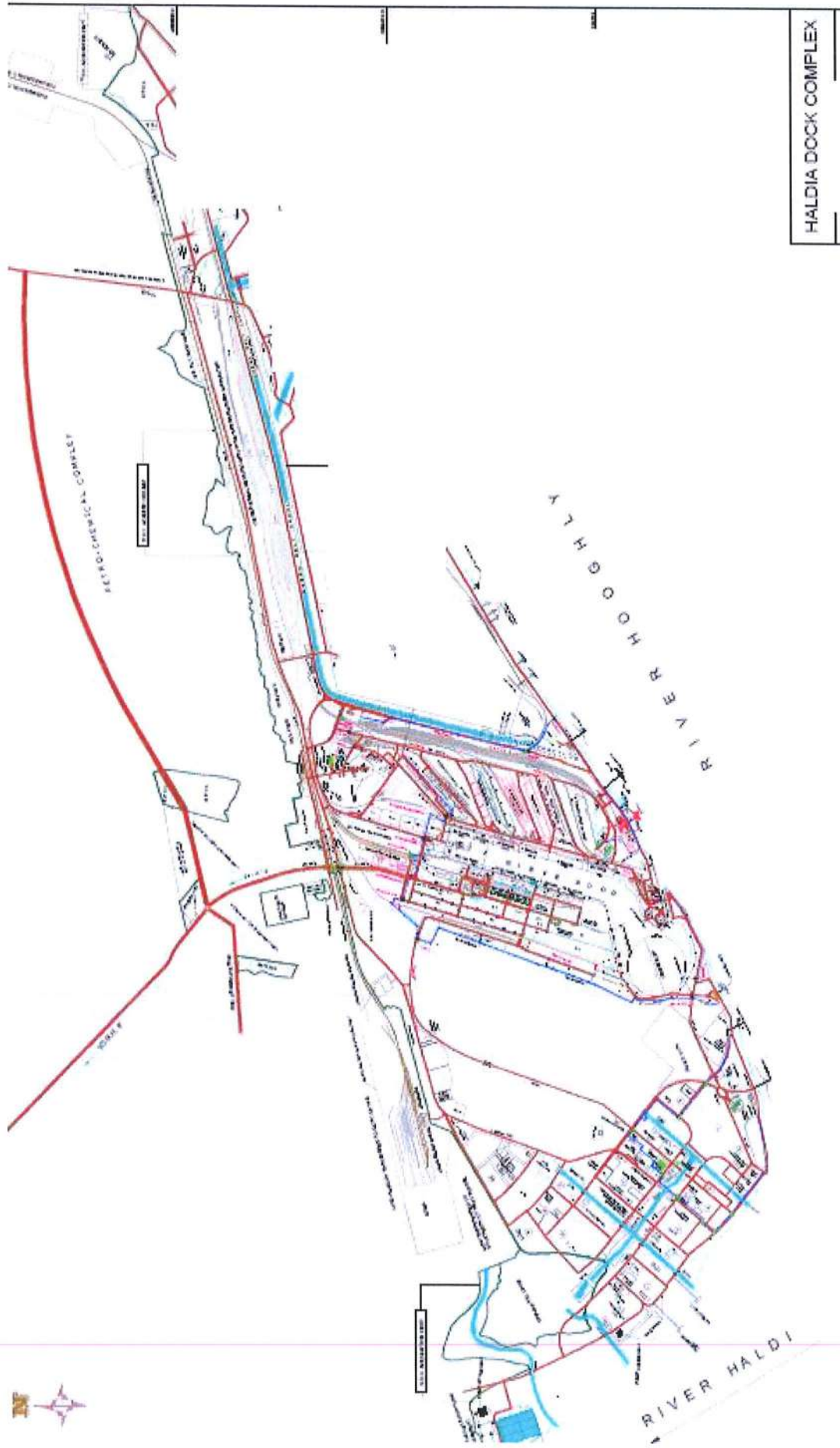
Marine sediment samples were collected from four locations namely **Near 1st Oil Jetty (Upstream)**, **Near Outer Terminal – II**, **Near Lock Approach** and **Near HFTPL Jetty (Downstream)**, tested for the given parameters and results recorded. Microbenthos, meiobenthos and macrobenthos organisms were identified in the marine sediment samples and recorded in the report.

3.6 Green Belt Development

Green belt surveys were conducted within the industry and township area of Haldia Dock Complex. The main objective of the green belt development is to absorb the dust and gaseous pollutants; ultimately it increases CO₂ absorption and releasing of O₂ for a better environment besides providing an aesthetic view.

3.7 Conclusion

Ambient air quality values recorded were within the stipulated NAAQ/ CPCB norms for industrial and mixed-use environment. Marine water quality was within the prescribed limits as per Primary Water Quality Criteria for ClassSW-IV (for Harbour Waters). All tested marine sediments adhered to the marine sediment quality standards. The recorded noise level in the day time and night time were compared with the CPCB standards and the results found – were within the limit. Biodiversity in green belt area was observed. Species diversity, richness, abundance and evenness values were Calculated.



1.0 INTRODUCTION

1.1 Background

Syama Prasad Mookerjee Port, Kolkata is the only river line port and one of the major ports in the country. Syama Prasad Mookerjee Port, Kolkata is established in 1870 and is presently serving a vast hinterland that comprises the entire Eastern India including Bihar, Jharkhand, Uttar Pradesh, Madhya Pradesh, Assam, Chhattisgarh, North-East Hill states and the land-locked countries of Nepal & Bhutan. Syama Prasad Mookerjee Port, Kolkata is often called the gateway to Eastern India. Syama Prasad Mookerjee Port, Kolkata comprises of two dock systems viz. Kolkata Dock System (KDS) and Haldia Dock Complex (HDC). The pilotage distance from Haldia to sand heads is 130 km and from HDC to Kolkata is 104 km upstream.

In order to assess the efficacy of the present environmental management particularly at Haldia Dock Complex and to further improve the air and water quality, Syama Prasad Mookerjee Port, Kolkata desired to carry out a detailed study on environmental management at Haldia Dock Complex. Haldia Dock Complex (HDC) is located on the western bank of river Hooghly at about 104 km downstream of Kolkata and 130 km upstream of sand heads.

1.2 Environmental Management Plan

Being concerned towards Environmental Protection, Syama Prasad Mookerjee Port, Kolkata has prepared an extensive Environmental Management Plan for port operations. The work was entrusted to **Hubert Enviro Care Systems Pvt. Ltd, Chennai** vide **Tender No. KoPT/Haldia Dock Complex/I&CF /IZ&R/T/345.**

The field monitoring studies were carried out for ambient air quality, ambient noise level, water quality, sediment quality, and green belt development, and their results are presented in this report.

1. Ambient Air Quality
2. Ambient Noise Quality
3. Marine Water Quality
4. Marine Biology
5. Sediment Quality
6. Green Belt Development

2.0 SCOPE AND METHODOLOGY

2.1 Scope & Methodology

The scope of the study and the present report covers the detailed characterisation of the existing environmental status in the project area for major environmental components namely Ambient Air Quality, Ambient Noise Level, Water Quality, Sediment Quality including Marine Biological analysis and Green Belt Development.

3.0 AMBIENT AIR QUALITY STATUS

3.1 Selection of Monitoring Stations

Ambient Air Quality Monitoring (AAQM) stations were set up at four locations with due consideration of Meteorological conditions on synoptic basis, Topography of the study area Representatives of regional background air quality for obtaining baseline status Representatives of likely impact areas and consultation with Halia Dock Complex officials. The monitoring locations are given in Table 3.1.

Table 3.1: Details of Ambient Air Quality Monitoring Locations

S. No.	Name of Location and Code	Code	Approximate Height (m)
1	3 rd Oil Jetty office building	AAQ 1	6
2	Marine House office building	AAQ 2	3
3	Electrical Maintenance office building) at Haldia Township	AAQ 3	8
4	Chiranjibpur Operational Building	AAQ 4	10

3.2 Sampling and Analytical Techniques:

With a view to collecting the samples, Envirotech make calibrated Respirable Dust Samplers (RDS-APM 460 BL) along with Gaseous attachment and Fine Particulate Sampler (FPS-APM 550) have been used. The RDS is capable of drawing air at a flow rate of 0.95 to 1.3 m³/min with very little pressure drop for RDS and FPS is designed to operate at an air flow rate of 1m³/hr. Filter papers (EPM 2000, Whattmann & Whattmann 46.2 dia) were used for the collection of particulate matters and heavy metals. SO₂& NO_x were collected by drawing air at a flow-rate of 0.5 liters per minute (lpm) through an absorbing solution for the duration of 24 hrs. Details procedures are discussed below.

Table-3.2: Sampling & Analysis Methodology

Sl. No.	Parameter	Methodology
1	Particulate Matter 10 (PM ₁₀) (µg/m ³)	IS: 5182 (Part -23):2006
2	Particulate Matter 2.5 (PM _{2.5}) (µg/m ³)	IS: 5182 (Part -24):2019
3	Sulphur Dioxide SO ₂ (µg/m ³)	IS: 5182 (Part -2):2001 West and Gaeke Method
4	Oxides of Nitrogen (µg/m ³)	IS: 5182 (Part - 6):2006, Jacob & Hochheiser

Sl. No.	Parameter	Methodology
		modified Method
5	CO	IS: 5182 (Part - 10):1999

PM₁₀: A calibrated RDS (Respirable Dust Sampler) is used for the determination of PM₁₀. PM₁₀ is a measure of particulate matter having size up to 10 μ . Air is sampled isokinetically through a cyclone where particles greater than 10 μ are separated and then passed through a glass microfiber filter. The difference in weight before and after sampling is determined and is divided by the volume of air.

PM_{2.5}: PM_{2.5} is a measure of particulate matter having size up to 2.5 μ . APM 550 fine particles sampler is based on Wind Impactor design standardized by USEPA for ambient air quality monitoring. Calibrated APM 550 fine particle sampler with PTFE 47 mm diameter filter media was used for the determination of fine particulate matter, PM_{2.5}.

SO₂: Modified West-Geake Spectrophotometric Method: Sulphur dioxide (SO₂) was absorbed in a scrubbing solution of potassium tetrachloro-mercurate (K₂HgCl₄) and was allowed to react with HCHO and then with Pararosaniline Hydrochloride (C₁₉H₁₈ClN₃). The absorbance of the product, red-violet dye was measured using Digital Spectrophotometer (Agilent – Cary60) at a wavelength of 560 nm.

NO₂: Jacob and Hochheiser modified Method: Nitrogen oxides as NO₂ (Nitrogen dioxide) were collected by bubbling air through sodium arsenate solution to form a stable solution of sodium nitrite. The nitrite ion produced during sampling is converted into a colour complex and by reaction of the exposed absorbing reagent with phosphoric acid, sulfanilamide and N (1-naphthyl) ethylamine dihydrochloride, and nitrogen dioxide concentration is determined using digital spectrophotometer (Agilent – Cary60) at a wavelength of 540 nm.

CO: Carbon monoxide is collected in a Teddler bag and CO was determined using Serinus 30 NDIR CO analyzer.

3.3 Analytical Result and Interpretation


The ambient air quality monitoring analytical results and interpretation are given in the following **Test Report and Figure**.

TEST REPORT-1

Name of the Client : M/s. Haldia Dock Complex, SMP, Kolkata
 Sample Description : Ambient Air Quality
 Sample Mark : AAQ 1 - 3rd Oil Jetty office building (Height ~ 6.0m)
 Lat: 22°01'01.07"N Long: 88°04'06.56"E
 Sample Drawn By : Hubert Enviro Care Systems Private Limited

S.No.	Sampling (hrs)	Sampling Date	Concentration of parameters monitored					
			SO ₂ (µg/m ³)	NO _x (µg/m ³)	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	CO (mg/m ³)	
1	24	01.02.2023	12.58	21.64	89.97	55.75	0.06	
2	24	03.02.2023	13.39	25.67	92.67	42.67	0.07	
3	24	08.02.2023	10.53	24.87	84.55	53.09	0.08	
4	24	10.02.2023	12.63	23.48	98.26	58.17	0.06	
5	24	15.02.2023	13.90	25.63	79.13	39.62	0.07	
6	24	17.02.2023	11.02	25.37	89.20	49.46	0.06	
7	24	22.02.2023	12.80	27.90	82.09	42.91	0.07	
8	24	24.02.2023	14.25	23.64	89.97	50.75	0.06	
			Min	10.53	21.64	79.13	39.62	0.06
			Max	14.25	27.9	98.26	58.17	0.08
			Avg	12.64	24.78	88.23	49.05	0.07
NAAQ –National Ambient Air Quality Standards (2009)			80	80	100	60	2	

Note: SO₂–Sulphur dioxide, NO_x- Nitrogen oxide, PM₁₀ - (Particulate Matter size less than 10 µm), PM_{2.5} - (Particulate Matter size less than 2.5 µm) CO - Carbon monoxide; NAAQ Norms-National Ambient Air Quality Stipulated by CPCB for Industrial Areas 2009.


Analyst




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FIGURE 1

Name of the Client :M/s. Haldia Dock Complex, SMP, Kolkata
 Sample Description : Ambient Air Quality
 Sample Mark : AAQ 1 - 3rd Oil Jetty office building (Height ~ 6.0m)
 Lat: 22°01'01.07"N Long: 88°04'06.56"E
 Sample Drawn By : Hubert Enviro Care Systems Private Limited

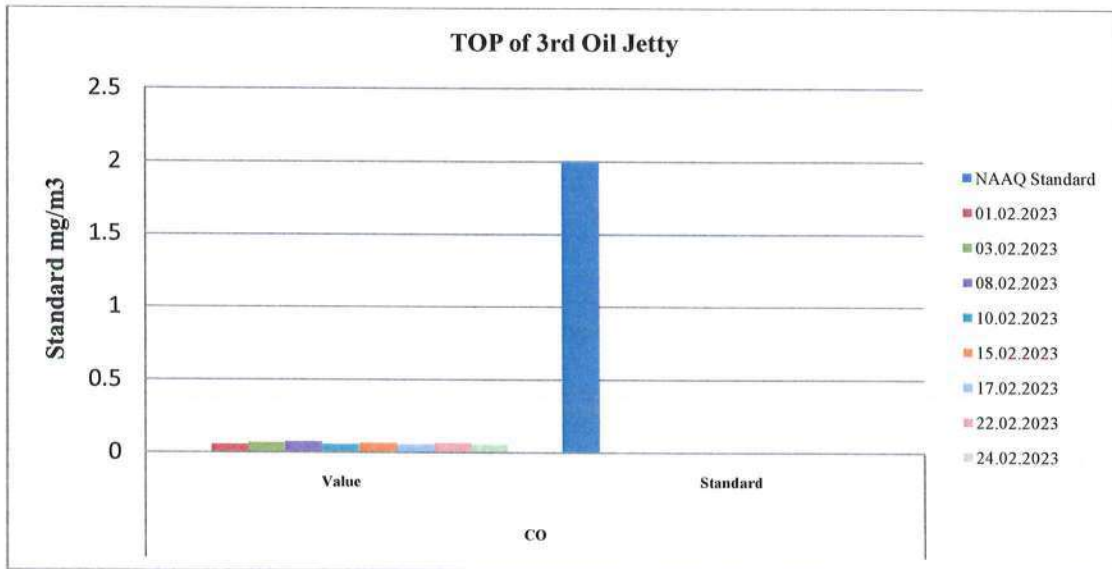
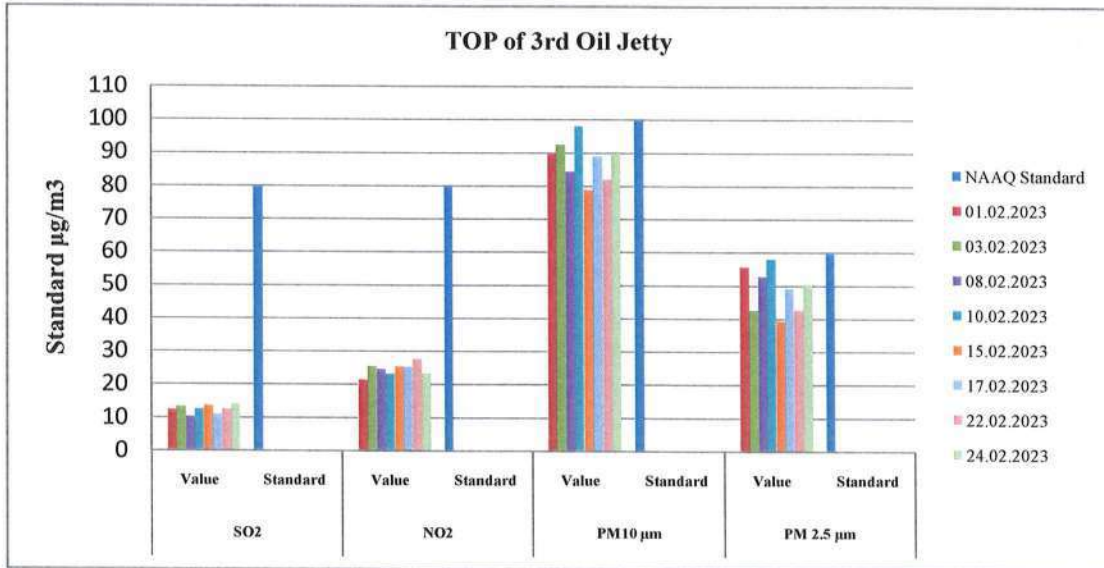


Figure 1. Graphical representation-1 of Ambient Air Quality 1 (Date Vs.Pollutant concentration (µg/m³))
 Graphical representation-2 of Ambient Air Quality 1 (Date Vs.Pollutant concentration (mg/m³))

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TEST REPORT-2

Name of the Client : M/s. Haldia Dock Complex, SMP, Kolkata
 Sample Description : Ambient Air Quality
 Sample Mark: AAQ 2 – Marine House office Building (Height~3m)
 Lat: 22°01'32.55"N Log: 88°05'17.88"E
 Sample Drawn By : Hubert Enviro Care Systems Private Limited

S.No.	Sampling (hrs)	Sampling Date	Concentration of parameters monitored				
			SO ₂	NO _x	PM ₁₀	PM _{2.5}	CO
			(µg/m ³)	(µg/m ³)	(µg/m ³)	(µg/m ³)	(mg/m ³)
1	24	01.02.2023	14.55	26.51	96.56	48.15	0.07
2	24	03.02.2023	15.05	27.48	80.31	45.14	0.08
3	24	08.02.2023	12.54	20.05	94.58	57.15	0.07
4	24	10.02.2023	13.02	25.58	75.88	43.73	0.06
5	24	15.02.2023	10.8	26.66	86.35	54.51	0.05
6	24	17.02.2023	12.96	21.42	91.77	52.43	0.09
7	24	22.02.2023	11.47	29.83	85.47	44.63	0.07
8	24	24.02.2023	12.49	26.24	88.52	50.67	0.07
Min			10.80	20.05	75.88	43.73	0.05
Max			15.05	29.83	96.56	57.15	0.09
Avg			12.86	25.47	87.43	49.55	0.07
NAAQ –National Ambient Air Quality Standards (2009)			80	80	100	60	2

Note: SO₂–Sulphur dioxide, NO_x- Nitrogen oxide, PM₁₀– (Particulate Matter size less than 10 µm), PM_{2.5}– (Particulate Matter size less than 2.5 µm) CO – Carbon monoxide; NAAQ Norms-National Ambient Air Quality Stipulated by CPCB for Industrial Areas 2009.


Analyst





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FIGURE 2

Name of the Client :M/s. Haldia Dock Complex, SMP, Kolkata
 Sample Description : Ambient Air Quality
 Sample Mark :AAQ 2 –Marine House Office Building (Height ~ 3 m)
 Lat: 22°01'32.55"N Log: 88°05'17.88"E
 Sample Drawn By : Hubert Enviro Care Systems Private Limited

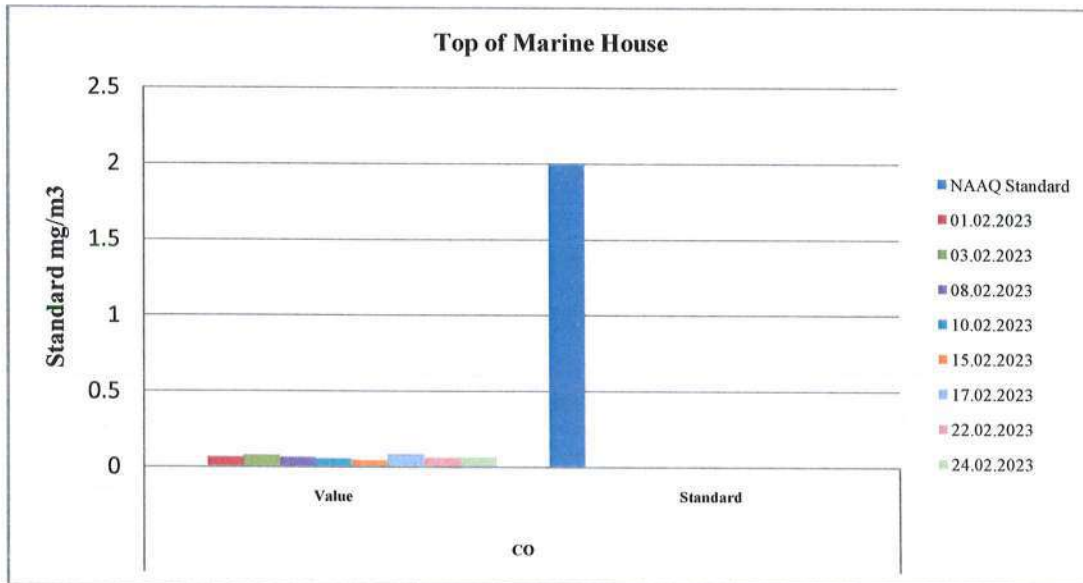
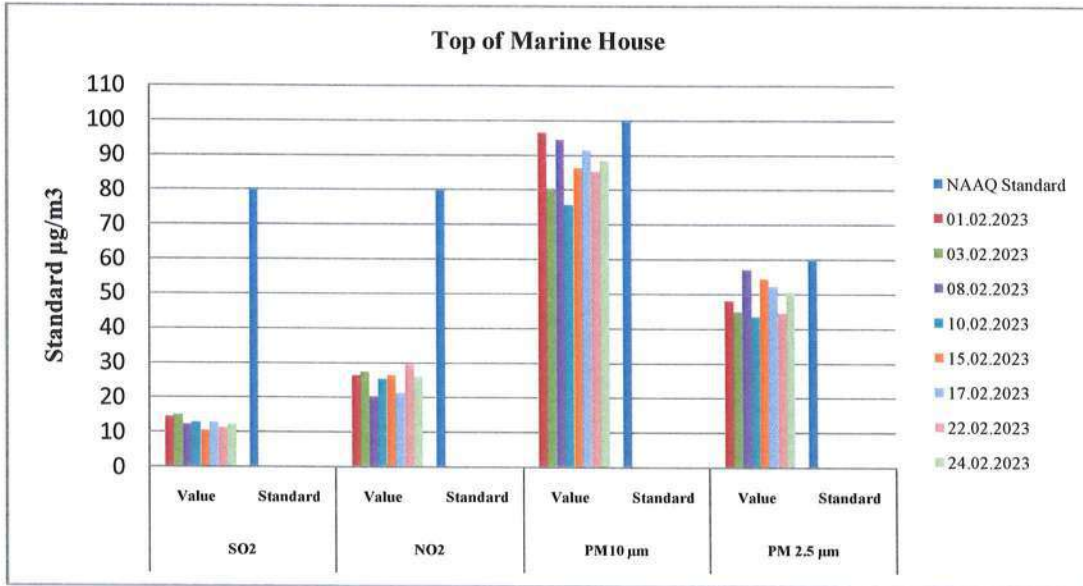


Figure 2. Graphical representation-1 of Ambient Air Quality 2 (Date Vs.Pollutant concentration (µg/m³))
 Graphical representation-2 of Ambient Air Quality 2 (Date Vs.Pollutant concentration (mg/m³))

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 Analyst



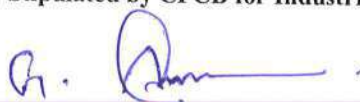
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TEST REPORT-3

Name of the Client : M/s. Haldia Dock Complex, SMP, Kolkata
 Sample Description : Ambient Air Quality
 Sample Mark : AAQ3 - Electrical Maintenance office building at Haldia Township (Height ~8m)
 Lat: 22°01'21.80"N, Log: 88°03'43.83"E
 Sample Drawn By : Hubert Enviro Care Systems Private Limited

S.No.	Sampling (hrs)	Sampling Date	Concentration of parameters monitored				
			SO ₂	NO _x	PM ₁₀	PM _{2.5}	CO
			(µg/m ³)	(µg/m ³)	(µg/m ³)	(µg/m ³)	(mg/m ³)
1	24	01.02.2023	13.55	25.21	97.09	51.42	0.06
2	24	03.02.2023	10.91	24.91	78.15	49.50	0.09
3	24	08.02.2023	13.47	26.09	84.00	38.71	0.07
4	24	10.02.2023	15.61	28.98	81.04	43.09	0.05
5	24	15.02.2023	12.74	26.73	95.41	55.76	0.07
6	24	17.02.2023	14.63	25.97	99.88	56.01	0.08
7	24	22.02.2023	11.87	23.01	88.50	56.00	0.05
8	24	24.02.2023	12.63	25.38	79.52	48.96	0.07
Min			10.91	23.01	78.15	38.71	0.05
Max			15.61	28.98	99.88	56.01	0.09
Avg			13.18	25.79	87.95	49.93	0.07
NAAQ –National Ambient Air Quality Standards (2009)			80	80	100	60	2

Note: SO₂–Sulphur dioxide, NO_x- Nitrogen oxide, PM₁₀ - (Particulate Matter size less than 10 µm), PM_{2.5} - (Particulate Matter size less than 2.5 µm) CO - Carbon monoxide; NAAQ Norms-National Ambient Air Quality Stipulated by CPCB for Industrial Areas 2009.



Analyst




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FIGURE 3

Name of the Client :M/s. Haldia Dock Complex, SMP, Kolkata
 Sample Description : Ambient Air Quality
 Sample Mark : AAQ3 - Electrical Maintenance office building at Haldia Township (Height ~8m)
 Lat: 22°01'21.80"N, Log: 88°03'43.83"E
 Sample Drawn By : Hubert Enviro Care Systems Private Limited

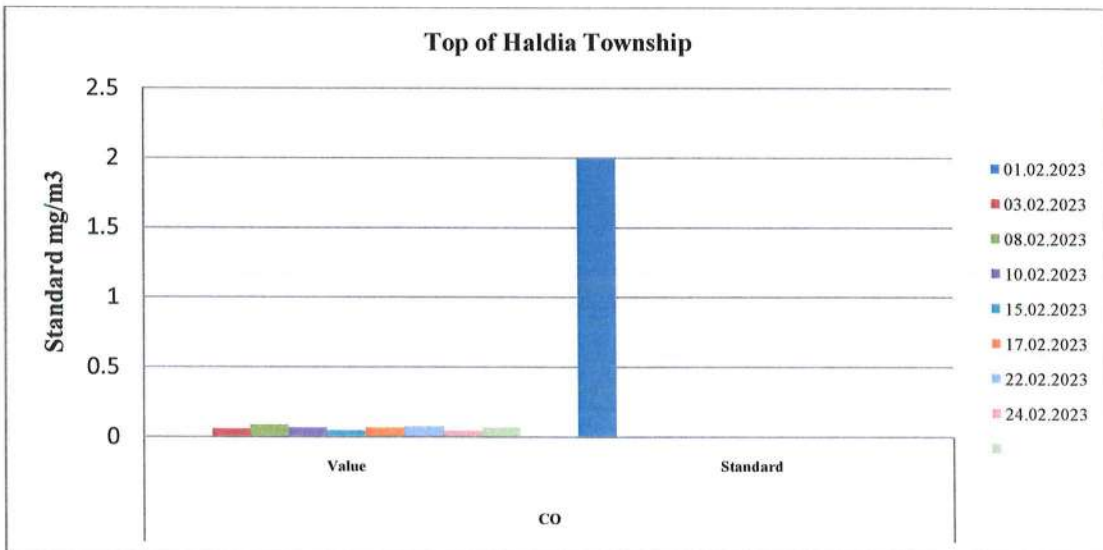
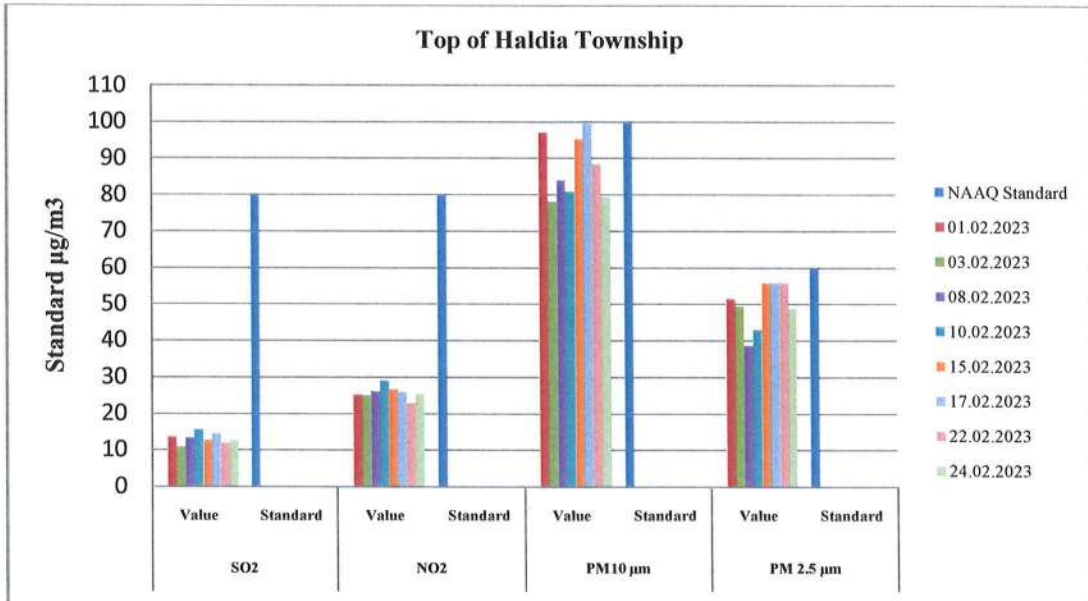


Figure 3. Graphical representation-1 of Ambient Air Quality 3 (Date Vs.Pollutant concentration (µg/m³))
 Graphical representation-2 of Ambient Air Quality 3 (Date Vs.Pollutant concentration (mg/m³))

G. [Signature]
 Analyst



M. [Signature]
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TEST REPORT-4

Name of the Client : M/s. Haldia Dock Complex, SMP, Kolkata
 Sample Description : Ambient Air Quality
 Sample Mark : AAQ 4 - Chiranjibpur Operational Building (Ht ~ 10m)
 Lat: 22°03'08.55"N Log:88°05'48.64"E
 Sample Drawn By : Hubert Enviro Care Systems Private Limited

S.No.	Sampling (hrs)	Sampling Date	Concentration of parameters monitored				
			SO ₂	NO _x	PM ₁₀	PM _{2.5}	CO
			(µg/m ³)	(µg/m ³)	(µg/m ³)	(µg/m ³)	(mg/m ³)
1	24	01.02.2023	13.05	29.98	98.90	55.98	0.07
2	24	03.02.2023	13.76	26.64	89.75	56.55	0.07
3	24	08.02.2023	11.41	25.82	85.44	49.72	0.05
4	24	10.02.2023	13.76	25.80	90.04	54.19	0.08
5	24	15.02.2023	10.30	26.92	86.54	48.56	0.05
6	24	17.02.2023	12.71	26.82	95.57	52.71	0.06
7	24	22.02.2023	14.37	28.32	82.96	43.38	0.08
8	24	24.02.2023	13.67	27.22	90.03	58.95	0.07
Min			10.30	25.80	82.96	43.38	0.05
Max			14.37	29.98	98.90	58.95	0.08
Avg			12.88	27.19	89.90	52.51	0.07
NAAQ –National Ambient Air Quality Standards (2009)			80	80	100	60	2

Note: SO₂-Sulphur dioxide, NO_x- Nitrogen oxide, PM₁₀ - (Particulate Matter size less than 10 µm), PM_{2.5} - (Particulate Matter size less than 2.5 µm) CO - Carbon monoxide; NAAQ Norms-National Ambient Air Quality Stipulated by CPCB for Industrial Areas 2009.

G. 

Analyst




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FIGURE 4

Name of the Client :M/s. Haldia Dock Complex, SMP, Kolkata
 Sample Description : Ambient Air Quality
 Sample Mark : AAQ 4 - Chiranjibpur Operational Building (Ht ~ 10m)
 Lat: 22°03'08.55"N Log:88°05'48.64"E
 Sample Drawn By : Hubert Enviro Care Systems Private Limited

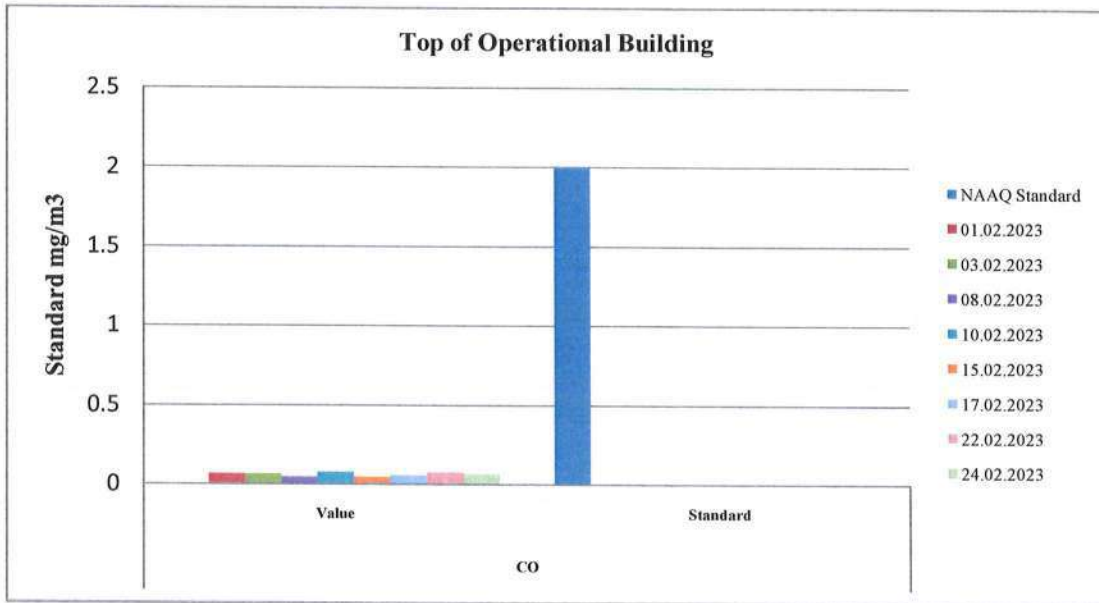
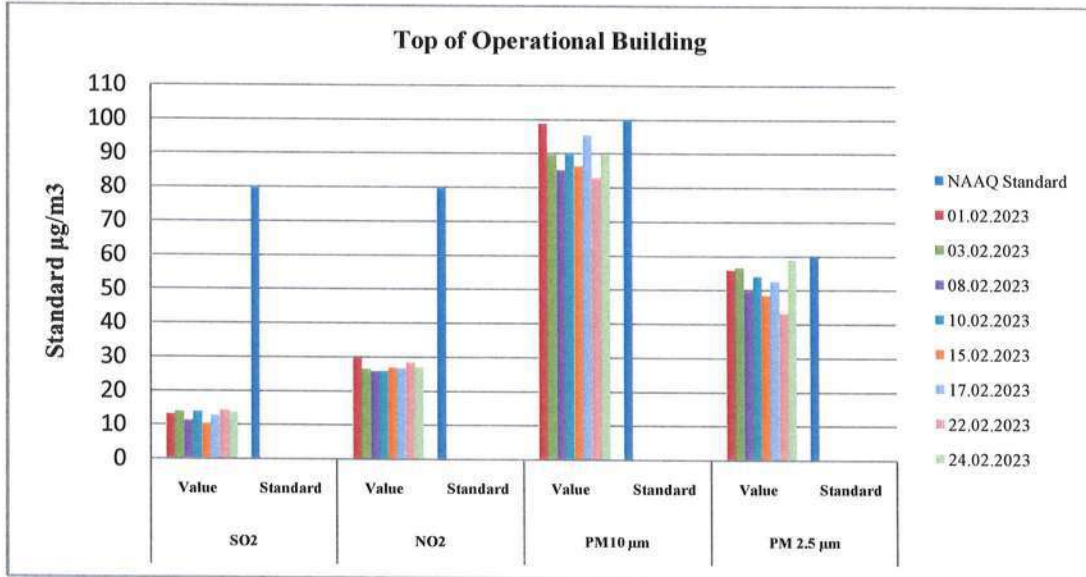


Figure 4. Graphical representation-1 of Ambient Air Quality 4 (Date Vs.Pollutant concentration (µg/m³))
 Graphical representation-2 of Ambient Air Quality 4 (Date Vs.Pollutant concentration (mg/m³))

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Analyst



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Authorized Signatory

Table-3.4: Sulphur Dioxide(SO₂)(µg/m³)

Location & Location Code	Minimum	Maximum	Standard Deviation	98th Percentile	Mean
AAQ 1 - 3 rd Oil Jetty office building	10.53	14.25	1.30	14.20	12.64
AAQ 2 – Marine House office building	10.80	15.05	1.42	14.98	12.86
AAQ3 - Electrical Maintenance office building at Haldia Township	10.91	15.61	1.49	15.47	13.18
AAQ 4 - Chiranjibpur Operational Building	10.30	14.37	1.38	14.28	12.88

Table-3.5: Nitrogen Dioxide (NO₂)(µg/m³)

Location & Location Code	Minimum	Maximum	Standard Deviation	98th Percentile	Mean
AAQ 1 - 3 rd Oil Jetty office building	21.64	27.90	1.87	27.59	24.78
AAQ 2 – Marine House office building	20.05	29.83	3.21	29.50	25.47
AAQ3 - Electrical Maintenance office building at Haldia Township	23.01	28.98	1.70	28.67	25.79
AAQ 4 - Chiranjibpur Operational Building	25.80	29.98	1.38	29.75	27.19



Table-3.6: Particulate Matter (PM₁₀) (µg/m³)

Location & Location Code	Minimum	Maximum	Standard Deviation	98th Percentile	Mean
AAQ 1 - 3 rd Oil Jetty office building	79.13	98.26	6.11	97.48	88.23
AAQ 2 – Marine House office building	75.88	96.56	7.01	96.28	87.43
AAQ3 - Electrical Maintenance office building at Haldia Township	78.15	99.88	8.55	99.49	87.95
AAQ 4 - Chiranjibpur Operational Building	82.96	98.90	5.24	98.43	89.90

Table-3.7: Particulate Matter (PM_{2.5}) (µg/m³)

Location & Location Code	Minimum	Maximum	Standard Deviation	98th Percentile	Mean
AAQ 1 - 3 rd Oil Jetty office building	39.62	58.17	6.71	57.83	49.05
AAQ 2 – Marine House office building	43.73	57.15	4.95	56.78	49.55
AAQ3 - Electrical Maintenance office building at Haldia Township	38.71	56.01	6.37	56.01	49.93
AAQ 4 - Chiranjibpur Operational Building	43.38	58.95	5.06	58.61	52.51



4.0 AMBIENT NOISEQUALITY

4.1 Monitoring Station Selection Criteria

The 12 monitoring stations were selected as per the noise source identified with reference to previous EIA study and discussion to official person of Haldia Dock Complex. The monitoring locations are given in Table 4.1.

Table 4-1: Noise Quality Monitoring Stations

S. No.	Location	Code
1	Chiranjibpur Operational Building	N1
2	Jawahar Tower	N2
3	Township Gate No - 04	N3
4	Port Hospital	N4
5	DAV School	N5
6	Port House	N6
7	GCBerth Main Gate	N7
8	HFTPL (MBC) Jetty	N8
9	Chiranjibpur Operational Building Gate	N9
10	Lock Gate	N10
11	Marine House	N11
12	Master Control	N12

4.2 Monitoring Methodology

Ambient noise level measurements in four identified cardinal directions were carried out using Extech sound level meter during daytime and night time. Noise measurements were made at 1.5 m above ground and about 3 m away from walls, buildings or other sound reflecting sources. In order to reduce the disturbances from standing waves, the noise level measured were averaged over + 0.5 m each of at least three positions. The mean values were taken for reporting.

Instrument The noise was monitored by digital sound level meter, MakeExtech, Model/ SL: 407780/100813422

Sound Level Meter is an instrument designed to respond to sound in approximately the same way as the human ear and to give objective reproducible measurements of sound pressure level. The system consists of a microphone, a processing section and a readout unit.

Procedure

- ❖ Press → **DATE TIME** + **POWER** → Hold for 3 Seconds
 - Display → **Date 11-07-01**
- ❖ Press → **DATE TIME**
 - Display → **Time 00** in minutes
- ❖ Press → **INTEG TIME**
- ❖ Press → Adjust Minute using **11** → to set required time in minutes (10sec to 24hrs)
 - Display → **00**
- ❖ Press → **LEQ SEL SPL** → to set SPL
- ❖ Press → **RECORD**
- ❖ Press → **PLAY** → to save the data
- ❖ Connect the meter to a pc via the RS - 232 cable
- ❖ Open to isound software
- ❖ Press → **DATA LOGGER**
- ❖ Press → **1 / 1**
- ❖ Press → **READ / SAVE**
- ❖ Press → **ERASE**

4.3 Analytical Result:

The noise levels in different locations were recorded and compared to the specifications of CPCB norms and the results are shown in following **Test reports and Figures**.

TEST REPORT-5

Name of the Client : M/s. Haldia Dock Complex, SMP, Kolkata
 Sample Description : Noise Monitoring
 Sample Drawn By : Hubert Enviro Care Systems Private Limited
 Sampling Date : 17/12/2022 04/02/2023 02/02/2023 01/02/2023

S. No	Monitoring Date Time (Hrs)	Monitoring Location & Hourly Leq Noise Level in dB(A)			
		Chiranjibpur Operational Building	Jawahar Tower	Township Gate No - 04	Port Hospital
		17/12/2022	04/02/2023	02/02/2023	01/02/2023
1	06-07	51.4	52.8	57.2	50.8
2	07-08	52.2	54.4	56.7	51.6
3	08-09	53.6	55.2	60.0	52.8
4	09-10	65.2	56.8	62.6	55.3
5	10-11	70.9	68.0	64.8	58.4
6	11-12	68.1	69.1	68.6	61.4
7	12-13	69.0	59.7	70.8	62.6
8	13-14	66.8	60.8	64.9	60.5
9	14-15	65.2	59.4	61.7	59.3
10	15-16	63.4	57.3	64.4	57.6
11	16-17	64.2	60.5	62.8	56.8
12	17-18	67.6	61.7	64.6	58.0
13	18-19	59.1	60.8	67.2	56.9
14	19-20	61.4	60.0	68.3	56.3
15	20-21	60.8	56.4	65.4	56.0
16	21-22	59.6	57.9	62.8	54.9
17	22-23	54.9	56.8	61.7	53.5
18	23-24	53.1	56.1	57.6	52.1
19	00-01	52.7	53.4	53.3	51.2
20	01-02	51.6	52.8	52.7	50.6
21	02-03	50.3	51.5	51.9	50.1
22	03-04	49.2	50.2	50.5	48.9
23	04-05	49.5	50.9	50.8	49.9
24	05-06	50.6	51.7	51.2	50.3
I	Ld	65.2	62.0	65.4	57.9
II	Ln	51.9	53.6	55.7	51.0
II	Ldn	63.6	60.5	63.9	56.6
Category		Industrial Area (Haldia Dock)			
CPCB Norms		Day: 75 & Night: 70			

Note: Monitoring Date represents 24 hours from 6:00 am next day. Legend: Leq-Equivalent Noise Level (hourly);

Ld-Day Time Equivalent Noise Level (06:00-22:00hrs); Ln-Night Time Equivalent Noise Level (22:00-06:00hrs); and Ldn-24 hourly Equivalent Noise Level.

*: CPCB-Norms-Ambient Noise Norms (Leq); Daytime is recorded in between 6a.m. and 10 p.m. and Night time is recorded in between 10 p.m. and 6a.m.

A warning limit of 85 dB(A) is set as the level below which very little risk to un-protected ear of hearing impairment exists for an eight hour exposure



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FIGURE-5

Name of the Client :M/s.Haldia Dock Complex, SMP, Kolkata
Sample Description : Noise Monitoring
Sample Drawn By : Hubert Enviro Care Systems Private Limited
Sampling Date : 17/12/2023 04/02/2023 02/02/2023 01/02/2023

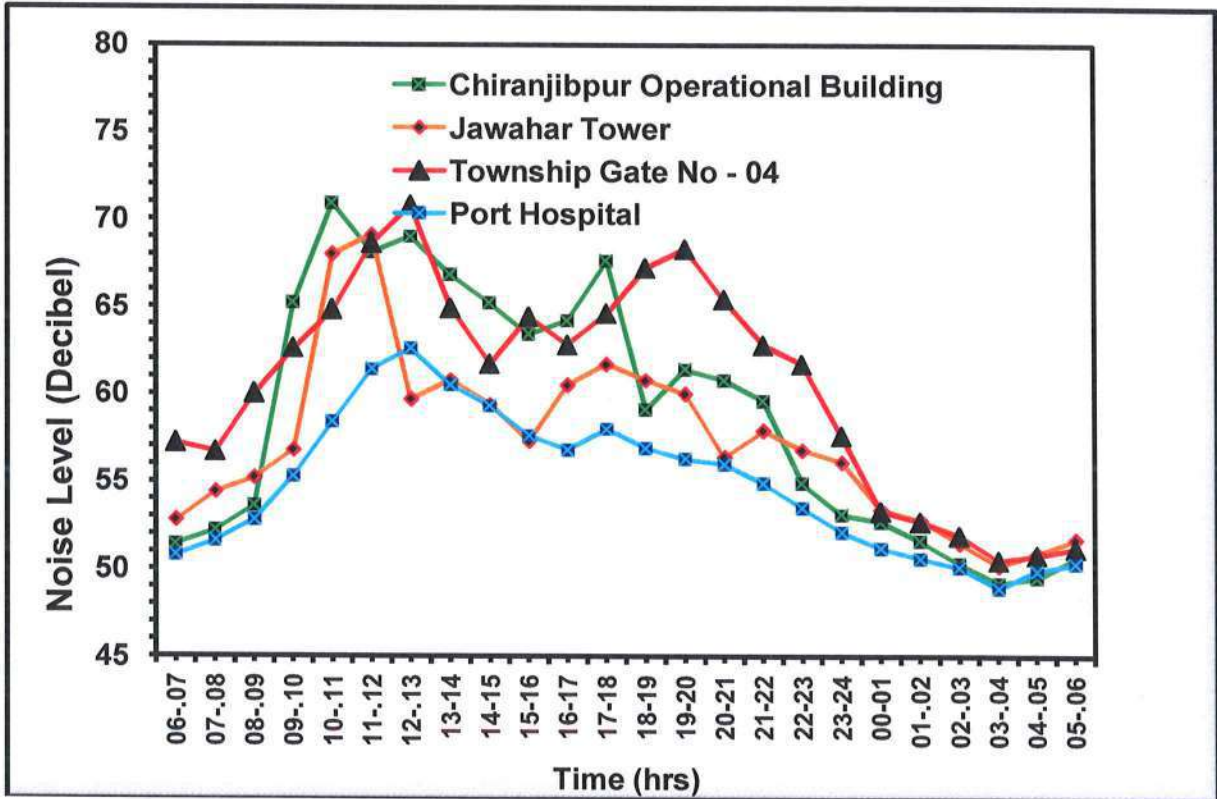


Figure 5: Graphical representation of Monitoring Location & Hourly Leq Noise Level in dB (A)



TEST REPORT-6

Name of the Client : M/s. Haldia Dock Complex, SMP, Kolkata

Sample Description : Noise Monitoring

Sample Drawn By : Hubert Enviro Care Systems Pvt Ltd

S.No	Location	Day Time (06.00 – 22.00 hrs.)						Night Time (22.00 – 06.00 hrs)						Ldn
		Noise Level, dB (A)						Noise Level dB (A)						
		Lmin	L10	L50	L90	Lmax	Ld*	Lmin	L10	L50	L90	Lmax	Ln	
1	Chiranjibpur Operational Building	51.4	52.2	66.8	60.8	70.9	65.2	49.2	53.1	51.6	49.5	54.9	51.9	63.6
2	Jawahar Tower	52.8	54.4	60.8	56.4	69.1	62.0	50.2	56.1	52.8	50.9	56.8	53.6	60.5
3	Township Gate No - 04	56.7	56.7	64.9	65.4	70.8	65.4	50.5	57.6	52.7	50.8	61.7	55.7	63.9
4	Port Hospital	50.8	51.6	60.5	56.0	62.6	57.9	48.9	52.1	50.6	49.9	53.5	51.0	56.6

Legend: Lmin- Minimum Level; L10, L50, L90 – Noise Level exceed for 10%, 50% & 90% of times and Lmax. – Maximum Level. Ld- Day Time Equivalent Noise Level (06:00-22:00); Ln-Night Time Equivalent Noise Level (22:00-06:00 hrs) and Ldn-24-hourly Equivalent Noise Level.

Noise Standards - CPCB:

Industrial Area : Day Time-75 dB (A); Night Time-70 dB (A).
 Commercial Area : Day Time-65 dB (A); Night Time-55 dB (A).
 Residential Area : Day Time-55 dB (A); Night Time-45 dB (A).
 Silence Zone : Day Time-50 dB (A); Night Time-40 dB (A).


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TEST REPORT-7

Name of the Client : M/s.Haldia Dock Complex, SMP, Kolkata

Sample Description : Noise Monitoring

Sample Drawn By : Hubert Enviro Care Systems Private Limited

Sampling Date : 28/01/2023 31/01/2023 25/01/2023 27/01/2023

S. No	Monitoring Date Time (Hrs)	Monitoring Location & Hourly Leq Noise Level in dB(A)			
		DVA School	Port House	GCB Main Gate	MBC Jetty
		28/01/2023	31/01/2023	25/01/2023	27/01/2023
1	06-07	49.9	51.3	61.8	49.3
2	07-08	50.7	52.9	64.9	50.1
3	08-09	52.1	53.6	68.3	51.3
4	09-10	53.6	55.1	70.8	63.7
5	10-11	56.2	56.3	73.0	56.7
6	11-12	58.4	57.4	66.6	61.6
7	12-13	57.3	58.0	64.7	60.8
8	13-14	55.1	59.0	63.1	58.8
9	14-15	53.6	57.7	59.9	57.6
10	15-16	51.9	55.6	62.6	55.9
11	16-17	52.7	58.8	61.0	55.1
12	17-18	55.9	59.9	62.8	56.3
13	18-19	57.4	59.0	65.2	55.2
14	19-20	59.6	58.3	66.3	54.5
15	20-21	59.0	54.6	63.5	54.2
16	21-22	57.9	56.2	61.0	53.4
17	22-23	53.4	55.1	59.9	52.0
18	23-24	51.6	54.3	55.9	50.6
19	00-01	51.2	51.9	61.8	49.7
20	01-02	50.1	51.3	56.2	49.1
21	02-03	48.8	50.0	60.4	48.7
22	03-04	47.8	48.7	58.0	47.5
23	04-05	48.1	49.4	59.3	48.5
24	05-06	49.1	50.2	57.7	52.8
I	Ld	56.0	57.1	66.4	57.7
II	Ln	50.4	51.9	59.1	50.2
II	Ldn	54.8	55.9	65.0	56.3
Category		Industrial Area (Haldia Dock)			
CPCB Norms		Day: 75 & Night: 70			

Note: Monitoring Date represents 24 hours from 6:00 am next day. Legend: Leq-Equivalent Noise Level (hourly);

Ld-Day Time Equivalent Noise Level (06:00-22:00hrs); Ln-Night Time Equivalent Noise Level (22:00-06:00hrs); and Ldn-24 hourly Equivalent Noise Level.

*: CPCB-Norms - Ambient Noise Norms (Leq); Daytime is recorded in between 6a.m. and 10p.m. and Night time is recorded in between 10 p.m. and 6a.m.

A warning limit of 85dB(A) is set as the level below which very little risk to un-protected ear of hearing impairment exists for an eight hour exposure



M. S. R.
Authorized Signatory

FIGURE-6

Name of the Client :M/s.Haldia Dock Complex, SMP, Kolkata
Sample Description : Noise Monitoring
Sample Drawn By : Hubert Enviro Care Systems Private Limited
Sampling Date : 28/01/2023 31/01/2023 25/01/2023 27/01/2023

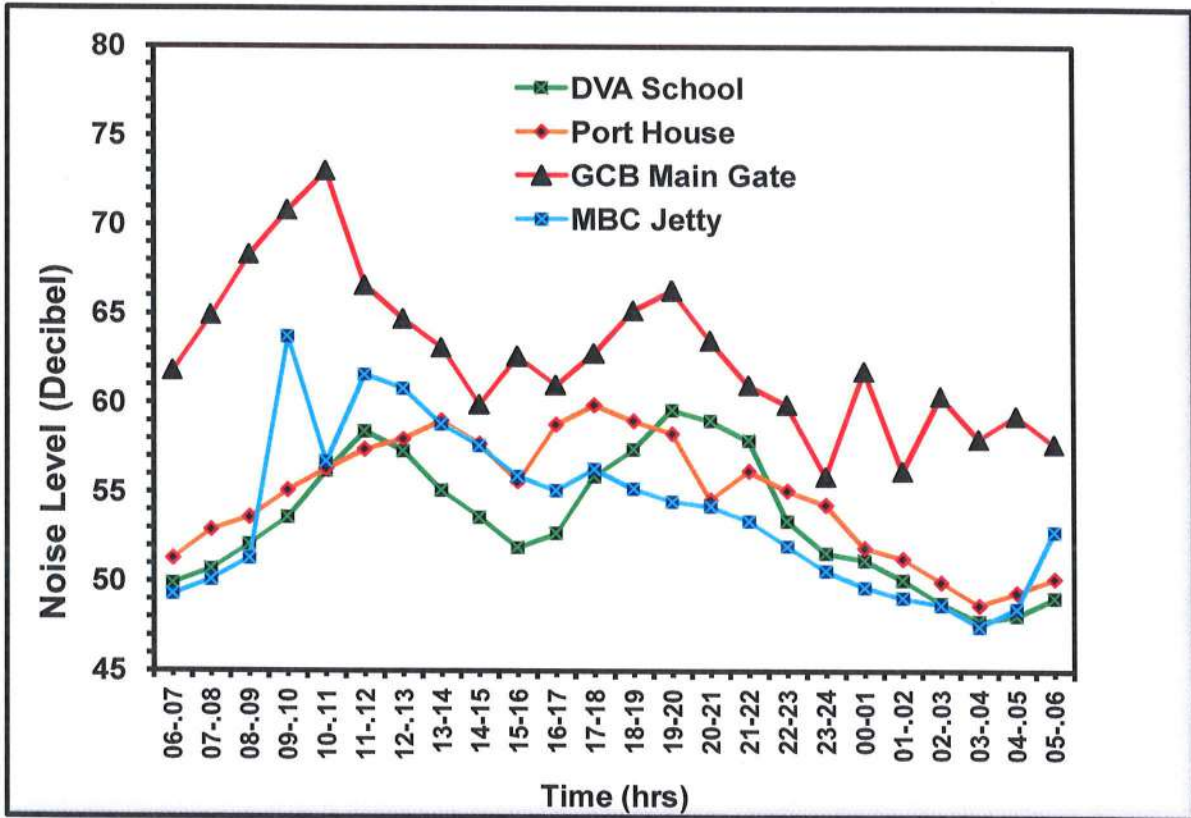


Figure 6: Graphical representation of Monitoring Location & Hourly Leq Noise Level in dB (A)



TEST REPORT-8

Name of the Client : M/s. Haldia Dock Complex, SMP, Kolkata

Sample Description : Noise Monitoring

Sample Drawn By : Hubert Enviro Care Systems Private Limited

S.No	Location	Day Time (06.00 – 22.00 hrs.)						Night Time (22.00 – 06.00 hrs)						Ldn
		Noise Level, dB (A)						Noise Level dB (A)						
		Lmin	L10	L50	L90	Lmax	Ld*	Lmin	L10	L50	L90	Lmax	Ln	
1	DAV School	49.9	50.7	55.1	59.0	59.6	56.0	47.8	51.6	50.1	48.1	53.4	50.4	54.8
2	DC Bungalow	51.3	52.9	59.0	54.6	59.9	57.1	48.7	54.3	51.3	49.4	55.1	51.9	55.9
3	GCB Main Gate	59.9	64.9	63.1	63.5	73.0	66.4	55.9	55.9	56.2	59.3	61.8	59.1	65.0
4	MBC Jetty	49.3	50.1	58.8	54.2	63.7	57.7	47.5	50.6	49.1	48.5	52.8	50.2	56.3

Legend: Lmin- Minimum Level; L10, L50, L90 – Noise Level exceed for 10%, 50% & 90% of times and Lmax. – Maximum Level. Ld- Day Time Equivalent Noise Level (06:00-22:00); Ln-Night Time Equivalent Noise Level (22:00-06:00 hrs) and Ldn-24-hourly Equivalent Noise Level.

Noise Standards - CPCB:

Industrial Area : Day Time-75 dB (A); Night Time-70 dB (A).
 Commercial Area : Day Time-65 dB (A); Night Time-55 dB (A).
 Residential Area : Day Time-55 dB (A); Night Time-45 dB (A).
 Silence Zone : Day Time-50 dB (A); Night Time-40 dB (A).


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TEST REPORT-9

Name of the Client : M/s. Haldia Dock Complex, SMP, Kolkata

Sample Description : Noise Monitoring

Sample Drawn By : Hubert Enviro Care Systems Private Limited

Sampling Date : 16/12/2022 20/12/2022 15/12/2022 03/02/2023

S. No	Monitoring Date Time (Hrs)	Monitoring Location & Hourly Leq Noise Level in dB(A)			
		Chiranjibpur Gate	Lock Gate (near DG Room)	Marine House	Master Control
		16/12/2022	20/12/2022	15/12/2022	03/02/2023
1	06-07	52.5	54.0	54.5	51.9
2	07-08	53.4	55.7	57.9	52.7
3	08-09	54.8	56.4	61.3	54.0
4	09-10	66.4	58.0	64.0	56.6
5	10-11	69.1	59.2	66.4	59.6
6	11-12	61.4	60.4	70.1	62.7
7	12-13	60.3	61.0	68.2	64.0
8	13-14	58.0	62.1	66.5	61.8
9	14-15	66.4	60.7	63.1	60.6
10	15-16	64.6	58.5	65.9	58.8
11	16-17	65.5	61.8	64.2	58.0
12	17-18	58.8	58.1	66.1	59.2
13	18-19	60.4	58.1	68.6	58.1
14	19-20	62.7	59.3	69.8	57.5
15	20-21	62.1	57.6	66.9	57.2
16	21-22	60.9	59.1	64.2	56.2
17	22-23	56.2	58.0	63.1	54.7
18	23-24	54.3	57.3	58.8	53.3
19	00-01	53.9	54.6	54.5	52.3
20	01-02	52.7	54.0	53.9	51.7
21	02-03	55.4	52.6	53.0	51.2
22	03-04	55.3	51.3	51.6	49.9
23	04-05	56.6	52.0	51.9	51.0
24	05-06	59.7	52.8	52.3	51.4
I	Ld	63.2	59.2	66.2	59.2
II	Ln	56.0	54.7	57.0	52.2
II	Ldn	61.9	58.2	64.7	57.9
Category		Industrial Area (Haldia Dock)			
CPCB Norms		Day: 75 & Night: 70			

Note: Monitoring Date represents 24 hours from 6:00 am next day. Legend: Leq - Equivalent Noise Level (hourly);

Ld - Day Time Equivalent Noise Level (06:00-22:00 hrs); Ln - Night Time Equivalent Noise Level (22:00-06:00 hrs); and

Ldn - 24 hourly Equivalent Noise Level.

*: CPCB - Norms - Ambient Noise Norms (Leq); Daytime is recorded in between 6 a.m. and 10 p.m. and Night time is recorded in between 10 p.m. and 6 a.m.

A warning limit of 85 dB(A) is set as the level below which very little risk to unprotected ear of hearing impairment exists for an eight hour exposure


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FIGURE-7

Name of the Client :M/s.Haldia Dock Complex, SMP, Kolkata
 Sample Description : Noise Monitoring
 Sample Drawn By : Hubert Enviro Care Systems Private Limited
 Sampling Date : 16/12/2022 20/12/2022 15/12/2022 03/02/2023

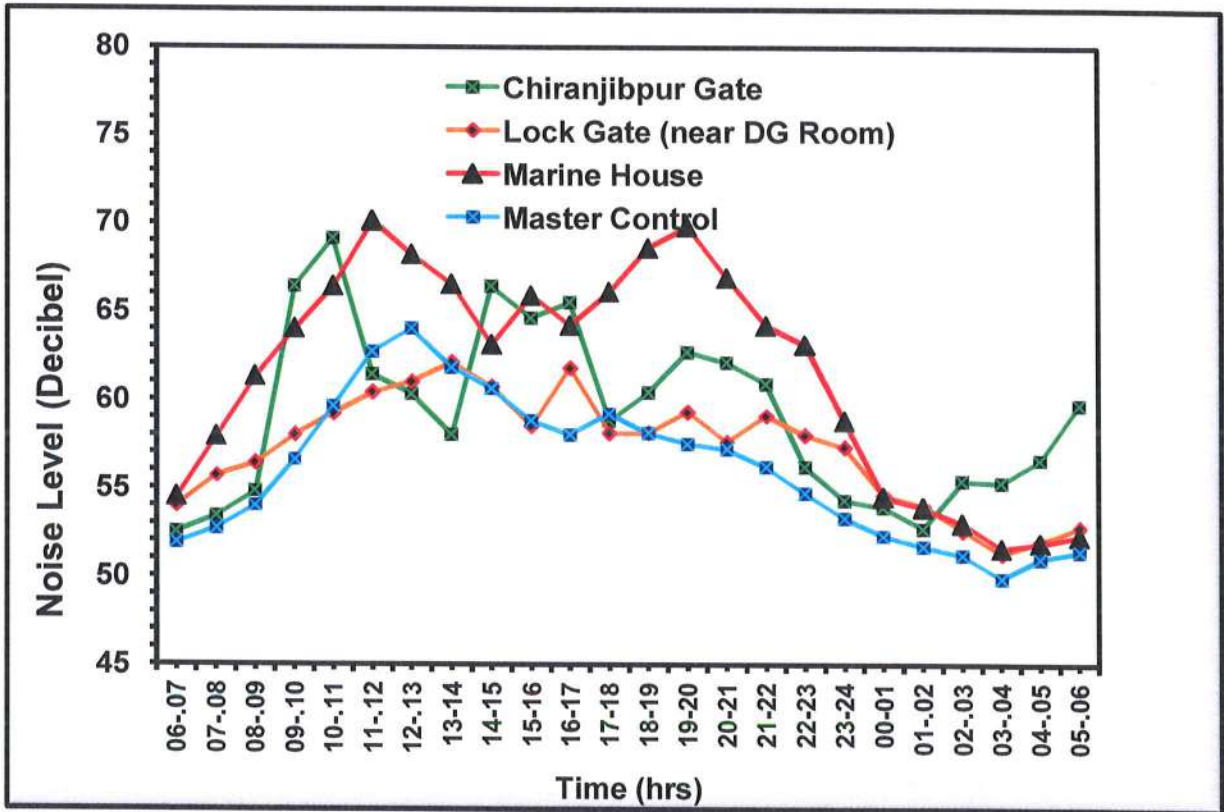


Figure 7: Graphical representation of Monitoring Location & Hourly Leq Noise Level in dB (A)



TEST REPORT-10

Name of the Client : M/s. Haldia Dock Complex, SMP, Kolkata
 Sample Description : Noise Monitoring
 Sample Drawn By : Hubert Enviro Care Systems Private Limited

S.No	Location	Day Time (06.00 – 22.00 hrs.)						Night Time (22.00 – 06.00 hrs)						Ldn
		Noise Level, dB (A)						Noise Level dB (A)						
		Lmin	L10	L50	L90	Lmax	Ld*	Lmin	L10	L50	L90	Lmax	Ln	
1	Chiranjibpur Gate	52.5	53.4	58.0	62.1	69.1	63.2	52.7	54.3	52.7	56.6	59.7	56.0	61.9
2	Lock Gate (near DG Room)	54.0	55.7	62.1	57.6	62.1	59.2	51.3	57.3	54.0	52.0	58.0	54.7	58.2
3	Marine House	54.5	57.9	66.5	66.9	70.1	66.2	51.6	58.8	53.9	51.9	63.1	57.0	64.7
4	Master Control	51.9	52.7	61.8	57.2	64.0	59.2	49.9	53.3	51.7	51.0	54.7	52.2	57.9

Legend: Lmin- Minimum Level; L10, L50, L90 – Noise Level exceed for 10%, 50% & 90% of times and Lmax. – Maximum Level. Ld- Day Time Equivalent Noise Level (06:00-22:00); Ln-Night Time Equivalent Noise Level (22:00-06:00 hrs) and Ldn-24-hourly Equivalent Noise Level.

Noise Standards - CPCB:

Industrial Area : Day Time-75 dB (A); Night Time-70 dB (A).
 Commercial Area : Day Time-65 dB (A); Night Time-55 dB (A).
 Residential Area : Day Time-55 dB (A); Night Time-45 dB (A).
 Silence Zone : Day Time-50 dB (A); Night Time-40 dB (A).



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5.0 WATER QUALITY STATUS

5.1 Monitoring Station Selection Criteria

The water monitoring stations were selected as per the water source of marine water identified with reference to previous EIA study and discussion to official person of Haldia Dock Complex. The monitoring locations are given in Table 5.1.

Table 5.1: Water Quality Monitoring Stations

Sl. No.	Water Sampling Station	Sample Code
Marine Water		
1	Near HFTPL Jetty (Downstream) – Surface (0.3 m)	MW1
2	Near HFTPL Jetty –Bottom (7m)	MW2
3	Near 1 st Oil Jetty (Upstream) – Surface (0.3 m)	MW3
4	Near 1 st Oil Jetty (Upstream) – Bottom (7m)	MW4
5	Near Outer Terminal – II- Surface (0.3 m)	MW5
6	Near Outer Terminal – II- Bottom (7m)	MW6
7	Near Lock Approach- Surface (0.3 m)	MW7
8	Near Lock Approach- Bottom (7m)	MW8

5.2 Monitoring Methodology

Water samples were collected and analyzed as per the procedures outlined in IS: 3025/ APHA. Sterilized bottles were used for collection of water samples for bacteriological analysis, stored in ice box and transported to the laboratory for analyses. Parameters like pH, Temperature, Dissolved Oxygen, Residual Chlorine, Conductivity, Free Ammonia, Total Hardness, Calcium Hardness and Magnesium Hardness were measured in the field while collecting the samples. MPN index (APHA Standard Method, 1992) of coliforms was determined in the laboratory as per standard methods.

Table 5.2: Analytical Procedure

S.No.	Parameters	Analytical Methods	Reference
1	pH (at 25 °C)	By pH meter	IS 3025 (Part - 11):1983
2	Colour	Visual comparison using Platinum - Cobalt	IS 3025(Part - 4):1983
3	Total Hardness as CaCO ₃	Titrimetric Method	IS 3025 (Part - 21):1983
4	Calcium as Ca	Titrimetric Method	IS 3025 (Part - 40):1991
5	Chloride as Cl	Argentometric Titration	IS 3025 (Part - 32):1988
6	Magnesium as Mg	EDTA Method	IS 3025 (Part - 46) 1994
7	Total Dissolved Solids	By Gravimetric	IS3025(Part-16):1984(Reaff:2014)

8	Sulphate as SO ₄	By UV- Spec	IS 3025(Part - 24):1986
9	Fluoride	By UV- Spec	IS 3025 (Part - 60):2008
10	Nitrate as NO ₃	By UV- Spec	ASTM(Part - 31)1978
11	Iron as Fe	By UV- Spec	IS 3025 (Part - 53):2003
12	Hexavalent Chromium as Cr 6+	By UV- Spec	IS3025Part(52):2003(Reaff:2014)
13	Zinc as Zn	ICPMS	IS 3025 (Part49)-1994(Reaff 2009)
14	Copper as Cu	ICPMS	IS 3025 (Pt 42)-1992(Reaff :2009)
15	Manganese as Mn	ICPMS	IS 3025:(Part - 59):2006
16	Cadmium as Cd	ICPMS	IS 3025 (Part - 41)1991
17	Lead as Pb	ICPMS	IS 3025(Part - 47)1994(Reaff 2009)
18	Arsenic as As	ICPMS	IS 3025:(Part-37):1988(Reaff 2009)
19	Mercury as Hg	ICPMS	IS3025(Part48):1994RA1999
20	Sodium as Na	Flame Photometer	IS3025 (Part - 45):1993
21	Potassium as K	Flame Photometer	IS3025 (Part - 45):1993
22	BOD. 5 days @ 20°C as O ₂	BOD Incubator	IS 3025 (Part - 44):1993
23	Dissolved Oxygen	Titrimetric Method	IS 3025 (Part - 38):1989
24	Nitrite as NO ₂	By UV- Spec	IS 3025(Part- 34):1988
25	Salinity	Argentometric Titration	2520AAPHA22ndEdn.2012

Table 5.3: Onsite parameters for analysis

S.No.	Parameters	Analytical Methods	Reference
1	pH (at 25 °C)	By Hand Meter	IS 3025 (Part - 11):1983
2	Dissolved oxygen	Iodimetry (Fixing & Titration)	IS 3025 (Part - 38):1989
3	Electrical Conductivity	Conductivity meter	IS 3025(Part-14):2013
4	Total Dissolved Solids	By Hand Meter	IS3025(Part-16):1984(Reaff:2014)

5.3 Sampling

Any adverse impact of water pollution will have serious effect on the environment. Hence, it becomes important to monitor the water quality periodically in the port area. The samples were analyzed as per IS: 3025, and compared to the specifications Primary Water Quality Criteria for Class SW- IV (For Harbour Waters).

5.4 Analytical Result:

The water levels in different locations were recorded and compared to the specifications of CPCB norms and the results are shown in Test report.

TEST REPORT-11

Name of the Client : M/s.Haldia Dock Complex, SMP, Kolkata
 Sample Description : Marine Water Quality
 Sample Drawn By : Hubert Enviro Care Systems Private Limited
 Sampling Date : 28/02/2023

S.No.	Parameters	Units	Primary Water Quality Criteria for Class SW- IV (for Harbour Waters)	Near HFTPL Jetty (Downstream)		Near 1st Oil Jetty (Upstream)	
				Lat: 22° 0' 53.85895" N Log: 88° 4' 5.79562" E		Lat: 22° 1' 6.43649" N Log: 88° 4' 49.17749" E	
				Surface at 0.3m	Bottom at 7m	Surface at 0.3m	Bottom at 7m
1	pH (at 25 °C)	-	6.5 – 9.0	7.74	7.70	7.67	7.63
2	Colour	Hazen Unit	No visible colour	BLQ(LOQ:1.0)	BLQ(LOQ:1.0)	BLQ(LOQ:1)	BLQ(LOQ:1)
3	Turbidity	NTU	-	47.8	57.6	38.6	84.3
4	Odour	-	No offensive odour	Agreeable	Agreeable	Agreeable	Agreeable
5	Chloride as Cl	mg/l	-	2022	1890	2426	2124
6	Total Suspended Solids	mg/l	-	826.0	810.0	893.0	787.0
7	Salinity	ppt	-	9.43	9.34	9.68	10.06
8	Total Dissolved Solids	mg/l	-	10500	10120	11640	11400
9	Sulphate as SO ₄	mg/l	-	562.95	694.15	603.64	637.40
10	Nitrate as NO ₃	mg/l	-	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)
11	Iron as Fe	mg/l	-	0.61	0.55	0.31	0.52
12	Zinc as Zn	mg/l	-	BLQ(LOQ0.1)	BLQ(LOQ0.1)	BLQ(LOQ0.1)	BLQ(LOQ0.1)
13	Chromium as Cr	mg/l	-	BLQ(LOQ0.01)	BLQ(LOQ0.01)	BLQ(LOQ0.01)	BLQ(LOQ0.01)
14	Copper as Cu	mg/l	-	BLQ(LOQ 0.01)	0.0193	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)
15	Cadmium as Cd	mg/l	-	BLQ(LOQ0.001)	BLQ(LOQ0.001)	BLQ(LOQ0.001)	BLQ(LOQ0.001)
16	Lead as Pb	mg/l	-	BLQ(LOQ0.005)	BLQ(LOQ0.005)	BLQ(LOQ0.005)	BLQ(LOQ0.005)
17	Arsenic as As	mg/l	-	BLQ(LOQ0.005)	BLQ(LOQ0.005)	BLQ(LOQ0.005)	BLQ(LOQ0.005)
18	Mercury as Hg	mg/l	-	BLQ(LOQ0.0005)	BLQ(LOQ0.0005)	BLQ(LOQ0.0005)	BLQ(LOQ0.0005)
19	Phosphate as PO ₄	mg/l	-	0.13	0.14	0.08	0.12
20	BOD, 5 days @ 20°C as O ₂	mg/l	5 mg/l	7.0	8.0	9.0	7.0
21	Oil and Grease	mg/l	-	BLQ(LOQ:4.0)	BLQ(LOQ:4.0)	BLQ(LOQ 4.0)	BLQ(LOQ:4)
22	Dissolved Oxygen	mg/l	3.0 mg/l or 40% saturation value whichever is higher	6.6	6.8	6.1	6.8
23	Nitrite as NO ₂	mg/l	-	BLQ(LOQ:0.02)	BLQ(LOQ:0.02)	BLQ(LOQ:0.02)	BLQ(LOQ:0.005)
24	Ammoniacal Nitrogen as NH ₃ -N	mg/l	-	2.27	0.34	0.18	0.37
25	Petroleum Hydrocarbons	mg/l	-	LQ(LOQ.00001)	BLQ(LOQ.00001)	BLQ(LOQ.00001)	BLQ(LOQ.00001)
26	Floating Matters	mg/l	10 mg/l	BLQ(LOQ:1.0)	BLQ(LOQ:1.0)	BLQ(LOQ:1.0)	BLQ(LOQ:1)
27	Electrical Conductivity	µS/cm	-	15441	14882	17118	16765
28	COD	mg/l	-	44.0	56.0	56.0	48.0
29	Alkalinity as CaCO ₃	mg/l	-	280	260	312	276
30	Total Hardness as CaCO ₃	mg/l	-	684	752	798	812
31	Calcium as Ca	mg/l	-	198	246	184	216
32	Magnesium as Mg	mg/l	-	76	104	86	78
33	Sodium as Na	mg/l	-	1052	962	958	846
34	Potassium as K	mg/l	-	96	64	102	84
35	Flouride as F	mg/l	-	0.74	0.89	0.64	0.45
36	Phenolic compound as C ₆ H ₅ OH	mg/l	-	BLQ(LOQ0.001)	BLQ(LOQ0.001)	BLQ(LOQ0.001)	BLQ(LOQ0.001)
37	Cyanide	mg/l	-	Absent	Absent	Absent	Absent
38	Aluminium	mg/l	-	9.8	10.2	9.4	8.6
39	Total coliforms	MPN/100 ml	-	1600	1600	1600	1600

Note: BLQ- Below the Limit of Quantification; LOQ- Limit of Quantification.

Analyst



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TEST REPORT-11

Name of the Client
Sample Description
Sample Drawn By
Sampling Date

:M/s.Haldia Dock Complex, SMP, Kolkata
: Marine Water Quality
: Hubert Enviro Care Systems Private Limited
: 28/02/2023

S.No.	Parameters	Units	Primary Water Quality Criteria for Class SW- IV (for Harbour Waters)	Near HFTPL Jetty (Downstream)		Near 1st Oil Jetty (Upstream)	
				Lat: 22° 0' 53.85895" N Log: 88° 4' 5.79562" E		Lat: 22° 1' 6.43649" N Log: 88° 4' 49.17749" E	
				Surface at 0.3m	Bottom at 7m	Surface at 0.3m	Bottom at 7m
1	pH (at 25 °C)	-	6.5 – 9.0	7.74	7.70	7.67	7.63
2	Colour	Hazen Unit	No visible colour	BLQ(LOQ:1.0)	BLQ(LOQ:1.0)	BLQ(LOQ:1)	BLQ(LOQ:1)
3	Turbidity	NTU	-	47.8	57.6	38.6	84.3
4	Odour	-	No offensive odour	Agreeable	Agreeable	Agreeable	Agreeable
5	Chloride as Cl	mg/l	-	2022	1890	2426	2124
6	Total Suspended Solids	mg/l	-	826.0	810.0	893.0	787.0
7	Salinity	ppt	-	9.43	9.34	9.68	10.06
8	Total Dissolved Solids	mg/l	-	10500	10120	11640	11400
9	Sulphate as SO ₄	mg/l	-	562.95	694.15	603.64	637.40
10	Nitrate as NO ₃	mg/l	-	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)	BLQ(LOQ 1)
11	Iron as Fe	mg/l	-	0.61	0.55	0.31	0.52
12	Zinc as Zn	mg/l	-	BLQ(LOQ0.1)	BLQ(LOQ0.1)	BLQ(LOQ0.1)	BLQ(LOQ0.1)
13	Chromium as Cr	mg/l	-	BLQ(LOQ0.01)	BLQ(LOQ0.01)	BLQ(LOQ0.01)	BLQ(LOQ0.01)
14	Copper as Cu	mg/l	-	BLQ(LOQ 0.01)	0.0193	BLQ(LOQ 0.01)	BLQ(LOQ 0.01)
15	Cadmium as Cd	mg/l	-	BLQ(LOQ0.001)	BLQ(LOQ0.001)	BLQ(LOQ0.001)	BLQ(LOQ0.001)
16	Lead as Pb	mg/l	-	BLQ(LOQ0.005)	BLQ(LOQ0.005)	BLQ(LOQ0.005)	BLQ(LOQ0.005)
17	Arsenic as As	mg/l	-	BLQ(LOQ0.005)	BLQ(LOQ0.005)	BLQ(LOQ0.005)	BLQ(LOQ0.005)
18	Mercury as Hg	mg/l	-	BLQ(LOQ0.0005)	BLQ(LOQ0.0005)	BLQ(LOQ0.0005)	BLQ(LOQ0.0005)
19	Phosphate as PO ₄	mg/l	-	0.13	0.14	0.08	0.12
20	BOD, 5 days @ 20°C as O ₂	mg/l	5 mg/l	7.0	8.0	9.0	7.0
21	Oil and Grease	mg/l	-	BLQ(LOQ:4.0)	BLQ(LOQ:4.0)	BLQ(LOQ 4.0)	BLQ(LOQ:4)
22	Dissolved Oxygen	mg/l	3.0 mg/l or 40% saturation value whichever is higher	6.6	6.8	6.1	6.8
23	Nitrite as NO ₂	mg/l	-	BLQ(LOQ:0.02)	BLQ(LOQ:0.02)	BLQ(LOQ:0.02)	BLQ(LOQ:0.005)
24	Ammoniacal Nitrogen as NH ₃ -N	mg/l	-	2.27	0.34	0.18	0.37
25	Petroleum Hydrocarbons	mg/l	-	LQ(LOQ.00001)	BLQ(LOQ.00001)	BLQ(LOQ.00001)	BLQ(LOQ.00001)
26	Floating Matters	mg/l	10 mg/l	BLQ(LOQ:1.0)	BLQ(LOQ:1.0)	BLQ(LOQ:1.0)	BLQ(LOQ:1)
27	Electrical Conductivity	µS/cm	-	15441	14882	17118	16765
28	COD	mg/l	-	44.0	56.0	56.0	48.0
29	Alkalinity as CaCO ₃	mg/l	-	280	260	312	276
30	Total Hardness as CaCO ₃	mg/l	-	684	752	798	812
31	Calcium as Ca	mg/l	-	198	246	184	216
32	Magnesium as Mg	mg/l	-	76	104	86	78
33	Sodium as Na	mg/l	-	1052	962	958	846
34	Potassium as K	mg/l	-	96	64	102	84
35	Flouride as F	mg/l	-	0.74	0.89	0.64	0.45
36	Phenolic compound as C ₆ H ₅ OH	mg/l	-	BLQ(LOQ0.001)	BLQ(LOQ0.001)	BLQ(LOQ0.001)	BLQ(LOQ0.001)
37	Cyanide	mg/l	-	Absent	Absent	Absent	Absent
38	Aluminium	mg/l	-	9.8	10.2	9.4	8.6
39	Total coliforms	MPN/100 ml	-	500	1600	900	1600

Note: BLQ- Below the Limit of Quantification; LOQ- Limit of Quantification.

Analyst



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TEST REPORT-13

Name of the Client : M/s. Haldia Dock Complex, SMP, Kolkata

Sample Description : Marine Water Biological Analysis (0.3 meter)

Sample Mark : Near 1st Oil Jetty (Downstream)
(Lat: 22° 1' 6.43649" N Log: 88° 4' 49.17749" E)

Sample Drawn By : Hubert Enviro Care Systems Private Limited

Sampling Date : 28/02/2023

S.No	Parameters	Values	Test Method
1	Phytoplankton (64µm mesh)		
	Total Cell Count	6600 cells/L	APHA 22 nd Edition 2012
	Total Genus	08	
	Genus	Streptotheca spp, Skeletonema spp, Ditylium spp, Rhizosolenia spp, Naviculac spp, Thalassiothrix spp, Biddulphia spp, Chaetoceros spp.	
Zooplankton (200µm mesh)			
2	Total Cell Count	2500 cells/L	APHA 22 nd Edition 2012
	Total Genus	03	
	Genus	Oithana rigida, Copepod nauplii, Acartia Spp,	


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TEST REPORT-14

Name of the Client : M/s.Haldia Dock Complex, SMP, Kolkata
 Sample Description : Marine Water Biological Analysis (0.3 meter)
 Sample Mark : Near Lock Approach (Lat: 22° 1' 28.54146" N Log: 88° 5' 14.06292" E)
 Sample Drawn By : Hubert Enviro Care Systems Private Limited
 Sampling Date : 28/02/2023

S.No	Parameters	Values	Test Method
1	Phytoplankton (64µm mesh)		
	Total Cell Count	7200 cells/L	APHA 22 nd Edition 2012
	Total Genus	08	
	Genus	Rhizosolenia spp, Scrippsiella spp, Thalassiosira Spp,, Alexandrium Spp, Phaeocystis Spp, Naviculae spp, Ceratium fuscus, Biddulphia Spp	
2	Zooplankton (200µm mesh)		
	Total Cell Count	3200 cells/L	APHA 22 nd Edition 2012
	Total Genus	05	
	Genus	Oithana rigida, Obelia Spp, Copepod nauplii, Acartia Spp, Eucalanus Spp.	


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TEST REPORT-15

Name of the Client : M/s.Haldia Dock Complex, SMP, Kolkata
 Sample Description : Marine Water Biological Analysis (0.3 meter)
 Sample Mark : Near Outer Terminal– II (Lat: 22° 1' 9.82758" N Log: 88° 4' 42.09802" E)
 Sample Drawn By : Hubert Enviro Care Systems Private Limited
 Sampling Date : 28/02/2023

S.No	Parameters	Values	Test Method
1	Phytoplankton (64µm mesh)		
	Total Cell Count	6000 cells/L	APHA 22 nd Edition 2012
	Total Genus	07	
	Genus	Chaetoceros spp, Dinoflagellates spp, Rhizosolenia spp, Scrippsiella spp, Naviculae spp, Dinopysis norvegica, Thalassiothrix spp.	
2	Zooplankton (200µm mesh)		
	Total Cell Count	4300 cells/L	APHA 22 nd Edition 2012
	Total Genus	07	
	Genus	Copepod nauplii, Eucalanus Spp, Obelia Spp, Titinopsis cylindrica, Globigerina Spp, Crab Zoea, Rhincalanus spp.	


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TEST REPORT-16

Name of the Client : M/s.Haldia Dock Complex, SMP, Kolkata
 Sample Description : Marine Water Biological Analysis (0.3 meter)
 Sample Mark : Near HFTPL Jetty (Downstream)
 (Lat: 22° 0' 53.85895" N Log: 88° 4' 5.79562" E)
 Sample Drawn By : Hubert Enviro Care Systems Private Limited
 Sampling Date : 28/02/2023

S.No	Parameters	Values	Test Method
1	Phytoplankton (64µm mesh)		
	Total Cell Count	7200 cells/L	APHA 22 nd Edition 2012
	Total Genus	08	
	Genus	Thalassiosira Spp, Ceratium fuscus, Scrippsiella Spp, Odontella Spp, Corethron Spp, Melosira Spp, Chaetoceros Spp, Rhizosolenia Spp, Naviculae Spp	
2	Zooplankton (200µm mesh)		
	Total Cell Count	3300 cells/L	APHA 22 nd Edition 2012
	Total Genus	05	
	Genus	Eucalanus Spp, Obelia Spp, Titinopsis cylindrica, Globigerina Spp, Crab Zoca	


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5.5 Light

The amount of light that phytoplankton are accumulated to not only affect their growth but also their fluorescence output. Phytoplankton situated at the top of the water column on a bright sunny day can get over-saturated with light energy thereby decreasing the amount of fluorescence that their cells give off. Conversely, phytoplankton deeper in the water column where there is minimal light may adapt their shapes to maximize processing light energy for growth, which in turn increases the amount of fluorescence per cell.

5.6 Chlorophyll Content Estimation

Chlorophyll-containing phytoplankton was measured; 25 ml of sample water are concentrated by filtration at low vacuum through a glass fiber filter. The pigments are extracted from the phytoplankton in 90% acetone with the aid of a mechanical tissue grinder and are allowed to steep 2-24 hours. The resulting slurry is centrifuged to clarify the solution, and the absorbance of the supernatant liquid was measured at different wavelengths to determine chlorophylls a, b, and c (630, 647 and 664) respectively. Absorbance values were entered into a set of equations to that utilize the extinction coefficients of the pure pigments in 90% acetone to simultaneously calculate the concentrations of the pigments in a mixed solution.

In the optical methods the pigments such as (Chlorophyll a, b, and c) were identified. The phytoplanktonic community of the Haldia Port reservoir is composed predominantly by Chlorophyceae and Bacillariophyceae. Phytoplanktonic community is dominated by cyanobacteria being the Chlorophyceae is the second most abundant group. Results are shown in **Figure 8 and 9**, respectively for the month of **Dec'2022– Feb'2023** in the place of Haldia Dock.

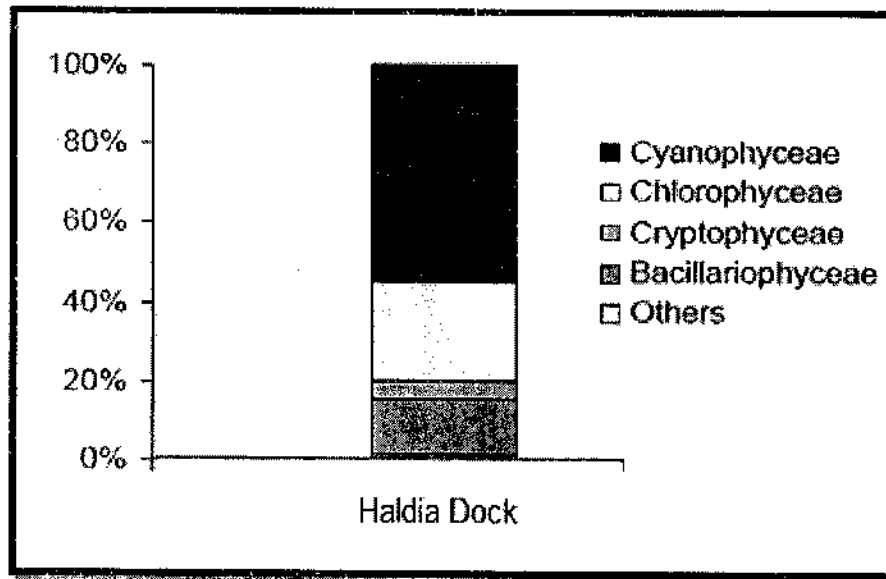


Figure 8. The Average phytoplankton distribution in the Haldia port during the period Dec 2022 – Feb 2023

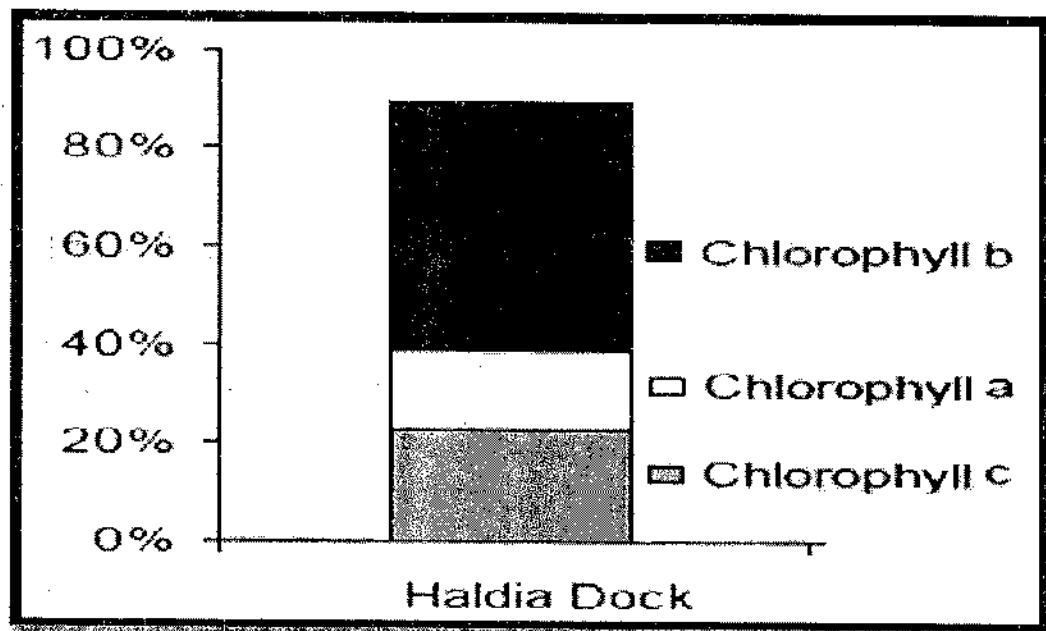


Figure 9. The Average concentration of Chlorophyll a, b and c in the Haldia port during the period Dec2022 – Feb 2023

5.7 Primary Productivity

Productivity refers to the rate of production on a unit area basis. The total amount of solar energy converted to chemical energy by green plant is gross primary production. The estimation of primary productivity is predicted on the relationship between oxygen evolution and carbon fixation. Primary productivity varies from freshwater to estuarine and from estuarine to marine water body like 3rd oil Jetty, 1st oil jetty, Project site and Lock Approach.

The data was observed for monthly variation from Dec'2022 – Feb'2023 of gross primary productivity (GPP), net primary productivity (NPP) and community respiration (CR) along with mean standard deviation from Dec'2022 – Feb'2023 as shown in Figure 4.

Table 5.4. Mean Monthly Variations of GPP, NPP and RES Values in $\text{gCm}^{-2}\text{day}^{-1}$ (Mean \pm SD) at Haldia Dock Complex during Dec'2022 – Feb'2023.

Months	Temperature of Water in $^{\circ}\text{C}$	GPP $\text{gCm}^{-2}\text{day}^{-2}$	NPP $\text{gCm}^{-2}\text{day}^{-1}$	RES (CR) $\text{gCm}^{-2}\text{day}^{-1}$	IS:10500 - 2012	
					Acceptable Limits	Permissible Limits
Dec	28.6	161.04 \pm 4.05	121.9 \pm 5.47	38.14 \pm 4.27	NA	NA
Jan	29.4	171.12 \pm 2.57	130.5 \pm 2.68	41.05 \pm 2.56	NA	NA
Feb	29.9	176.76 \pm 2.72	142.9 \pm 2.89	42.07 \pm 3.64	NA	NA

Note: GPP - Gross Primary Productivity, NPP - Net Primary Productivity, CR - Community Respiration, NA – Not Applicable.



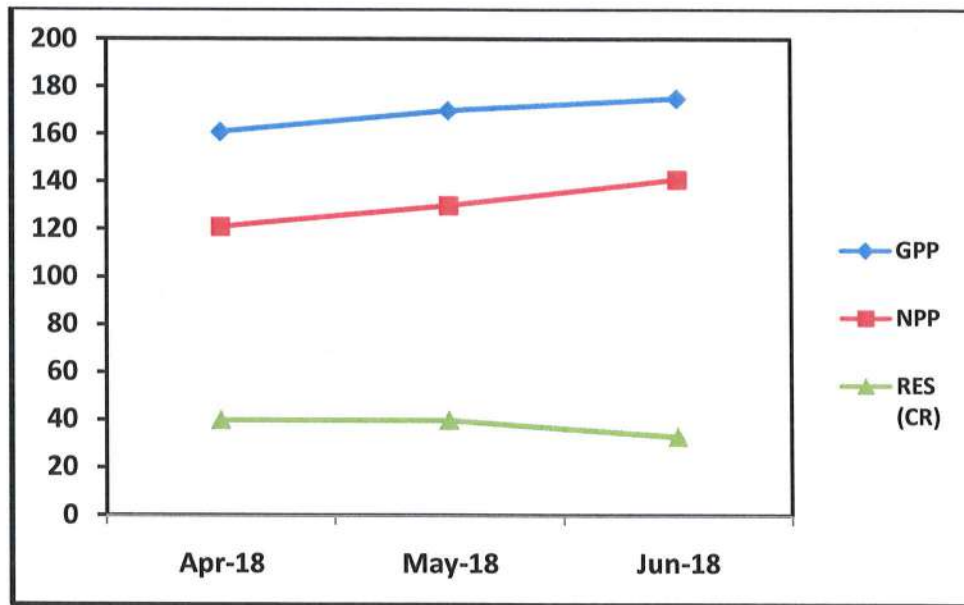


Figure10. Monthly variations in Primary Productivity (GPP, NPP & CR) of Haldia Port 2022 ($\text{gCm}^{-2}\text{day}^{-1}$).

NB: The shellfish and finfish in the study area have not found during the monitoring time

6.0 SEDIMENT QUALITY RESULTS

6.1 Monitoring Location Selection Criteria

The sediment sampling locations were selected as per the identified with reference to previous EIA study and discussion to official person of Haldia Dock Complex. The monitoring locations are given in Table 6.1.

Table 6.1: Sediment Quality Monitoring Locations

Sl. No.	Sediment Sampling Location	Sample Code
1	Near 1 st Oil Jetty	S1
2	Near HFTPL Jetty	S2
3	Near Lock Approach	S3
4	Near Outer Terminal – II	S4

6.2 Monitoring Methodology

Sediment samples were collected at four locations and analyzed as per the standard existing procedures. Sterilized canisters were used for collection of sediment samples, stored in ice box and transported to laboratory for chemical analysis as per APHA Standard Method and results recorded for chemical parameters like pH, Texture, Sodium, Potassium, Phosphate, Chlorides and Sulphates.

Sediment grab samples were also collected using a Petersen grab, sieved and processed for biological analysis – microbenthic, meiobenthic and macrobenthic community structure analyses in laboratory and results reported in line with the procedures of APHA 22nd Edition 2012 and referring standard species identification references. The benthos samples processing is described below:

The collected wet sediment samples are sieved with varying mesh sizes for segregating the organisms. Macrobenthos are organisms which are retained in the sieve having mesh size between 0.5 and 1 mm. The term meiofauna loosely defines a group of organisms by their size, larger than microfauna but smaller than macrofauna, rather than a taxonomic grouping. In practice, that is organisms that can pass through a 1 mm mesh but will be retained by a 45 µm mesh. Organisms below size of 45 µm are regarded as microbenthos. The sieved organisms are then stained with Rose Bengal and sorted into different groups. The number of organisms in each grab sample is expressed in number per meter square.

6.3 Sampling

The marine sediment sampling in different locations were conducted and chemical analyses for various parameters were completed as per APHA methods and the results are provided in the following report.

Microbenthos, meiobenthos, macrobenthos were recorded in marine sediment samples collected from four locations namely **Near 1st Oil Jetty (Upstream), Near Lock Approach, Near Outer Terminal – II and Near HFTPL Jetty (Downstream)** and results are recorded in Annexure.

In microbenthos, organisms recorded included diatoms, ciliates, Amoeba, protozoans and flagellates. Groups including bivalves, echinoderms, sea anemones, sea squirts, turbellarians, and polychaete worms were recorded under macrobenthos.

TEST REPORT-17

Name of the Client : M/s. Haldia Dock Complex, SMP, Kolkata
 Sample Description : Sediment Analysis
 Sample Drawn By : Hubert Enviro Care Systems Private Limited
 Sampling Date : 28/02/2023

S.No.	Parameters	Units	Near 1 st Oil Jetty (Upstream)	Near HFTPL Jetty (Downstream)	Near Lock Approach	Near Outer Terminal – II
1	pH	-	7.22	7.30	6.82	7.12
2	Texture		Clay Loam	Clay	Clay Loam	Clay
	Sand	%	34.12	28.62	25.56	28.46
	Silt	%	39.41	39.66	43.20	30.14
	clay	%	26.47	31.72	31.14	41.40
3	Sodium	mg/kg	814.41	414.41	870.65	986.14
4	Potassium	mg/kg	58.0	26.25	62.43	74.20
5	Phosphate	mg/kg	3.44	4.16	10.90	3.56
6	Chlorides	mg/kg	1706.10	598.14	1794.20	2102.83
7	Sulphates	mg/kg	1941	1084.16	1020.44	530.54
8	Cadmium as Cd	mg/kg	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)
9	Copper as Cu	mg/kg	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)
10	Lead as Pb	mg/kg	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)
11	Zinc as Zn	mg/kg	7.56	6.58	8.46	6.96
12	Magnesium as Mg	mg/kg	652	725	689	958
13	Arsenic as As	mg/kg	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)	BLQ(LOQ 0.1)



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TEST REPORT-18

Name of the Client : M/s.Haldia Dock Complex, SMP, Kolkata
 Sample Description : Sediment Biological Analysis
 Sample Mark : Near 1st Oil Jetty
 Sample Drawn By : Hubert Enviro Care Systems Private Limited
 Sampling Date : 28/02/2023

S.No	Parameters	Values	Test Method
1	Microbenthos		
	Total Genus	04	APHA 22 nd Edition 2012
	Genus	Oithana rigida, Obelia Spp, Copepod nauplii, Acartia Spp.	
2	MacroBenthos		
	Total Genus	05	APHA 22 nd Edition 2012
	Genus	Oithana rigida, Obelia Spp, Copepod nauplii, Acartia Spp, Eucalanus Spp.	
3	Meiobenthos		
	Total Genus	05	APHA 22 nd Edition 2012
	Genus	Eucalanus Spp, Obelia Spp, Titinopsis cylindrica, Globigerina Spp, Crab Zoca	


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TEST REPORT-19

Name of the Client : M/s.Haldia Dock Complex, SMP, Kolkata
 Sample Description : Sediment Biological Analysis
 Sample Mark : Near Lock Approach
 Sample Drawn By : Hubert Enviro Care Systems Private Limited
 Sampling Date : 28/02/2023

S.No	Parameters	Values	Test Method
1	Microbenthos		
	Total Genus	05	APHA 22 nd Edition 2012
	Genus	Dinoflagellates, Odontella Spp, Corethron Spp, Naviculae Spp, Thalassiosira Spp	
2	MacroBenthos		
	Total Genus	08	APHA 22 nd Edition 2012
	Genus	Rhizosolenia spp, Scrippsiella spp, Thalassiosira Spp, Alexandrium Spp, Phaeocystis Spp, Naviculae spp, Ceratium fuscus, Biddulphia Spp	
3	Meiobenthos		
	Total Genus	04	APHA 22 nd Edition 2012
	Genus	Obelia Spp, Acartia Spp, Titinopsis Spp, Copepods	


Analyst Signatory


Authorized Signatory



TEST REPORT-20

Name of the Client : M/s.Haldia Dock Complex, SMP, Kolkata
 Sample Description : Sediment Biological Analysis
 Sample Mark : Near Outer Terminal – II
 Sample Drawn By : Hubert Enviro Care Systems Private Limited
 Sampling Date : 28/02/2023

S.No	Parameters	Values	Test Method
1	Microbenthos		
	Total Genus	05	APHA 22 nd Edition 2012
	Genus	Oithana rigida, Obelia Spp, Copepod nauplii, Acartia Spp, Eucalanus Spp.	
2	MacroBenthos		
	Total Genus	07	APHA 22 nd Edition 2012
	Genus	Chaetoceros spp, Dinoflagelates spp,Rhizosolenia spp,Scrippsiella spp,Naviculae spp,Dinopysis norvegica, Thalassiothrix spp.	
3	Meiobenthos		
	Total Genus	07	APHA 22 nd Edition 2012
	Genus	Copepod nauplii,Eucalanus Spp,Obelia Spp,Titinopsis cylindrica,Globigerina Spp, Crab Zoea, Rhincalanus spp.	


 Analyst Signatory


 Authorized Signatory



TEST REPORT-21

Name of the Client : M/s. Haldia Dock Complex, SMP, Kolkata
 Sample Description : Sediment Biological Analysis
 Sample Mark : Near HFTPL Jetty
 Sample Drawn By : Hubert Enviro Care Systems Private Limited
 Sampling Date : 28/02/2023

S.No	Parameters	Values	Test Method
1	Microbenthos		
	Total Genus	04	APHA 22 nd Edition 2012
	Genus	Obelia Spp, Acartia Spp, Titinopsis Spp, Copepods	
2	MacroBenthos		
	Total Genus	05	APHA 22 nd Edition 2012
	Genus	Obelia Spp, Acartia Spp, Copepod nauplii, Titinopsis spp, Eucalanus Spp	
3	Meiobenthos		
	Total Genus	06	APHA 22 nd Edition 2012
	Genus	Gymnodium Spp, Rhizosolenia Spp, Dinophysis Spp, Odontella Spp, Navicula Spp, Thalassiosira Spp	


Analyst Signatory




Authorized Signatory

7.0 GREEN BELT DEVELOPMENT

7.1 Biodiversity Assessment of Green belt trees

The main objectives of Green Belt development within industrial premises are to absorb the dust and gaseous pollutants, increasing CO₂ absorption and releasing of O₂ for better environment besides providing aesthetic view. It is mandatory that all industrial units have to maintain at least 33 % of Green belt area of the total plot area. Biodiversity encompasses the variety of life at all levels of organization, from genetic diversity within a species to diversity within entire regions or ecosystems. Biodiversity has to be assessed quantitatively with proper scientific, ecological and statistical methods like Quadrat sampling, enumeration of species list, counting and mapping of vegetation. The green belt development has to be maintained regularly within the periphery of the area by the industrial unit as per the statutory requirements of pollution control authorities. Dust deposition

The existing Green Belt area in the industrial premises was physically surveyed and the list of available tree species has been enumerated and presented below.

Table 7. Illustrates the list of tree species observed overall. Species counted at specific location (Port House/Cluster IV/Cluster VI/DAV School/Cluster VIII) around 5 Kilometers in the M/s. Haldia Dock Complex, SMP, Kolkata area during the Dec 2022 – Feb 2023 biodiversity survey has been given.

S. No.	Scientific Name	Common/Local Name	Family	Count	pi	lnpi	(-) pi*lnpi
1	<i>Acacia auriculiformis</i>	Akasmoni	Mimosaceae	53	0.0271	-3.6094	0.0977
2	<i>Acacia nilotica</i>	Babul	Mimosaceae	21	0.0107	-4.5352	0.0486
3	<i>Achras sapota</i>	Sapeda	Zapotaceae	15	0.0077	-4.8716	0.0373
4	<i>Adina cordifolia</i>	Haldu	Rubiaceae	0	0	0	0
5	<i>Aegle marmelos</i>	Wood Apple	Rutaceae	55	0.0281	-3.5723	0.1003
6	<i>Albizia lebeck</i>	Siris	Mimosaceae	31	0.0158	-4.1457	0.0656
7	<i>Alstonia scholaris</i>	Chatim	Apocyanaceae	30	0.0153	-4.1785	0.0640
8	<i>Artabotrys hexapetalus</i>	Kathali chapa	Annonaceae	33	0.0169	-4.0832	0.0688
9	<i>Anthocephalus chinensis</i>	Kadam	Rubiaceae	19	0.0097	-4.6352	0.0450
10	<i>Areca catechu</i>	Betel nut Palm	Palmaceae	21	0.0107	-4.5352	0.0486
11	<i>Artocarpus integrifolia</i>	Jackfruit	Moraceae	45	0.0230	-3.7730	0.0867
12	<i>Azadirachta indica</i>	Neem	Meliaceae	22	0.0112	-4.4886	0.0504
13	<i>Bougainvillea spectabilis</i>	Paper flower	Nyctaginaceae	45	0.0230	-3.7730	0.0867
14	<i>Bombax malabaricum</i>	Red Silk Cotton tree	Bombacaceae	17	0.0087	-4.7465	0.0412
15	<i>Borassus flabellifer</i>	Palmyra palm	Palmae	31	0.0158	-4.1457	0.0656
16	<i>Callistemon speciosus</i>	Bottle brush tree	Myrtaceae	71	0.0363	-3.3170	0.1203
17	<i>Cycas revoluta</i>	Cycas	Cycadaceae	35	0.0179	-4.0243	0.0719
18	<i>Cassia fistula</i>	Indian Laburnum, Golden shower tree	Caesalpiniaceae	25	0.0128	-4.3608	0.0557
19	<i>Cassia siamea</i>	Chakunda	Caesalpiniaceae	35	0.0179	-4.0243	0.0719
20	<i>Casuarina equisetifolia</i>	Australian pine tree, Jhau	Casuarinaceae	97	0.0495	-3.0050	0.1489
21	<i>Cocos nucifera</i>	Coconut palm	Palmae	42	0.0215	-3.8420	0.0824
22	<i>Dalbergia sissoo</i>	Indian Rosewood, Sishu	Fabaceae	12	0.0061	-5.0948	0.0312
23	<i>Delonix regia</i>	Flame tree, Gulmohar	Caesalpiniaceae	21	0.0107	-4.5352	0.0486
24	<i>Dillenia indica</i>	Elephant Apple, Chalta	Dilleniaceae	15	0.0077	-4.8716	0.0373
25	<i>Eriodendron anfractuosum</i>	White Silk Cotton tree	Bombacaceae	11	0.0056	-5.1818	0.0291
26	<i>Eucalyptus globulus</i>	Eucalyptus	Myrtaceae	17	0.0087	-4.7465	0.0412
27	<i>Excoecaria agallocha</i>	Geanoa	Euphorbiaceae	0	0	0	0
28	<i>Feronia elephantum</i>	Elephant apple	Rutaceae	7	0.0036	-5.6338	0.0201
29	<i>Ficus bengalensis</i>	Banyan tree	Moraceae	11	0.0056	-5.1818	0.0291
30	<i>Ficus cunia</i>	Fig tree	Moraceae	19	0.0097	-4.6352	0.0450
31	<i>Ficus religiosa</i>	Peepul tree	Moraceae	17	0.0087	-4.7465	0.0412
32	<i>Gliricidia sepium</i>	Gliricidia, Quickstick	Fabaceae	21	0.0107	-4.5352	0.0486
33	<i>Gmelina arborea</i>	Gamhar	Verbanaceae	10	0.0051	-5.2771	0.0270
34	<i>Grevillea robusta</i>	Silver fir, Silky Oak	Proteaceae	0	0	0	0
35	<i>Grewia asiatica</i>	Phalsa	Tiliaceae	0	0	0	0
36	<i>Holarrhena antidysenterica</i>	Kurchi	Apocynaceae	0	0	0	0



37	<i>Holoptelea integrifolia</i>	Indian Elm	Ulmaceae	21	0.0107	-4.5352	0.0486
38	<i>Lagerstroemia flosreginae</i>	Jarul	Lythraceae	31	0.0158	-4.1457	0.0656
39	<i>Leucaena leucocephala</i>	White Lead tree, Subabul	Mimosaceae	35	0.0179	-4.0243	0.0719
40	<i>Mangifera indica</i>	Mango tree	Anacardiaceae	75	0.0383	-3.2622	0.1250
41	<i>Michella champaca</i>	Champak	Magnoliaceae	0	0	0	0
42	<i>Millingtonia hortensis</i>	Indian Cork tree	Bignoniaceae	0	0	0	0
43	<i>Mimusops elengi</i>	Spanish Cherry, Bakul	Zapotaceae	71	0.0363	-3.3170	0.1203
44	<i>Morinda citrifolia</i>	Indian Mulberry	Rubiaceae	0	0	0	0
45	<i>Moringa pterygosperma</i>	Drumstick tree, Sajina	Moringaceae	14	0.0072	-4.9406	0.0353
46	<i>Morus indica</i>	Mulberry	Moraceae	0	0	0	0
47	<i>Nephelium litchi</i>	Litchi	Sapindaceae	9	0.0046	-5.3825	0.0247
48	<i>Peltophorum pterocarpum</i>	Radhachura	Fabaceae	211	0.1078	-2.2278	0.2401
49	<i>Phoenix sylvestris</i>	Date palm	Palmae	31	0.0158	-4.1457	0.0656
50	<i>Pithecellobium dulce</i>	Manila Tamarind	Fabaceae	15	0.0077	-4.8716	0.0373
51	<i>Plumeria acutifolia</i>	Pagoda tree	Apocynaceae	9	0.0046	-5.3825	0.0247
52	<i>Polyalthia longifolia</i>	False Ashoka, Debbaru	Annonaceae	39	0.0199	-3.9161	0.0780
53	<i>Pongamia glabra</i>	Pongam Oil Tree, Karang	Fabaceae	11	0.0056	-5.1818	0.0291
54	<i>Psidium guajava</i>	Guava	Myrtaceae	200	0.1021	-2.2814	0.2330
55	<i>Pterospermum acerifolium</i>	Muchkund	Sterculiaceae	0	0	0	0
56	<i>Putranjiva roxburghii</i>	Putranjiva	Euphorbiaceae	0	0	0	0
57	<i>Samanea saman</i>	Rain tree	Fabaceae	11	0.0056	-5.1818	0.0291
58	<i>Saraca indica</i>	Ashok	Fabaceae	41	0.0209	-3.8661	0.0810
59	<i>Sesbania grandiflora</i>	Hummingbird tree, Bakful	Fabaceae	11	0.0056	-5.1818	0.0291
60	<i>Sonneratia apetala</i>	Keora	Lythraceae	0	0	0	0
61	<i>Spathodea campanulata</i>	Fountain tree	Bignoniaceae	9	0.0046	-5.3825	0.0247
62	<i>Swietenia mahagoni</i>	Mahogany	Meliaceae	35	0.0179	-4.0243	0.0719
63	<i>Syzygium cumini</i>	Jam, Java plum	Myrtaceae	39	0.0199	-3.9161	0.0780
64	<i>Syzygium samarangense</i>	Rose apple, Jamrul	Myrtaceae	35	0.0179	-4.0243	0.0719
65	<i>Tamarindus indica</i>	Tamarind	Fabaceae	3	0.0015	-6.4811	0.0099
66	<i>Tamarix dioica</i>	Nona Jhau	Tamaricaceae	31	0.0158	-4.1457	0.0656
67	<i>Tectona grandis</i>	Teak	Verbenaceae	7	0.0036	-5.6338	0.0201
68	<i>Terminalia arjuna</i>	Arjun	Combretaceae	15	0.0077	-4.8716	0.0373
69	<i>Terminalia catappa</i>	Indian Almond	Combretaceae	13	0.0066	-5.0147	0.0333
70	<i>Tabubia rosea</i>	pink poui	Bignoniaceae	19	0.0097	-4.6352	0.0450
71	<i>Trema orientalis</i>	Charcoal tree	Ulmaceae	13	0.0066	-5.0147	0.0333
72	<i>Trewia nudiflora</i>	Pituli	Euphorbiaceae	0	0	0	0
			Total	1958			3.686



7.2 Biodiversity Indices

The field survey was completed by HECS team in covered location at Chairmen House/Cluster IV/DAV School/Cluster VIII around 5 Kilometers in the **M/s. Haldia Dock Complex, SMP, Kolkata** during Dec 2022 to Feb 2023; a total number of 1958 trees (N) have been recorded in the green belt area which comprise 59 numbers of species (S).

Shannon-Wiener Diversity (Biological Diversity)

Shannon-Wiener Index, originally proposed by Claude Shannon, a physicist, is the most commonly used biodiversity indices. It is also called Shannon's diversity index. It is an index that is commonly used to characterize species diversity in a community.

Shannon-Wiener Index is defined by the following function:

$$H = \Sigma[(pi) \times \ln(pi)]$$

H = 3.686 (As per the Table Calculation)

Where:

- p_i = proportion of total sample represented by species i . Divide no. of individuals of species i by total number of samples.

The biological diversity (Shannon-Weiner Index- H') value recorded is 3.686, which represents relatively good diversity among the green belt plant species.

Species Richness (D)

Species richness is the number of different species represented in an ecological community, landscape or region. Species richness is simply a count of species, and it does not take into account the abundances of the species or their relative abundance distributions.

The larger the sample, the more species we would expect to find. Species richness is calculated by dividing the number of species by the square root of the number of individuals

in the sample. This particular measure of species richness is known as D, the Menhinick's index:

$$D = \frac{s}{\sqrt{N}}$$

$$D = 59/\sqrt{1958} = 1.33$$

Where s equals the number of different species represented in your sample, and N equals the total number of individual organisms in the sample.

Species Evenness(J')

Species evenness refers to how close in numbers each species in an environment is. Mathematically it is defined as a diversity index, a measure of biodiversity which quantifies how equal the community is numerically. Species evenness is used to assess how evenly the population is spread across the species in an area.

Species Evenness= H/H_{max} :

$$H = 3.686$$

$$H_{max} = \ln(S) = \ln(59) = 4.078$$

$$= 3.686/4.078 = 0.904$$

Significant species evenness (J') of 0.904 has been recorded among all the species surveyed.

Depicts the biodiversity indices plot for the green belt tree species surveyed in and around the M/s. Haldia Dock Complex, SMP, Kolkata area. Based on the biodiversity, indices calculations was performed using software PRIMER for the trees surveyed at M/s. Haldia Dock Complex, SMP, Kolkata green belt areas, it is inferred that the areas indicate higher species richness (1.33), diversity (3.686) and significant evenness (0.904) as shown in Figure 11.

Girth Size: Girth is a measurement of the distance around the trunk of a tree measured perpendicular to the axis of the trunk. The girth size is measured on an average at the height of 1.5m above the ground. The girth size varies 36 to 182 cm in the study area during the monitoring period.

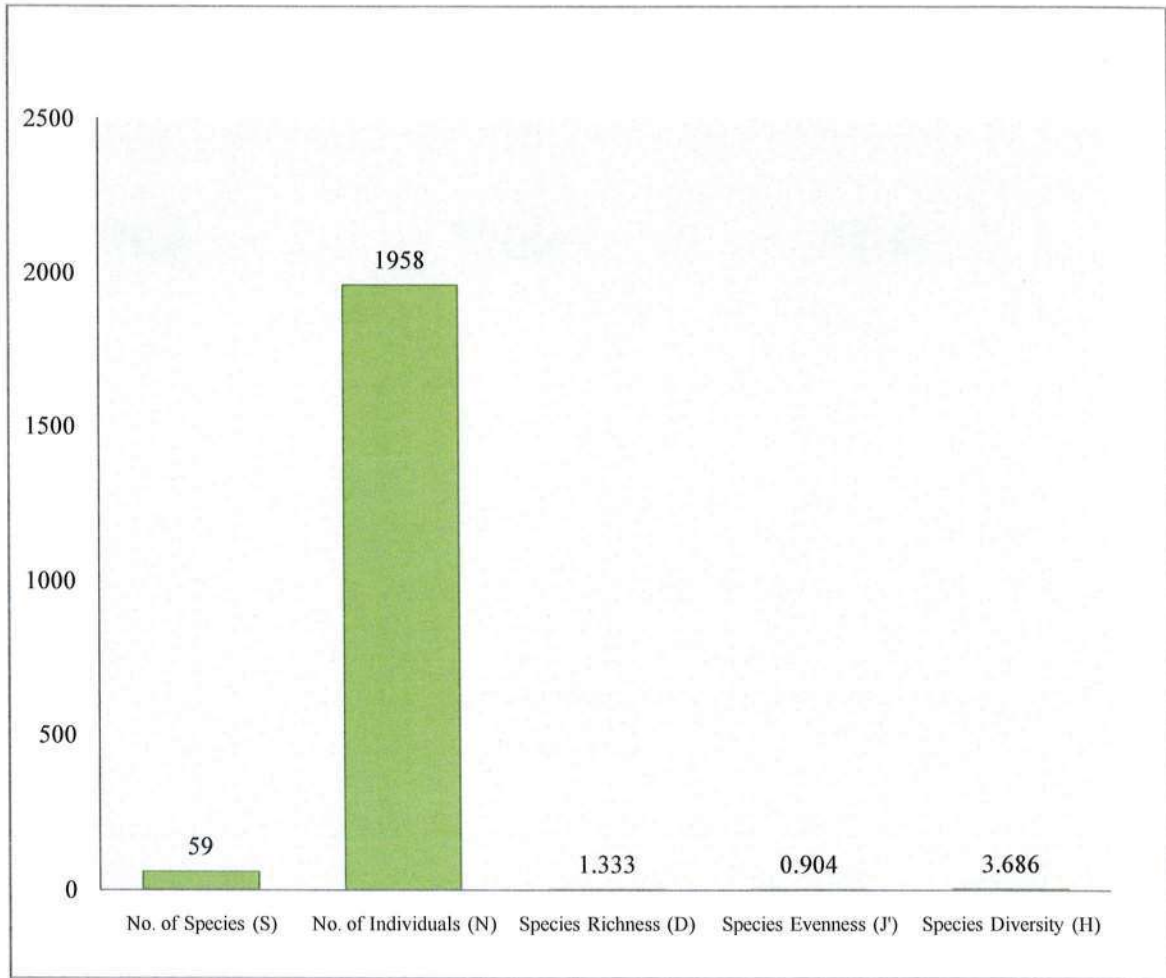










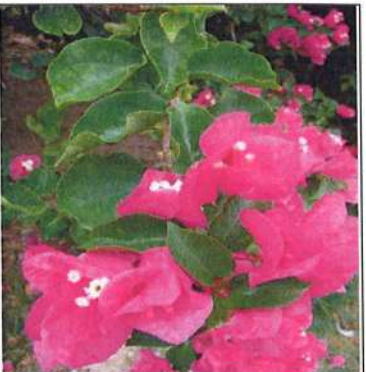









Figure 11. Biodiversity indices plot for the green belt tree species.





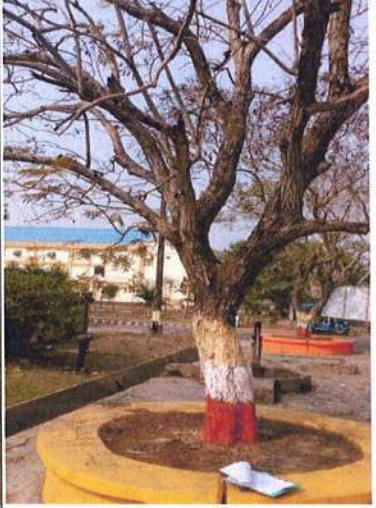




HaldiaDock Complex, SMP, Kolkata


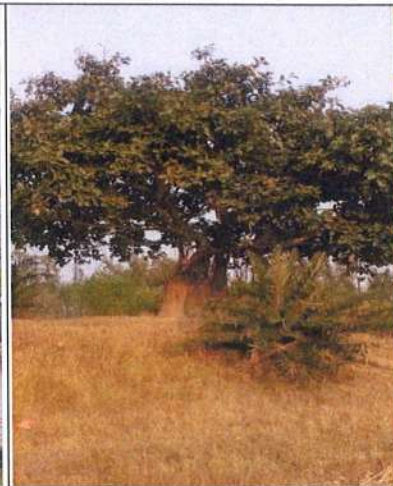



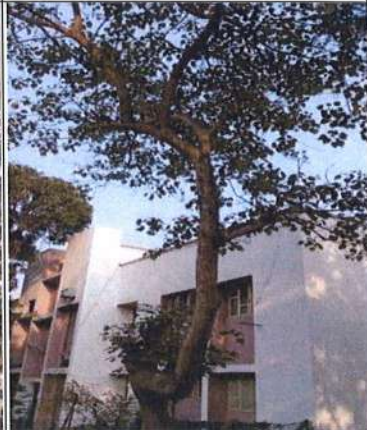



Green Belt Survey










Covered Location at Chairmen House/Cluster IV/DAV School/Cluster VIII




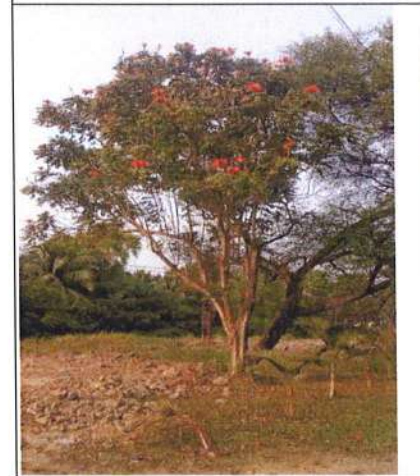

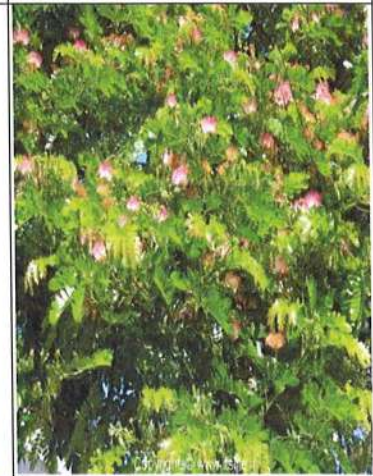



		
1. Akasmoni <i>Acacia auriculiformis</i>	2. Babul <i>Acacia nilotica</i>	3. Sapeda <i>Achras Sapota</i>
		
4. Wood Apple <i>Aegle Marmelos</i>	5. Siris <i>Albizzia lebbeck</i>	6. Kathali chapa <i>Artabotrys hexapetalus</i>






		
7. Chatim <i>Alstonia scholaris</i>	8. Kadam <i>Anthocephalus chinensis</i>	9. Paper flower <i>Bougainvillea spectabilis</i>
		
10. Indian Almond <i>Terminalia catappa</i>	11. Jack Fruit <i>Artocarpus Integrifolia</i>	12. Neem <i>Azadirachta Indica</i>
		
13. Cycas <i>Cycas revoluta</i>	14. Red Silk Cotton Tree <i>Bombax malabaricum</i>	15. Palmyra palm <i>Borassus flabellifer</i>
		
16. Bottle brush tree <i>Callistemon speciosus</i>	17. pink poui <i>Tabubia rosea</i>	18. Golden shower tree <i>Cassia fistula</i>

		
<p>19. Chakunda <i>Cassia siamea</i></p>	<p>20. Jhau <i>Casuarina equisetifolia</i></p>	<p>21. Coconut palm <i>Cocos nucifera</i></p>
		
<p>22. Indian Rosewood/Sishu <i>Dalbergia Sissoo</i></p>	<p>23. Flame tree/Gulmohar <i>Delonix regia</i></p>	<p>24. Elephant Apple/ Chalta <i>Dillenia Indica</i></p>
		
<p>25. White silk cotton tree <i>Eriodendron anfractuosum</i></p>	<p>26. Eucalyptus <i>Eucalyptus globulus</i></p>	<p>27. Betel Nut Palm <i>Areca Catechu</i></p>

		
<p>28. Elephant apple <i>Feronia elephantum</i></p>	<p>29. Banyan tree <i>Ficus bengalensis</i></p>	<p>30. Fig tree <i>Ficus cunia</i></p>
		
<p>31. Peepul tree <i>Ficus religiosa</i></p>	<p>32. Gliricidia/Quickstick <i>Gliricidia sepium</i></p>	<p>33. Gamhar <i>Gmelina arborea</i></p>
		
<p>34. Indian Elm <i>Holoptelea integrifolia</i></p>	<p>35. Jarul <i>Lagerstroemia flosreginae</i></p>	<p>36. White Lead tree, Subabul <i>Leucaena leucocephala</i></p>

		
37. Mango tree <i>Mangifera indica</i>	38. Spanish Cherry, Bakul <i>Mimusops elengi</i>	39. Charcoal tree <i>Trema orientalis</i>
		
40. Drumstick tree/ Sajina <i>Moringa pterygosperma</i>	41. Litchi <i>Nephelium litchi</i>	42. Radhachura <i>Peltophorum pterocarpum</i>
		
43. Date palm <i>Phoenix sylvestris</i>	44. Manila Tamarind <i>Pithecellobium dulce</i>	45. Pagoda tree <i>Plumeria acutifolia</i>

		
<p>46. False Ashoka, Debdaru <i>Polyalthia longifolia</i></p>	<p>47. Pongam Oil Tree, Karang <i>Pongamia glabra</i></p>	<p>48. Guava <i>Psidium guajava</i></p>
		
<p>49. Fountain tree <i>Spathodea campanulata</i></p>	<p>50. Mahogany <i>Swietenia mahagoni</i></p>	<p>51. Rain tree <i>Samanea saman</i></p>
		
<p>52. Ashok <i>Saraca indica</i></p>	<p>53. Hummingbird tree, Bakful <i>Sesbania grandiflora</i></p>	<p>54. Rose apple, Jamrul <i>Syzygium samarangense</i></p>

		
<p>55. Jam, Java plum <i>Syzygium cumini</i></p>	<p>56. Tamarind <i>Tamarindus indica</i></p>	<p>57. Nona Jhau <i>Tamarix dioica</i></p>
		
<p>58. Teak <i>Tectona grandis</i></p>	<p>59. Arjun <i>Terminalia arjuna</i></p>	