DRAFT REPORT

June, 2023

ENVIRONMENTAL IMPACT ASSESSMENT

Damodar Valley Corporation (DVC)

For

Proposed Expansion of Raghunathpur Thermal Power Station by installing unit of 1320 (2x660) MW Thermal Power Plant (Phase - II)

At

Village Raghunathpur, District Purulia, West Bengal

Envirotech

Envirotech East Pvt. Limited

An ISO 9001:2015, ISO 14001:2015 & ISO 45001:2018 Certified Company Inhouse Laboratory Recognised by Ministry of Environment, Forest & Climate Change, Govt. of India Accreditated by NABET, Quality Council of India as an EIA Consultant

NABET Certificate No.: NABET/EIA/2225/RA 0279

Baseline Monitoring Period: 1st December, 2022 to 28th Feb, 2023

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Envirotech East Pvt. Limited

An ISO 9001:2015, ISO 14001:2015 & ISO 45001:2018 Certified Company

- **Laboratory Recognized by MoEF&CC, Govt. of India**
- **Laboratory Recognized by West Bengal Pollution Control Board**
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CIN NO : U74210WB1989PTC047403

Date: 09.th June, 2023

TO WHOM IT MAY CONCERN

Subject: Environment Clearance in respect of proposed DVC, RTPS-PH-II (2x660 MW) by M/s Damodar Valley Corporation

Refer: File No. J-13011/22/2007-IA-II(T)
Proposal No. IA / WB / THE /420393/ 2023

We do hereby declare that we, M/s Envirotech East Pvt. Ltd. have undertaken the Environmental Impact Assessment Study for the subject job, as per the EIA Notification, 2006 and in compliance with the finalized Terms of Reference, issued by Ministry of Environment, Forest & Climate Change (MoEF&CC), Govt.of India vide its letter (Ref. File No. J-13011/22/2007-IA-II(T) dated 10th May, 2023. The prescribed TORs have been complied with and that the data submitted is factually correct.

For Envirotech East Pvt. Ltd.

(Asoke Kumar Banerjee)
Director

DAMODAR VALLEY CORPORATION
OFFICE OF THE CHIEF ENGINEER (EM&PC)
DVC TOWERS: VIP ROAD
Kolkata – 700 054

Phone No. 033-6607 3025

No. EM&PC/RTPS-PH-II/1361 Date: 13th June, 2023

TO WHOM IT MAY CONCERN

Subject: Environment Clearance in respect of proposed DVC, RTPS-PH-II (2x660 MW) by M/s Damodar Valley Corporation

Refer: File No. J-13011/22/2007-IA-II(T)
Proposal No. IA / WB / THE /420393/ 2023

This is to certify that we, **M/s Damodar Valley Corporation** have gone through the entire Environmental Impact Assessment report, prepared by M/s Envirotech East Pvt. Ltd., Kolkata as per the EIA Notification, 2006 and in compliance with the finalized Terms of Reference, issued by Ministry of Environment, Forest & Climate Change (MoEF&CC), Govt.of India, vide its letter (Ref. File No. J-13011/22/2007-IA-II(T)) dated 10th May, 2023, for the above-mentioned project. The Information/data as given in the EIA report has been checked at our end and is found to be factually correct in all respect.

Thanking you,

Yours Sincerely,
Kolkata Port Accretion Ltd.

.....
For M/s Damodar Valley Corporation

Shri Rakesh Ranjan Pandey
Chief Engineer-I (M), EM&PC, DVC-HQs

DECLARATION

Declaration by Experts contributing to the EIA report for Environment Clearance in respect of proposed DVC, RTPS-PH-II (2x660 MW) at vill: Raghunathpur, Dist: Purulia, West Bengal by M/s Damodar Valley Corporation.

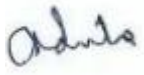
This project falls under Sl. No. 1(d), [i.e.,Thermal Power Plant)] of Category "**A**" of the list of the projects of the schedule shall require prior Environmental Clearance from Ministry of Environment, Forest & Climate Change (MoEF&CC), Govt.of India.

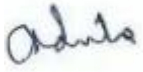
We, hereby, certify that we were part of the EIA team in the following capacity that developed the above EIA.

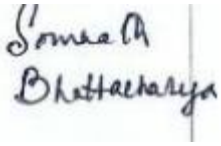
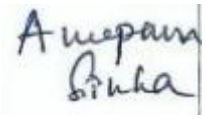
EIA Co-ordinator : Thermal Power Plant

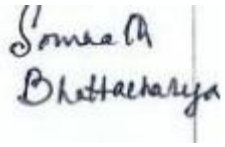
Name : Mr. Ajay Kumar Sinha

DECLARATION BY EIA CO-ORDINATORS / FUNCTIONAL AREA EXPERTS INVOLVED IN THE PREPARATION OF EIA REPORT

Discipline	Name of Expert	Key Qualifications indicating area of specialization relevant to the respective discipline	Involvement (Period & Task)	Signature
EIA Coordinator :				
Mr. A. K. Sinha		P.G. Diploma in Environmental Science and Technology	February, 2023 to till date Assessment & identification of the overall project, co-ordination with respective functional area experts, finalisation of action plans for the overall preparation of EIA/EMP report	
Functional Area Experts involved:				
Air Pollution	Mr. T. Kundu	Bachelor of Technology (Chemical Engineering)	February, 2023 to till date Finalization of monitoring locations for Ambient Air Quality Monitoring, evaluation of Ambient Air Quality results, suggestions & finalization of air pollution control measures, with client and contribution to overall EIA/EMP report preparation.	

Meteorology	Mr. A K. Sinha	P.G. Diploma in Environmental Science and Technology	February, 2023 to till date Identification of air emission sources and their inventorisation, prediction of cumulative impacts on ambient air quality due to all identified point & mobile sources, suggestions & finalization of mitigation measures with project proponent and contribution to overall EIA/EMP report preparation.	
Water Pollution Control	Mr. Asoke Kumar Banerjee	M.Sc. (Chem.)	February, 2023 to till date Finalization of sampling locations for surface water and ground water quality monitoring, evaluation of water quality results, analysis of water balance, identification of sources for wastewater generation and give suggestions on suitable water pollution control, exploring the ways for conservation of water, identification & assessment of impacts, finalization of mitigation measures with project proponent and contribution to overall EIA/EMP report	

			preparation.	
Geology Hydrology	Dr. Somenath Bhattacharya	Ph.D in Geology	February, 2023 to till date Assessment of existing Geology and hydrology of the area, Understanding and representing groundwater conditions, finalization of groundwater sampling locations, finalization of survey findings, identification of probable impact due to proposed industrial activity, suggestion of mitigation measures and contribution to overall EIA/EMP report preparation.	
Ecology & Bio-diversity	Dr. (Mrs.) Anupam Sinha	Ph.D in Botany	February, 2023 to till date Assessment of the existing Ecology & Bio-diversity with proper emphasis on eco-sensitive locations, assessment of possible impacts to the biological and ecological environment of the area due to the proposed industrial activity and EIA/EMP report preparation.	
	Ms. Puja Ghosh (TM)	M.Sc in Environmental Science		
Noise & Vibration	Mr. R.K. Dasgupta	Bachelor of Engineering (Mechanical)	February, 2023 to till date Finalization of noise	

			sampling location and analysis of data, identification of impacts, suggestions & finalization of suitable mitigation measures with client and contribution to overall EIA/EMP report preparation.	
Land Use	Dr. Somenath Bhattacharya	Ph.D in Geology	February, 2023 to till date Site visit, supervising development of land use maps of study area using GIS tools, finalization of landuse maps, based on ground truth verification, identification of any probable changes due to the proposed industrial activity and contribution to EIA/EMP report preparation.	
Solid & Hazardous Waste	Mr. Asoke Kumar Banerjee	M.Sc. (Chem.)	February, 2023 to till date Identification of potential solid & hazardous waste generating sources and their inventorisation, finalization of waste management strategies, identification of impacts, finalization of mitigation measures with project proponent and contribution to overall EIA/EMP report preparation.	

Soil Conservation	Mr. Asoke Kumar Banerjee	M.Sc. (Chem.)	February, 2023 to till date Finalization of soil sampling locations, identification of potential sources of impacts due to project, finalization of suitable mitigation measures with project proponent and contribution to overall EIA/EMP report preparation.	
Risk & Hazard	Mr. T. Kundu	Bachelor of Technology (Chemical Engineering)	February, 2023 to till date Identification of major hazards, assessment of risks associated with the proposed project, quantification of the identified risks with the help of the standard software. preparation of on-site and off-site emergency plan and contribution to overall EIA/EMP report preparation.	
Socio-economics	Prof. Pabitra Sengupta	M.Sc. (Economics)	February, 2023 to till date Field survey, assessment of the existing socio-economic scenario of the area, assessment of possible changes to socio-economics of the area due to the proposed project and contribution	

			to overall EIA/EMP report preparation.	

CONTENTS

Annexures:

ANNEXURE	DESCRIPTION
I	Standard TOR from MoEF&CC, Govt. Of India
II	NOCs & Valid Consent to Operate (CTO) & Environmental Clearance (EC) of Existing Plant
III	Ambient Air Quality Data
IV	Relevant Indian Standards

CHAPTER-1.0
INTRODUCTION

1.1 PURPOSE OF THE REPORT

Damodar Valley Corporation (DVC) is a government-owned power generator which operates in the Damodar River area of West Bengal and Jharkhand states of India to handle the Damodar Valley Project. The statutory corporation operates both thermal power stations and hydel power stations under the ownership of Ministry of Power, Government of India. DVC is headquartered in the Kolkata city of West Bengal, India.

The existing Raghunathpur Thermal Power Station (RTPS) of DVC is located at village Raghunathpur, having total installed capacity of 1200 MW (2x600 MW) under Ph-1 and both units are under commercial operation since March 2016, based on Environmental Clearance, accorded by MoEF&CC on 18th October 2007.

Earlier RTPS was accorded Environment Clearance on 23.05.2012 by MOEF&CC for 2x660 MW under Phase II. Public Hearing for this project was successfully conducted. However, due to one or more reasons, activities of Ph-II could not be taken up further and the project was dropped by DVC in 2014-15 and contracts for different packages were terminated.

However, considering the demand-supply position and projected growth of load demand in the valley area arising out mainly due to decommissioning of various units of DVC viz... Durgapur TPS, Bokaro 4“PS-B and Chandrapura TPS, the Board of DVC accorded approval for the revival of erstwhile Raghunathpur TPS Ph-II (2x660 MW) and in principle approval was accorded by Ministry of Power on 23.02.2022.

On the basis of approval from Ministry of Power, DVC proposes for Expansion of Raghunathpur Thermal Power Station by installing capacity 1320 (2x660) MW (Phase- II).

It is pertinent to mention here that the land requirement for RTPS phase – 2 will be 150 acres, which is available within the existing project area of 840.53 Hectares (2077 acres), which is already acquired.

As per EIA Notification 2006, published on 14th September 2006, all projects or activities, including expansion and modernization of existing projects or activities or change in Product Mix, falling under Category 'A' in the Schedule shall require prior Environmental Clearance from Ministry of Environment, Forest & Climate Change (MoEF&CC), Govt. of India.

The proposed expansion project of **M/s Damodar Valley Corporation** falls under Sl. No. 1(d) () under category 'A' of the EIA Notification, 2006.

The company submitted an online application along with filled up 'Form 1' in the prescribed format and Pre-feasibility Report to Ministry of Environment, Forest & Climate Change (MoEF&CC), Govt. of India dated 6th March, 2023 for seeking Terms of Reference for its proposed expansion of Raghunathpur Thermal Power Station.

The Ministry of Environment, Forest and Climate Change has considered the application and subsequently the expansion proposal of Raghunathpur Thermal Power Station of DVC was considered by the Expert Appraisal Committee (EAC) for Thermal Power Projects (The Sectoral Expert Appraisal Committee of MoEF&CC) in its 39th EAC Meeting held on 31" March, 2023.

After detailed deliberation on the information submitted the Hon'ble Expert Appraisal Committee (EAC) for Thermal Power Projects recommended the proposal for grant of Standard ToR with public hearing for conducting EIA study to the project for expansion of Raghunathpur Thermal Power Station by installing unit of 1320 (2x660) MW Thermal Power Plant (Phase-II) in an area of 341.81 ha at village Raghunathpur, District Purulia (West Bengal) by M/s Damodar Valley Corporation, under the provisions of EIA Notification. 2006 and as amended along with the certain additional/specific ToR.

Based on recommendation of EAC, the MoEF&CC accorded approval for **Standard ToR [Ref. F. No. J-13011/22/2007-IA.II (T)] on 10.05.2023** for conducting EIA study to the project for proposed expansion of Raghunathpur Thermal Power Station by installing unit of 1320 (2x660) MW Thermal Power Plant (Phase-II) at village Raghunathpur, District Purulia (West Bengal) by M/s. Damodar Valley Corporation, under the provisions of EIA Notification, 2006, as amended along with the additional / specific ToR.

As advised by the MoEF&CC the Draft EIA/EMP Report was prepared, accommodating all the components, based on Standard TORs for its submission to West Bengal Pollution Control Board (WBPCB) for the conduction of Public Hearing / Consultation.

This EIA Report is prepared on the basis of the available secondary data/ literature along with the on-site data during the period (**1st December, 2022 to 28th February, 2023**), generated through on-site monitoring of relevant environmental components and parameters.

1.2 IDENTIFICATION OF THE PROJECT

M/s. Damodar Valley Corporation has already an operational Thermal Power Station (RTPS) located at village Raghunathpur of Purulia district of West Bengal, having total installed capacity of 1200 MW (2x600 MW) under Phase -1. Damodar Valley Corporation (DVC) intends to expand the capacity of Raghunathpur TPS by setting up additional two units of 660 MW each (2x660 MW) based on Supercritical technology under Raghunathpur TPS Ph-II. The expansion project to be accommodated within the land available with Raghunathpur TPS premises.

Raghunathpur TPS Project shall be a coal based thermal power project with Super critical technology.

Major components of the power project are Coal Handling and Storage Plant, Fuel Oil Handling and Storage Plant, Water Intake and Treatment Systems, Steam Generator and its auxiliaries, Steam Turbine and its auxiliaries, Water Cooled Condenser, Auxiliary Cooling System, Ash Handling Plant, Electrical Generators, Transformers and Switchyard, various Control and Instrumentation systems etc.

The proposed project will help DVC to meet growing demand of power in the valley region. This project will also help in bridging demand supply gap in the State of West Bengal & Jharkhand.

The overall project scenario is presented in **Table-1.1.**

TABLE-1.1
OVRALL PROJECT SCENARIO

Facility	Existing		Proposed		Ultimate	
	Plant configuration	Capacity	Plant configuration	Capacity	Plant configuration	Capacity
Thermal Power Plant	2 X 600 MW	1200 MW	2 X 660 MW	1320 MW	2 X 600 MW + 2 X 660 MW	2520 MW

Land requirement for RTPS phase – 2 will be 150 acres, which is available within the existing project area of 840.53 Hectares (2077 acres), which is already acquired.

Most of the facilities are available for setting up of the proposed Thermal Power Plant such as Electricity, Water, Transportation of raw materials and power distribution etc.

The photographs of the existing plant site are given below in **Figure-1.1.1**.

FIGURE-1.1.1 EXISTING PLANT PHOTOGRAPHS

Plant Gate

Cooling Tower

Water Reservoir

Sewage Treatment Plant

Rain water harvesting

Green Belt

1.3 THE PROJECT PROPONENT

Damodar Valley Corporation (DVC) came into existence on 7th July 1948 as the first multipurpose river valley project of independent India. The Corporation (DVC) came into existence by an Act of the Central Legislature. The emergence of DVC culminated to harness the rampaging flood water of Damodar River which every year brought untold miseries to the population residing in Damodar River Valley spread across the states of West Bengal and Jharkhand. DVC has been generating and transmitting power since 1953.

Total installed capacity of DVC is as follows:

Sl. No.	Name of Power Station	Installed Capacity	Total Capacity
THERMAL POWER			
1.	MEJIA (BANKURA)	4 X 210 MW 2 X 250 MW 2 X 500 MW	2340 MW
2.	BOKARO - A (BOKARO)	1 X 500 MW	500 MW
3.	CHANDRAPURA (BOKARO)	2 X 250 MW	500 MW
4.	DURGAPUR (PASCHIM BARDHAMAN)	1 X 210 MW	210 MW
5.	DURGAPUR STEEL (BURDWAN)	2 500 MW	1000 MW
6.	KODERMA	2 X 500 MW	1000 MW
7.	RAGHUNATHPUR	2 X 600 MW	1200 MW
	SUB TOTAL (A)		**6,750 MW**
HYDEL POWER			
1.	MAITHON HYDEL	2 X 20 MW	63.2 MW

	(BURDWAN)	1 X 23.2 MW	
2.	PANCHET HYDEL (DHANBAD)	2 X 40 MW	80 MW
3.	TILAIYA HYDEL (HAZARIBAGH)	2 X 2 MW	4 MW
	SUB TOTAL (B)		**147.2 MW**
			GRAND TOTAL (A + B) = 6,897.2 MW

1.4 BRIEF DESCRIPTION OF THE PROJECT

1.4.1 NATURE OF THE PROJECT:

The proposed expansion project of **M/s Damodar Valley Corporation** falls under Sl. No. 1(d) (Thermal Power Plant) under category 'A' of the EIA Notification, 2006 and therefore, shall require prior Environmental Clearance from Ministry of Environment, Forest & Climate Change (MoEF&CC), Govt. of India. Abstract of the list of project or activity of the schedule of EIA Notification, 2006 is given below:

Project Activity		Category with threshold limit		Condition if any
		A	B	
1		Mining, extraction of natural resources and power generation (for a specified production capacity)		
(1)	(2)	(3)	(4)	(5)
1(d)	Thermal Power Plants	V " ≥ 500 MW (coal / lignite / naphtha & gas based); ≥ 50 MW (Pet coke diesel and all other fuels including refinery residual oil waste except biomass); ≥ 20 MW (based on biomass or non hazardous municipal waste as fuel).”;	< 500 MW (coal / lignite / naphtha & gas based); 15 MW (based on biomass or non hazardous municipal waste as fuel).”;	V “General Condition shall apply. Note: (i) Power plant up to 15 MW, based on biomass and using auxiliary fuel such as coal / lignite / petroleum products up to 15% are exempt. (ii) Power plant up to 15 MW, based on nonhazardous municipal waste and using auxiliary fuel such as coal / lignite / petroleum products up to 15% are exempt. (iii) Power plants using waste heat boiler without any auxiliary fuel are exempt.”;

Raghunathpur Ph-II was accorded environmental clearance on 23.05.2012 from Ministry of Environment and Forests & Climate Control (MOEF&CC) with a validity period of 5 years. The validity of environmental clearance has expired on 22.05.2017.

Sl. No.	Certificate Obtained	File No.	Date of Issue	Name of Units	Obtained from
1.	Environmental Clearance (EC) in the name of M/s Damodar Valley Corporation	Letter No. J-13011/22/2007-IA.II(T)	18.10.2007	2x600 MW Thermal Power Plant	Ministry of Environment, Forest & Climate Change, Govt. of India
2	Environmental Clearance (EC) in the name of M/s Damodar Valley Corporation	Letter No. J-13012/258/2007-IA.II(T)	23.05.2012	2x660 MW Thermal Power Plant *	Ministry of Environment, Forest & Climate Change, Govt. of India

Sl. No.	Certificate Obtained	Memo No.	Date of Issue	Name of Units	Obtained from
1.	Consent to Operate (CTO) in the name of M/s Damodar Valley Corporation, Valid upto 31.10.2023	Memo No. 2097-WPBA / Red(Prl)/ Cont(380)/2015	31.10.2018	2x600 MW Thermal Power Plant	West Bengal Pollution Control Board (WBPCB)

1.4.2 SIZE OF THE PROJECT:

Damodar Valley Corporation proposes expansion of its Raghunathpur Thermal Power Station (RTPS) by adding 1320 MW capacity coal based thermal power. At present, installed capacity of RTPS is 1200 MW. After expansion the ultimate capacity will be 2520 MW.

The overall project scenario, containing the existing as well as the proposed units are presented in Table-1.1.

1.4.3 LAND

Land requirement for RTPS phase – 2 will be 150 acres, which is available within the existing project area of 840.53 Hectares (2077 acres), which is already acquired.

1.4.4 LOCATION OF PROJECT SITE

Raghunathpur Thermal Power Station (RTPS) is located in Raghunathpur Sub-Division of Purulia District of West Bengal. The Project is located at 38 Km from District Head Quarters Purulia and is well connected by Purulia-Barakar State Highway SH-5. Nearest National Highway NH-19, which was previously referred to Delhi–Kolkata Road is about 44 Km from the Site.

Nearest town is Raghunathpur located at a distance of 7 Km from the project. The nearest Railway Station Bero on Adra-Asansol Broad Gauge line of South-Eastern Railway is located at 20 Km.

The geographical co-ordinates of the project area is Latitude 23°36'6.90"N to 23°37'59.54"N and Longitude 86°38'51.12"E to 86°40'5.07"E with above mean sea level (AMSL) as 30 m. (98.43 ft).

The four points on the boundary of the project site are as follows:

1. Latitude - 23°37'28.76"N & Longitude - 86°40'0.87"E (TRC)
2. Latitude - 23°37'59.54 N & Longitude - 86°38'51.12" E (TLC)
3. Latitude - 23°36'6.90"N & Longitude - 86°39'13.82"E (BLC)
4. Latitude - 22°36'8.71"N & Longitude - 86°40'5.07"E (BRC)

(Where, T: Top, B: Bottom, L: Left, R: Right, C: Corner, M: Middle)

The four points on the boundary of the ash pond are as follows:

1. Latitude - 23°37'28.76"N & Longitude - 86°40'0.87"E (TRC)
2. Latitude - 23°37'12.74" N & Longitude - 86°37'22.83" E (TLC)
3. Latitude - 23°36'25.18"N & Longitude - 86°37'3.97"E (BLC)
4. Latitude - 23°36'11.23"N & Longitude - 86°37'56.92"E (BRC)

(Where, T: Top, B: Bottom, L: Left, R: Right, C: Corner, M: Middle)

The geographical co-ordinates of the ash pond is Latitude 23°36'11.23"N to 23°37'12.74"N and Longitude 86°37'3.97"E to 86°38'4.73"E.

Google Map of the project site location & its surroundings is shown in **Figure-1.3** and the Toposheet Map, showing the project site and its surrounding is presented in **Figure-1.4**.

FIGURE-1.3: GOOGLE MAP PROJECT SITE & ITS SURROUNDING AREA
Project Site Location:
Village - Raghunathpur, District – Purula
Geographical co-ordinates: Latitude: 23°36'5.53"N to 23°37'59.06"N & Longitude: 86°38'51.38"E to 86°40'2.18"E (for project site)
Latitude 23°36'11.23"N to 23°37'12.74"N and Longitude 86°37'3.97"E to 86°38'4.73"E (for ash pond)

Above Mean Sea Level (AMSL): 511.8 ft (156 m)

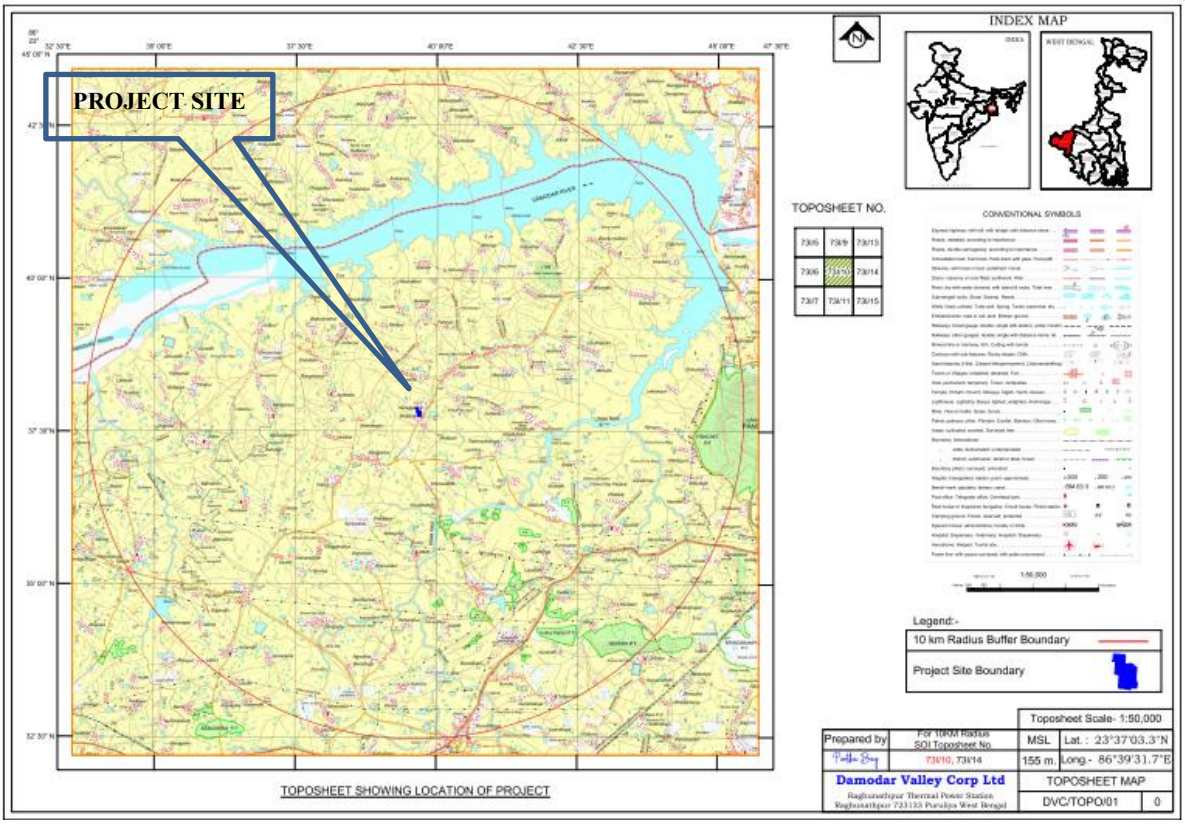


FIGURE-1.4 : TOPOSHEET MAP
PROJECT SITE & ITS SURROUNDING AREA
(TOPOSHEET NO 73N/7 & 73N/8), Scale 1;50,000

1.4.5. Existing Road Connectivity

Figure showing the transportation route map to the project site has been given in **Figure 1.5.**

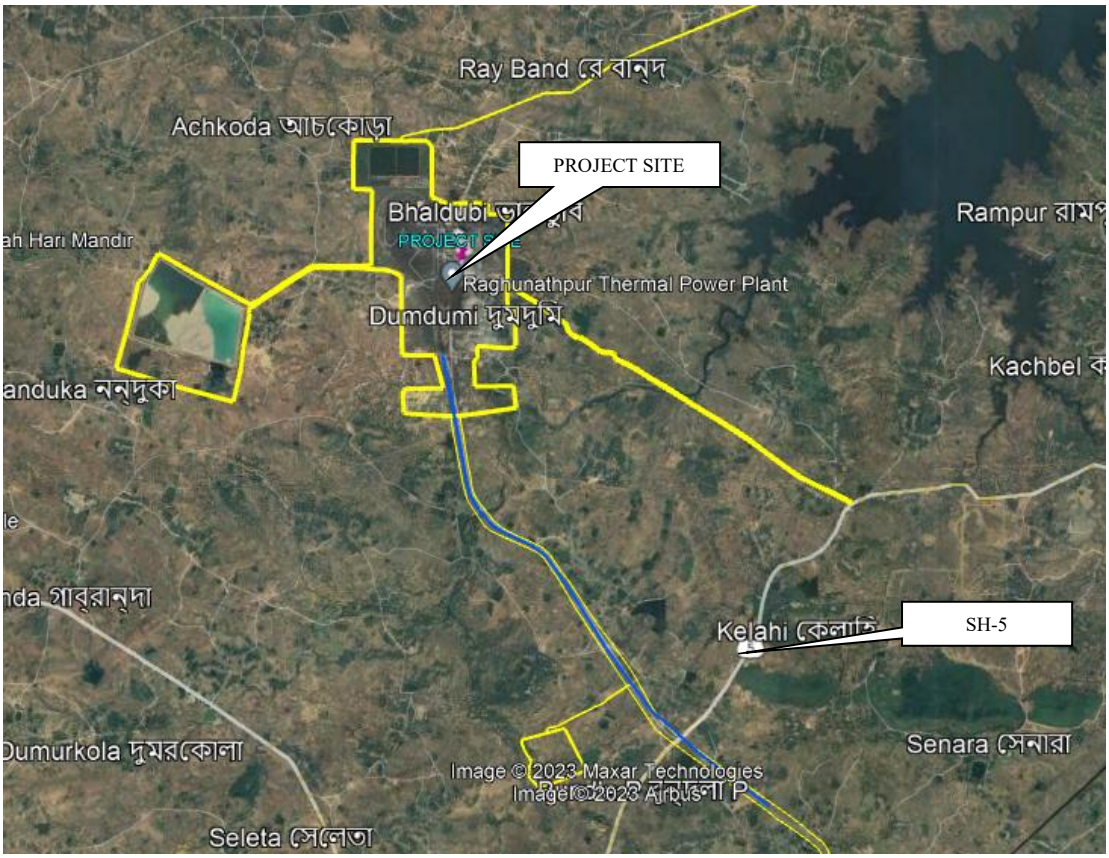


FIGURE-1.5: ROAD TRANSPORT MAP

Details of roads surrounding the project site are shown in **Figure 1.6**. The project site of M/s Damodar Valley Corporation is surrounded by one road belong to DVC which connects Purulia-Barakar State Highway SH-5 towards SE direction.

Figure 1.6. - Road Connecting to DVC Plant with Purulia-Barakar State Highway SH-5

1.4.6 Need of the Project

Damodar Valley Corporation (DVC) is one of the earliest organizations under Govt. of India vested with the power to generate and distribute power within its licenced area.

Raghunathpur STPP Ph-II (2x660 MW) is being proposed as an expansion project of the Ph-I (2x600MW), in the district of Purulia, West Bengal mainly to cater to huge projected demand in the valley area located in the states of Jharkhand and West Bengal. The project is envisaged to start generating power during the period of 2027-2028. The surplus power, if any would be pumped into suitable grid to meet the power requirement of other states in country.

Pk-Scenario									
Sl.	Attributes		2022-2023	2023-2024	2024-2025	2025-2026	2026-2027	2027-2028	2028-2029	2029-2030
			MW	MW	MW	MW	MW	MW	MW	MW
1	Own Source	Total Thermal Availability	5412	5312	5312	5312	5312	5841	6369	6369
2		Total Hydel Availability	90	90	93	93	93	1593	1593	1593
3		Tortal Renewable Generation	NIL	NIL	NIL	NIL	NIL	NIL	NIL	200
4	Bilat. Import	MPL	130	130	130	130	130	130	130	130
5		ISGS (Thermal+ Hydel)	180	180	180	180	180	180	180	180
6	Bilat. Export Commitment	($) LTA (as per availability considered)	2060	2060	2060	2060	2060	2323	2588	2588
7		(*) STOA	350	350	350	350	350	350	350	350
8	(#) Bilateral Import Solar Share with Pk 6Hrs Support (Solar + Storage)			200	200	200	200	200	200	200
9	Internal Demand	DVC(Firm Consumer)+ JBVNL+TSL+Rail	**3707**	**3892**	**4086**	**4291**	**4505**	**4731**	**4967**	**5215**
10	Surplus / Shortfall		-305	-390	-582	-786	-1000	540	567	319

Sl.1: Total Thermal generation has been considered based on station-wise yearly PAF of 2021-2022. Gen. of DTPS-4 has been considered up to 2022-23 only and as the max. gen in 21-22. For RTPS Ph-II, 85% availability has been considered. RTPS Ph-II single unit is considered to be commissioned by 2027-28 and the second unit in the subsequent FY.

Sl.2: Total Hydel generation has been considered as per the up gradation of units as per DVC records

Sl.3: Solar Gen has not been considered due to Evening Pk. Demand scenario. However, 200 MW of Hydrogen fuel-based generation has been considered in 2029-30 (as per DVC record)

Sl.4 & 5: Bilateral import considered as per present status

Sl.6: LTA fig. is as per the present PPAs. LT agreement of RTPS Ph-II has been assumed as 50% with effect from 2027-28 onwards. Further, bilateral export will be finalized in future.

Sl.7: STOA is considered as per present status.

Sl.8: Demand projected considering 5% growth on yearly basis.

1.5 BRIEF LEGAL FRAMEWORK FOR EIA STUDY

1.5.1 Procedure for Environmental Clearance

Environmental clearance of any new project or expansion of existing projects is now done as per the new notification of the Ministry of Environment, Forest and Climate Change (MoEF&CC), Govt. of India dated 14th September 2006. The new notification requires prior environmental clearance of all projects from competent central govt. or state govt. authorities, as may be the case. The projects are now classified into Category "A" or Category "B" projects based on spatial extent of potential impacts on human health and natural & man-made resources. The Category "A" projects require prior clearance by the MoEF&CC, Govt. of India while the Category "B" projects have to get clearance from the State level Environment Impact Assessment Authority (SEIAA), constituted by the Central Government for this purpose.

The environment clearance procedure for new projects will require maximum of four stages all of which may not be applicable to all the projects. These four stages in sequential order are as follows:

Stage 1 - Screening: It refers to the definite assignment of environmental category to projects or activities where the same is not completely specified. In case of Category 'B' projects scrutiny of application at State level to categorize project in 'B1' or 'B2' is done. The B2 projects do not require EIA Reports. The present project is categorized as Category 'A' project and thus, this stage is not applicable.

Stage 2 - Scoping: It refers to the process by which the Expert Appraisal Committee in the case of Category 'A' project and State- level Expert Appraisal Committee in the case of Category 'B1' project determine detailed and comprehensive Terms of Reference (ToR) addressing all relevant environmental concerns for the preparation of an EIA report in respect of the project for which prior environmental clearance is sought. The ToR for this project was granted on 10th May, 2023.

Stage 3 - Public Consultation: It refers to the process by which concern of local people and other stakeholders are ascertained and their views taken regarding the project. The Public Consultation takes place in two steps: Public hearing and written responses. The public hearing is conducted under the supervision of State Pollution Control Board near the project site.

Public Consultation for this project has to be conducted.

Stage 4 - Appraisal: This refers to detailed scrutiny by the Expert Appraisal Committee or State Level Expert Appraisal Committee of the application and other documents like the final EIA report. The final EIA report for this project will be prepared after Public Hearing for the final appraisal by EAC for grant of Environment Clearance.

BOX 1.1: SCOPE OF THE STUDY

- To conduct literature review and collect the data relevant to study area
- Project appreciation in terms of its environmental pollution potential and detrimental impacts on different environmental attributes.
- To undertake environmental monitoring so as to establish the baseline environmental status of the study area
- To identify existing pollution load due to various activities in the ambient levels
- To identify the basic environmental status including the meteorological parameters and socio-economic environment of the proposed study area
- To predict incremental levels of pollutants in the study area due to the proposed plant activities
- To evaluate the predicted impact on the various environmental attributes in the study area by using scientifically developed and widely accepted environmental impact methodologies
- To prepare an environmental management plan outlining the measures for improving the environmental quality for environmentally sustainable development
- To identify critical environmental attributes required to be monitored

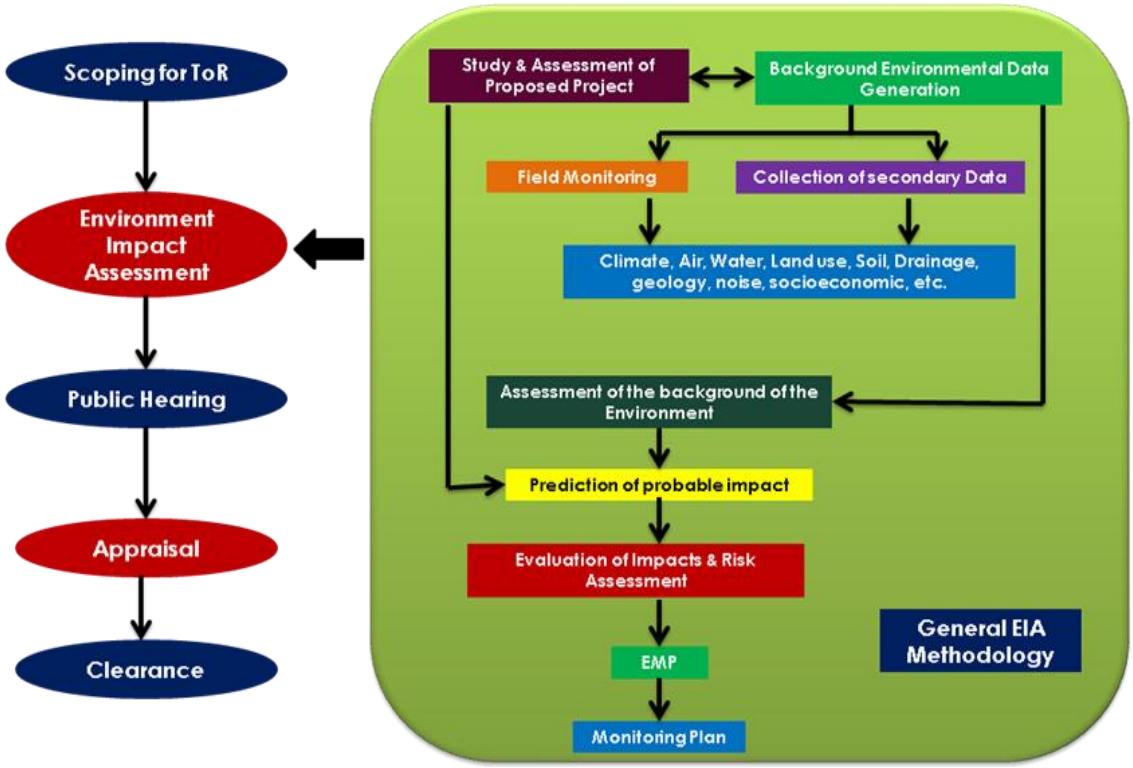
The steps of Environmental Clearance for proposed project is shown in **Figure-1.7**.

1.5.2 Post Environmental Clearance Monitoring

For category "A" projects, the project proponent shall prominently advertise in the newspapers indicating that the project has been accorded environmental clearance and the details of MoEF&CC website where it is displayed.

The project management shall submit half-yearly compliance reports in respect of the stipulated prior environmental clearance terms and conditions in hard & soft copies to the regulatory authority concerned on 1st June and 1st December of each calendar year. All such reports shall be public documents. The latest such compliance report shall be displayed on the web site of the concerned regulatory authority.

FIGURE 1.7: STEPS OF ENVIRONMENTAL CLEARANCE FOR PROPOSED PROJECT



1.6 SCOPE OF STUDY- DETAILS OF REGULATORY SCOPING CARRIED OUT AS PER TERMS OF REFERENCE

The Environmental Impact Assessment and Environment Management Plan for the proposed expansion project addressing the environment related issues are prepared in accordance with the requirements of terms of reference (TOR), prescribed by MoEF&CC, Govt. of India.

The study evaluates the prevailing environmental conditions. The adverse impacts have been identified and possible mitigation measures have been drawn in order to protect the environment. In order to carry out the study, the baseline environmental scenario has been established.

The main objectives of the present EIA/EMP study are briefly summarized below:

- To establish the baseline environmental scenario.
- To identify, predict and assess the impacts of proposed future project on the environment.

- To prepare a detailed action plan for implementation of mitigative measures.
- To suggest preventive measures to minimize adverse impacts and to maximize beneficial impacts.
- To suggest a monitoring programme to evaluate the effectiveness of mitigative measures.
- To suggest the formation of a core group responsible for implementation of the EMP.
- To prepare a capital cost estimate for environment management plan.
- To address the concerns of disaster management, CSR and points raised in public hearing.

The scope of the present study is to conduct EIA covering all the disciplines of environment and field monitoring in relevant disciplines over one full season of 3 (three) months (excluding monsoon months). The draft EIA report was prepared as per the MoEF&CC Notification dated 14.09.2006. After completion of the Public Consultation, all the environmental concerns expressed during the Public Consultation process have been addressed and appropriate changes in the draft EIA Report have been made accordingly to formulate the Final EIA Report.

Secondary and primary data collection was done comprising of, but not restricted to the following:

- Long Term Climatic data from Indian Meteorological Department (IMD) for available previous decade
- Geo-hydrological aspects based on available data from various sources
- Identification of water bodies, hills, roads etc. within 10 km radius
- Details of fauna, flora, information in forests, major habitats, sanctuaries, sensitive places within a distance of 10 km from the project site (including forest details).
- Major industries within 10 km radius.
- Historical monuments and sanctuaries within 10 km radius.
- Land use pattern within core zone and buffer zone (10 km radius around the core zone), Cropping pattern.
- Demography and Socio-economic based on last available Census data for entire study area

The preparation of EIA/EMP has been done as per the generic structure prescribed in EIA Notification dated 14th September 2006.

In line with the TOR, baseline environmental data was generated as shown below:

AREA	PARAMETERS	NO. OF LOCATIONS	FREQUENCY
Air Quality	PM_{10}, $PM_{2.5}$, SO_2, NO_2 & CO	8	Twice in a week
Micro Meteorology	Temperature, Relative Humidity, Atmospheric Pressure, Wind Speed, Wind Direction, Rainfall etc.	1	Continuous on 24-hourly basis
Water Quality (Surface & Ground)	Physical, Chemical & Biological	12 (Surface) 9 (Ground)	Once in the study period
Soil Quality	Physical and Chemical	4	Once in the study period
Land Use	Land use using Satellite Imagery	Study area	Once in the study period
Noise Level	-	10	Once in the study period (Day & Night)
Ecology & Bio-diversity	Terrestrial & Aquatic Flora and Fauna	Study area	Once in the study period
Demography & Socio-economy	Population Profile, Socio-economic scenario & Infrastructural Facilities	Study Area	Based on census data and sample survey

1.7 STATUS OF LITIGATIONS

There are no litigations/ court cases pending against the project.

1.8 COMPLIANCE OF TERMS OF REFERENCE (TOR)

Ministry of Environment, Forests & Climate Change (MoEF&CC), Govt. of India issued Standard Terms of Reference vide letter [Ref. F. No. J-13011/22/2007-IA.II (T)] dated 10.05.2023 **(Annexure-I)** for undertaking detailed EIA study for obtaining EC in accordance with the provisions of the EIA Notification 2006.

This EIA Report is prepared on the basis of the available secondary data/ literature along with the on-site data during the period **(1st December, 2022 to 28th February, 2023),** generated through on-site monitoring of relevant environmental components and parameters.

CHAPTER-2.0
PROJECT DESCRIPTION

2.1 DESCRIPTION

M/s. Damodar Valley Corporation has already an operational Thermal Power Station (RTPS) located at village Raghunathpur of Purulia district of West Bengal, having total installed capacity of 1200 MW (2x600 MW) under Phase -1. Damodar Valley Corporation (DVC) intends to expand the capacity of Raghunathpur TPS by setting up additional two units of 660 MW each (2x660 MW) based on Supercritical technology under Raghunathpur TPS Ph-II. The expansion project will be accommodated within the land available with Raghunathpur TPS premises.

Major components of the power project are Coal Handling and Storage Plant, Fuel Oil Handling and Storage Plant, Water Intake and Treatment Systems, Steam Generator and its auxiliaries, Steam Turbine and its auxiliaries, Water Cooled Condenser, Auxiliary Cooling System, Ash Handling Plant, Electrical Generators, Transformers and Switchyard, various Control and Instrumentation systems etc.

The proposed project will help DVC to meet growing demand of power in the valley region. This project will also help in bridging demand supply gap in the State of West Bengal & Jharkhand.

The overall project scenario is presented in **Table - 2.1.**

TABLE - 2.1

Facility	Existing		Proposed		Ultimate	
	Plant configuration	Capacity	Plant configuration	Capacity	Plant configuration	Capacity
Thermal Power Plant	2 X 600 MW	1,200 MW	2 X 660 MW	1,320 MW	2 X 600 MW + 2 X 660 MW	2,520 MW

The principal features or highlights of the proposed project expansion of DVC Raghunathpur TPS, under study are as follows:

PROPOSED PROJECT HIGHLIGHTS	
Location	Village - Raghunathpur, P.S. - Raghunathpur, District - Purulia, West Bengal.
Toposheet No.	73N/7 & 73N/8
Site Co-ordinates	The geographical co-ordinates of the project area Latitude 23°36'6.90"N to 23°37'59.54"N and Longitude 86°38'51.12"E to 86°40'5.07"E
Ash pond co-ordinates	The geographical co-ordinates of the ash pond is Latitude 23°36'11.23"N to 23°37'12.74"N and Longitude 86°37'3.97"E to 86°38'4.73"E.
Plant site elevation above MSL	30 m. (98.43 ft).
Nearest Highway	The Project is well connected by Purulia-Barakar State Highway SH-5. Nearest National Highway NH-19, which was previously referred to Delhi–Kolkata Road is about 44 Km from the Site.
Nearest Railway Station	The nearest railway station to the site is Bero on Adra-Asansol Broad Gauge line of South-Eastern Railway is located at 20 Km
Nearest Airport	Kazi Nazrul Islam Airport, Andal, Durgapur – 60 km in E direction from the project site.
Nearest Sea port	Kolkata Port is located approx. 206 km distance to the project site in SE direction.
Nearest major water body	Damodar River is passing about 20 km distance in E direction w.r.t the project site.
Nearest village/town	Nearest town is Raghunathpur located at a distance of 7 Km from the project.
Land requirement	Land requirement for RTPS phase – 2 will be 150 acres, which is available within the existing project area of 840.53 Hectares (2077 acres), which is already acquired.
Ash pond area	Land of 507.480 acres (205.37 Ha.) for the existing Ash disposal system in RTPS (ph-1) comprising of Ash pond, ash pipeline corridor, green belt etc. will be utilised for RTPS (Ph-2) also.
Raw water requirement & source	Water to the tune of 207591 KLD will be needed for the overall project. (Existing: 112542 KLD * Proposed: 95049 KLD) Source: Panchet Dam
Power requirement	82.5 MW (Source : Captive)
Fuel requirement	6.60 MTPA Coal, sourced from Central Coalfield Limited (CCL). Coal linkage with CCL is available.

Effluent generation & disposal	The plant will be designed as a zero liquid discharge plant. The process water will be recirculated through cooling and treatment. The entire wastewater will be recycled for various purposes inside the plant. Domestic waste water will be treated in Sewage Treatment Plant (STP). Treated domestic waste water will be used for greenbelt purpose inside the plant premises.
Air pollution control	Dust Suppression and Extraction Systems, Electrostatic Precipitators (ESP), Flue Gas Desulphurisation System and NOx Control System at relevant points will be installed.
Ash Generation & Management	29,70,000 TPA ash will be generated from Boiler. <u>Management:</u> Efforts will be made with authorities of coal mines and other minerals mines for ash in filling of abandoned mines/stone query areas and also used in construction of National/State Highway located within 300 km of proposed power station. Construction of Varanasi Expressway: around 200 kms. Stretch falls under Purulia district where significant quantum of ash shall be utilized. Fly ash will also be utilized as a raw material for the cement grinding unit / brick manufacturing Shree cement & ACC Cement plants are located in nearby' areas where considerable quantity of fly ash shall be utilized.
Manpower	350 persons (both regular and contractual)
Project cost	Rs. 11,554.29 Crores

2.2 NEED FOR THE PROJECT

DVC has been engaged in generation, transmission and distribution of electrical energy since 1953 and during the course of more than 74 years it has succeeded not only in meeting the expectation of the consumers but also has elevated its level of performance by adapting to the challenges of time and new technologies to ensure reliable and quality power supply. DVC presently owns and operate seven (07) Thermal Power Plants at BTPS-A (1x500MW), CTPS-7&8 (2x250MW), DTPS-4 (1x210MW), DSTPS (2x500MW), MTPS (4x210MW, 2x250MW, 2x500MW), RTPS Ph-I (2x600MW) and KTPS (2x500MW) and three (03) Hydel Power Stations at Tilaiya (2x2MW), Maithon (2x20MW, 1x23.2MW) and Panchet

(2x40MW).

In keeping with the industrialization in the Damodar Valley Area (DVA), power generation, transmission and distribution have gained priority for providing electricity to the core industries like Steel, Coal, Railways and other industries and consumers directly and also through respective State Electricity Boards.

Demand - Availability

The existing Generation capacity of DVC is 6897 MW. Reference 19th EPS the projected Load for the firm consumers is about to increase to 4439MW along with the annual growth shown as shown in the table below:

DVC is presently having a load demand of 3413 MVA from the firm consumers. As per Mandate of MoP, DVC has to build infrastructure to cater 5000MVA load by 2022-23 and 10,000MVA load by 2023-24.

However, presently the 400KV/220KV/132KV transmission network of DVC has to additionally cater to the open access and schedule mode of loads wherein the System internal handling capacity is to the tune of 4555MVA. The enhancement of Loads of JBVNL in their internal system would also have an impact on the DVC Network Utilization. Due to inception of the Covid, the load growth is little bit on slower side and the projected average peak load is re-casted on 2026-27 with a Total internal contract demand (CD) of 5829MVA (5654MW).

In tune with such capacity addition, Raghunathpur STPP Stage-II (2x660 MW) is being proposed as an expansion project of the Stage-I (2x600MW), in the district of Purulia, West Bengal by Damodar Valley Corporation (DVC) mainly to cater to huge projected demand in the valley area located in the states of Jharkhand and West Bengal. DVC has also drawn up Master Plan for setting up of additional EHV Lines and Sub-stations as well as strengthening of DVC Grid for evacuation and distribution of power due to addition of RTPS-PH-II. The Master Plan, inter alia, includes proposal of new 400KV & 220KV Substations, 400KV/220KV transmission connectivity's, strengthening of 132KV transmission Lines with HTLS conductors to cater to this Load growth with the existing generation capacity along with mitigation of N-1 contingent situation. Load Flow studies have been carried out considering different cases as per the above plan.

2.3 LOCATION OF PROJECT SITE

Raghunathpur Thermal Power Station (RTPS) is located in Raghunathpur Sub-Division of Purulia District of West Bengal. The Project is located at 38 Km from District Head Quarters Purulia and is well connected by Purulia-Barakar State Highway SH-5. Nearest National Highway NH-19, which was previously referred to Delhi–Kolkata Road is about 44 Km from
the Site.

Nearest town is Raghunathpur located at a distance of 7 Km from the project. The nearest Railway Station Bero on Adra-Asansol Broad Gauge line of South-Eastern Railway is located at 20 Km.

Approach

The Site can be approached from District Head Quarters Purulia through State Highway SH-5 (Purulia-Barakar). The nearest airport is Kazi Nazrul Islam Airport at Durgapur at a distance of about 92 Km from project site.

Town/City

Nearest Town - Raghunathpur About 7 Km
District Head Quarters - Purulia About 38 Km
Nearest City - Asansol About 50 Km
Nearest Major City - Kolkata About 270 Km

Airport

Nearest Commercial Airport	Kazi Nazrul Islam Airport, Durgapur	About 92 Km
Nearest Major Commercial Airport	Netaji Subhash Chandra Bose International Airport, Kolkata	About 258 Km

Rail

Nearest Raiway station	Bero	About 20 Km
Other nearby important Railway station	Asansol Durgapur	About 50 Km About 50 Km

Sea Port

Nearest Commercial Sea port	Haldia port	About 310 Km

The location of project site on Google view map and Toposheet is presented in **Figure-2.1** & **2.2** respectively.

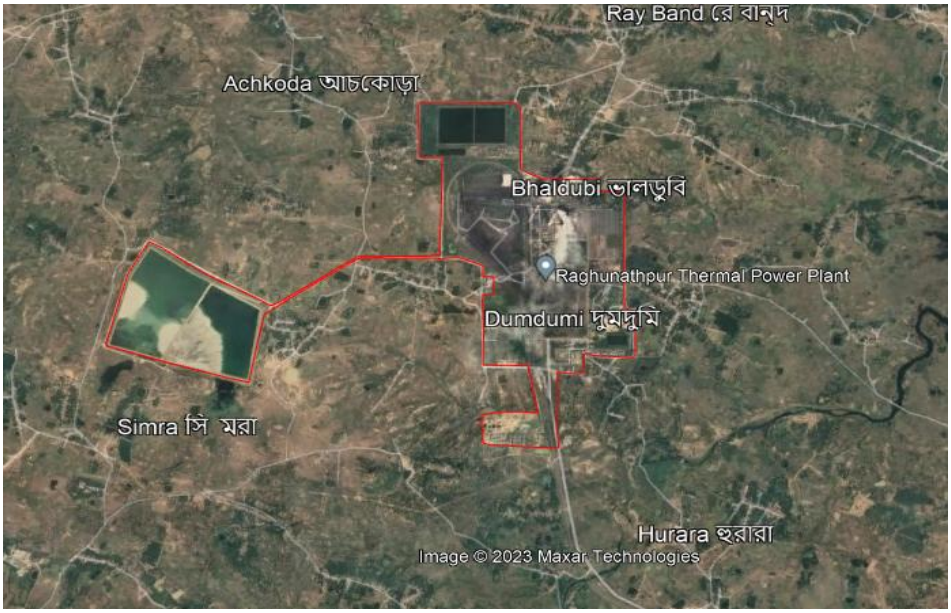


FIGURE-2.1: GOOGLE MAP PROJECT SITE & ITS SURROUNDING AREA
Project Site Location:
Village - Raghunathpur, District – Purulia
Geographical co-ordinates: Latitude: 23°36'5.53"N to 23°37'59.06"N & Longitude: 86°38'51.38"E to 86°40'2.18"E (for project site)
Latitude 23°36'11.23"N to 23°37'12.74"N and Longitude 86°37'3.97"E to 86°38'4.73"E (for ash pond)

Above Mean Sea Level (AMSL): 511.8 ft (156 m)

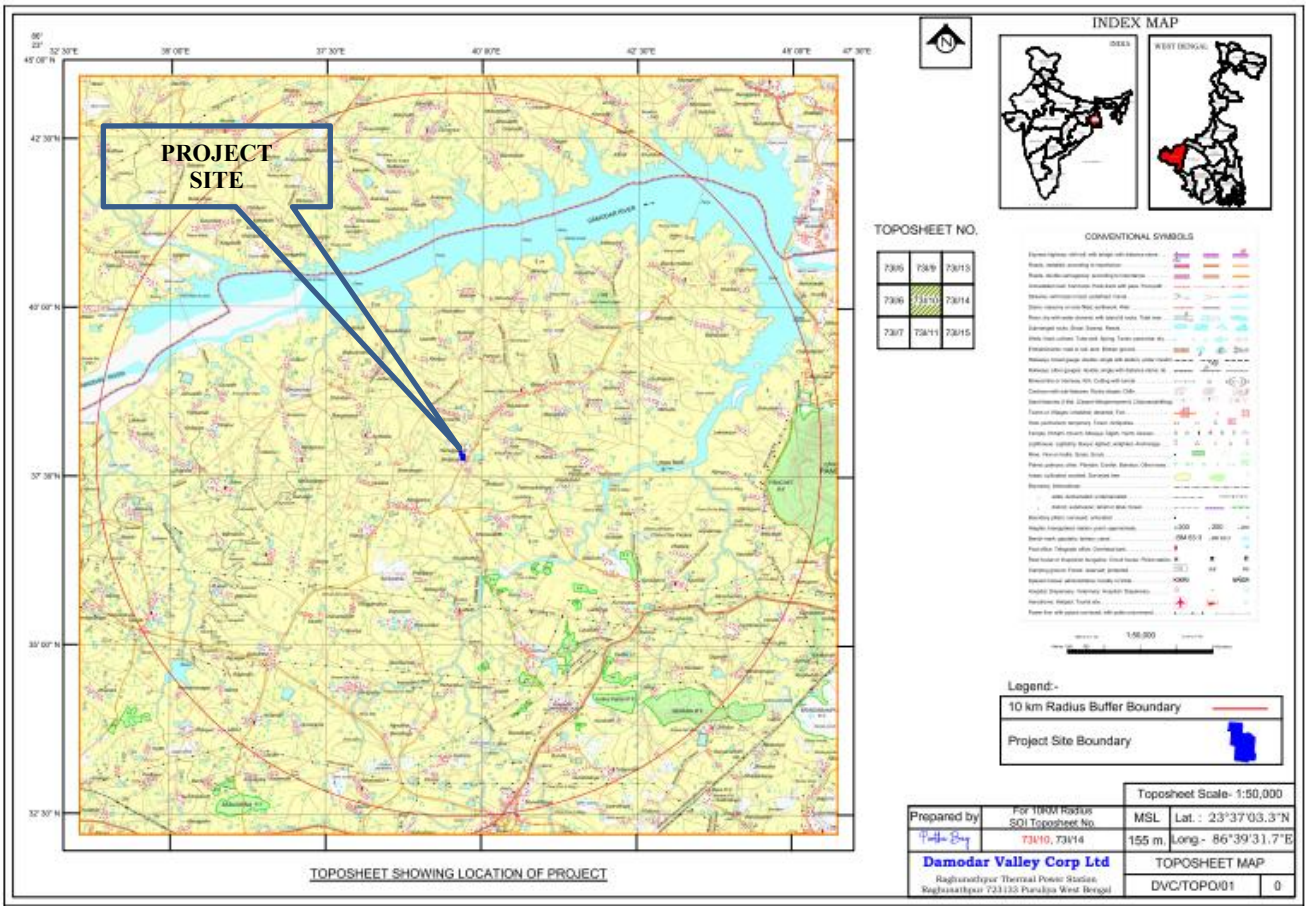


FIGURE-2.2 : TOPOSHEET MAP
PROJECT SITE & ITS SURROUNDING AREA
(TOPOSHEET NO 73N/7 & 73N/8), Scale 1;50,000

2.4 SIZE OR MAGNITUDE OF OPERATION

2.4.1 SIZE OF THE PROJECT

Damodar Valley Corporation (DVC) intends to expand the capacity of Raghunathpur TPS by setting up additional two units of 660 MW each (2x660 MW) based on Supercritical technology under Raghunathpur TPS Ph-II. The expansion project to be accommodated within the land available with Raghunathpur TPS premises.

Major components of proposed Raghunathpur TPS (2x660 MW) Power Project are as follows:

1. Steam Generator and its Auxiliaries.
2. Steam Turbine and its auxiliaries.
3. Electrical Generators, Transformers and Switchyard.
4. Control and Instrumentation systems.
5. Air Pollution Control Systems like Dust Suppression and Extraction.
6. Systems, Electrostatic Precipitators, Flue Gas Desulphurisation
7. System and NOx Control System
8. Water Intake and Treatment Systems
9. Condenser and Auxiliary Cooling System
10. Fuel Oil System
11. Coal Handling and Storage System
12. Ash Handling, Utilisation and Disposal System
13. Site Drainage, Effluent Treatment and Sewage Treatment Systems
14. with facilities for Recycle and Reuse
15. Township with various residential and non-residential facilities
16. Green belt, afforestation and landscaping systems.

The salient features of proposed power plant are presented in Table-2.1.

Table - 2.1

DETAILS OF POROPOSED POWER PLANT

Sl. No.	Features	Description
1.	Capacity	1320 MW
2.	Configuration	2 X 660 MW
3.	Technology	Super Critical Technology
4.	Mode of operation	Base Load (However, continuous operation under two-shift and cyclic modes during certain periods of the year is also envisaged.)
5.	Fuel	Coal (It is envisaged to co-fire 20% biomass along with coal in the steam generator)
7.	Fuel	Rail & Road

	Transportation	
8.	Power evacuation	The power evacuation is proposed through two numbers of 400/220/132KV DVC Sub-stations envisaged for evacuation of Ph-II power of the project.
9.	Commissioning Schedule	1 x 660 MW - 50 months from Zero date. Next unit of 660 MW - after 6 months gap from first unit.

2.4.2 LAND AREA OF THE PROJECT

Land requirement for RTPS phase – 2 will be 150 acres, which is available within the existing project area of 840.53 Hectares (2077 acres), which is already acquired.

Land of 507.480 acres (205.37 Ha.) for the existing Ash disposal system in RTPS (ph-1) comprising of Ash pond, ash pipeline corridor, green belt etc. will be utilised for RTPS (Ph-2) also.

The ash dyke is about 3 Km from Plant premises.

2.4.3 PLANT LAYOUT

Layout of the power plant has been optimized considering the space requirements of all the equipment, systems, buildings and structures, coal storage area, ash silos, start-up fuel oil tanks and pump house, water treatment plant, cooling tower, cooling water pump house, for the proposed 2X660 MW plant. Necessary plant drainage system would be provided at the proposed power plant site. In laying out various facilities, consideration has been given to the following general aspects:

- Provision to install 2x660 MW units including cooling towers;
- The startup power requirement will be derived from 400 kV existing DVC, Raghunathpur.
- Coal storage yard for 15 days requirement at site for proposed 2 X 660 MW units;

- Ash silos for fly ash and ash pond area;
- Water treatment facilities; and
- Availability of adequate space for fabrication/storage of construction equipment and materials.

All facilities of the plant area are laid out in close proximity to each other to the extent practicable so as to minimize the extent of land required. The layout also facilitates movement of men and materials between the various facilities both.

The plant layout showing the proposed facilities, Greenbelt area, Ash pond, Rain Water Harvesting, vehicular parking area, internal road etc. has been shown as Figure-2.3.

The land use breakup of the project site has been presented in Table - 2.2 below.

Table-2.2: LANDUSE BREAKUP

LAND USE:-

SL.NO.	DESCRIPTION	EXISTING UNIT	PROPOSED UNIT
		AREA IN ACRES	
1	Main Power House (Boiler+TG+ESP+FANS+MILLS)	90	90
2	Coal Handling Plant	100	
3	Switch Yard	45	45
4	Lime Storage & FGD etc.	15	15
5	Ash Disposal Area	300	
6	Township (CISF Complex)	72	
7	In Plant Water Reservoir, Cooling Tower etc.	250	
8	Water Corridor	33	
9	Corridor between ash pond and plant	22	
10	Rail cum Road Corridor	340	
11	Township (including Approch Road) for Employee	70	
12	Road Widening (SH5, Jharukhamar Ghutitora plant Gate)	19	
13	Plant area approach Road & Free space	20	
14	Greenbelt	551	
	TOTAL LAND	2077	

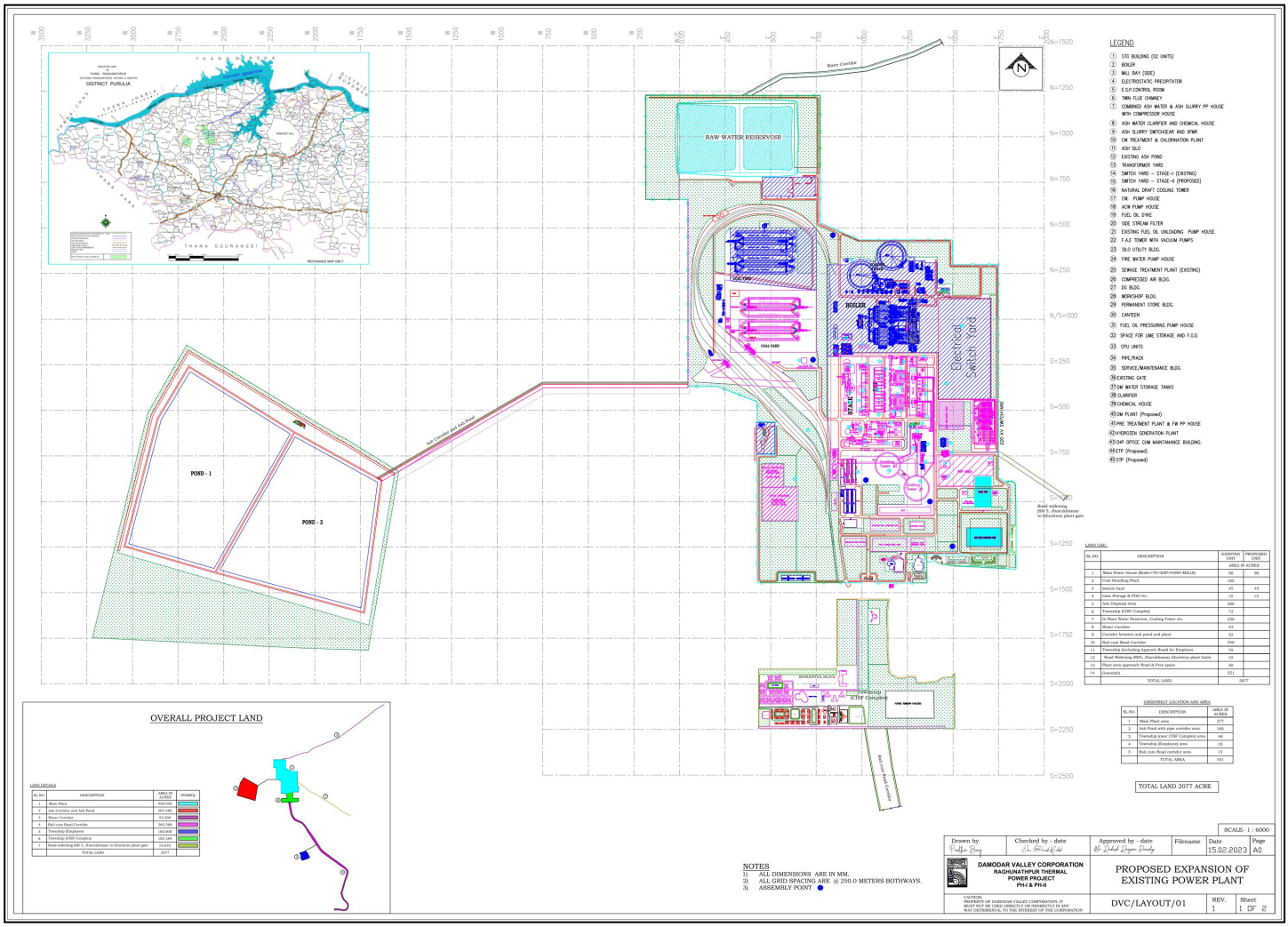


Figure-2.3 Plant Lay out

2.5 PROPOSED SCHEDULE FOR APPROVAL & IMPLEMENTATION

The installation of proposed project along with utilities and services require procurement of equipment, equipment foundations, award of all contracts and supervision of all construction jobs at plant site. The factors which are responsible for timely implementation of the project are:

The major phases of the project during its implementation are classified as under: -

a. Design and Engineering Phase
b. Tendering and award Phase
c. Manufacturing
d. Inspection and expediting
e. Construction / Erection Phase, and
f. Commissioning Phase

As per an initial estimate around 50 (fifty) months will be needed for implementation of the first 660 MW after obtaining necessary Environmental Clearance and NOC. Second 660 MW will be implemented after 6 (six) months consecutive to the first 660 MW.

Master Project Implementation Programme-Master Network (MNW)

A Master Network (MNW), which is the overall program of project implementation may be finalized in consultation with Engineering & relevant groups at Corporate and Site. The MNW is based on project contract package classification. It identifies the key milestone dates for each package in the areas of engineering, procurement, manufacturing, dispatch, construction, erection, testing and commissioning. The date of order of the main plant equipment is the zero date of the Master Network. The MNW forms the basis of all detailed physical scheduling for all contract packages.

2.6 RAW MATERIALS / FUEL (COAL)

Coal requirement for the project is estimated at 6.60 MTPA corresponding to 85% PLF considering GCV of 3200 Kcal/Kg.

M/s Central Coalfields Limited (CCL) on 03.01.2011 issued a Letter of Assurance (LOA) for 4.69 MTPA of E-Grade Coal for Ph-II. DVC vide its letter ref. no- ED(Fuel)/MOP/RTPS, Ph-II/2021-22/559 dated: 21.03.2022 to Ministry of Power has requested extension of validity of LOA for a further period of 4 years with effect from 31.03.2022 towards fuel security of RTPS Ph-II.

Further, SLC-LT, in its meeting held on 08.08.2022, has recommended the grant of coal linkage under Para B (i) of SHAKTI Policy to Raghunathpur TPS Ph-II from Coal India Limited.

Mode of transportation of Coal:

The transportation of Coal from Coal Mines to Raghunathpur Ph-II is proposed through both – Rail & Road mode. Accordingly, Coal for proposed 1320 MW project is proposed to be transported from Central Coalfields Ltd (CCL) to the project site through Indian Railways network, already existing at Raghunathpur TPS and then through Road.

Chemical Composition of Coal:

Coal quality parameters considered for Raghunathpur Thermal Power Plant Ph-II is given in Table-2.3.

TABLE - 2.3

Chemical Analysis of Domestic Coal	
Analysis	**Domestic Coal**
Moisture (%)	13-14
Ash (%)	34-43
Sulphur Content (%)	0.5 (max)
GCV (K-Cal/Kg)	3,200 - 3,900

Geochemical analysis of trace elements in coal has been presented below in **Tables - 2.4.**

TABLE - 2.4

Geochemical Analysis of Trace Elements of Coal		
Sl. No.	**Parameters**	**Range (ppm)**
1	Co	17.0 – 36.5
2	Cu	66.0 – 105.0
3	Cr	55.0 – 58.5
4	Mn	745.0 – 935.0
5	Ni	59.0 – 78.0
6	Pb	18.5 – 22.0
7	As	4.0 – 5.0

Auxiliary Fuel

Start-up, warm-up and low load operation (up to 30%) will be carried out by LDO for which storage tanks (2 x 2500 KL) and associated facilities

have been envisaged for the plant. LDO will be brought to the plant by rail line and unloaded in to the storage tanks by means pumps.

Storage:

Details of material storage is given below in **Tables - 2.5.**

TABLE - 2.5

Storage Details	
Materials	**Days**
Coal	16
Gypsum	7
Limestone	7
LDO	5,000 KL

2.7 TECHNOLOGY AND PROCESS DESCRIPTION

2.7.1 Super Critical Technology

Raghunathpur TPS Project shall be a coal based thermal power project with Super critical technology. Major components of the power project are Coal Handling and Storage Plant, Fuel Oil Handling and Storage Plant, Water Intake and Treatment Systems, Steam Generator and its auxiliaries, Steam Turbine and its auxiliaries, Water Cooled Condenser, Auxiliary Cooling System, Ash Handling Plant, Electrical Generators, Transformers and Switchyard, various Control and Instrumentation systems etc.

The Steam Generators (SG) shall be supercritical once through type, water tube, direct pulverised coal fired, top supported balanced draft furnace, single reheat, radiant, dry bottom type, suitable for outdoor installation. The gas path arrangement shall be single pass (tower type) or two pass type having 256 kg/cm2 pressure at super heater outlet and SH/RH outlet temperature of 568°C/596°C.

It is envisaged to co-fire 20% biomass along with coal in the steam generator.

Supercritical Technology and its Advantages

Super critical technology has many advantages over sub-critical technology. Plants with super critical technology have better efficiency due

to higher steam parameters resulting in lesser coal consumption than the sub-critical plants.

Lower amount of coal burnt in the power plant for same amount of electrical
power being produced means lesser CO2, and SOx emissions. Carbon-dioxide emissions, a major cause of concern today due to its global warming potential causing climate change, are reduced. This has been a major factor for adoption of supercritical technology.

In other words, supercritical power plants are highly efficient plants with best available pollution control technology, reduces existing pollution levels by burning less coal per megawatt-hour produced, capturing the vast majority of the pollutants. This increases the kWh produced per kg of coal burned, with fewer emissions.

Because of the above techno-economic benefits along with its environment friendly cleaner technology; more and new power plants are coming-up with this state-of-the-art technology. As environment legislations are becoming more stringent, adopting this cleaner technology have benefited immensely in all respect. As LHV (lower heating value) is improved (from 40% to more than 45%); a one percent increase in efficiency reduces by two percent, specific emissions such as CO2, NOx, SOx and particulate matters.

“Supercritical” is a thermodynamic expression describing the state of a substance where there is no clear distinction between the liquid and the gaseous phase (i.e. they are a homogenous fluid). Water reaches this state at a pressure above 22.1 MPa. The efficiency of the thermodynamic process of a coal-fired power describes how much of the energy that is fed into the cycle is converted into electrical energy. The greater the output of electrical energy for a given amount of energy input, the higher the efficiency. If the energy input to the cycle is kept constant, the output can be increased by selecting elevated pressures and temperatures for the water-steam cycle.

Increased thermal efficiency observed when the temperature and pressure of the steam is increased. By raising the temperature from 580°C to 760°C and the pressure out of the high pressure feed-water pump from 33 MPa to 42 MPa, the thermal efficiency improves by about 4% (Ultra-

supercritical steam condition).

Moreover, there are various operational advantages in case of supercritical power plant. There are several turbine designs available for use in supercritical power plants. These designs need not fundamentally differ from designs used in sub critical power plants. However, due to the fact that the steam pressure and temperature are more elevated in supercritical plants, the wall-thickness and the materials selected for the high-pressure turbine section need reconsideration. The supercritical plant needs 'once-through' boiler, where as 'drum' type boiler is required by sub-critical power plant. In fact, once-through boilers are better suited to frequent load variations than drum type boilers, since the drum is a component with a high wall thickness, requiring controlled heating.

The performance of supercritical plant depends on steam condition. Steam conditions up to 30 MPa/600°C/620°C are achieved using steels with 12 % chromium content up to 31.5 MPa/620°C/620°C is achieved using Austenite,
which is a proven, but expensive, material. Nickel-based alloys, would permit 35 MPa/700°C/720°C, yielding efficiencies up to 48%. Lot R&D inputs and allying with suppliers are required to achieve higher performance.

Moreover, fuel flexibility is not compromised in Once-Through Boilers. A wide
variety of fuels have already been implemented for once-through boilers. All
types of coal as well as oil and gas have been used.

Capital cost of a super critical plant is higher than that of sub-critical plant due to its higher operating pressure and also because of use of superior materials in boiler and turbine. This additional capital cost depending on fuel cost, may be offset by saving in fuel cost. If the fuel cost is high, then saving due to efficiency improvement is more.

Thus, new pulverized coal combustion systems – utilizing supercritical and ultra supercritical technology – operate at increasingly higher temperatures and pressures and therefore achieve higher efficiencies than conventional sub-critical units with significant CO2 reductions. The objective of power plants within today's market boundaries is more than

ever to ensure high efficiency (to reduce the environmental impact as much as possible) while at the same time to increase their economics in competition to existing alternatives. The development of an economical and efficient concept needs to look at the steam turbine all other main components like boiler, flue gas cleaning equipment and the optimization of the water-steam-cycle as main parts for the optimization.

While developing the details of water system for the project utmost care shall be taken to minimize water requirement as well as effluent generation. Main features of the water system shall include:

- Re-circulating type C.W. system with cooling towers/open system complying with MoEF&CC requirements.

- In case of cooling towers, utilization of cooling tower blow down for coal dust suppression and extraction system, service water system, ash handling and fire fighting

- Recycle and reuse of effluents from coal dust suppression and extraction system and service water system.

- Ash water recirculation system

- Recirculation of filter backwash to clarifier inlet

2.7.2 Process Description

In a thermal power plant, the chemical energy of the fuel (coal) is first converted into thermal energy (during combustion), which is converted to mechanical energy (through turbine) and finally into electrical energy (through a generator).

The schematic diagram of the process of power generation a coal based thermal power plant is shown in Figure-2.4.

1. The coal is transferred from coal handling plant by conveyor belt to the coal bunkers, from where it is fed to the pulverizing mills, which grind it to fine powder. The finely powdered coal, mixed with air is then blown into the boiler by a fan where it burns like a gas;

2. The process of combustion releases thermal energy from coal. The boiler walls are lined with boiler tubes containing high quality demineralized water (known as boiler feed water). The combustion heat is absorbed by the boiler tubes and the heat converts the boiler feed water into steam at high temperature and pressure. The steam, discharged through nozzles on the turbine blades, makes the turbine to rotate, which in turn rotate the generator coupled to the end of the turbine. Rotation of generator produces electricity, which is passed to the step-up transformer to increase its voltage so that it can be transmitted efficiently. The power is evacuated via switch yard through a transmission system;

3. During combustion, the non-combustible part of coal is converted into ash. small part of ash (about 20 %) binds together to form lumps, which fall into the ash pits at the bottom of the furnace. This part of ash, known as bottom ash is water quenched, ground and then conveyed to pits for subsequent disposal to ash disposal area or sale;

4. Major part of the ash (about 80%) is in fine powder form, known as fly ash, and is carried out of the boiler along with the flue gas. The flue gas, after heat recovery, is passed through the Electrostatic Precipitators, where the ash is trapped by electrodes charged with high voltage electricity;

5. The flue gases exiting from the Electrostatic Precipitators (ESPs) are discharged through tall chimney for wider dispersal of remaining ash particles and gases. The ash collected in the ESP hoppers is extracted in dry form and conveyed to dry ash storage silos from where it is supplied to user industries;

6. Unused part of fly ash is mixed with water and conveyed to ash disposal area in a slurry form. Ash can also be lifted from ash disposal areas for utilization;

7. The steam, after passing through the turbines, is condensed back into water in condensers and the same is re used as a boiler feed water for making steam. The reasons for condensing and reusing the steam are following:

- The cost of boiler feed water is very high as it is very pure demineralized water hence reuse is economical; and

- The use of condenser lowers the temperature at the exit end and hence

increases the efficiency of the turbine.

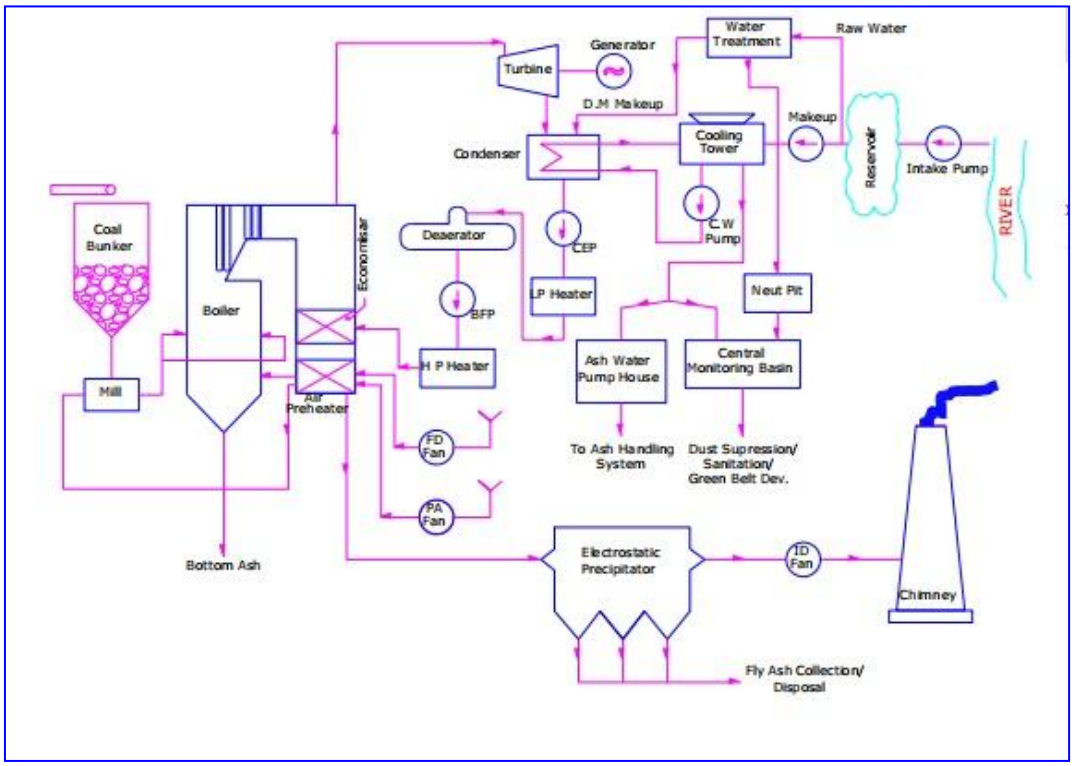


Fig. - 2.4. Process of power generation Raghunathpur Thermal Power Plant

2.8 MECHANICAL SYSTEM

2.8.1 Steam Generator & Auxiliaries

The Steam generators (SG) shall be Supercritical, Once through, Water tube, Direct pulverized coal fired, Top supported, Balanced draft furnace, Single reheat, Radiant furnace, Dry bottom type, suitable for outdoor installation. The gas path configuration shall be single pass (tower type) or two pass type.

Higher steam parameters with supercritical technology is proposed for the project to have the advantage of higher efficiency/reduced heat rate and reduced environmental emissions.

The steam Generator and its auxiliaries shall be designed for firing Indian coal identified for this project. Boiler shall also be capable of firing imported coal with upto 30% blending with domestic coal. Steam Generator design shall be suitable for variable pressure operation from

30% to 100% BMCR.

The main parameters at 100% BMCR will be as follows:

Sl. No.	Parameter	Value
1.	Main Steam Flow at Super-heater Outlet	2120 TPH
2.	MS Pressure at Super-heater Outlet	256 Kg/Cm^2 (abs)
3.	MS Temperature at Super-heater Outlet	568°C
4.	Steam flow to Re-heater (CRH)	1693 TPH
5.	Steam Temperature at Re-heater Outlet	596°C
6.	Feed Water Temperature at Economizer Inlet	293°C

It is envisaged to co-fire 20% biomass (with respect to heat input of the total BMCR capacity) along with coal in the steam generator. The same is to be achieved by way of mixing the prepared biomass as a co-firing fuel in the pulverisers through coal feed bunkers.

Suitable space for CO2 Capture, H2 Production, Methanol Production and load considerations in trestles along with space for pumps/ranks for methanol firing for initial start-up, low load operation and as secondary fuel shall be kept.

Steam Generator Circulation System

The furnace containment will be formed by membrane walls and will consist of vertical plain/rifle tubes or wrap around helical tubes. The steam generator start-up system envisages SG start up drain system with SG start up drain circulation pump. Separator(s) will be used during start up for separating the steam water mixture upto the minimum once through load, above which it will be running dry.

Steam Generator Circulation System

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Fuel Oil System

Light Diesel Oil (LDO) shall be used for initial start-up, low load operation and as secondary fuel for pulverized coal flame stabilization at the start ups/low load operations. Necessary oil supply scheme with pumps, filters and valves will be provided. The burners, air registers etc. will have independent pneumatic drives and the entire operation of purging, insertion, air and fuel sequencing shall be automatic. Ignition of oil shall be directly by igniters. LDO system shall be sized for 30% BMCR capacity of the Steam Generators. Steam Generator will be so designed that oil firing for flame stabilization will not be required beyond 40% BMCR.

Existing storage of Ph-I is sufficient to meet the requirement of Ph-II as per latest CERC norms.

Coal Preparation & Firing System

The coal burning system will comprise of coal mills of vertical spindle type. The number and capacities of the mills shall be so selected that while firing the worst and design coals at BMCR/TMCR, the following spare capacities are ensured.

a) With 90% mill loading of the working mills, no spare mill at 100% BMCR while firing the worst coal.

b) With 90% mill loading of the working mills, at least one mill will be spare while firing the design coal at 100% BMCR.

c) With 90% loading of the working mills, at least one mill will be spare at 100% TMCR load with worst coal firing.

Coal from raw coal bunkers will be fed into the mills by belt driven gravimetric coal feeders.

There will be two axial type Primary Air (PA) fans for transporting the pulverized coal from mills to the coal burners through Pulverized Fuel pipes. Two (2) seal air fans will be used for fulfilling the sealing air requirement of all the mills.

Environment Control

The steam generator shall be designed to comply with the notification dated 7th December 2015 of Ministry of Environment, Forest and Climate Change, which limits the emission of particulate matter to 30 mg/Nm3 ,

SO2 emission to 100 mg/Nm3 and NOx emission to 100 mg/Nm3 for thermal power plant units to be installed after 1st January 2017. The emission control shall be achieved through steam generator design features and through external control equipment.

Electrostatic Precipitator

It is proposed to install adequately sized electrostatic precipitator having an efficiency that limits the outlet emission to the applicable value of 30 mg/Nm3 . The electrostatic precipitators will have adequate numbers of parallel gas streams, isolated from each other on the electrical as well as gas side and will be provided with gas tight dampers at inlets and outlets of each stream, so as to allow maintenance to be carried out safely on the faulty stream, while the unit is working. Electrostatic precipitator will be provided with transformer rectifier sets, microprocessor based programmable type rapper control system and ESP management system to ensure safe and optimum operation of ESP. The dust collection hoppers at all strategic locations will have a minimum storage capacity of eight (8) hours. The hoppers will have heating arrangements to prevent ash sticking to the sloping sides and down pipes. Level indicators to indicate ash levels in the hoppers and trip the ESP in case of high ash levels in the ash hoppers are also envisaged to ensure safety of ESP.

In order to meet the environment norms and maintain the sustained efficiency of ESP, it shall be adequately designed with sufficient margins for all operating conditions. The Electrostatic Precipitator Management System (EPMS) in conjunction with opacity monitor shall continuously monitor and maintain the optimum energy level to achieve higher efficiency of ESP.

NO_X Control System

NO_X emission from the steam generator shall be reduced to the applicable value of 100 mg/Nm3 by employing:

(a) Low NO_X burners (LNB), which reduces the air available to the fuel stream during the devolatilization process and thus reduces NO_X production.

(b) Combustion Staging, which is based on creation of fuel rich combustion zone through separation of part of secondary air which is added downstream of main combustion zone as over-fire-air (OFA).

(c) Suitable technology (SNCR/SCR) for further reduction of NO_X upto the applicable value.

Flue Gas Desulphurization System (FGD)

Wet limestone-based flue gas desulphurization (FGD) system shall be installed at the tail end of the steam generator downstream of the ESP to reduce SO2 emission to the applicable value of 100 mg/Nm3 . The FGD shall be provided with limestone slurry preparation system which shall grind limestone to desired fineness. The FGD shall have a scrubber as the main reaction vessel in which SO2 gas shall be captured in limestone slurry
to produce gypsum. The scrubber shall be provided with bypass system.

Necessary auxiliary equipment and systems like mills, cyclones, vacuum filters, belt conveyors, pumps, storage vessels, piping and fittings etc. shall complete the FGD plant.

Following elevators shall be provided for easy access & movement of man/materials in FGD plant

a. One (1) number passenger cum goods elevator of minimum capacity of 1000 Kg for each Absorber.
b. One (1) number passenger cum goods elevator of minimum capacity of 1000 Kg in Limestone Grinding System Building.
c. One (1) number passenger cum goods elevator of minimum capacity of 1000 Kg in Gypsum Dewatering Building.
d. One (1) number passenger elevator of minimum capacity of 680 Kg in MCC cum control room building of FGD plant

2.8.2 Coal & Lime Transportation and Handling System

Coal Transportation

The daily coal requirement for 2x660 MW unit shall be about 21000 tons based on gross calorific value of 3200 Kcal/ kg, 100% plant load factor and 2151 Kcal/Kwh unit heat rate.

The envisaged mode of coal transportation from the coal mines to the power plant is by BOXN wagons. The BOXN rake shall be unloaded at either Single Rota side Wagon Tippler or twin rotary wagon tippler.

Coal Handling System

One coal handling plant of 1600 MTPH capacity is already provided for Raghunathpur Phase -I (2x600 MW). For Phase -II also, it is proposed to

have one additional independent coal handling plant of 2000 MTPH rated capacity with parallel double stream (one working and one standby) of belt conveyors along with facilities for receiving, unloading, crushing and conveying the crushed coal to boiler bunkers and stacking/ reclaiming the coal to/from crushed coal stockyards for Phase -II. Two (2) nos. rail mounted, travelling stacker-reclaimer, bucket wheel type is proposed for coal stockyard management in the Phase -II. Coal handling plant for Phase -II shall also have a dedicated coal unloading terminal with a single rota side wagon tippler and a twin rotary wagon tippler.

The overall operating period time of the coal handling plant shall be 16 hours spread over two shifts per day leaving third shift exclusively for routine inspection and maintenance. The proposed CHP for Phase -II shall cater to the peak daily requirement to coal for both units in two bunker filling cycles in 12 hr., effective operations.

It is envisaged that ROM coal shall be supplied to Raghunathpur Phase-II. Coal handling plant for Phase-II shall have crushers for ultimately sizing the coal to (-) 20 mm. From the crusher house the crushed coal can either be conveyed directly to the coal bunkers through a series of conveyors or stacked on to the crushed coal stockpiles by means of stacker Reclaimer. Motorized traveling trippers shall be provided to feed crushed coal into the raw coal bunkers of the boilers.

Coal stockyards proposed for the Phase -II shall have crushed coal storage capacity equivalent to approx. 16 days coal consumption for 2x660 MW units.

Wind barriers shall be provided all around the coal stockpile. Dust suppression and service water system shall be provided throughout the coal handling plant for Phase-II. The receiving and unloading of BOXN wagon rakes shall be controlled and monitored from the wagon tippler control rooms located adjacent to wagon tipplers. A centralized independent main CHP control room (DDCMIS) shall be provided to control and monitor the operations of the entire coal handling system for Phase II. The provision for interconnection shall be provided from Phase-I to Phase -II and from Phase -II to Phase -I. Facility to feed uncrushed coal (transported through trucks) is also provided.

Limestone, Gypsum and Bio-mass Handling System

The raw limestone received through trucks shall be unloaded through truck tippers, crushed to (-) 20 mm size and stored in limestone storage silos, suitable for 7 days of requirement. From the limestone storage silos,the crushed limestone shall be fed to the limestone day silos.

Gypsum fed from the vacuum belt filter shall be stored in gypsum storage shed. 7 days of gypsum shall be stored in this storage shed.

Biomass received through trucks shall be unloaded through truck tippers and stored in storage silos. From the biomass storage silos, the biomass pellets shall be fed to the coal conveyors for further transportation with coal for bunkering.

2.8.3 Ash Handling System

The bottom ash shall be extracted and disposed off in wet form. The fly ash shall be extracted in dry form from the electrostatic precipitator hoppers. This dry ash is taken to buffer hoppers for its onward transportation in dry form to storage silos for utilization. In case of non-utilization, fly ash can be converted to slurry in wetting units/through feeder ejectors for its ultimate disposal in wet form to ash disposal area.

Bottom Ash Handling System

Bottom ash is extracted either by using a continuously operating submerged scraper chain conveyor system or by using intermittently operating jet pumps in conjunction with a water impounded hopper. Dry type bottom ash hoppers shall be used in case of the submerged scraper chain conveyor system.

In case of continuous BA extraction system involving submerged scrapper conveyors, the bottom ash from all the units is led to a common Bottom ash slurry disposal pump house.

In case of the intermittently operating jet pump system, the jet pumps would convey the bottom ash slurry from water impounded BA hoppers to the slurry sump of the common Bottom ash slurry disposal pump house.

Economiser and air-preheater ash shall be handled in wet form. Coarse ash slurry from economizer and air preheater hoppers shall also be led to

the slurry sump of the Bottom ash slurry disposal pump house.

Bottom ash from the Bottom ash slurry disposal pump house shall be taken either to the dewatering bins or to combined ash slurry pump house. Bottom ash can be transported from these dewatering bins through trucks.

No pits will be permitted in the boiler area to accommodate the water impound hoppers.

Fly Ash Handling System

Pneumatic conveying system (either vacuum system or pressurized system) shall be employed for extraction of fly ash from the electrostatic precipitator hoppers in dry form. This dry ash shall be taken to buffer hoppers of each unit or to the intermediate silos located at approx. 600-700 m from ESP. The dry ash buffer hoppers shall be located adjacent to the ESP. Dry ash from buffer hoppers/intermediate silos shall be transported to main storage silos. The main ash storage silos shall be placed on the rail line for further utilization through rail wagons. Silo utility building shall be provided with fencing, office block, gate complex and passage for entry/exit vehicles. There shall be two nos. of ash silos. The storage capacity of each silo shall be about 16 hr. of production of fly ash (based on performance coal analysis) of each unit. The user industries shall take the dry fly ash from these silos in closed tankers/Rail wagons/Open trucks. For wet disposal of dry ash extracted from various ESP hoppers, the same shall be diverted to feeder ejector placed below IM silos located near combined ash slurry pump house. Ash classifiers shall be provided to classify fly ash into fine and coarse ash.

Ash Slurry Disposal System

It is envisaged to have combined ash slurry disposal system. The bottom ash slurry and fly ash slurry from units shall be led to the common slurry sump of the combined ash slurry disposal pump house. The combined ash slurry is pumped using heavy duty centrifugal slurry pumps to existing ash dyke of Ph-I, approximately 3 Km from the plant. There shall be common ash slurry pump house with two (2) working streams, one operation standby stream and one maintenance standby stream. The entire pumping stream shall be provided with its individual disposal pipes. No crossover is being envisaged in the disposal piping.

Ash Water System

Ash water system consisting of required water pump, piping and valve etc., to cater to LP and HP water requirement shall be provided. It is also proposed to re-circulate the ash water from the ash dyke area to plant area for its re-use in ash handling system. The make-up to ash handling system during recirculation shall be provided from CW blow down/plant make-up system.

2.8.3 Steam Turbine

The steam turbine shall be tandem compound, single reheat, regenerative, condensing, multi cylinder design with separate HP, separate IP and separate LP casing(s), OR combined HP-IP and separate LP casing(s), directly coupled with the generator suitable for indoor installation. The plant would be designed to operate as a base load station. However, continuous operation under two-shift and cyclic modes during certain periods of the year is also envisaged. The turbine design shall cover adequate provision for quick start-up and loading of the units to full load at a fast rate. The turbine shall be capable of operating on variable pressure mode as well as modified sliding pressure mode. The turbine shall be provided with suitable margins for VWO flow.

2.8.4 Condenser

Single pass or double pass condenser with stainless steel tubes of welded type as per ASTM-A-249-TP304 or austenitic alloy steel tubes SA-450 continuous without any circumferential joint shall be adopted. The condenser shall be with divided water box construction. It shall be horizontal, surface type with integral air cooling section. Condenser hot-well shall be sized for three (3) minutes storage capacity (between normal and low-low level) of total design flow with the turbine operating at VWO condition, 3% make-up, and design back pressure. The condenser shall be adequately sized to cater to all the conditions of turbine operation including the abnormal operating conditions such that condenser would not be a bottle neck at any stage of operation. The exact condenser parameters shall be optimised on the basis of site data and most economical combination of cooling surface and circulating water quantity. The condenser shall be designed, manufactured and tested in accordance with the latest applicable requirements of the Heat Exchange Institute (HEI), USA. Provision of separate sponge rubber ball type condenser on-load tube cleaning system for each half of the condenser including ball circulation pumps, strainer, ball monitoring system etc. shall be made.

Provision of multi condenser configuration with dual pressure arrangement is also envisaged as per optimisation done by the bidder.

2.8.5 Air Extraction System

Each unit shall comprise of (2x100%) vacuum pumps per unit or 2x100% vacuum pumps for each condenser shell (in case dual pressure condensers are offered) along with all accessories and instrumentation for condenser air evacuation. The vacuum pumps and accessories shall be used to create vacuum by removing air and non-condensable gases from steam condenser during plant operation. Vacuum pumps shall be of single/two stage liquid ring type with both stages (if two-stage pump is selected) mounted on a common shaft. Vacuum pumps shall be sized as per latest HEI requirements.

2.9 WATER SYSTEM

Make up water requirement for this project would be about 3960 M^3/hr., (approx. 40 Cusec) with ash water recirculation system (AWRS) and would be about 5860 M^3/hr., without AWRS. Water balance diagram is enclosed as Fig. - 2.5.

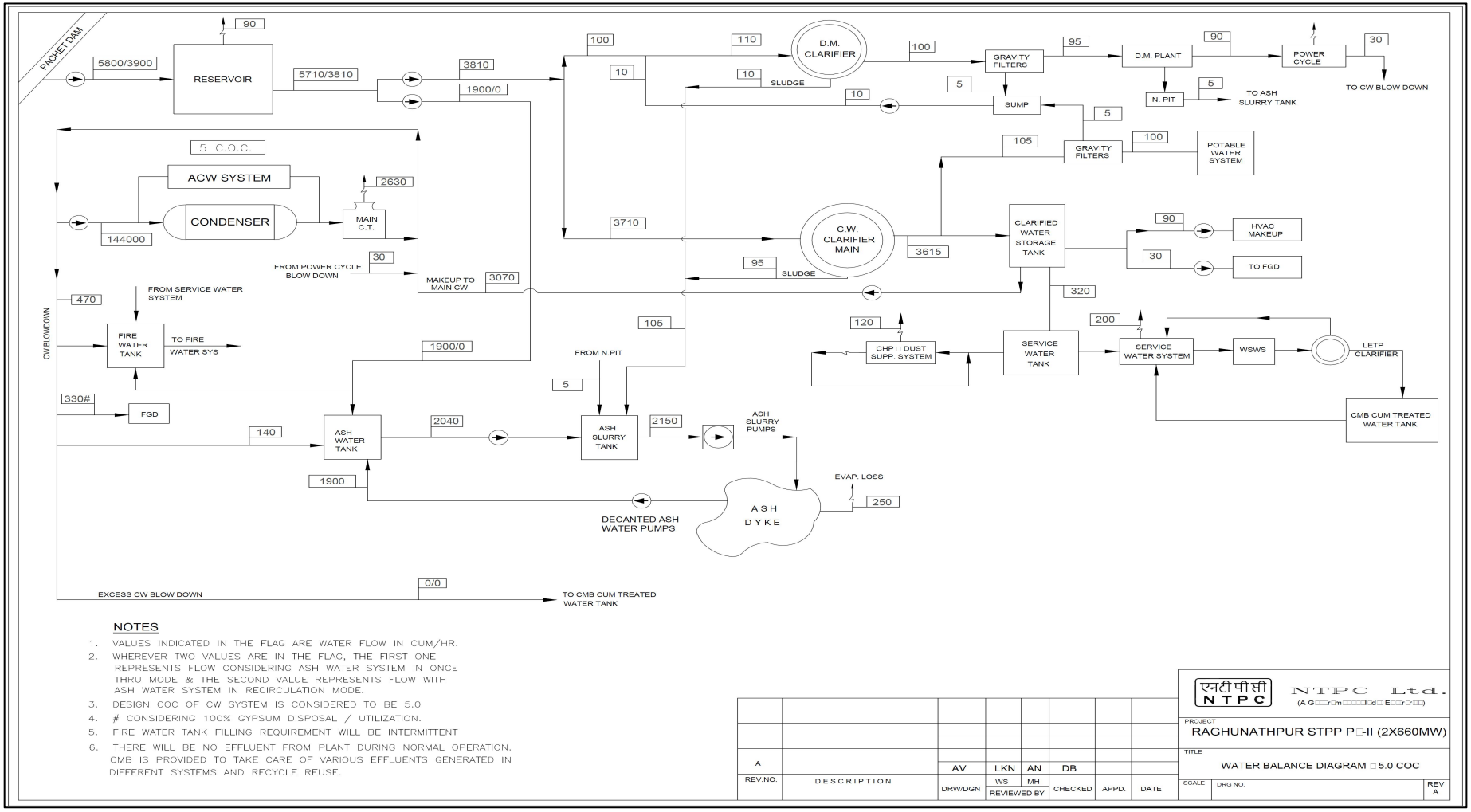
The source of water for the project is Panchet Dam which is at a distance of about 12 Km from the site.

Water systems of the Plant shall comprise of the following:

- Make-up water
- Re-circulating water
- Once through water
- Emergency water
- Drinking water
- Fire water
- Dust suppression water
- Water for plantation

Water is mainly required for cooling of equipment, dust suppression, plantation etc.

Fig. 2.5 - Water Balance Diagram



NOTES

1. VALUES INDICATED IN THE FLAG ARE WATER FLOW IN CUM/HR.
2. WHEREVER TWO VALUES ARE IN THE FLAG, THE FIRST ONE REPRESENTS FLOW CONSIDERING ASH WATER SYSTEM IN ONCE THRU MODE & THE SECOND VALUE REPRESENTS FLOW WITH ASH WATER SYSTEM IN RECIRCULATION MODE.
3. DESIGN COC OF CW SYSTEM IS CONSIDERED TO BE 5.0
4. # CONSIDERING 100% GYPSUM DISPOSAL / UTILIZATION.
5. FIRE WATER TANK FILLING REQUIREMENT WILL BE INTERMITTENT
6. THERE WILL BE NO EFFLUENT FROM PLANT DURING NORMAL OPERATION. CMB IS PROVIDED TO TAKE CARE OF VARIOUS EFFLUENTS GENERATED IN DIFFERENT SYSTEMS AND RECYCLE REUSE.

REV.NO.	DESCRIPTION	DRW/DGN	REVIEWED BY	CHECKED	APPD.	DATE
A		AV	LKN / WS, AN / MH	DB		

एनटीपीसी NTPC Ltd. (A G□□□m□□□□□d E□□r□□)

PROJECT: RAGHUNATHPUR STPP P□-II (2X660MW)

TITLE: WATER BALANCE DIAGRAM □ 5.0 COC

SCALE | DRG NO. | REV A

2.9.1 Make-up Water & Raw Water System

The Make-up water for the project shall be drawn from Panchet Dam on Damodar River. A water intake pump house is being constructed in the Panchet Dam over Damodar River by providing RCC well foundation during Ph-I of the project. Space provision is already provided in this Intake well cum pump house for future requirement. Accordingly, it is proposed to utilize the same pump house. For Ph-II, it is proposed to install three (3) numbers of 50% capacity Intake water pumps in the Intake Well cum Pump House located inside the river.

Capacity of each intake water pump would be 3700 M^3/hr., i.e., identical to the pumps being provided under Ph-I (although the required capacity of Intake Pumps is working out as 3200 M^3/hr., only). Likewise, the approach bridge being provided connecting the river (Intake water) pump house to the bank can accommodate additional pipeline for Ph-II of the project. Make-up water shall be drawn from above mentioned source and shall be pumped to a raw water reservoir being provided within the boundary of Power Plant under Ph-I.

It is proposed to provide one number of pipelines under proposed Ph-II from make-up water pump house to raw water reservoir. The pipeline shall be designed in such a way that it shall deliver discharge of two make-up water pumps. The pipeline shall be protected against corrosion using suitable external coating and wrapping. Further, the pipe shall be protected against galvanic corrosion by providing Cathodic Protection System.

Interconnection of intake water pipelines, being provided under Ph-I and Ph-II, at river end shall be provided to have flexibility in operation.

2.9.2 Raw Water System

A Raw Water Pump House near Raw Water Reservoir is constructed under Ph-I. This Pump House also has provision for future requirement.

Accordingly, Raw Water Pumps for pumping the water to PT plant and to Ash handling plant under Ph-II shall be installed in this pump house. It is proposed to install five (5) numbers of pumps i.e., three (3) no. (2W + 1S) 2500 M3/hr., for PT Plant and two (2) no. (1W + 1S) 2000 M3/hr., for Ash handling plant.

Both the pump houses, constructed under Ph-I, i.e., Intake Make-up

Water Pump House and Raw Water Pump House shall be augmented to cater to Ph-II requirements. The makeup water system as well as Raw water system under Ph-II shall be provided with required instrumentation, interlocks, PLC based controls, control panels to facilitate safe & reliable operation.

2.9.3 Water Treatment System

The water treatment system of the project comprises of Water Pre-treatment Plant, Demineralizing Plant, Chlorine dioxide Plant, Condensate Polishing Plant, CW Treatment Plant and ETP as described below:

Water Pre-treatment Plant

The pre-treatment plant would be designed to remove suspended/colloidal matter in the raw water. Pre-treatment (PT-CW) plant shall be provided for meeting the water requirements of Cooling Water system, HVAC system, Service water system, Coal Handling plant & FGD systems etc. Pre-treatment (PT-DM) plant shall be provided for meeting the water requirements of DM plant.

DM Plant

The DM plant shall be sized to meet the make-up water requirement of the steam cycle, make up to closed circuit auxiliary system, hydrogen generation plant and stator water cooling system.

Chlorine Di-oxide Plant

Chlorine Di-oxide Plant shall be provided for generating & dosing ClO_2 in the CW system to avoid the growth of algae and bacteria.

CW Treatment Plant

It is proposed to provide suitable Chemical treatment program of acid dosing and scale cum corrosion inhibitor for the CW system for control of water chemistry. It is proposed to provide acid & chemical storage tanks and dosing pumps. The plant shall be provided with neutralization pits, disposal pumps with required corrosion measurement rack, instrumentation for interlocks and controls, control panels etc. to facilitate safe & reliable operation.

2.9.4 Liquid Effluent Treatment Plant Complying Zero Discharge Norms

The liquid effluents shall be collected and treated / recycled generally as per the following design philosophy

i) The filter backwash water of PT Plant shall be collected and recycled

back to the DM system clarifier.

ii) The sludge from clarifiers/tube settlers of Water PT & LET plants shall be collected in a sump/pit and shall be pumped to ash slurry sump for disposal to ash dyke.

iii) The waste effluents from neutralization pits of DM plant and Condensate Polishing Plant shall be collected in the respective neutralization pits and neutralized before pumping to ash slurry sump for use.

iv) Coal Slurry Settling Ponds (CSSP) shall be provided to remove coal particles from coal handling plant waste. Decanted water shall be recycled back for use in the coal dust suppression system.

v) To receive & treat excess storm water (considering rainstorm condition), Clarifier feed pumps (2x50%), reactor clarifier (1x100%), belt filter press (2x50%), Clarified Water Transfer Pumps (2x50%) and required chemical storage & dosing system shall also be provided.

vi) The treated effluents conforming to the prescribed standards only shall be re-circulated and reused within the plant. Arrangements shall be made that plant effluents and storm water do not get mixed.

vii) Service water effluents from various areas shall be separately routed to a sump. From the sump the waste service water shall be pumped up to lamella clarifier/tube settler for treatment. Treated service water shall be sent back to service water tank & Ash water tank to the extent possible for re-use.

viii) Treated effluents/excess CW blow down (if any) shall be collected in Central Monitoring Basin (CMB) and shall be recycled & re-used after clarifier as mentioned above.

2.9.5 Storm Water Management

Storm water management is already being done by installing intercepting drains in the plant area and led to water reservoir which will help in conserving the fresh water. The storm water drainage has taken into account the topography of the plant area, intensity of hourly rainfall and existing drainage pattern of the area.

The storm water drainage system consists of a network of open drains. The

run-off from plant area, open areas, buildings and installation is being carried through the network of open drains running all along the road system and finally collected in raw water reservoir after pre-treatment.

Storm water management for Phase - II project will also follow the existing set up.

To receive & treat excess storm water (considering rainstorm condition), Clarifier feed pumps (2x50%), reactor clarifier (1x100%), belt filter press (2x50%), Clarified Water Transfer Pumps (2x50%) and required chemical storage & dosing system shall also be provided.

The treated effluents conforming to the prescribed standards only shall be re-circulated and reused within the plant. Arrangements shall be made that plant effluents and storm water do not get mixed.

2.10 PLANT & INSTRUMENTATION AIR SYSTEM

For meeting the Instrument Air and Service Air requirement of Main Plant and Auxiliaries, required numbers of Air Compressors & Air-Drying Plants (ADP) shall be provided. For instrument air requirement, the capacity of compressors and ADP shall be decided based on the requirements of Main Plant supplier (especially Steam Generator vendor) and other auxiliary plant and data need to be obtained.

2.11 AIR CONDITIONING SYSTEM

Air conditioning system shall be provided for all those areas which require close control of environment conditions and shall cover the following areas:

a) Control tower areas including Control Rooms, Control Equipment Rooms, Computer and Programmers Rooms, UPS /Battery Charger Rooms, Conference Room, Shift Charge Engineer's Room, Steam & Water Analysis Rooms (SWAS), etc.,

b) ESP control rooms.

c) FGD Control Room

d) Ash Handling Control Room

e) Water System Control Rooms

f) Switchyard Control Room

g) Service Building

h) Any other area which contains control and instrumentation equipment requiring air conditioning or otherwise requires to be air conditioned.

2.12 FIRE PROTECTION SYSTEM

A comprehensive fire detection and protection system is envisaged for the project. This system shall generally be as per the recommendations of TAC (India)/ IS: 3034 & NFPA- 850/equivalent standard.

The following protection systems are envisaged:

i) CW blow down shall be used for supply of fire water. Two alternate connections, one from raw water line and other from service water line shall also be provided as a back-up source for fire water. Two numbers of Steel tanks for storage of fire water shall be provided. Fire water horizontal centrifugal pumps shall be located in the fire water pump house for hydrant and spray system and the same shall be driven by electric motors and diesel engines as per the regulations of TAC.

ii) For the above fire water pumping station, automatic pressurization system consisting of jockey pumps driven by electric motors shall be provided.

iii.) In addition to above, hydrant & spray booster pumps shall be located in the fire water booster pump house for hydrant and spray system and the same shall be driven by electric motors and diesel engines as per the regulations of TAC.

iv.) Hydrant system for complete power plant covering main plant building, boiler area, turbine and its auxiliaries, coal handling plant, biomass handling plant, all pump houses and miscellaneous buildings of the plant.

The system shall be complete with piping, valves, instrumentation, hoses, nozzles, hose boxes/stations etc.

v.) Automatic high velocity water spray system for all transformers located in transformer yard and transformers having oil capacity of 2000 liters

and above located within the boundary limits of plant, Main and unit turbine oil tanks and purifier, oil canal, generator seal oil system, lube oil system for turbine driven boiler feed pumps/lube oil console, boiler burner fronts, fuel oil station rack in boiler, etc. This system shall consist of QB detectors, deluge valves, projectors, valves, piping & instrumentation. Automatic Nitrogen injection system for all transformers located outside plant boundary where water-based fire protection system not envisaged (of rating 10 MVA and above or in case of oil filled transformers with oil capacity of more than 2000 liters).

vi.) Automatic medium velocity water spray system for cable vaults and cable galleries of main plant, switchyard control room and ESP control room, FGD building and all cable trestles of main plant area (from transformer yard to chimney) consisting of smoke detectors (as applicable), linear heat sensing cable detectors, deluge valves, spray nozzles/projectors, isolation valves, piping, instrumentation, etc.

vii.) Automatic medium velocity water spray system for coal conveyors, crusher house, transfer points, Stacker reclaimers, biomass conveyors & TPs consisting of QB detectors, linear heat sensing cables, deluge valves, nozzles, piping, instrumentation, etc.,

viii.) Automatic medium velocity water spray system for fuel oil pressurizing pump house, DG Sets, etc., consisting of QB detectors, deluge valves, nozzles, piping, instrumentation, etc.

ix.) For protection of Central control room, Control equipment room, Programmer room, UPS room, etc. Inert Gas extinguishing system as per NFPA-2001 would be opted.

x.) Fire detection and alarm system-microprocessor based analogue, addressable type fire detection and alarm system shall be provided to cover the complete power plant. Following types of fire detection shall be employed.

- Multisensor type smoke detection system
- Linear heat sensing cable detector.
- Quartzoid bulb heat detection system.
- Infra-red type heat detectors (for all coal & biomass conveyors)

xi) Portable and mobile extinguishers, such as pressurized water type,

carbon-dioxide type, foam type, dry chemical powder type, shall be provided at strategic locations throughout the plant.

xii) Complete instrumentation and control system for the entire fire detection and protection system shall be provided for safe operation of the complete system.

2.13 AUXILIARY FACILITIES

General Store

A single bay building will keep equipment spares, hard wares, wearing parts and consumables.

Repair and maintenance shop

The plant repair and maintenance facilities will be centralized to take care of regular maintenance work. Tool room, hydraulic and pneumatic equipment repair, welding section, office, toilet etc. will be suitably located.

Laboratory Facilities

Facilities will be provided for collection of various samples and carrying out necessary analysis as required for operation of the plant.

Other Facilities

Besides the repair and maintenance shop, and general stores, other auxiliary facilities like general administrative building, first aid station, canteen will also be provided.

2.14 POWER

Estimated Power requirement for phase-II project is 82.5 MW. The required power will be sourced from Phase-I project of DVC Raghunathpur.

The start-up power requirement of the plant has been proposed to be met from Ph-I system by provision of suitable 400/11kV Station Transformers.

Emergency power supply:

For the safe shutdown of the plant under emergency condition and in case of total power failure, diesel generating sets shall be installed for feeding certain essential applications like battery chargers, emergency lighting, essential air conditioning/ventilation and all auxiliaries necessary for barring operation of main and BFP turbines etc. The unit emergency switchgear section of each unit shall be fed by one diesel generator of adequate capacity.

One no. Diesel Generator (DG) set per unit along with one common standby DG set common for two units shall be provided as indicated in the single line diagram. Cable interconnection shall be provided from DG to respective unit emergency switchgear.

A separate DG set common for the entire plant shall be provided for catering to requirements of FGD system during normal power outage.

Auxiliary power supply:

Conventional station transformer scheme has been considered for DPR purpose. Considering large size of the generating units and techno economic considerations, standard 11kV, 3.3kV and 415V scheme has been adopted.

Following auxiliary power supply system is proposed:

400 kV generation Step-up transformers along with 400kV Class ST for deriving station supply Station supply. The voltages adopted for the AC auxiliary system are:

415 V - For motors rated upto 200 kW. (Energy Efficient Motors)
3.3 kV - For motors above 200 kW and upto 1500 kW.
11 kV - For motors rated above 1500 kW

2.15 MANPOWER PLANNING

The project will require additional 350 manpower for phase - II.

In addition, a considerable number of indirect employment is also envisaged for the proposed expansion.

Training & Development

DVC has laid stress on Training and Development as one of the main measures for improving the performance of its employees. To achieve this, a string of modern and well-equipped training institutes has been set up at different projects. DVC may engage with the training institutes of NTPC and/or other power utilities or establish its own training center depending on requirement.

Pre-employment Training

Pre-employment training aims at providing requisite skills and confidence to the personnel who enter the organization as fresh trainees at different

induction levels. Four types of long-duration training schemes are in vogue in DVC to take care of this aspect of training.

Sl. No.	Name of Training Scheme	Duration
1	Executive Training (Engineering)	1 year
1	Executive Training (Finance & HR)	1 year
1	Executive Training (Chemistry)	1 year
1	Diploma / ITI Training	1 year

2.16 ASH MANAGEMENT

Ash and Gypsum shall be the major solid waste likely to be generated from RTPS, Ph-II.

Ash shall be generated due to combustion of coal. Around 29,70,000 TPA Ash will be generated from Boiler, out of which 80% shall be generated as Fly Ash, while 20% of the ash shall be generated as bottom ash.

Total Ash generation	29,70,000 TPA
Fly Ash (80%)	23,76,000
Bottom Ash(20%)	5,94,000

The ash management scheme involves collection of fly ash and bottom ash through dewatering bins, supply of ash to entrepreneurs for utilization, promoting ash utilization and safe disposal of unused ash (if any). DVC shall make maximum efforts to utilize the ash for various purposes. Unused fly ash and bottom ash shall be disposed-off through combined ash slurry disposal system in the ash pond, in case of emergency only. A blanket of water shall be maintained over the entire bottom ash pond to control fugitive dust emission. Gypsum generated from FGD system shall also be utilized/ disposed of in an environmentally suitable manner.

Besides, there will be generation of Used / Spent Oil in very small quantity. Used oils removed from machinery, gear boxes, compressors etc. will be collected in drums and temporarily stored in specifically earmarked areas. They will be disposed through the authorised agencies.

Typical Characterization of Fly & Bottom Ash and Slag

Type of ash	Typical Chemistry
Fly Ash	Color – Gray Sp. Gravity – 2.17 Surface Area – 380 m^2/kg Permeability - 2.50 × 10^{-5} cm/sec Silica as SiO_2 – 70% Fe_2O_3 – 7% Al_2O_3+P_2O_5 – 16.5% MgO+CaO – 3% LOI (Unburnt C) – 2% Others – 1.5% Trace Element in mg/kg: Cr : 80 -100 Mn : 60 - 120 Pb : 30 - 60 Zn : 60 - 120 Cu : 60 - 90 Ni : 30 - 60 Co : 10 – 20
Bottom Ash	Color – Blackish Gray Sp. Gravity – 2.25 Surface Area – 330 m^2/kg Permeability - 3.0 × 10^{-5} cm/sec Silica as SiO_2 – 68% Fe_2O_3 – 4.5% Al_2O_3+P_2O_5 – 9% MgO+CaO – 3.5% LOI (Unburnt C) – 11% Others – 4% Trace Element in mg/kg: Cr : 50 -75 Mn : 80 - 150 Pb : 10 - 20 Zn : 30 - 40 Cu : 40 - 50 Ni : 20 - 30 Co : 10 – 12

Ash Utilization Plan

The ash generated from RTPS shall be utilized only for the following eco-friendly purposes, namely

1. Fly ash-based products viz. bricks, blocks, tiles, fibre cement sheets, pipes, boards, panels
2. Cement manufacturing, ready mix concrete
3. Construction of road and fly over embankment, Ash and Geo_x0002_polymer-based construction material

4. Construction of dam
5. Filling up of low-lying area
6. Filling of mine voids
7. Manufacturing of sintered or cold bonded ash aggregate
8. Agriculture in a controlled manner based on soil testing
9. Construction of shoreline protection structures in coastal districts
10. Export of ash to other countries
11. Any other eco-friendly purpose as notified from time to time.

The company shall comply with the stipulations of MOEF&CC's Gazette Notification on fly ash dated 31-12-2021.

Fly ash generated at the thermal power station shall be utilized in the areas of cement, concrete & building products manufacturing, road embankment construction, land development, mine filling, shoreline protection structure, agriculture etc.

	ASH UTILIZATION REPORT						
Financial Year	Coal Consumed (MT)	Ash Content (%)	Ash Generated (MT)	Dry Fly Ash Utilization (MT)	Pond ASH (MT)	Pond Ash Utilization (MT)	% of Ash Utilization
2016-17	1199529.71	36	437206.00	5875	431331.00		1.34
2017-18	1421918.42	36	507773.00	16715	491058.00		3.29
2018-19	1897169.04	42	802385.00	78320	724065.00		9.76
2019-20	3101799.23	44.85	1396894.35	175910	1220984.35		12.59
2020-21	3167467.29	43.93	1397587.78	193534.18	1204053.60		13.85
2021-22	3737731.59	46.17	1824469.29	123146.69	1701322.60		6.75
2022-2023 (up to January 23)	2886223.542		1399003.19	60125.242	1150292.01	188585.94	17.78

For the Financial year 2022-23
Utilization Dry Fly Ash (DFA) from April 2022 to January 2023 is 60125.242 MT
Utilization Pond Ash from April 2022 to January 2023 is 188585.94 MT
Utilization of Dry Fly Ash(DFA) of Quantity of 3 lac MT from SILO will be start from 17/08/2022.
Utilization of Dry Fly Ash(DFA) of Quantity of 2.30 lac MT from ESP Hopper by bagging will be started shortly. LOA issued to the agency M/s. Ash Tech Pvt.L td on 24/05/2022. Process for site clearance is under process.
Less Utilization of DFA as following reason
1. Due to technical problem for transportation in Silo
2. Less demand in this area only one cement plant nearer to RTPS. Other agencies less demand due to transportation cost is high.
3. Technical constraint in ESP Hopper for collection of ash and transportation in Silo.
Pond ash Evacuation is less due to following reason
1. Geographical position of RTPS also local issue arise during transportation of pond ash movement.
2. All the mines void are situated in Paschim Bardhaman district. No entry imposed in day time by district Administration due to road congestion.

Ash Pond

Land of 507.480 acres (205.37 Ha.) for the existing Ash disposal system in RTPS (ph-1) comprising of Ash pond, ash pipeline corridor, green belt etc. will be utilised for RTPS (Ph-2, 2 x 660 MW) also. As per DVC, the capacity of existing ash dyke has been considered including Ph-II also.

The ash dyke is about 3 Km from Plant premises.

Details of the ash pond, its life span, height, legacy ash, ash utilisation for last 5 years with its transportation details:

Design capacity Ash Pond no. 1	68.42 LMT
Design capacity Ash Pond no. 2	47.76 LMT
Bulk density of ash	1.09
Height of ash Pond at Decantation well	17.25 Mtrs
Legacy Ash up to FY 2021-22	57.72 LMT
Evacuation from ash Pond (till Jan, 2023)	
Present Legacy	55.94 LMT

ASH POND DETAILS

MIS (for Thermal Power Station)				
Report of Raghunathpur TPS for the month of 19th January,2023				
S.No.	**Parameters**	**Internal MOU Target,if any**	**Cumulative FY 22-23**	**Brief remarks/explanations, if any**
1	Pond Ash Utilization (%)	i. MOU with NHAI for lifting of 2.50 LMT of pool ash ii. MOU with ECL for lifting 11.09 LMT of pool ash iii. MOU with NHAI PIU Durgapur dated 26.08.2022 for lifting of 3.96 LMT of Pond Ash	178435.70 MT	Stock of the beginning of month : 66,21,920.00 MT Generation during the month : 49565.79 MT Utilised during the month : 211165.79 MT Stock at the end of month : 66,50,320.00 MT

Name of Agency	Monthly Evacuation of Ash Pond in (MT)									Total Quantity
	May	June	July	August	September	October	November	December	January	
M/S UNITED COAL CARRIERS	21.2.09	225.36	20271.91	820.80	2609.084	10251.99	24143.390	12519.860	7775.390	80719.87
OM SHARDA LOGISTICS PVT.LTD	169.58	46.60	13865.66	319.06	1154.380	6029.430	13601.510	7544.390	8050.080	50780.69
SHARMA TRANSPORT AGENCY	36.71	0.00	4723.17	362.86	37.030	28.790	0.000	0.000	0.000	5188.56
BKB TRANSPORT PVT.LTD	0.00	0.00	8254.25	305.29	1203.000	5757.850	13296.890	7588.980	5340.320	41746.58
	2308.38	271.96	47114.99	1808.01	5003.49	22068.06	51041.79	27653.23	21165.79	178435.7

Height of Ash Pond at Decantation Well = 17.25 m (According to Drawing)

ASH POND DETAILS

DAILY INSPECTION REPORT OF RUNNING ASH PONDS

Name of TPS - Raghunathpur Thermal Power Station, DVC **Date : 20.01.2023**

Sl. No.		Pond No 1 Designed capacity 62.77 L cum 68.42 L MT		Pond No 2 Designed capacity 46.32 L cum Available capacity 43.82 L cum 47.76 L MT (As over 1.48 L Sq m area earth of avg depth 1.5 m had not been excavated due to resistance of villagers.)	
1	Approx available ash holding capacity	Available capacity			
		In L cum	In L MT	In L cum	In L MT
		20.7685	22.6377	24.8065	27.0391
2	Minimum available free board (In mt)	Not yet reach		Not yet reach	
3	No. Of locations where dyke is in critical condition due to rain cuts/rat holes etc.	No		No	
4	Persistence of any alarming seepage or percolation	No		No	
5	Condition of Decantation well or overflow pipes	Good		Good	
6	Condition of ash water recovery pump house	Good		Good	

Over all assessment of health of pond - Good

Note : Considering Bulk Density of Ash 1.09

ASH UTILIZATION REPORT

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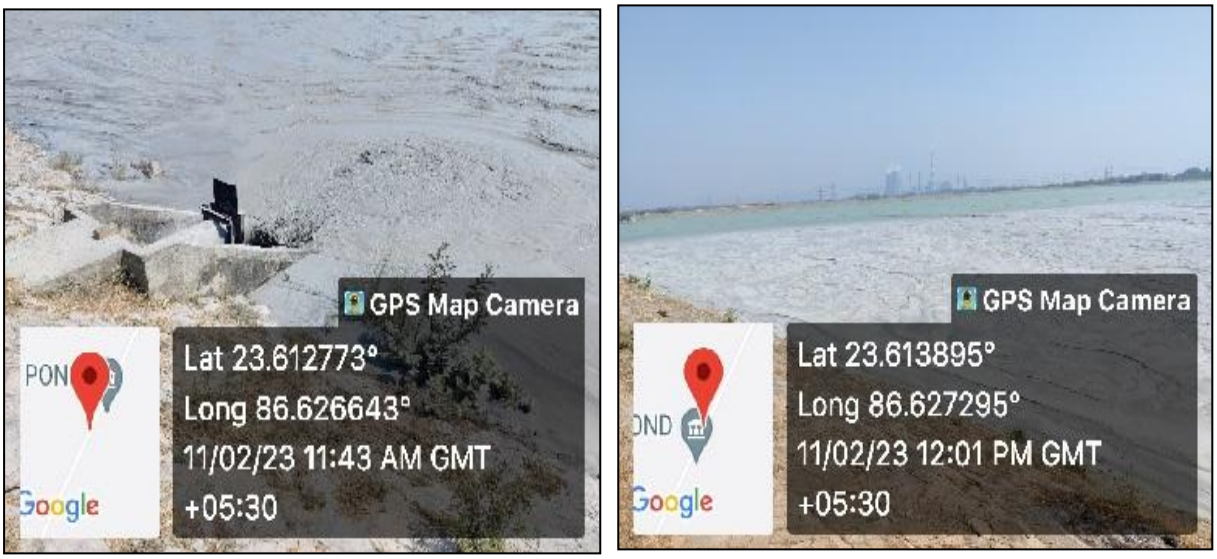


Existing Ash Pond

Hazardous Waste

Resin, Transformer Oil, Glass wood like hazardous wastes are envisaged in Raghunathpur Thermal Power Plant.

Present Status

Sl. No.	Hazardous Waste	Generation	Management
1	Resin	0.280 MT (till 2022)	disposed to West Bengal Waste Management Limited.
2	Transformer Oil	1400 Litre (till 2022)	Auction will be done
3	Glass wood (collected during over hauling of Unit#1)	Tested and its disposal under process.	

HAZARDOUS WASTE GENERATION AND STORAGE FACILITIES

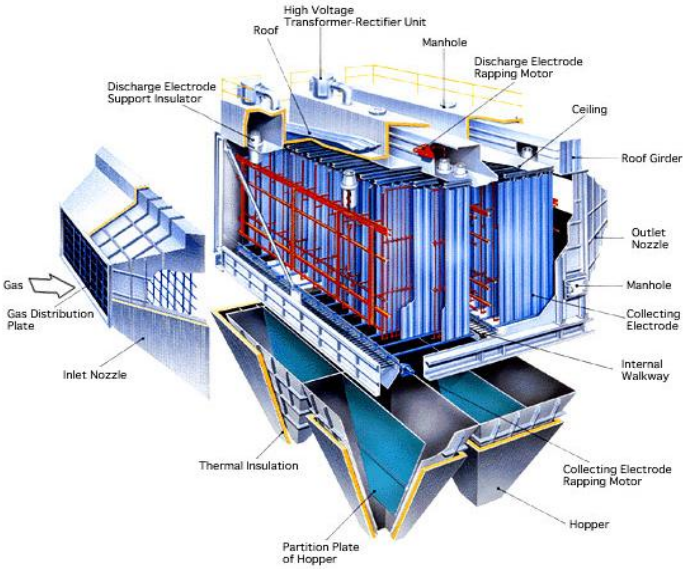
2.13 POLLUTION CONTROL MEASURES

Raghunathpur Thermal Power Station (RTPS), Ph-I (2x600 MW) was accorded environmental clearance on 18.10.2007 and the project is under commercial operation. Expansion of the project by installing additional two units of 660 MW within the same premises (land acquired under Ph-I) is environmentally compatible, as the site conforms to the environmental guidelines for sitting of thermal power projects of Ministry of Environment, Forests & Climate Change (MOEF&CC). As many of the activities related to development of site and establishment of infrastructure has already been taken up under Ph-I, the impact due to construction of RTPS, Ph-II will be less as compared to construction at green field site.

Electrostatic Precipitators:

High efficiency Electrostatic precipitators (ESP) would be installed to control the emission of ash particles. The precipitators would be designed to limit the particulate emission to 30 mg/Nm^3. To facilitate wider dispersion of emissions, a chimney of suitable height as MOEF&CC notification dated 28.06.2018 will be constructed. The chimney would be provided with personal access for regular monitoring of stack emissions.

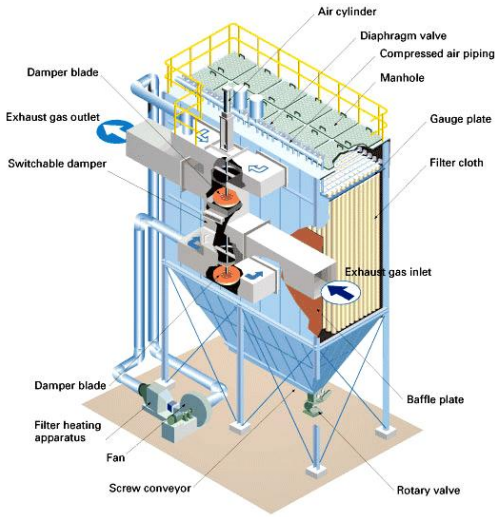
For the control of fugitive dust emission within and around the coal handling plant, coal dust extraction and suppression systems would be provided. Dust suppression system would be installed at all requisite points in CHP and coal stack yard.



CROSS SECTIONAL VIEW OF ELECTROSTATIC PRECIPITATOR (ESP)

Sources	Mitigation Measures
Unloading of Raw Material	Sprinkler / Dry Fog Dust Suppression System
Raw Material Handling System for Power Plant	Bag Filter / Dry Fog Dust Suppression System
Boiler Flue Gases	Electrostatic Precipitator (ESP)
Ash Handling Area	Fixed and Mobile water Sprinkler

With the implementation of all the above control measures, the gaseous emissions shall be contained within the acceptable limits, thus ensuring the full compliance to National Ambient Air Quality Emission Standards issued by the Ministry vide G.S.R. No. 826(E) dated 16th November, 2009.



CROSS SECTIONAL VIEW OF BAG FILTER

DRY FOG DUST SUPPRESSION SYSTEM

Flue Gas Desulphurization System (FGD):

Wet limestone-based flue gas desulphurization (FGD) system shall be installed at the tail end of the steam generator downstream of the ESP, in which SO_2 gas shall be captured in limestone slurry to produce gypsum.

The FGD System shall be provided with bypass system. Necessary auxiliary equipment and systems like cyclones, vacuum filters, belt conveyors, pumps, storage vessels for different liquids, piping and fittings, zero liquid discharge (ZLD) etc. shall complete the FGD plant.

NO_X Control System:

NO_x emission from the steam generator shall be controlled by employing low NO_x burners (LNB), combustion staging and reducing NO_x in the tail flue gas. Suitable technology, taking into consideration the boiler furnace conditions and high ash Indian coals, for reduction of NO_x to N2 using either SNCR (selective non catalytic reduction) or SCR (selective catalytic reduction) technology as applicable shall be employed.

Control of Fugitive Emissions at various auxiliary facilities inside the plant:

Fugitive emissions from various auxiliary facilities would be significant as there will be air pollution due to activities like material handling and transfer points of materials and movement of vehicles. These operations generate large quantity of dust. Specific instances of fugitive dust generation may include dust blown by wind from the raw-materials stockpile, dust caused by vehicular traffic within the factory, dust leakage from conveyors, conveyor transport points, storage hoppers and packers etc. Control measures like good housekeeping, proper maintenance, wetting of dusty areas, use of enclosed storage wherever feasible etc., would considerably reduce fugitive dust.

For the purpose of effective prevention and control of fugitive emissions, following efforts are made and the same practice shall be followed after the implementation of the overall project:

- Storage area is clearly earmarked.
- Enclosure is provided for all the loading & unloading operations, if possible.
- All transfer points are fully enclosed.
- Airborne dust shall be controlled by sprinkling of water.
- All roads are paved on which movement of raw materials or products will takes place.
- Mobile vacuum cleaners shall be used to regularly clean the roads. Besides, fixed vacuum cleaners shall be used to regularly clean the plant floor areas, roof top etc.
- Leak proof trucks/dumpers shall be used for carrying coal and other raw materials and they shall be covered with tarpaulin.
- Wind shelter fence and chemical spraying shall be provided on the raw material stock piles.
- Preventive measures are employed to minimize dust build up on road.
- Conveyors are provided with conveyor cover.
- Maintenance of air pollution control equipment is done regularly.
- All the workers are provided with disposable dust mask.
- Green belt is being developed around the plant to arrest the fugitive emissions.
- Regular training is given to the personnel operating and maintaining fugitive emission control system.
- Tyre washing facilities shall be provided at the entrance of the plant gates.

The fugitive emission will be monitored at following locations within plant area as per CPCB guidelines.

With the implementation of all the above control measures, the gaseous emissions shall be contained within the acceptable limits, thus ensuring the full compliance to National Ambient Air Quality Emission Standards issued by the Ministry vide G.S.R. No. 826(E) dated 16th November, 2009.

Water Pollution Control System

Make up water requirement for this project would be about 3960 M^3/hr (approx. 40 Cusec). An effluent management scheme would be implemented with the objective of optimization of various water systems so

as to reduce intake water requirement which would result in zero waste water discharge.

The effluent management scheme would essentially involve collection, treatment and recirculation/ disposal of various effluents. Adequate treatment facilities would be provided to all the waste streams emanating from the power plant to control water pollution. This would include physico-chemical and biological treatment for other effluents as follows:

- The filter backwash water of PT Plant shall be collected and recycled back to the respective system clarifier.

- The sludge from clarifiers of PT plants shall be collected in a sump/pit and shall be pumped to bottom ash slurry tank for disposal to ash dyke.

- The waste effluents from neutralization pits of DM plant and Condensate Polishing Plant shall be collected in the respective neutralization pits and neutralized before pumping to bottom ash slurry tank before final disposal.

- Coal settling system and clarifier system for coal settling area shall be provided to remove coal particles from coal handling plant waste. Decanted water shall be pumped back to the coal dust suppression system. To receive & treat excess storm water (considering rainstorm condition), Clarifier feed pumps, reactor clarifiers, belt filter press, Clarified Water Transfer Pumps and required chemical storage & dosing system shall also be provided.

- Service water effluent drains from various areas shall be separately routed to a sump. From the sump the service water shall be pumped up to lamella clarifier / tube settler for treatment of suspended solids. Treated service water shall be sent back to service water tank for reuse through CMB cum treated water tank.

The main sources have identified which are responsible to generate wastewater are as follows:

- Underflow from Raw Water Clariflocculator
- Backwash Waste from Filtration Plant
- Run-off water from Raw Material Storage Yards
- Cooling Tower & Boiler Blow-down
- Domestic wastewater

Sludge from Raw Water Clariflocculator and Backwash from Filtration Plant will be led to a thickener for removing suspended solids. The

overflow from the thickener will be reused in the plant water system. The Sludge from the thickener will be dried and dumped.

Cooling Tower & Boiler Blow-down from various recirculation systems will be cascaded for reuse in Ash Handling, gardening and dust suppression as shown in water balance diagram.

Efforts will be made to harvest rainwater in the plant. Run-off water from the office areas, shop roofs will be collected and stored for future use. The plant will be designed as a zero discharge plant as far as the process effluents are concerned. The water will be recirculated through cooling and treatment. No plant effluent will be discharged outside the plant premises. The entire waste water will be recycled for various purposes inside the plant.

Domestic effluent from the various buildings / sheds of the plant will be conveyed through STP.

Suitable waste water management facilities will be provided for the proposed expansion project. Proposed Industrial waste as well as Domestic Waste water management systems for the proposed activities are appended below in **Table-2.6:**

Table-2.6

List of Water Pollution Control Systems

Source	Pollutants	Control System
Raw Water Treatment Plant (softening through ion exchange)	Treatment through ion exchange	Ion exchanger maintained by the supply agency.
Cooling Tower & Boiler Blow down	Temperature, Dissolved Solids, Free Cl and TSS	Used in the plant area for Gardening/ Dust suppression.
DM Water Plant	pH	After Neutralizing Pit, the treated waste water will be used in non-critical purposes within the plant premises.
Canteens, Toilets	BOD, O&G, TSS/TDS.	Sewage Treatment Plant (STP). Treated waste water will be used for gardening purpose.

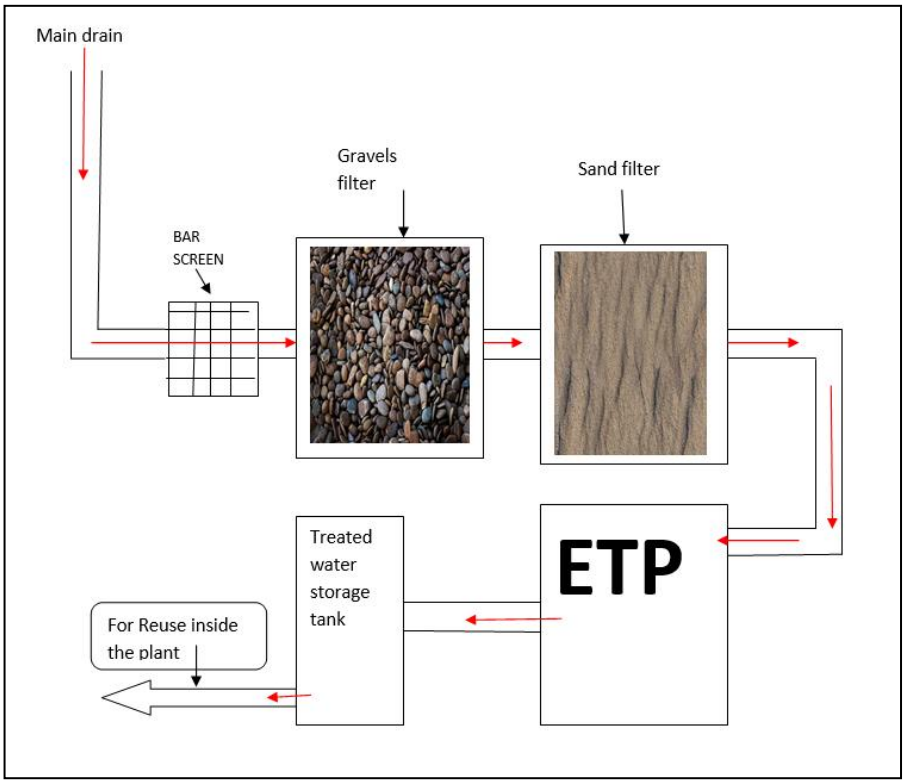


FIGURE-2.6 SETTLING TANK

Sewage Treatment Plant (STP)

Sewage from the various building in the plant will be routed through sewage treatment plant (STP) and treated wastewater will be used for green belt development within the premises.

A network of underground sewerage system shall be provided in the plant area collecting sanitary waste from all buildings having toilet facilities. Sewage Treatment Plant shall be provided and shall have sufficient capacity to cater for the discharge of plant. CI pipes shall be used for catch pipes and RCC concrete pipes shall be used for trunk sewage disposal pipes. However, CI pressure pipes shall be used for disposal under pressure.

Sewage treatment plant (STP) based on SBR technology is proposed to be set-up in the proposed project. A well-designed sewer network will collect wastewater from different sections of the plant area. The sewer network will convey the wastewater into the STP.

STP Details

The proposed STP will be designed for treatment of raw sewage during

operation phase to maintain the desired quality of treated wastewater. The expected characteristics of raw sewage are as follows:

Sr. No.	Parameter	Concentration
1.	pH	6.5 – 8.5
2.	Suspended solids	200 – 250 mg/l
3.	BOD	250 – 300 mg/l

The expected characteristics of the treated sewage on adopting the scheme of treatment are as follows:

Sr. No.	Parameter	Concentration
1.	pH	6.5 – 8.0
2.	BOD	<5 mg/l
3.	TSS	<10 mg/l

FIGURE-2.7 Existing STP at RTPS (Ph - I)

2.14 RAIN WATER HARVESTING

Rainwater harvesting system will be planned as per feasibility and requirement during detailed design and engineering stage. All the buildings shall be designed to take care of Rainwater harvesting & Ground water recharging.

FIGURE-2.8 Existing Rain Water Harvesting Pond at RTPS (Ph - I)

2.17 STORM WATER MANAGEMENT

The effectiveness of the drainage system depends on proper cleaning of all drainage pipes/channels. Regular checking will be done to see that none of the drains are clogged due to accumulation of sludge/sediments. The clogged drains will be cleaned as soon as possible, preferably the same day. The catch-pits linked to the storm water drainage system from the raw material handling areas will be regularly checked and cleaned to ensure their effectiveness. This checking and cleaning will be rigorous during the monsoon season, especially at the time of heavy rains forecast.

2.18 LAND & GREENBELT DEVELOPMENT

Considering the need of open space for fire fighting and safety requirement, greenbelt has been planned along the periphery in addition to small patches of green area in the unutilized open space, roadside tree plantation and grass lawns. The peripheral green belt varies in width to suit the plant design requirement. The greenery is shown in the plant layout (**Figure-2.3**).

The entire plant area (Phase - I & Phase - II) will be 840.50 Hectares (2077 Acres)

M/s Damodar Valley Corporation has earmarked earmarked for green belt development 222.97 Hectares (551 Actes.) i.e. 33% of 840.5 hactares / 2077 acres for its thremal power plant located at Raghunathpur.

Out of which 80.93 hectares (200 acres) of greenbelt has already been developed all around the plant boundary area within the plant premises where around 141951 number trees (@1754 number trees per hectare) have been planted. As per guidelines of MoEFCC, green belt density shall be 2,500 trees per hectare. Therefore, to make-up the existing short fall (2500 - 1754 = 746), DVC will carry out additional plantation on existing 80.93 hectares green belt area @ 746 number of trees per hectare.

Therefore, proposed green belt will be as follows:

1. 3,55,100 number trees on 142.04 Hectares (@2500 number of trees per hectare) plus
2. 60,374 number tress on 80.93 hectares (@746 number of trees per hectare)

Hence, 557425 number of trees will be planted in total for Stage - II project.

TOTAL LAND FOR GREEN BELT	GREEN BELT AREA		NUMBER OF TREES		TOTAL
	EXISTING	PROPOSED	EXISTING	PROPOSED	
222.97 Hectares (551 acres) of land (33% of 840.5 hactares / 2077 acres)	80.93 hectares (200 acres)	142.04 Hectares (351 acres)	1,41,951 Trees on 80.93 Ha. **[@1754 trees per hectare]**	3,55,100 (@2500 number of trees per hectare for 142.04 hectares)	**557,425** (1,41,951 + 60,374 + 3,55,100) number of trees on 222.97 Ha i.e. (@2500 number trees per hectare
				Plus Balance 60,374 trees on 80.93 Ha @746 number of trees per hectare.	

2.20 PROJECT COST

DESCRIPTION	COST
Total Capital Cost of the Project	Rs. 11554.29 Crores
Total Capital Cost for Environmental Pollution Control Measures	Rs. 880 Crores
Recurring Cost / annum for Environmental Pollution Control Measures	Rs. 84 Crores

2.21 SUSTAINABLE DEVELOPMENT MECHANISM (SDM)

Kyoto Protocol of United Nations Framework Convention on Climate Change (UNFCCC) has come into force from February 2005. Clean Development Mechanism (CDM) contained in Article 12 of the protocol allows governments or private entities in the industrialized countries to implement and / or purchase emission reduction from projects in developing countries and receive credit in the form of "Certified Emission Reductions" (CERs). With the completion of tenure for second commitment period on 31 December 2020, Kyoto Protocol/CDM is no more valid at present.

In the meanwhile, The Paris Agreement, second legally binding international treaty on climate change was adopted at COP 21 in Paris on 12 December 2015 and entered into force on 4 November 2016. The agreement brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects by reaching global peaking of greenhouse gas emissions as soon as possible to achieve a climate neutral world by mid-century. The Paris Agreement works on a 5-year cycle of increasingly ambitious climate action carried out by countries. Countries submit their plans for climate action known as nationally determined contributions (NDCs), in which they communicate actions they will take to reduce their Greenhouse Gas emissions in order to reach the goals of the Paris Agreement.

Article 6 of Paris Agreement provides following mechanisms to all countries to achieve efficiency gains by taking advantage of their differing marginal costs of abatement and thereby potentially facilitate enhanced ambition.

Article 6.4: A new international carbon mechanism is envisaged functioning under the authority and guidance of an international body, such as the UNFCCC, for the trading of emissions reductions created anywhere in the world by the public or private sector. This new market is sometimes referred to as the "Sustainable Development Mechanism" (SDM). It would replace the Clean Development Mechanism (CDM).

Article 6.2: A basis for countries to engage in various modes of joint market cooperation, including mechanisms such as bilateral/ multilateral crediting mechanisms (at project, program, or policy levels) or linking of existing domestic climate policy instruments under bilateral or multilateral agreements. It will allow a country that has beaten its Paris climate pledge to sell any overachievement to a nation that has fallen short against its own goals. It could be in terms of emissions as well as other types of targets, such as renewable energy capacity or forest expansion.

In this regard, it is to be mentioned that at present article 6.0 of Paris agreement is being finalized /negotiated & is likely to be operational by 2023.

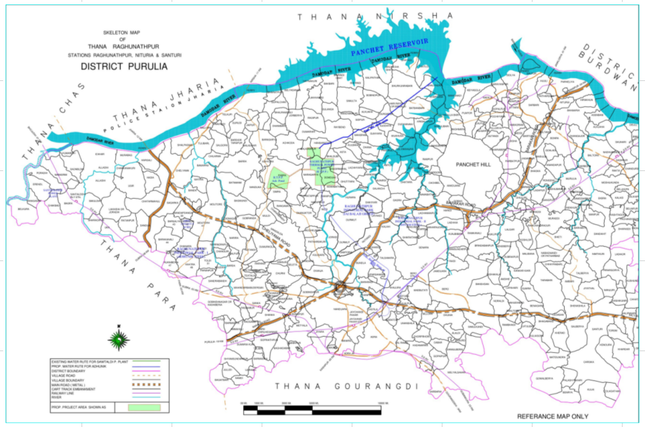
Sustainable Development Mechanism (SDM) under article 6.4 or Bilateral/ Multilateral crediting mechanisms under article 6.2 provides an opportunity to earn revenue through the reduction of greenhouse gas emissions (GHG). The revenue will play an important role as it will further ameliorate the project IRR.

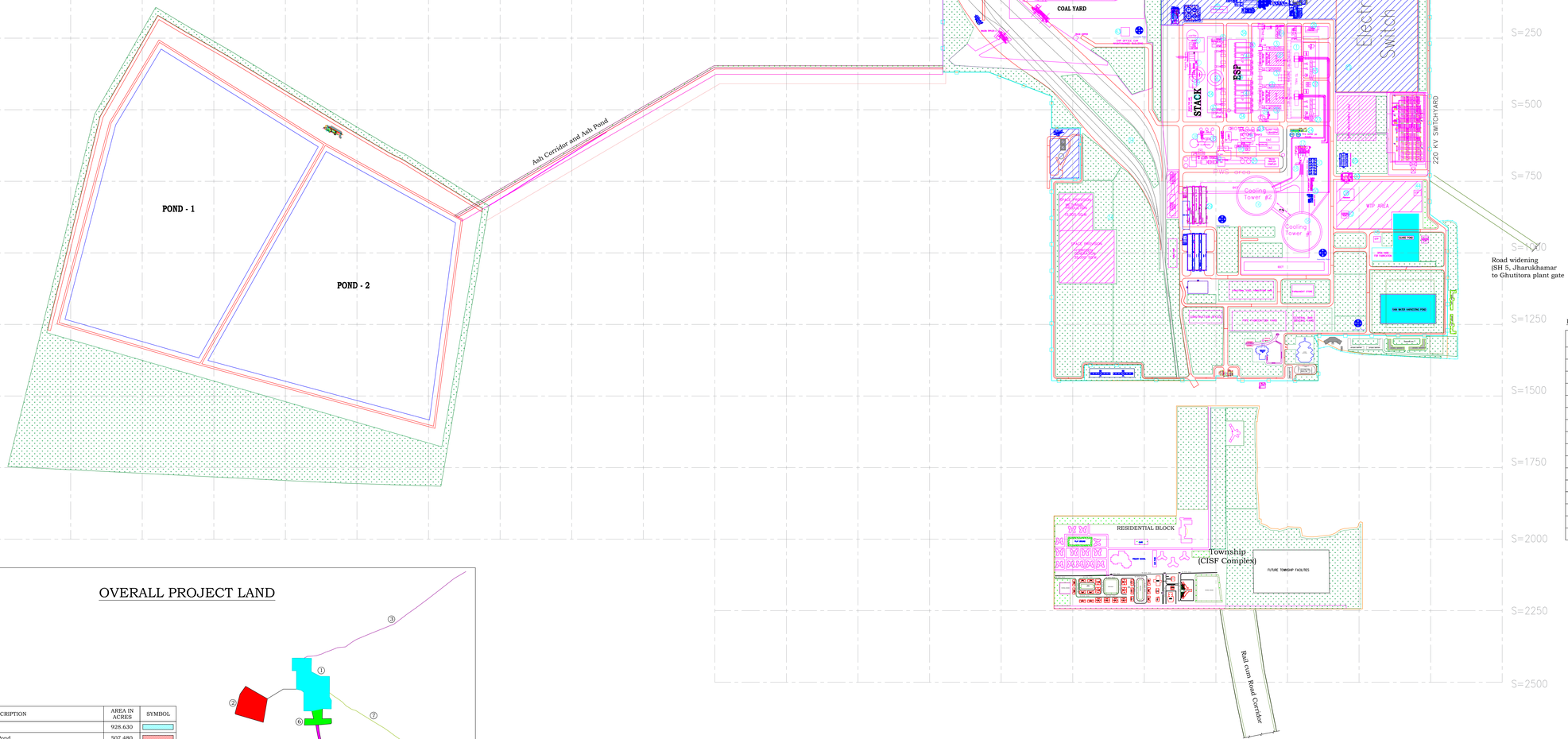
Accordingly, SDM benefits under article 6.4 or Bilateral/ Multilateral crediting mechanisms under article 6.2 are proposed to be availed in this project to improve the Project IRR, whenever these will be operationalized.

2.22 CONCLUSION

The land requirement for RTPS phase – 2 will be 150 acres, which is available within the existing project area of 840.53 Hectares (2077 acres), which is already acquired.

After the implementation of the proposed project, the overall plant operation will be based on Zero Liquid Discharge concept. With implementation of proper Air Pollution Control measures in connection with the proposed expansion of Thermal Power Plant, the plant will achieve more stringent norms. DVC has been .endeavoring to adopt best practices in the area of solid & Hazardous Waste management, which will continue with the implementation of the proposed project. Fly ash will be 100% utilised for cement making / brick making. The company has proposed an exhaustive rainwater harvesting scheme to harvest rainwater.





LEGEND

1. STG BUILDING (02 UNITS)
2. BOILER
3. MILL BAY (SIDE)
4. ELECTROSTATIC PRECIPITATOR
5. E.S.P.CONTROL ROOM
6. TWIN FLUE CHIMNEY
7. COMBINED ASH WATER & ASH SLURRY PP HOUSE WITH COMPRESSOR HOUSE
8. ASH WATER CLARIFIER AND CHEMICAL HOUSE
9. ASH SLURRY SWITCHGEAR AND XFMR
10. CW TREATMENT & CHLORINATION PLANT
11. ASH SILO
12. EXISTING ASH POND
13. TRANSFORMER YARD
14. SWITCH YARD – STAGE–I (EXISTING)
15. SWITCH YARD – STAGE–II (PROPOSED)
16. NATURAL DRAFT COOLING TOWER
17. CW. PUMP HOUSE
18. ACW PUMP HOUSE
19. FUEL OIL DYKE
20. SIDE STREAM FILTER
21. EXISTING FUEL OIL UNLOADING PUMP HOUSE
22. F.A.E TOWER WITH VACUUM PUMPS
23. SILO UTILITY BLDG.
24. FIRE WATER PUMP HOUSE
25. SEWAGE TREATMENT PLANT (EXISTING)
26. COMPRESSED AIR BLDG.
27. DG BLDG.
28. WORKSHOP BLDG.
29. PERMANENT STORE BLDG.
30. CANTEEN
31. FUEL OIL PRESSURING PUMP HOUSE
32. SPACE FOR LIME STORAGE AND F.G.D.
33. CPU UNITS
34. PIPE/RACK
35. SERVICE/MAINTENANCE BLDG.
36. EXISTING GATE
37. DM WATER STORAGE TANKS
38. CLARIFIER
39. CHEMICAL HOUSE
40. DM PLANT (Proposed)
41. PRE TREATMENT PLANT & FW PP HOUSE
42. HYDROZEN GENERATION PLANT
43. CHP OFFICE CUM MAINTANANCE BUILDING.
44. ETP (Proposed)
45. STP (Proposed)

LAND USE:-

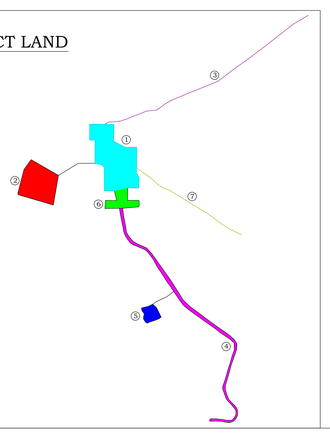
SL.NO.	DESCRIPTION	EXISTING UNIT	PROPOSED UNIT
		AREA IN ACRES	
1	Main Power House (Boiler+TG+ESP+FANS+MILLS)	90	90
2	Coal Handling Plant	100	
3	Switch Yard	45	45
4	Lime Storage & FGD etc.	15	15
5	Ash Disposal Area	300	
6	Township (CISF Complex)	72	
7	In Plant Water Reservoir, Cooling Tower etc.	250	
8	Water Corridor	33	
9	Corridor between ash pond and plant	22	
10	Rail cum Road Corridor	340	
11	Township (including Approch Road) for Employee	70	
12	Road Widening (SH5, Jharukhamar Ghutitora plant Gate)	19	
13	Plant area approach Road & Free space	20	
14	Greenbelt	551	
	TOTAL LAND	2077	

GREENBELT LOCATION AND AREA

SL.NO.	DESCRIPTION	AREA IN ACRES
1	Main Plant area	277
2	Ash Pond with pipe corridor area	180
3	Township (near CISF Complex) area	48
4	Township (Employee) area	33
5	Rail cum Road corridor area	13
	TOTAL AREA	551

TOTAL LAND 2077 ACRE

OVERALL PROJECT LAND



LAND DETAILS

SL.NO.	DESCRIPTION	AREA IN ACRES	SYMBOL
1	Main Plant	928.630	
2	Ash Corridor and Ash Pond	507.480	
3	Water Corridor	53.268	
4	Rail cum Road Corridor	363.368	
5	Township (Employee)	100.000	
6	Township (CISF Complex)	105.184	
7	Road widening (SH 5, Jharukhamar to Ghutitora plant gate	19.070	
	TOTAL LAND	2077	

NOTES
1) ALL DIMENSIONS ARE IN MM.
2) ALL GRID SPACING ARE @ 250.0 METERS BOTHWAYS.
3) ASSEMBLY POINT

SCALE- 1 : 6000

Drawn by	Checked by - date	Approved by - date	Filename	Date	Page
Partha Bag	Mr. Subhajit Dutt	Mr. Rakesh Ranjan Pandey		15.02.2023	A0

DAMODAR VALLEY CORPORATION
RAGHUNATHPUR THERMAL POWER PROJECT
PH-I & PH-II

PROPOSED EXPANSION OF EXISTING POWER PLANT

DVC/LAYOUT/01 | REV. 1 | Sheet 1 OF 2

CHAPTER-3.0
DESCRIPTION OF THE ENVIRONMENT

3.1 GENERAL DESCRIPTION

3.1.1 INTRODUCTION

M/s. Damodar Valley Corporation has already an operational Thermal Power Station (RTPS) located at village Raghunathpur of Purulia district of West Bengal, having total installed capacity of 1200 MW (2x600 MW) under Phase -1. Damodar Valley Corporation (DVC) intends to expand the capacity of Raghunathpur TPS by setting up additional two units of 660 MW each (2x660 MW) based on Supercritical technology under Raghunathpur TPS Ph-II. The expansion project to be accommodated within the land available with Raghunathpur TPS premises.

The geographical co-ordinates of the project area is Latitude 23°36'6.90"N to 23°37'59.54"N and Longitude 86°38'51.12"E to 86°40'5.07"E with above mean sea level (AMSL) as 30 m. (98.43 ft).

The four points on the boundary of the project site are as follows:

1. Latitude - 23°37'28.76"N & Longitude - 86°40'0.87"E (TRC)
2. Latitude - 23°37'59.54 N & Longitude - 86°38'51.12" E (TLC)
3. Latitude - 23°36'6.90"N & Longitude - 86°39'13.82"E (BLC)
4. Latitude - 22°36'8.71"N & Longitude - 86°40'5.07"E (BRC)

(Where, T: Top, B: Bottom, L: Left, R: Right, C: Corner, M: Middle)

The four points on the boundary of the ash pond are as follows:

1. Latitude - 23°37'28.76"N & Longitude - 86°40'0.87"E (TRC)
2. Latitude - 23°37'12.74” N & Longitude - 86°37'22.83" E (TLC)
3. Latitude - 23°36'25.18"N & Longitude - 86°37'3.97"E (BLC)
4. Latitude - 23°36'11.23"N & Longitude - 86°37'56.92"E (BRC)

(Where, T: Top, B: Bottom, L: Left, R: Right, C: Corner, M: Middle)

The geographical co-ordinates of the ash pond is Latitude 23°36'11.23"N to 23°37'12.74"N and Longitude 86°37'3.97"E to 86°38'4.73"E.

Google Map of the project site location & its surroundings is shown in **Figure-3.1.1** and the Toposheet Map, showing the project site and its surrounding is presented in **Figure-3.1.2**.

3.1.2 TRANSPORTATION & SURROUNDINGS

Raghunathpur Thermal Power Station (RTPS) is located in Raghunathpur Sub-Division of Purulia District of West Bengal. The Project is located at 38 Km from District Head Quarters Purulia and is well connected by Purulia-Barakar State Highway SH-5. Nearest National Highway NH-19, which was previously referred to Delhi–Kolkata Road is about 44 Km from the Site.

Nearest town is Raghunathpur located at a distance of 7 Km from the project. The nearest Railway Station Bero on Adra-Asansol Broad Gauge line of South-Eastern Railway is located at 20 Km.

3.1.3 COVERAGE OF THE STUDY AREA

The EIA is aimed for determining the environmental impacts on the "Study Area", which encompasses all areas falling within a radius of 10 Kms around the project site. There are no eco-sensitive areas like National Park/ Wildlife Sanctuary/ Bird Sanctuary etc. within 10 km radius around the proposed project site. The 10 Km radius study area around the project site on Google map and Toposheet Map has been presented in **Figure-3.1.1** and **Figure-3.1.2**.

The major environmental disciplines studied in this EIA report include soil, land use, meteorology, air quality, surface and ground water quality, noise, ecology, demography and socio-economics.

The following chapter present the detailed discussion on the field data, generated for soil, meteorology, air quality, water quality, noise, ecology and socio-economics during three months' period **(1st December, 2022 – 28th February, 2023)** along with the relevant secondary data, collected from various agencies on the relevant disciplines.

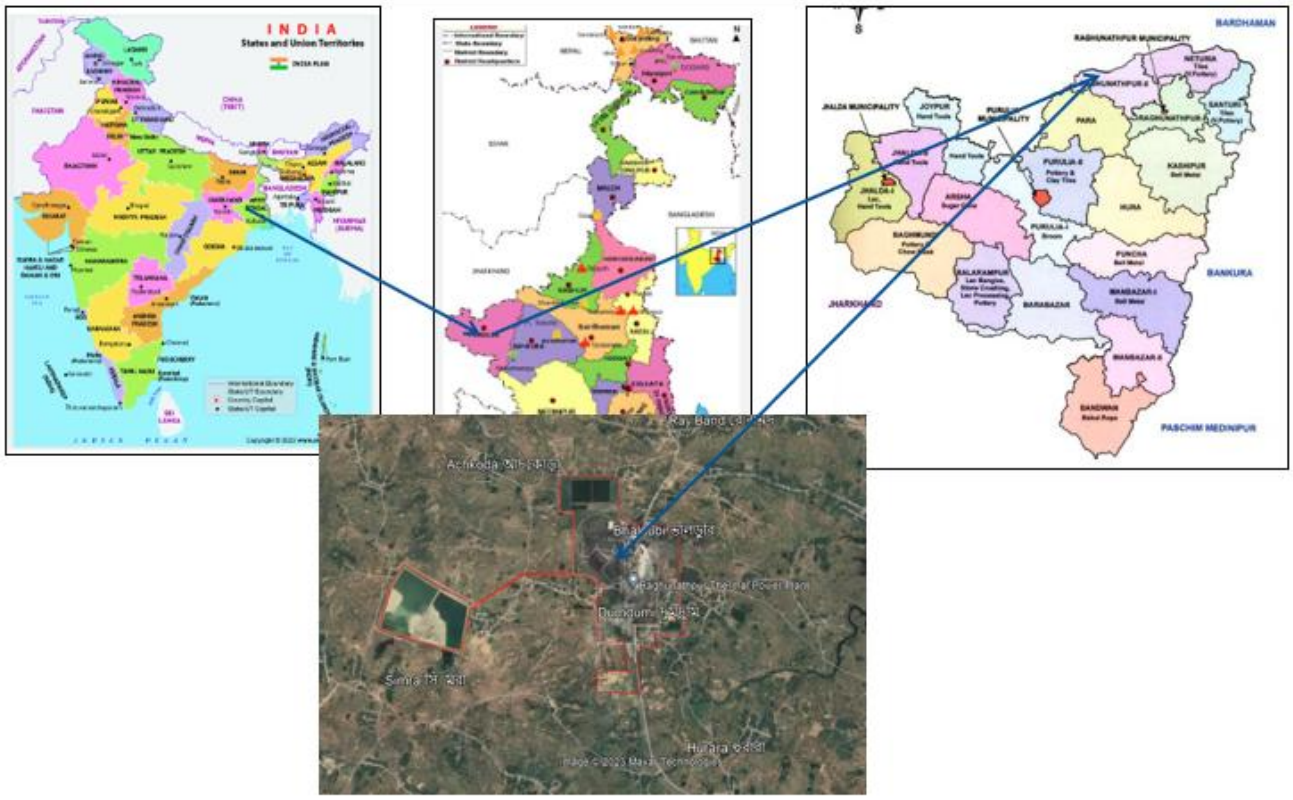


FIGURE-3.1.1: GOOGLE MAP PROJECT SITE & ITS SURROUNDING AREA
Project Site Location:
Village - Raghunathpur, District – Purula
Geographical co-ordinates: Latitude: 23°36'5.53"N to 23°37'59.06"N
& Longitude: 86°38'51.38"E to 86°40'2.18"E (for project site)
Latitude 23°36'11.23"N to 23°37'12.74"N and Longitude 86°37'3.97"E to 86°38'4.73"E (for ash pond)

Above Mean Sea Level (AMSL): 511.8 ft (156 m)

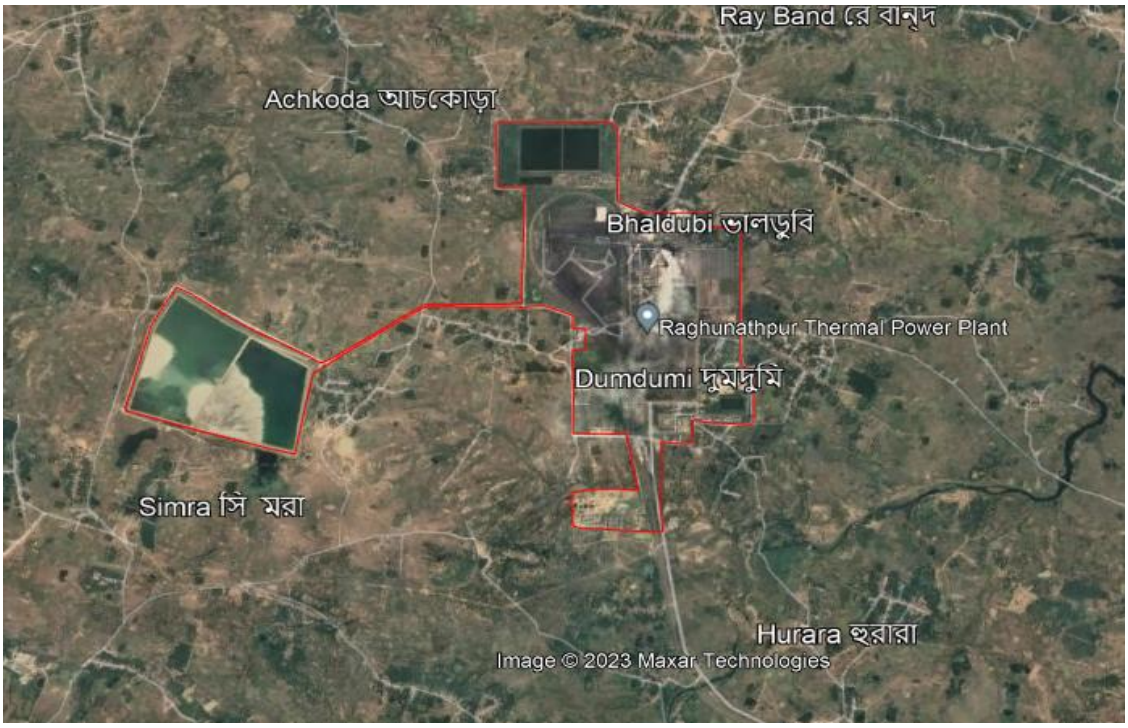


FIGURE-3.1.2: GOOGLE MAP PROJECT SITE & ITS SURROUNDING AREA
Project Site Location:
Village - Raghunathpur, District – Purulla
Geographical co-ordinates: Latitude: 23°36'5.53"N to 23°37'59.06"N & Longitude: 86°38'51.38"E to 86°40'2.18"E (for project site)
Latitude 23°36'11.23"N to 23°37'12.74"N and Longitude 86°37'3.97"E to 86°38'4.73"E (for ash pond)

Above Mean Sea Level (AMSL): 511.8 ft (156 m)

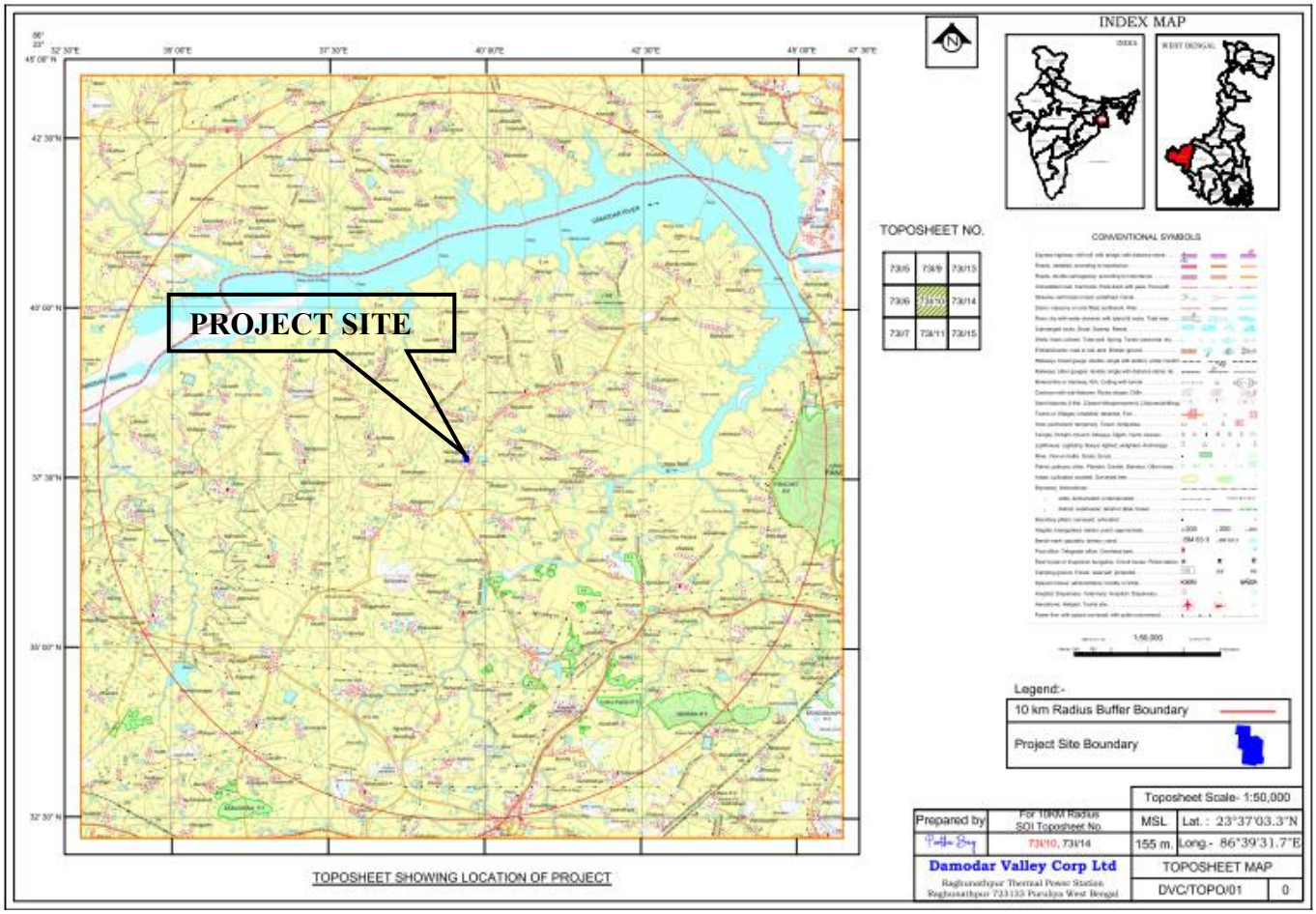


FIGURE-3.1.3 : TOPOSHEET MAP
PROJECT SITE & ITS SURROUNDING AREA
(TOPOSHEET NO 73N/7 & 73N/8), Scale 1;50,000

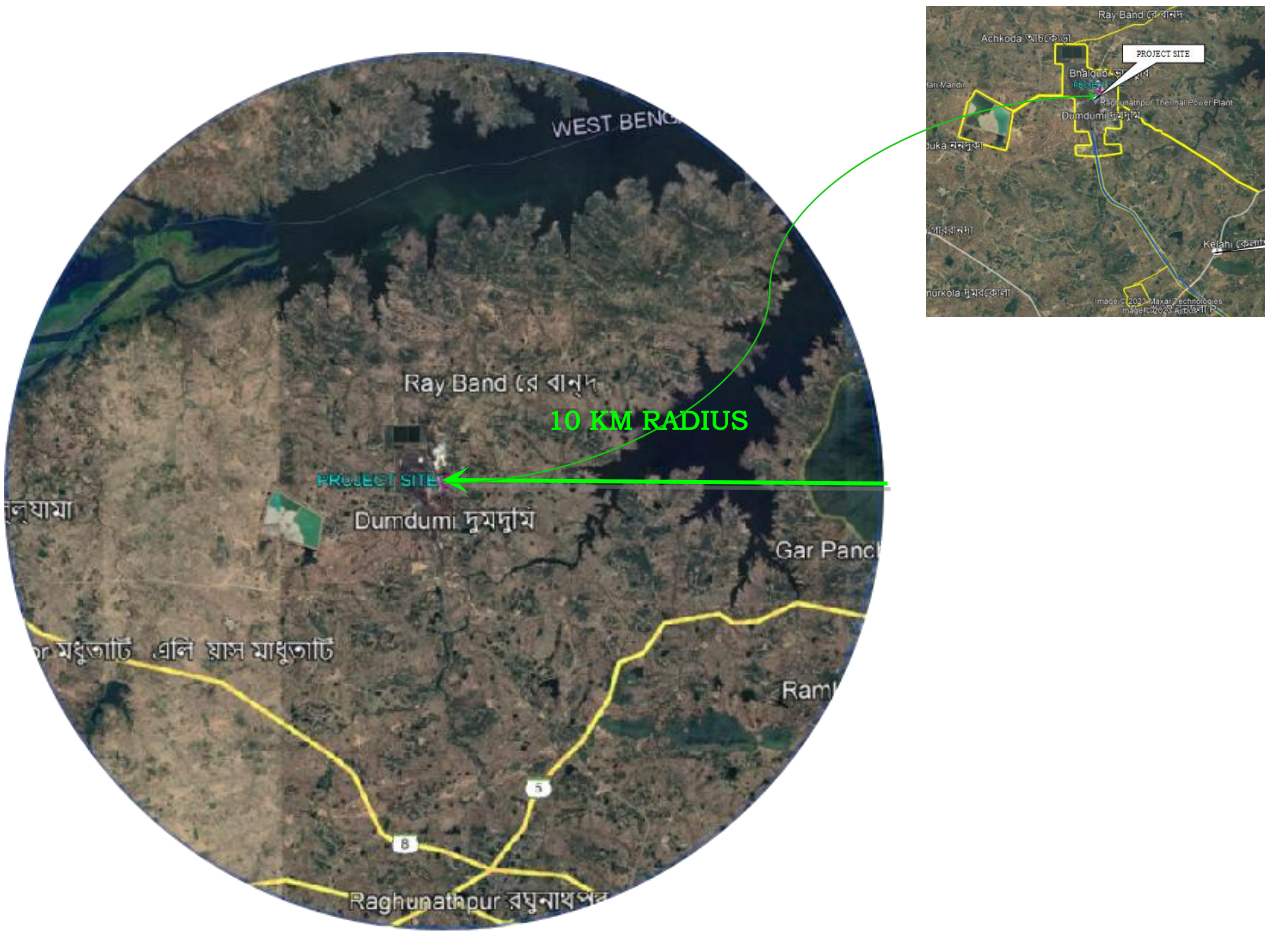


FIGURE-3.1.4
10 KM RADIUS STUDY AREA ON GOOGLE MAP

3.1.4 STUDY METHODOLOGY

The baseline environmental quality for winter season has been assessed based on primary data generated during field survey and secondary data available for the project site.

Table-3.1
Baseline data generation Matrix

Attribute	Parameters	Locations/Source
Land Environment	Physiography & Drainage	Primary & Secondary information
	Geology & Geo-Hydrology	Primary & Secondary data
	Land use	Primary & secondary data
	Soil Quality	4 Locations/ Primary & Secondary data
Meteorology	Temperature, Humidity, Atmospheric Pressure, Wind speed & Direction etc.	1 Location/ Primary & Secondary data
Air Environment	PM_{10}, $PM_{2.5}$, Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2), and Carbon Monoxide (CO)	8 Locations / Primary & Secondary data
Noise	Noise Level (dB Leq)	10 Locations/Primary data
Surface water	Physical, Chemical & Biological Parameters	10 Locations/Primary data
Ground water	Physical, Chemical & Biological Parameters	9 Locations/Primary data
Ecology	Terrestrial & Aquatic	Core and Buffer Zone, Primary & Secondary data
Demography & Socio-economy	Demography & Socio-economy	Core and Buffer Zone, Primary & Secondary data

3.2 GEOLOGY & GEOHYDROLOGY OF THE STUDY AREA

3.2.1 GEOLOGY OF THE STUDY AREA

The whole study area is basically plain land having several medium and small size hills like Garhpanchkot hill, Garangi hill, Parts of Muradi Hill etc. with very dense to medium dense patchy vegetation. Panchet Forest is a dense forest, situated on the Garhpanchkot Hill. The study area can be described as lying on the first step of gradual descent from the table land of Chotonagpur (Ranchi Plateau). The general characteristics are those of an upland area with rolling topography gradually dying out

eastward. This rolling topography is characterized by hilly terrain. General elevation of land surfaces of the study area ranges from 300m to 150m, the master slope being towards the East and South-East. The surface features in the undulating plain mostly include high lands alternating with long stretches of low lying areas. Due to undulating nature of the topography, the soil is generally gravelly. Lateritic soil prevails in the uplands. The alluvial areas are found in very narrow strips along the rivers. The valleys are steep along the rivers. The cultivable lands are mostly located in the low lying areas and on the slope between high and low lands.

The study area is under the district of Purulia and Barddhaman in the state of West Bengal. The study area has an average elevation of the land surface ranges from 150 m to 300 m from MSL and the master slope is towards the east and south-east. The study area forms the lowest step of the Chota Nagpur Plateau. The general scenario of the study area is undulating land with scattered hills. The area corresponds to eastern fringe of Chhotanagpur plateau and gradually merges with depositional fluvial terraces of Damodar-Dwarkeswar-Kangsaboti River.

The terrain is especially granite and gneiss with enclaves of metasedimentaries and metabasics. The study area is characterized by undulating topography with rugged hilly terrains. In the eastern and south-eastern part of the area the slope ranges between 10 to 20 m/km. In the central part of the study area the slope is less than 10m/km and forms a depression. Again in the western part the slope is higher and ranges from 20-80 meter per km. The general slope Map of Purulia District has been presented in **Figure-3.1.5**. There are about 17 prospects near the study area. 10 are of coloured granite variety (Pinkish grey-pink-dark grey/block) represented by granite, perphyritic granite, granite gneiss. The remaining 7 are of black granite constitutes basic (such as dolerite, gabbro, diorite etc,) and charnockites - basic granulities. The study area is covered by mostly residual soils formed by weathering of bed rocks.

Porphyritic granite, associated with metamorphic rocks and migmatites of East Manbhum (23°27′45″ – 23°35′ N. Lat.; 86°30′ – 86°49′ E. Long.), India, crops out as a lenticular body exhibiting well-developed planar banding of alternating feldspar phenocrysts and a finer-grained assemblage of quartz, feldspar and accessories. There are random arrangements of phenocrysts within the banding, or they show perceptible lineation. Lineation, foliation as well as joints are primary. Regional distribution of flow layers indicates an inclined lens.

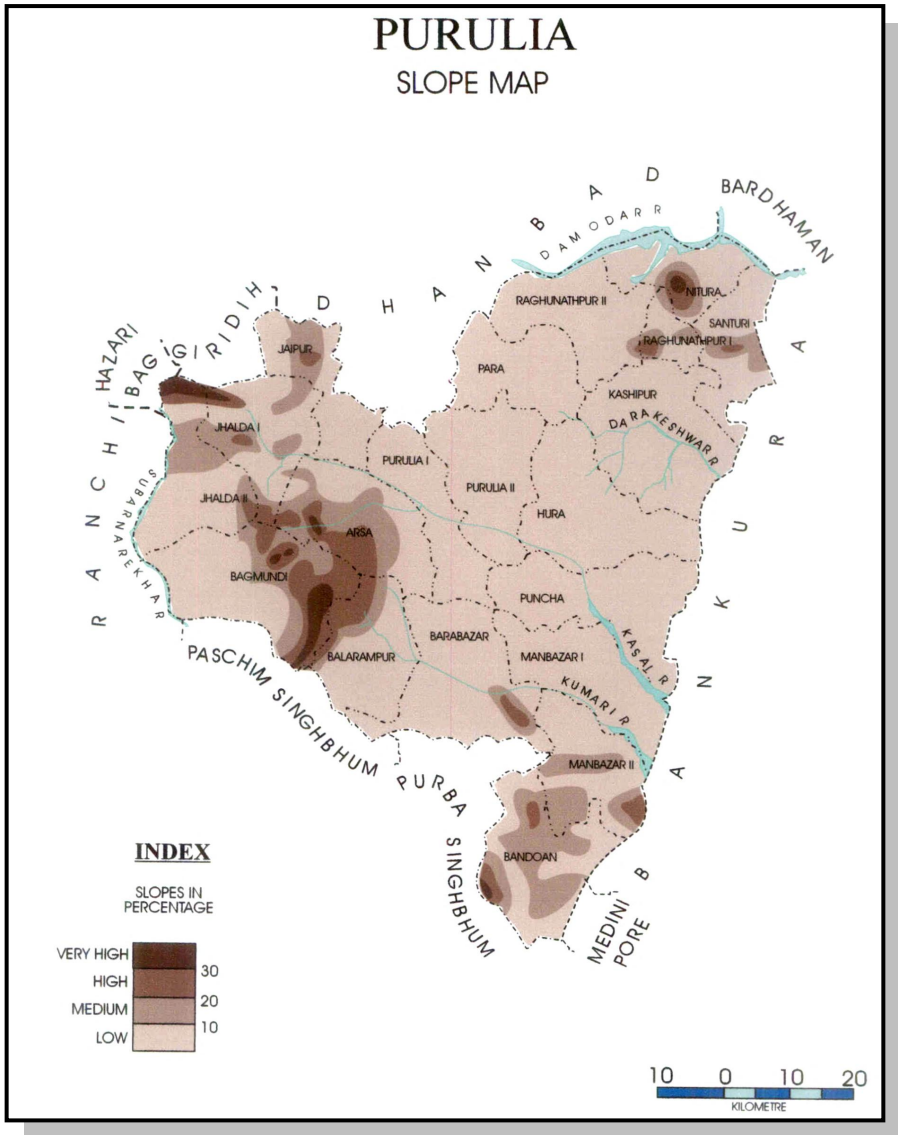


FIGURE-3.1.5 GENERAL SLOPE OF PURULIA DISTRICT

Types and Structure of Rocks:

The porphyritic granite is concordant for the greater length except toward the eastern margin of the exposure. In North-North-East of the study area, it is discordant with the structural trends of the country rocks. There are some small-scale discordances where the granite boundary takes sharp turns, leaving the schistose alignments of the country rocks abutting against the boundary. Spatial distribution of foliation, lineation as well as joints of the porphyritic granite is free of that of the metamorphic and migmatitic country rocks. Wall rocks have been mylonitized, and three joint systems are developed. Distribution and concentration of joints prove that the effect of tension was greater close to the contact.

Lineations in the country rocks are parallel to one another. It is mainly of two types produced by (1) microfolds of different dimensions and (2) alignment of elongated minerals such as quartz or sillimanite. Biotite fabric of the metamorphic rocks is not indicative of their tectonic trend as the mineral is an outcome of neocrystallization. The metamorphic rocks are found in these areas which have been generated due to a high grade of regional metamorphism. Fabric of migmatites, ultramigmatitic granite gneiss, quartz in leptynites (granulites) are very similar to that of the metasediments and their orientation indicates the tectonitic orientation during metasomatic recrystallization.

Country rocks show simultaneous fabric reconstitution near the porphyritic granite. Along the granite contact the fabric is symmetrical about the bisectrices of the shear joints as a result of intrusion of porphyritic granite. The intrusion also produced minor secondary folds or intensification of folding. Quartz fabric of the porphyritic granite is independent, with respect to its pattern and relation to geographic coordinates, of the country rock fabric.

The metamorphic rocks of Chhotanagpur Granite belt exposed in Manbazar area near the study area in Purulia district of West Bengal provides an opportunity to study the relation between the deformation as expressed by the complexity of structure and metamorphism in upper greenschist facies. The area forms a part of a large shear zone in the northern part of South Purulia Shear Zone (SPSZ). The major rock types include phyllite, mica-schist, amphibolites, gondite, granite gneiss, augen gneiss, granite mylonite and tourmaline rich pegmatite. The southern part of the area is characterised by the presence of granite, amphibolite and quartz-mica schist. The granites and amphibolites are deformed to variable degrees from simple granite gneiss, through proto-mylonite to mylonite. The mylonitization may be related to the shearing along the WNW–ESE trending SPSZ. The schistose quartzite and amphibolites occurs as xenoliths within the deformed granite body. The nature of the parent rock of amphibolite is also debatable; it might be mafic igneous rock occurring as dyke, or impure calc-magnesium sediments. From the field relations it appears that at least some of the amphibolites were doleritic intrusives into the metasediments and older than the granite. Gondite is present as an isolated rock body surrounded by the granite. It is later refolded by the same deformation that has affected the granite.

Purulia district is endowed with mineral resources of a wide range of varieties. As per the findings of GSI, there are 10 types of mineral deposits in this district. The main ones are Coal, Limestone, Rock Phosphate, China Clay, Quartz etc. The main mineral of the district is Coal. There are two big Collieries in Purulia district, one at Ranipur and the other at Parbelia. Deoli and Bhamuria are the other Coal mines. The other important minerals, explored till date are Apatite or Rock Phosphate of Beldi, Panrkidi etc, Limestone of Jhalda, Basemetal of Tamakhun, China clay of Mahatomara, Fire clay of Malti, Quartz of mirmi, Decorative Stone of Bero, Dhunia etc.

Lithology and Geological Units of Purulia District has been presented in Figure-3.1.6.

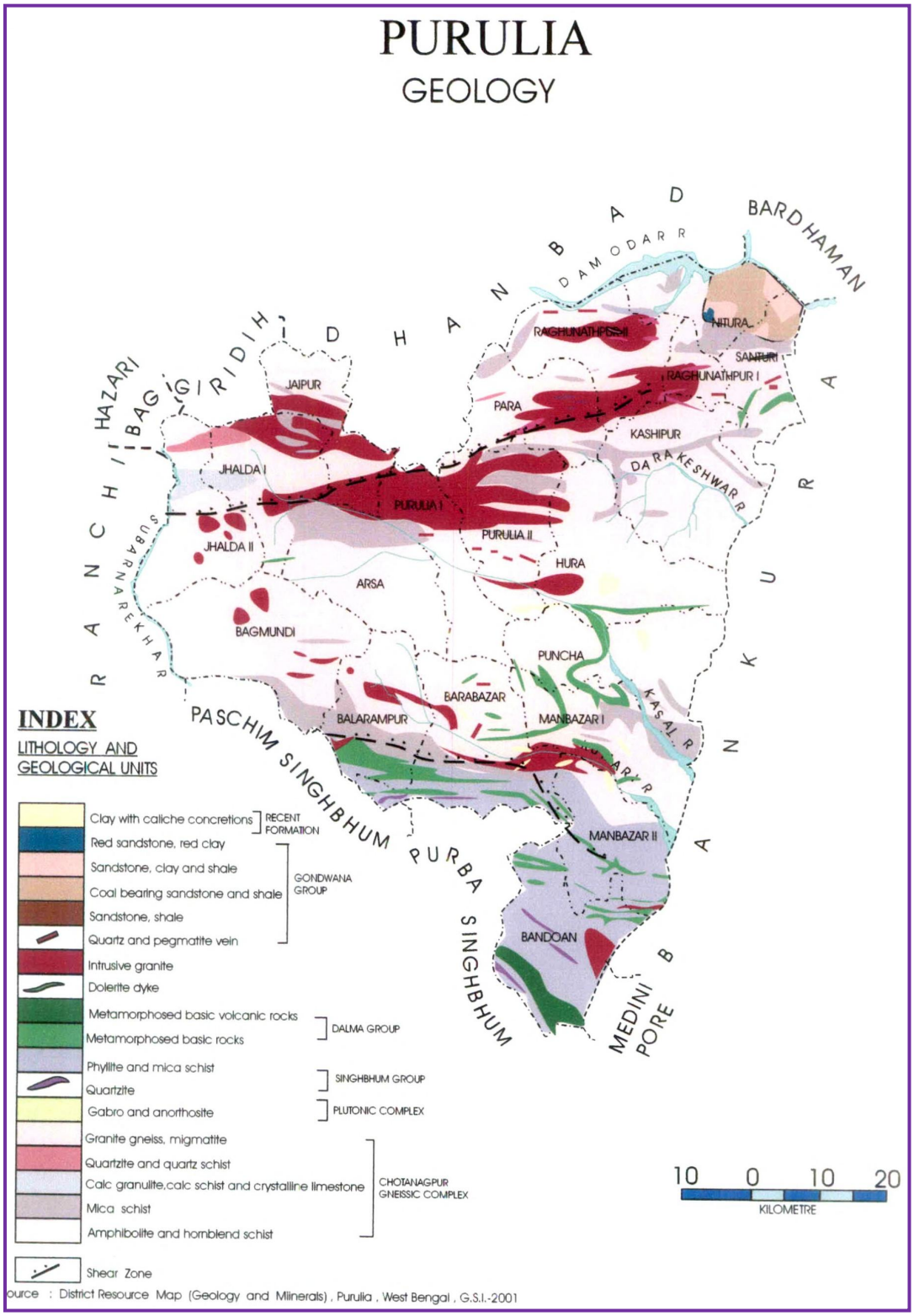


FIGURE-3.1.6
LITHOLOGY & GEOLOGICAL UNITS OF PURULIA DISTRICT

Soils Formations:

The soils of the study area are generally of residual type and derived from the weathered Archean granites, gneisses and schists. Their profile development is disturbed by the long continued erosion. Older alluviums of Pleistocene to sub-recent age exist along the northern base of Bagmundi hills. The newer alluviums of sub-recent to recent age are found along the Subarnarekha, Kasai and Damodar river valleys.

The soils of the Purulia district may be classified into three groups according to their association with geological formations under different geological eras. Each major group is also subdivided on the basis of texture, soil drainage and degree of erosion.

1. Soils associated with Archean Granite - Gneiss landscape.
   a) Deep well drained to moderately drained sandy loam soils,
   b) Shallow well drained sandy loam soils,
   c) Very deep imperfectly drained sandy loam soils,

2. Soils associated with Dharwar landscape.
   a) Very shallow somewhat excessively drained sandy loam soils,
   b) Shallow moderately well drained , coarse loamy soils,
   c) Deep moderately well drained sandy loam soils,

3. Soils associated with Gondwana landscape.
   a) Shallow imperfectly drained sandy loam soils,
   b) Shallow moderately well drained sandy loam soil,

The maximum portion of the study area is under the Soils associated with Gondwana landscape.

The soil classification map of Purulia District has been presented in **Figure-3.1.7.**

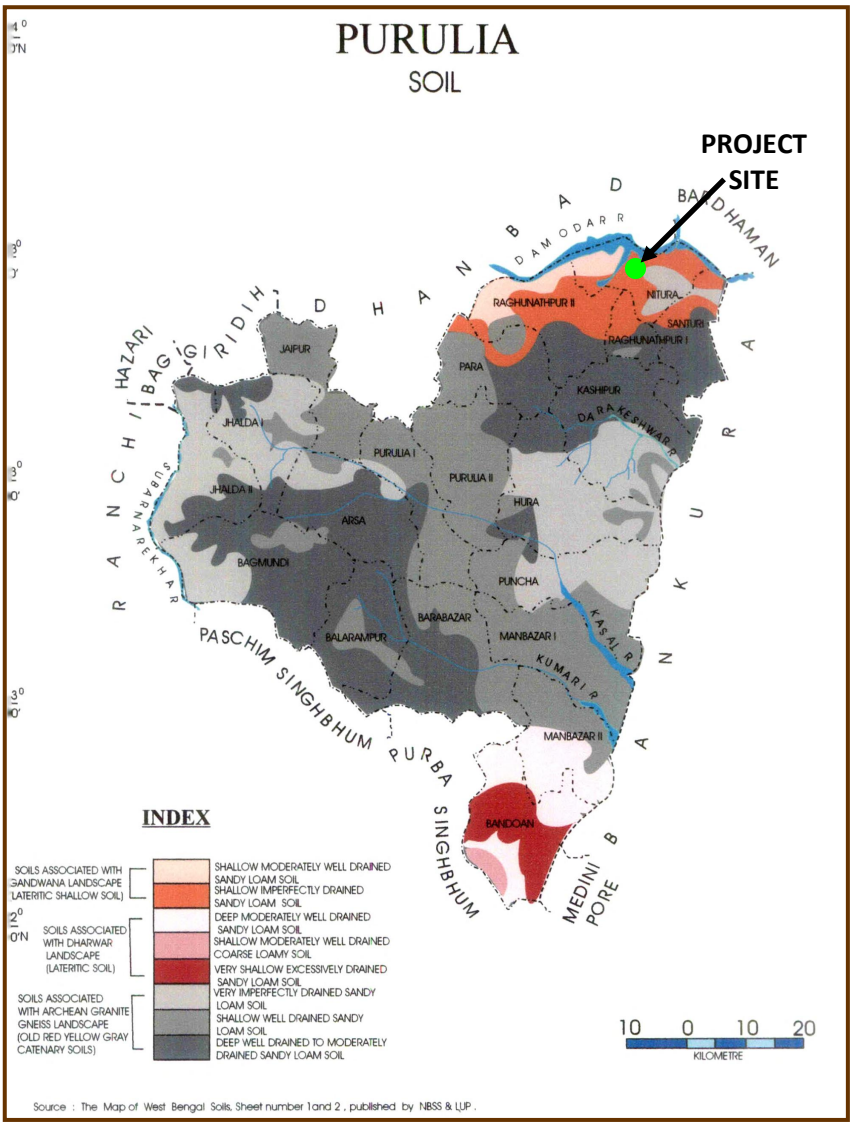


FIGURE-3.1.7
SOIL CLASSIFICATION MAP OF PURULIA DISTRICT

3.2.2 GEOHYDROLOGY OF THE STUDY AREA

3.2.2.1 GROUND WATER GEOHYDROLOGY

The study area is a part of Chhotonagpur plateau and is underlain mainly by Precambrian metamorphics excepting a small area in the northeastern part where sedimentaries of Gondwana age are exposed. Adjacent to major rivers and streams, unconsolidated Quaternary sediments occur as discontinuous patches.

GEOHYDROLOGY OF GROUNDWATER:

In the study area, groundwater is present at shallow depth under water table condition within the weathered mantle, fractured zone of hard rock as well as narrow zone of unconsolidated sediment along major valleys. The potential aquifers comprise two units, viz (i) a weathered residuum which is in general 8 -10 m thick, porous and unconsolidated, containing water in the interstices and (ii) underlying fractured hard rocks which stored water within zones of the secondary porosity.

Water Table:

The water table in general is at depths varying between 6 and 8 m bgl during pre-monsoon period and between 2 and 4 m bgl during post-monsoon period. In the southern and extreme north-eastern parts of the study area the water table is at depths greater than 8m bgl. Water table, in general fluctuates between 3 m and 4 m bgl. Greater fluctuation of water table is observed mostly in mica schist and Gondwana terrain and relatively lower fluctuation is recorded in granitic terrain.

Potentiality of aquifers and Transmissivity:

Large diameter dugwell pump tests at the study area reveal that the potentiality of the aquifer to transmit water was of low order and transmissivity value ranged between 2.42 and 11.61 m^2/day. The specific yield value ranged between $0.79X10^{-1}$ and $2.82X10^{-1}$ indicating that the aquifers were unconfined in nature. The average yield of dug wells in granite gneiss, mica schist and sandstone formations were 4.80 m^3/hr, 0.92 m^3/hr and 16 m^3/hr respectively.

The potentiality of the aquifers to transmit water is of low order and therefore most of the open dug wells are dried up during peak summer and create a severe scarcity of drinking water. So it has been suggested that the depth of dugwells should be increased and well boring should be done at the bottom of the well to increase the yields.

As per the standard of drinking water (BIS 10500, 1991) the groundwater of the study area is fresh and potable. The Sodium absorption ratio, percent of sodium and electrical conductivity indicate that the groundwater is in general suitable for irrigation of most crops on almost all types of soils.

SURFACE WATER HYDROLOGY:

Drainage and Density:

Mode of draining water or drainage is an important controlling factor in influencing soil erosion. Generally soil loss or removal is accompliced by running water and that is why it is pertinent to have a discussion on drainage in the study area.

A number of rivers and rivulets drain the district. All the rivers have an easterly or south-easterly course. Only the Subarnarekha flows almost to the south along the western border and receives west and south-west flowing tributaries. Subarnarekha, Damador and Kasai rivers are the perennial rivers. Most rivers and rivulets are non-perennial and subject to occasional flash flood. The river beds are usually covered with gravels and sands. Their banks are abrupt and broken into deep gullies. None of the river is navigable.

The varying underlying geological structure, surface morphometry and stage of evolution together have given rise to a variety of drainage and channel patterns. The most common of these is the dendritic pattern which is found all over the erosional plain. The alignments of the tributaries and sub tributaries of river Kumari, Darakeswar, Kasai and Damodar form dendritic pattern. Radial Drainage pattern is found along the summits of the hills. The major river in the study area is Damodar. The Drainage Map of Purulia District has been presented in **Figure-3.1.8**.

Drainage System of the Study Area:

The major surface water bodies in the study area are the Panchet Dam (Reservoir), Damodar River, Barakar River and Khudia River. The River Damodar is mainly perennial in nature, which means it has sufficient water to flow all around the year. The nearest distance of the Damodar River is 2.4 Km from the Project Site. River Barakar is the main tributary of the River Damodar. River Barakar meets with the River Damodar at Fatepur. Khudia River is the main tributary of the River Barakar. The confluence point of the River Barakar and the river Khudia is at Hatinal. Besides, a number of confined water bodies, viz. tanks, ponds, jheels, roadside burrows etc. which form a part of surface hydrological system, exist within the study area. As the River Damodar is the main drainage channel of the region, this river receives pollution loads of industrial and domestic waste water and also agricultural run-off.

Damodar River:

Damodar River rises in the eastern part of Palamau district of Bihar at an elevation of approximately 600 mtr and has a course of 538 kms before it merges with Hooghly in West Bengal. The basin of this river is surrounded by the qranite gneiss of Chotanagpur which is affected by the boundary fault. The Catchments of this river receive an average rainfall of 120 -150 cm of which 90% rainfall occurs during the four months only i.e. June to Sept. of a year. In addition to this, valley receives rainfall from tropical cyclones in the upper catchments plateau part of the area. As mentioned above the concentrated rainfall during the monsoon over gneissic rocks, sandstones and shale under hot and humid climate causes severe erosion of rock materials and thereby loading the water streams with great amount of sediments. This causes choking of riverbed, which in turn results in flooding of surrounding region. Prior to construction of various dams on this river, the region had bad experience of severe floods.

The Panchet Hill dam has been constructed on the Damodar river, 5 kms above the confluence with its main tributary Barakar. One of the right bank tributaries of Damodar is Gobai or Gowai Nadi. There are numerous short non-perennial tributaries of Goabai namely Mas Jhar, Chapai Nala, Parga Nala, Jaria Nala, Falari Jhar, Khukraghata Nala, Taragunia Nala and Harai Nala. Gullies have formed along the banks of all these streams. The middle and lower portions of the Gobai are fully sand choked.

Panchet Dam:

Panchet Dam, constructed on Damodar River comes under the study area. The dam is 22,155 ft. long and 134 ft. high. It is a part of Damodar Valley Corporation. A hydel station has also been constructed against the back ground of Panchet hill in the eastern side of the dam with a generating capacity of 40 MW power. Panchet dam lies on Damodar River 5 kms upstream at the confluence of Barakar and Damodar River and at the western fringe of Raniganj Coalfield in west Bengal.

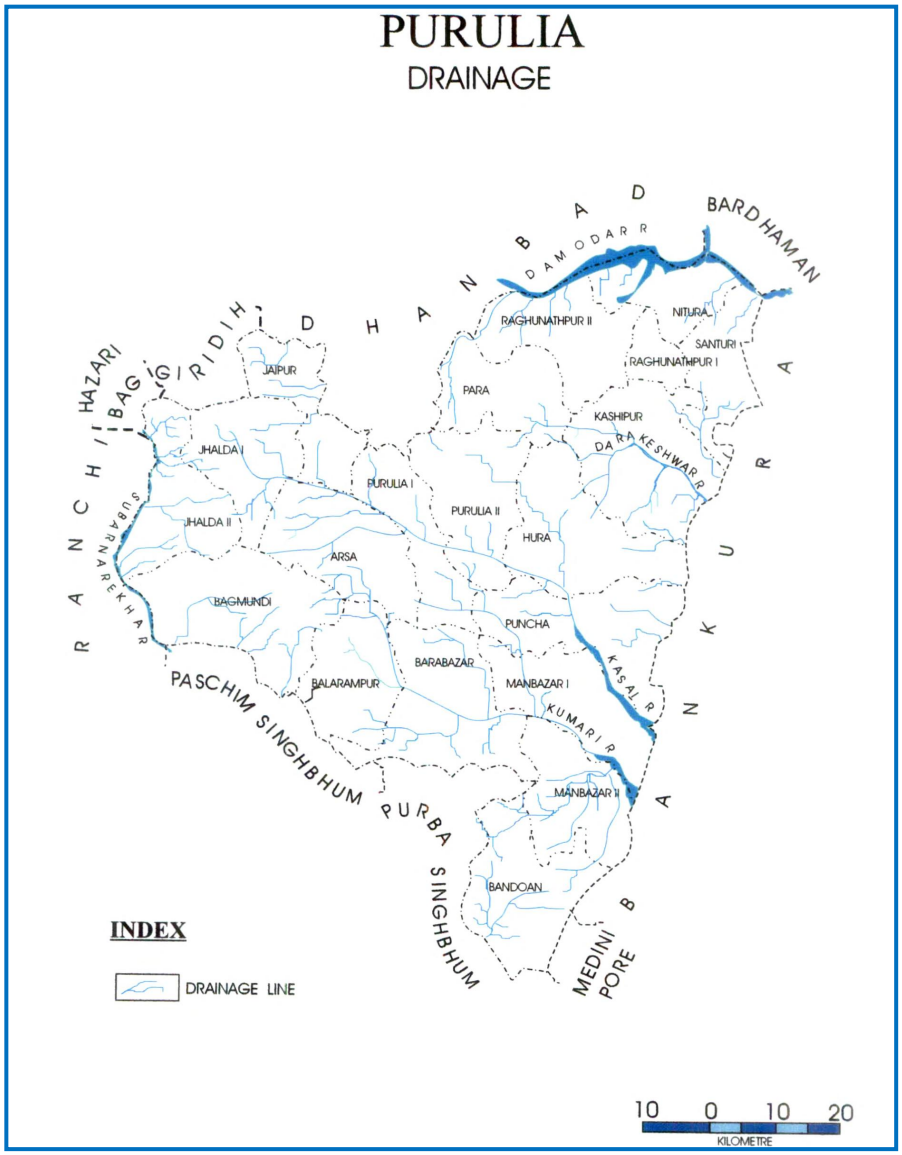


FIGURE-3.1.8
DRAINAGE MAP OF PURULIA DISTRICT

MANAGEMENT PLAN FOR RECHARGING THE AQUIFERS AT THE PROJECT AREA

Recharging of the aquifers within plant premises is not applicable for this industrial project. However, efforts would be made for the conservation of surface water and ground water at the project area.

Management Plan for the Conservation of Surface Water & Ground Water at the Project Area:

Conservation of Surface Water Resources:

1. No garbage dumping will be made near any surface water / ground water resource.
2. Technique of improvement of water quality using aquatic plants and fishes will be introduced where necessary in order to avoid mosquito breeding.
3. No sewage will be diverted to water bodies in order to maintain their water quality.
4. Rain water harvesting system will be introduced at the project site.

Conservation of Ground Water Resources

Efforts will be made to maintain the sustainability of ground water resources by arresting the ground water outflows by Watershed Management.

As the soil erosion of the study area is influenced by water it is essential to consider intensity, amount and duration of rainfall to assess rainfall erosivity (i.e., R factor) of the area. As per the secondary data, the average annual rainfall is 1322 mm. Maximum rainfall 1427 mm occurs in the hilly part of Bagmundi. In the eastern part the average annual rainfall varies between 1300 mm to 1400 mm. The rainfall generally decreases towards the north-west.

3.2.3 RAINFALL

Nearly 80 percent of the annual rainfall occurs during the monsoon period (June - September). The later part of south west monsoon season (September - October) is associated with the tropical depressions originating in the Bay of Bengal. These causes nearly 45 mm of rain in the eastern part and 40 mm in the north-western part .The intensity of rainfall due to these depressions sometimes becomes very great and may cause enhanced soil erosion in the district. During winter, western disturbances generally cause light rainfall. This does not cause any major soil erosion problem. During hot weather season of March to May , rainfall is caused by the Nor'westers or Kalbaisakhis. Kalbaishakhis generally bring sudden rainfall with great intensities. Besides, the season in which it occurs is characterized by the presence of bare soil mostly devoid of vegetation. Therefore it causes considerable amount of soil erosion. A Map showing the rainfall of the Purulia District including the study area is presented in **Figure-3.2.3.1**.

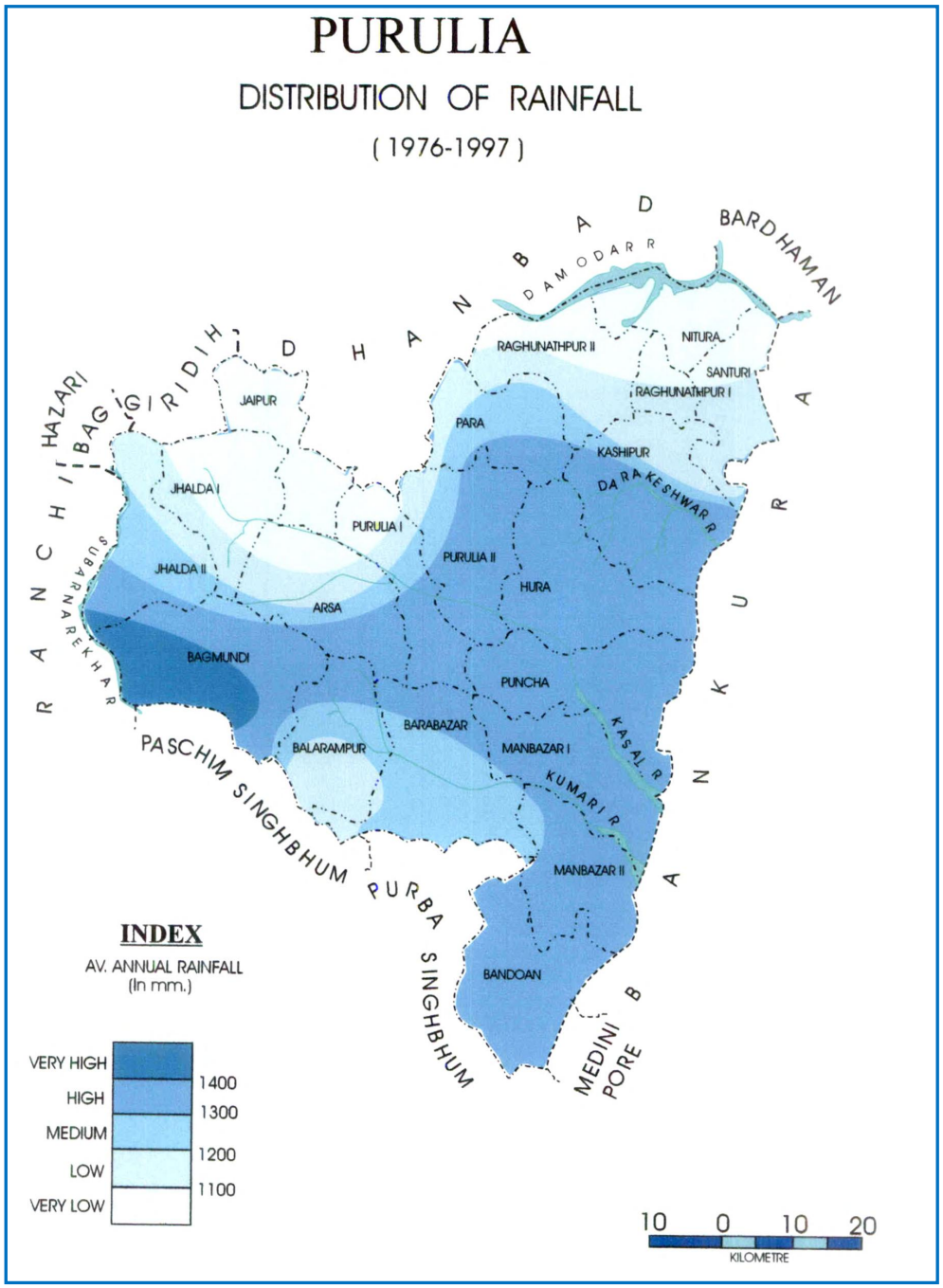


FIGURE-3.2.3.1
DISTRIBUTION OF RAINFALL IN PURULIA DISTRICT

3.4 SEISMICITY

As per seismic hazard zonation map, West Bengal experiences earthquakes at a relatively lower frequency. According to the IMD catalogue regions are divided in the seismic zones II to V (low damage to very high damage), corresponding to PEAK GROUND ACCELERATION (PGA) of 0.1, 0.2 and 0.25 (1 g = 980 Gal2) respectively.

According to IS:1893-1984, the Project Site falls under Zone-III. It means that the earthquake shock in the area is minor. There is no major earthquake episode recorded in the study area till date. Seismic Zoning Map of India with mentioning of the project site has been presented in Figure-3.3.1.

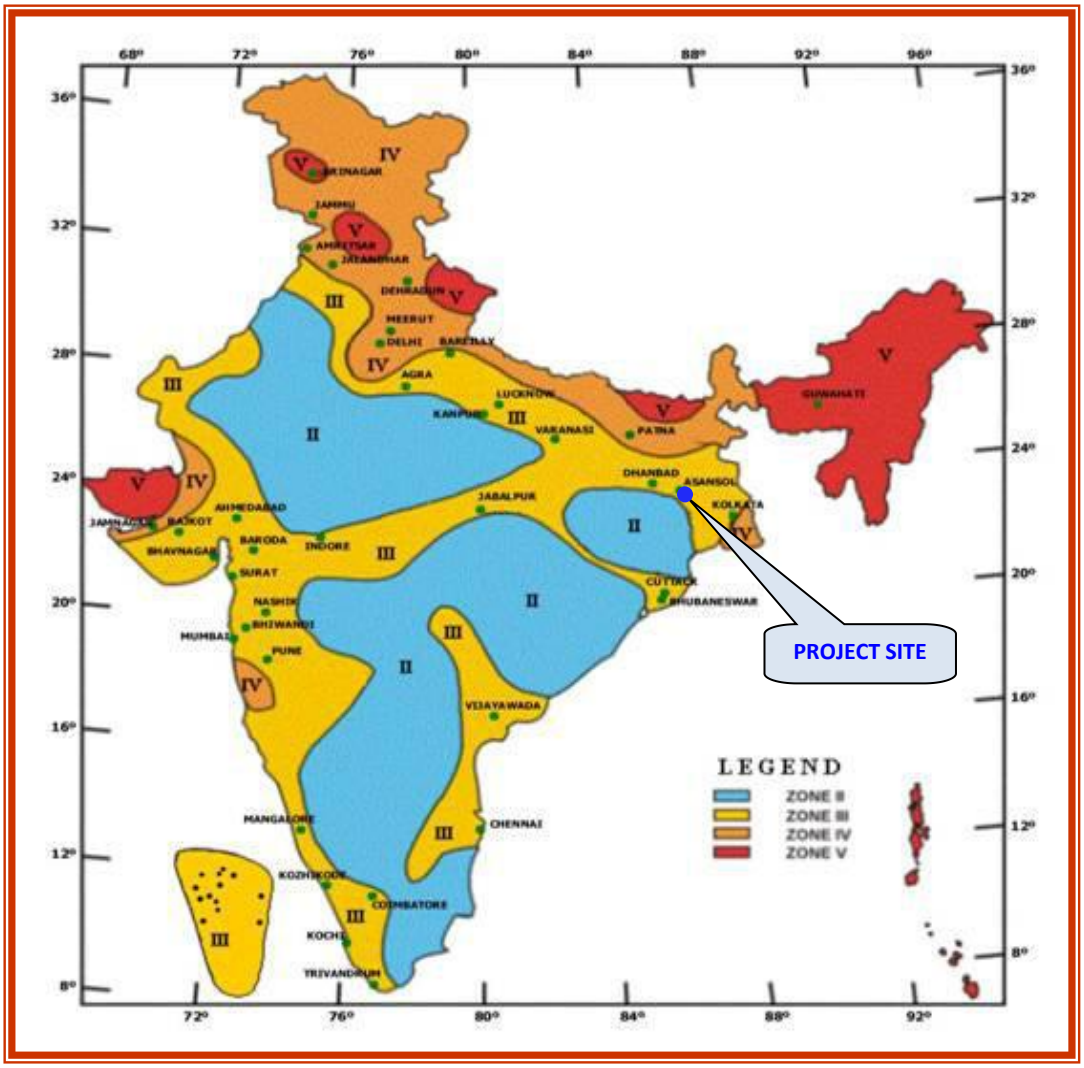


FIGURE-3.4.1
SEISMIC ZONING MAP OF INDIA INDICATING THE STUDY AREA

3.6 INDUSTRIAL ENVIRONMENT

There is no major industries found within the 10 km radius study area around the project site.

3.7 LAND USE

3.7.1 INTRODUCTION

The project site is located at illage Raghunathpur, District Purulia (West Bengal). The geographical co-ordinates of the project area is Latitude 23°36'6.90"N to 23°37'59.54"N and Longitude 86°38'51.12"E to 86°40'5.07"E with above mean sea level (AMSL) as 30 m. (98.43 ft). .

3.7.2 METHODOLOGY

The sensitivity of the environment i.e., existing land use is studied through Geographical Information System (GIS). Geographic Information System (GIS) is a scientific technique, which has revolutionized the way that land is inventoried, managed, planned and studied. GIS provides the theories and methods for organization and analysis of original measurements of location and secondary spatial data as well as topography. As an information system GIS provides the theories and methods for organization, storage, analysis, modeling, mapping and display of physical and biological data, as well as the distribution of cultural or socio-economic data. GIS applications are diverse. They include determining the suitability of land for different uses, planning future land uses for different objectives, analyzing land and land-cover properties for both resource inventories and scientific studies, and sitting of developmental activities.

3.7.3 DATA ANALYSIS

Remote Sensing Data

To study and map the land use pattern of the area, LANDSAT TM-1 multispectral imagery has been used as input data. The spatial resolution of the satellite data is 30 m. The bands used as input data for the current study have the following features:

Band 2: 0.52 - 0.59 µm (green): This band corresponds to the green reflectance of healthy vegetation and is spanning the region between the blue and red chlorophyll absorption bands.

Band 3: 0.62 - 0.68 μm (red): This red chlorophyll absorption band of healthy green vegetation is one of the most important bands for vegetation discrimination. In addition, it is useful for soil-boundary and geological boundary mapping. Band 3 may exhibit more contrast than bands 1 and 2 because the effect of the atmosphere is reduced. The 0.69 m cut-off represents the beginning of a spectral region from 0.68 to 0.75 m where vegetation reflectance crossovers occur that can reduce the accuracy of vegetation studies.

Step - I	Layer stacking of three distinct file into a single file and create FCC
Step - II	Select an appropriate band used throughout the analysis. An examination of the three bands shows that the one visible band (2) provides less evidence of the various water surfaces across the image. Band 4, the near infrared band, clearly separates water bodies from other surfaces. Band 3 help to distinguish vegetation cover.
Step - III	Digital classification: Un-supervised ISO data classification carried out considering green, red, NIR bands with 5 iteration and expected number of classes 50
Step - IV	Aggregation of classes obtain through this classification session into classes having significance on the physical world was then carried out based on DN value.
Step - V	Visual interpretation is also done since digital classification only consider pixel values not the geographic location, association, shape, etc.
Step -VI	Area Calculation of each Land Use/Land Cover Classes
Step- VII	Comparison with some reference data and sample ground validation
Step - VIII	Final Map and Report

Band 4: 0.77 - 0.86 μm (near infrared): For reasons discussed above, the lower cut-off for this band was placed above 0.75 m. This band is especially responsive to the amount of vegetation biomass present in a scene. It is useful for identification of vegetation types, and emphasizes soil-crop and land-water contrasts.

3.7.4 OTHER SECONDARY DATA

The secondary database considered for validation and geo-referencing of the image is as follows:

- Topographical map in 1inch: 1mile of Survey of India: 73N/7 and N/8
- District Planning Series Map, NATMO, 1998;

3.7.5 DIGITAL IMAGE PROCESSING

The digital image processing includes image rectification; image enhancement; visual interpretation and land use mapping.

Image Rectification

The satellite images are given in BSQ (Band Sequential) format. These are imported to Erdas environment. Then geometric correction applied to the images to correct the distorted image data to create a more faithful representation of original scene. Image rectification procedures are often termed 'pre- processing' operations because they normally precede further manipulation and analysis of the image data to extract specific information.

Image Enhancement

This procedure is applied to the images in order to more effectively display or record the data for subsequent visual interpretation. High pass filter used to visualize more correctly the linear features such as, roads, rail, canal, river etc. Histogram Equalization was used to distinguished area of the same tone.

Visual Interpretation and Land use Mapping

Satellite imagery contains detail records of features on the ground at the time of satellite overpass. An image interpreter systematically examines the images for generating the information required by him. Other supporting materials such as published maps and reports from various sources will increase the accuracy of the interpretation. The chain of process in visual interpretation of the shape and pattern in an image begins with detection. There are certain fundamental characteristics seen on images which aid in the visual interpretation of satellite imagery. These are tone/ color, size, shape, texture, pattern, location, association, resolution and season. Visual interpretation is subjective and differs from person to person and also upon the season, scale, spectral bands, spatial resolution, overall image contrast & quality of the data.

The procedure for mapping for land use from satellite imagery of different season & on different scale is well established. Several parameters like terrain, climatic conditions, socio-economic trends, and environmental influences etc. play vital role in the existence of various land use categories.

Study limitation

Some limitations for the interpretation of the satellite data are:

- One season data sometimes give same spectral response of different objects creates confusion in image analysis and sub classification.

- One time data is unable to show sub-classification in the study area.
- Area of the line features like road; rail etc. is not been included since GIS does not give any calculation.

The topography of the Study Area does not show much variation in the land use / land cover pattern. The region is mostly covered by agricultural land with some forest land and patches of green vegetations either planted by local inhabitants or are the natural vegetations within the study area.

The land use / land cover pattern of the Study Area have been framed from the Satellite Imagery and Toposheet and authenticated by field visit. The land use / land cover pattern of the Study Area, may be divided into following 9 categories: (i) Agricultural Land (ii) Forestland (iii) Grasses and scrub (iv) Open Area (v) Vegetation within settlement (vi) Sand / Shallow water (vii) Settlement; (viii) Water bodies (ix) River.

The above categories of land use and land cover pattern cover an area of about 314 sq km. The percentage of land area covered in figures is mentioned in the Table and has been illustrated through the pie diagram.

The area under different land use/ land cover of Study Area is presented in the following Land use and Land cover Map.

3.7.6 LAND UTILIZATION PATTERN

The land use describes the change in pattern of land features due to the human activity whereas the land cover refers to the existing surface features on the earth. Thus it describes the pattern of development of the area. The pattern of land use and land cover is less variable as the land is alluvial plain. So the fertile land of the study area is mostly covered by green vegetation or agricultural crops and grasslands. The study area is spread over 314 sq km area. The green natural vegetation surrounding the settlements, forests open area, sand / shallow water, river and water-bodies are the land cover in the study area and the agricultural land or open crops and grasslands and the built-up area is the type of land use. The pattern of land use and land cover is described below: Classification of Land Use Land Cover (LULC) in the study area is tabulated in **Table-3.7.1**. **Figure-3.7.1** shows the Pie diagram of LULC in the study area.

Table-3.7.1
Classification of Land Use Land Cover (LULC) in the study area

Sl. No	Class	Area (in km^2)	Area (in Percentage)
1	Forest	17.6	5.6
2	Mixed Crop Land	202.8	64.5
3	Open Area Without Scrub	1.1	0.3
4	Open Area With Scrub	4.1	1.3
5	River & Reservoir	43.3	13.8
6	Settlements	41.9	13.3
7	Water bodies	3.5	1.1
Total of all classes		314.3	100.00

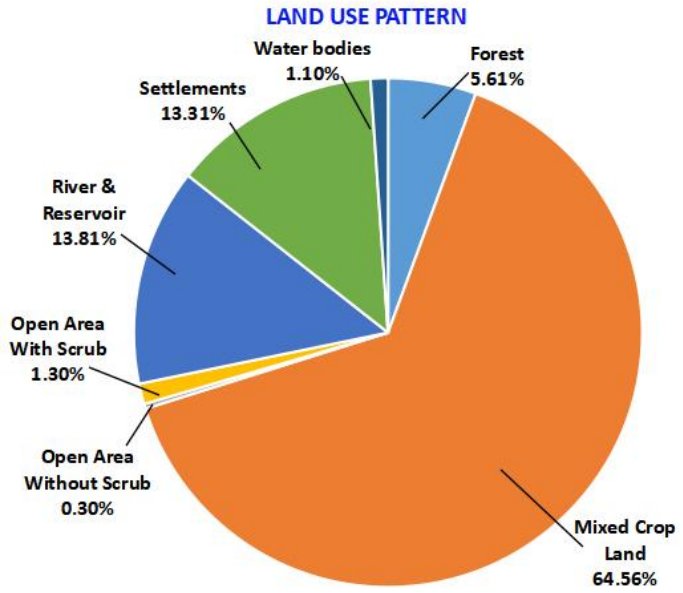


Figure-3.7.1
Pie Diagram of Land Use Land Cover (LULC) in the study area

3.7.7 LAND PATTERN

The data base on land use / land cover for the study area is discussed as follows:

The region is mostly covered by agricultural land with settlements and patches of green vegetations either planted by local inhabitants or are the natural vegetations within the study area. The land use / land cover pattern of the Study Area have been framed from the Satellite Imagery and Toposheet and authenticated by field visit. The land use / land

cover pattern of the Study Area, may be divided into following 9 categories: (i) Forest (ii) Mixed Crop Land (iii) Open areas without scrub/ sandy areas (iv) Open area with scrubs (v) River and reservoirs (vi) Settlements (vii) Water bodies. The above categories of land use and land cover pattern cover an area of about 314 km^2. The percentage of land area covered in figures is mentioned in the Table and has been illustrated through the pie diagram. The area under different land use/ land cover of Study Area is presented in the following Land use and Land cover Map. The category wise land utilization pattern is described below:

- **Forest and Dense Vegetation:** The category of forest land and dense vegetations in the study area consists mostly of open mixed jungle and dense vegetation on open lands or along roadside. As it is interpreted from the satellite imagery, the dense vegetation in the area also consists of the vegetations by plantations, social forestry and orchards in the area. Mostly open mixed jungle or the dense vegetations have been observed surrounding the settlements. The trees are of average height and important trees are mango, banyan, banana, jackfruits, sal, mahua etc. The total forest area covers only about 17.6 km^2 which is 5.6 % of the total land area.

- **Settlements:** Settlements in the study area refer to the towns as well as village settlements with all infrastructural facilities like roads, railways, markets etc. It also covers the industrially built-up areas. The study area is densely populated area with many settlements spread along the main roads and railways and along the National Highway, NH-2 also called The Grand Trunk Road.

  Settlements cover mostly 41.90 km^2 of land area which is 13.3% of the total 10km study area. Some village settlements are Gusaidanga, Rampur, Radhamadhabpur, Ganggutiya, Sonari, Chumgari, Babuldih, Desongarh etc.

- **Open Area:** Open area covers the maximum land in the Study area. It is a category of wasteland. These are open barren land which is not suitable for agriculture. These lands have badland topography i.e. soil nutrients are lost either by erosion or frequent use by human beings. The lands are generally devoid of any green vegetation. Open area can be considered as land cover as well as land use.

  Sometimes the vegetation on the patches of lands is cleared due to frequent use for agriculture and other purposes. Because of

multipurpose use these kinds of lands have lost the fertility and remain barren without any vegetation. Such kind of open areas fall in the category of landuse. Sometimes due to presence of gravels and rocks or simply sands, open areas are formed which are devoid of any vegetation. Such kind of open areas fall in the category of landcover. In the study area the sandbars formed along the banks of Damodar River also comes in the category of open area. These sandbars are formed in the summer season when the water is dried up and depositions occur along the river banks.

The Study Area has 1.1 km^2 of land under the category of open area which is 0.3% of total land use and land cover. Open area excluding the sand bars cover the entire study area in patches.

- **Land with Scrub:** The land with scrubs covers about 4.1 km^2 i.e., 1.3% of total land area. This kind of land cover refers to the land area where the natural vegetation consists of bushes and scrubs/shrubs and very little growth of grasses. The soil of this type of land area with very few unwanted vegetation is unsuitable for agricultural purposes and is classified in the wasteland category. Only small thorny bushes and grasses are sustained in this soil. Generally this type of land cover may be observed to be spread within the agricultural land of any area. In the proposed study area also, this type of land cover is spread throughout the study area along with the open areas.

- **Water Bodies:** Water bodies refer to the small water reservoirs like ponds, lakes, tanks etc. Water bodies cover only 3.5 km^2 of land area which is 1.1% of total land use.

- **River**: River Damodar is located in the extreme north-northeastern part of the Project Site at about 4-5 km away. This River is flowing from north to northeast direction in the study area. The River covers about 43.3 km^2 of land of the study area which is 13.8% of the total land area. The land use pattern is shown in **Figure-3.5.1**.

FIGURE 3.7.2 : LAND USE PATTERN OF THE STUDY AREA

3.8 SOIL

Soil may be defined as a thin layer of earth's crust that serves as a natural medium for the growth of plants. It is the unconsolidated mineral matter that has been subjected to and influenced by genetic and environmental factors such as parent materials, climate, organisms and physico-chemical action of wind, water and sunlight, all acting over a period of time. Soil differs from the parent materials in the morphological, physical, chemical and biological properties. Also soil differs among themselves in some or all the genetic or environmental factors, therefore, some soils are yellow, some are black, some are reddish, some are coarse textured. They serve as a reservoir of nutrients for plants and crop and also provide mechanical anchorage and favorable tilth.

3.8.1 FIELD STUDY, SAMPLING & ANALYSIS

To assess the impacts of the proposed expansion project activities on the soil in the study area, the physico-chemical characteristics of soils within the study area have been examined by obtaining soil samples from selected points and analysis of the same. Four (4) sampling stations in the nearby villages were selected for studying soil characteristics, which have been shown in **Table-3.8.1**. Stations have been selected, keeping in view the vegetative cover, soil types and possible maximum deposition of pollutants emitted through stacks, which would accord an overall idea of the soil characteristics within the study area.

The Soil Quality Monitoring locations have been presented in **Figure-3.8.1**.

The samples were collected during February, 2023. A number of parameters were determined which are indicative of physical, chemical and fertility characteristics. The physico-chemical characteristics of the soils in the study area, as obtained from the analysis of the soil samples, are presented in **Table-3.8.2**.

3.8.2 CHARACTERISTICS OF SOIL IN THE STUDY AREA

Soil erodibility i.e. the response of a soil to the erosion process is complex and is largely influenced by soil properties such as texture, structural stability, organic matter content and permeability. Generally sandy soils have lower runoff rates, and are more easily detached, but less easily transported than silt soils. Clay soils are not easily detached, but lower infiltration rates may lead to greater run-off and increased erosion. Silt soils tend to have the greatest erodibilities since particles are easily detached and transported. Organic matter has considerable

binding effect on soil particles. Therefore it helps in the formation of soil aggregates i.e. soil structure. This formation of soil structure makes the soil less vulnerable to erosion.

The soil type in the study area is basically "Shallow imperfectly drained sandy loam soil". This type of soil is found on very gently sloping to undulating plains with gravelly loamy surface and moderate erosion in the Raghunathpur block. The main soil texture in the study area is sandy loam.

Locations of soil sampling with code number are shown in **Table-3.8.1** and soil characteristics of these soil samples have been summarized in **Table-3.8.2**.

FIGURE-3.8.1
SOIL SAMPLING LOCATIONS

TABLE-3.8.1
CODE NO. & NAME OF LOCATIONS

Code	Sampling Location	Sampling Season	Distance & Direction from the Project Site	Latitude	Longitude
SQ-1	Ghutitara Village	February, 2023	1.4 km, ESE	23°36'52.95"N	86°40'26.40"E
SQ-2	Mangalda Village		6.0 km, SSW	23°34'24.86"N	86°37'44.77"E
SQ-3	Achkoda Village		3.2 km, WNW	23°38'1.66"N	86°38'3.03"E
SQ-4	Mangram Village		3.8 km, NE	23°38'32.31"N	86°41'19.25"E

3.8.2.1 PHYSICAL CHARACTERISTICS

The physical properties examined include colour, texture, bulk density, porosity and water holding capacity. Colour of soils was observed generally as reddish brown. It is well documented that reddish brown soil are slightly acidic in nature with sufficient amount of nitrogen, calcium, phosphate and other plant nutrients.

Soils having larger particles usually have higher bulk density than those of smaller particles. Bulk density of soils in the study area varied between (1.16 - 1.36) gm/cm^3 which is in normal range for such soils. Water Holding Capacity of these soils ranged between (35.5 – 39.7)%.

3.8.2.2 CHEMICAL CHARACTERISTICS

The soils were almost neutral pH range (6.5 - 6.7). Electrical conductivity (EC) was found varying between (524 - 616) µmhos/cm. In soil samples, calcium content of the soils varied between (369 - 442) mg/kg. Ranges of sodium in the soils varied between (135 - 172) mg/kg. In soils, sodium generally occurs as NaCl, Na_2SO_4 and sometimes, as Na_2CO_3 and other soluble salts. In comparison to sodium, potassium levels were slightly low. Range of potassium varied between (122 - 137) mg/kg. In the study area, Nitrogen level varied between (59 - 78) mg/kg. Most of the nitrogen is available in form of nitrates, nitrites, NH_4^+ and organic nitrogen. The Phosphorous content ranged between (27.9 - 31.4) mg/kg. Cation Exchange Capacity (CEC) varied between (22.3 – 25.5) meq/100 gm. Ranges of Magnesium and Sulphur were varied between (150 - 208) mg/kg and (25.1 - 28.2) mg/kg. Organic Matter in the soils was observed to be ranging between (1.1 – 1.7)%.

TABLE-3.8.2
SOIL QUALITY IN THE STUDY AREA

Sl. No	PARAMETERS	UNIT	SAMPLING LOCATIONS			
			SQ-1	SQ-2	SQ-3	SQ-4
PHYSICAL CHARACTERESTICS						
1	**TEXTURE**	-	Redish Brown	Redish Brown	Redish Brown	Redish Brown
a)	Sand	%	**Clay Loam**	**Clay Loam**	**Clay Loam**	**Clay Loam**
b)	Silt	%	47	48	50	49
c)	Clay	%	24	25	28	27
2	BULK DENSITY	gm/cm^3	29	27	22	24
3	POROSITY	%	1.16	1.2	1.36	1.32
4	WATER HOLDING CAPACITY	%	38.6	37.6	33	34.7
CHEMICAL CHARACTERESTICS						
1	pH (1:5 extraction)	-	6.7	6.8	6.5	6.6
2	EC (1:5 extraction)	µmhos/cm	554	524	568	616
3	Calcium (as Ca)	mg/kg	419	394	369	442
4	Magnessium (as Mg)	mg/kg	197	170	150	208
5	Sodium (as Na)	mg/kg	151	148	135	172
6	Potasium (as K)	mg/kg	137	129	122	125
7	Sulphur (as S)	mg/kg	25.9	25.8	25.1	28.2
8	Nitrogen (as N)	mg/kg	70	61	59	78
9	Phosphorous (as P)	mg/kg	30.3	28.6	31.4	27.9
10	CEC	meq/100 gm	22.3	23.2	25.5	23.8
11	Organic Matter	%	1.7	1.2	1.1	1.6
12	Copper (as Cu)	mg/kg	6.3	5.8	6.5	7.5
13	Chromium (as Cr)	mg/kg	6.5	7.4	7.2	9.2
14	Zinc (as Zn)	mg/kg	11.2	10.3	9.1	12.6
15	Lead (as Pb)	mg/kg	2.6	1.9	1.6	2.7
16	SAR	-	1.5	1.6	1.5	1.7

3.8.3 OBSERVATION & CONCLUSION

Observation on soil characteristics:

1) The pH of the soil was found to be slightly acidic, which will favour the growth of biota.
2) Texture was found to be clayey loam with good water holding capacity
3) Plant nutrient like phosphorus, nitrogen, potassium and organic matter were found to be moderate level as per ICAR Handbook.
4) Trace metals and non metals also were found to be sufficient for Plant growth.

3.9 METEOROLOGY

3.9.1 SEASONS

The climate of the project area is humid and tropical. It is characterised by a hot and dry summer from March to May, a south-west monsoon or rainy season from June to September, a pleasant post-monsoon or retreating monsoon from October to November and a cool winter from December to February. Therefore, climatologically, four seasons viz. summer (pre-monsoon), monsoon, post-monsoon and winter could be deciphered comprising the following months:

Summer	:	March, April, May
Monsoon	:	June, July, August, and September
Post-monsoon	:	October, November
Winter	:	December, January, and February

3.9.2 PAST RECORDS OF IMD, DURGAPUR

3.9.2.1 Data Collected

The meteorological data described in this section have been collected from the IMD Station located at Purulia and deemed to be representative of the study area. Available meteorological data for the past 30 years' period (1971-2000) have been collected and have been summarized. The climatic features of this station are presented in **Tables 3.9.1**.

3.9.2.2 Temperature

At Purulia, the daily mean maximum temperature for the past 30 years' period (1971 – 2000) was recorded from 38.5°C (May) to 24.9°C (January) and daily mean minimum temperature for the past 30 years' period (1971 – 2000) was recorded from 25.5°C (June) to 11.7°C (January) **(Table-3.9.1)**.

3.9.2.3 Relative Humidity

Humidity was fairly high through the major part of the year at Purulia. In day time the overall annual mean relatively humidity was 71% while in night time it was 59% for the past 30 years' period (1971 – 2000) **(Table-3.9.1)**. The mean relative humidity of Monsoon and Post monsoon seasons was ranging between 86% - 70% in day time and 80% - 61% in night time for the past 30 years' period (1971 – 2000). The mean relative humidity of summer and winter seasons was ranging between 71% - 55% in day time and 59% - 38% in night time. From these 30 years' IMD data it was found that the relative humidity was fairly very high in Monsoon season (June, July, August, and September).

3.9.2.4 Atmospheric Pressure

The overall annual mean atmospheric pressures was recorded 736 mmHg in day time and 733 mmHg in night time **(Table-3.9.1)**. Day Time mean maximum atmospheric pressures was recorded 742 mmHg (December) and night Time mean maximum atmospheric pressures was recorded 729 mmHg (June). Day Time mean minimum atmospheric pressures was recorded 739 mmHg (December) and night Time mean minimum atmospheric pressures was recorded 727 mmHg (June).

3.9.2.5 Cloud Cover

The mean monthly data revealed that the cloud cover in day time ranged between 1.5 Oktas (at month of December) to 7.3 Oktas (at month of August) and in night time it ranged between 1.3 Oktas (at month of December) to 7.2 Oktas (at month of August). The overall annual mean cloud cover was found 3.9 Oktas in day and 1.3 Oktas night time **(Table-3.9.1)**.

3.9.2.6 Wind Speed and Direction

The annual mean wind speed is around 3.4 km/hr at Purulia with the mean monthly wind speed was ranged between 1.8 km/hr (during November) and 5.2 km/hr (during June) **(Table-3.9.1).** The predominant wind direction was observed South.

3.9.3 ON-SITE METEOROLOGICAL OBSERVATORY

Air Pollutants upon discharge to atmosphere pass through a number of mechanisms, which include diffusion and transportation leading to dispersion. These mechanisms are governed by the local atmospheric conditions. All these results in the necessity to collect the meteorological parameters like ambient temperature, wind speed, wind direction, and other weather conditions (relative humidity, atmospheric pressure etc.), which will be ultimately used for the prediction of the ground level concentrations of the air pollutants through mathematical modelling.

For this purpose as also to corroborate and supplement the long term meteorological data availed from IMD, Purulia. a sophisticated on-site meteorological observatory was established close to the project site and operated continuously for three months period (**December, 2022 – February, 2023**).

The observatory was located about 10 m above the ground level and ensured to be free from any obstruction to wind. Besides, this location was found to be most suitable one being close to the project site. The

summary of the on-site data generated in respect of the above parameters for the period mentioned above are presented in **Table-3.9.2**. The Wind rose diagram for the entire period is shown in **Figure-3.9.1** to **Figure-3.9.4**.

3.9.4 ON-SITE METEOROLOGICAL DATA

3.9.3.1 TEMPERATURE

The monthly maximum and minimum temperatures recorded on-site during the aforesaid Study period **(December, 2022 – February, 2023)** varied between (26.0 - 30.5)°C and (9.5 - 11.0)°C respectively with overall maximum and minimum temperatures being 30.5°C and 9.5°C respectively **(Table-3.9.1)**. It could be observed that, the pattern of data recorded on-site generally matches with the past data of IMD data.

3.9.3.2 RELATIVE HUMIDITY

The monthly maximum and minimum relative humidity recorded on-site during the said Study period varied between (62 - 71)% and (44 - 56)% respectively, the overall maximum and minimum being 71.0% and 44.0% respectively **(Table-3.9.1)**.

3.9.3.3 ATMOSPHERIC PRESSURE

The overall maximum and minimum atmospheric pressures recorded on-site during the said monitoring period were 744.8 mmHg and 740.2 mmHg respectively **(Table-3.9.1)**.

3.9.3.4 WIND SPEED & DIRECTION

The maximum wind speed 3.3 Km/hr was recorded in the month of December, 2022 while the overall mean wind speed during the whole monitoring period was 2.7 Km/hr. **(Table-3.9.1)**. The predominant wind direction was observed as North-West, North.

Table 3.9.1

Mean Monthly Summary of Climatological Data Collected from IMD, Purulia (1971-2000)

स्टेशन : पुरुलिया अक्षांश LAT. 23°20' देशांतर LONG. 86°25' समुद्री तल माध्य से ऊंचाई *HEIGHT ABOVE M.S.L.* 255 मीटर *METRES* प्रक्षणों पर आधारित

STATION : Purulia **BASED ON OBSERVATIONS** 1971-2000

माह / MONTH		स्टेशन का सतह दाब / STATION LEVEL PRESSURE	वायु तापमान / AIR TEMPERATURE										आर्द्रता / HUMIDITY		मेघ की मात्रा / CLOUD AMOUNTS		वर्षा / RAINFALL					
			माध्य / MEAN						चरम / EXTREMES													
			शुष्क बल्ब / DRY BULB	नम बल्ब / WET BULB	दैनिक अधिकतम / DAILY MAX	दैनिक न्यूनतम / DAILY MIN	माह में उच्चतम / HIGHEST IN THE MONTH	माह में निम्नतम / LOWEST IN THE MONTH	उच्चतम / HIGHEST	दिनांक और वर्ष / DATE AND YEAR	निम्नतम / LOWEST	दिनांक और वर्ष / DATE AND YEAR	सापेक्ष आर्द्रता / RELATIVE HUMIDITY	वाष्प दाब / VAPOUR PRESSURE	समस्त मेघ / ALL CLOUDS	निम्न मेघ / LOW CLOUDS	मासिक योग / MONTHLY TOTAL	वर्षा के दिनोंकी संख्या / NO. OF RAINY DAYS	वर्षसहित सबसे नम महीने का योग / TOTAL IN WETTEST MONTH WITH YEAR	वर्षसहित शुष्कतम महीने का योग / TOTAL IN DRIEST MONTH WITH YEAR	24 घंटोकी सबसे भारी वर्षा / HEAVIEST FALL IN 24 HOURS	दिनांक और वर्ष / DATE AND YEAR	माध्य पवन गति / MEAN WIND SPEED
		एच.पी.ए hPa	डि. से °C	डि. से °C	डि. से °C	डि. से °C	डि. से °C	डि. से °C	डि. से °C		डि. से °C		प्रतिशत %	एच.पी.ए hPa	आकाश के अष्टमाश Oktas of sky		मि.मि. mm		मि.मि. mm	मि.मि. mm	मि.मि. mm		कि.मी. प्र. घं. Kmph
जनवरी / JAN	I	988.4	15.8	13.0	24.9	11.7	28.9	8.0	33.4	1	3.8	13	71	12.8	1.5	1.1	13.3	1.3	50.8	0.0	45.6	21	1.9
	II	985.0	22.3	16.8						1977		1989	55	14.9	1.8	1.1			1971			1998	
फरवरी / FEB	I	986.5	18.9	15.0	27.9	14.4	33.0	10.1	37.3	22	6.3	20	64	14.2	1.7	1.3	24.8	2.1	106.4	0.0	62.2	2	2.6
	II	982.6	25.9	18.5						1967		1989	46	15.4	1.9	1.5			1981			1979	
मार्च / MAR	I	983.7	24.4	18.6	33.4	19.2	38.4	14.4	41.7	31	10.7	4	55	16.9	1.5	1.0	25.0	2.0	85.0	0.0	77.0	30	3.3
	II	979.4	31.2	21.4						1955		1987	40	17.6	2.2	1.6			1988			1998	
अप्रैल / APR	I	980.0	29.1	22.4	37.8	23.6	41.8	19.3	46.0	29	13.5	2	55	21.9	1.8	1.2	40.8	2.9	209.8	0.0	60.0	25	4.2
	II	975.5	34.8	23.6						1999		1965	38	20.1	3.0	2.6			1993			1976	
मई / MAY	I	976.5	30.5	24.9	38.5	25.3	43.4	21.0	46.3	20	15.6	3	63	27.2	2.4	1.8	69.6	4.8	162.0	4.3	66.4	27	5.0
	II	972.3	34.9	25.2						1972		1987	47	24.4	4.0	3.4			1977	1957		1989	
जून / JUN	I	972.5	29.6	25.9	35.6	25.5	41.8	22.0	46.2	10	18.3	12	74	30.4	4.7	3.8	249.0	12.0	842.0	43.4	147.6	23	5.2
	II	969.4	31.6	26.1						1966		1988	66	29.4	6.2	5.2			1984	1987		1996	
जुलाई / JUL	I	972.6	27.8	25.7	32.2	24.8	35.9	22.4	40.7	6	17.8	14	84	31.3	6.5	5.6	302.6	16.0	573.6	106.3	148.3	6	4.3
	II	969.9	29.1	26.1						1982		1953	78	31.5	7.0	6.1			1987	1972		1951	
अगस्त / AUG	I	973.9	27.3	25.6	31.6	24.6	34.4	22.7	37.8	3	17.2	27	86	31.3	6.4	5.7	306.3	15.8	520.0	196.4	150.8	28	4.2
	II	970.9	28.9	26.1						1972		1953	80	31.7	6.9	5.8			1967	1999		1972	
सितम्बर / SEP	I	978.2	27.3	25.1	31.7	24.0	34.7	21.9	39.0	28	17.0	27	83	30.3	5.0	4.3	268.3	12.1	773.6	52.4	181.6	15	3.4
	II	974.9	28.7	25.6						1981		1986	77	30.3	6.1	5.1			1978	1968		1958	
अक्तूबर / OCT	I	983.4	25.6	22.7	31.4	21.4	34.1	17.6	39.4	1	13.2	22	77	25.3	2.5	2.1	87.2	4.2	260.4	0.0	190.6	19	2.2
	II	979.9	28.2	23.7						1974		1986	67	25.7	3.4	2.5			1999			1999	
नवम्बर / NOV	I	987.0	21.5	18.1	28.9	16.9	31.7	13.1	35.1	5	7.7	29	70	18.3	1.7	1.2	19.9	1.1	135.0	0.0	97.0	10	1.8
	II	983.6	25.3	20.2						1981		1985	61	19.8	2.0	1.4			1995			1995	
दिसम्बर / DEC	I	989.2	16.9	14.0	25.5	12.6	28.5	9.4	33.3	1	5.7	26	70	13.7	1.4	0.7	11.4	0.8	88.0	0.0	49.6	23	1.9
	II	985.7	22.0	17.2						1955		1961	59	15.8	1.6	0.8			1991			1991	
वार्षिक योग या माध्य / ANNUAL TOTAL OR MEAN	I	981.0	24.5	20.8	31.6	20.3	43.5	7.9	46.3	20	3.8	13	71	22.7	3.1	2.5	1418.2	75.0	2138.8	927.6	190.6	19	3.4
	II	977.5	28.5	22.5					5	1972	1	1989	59	23.0	3.8	3.1			1978	1957	10	1999	
वर्षोंकी सं / NUMBER OF YEARS	I																						
	II	30	30	30	30	29	30	29	72		72		30	30	30	30	28	28	50	50	51		26

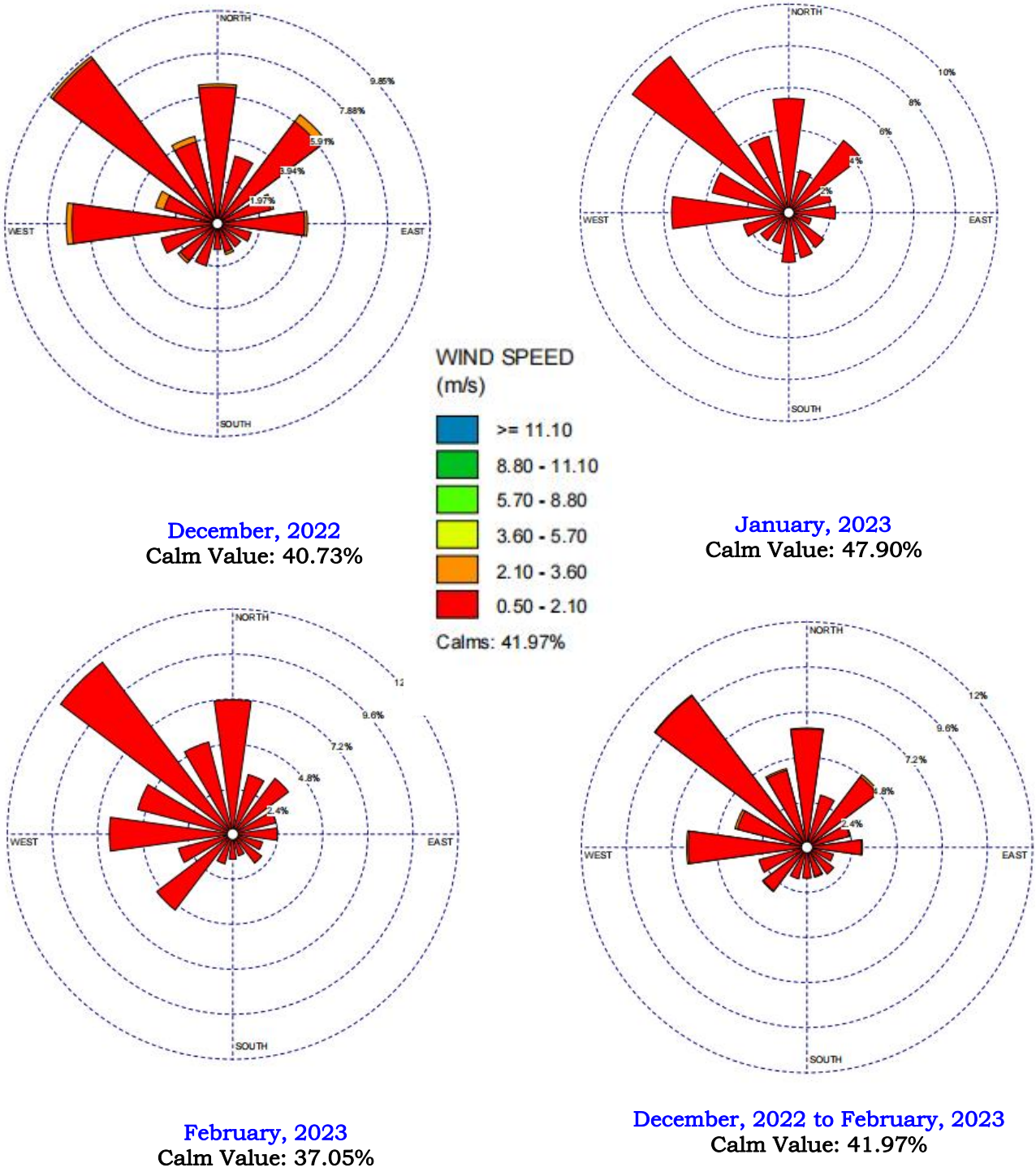
Table 3.9.1 (Contd...)
Monthly Summary of Climatological Data Collected from IMD, Purulia (1971-2000)

स्टेशन : पुरुलिया
STAION : Purulia

		मौसम परिघटना						पवन													मेघ											दृश्यता				
		के साथ दिनों की संख्या						पवन की गती के साथ दिनों की संख्या (कि. मी. प्र. घं.)				पवन की दिशा के दिनों की संख्या का प्रतिशत									मेघ मात्रा (सभी मेघ) सहित दिनों की संख्या - अष्ठमांश					निम्न स्तरी मेघ मात्रा सहित दिनों की संख्या - अष्ठमांश						दृश्यता सहित दिनों की संख्या				
माह		वर्षण 0.3 मि.मि.या अधिक	ओले	गर्जन	कुहरा	धूल भरी आंधी	चंड वात	62 या अधिक	20-61	1-19	0	उ	उपू	पू	दपू	द	दप	प	उप	शांत	0	ले-2	3-5	6-7	8	0	ले-2	3-5	6-7	8	कुहरा 8	1 कि.मी. नक	1-4 कि.मी.	4-10 कि.मी.	10-20 कि.मी.	20 कि.मी. से अधिक
		WEATHER PHENOMENA						WIND													CLOUD											VISIBILITY				
		No. OF DAYS WITH						No. OF DAYS WITH WIND SPEED (Km. p. h.)				PERCENTAGE No. OF DAYS WIND FROM									No. OF DAYS WITH CLOUD AMOUNT (ALL CLOUDS) OKTAS					No. OF DAYS WITH LOW CLOUD AMOUNT OKTAS						No. OF DAYS WITH VISIBILITY				
MONTH		PPT 0.3 mm Or more	HAIL	THUN DER	FOG	DUST STORM	SQU ALL	62 Or more	20-61	1-19	0	N	NE	E	SE	S	SW	W	NW	CALM	0	T-2	3-5	6-7	8	0	T-2	3-5	6-7	8	FOG 8	UP TO 1 Km.	1-4 Kms.	4-10 Kms.	10-20 Kms.	OVER 20 Kms.
जनवरी	I	2.2	0.0	0.7	0.5	0.0	0.0	0	0	22	9	7	2	0	2	1	5	11	43	29	21	3	3	2	2	24	1	2	2	2	0	0.2	0.4	3.4	6.6	20.5
JAN	II							0	0	6	25	3	2	1	1	0	1	1	11	80	17	5	4	3	2	23	3	2	1	2	0	0.1	6.5	18.5	5.8	0.1
फरवरी	I	3.3	0.1	2.3	0.1	0.1	0.0	0	0	20	8	10	2	1	3	1	8	10	38	27	18	3	3	2	2	20	2	2	2	2	0	0.0	0.5	3.6	5.0	19.0
FEB	II							0	0	11	17	5	2	0	2	0	4	2	22	63	15	4	5	2	2	18	3	3	2	2	0	0.0	1.6	8.1	11.6	6.7
मार्च	I	3.6	0.3	3.7	0.2	0.4	0.0	0	0	22	9	7	2	1	3	3	9	11	34	30	19	4	4	2	2	24	2	2	1	2	0	0.0	0.4	3.4	4.7	22.4
MAR	II							0	0	18	13	6	2	1	5	1	4	4	32	45	15	5	5	3	3	20	4	3	2	2	0	0.1	1.3	7.6	5.9	16.2
अप्रैल	I	4.6	0.3	6.5	0.1	1.1	0.0	0	0	22	8	5	4	1	14	7	11	9	20	29	17	5	5	2	1	21	3	3	2	1	0	0.0	0.3	2.3	5.1	22.3
APR	II							0	0	23	7	4	4	3	15	3	7	6	33	25	11	6	6	4	3	12	6	5	4	3	0	0.0	1.7	5.6	6.1	16.6
मई	I	7.6	0.1	8.8	0.0	1.4	0.0	0	0	24	7	3	5	4	23	13	15	3	12	22	14	6	6	3	2	18	4	4	3	2	0	0.1	0.7	2.7	6.1	21.5
MAY	II							0	0	25	6	5	8	5	26	6	7	1	22	20	5	6	9	5	6	9	6	7	4	5	0	0.0	2.5	6.9	6.9	14.7
जून	I	15.1	0.0	12.2	0.1	0.7	0.0	0	0	24	6	3	6	2	28	12	14	4	12	19	4	4	8	6	8	11	2	5	5	7	0	0.4	2.1	4.5	7.5	15.5
JUN	II							0	1	23	6	2	8	3	32	6	11	1	16	21	1	2	6	6	15	3	4	7	5	11	0	0.3	5.3	10.7	6.3	7.4
जुलाई	I	21.5	0.0	12.6	0.0	0.0	0.0	0	0	24	7	2	6	4	20	7	24	3	11	23	0	1	6	10	14	3	2	6	8	12	0	0.2	2.8	7.4	11.0	9.5
JUL	II							0	0	22	9	2	6	3	25	6	17	2	9	30	0	0	4	8	19	1	2	8	6	14	0	0.6	5.5	12.7	7.6	4.6
अगस्त	I	20.5	0.0	10.9	0.0	0.0	0.0	0	0	23	8	2	11	7	24	5	13	2	11	25	0	1	5	11	14	2	2	6	9	12	0	0.3	2.6	7.5	11.4	9.2
AUG	II							0	0	21	10	1	7	5	31	5	9	1	10	31	0	0	5	8	18	1	2	9	6	13	0	0.4	6.4	11.3	8.1	4.9
सितम्बर	I	15.8	0.0	9.5	0.1	0.0	0.0	0	0	21	9	4	7	4	21	5	10	3	16	30	3	4	7	7	9	8	3	5	7	7	0	0.3	2.6	4.6	8.2	14.3
SEP	II							0	0	16	14	2	6	4	26	3	6	1	6	46	1	2	5	6	16	3	4	8	4	11	0	0.5	5.2	11.5	7.2	5.6
अक्तूबर	I	6.3	0.0	3.2	0.3	0.0	0.0	0	0	20	11	7	6	3	6	3	5	4	30	36	14	4	5	4	4	18	3	3	3	4	0	0.0	0.9	3.3	5.9	21.0
OCT	II							0	0	7	24	2	4	1	7	2	3	1	5	75	7	7	8	4	5	12	6	6	3	4	0	0.3	2.8	14.8	7.5	5.6
नवम्बर	I	2.2	0.0	0.4	0.1	0.0	0.0	0	0	21	9	8	4	0	2	1	2	6	48	29	18	4	4	2	2	22	2	2	2	2	0	0.0	0.2	3.3	4.4	22.1
NOV	II							0	0	3	27	1	1	0	1	1	1	0	6	89	15	6	5	2	2	19	5	3	1	2	0	0.0	8.4	19.5	1.9	0.3
दिसम्बर	I	1.2	0.0	0.3	0.3	0.0	0.0	0	0	24	7	5	1	0	2	0	4	10	53	25	22	3	3	2	1	27	1	1	1	1	0	0.1	0.3	3.1	5.7	21.8
DEC	II							0	0	3	28	1	0	0	1	0	1	1	6	90	18	5	5	2	1	25	2	2	1	1	0	0.1	11.3	19.5	0.0	0.1
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN	I	104.0	0.8	71.2	1.7	3.7	0.0	0	1	267	97	5	5	2	13	5	10	6	27	27	152	42	58	54	59	201	27	39	44	54	0	1.4	13.6	49.1	80.7	220.1
	II							0	2	172	191	3	4	2	14	3	6	2	15	51	109	50	64	53	89	147	46	64	39	69	0	2.3	58.3	149.6	74.8	80.0
वर्षोंकी सं NUMBER OF YEARS	I	30						30				30									30					30						30				
	II																																		

TABLE-3.9.1
ON-SITE METEOROLOGICAL DATA
(December, 2022 – February, 2023)

Month	Temperature (°C)		Relative Humidity (%)		Barometric Pressure (mm Hg)		Average Velocity (Km/hr)
	Max.	Min.	08:30 hrs.	17:30 hrs.	08:30 hrs.	17:30 hrs.	
DECEMBER, 2022	29.0	10.0	71	56	745.9	740.3	3.3
JANUARY, 2023	26.0	9.5	72	44	747	747.1	2.3
FEBRUARY, 2023	30.5	11.0	62	49	744.8	740.2	2.5
OVERALL	30.5	9.5	71.0	44.0	744.8	740.2	2.7



December, 2022
Calm Value: 40.73%

January, 2023
Calm Value: 47.90%

February, 2023
Calm Value: 37.05%

December, 2022 to February, 2023
Calm Value: 41.97%

FIGURE-3.9.1

WIND ROSE DIAGRAM FOR THE PERIOD OF DECEMBER, 2022 TO FEBRUARY, 2023

3.10 AIR QUALITY

3.10.1 SELECTION OF MONITORING STATIONS

The sources of air pollution in the region are industrial emissions, vehicular traffic, dust arising from unpaved village roads and domestic fuel burning. The prime objective of the baseline air quality study was to establish the existing ambient air quality of the area. This will be useful for assessing the conformity to standards of the ambient air quality during the operation of the proposed expansion project.

The monitoring locations for establishing the baseline status of ambient air quality has been identified on the basis of the following considerations:

1. Meteorological conditions
2. Topography of the study area
3. Category of the area like habitat, forest etc.
4. Representative of likely affected area

Further, due consideration were also given to the likely affected zones during construction and operation of the plant. The location of human habitation and other sensitive areas within the study area were also considered in selection of ambient air quality monitoring locations.

Eight (8) numbers of monitoring stations were set up to assess the existing air quality of the study area. The locations of the monitoring stations were based on the frequent wind directions in order to site the stations as close as feasible to the anticipated maximum pollutant deposition areas, moreover, duly considering human habitation and proximity to sensitive zones within the study area. Logistic considerations as ready accessibility, security, availability of reliable power supply etc. were examined while finalizing the monitoring locations.

The Ambient Air Quality Monitoring locations have been presented in **Figure-3.10.1**. The relative direction, distance, latitude and longitude of these locations with respect to the project site have been tabulated in **Table-3.10.1**.

3.10.2 PARAMETERS & FREQUENCY OF MONITORING

Ambient Air Quality Monitoring has been conducted for the period **(December, 2022 – February, 2023)** at a frequency of twice a week at each station adopting a continuous 24 hours schedule in respect of the following parameters:

- Particulate Matter-10 (PM_{10})
- Particulate Matter-2.5 ($PM_{2.5}$)
- Sulphur Dioxide (SO_2)
- Nitrogen Dioxide (NO_2)

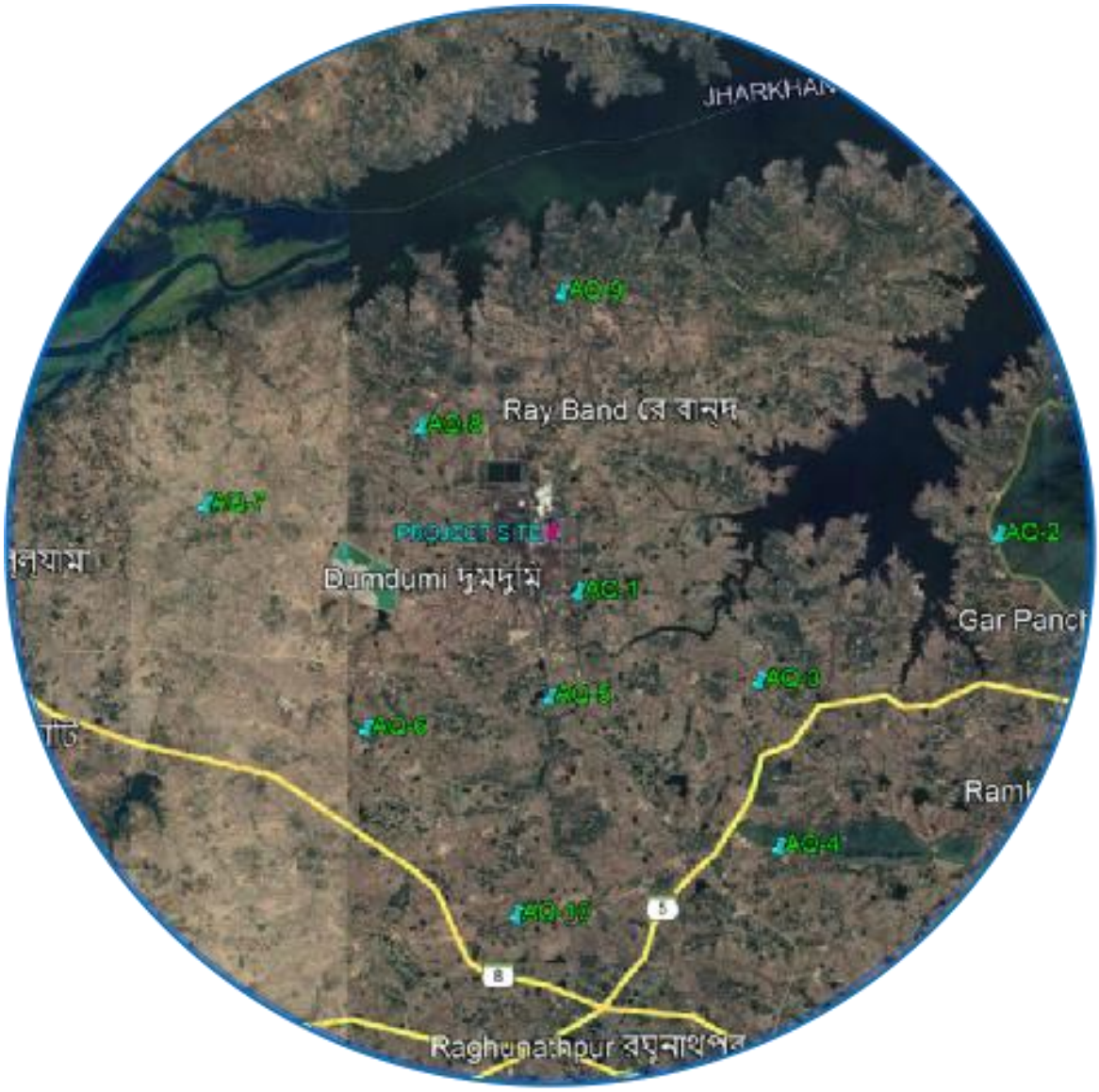
Carbon Monoxide (CO) monitoring has been conducted for the same period at a frequency of twice a week at each station adopting a continuous 8 hours schedule.

TABLE - 3.10.1
AMBIENT AIR QUALITY MONITORING LOCATIONS

Sl. No.	Location Code	Location	Aerial Distance w.r.t. Project site (km)	Direction w.r.t. Project site	Criteria for Selection
1	AQ1	Near Project Site (Kewabathan)	1.3	SSE	Representation of the Project Site.
2	AQ2	Rampur Vivekananda Vidyalaya	8.4	E	Located in the settlement area
3	AQ3	Laldanga Sishu Sikha Kendro	4.8	SE	Located in the settlement area and representing the predominant down-wind direction.
4	AQ4	Mahul Bari Primary School	7.3	SE	Located in the Settlement and agriculture area
5	AQ5	Nildih High School (HS)	3.1	S	Location in the Settlement and agriculture area and representing the 2nd predominant down-wind direction.
6	AQ6	Muldi Village	5.1	SW	Located in the settlement area.
7	AQ7	Barrah Anchal High School (H.S.)	6.5	W	Located in the settlement area.
8	AQ8	Achkoda Mallikpara	3.1	NW	Located in the village and Settlement area and representing the predominant up-wind direction.
9	AQ9	Sulanga Village	4.4	N	Located in the village and Settlement area and representing the 2nd predominant up-wind direction.

10	AQ10	Sarak Para Nanduara Village	7.2	S	Located in the village and Settlement area and representing the 2nd predominant down-wind direction.

Location Code	Location	Co-ordinates	
		Latitude	Longitude
AQ1	Near Project Site (Kewabathan Primary School)	23°36'30.55"N	86°39'56.25"E
AQ2	Rampur Vivekananda Vidyalaya	23°37'7.09"N	86°44'33.84"E
AQ3	Laldanga Sishu Sikha Kendro	23°35'37.41"N	86°41'56.13"E
AQ4	Mahul Bari Primary School	23°33'57.42"N	86°42'10.07"E
AQ5	Nildih High School (HS)	23°35'26.77"N	86°39'37.41"E
AQ6	Muldi Village	23°35'6.86"N	86°37'36.74"E
AQ7	Barrah Anchal High School (H.S.)	23°37'21.61"N	86°35'49.21"E
AQ8	Achkoda Mallikpara Near Manasa Temple	23°38'9.78"N	86°38'11.37"E
AQ9	Sulanga Village	23°39'31.72"N	86°39'43.98"E
AQ10	Sarak Para Nanduara Village	23°33'15.03"N	86°39'16.71"E



Location Code	Location Name	Distance (km)	Direction
AQ1	Near Project Site (Kewabathan)	1.3	SSE
AQ2	Rampur Vivekananda Vidyalaya	8.4	E
AQ3	Laldanga Sishu Sikha Kendro	4.8	SE
AQ4	Mahul Bari Primary School	7.3	SE
AQ5	Nildih High School (HS)	3.1	S
AQ6	Muldi Village	5.1	SW
AQ7	Barrah Anchal High School (H.S.)	6.5	W
AQ8	Achkoda Mallikpara	3.1	NW
AQ9	Sulanga Village	4.4	N
AQ10	Sarak Para Nanduara Village	7.2	S

FIGURE-3.10.1
AMBIENT AIR QUALITY MONITORING STATIONS

TABLE-3.10.2

STATISTICAL ANALYSIS RESULTS OF AIR POLLUTANTS

(Period: December, 2022 - February, 2023)

POLLUTANTS	LOCATIONS	MES	MIN	MAX	A.M.	P - 98
PM10 ($\mu g/m^3$)	Near Project Site (Kewabathan)	25	56	77	64.8	76.0
	Rampur Vivekananda Vidyalaya	25	50	66	57.9	65.0
	Laldanga Sishu Sikha Kendro	25	58	79	68.0	79.0
	Mahul Bari Primary School	25	55	73	63.4	73.0
	Nildih High School (HS)	25	65	88	74.0	88.0
	Muldi Village	25	62	78	69.0	78.0
	Barrah Anchal High School	25	52	67	58.4	66.5
	Achkoda Mallikpara	25	64	85	71.6	85.0
	Sulanga Village	25	57	76	67.4	76
	Sarak Para Nanduara Village	25	60	74	66.5	74
	Overall	**200**	**50**	**88**	**65.9**	**-**
PM2.5 ($\mu g/m^3$)	Near Project Site (Kewabathan)	25	24	38	29.1	36.5
	Rampur Vivekananda Vidyalaya	25	19	30	26.0	30.2
	Laldanga Sishu Sikha Kendro	25	24	38	31.1	37.5
	Mahul Bari Primary School	25	22	33	29.1	32.9
	Nildih High School (HS)	25	28	43	33.9	43.1
	Muldi Village	25	25	39	32.1	38.8
	Barrah Anchal High School	25	20	31	26.1	30.9
	Achkoda Mallikpara	25	28	42	33.2	41.7
	Sulanga Village	25	26	39	31.4	39
	Sarak Para Nanduara Village	25	27	35	30.7	34
	Overall	**200**	**19**	**43**	**30.1**	**-**
SO2 ($\mu g/m^3$)	Near Project Site (Kewabathan)	25	8	18	12.3	18.0
	Rampur Vivekananda Vidyalaya	25	4	8	6.1	8.0
	Laldanga Sishu Sikha Kendro	25	6	13	8.4	12.5
	Mahul Bari Primary School	25	5	10	7.4	10.0
	Nildih High School (HS)	25	9	16	12.2	16.0
	Muldi Village	25	8	14	10.7	13.5
	Barrah Anchal High School	25	4	9	6.6	9.0
	Achkoda Mallikpara	25	8	15	10.4	14.5
	Sulanga Village	25	5	11	6.8	10.52
	Sarak Para Nanduara Village	25	9	17	11.6	16.04
	Overall	**200**	**4**	**18**	**9.3**	**-**
NO2 ($\mu g/m^3$)	Near Project Site (Kewabathan)	25	20	38	25.7	34.6
	Rampur Vivekananda Vidyalaya	25	11	25	17.7	24.0
	Laldanga Sishu Sikha Kendro	25	14	30	19.2	28.1
	Mahul Bari Primary School	25	15	27	20.9	27.0
	Nildih High School (HS)	25	23	40	30.5	39.0
	Muldi Village	25	18	33	25.8	32.5
	Barrah Anchal High School	25	12	23	18.4	23.0

	LOCATIONS	MES	MIN	MAX	A.M.	P -98
	Achkoda Mallikpara	25	16	35	23.4	34.5
	Sulanga Village	25	10	22	16.2	21.52
	Sarak Para Nanduara Village	25	17	31	22.4	31
	Overall	**200**	**11**	**40**	**22.7**	**-**
CO (mg/m^3)	Near Project Site (Kewabathan)	75	0.233	1.143	0.589	1.083
	Rampur Vivekananda Vidyalaya	75	0.111	0.697	0.351	0.653
	Laldanga Sishu Sikha Kendro	75	0.268	0.828	0.466	0.758
	Mahul Bari Primary School	75	0.172	0.644	0.365	0.589
	Nildih High School (HS)	75	0.205	1.158	0.631	1.121
	Muldi Village	75	0.245	0.784	0.450	0.740
	Barrah Anchal High School (H.S.)	75	0.123	0.588	0.367	0.562
	Achkoda Mallikpara	75	0.185	0.925	0.513	0.844
	Sulanga Village	75	0.154	0.619	0.349	0.584
	Sarak Para Nanduara Village	75	0.181	0.753	0.421	0.725
	Overall	**600**	**0.111**	**1.158**	**0.45**	**-**

N.B.: **MES** - No. of measurements, **MIN** - Minimum, **MAX** - Maximum, **A.M.** - Arithmetic Mean, **P-98** - 98 Percentile.

3.10.3 RESULTS & DISCUSSIONS

Statistical analysis (minimum, maximum, arithmetic mean) of the ambient air quality in the study area for the entire three months monitoring period are shown in **Table-3.10.2**.

The following implications can be made on the basis of the obtained results:

3.10.3.1 Particulate Matter-10 (PM_{10})

Arithmetic Mean of the 24-hourly average values of PM_{10} varied station-wise between 50.0 $\mu g/m^3$ (at Rampur Vivekananda Vidyalaya) to 88.0 $\mu g/m^3$ (at Nildih High School (HS)) with overall mean of all 8 stations being 65.9$\mu g/m^3$.

Arithmetic Mean of the 24-hourly average values of PM_{10} at all locations is under the limit of (100 $\mu g/m^3$) National Ambient Air Quality Standards, 2009.

3.10.3.2 Particulate Matter - 2.5 ($PM_{2.5}$)

Arithmetic Mean of the 24-hourly average values of $PM_{2.5}$ varied station-wise between 19.0 $\mu g/m^3$ (at Rampur Vivekananda Vidyalaya) to 43.0 $\mu g/m^3$ (at Nildih High School (HS)) with overall mean of all 8 stations being 30.1 $\mu g/m^3$.

Arithmetic Mean of the 24-hourly average values of $PM_{2.5}$ at all locations is under the limit of (60 $\mu g/m^3$) National Ambient Air Quality Standards, 2009.

3.10.3.3 Sulphur Dioxide (SO_2)

Arithmetic mean of 24-hourly average values of SO_2 varied station wise between 4.0 $\mu g/m^3$ (at Rampur Vivekananda Vidyalaya) to 18 $\mu g/m^3$ (Near Project Site (Kewabathan)) with overall mean of all 8 stations being 9.3 $\mu g/m^3$.

Arithmetic Mean of the 24-hourly average values of SO_2 at all locations is under the limit of (80 $\mu g/m^3$) National Ambient Air Quality Standards, 2009.

3.10.3.4 Nitrogen Dioxide (NO_2)

The overall arithmetic mean of 24-hourly average values of NO_2 over the entire study area was 22.7 $\mu g/m^3$ while individual arithmetic mean levels computed at 8 stations ranged between 11.0 $\mu g/m^3$ (at Rampur Vivekananda Vidyalaya) to 40.0 $\mu g/m^3$ (at Nildih High School (HS)).

Arithmetic Mean of the 24-hourly average values of NO_2 at all locations is under the limit of (80 $\mu g/m^3$) National Ambient Air Quality Standards, 2009.

3.10.3.5 Carbon Monoxide (CO)

The overall arithmetic mean of 8-hourly average values of CO over the entire study area was 0.349 mg/m^3 while individual arithmetic mean levels computed at 8 stations ranged between 0.111 mg/m^3 Jangichak (at Rampur Vivekananda Vidyalaya) to 1.158 mg/m^3 (at Nildih High School (HS)).

Arithmetic Mean of the 24-hourly average values of CO at all locations is under the limit of (2 mg/m^3) National Ambient Air Quality Standards, 2009.

The graphical analyses of the concentrations of all pollutants have been shown in **Figure-3.10.2** to **Figure-3.10.6**.

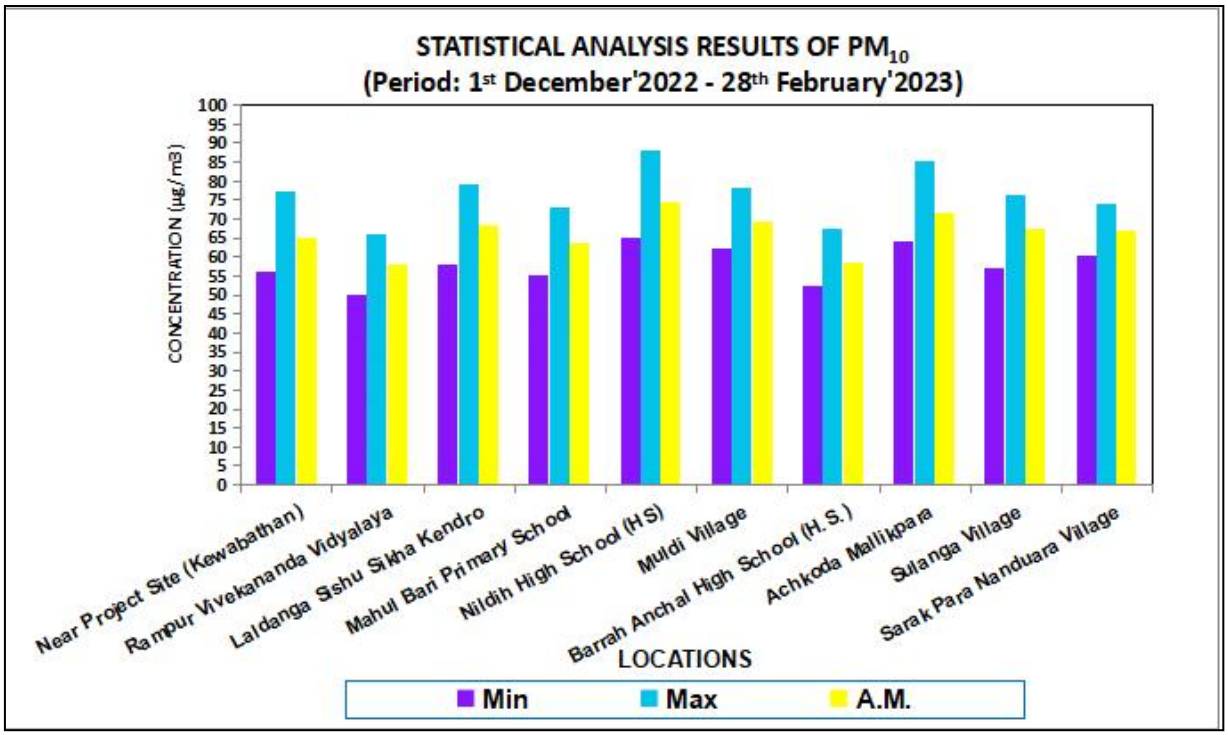


FIGURE-3.10.2: DIAGRAM OF PM_{10} OF ALL AAQM STATIONS

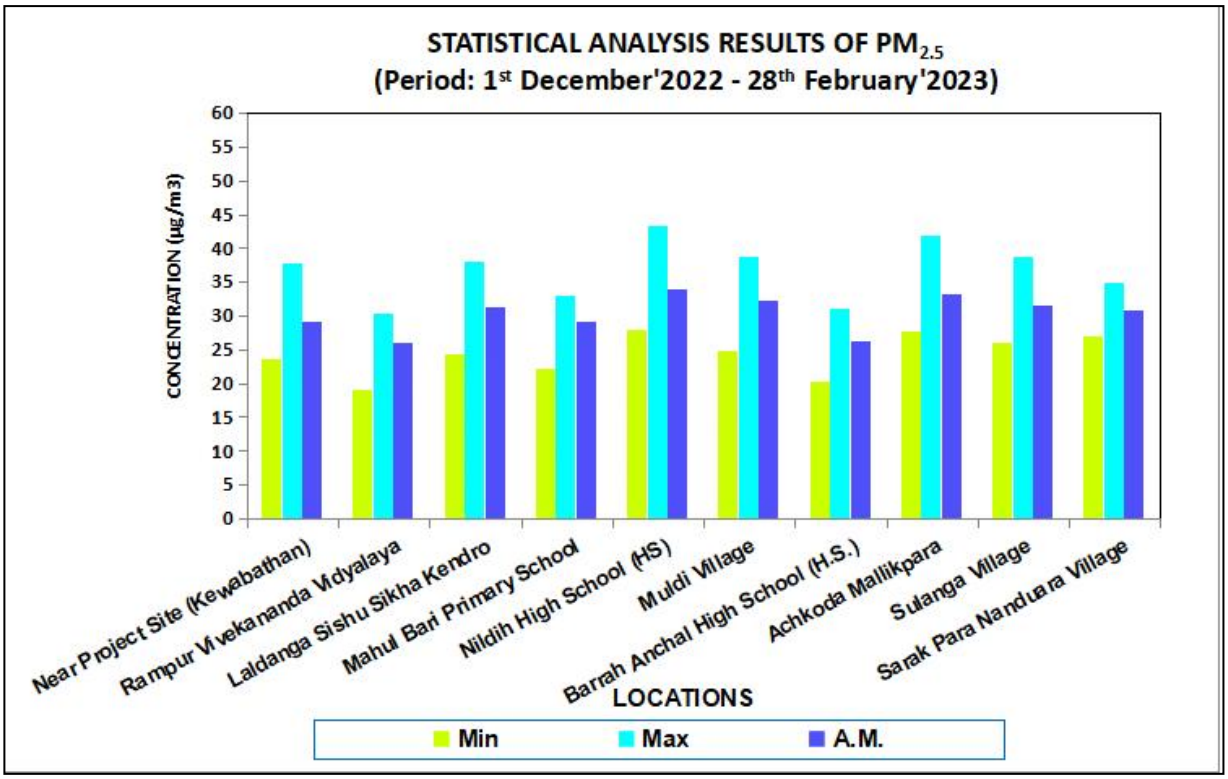


FIGURE-3.10.3: DIAGRAM OF $PM_{2.5}$ OF ALL AAQM STATIONS

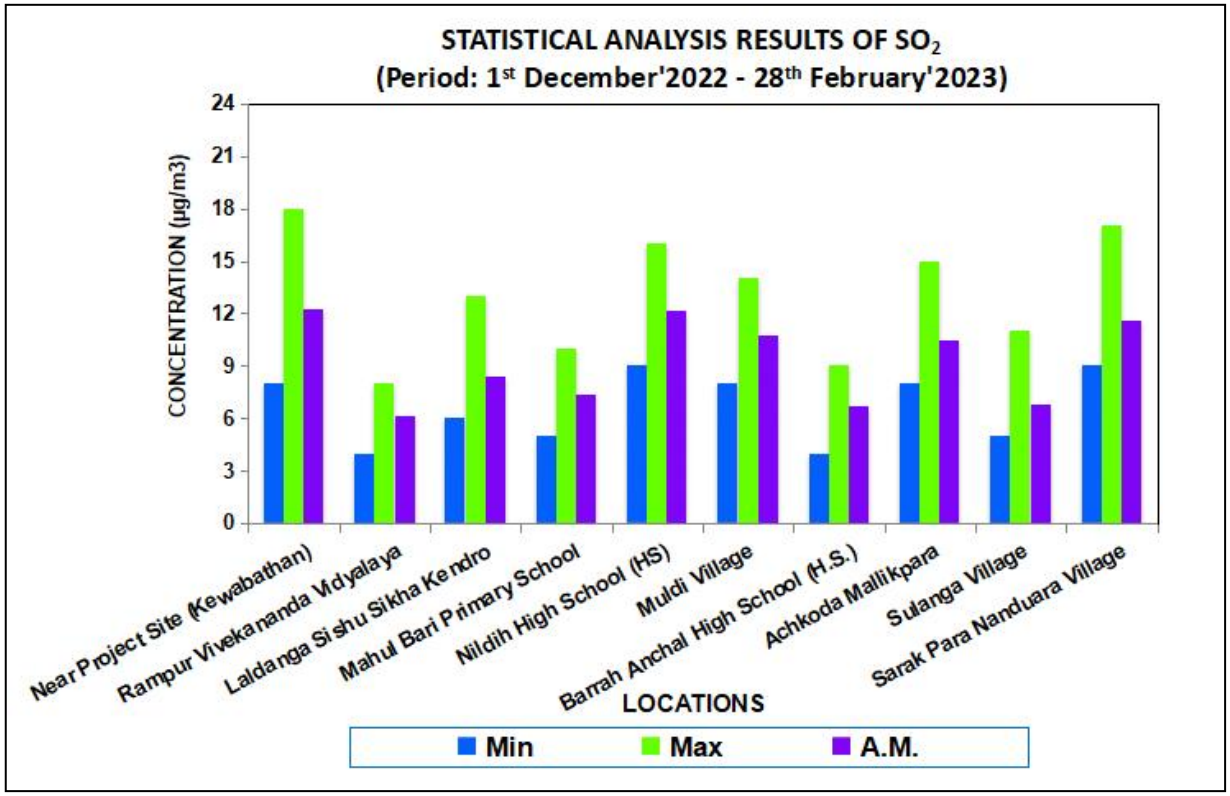


FIGURE-3.10.4: DIAGRAM OF SO_2 OF ALL AAQM STATIONS

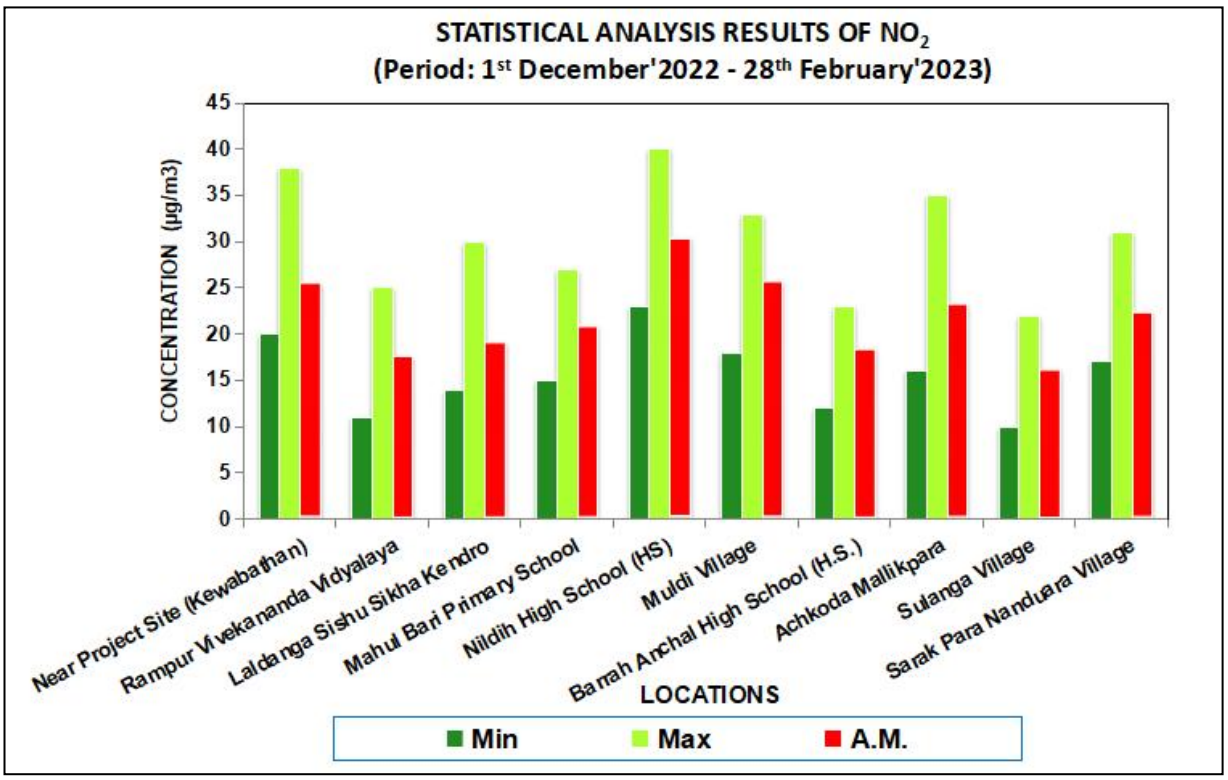


FIGURE-3.10.5: DIAGRAM OF NOx OF ALL AAQM STATIONS

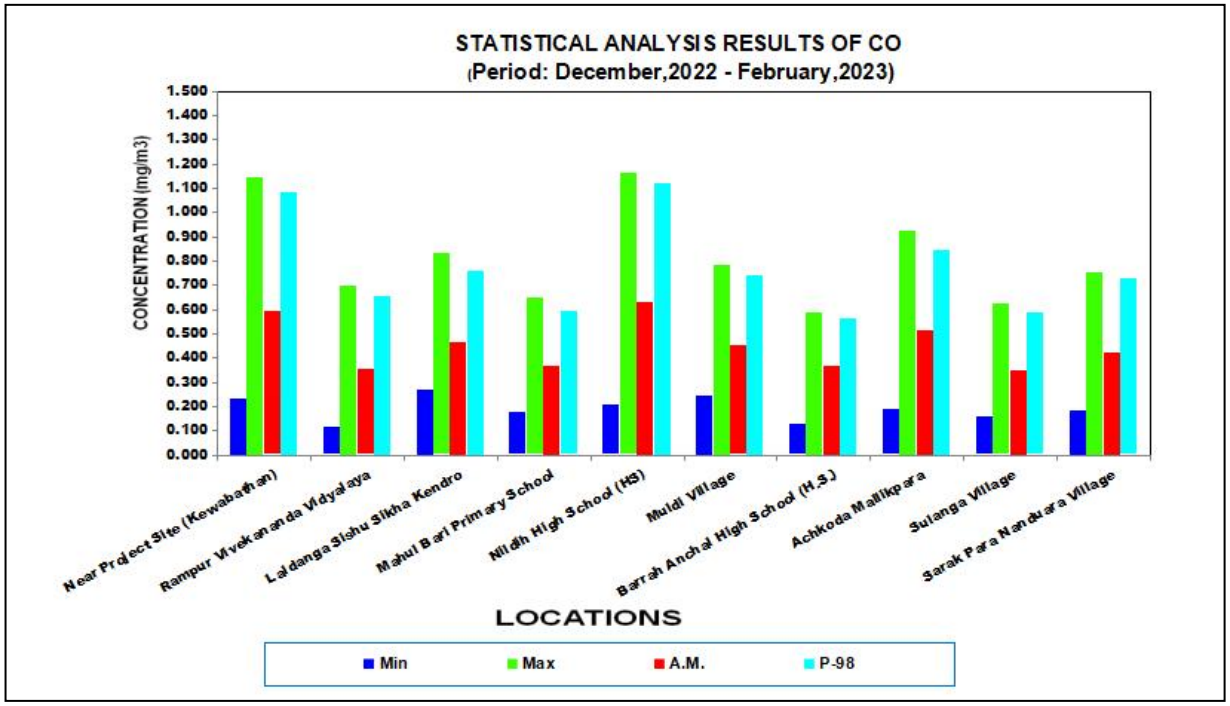


FIGURE-3.10.6: DIAGRAM OF COOF ALL AAQM STATIONS

National Ambient Air Quality Standards

S. No.	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, Residential, Rural and Other Area	Ecologically Sensitive Area (notified by Central Government)	Methods of Measurement
(1)	(2)	(3)	(4)	(5)	(6)
1	Sulphur Dioxide (SO_2), µg/m^3	Annual*	50	20	- Improved West and Gaeke
		24 hours**	80	80	-Ultraviolet fluorescence
2	Nitrogen Dioxide (NO_2), µg/m^3	Annual*	40	30	- Modified Jacob & Hochheiser (Na-Arsenite)
		24 hours**	80	80	- Chemiluminescence
3	Particulate Matter (size less than 10µm) or PM_{10} µg/m^3	Annual*	60	60	- Gravimetric - TOEM
		24 hours**	100	100	- Beta attenuation
4	Particulate Matter (size less than 2.5µm) or $PM_{2.5}$ µg/m^3	Annual*	40	40	- Gravimetric - TOEM
		24 hours**	60	60	- Beta attenuation
5	Ozone (O_3) µg/m^3	8 hours**	100	100	- UV photometric - Chemilminescence
		1 hour**	180	180	- Chemical Method
6	Lead (Pb) µg/m^3	Annual*	0.50	0.50	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper
		24 hours**	1.0	1.0	- ED-XRF using Teflon filter
7	Carbon Monoxide (CO) mg/m^3	8 hours**	02	02	- Non Dispersive Infra Red (NDIR) spectroscopy
		1 hour**	04	04	
8	Ammonia (NH_3) µg/m^3	Annual*	100	100	-Chemiluminescence
		24 hours**	400	400	-Indophenol blue method

(1)	(2)	(3)	(4)	(5)	(6)
9	Benzene (C_6H_6) $\mu g/m^3$	Annual*	05	05	- Gas chromatography based continuous analyzer - Adsorption and Desorption followed by GC analysis
10	Benzo(a)Pyrene (BaP) - particulate phase only, ng/m^3	Annual*	01	01	- Solvent extraction followed by HPLC/GC analysis
11	Arsenic (As), ng/m^3	Annual*	06	06	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper
12	Nickel (Ni), ng/m^3	Annual*	20	20	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper

* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

** 24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

Note. — Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.

SANT PRASAD GAUTAM, Chairman
[ADVT-III/4/184/09/Exty.]

Note: The notifications on National Ambient Air Quality Standards were published by the Central Pollution Control Board in the Gazette of India, Extraordinary vide notification No(s). S.O. 384(E), dated 11th April, 1994 and S.O. 935(E), dated 14th October, 1998.

3.10.4 Conclusion

The above table reveals that the ambient air quality monitoring stations like near (AQ1), (AQ2), (AQ3), (AQ4) and (AQ5) are likely to be affected by pollution arising due to brick field, industries and transportation of materials during the operational phase of the project.

The values of all the ambient air parameters i.e., PM_{10}, $PM_{2.5}$, SO_2, NO_2 and CO at the respective 8 monitoring locations are within the stipulated limits on all the occasions as per NAAQ Standard. The maximum value of PM_{10} was observed at Nildih High School (HS) i.e., 88 $\mu g/m^3$, which is considerably on higher side, but is still within the standard. This may be attributed to the wind blown dust due to the unpaved roads and the vehicular emissions in the area.

3.11 WATER ENVIRONMENT

3.11.1 WATER BODIES IN THE STUDY AREA

The main surface water body in the study area is the river Damodar. This river is mainly perennial in nature, which means it has sufficient water to flow all around the year. Besides, a number of confined water bodies, viz. Tanks, Ponds, Jheels, road side burrows etc. which form a part of surface hydrological system, exist within the study area. As the River Damodar is the main drainage channel of the region, this river receives pollution loads of industrial and domestic waste water and also agricultural run-off. Ground water sources are mainly bore wells, tube wells and dug wells which are scattered in the whole study area.

3.11.2 WATER SAMPLING

As surface water, water samples were collected and analyzed from total ten (10) locations, including two (2) different locations from the Damodar River water and eight (10) from different ponds of different locations, Ground water samples were collected and analyzed from total nine (9) different locations from tube wells /bore wells to assess the baseline status of the whole water quality in the study area.

Out of two water (Damodar River) samples, one was collected near Jamuadih Village and the other near (Near Telkupi) village.

All the samples were analyzed with respect to physical, chemical and biological parameters including toxic organics and metals, adopting Standard methods. The locations of the sampling points for both surface and ground water are tabulated in **Table-3.11.1**. Surface water and Ground water sampling locations have been presented in **Figure-3.11.1** and **Figure-3.11.2** respectively.

3.11.3 SURFACE WATER QUALITY

All the samples were analyzed with respect to physical, chemical and biological parameters including toxic organics and metals, adopting Standard methods. Sampling and analysis of surface water were carried out following the analysis techniques and methodology described in relevant Indian Standards and as per 23rd edition of "Standard Methods for the Examination of Water and Waste Water" published by American Public Health Association (APHA), 2017. Analysis results of all surface water samples were compared with CPCB Water Quality Criteria for Surface Water.

3.11.3.1 RESULTS OF SURFACE WATER QUALITY MONITORING:

Results of Water Quality from the River Water:

The water quality monitoring results of river water samples (**SW1, SW-2)** have been compiled in **Table-3.11.3**.

The pH values of the collected two water samples (**SW1 and SW2**) from the river water were found pH 7.2- 7.5 Value of Dissolved Oxygen were observed (6.7- 7.7) mg/lit. Total Dissolved Solids were found (196 - 206) mg/lit while value of total Hardness (as $CaCO_3$) & total Alkalinity (as $CaCO_3$) were found (102 - 117) mg/lit & (109 - 119) mg/lit respectively. Calcium (as Ca) & Magnesium (as Mg) were found (29 - 30) mg/lit and (7 - 10) mg/lit respectively. Oil and grease was below detection limit (<1.4 mg/lit) in these sample. Sulphate (as SO_4), Nitrate (as NO_3) and Chloride (as Cl) were observed (14 - 20) mg/lit, (2.7 - 3.3) mg/lit and (40 - 43) mg/lit respectively. Iron (as Fe) contents were found (0.15 - 0.19) mg/lit and BOD were found (2 - 2) mg/lit respectively.

Heavy metals like Copper (as Cu), Lead (as Pb), Cadmium (as Cd), Chromium (as Cr), Manganese (as Mn), Arsenic (as As) and Mercury (as Hg) in these Canal water sample (**SW1 & SW2**) were below their respective detection limits.

Results of Pond Water Quality:

The water quality monitoring results of eight (8) pond water samples (**SW3** to **SW12**) have been compiled in **Table-3.13.2**.

The pH values of the collected pond water samples were found in the range of (7.02 – 7.82). Dissolved Oxygen was observed in the ranges of (6.08 – 7.19) mg/lit. Total Dissolved Solids were found in the ranges of (290 – 394) mg/lit while total Hardness (as $CaCO_3$) & total Alkalinity (as $CaCO_3$) were found (131 - 172) mg/lit & (109 - 119) mg/lit respectively. Calcium (as Ca) & Magnesium (as Mg) were found varying in the ranges of (30 – 52) mg/lit and (8 – 17) mg/lit respectively. Oil and grease was below detection limit (<1.4 mg/lit) in these samples. Sulphate (as SO_4), Nitrate (as NO_3) and Chloride (as Cl) were observed varying in the ranges of (13 – 36) mg/lit, (3.8 – 6.6) mg/lit and (64 – 112) mg/lit respectively. Values of Iron (as Fe) were found in the ranges of (0.16 – 0.25) mg/lit .

Heavy metals like Copper (as Cu), Lead (as Pb), Cadmium (as Cd), Chromium (as Cr), Manganese (as Mn), Arsenic (as As) and Mercury (as

Hg) of these pond water samples (**SW3** to **SW12**) were below their respective detection limits.

3.11.4 GROUND WATER QUALITY

Ground Water samples (from bore-well and Tube well) were collected from 9 locations (GW1 to GW9). Locations of ground water sampling have been shown in **Table-3.11.1**. The ground water quality monitoring results have been presented in **Table-3.11.2**.

Sampling and analysis of ground water were carried out following the analysis techniques and methodology described in relevant Indian Standards. The ground water quality monitoring results have been tabulated in **Table-3.11.2**.

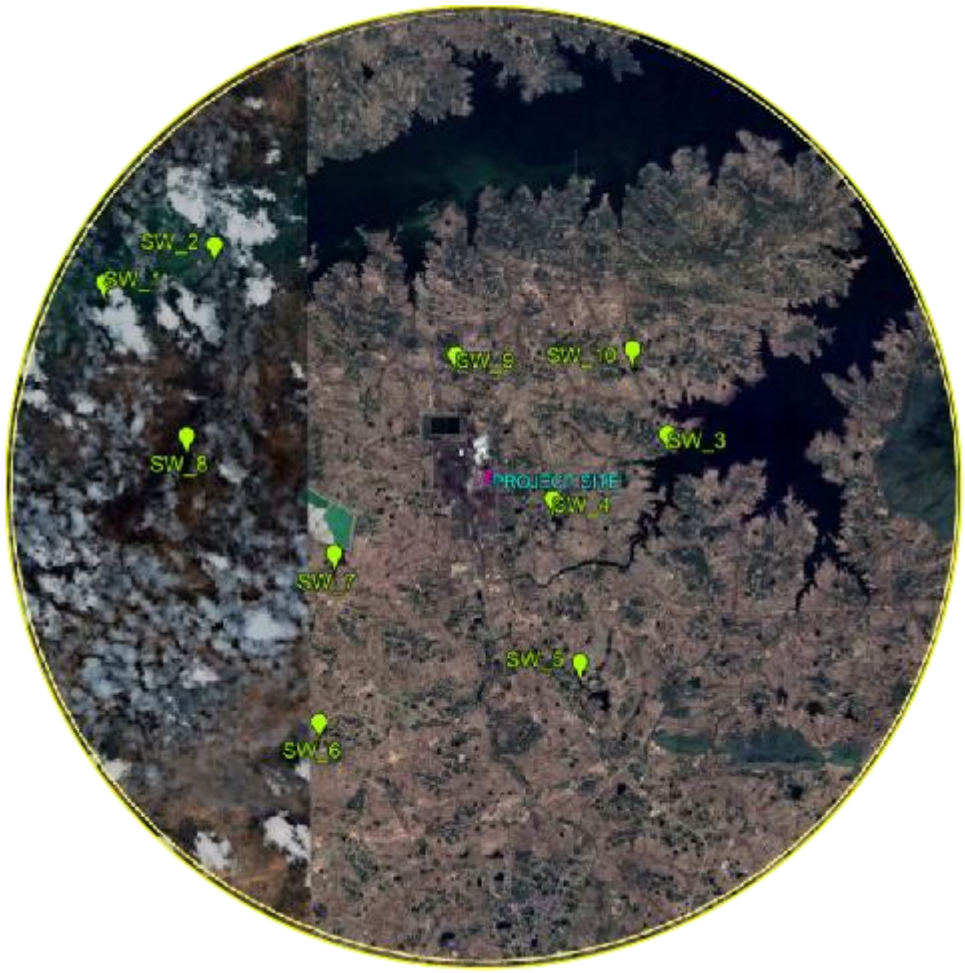
3.11.4.1 RESULTS OF GROUND WATER QUALITY MONITORING:

The pH values of collected ground water samples were found in the range of (6.6 – 7.5). Total Dissolved Solids (TDS) was found in the range of (336 – 552) mg/lit, while Total Hardness (as $CaCO_3$) was found in the ranges of (158 – 222) mg/lit. Alkalinity (as $CaCO_3$) was found in the ranges of (135 – 251) mg/lit. Calcium (as Ca) and Magnesium (as Mg) were found varying in the ranges of (43 – 70) mg/lit and (8 – 16) mg/lit respectively. Sulphate (as SO_4), Nitrate (as NO_3) and Chloride (as Cl) were observed in the ranges of (10 – 38) mg/lit, (3.0 – 5.7) mg/lit and (778 – 145) mg/lit respectively. Iron (as Fe) content was found in the range of (0.23 – 0.43) mg/lit and Zinc (as Zn) content was found (0.08 – 0.11) mg/lit.

Other heavy metals like Copper (as Cu), Lead (as Pb), Cadmium (as Cd), Chromium (as Cr), Manganese (as Mn), Arsenic (as As) and Mercury (as Hg) were below their respective detection limits.

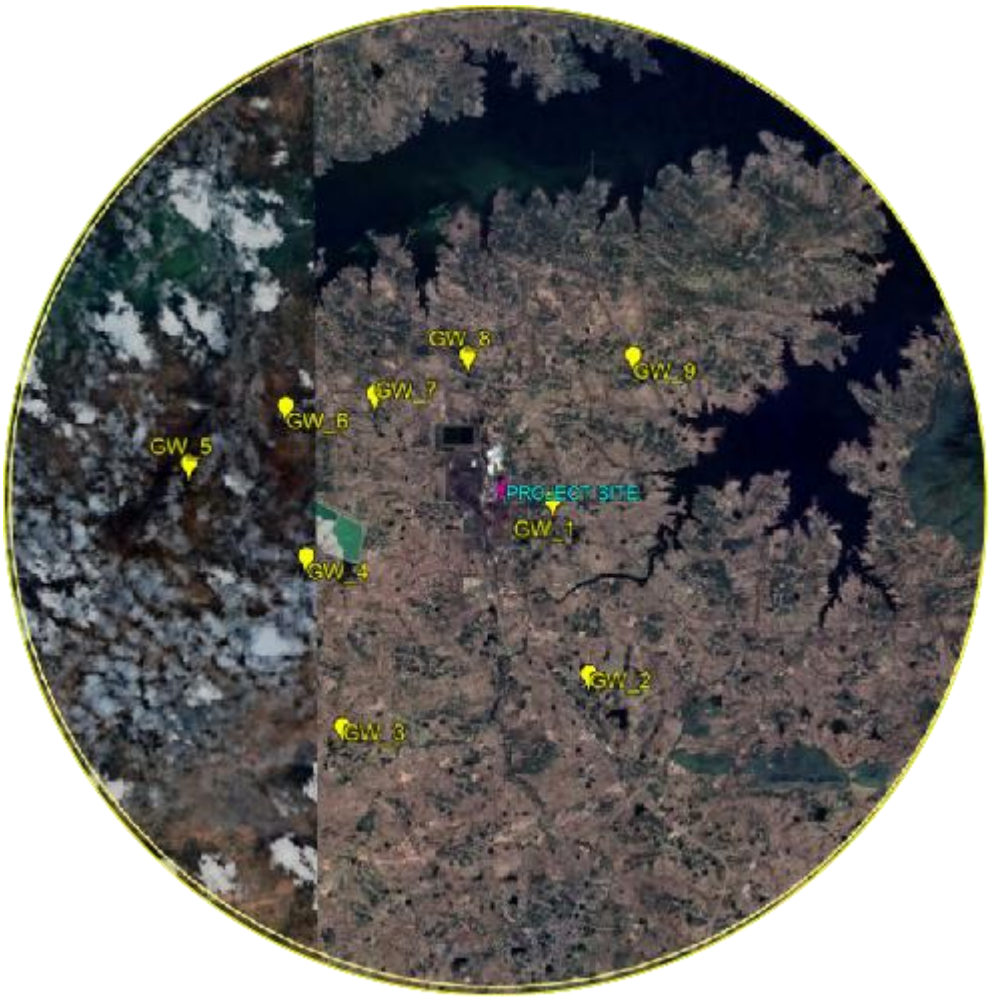
TABLE-3.11.1
WATER QUALITY MONITORING LOCATIONS IN THE STUDY AREA

Sample Code	Locations	Latitude	Longitude
SURFACE WATER:			
SW1	Damodar River (Jamuadih)	23°39'14.39"N	86°34'52.64"E
SW2	Damodar River (Telkupi)	23°39'40.26"N	86°36'15.82"E
SW3	Panchet Dam (Bagraybari)	23°37'30.14"N	86°41'55.69"E
SW4	Pond Water (Ghutitara Village)	23°36'46.04"N	86°40'29.36"E
SW5	Pond Water (Durmut Village)	23°34'53.76"N	86°40'50.07"E
SW6	Pond Water (Mangalda Village)	23°34'12.87"N	86°37'34.64"E
SW7	Pond Water (Simra Village)	23°36'8.52"N	86°37'45.91"E
SW8	Pond Water (Barra Village)	23°37'29.17"N	86°35'55.15"E
SW9	Pond Water (Dumurhir Village)	23°38'24.94"N	86°39'16.79"E
SW10	Pond Water (Guniara Village)	23°38'28.60"N	86°41'29.38"E
GROUND WATER:			
GW1	Ghutitara (Tubewell water)	23°36'53.50"N	86°40'18.02"E
GW2	Durmut (Tubewell water)	23°34'57.32"N	86°40'44.47"E
GW3	Mangalda (Tubewell water)	23°34'22.64"N	86°37'45.54"E
GW4	Simra (Tubewell water)	23°36'16.01"N	86°37'19.17"E
GW5	Barra (Tubewell water)	23°37'17.88"N	86°35'53.82"E
GW6	Baragarya (Tubewell water)	23°37'56.30"N	86°37'4.23"E
GW7	Achkoda (Tubewell water)	23°38'4.17"N	86°38'8.73"E
GW8	Dumurhir (Tubewell water)	23°38'29.89"N	86°39'16.47"E
GW9	Mangram (Tubewell water)	23°38'29.68"N	86°41'16.50"E



Sample Code	Location	Direction & Distance from centre of project site (km)	Date of Sampling
SW1	Damodar River (Jamuadih)	9.0 - WNW	05.01.2023
SW2	Damodar River (Telkupi)	7.4 - NW	05.01.2023
SW3	Panchet Dam (Bagraybari)	3.9 - E	05.01.2023
SW4	Pond Water (Ghutitara Village)	1.6 - ESE	05.01.2023
SW5	Pond Water (Durmut Village)	4.6 - SSE	05.01.2023
SW6	Pond Water (Mangalda Village)	6.5 - SSW	05.01.2023
SW7	Pond Water (Simra Village)	3.7 - WSW	05.01.2023
SW8	Pond Water (Barra Village)	6.4 - W	05.01.2023
SW9	Pond Water (Dumurhir Village)	2.4 - NNW	05.01.2023
SW10	Pond Water (Guniara Village)	4.0 - NE	05.01.2023

FIGURE-3.11.1
SURFACE WATER SAMPLING LOCATIONS



Sample Code	Location	Direction & Distance from centre of project site (km)	Date of Sampling
GW1	Ghutitara (Tubewell water)	1.2 - ESE	06.01.2023
GW2	Durmut (Tubewell water)	4.5 - SSE	06.01.203
GW3	Mangalda (Tubewell water)	6.0 - SSW	06.01.2023
GW4	Simra (Tubewell water)	4.3 - WSW	06.01.2023
GW5	Barra (Tubewell water)	6.4 -W	06.01.2023
GW6	Baragarya (Tubewell water)	4.6 - WNW	06.01.2023
GW7	Achkoda (Tubewell water)	3.1 - NW	06.01.2023
GW8	Dumurhir (Tubewell water)	2.6 - NNW	06.01.2023
GW9	Mangram (Tubewell water)	3.7 - NE	06.01.2023

FIGURE-3.11.2
SURFACE WATER SAMPLING LOCATIONS

TABLE-3.11.2
GROUND WATER QUALITY

Sl.NO	Parameter	Unit	Concentrations (Code : GW_1 to GW_5)				
			GW_1	GW_2	GW_3	GW_4	GW_5
1	Colour	Hazen	<5	<5	<5	<5	<5
2	Odour		Unobj.	Unobj.	Unobj.	Unobj.	Unobj.
3	Taste		Agreeabl	Agreeabl	Agreeable	Agreeabl	Agreeable
4	Turbidity	NTU	<1	<1	<1	<1	<1
5	pH	-	6.96	7.11	6.65	6.99	7.05
6	Conductivity	µS/cm	645	719	658	805	882
7	Free Residual Chlorine (mg/L)	mg/L	174	187	173	220	200
8	Total Dissolved Solids	mg/L	0.3	0.26	0.27	0.3	0.43
9	Phenol (as C6H5OH)	mg/L	87	106	103	128	145
10	Total Hardness (as CaCO3)	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
11	Total Alkalinity (as CaCO3)	mg/L	0.23	0.32	0.21	0.32	0.4
12	Chloride (as Cl)	mg/L	398	439	374	450	552
13	Sulphate (as SO4)	mg/L	55	54	43	65	67
14	Nitrate (as NO3)	mg/L	9	13	16	14	8
15	Fluoride (as F)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
16	Calcium (as Ca)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
17	Magnesium (as Mg)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
18	Ammonia (as Total NH3-N)	mg/L	26	25	27	30	38
19	Boron (as B)	mg/L	4.7	4.6	3	4.7	5.7
20	Chromium (as Cr)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
21	Copper (as Cu)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
22	Manganese (as Mn)	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003
23	Zinc (as Zn)	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002
24	Cadmium (as Cd)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
25	Iron (as Fe)	mg/L	<0.05	<0.05	<0.05	<0.05	0.09
26	Lead (as Pb)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
27	Silver (as Ag)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
28	Nickel (as Ni)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
29	Arsenic (as As)	ppb	<0.02	<0.02	<0.02	<0.02	<0.02
30	Mercury (as Hg)	ppb	179	204	135	206	222
31	Total Coliforms	MPN/100	N.D.	N.D.	N.D.	N.D.	N.D.

Unobj. – Unobjectional

CODE	LOCATION NAME
GW1	Ghutitara (Tubewell water)
GW2	Durmut (Tubewell water)
GW3	Mangalda (Tubewell water)
GW4	Simra (Tubewell water)
GW5	Barra (Tubewell water)

TABLE-3.11.2 (Continued)
GROUND WATER QUALITY

Sl.NO	Parameter	Unit	Concentrations (Code : GW_6 to GW_9)			
			GW_6	GW_7	GW_8	GW_9
1	Colour	Hazen	<5	<5	<5	<5
2	Odour		Unobj.	Unobj.	Unobj.	Unobj.
3	Taste		Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity	NTU	<1	<1	<1	<1
5	pH	-	7.47	7.53	7.13	7.35
6	Conductivity	µS/cm	663	562	764	578
7	Free Residual Chlorine (mg/L)	mg/L	182	158	222	175
8	Total Dissolved Solids	mg/L	0.26	0.23	0.4	0.27
9	Phenol (as C6H5OH)	mg/L	105	86	139	78
10	Total Hardness (as CaCO3)	mg/L	<0.1	<0.1	<0.1	<0.1
11	Total Alkalinity (as CaCO3)	mg/L	0.32	0.23	0.37	0.38
12	Chloride (as Cl)	mg/L	362	346	438	336
13	Sulphate (as SO4)	mg/L	53	45	70	48
14	Nitrate (as NO3)	mg/L	12	11	11	13
15	Fluoride (as F)	mg/L	<0.05	<0.05	<0.05	<0.05
16	Calcium (as Ca)	mg/L	<0.05	<0.05	<0.05	<0.05
17	Magnesium (as Mg)	mg/L	<0.05	<0.05	<0.05	<0.05
18	Ammonia (as Total NH3-N)	mg/L	16	10	13	29
19	Boron (as B)	mg/L	4.6	3.7	4.7	3
20	Chromium (as Cr)	mg/L	<0.001	<0.001	<0.001	<0.001
21	Copper (as Cu)	mg/L	<0.001	<0.001	<0.001	<0.001
22	Manganese (as Mn)	mg/L	<0.003	<0.003	<0.003	<0.003
23	Zinc (as Zn)	mg/L	<0.002	<0.002	<0.002	<0.002
24	Cadmium (as Cd)	mg/L	<0.01	<0.01	<0.01	<0.01
25	Iron (as Fe)	mg/L	0.08	<0.05	0.11	0.09
26	Lead (as Pb)	mg/L	<0.05	<0.05	<0.05	<0.05
27	Silver (as Ag)	mg/L	<0.01	<0.01	<0.01	<0.01
28	Nickel (as Ni)	mg/L	<0.05	<0.05	<0.05	<0.05
29	Arsenic (as As)	ppb	<0.02	<0.02	<0.02	<0.02
30	Mercury (as Hg)	ppb	187	167	251	174
31	Total Coliforms	MPN/100	N.D.	N.D.	N.D.	N.D.

Unobj. – Unobjectional

CODE	LOCATION NAME
GW6	Baragarya (Tubewell water)
GW7	Achkoda (Tubewell water)
GW8	Dumurhir (Tubewell water)
GW9	Mangram (Tubewell water)

TABLE-3.11.3
SURFACE WATER QUALITY

Sl.No.	Parameter	Unit	Concentrations (Code : SW_1 to SW_6)					
			SW_1	SW_2	SW_3	SW_4	SW_5	SW_6
1	Colour	Hazen Unit	<5	<5	<5	<5	<5	<5
2	Odour		Unobj.	Unobj.	Unobj.	Unobj.	Unobj.	Unobj.
3	pH		7.5	7.22	7.54	7.08	7.82	7.11
4	Conductivity	µS/cm	343	364	583	505	478	667
5	Dissolved Oxygen	mg/L	6.72	7.7	6.43	6.63	7.19	6.5
6	Chemical Oxygen Demand	mg/L	10	14	20	19	16	20
7	Biochemical Oxygen Demand (3 days at 270C)	mg/L	2	2	6	4	4	5
8	Total Coliforms	MPN/100	1358	1751	1056	1030	749	1128
9	Total Dissolved Solids	mg/L	196	206	345	316	297	394
10	Oil & Grease	mg/L	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4
11	Total Hardness (as CaCO3)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
12	Total Alkalinity (as CaCO3)	mg/L	102	117	160	142	172	162
13	Chloride (as Cl)	mg/L	40	43	112	90	73	102
14	Sulphate (as SO4)	mg/L	14	20	27	20	13	35
15	Nitrate (as NO3)	mg/L	3.36	2.74	3.82	5.17	4.46	6.39
16	Fluoride (as F)	mg/L	0.4	0.47	0.29	0.36	0.26	0.48
17	Calcium (as Ca)	mg/L	29	30	48	42	49	52
18	Magnessium (as Mg)	mg/L	7	10	10	9	12	8
19	Phenol (as C6H5OH)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
20	Copper (as Cu)	mg/L	0.15	0.19	0.18	0.22	0.2	0.21
21	Iron (as Fe)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
22	Manganese (as Mn)	mg/L	<0.05	<0.05	0.12	<0.05	<0.05	<0.05
23	Zinc (as Zn)	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
24	Boron (as B)	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
25	Lead (as Pb)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
26	Cadmium (as Cd)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
27	Hexavalent Chromium (as Cr+6)	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
28	Arsenic (as As)	ppb	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
29	Mercury (as Hg)	ppb	119	109	157	138	168	160
30	Ammonia (as NH3-N)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
31	Sodium Absorbance Ratio	-	1.3	1.4	2.4	2	1.3	2.3

Unobj. – Unobjectionable

CODE	LOCATION NAME
SW1	Damodar River (Jamuadih)
SW2	Damodar River (Telkupi)
SW3	Panchet Dam (Bagraybari)
SW4	Pond Water (Ghutitara Village)
SW5	Pond Water (Durmut Village)
SW6	Pond Water (Mangalda Village)

TABLE-3.11.3 (Continued)
SURFACE WATER QUALITY

Sl.No.	Parameter	Unit	Concentrations (Code : SW_7 to SW_12)			
			SW_7	SW_8	SW_9	SW_10
1	Colour	Hazen Unit	<5	<5	<5	<5
2	Odour		Unobj.	Unobj.	Unobj.	Unobj.
3	pH		7.48	7.44	7.22	7.02
4	Conductivity	µS/cm	572	506	626	514
5	Dissolved Oxygen	mg/L	6.1	6.6	6.3	7.2
6	Chemical Oxygen Demand	mg/L	24	20	24	15
7	Biochemical Oxygen Demand (3 days at 270C)	mg/L	7	6	6	3
8	Total Coliforms	MPN/100	1358	966	1133	721
9	Total Dissolved Solids	mg/L	324	295	391	290
10	Oil & Grease	mg/L	<1.4	<1.4	<1.4	<1.4
11	Total Hardness (as CaCO3)	mg/L	<0.001	<0.001	<0.001	<0.001
12	Total Alkalinity (as CaCO3)	mg/L	162	131	143	146
13	Chloride (as Cl)	mg/L	71	64	104	87
14	Sulphate (as SO4)	mg/L	30	23	36	20
15	Nitrate (as NO3)	mg/L	6.66	3.9	5.42	6.53
16	Fluoride (as F)	mg/L	0.56	0.37	0.48	0.48
17	Calcium (as Ca)	mg/L	44	35	40	30
18	Magnessium (as Mg)	mg/L	13	11	10	17
19	Phenol (as C6H5OH)	mg/L	<0.05	<0.05	<0.05	<0.05
20	Copper (as Cu)	mg/L	0.2	0.23	0.16	0.25
21	Iron (as Fe)	mg/L	<0.05	<0.05	<0.05	<0.05
22	Manganese (as Mn)	mg/L	<0.05	0.06	0.1	<0.05
23	Zinc (as Zn)	mg/L	<0.02	<0.02	<0.02	<0.02
24	Boron (as B)	mg/L	<0.002	<0.002	<0.002	<0.002
25	Lead (as Pb)	mg/L	<0.001	<0.001	<0.001	<0.001
26	Cadmium (as Cd)	mg/L	<0.01	<0.01	<0.01	<0.01
27	Hexavalent Chromium (as Cr+6)	mg/L	<0.003	<0.003	<0.003	<0.003
28	Arsenic (as As)	ppb	<0.05	<0.05	<0.05	<0.05
29	Mercury (as Hg)	ppb	162	134	170	134
30	Ammonia (as NH3-N)	mg/L	<0.05	<0.05	<0.05	<0.05
31	Sodium Absorbance Ratio	-	1.9	1.5	2.7	2

Unobj. – Unobjectionable

CODE	LOCATION NAME
SW7	Pond Water (Simra Village)
SW8	Pond Water (Barra Village)
SW9	Pond Water (Dumurhir Village)
SW10	Pond Water (Guniara Village)

TABLE-3.11.4
SURFACE WATER QUALITY CRITERIA AS PER CPCB

Sl. No.	Parameters	Class A	Class B	Class C	Class D	Class E
1	pH	6.5–8.5	6.5–8.5	6.0–9.0	6.5–8.5	6.0–8.5
2	Dissolved Oxygen (as O_2), mg/l, min	6	5	4	4	-
3	BOD, 5 days at 20°C, max	2	3	3	-	-
4	Total Coliform organism, MPN/100 ml, max	50	500	5000	-	-
5	Free ammonia (as N), mg/l, max	-	-	-	1.2	-
6	Electrical Conductivity, µmhos/cm, max	-	-	-	-	2250
7	Sodium Absorption Ratio, max	-	-	-	-	26
8	Boron (as B), mg/l, max	-	-	-	-	2

Class A: Drinking water source without conventional treatment but after disinfection.
Class B: Outdoor bathing (organized).
Class C: Drinking water source after conventional treatment and after disinfection.
Class D: Propagation of Wild life and Fisheries.
Class E: Irrigation, Industrial Cooling, and Controlled Waste Disposal.
Below E: Not meeting A, B, C, D & E Criteria.

Designated Best Use Water Quality Criteria

Designated-Best-Use	Class of water	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	Total Coliforms Organism MPN/100ml shall be 50 or less pH between 6.5 and 8.5 Dissolved Oxygen 6mg/l or more Biochemical Oxygen Demand 5 days 20C 2mg/l or less
Outdoor bathing (Organised)	B	Total Coliforms Organism MPN/100ml shall be 500 or less pH between 6.5 and 8.5 Dissolved Oxygen 5mg/l or more Biochemical Oxygen Demand 5 days 20C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	Total Coliforms Organism MPN/100ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4mg/l or more Biochemical Oxygen Demand 5 days 20C 3mg/l or less
Propagation of Wild life and Fisheries	D	pH between 6.5 to 8.5 Dissolved Oxygen 4mg/l or more Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	pH betwwn 6.0 to 8.5 Electrical Conductivity at 25C micro mhos/cm Max.2250 Sodium absorption Ratio Max. 26 Boron Max. 2mg/l

[Source: https://cpcb.nic.in/wqm/Designated_Best_Use_Water_Quality_Criteria.pdf]

CONCLUSION FROM SURFACE WATER ANALYSIS

As per CPCB norms of classification of surface water,

(a) Damodar river water quality (**SW1** & **SW2**) parameters are within the standard for Class C i.e., Drinking water source after conventional treatment and after disinfection.

(b) The Pond water quality (SW1 & SW2) parameters are within the standard for Class C except for BOD levels in case of SW3, SW4, SW5, SW6, SW7, SW8 , SW9 and SW10 where the values are 6 mg/l, 4 mg/l, 4 mg/l, 5 mg/l, 7 mg/l, 6 mg/l,6 mg/l and 3 mg/l respectively, which is more than the standard (3 mg/l). Hence, this water is suitable for "Propagation of Wildlife & Fisheries" (i.e., Class D) and "Irrigation, Industrial Cooling, and Controlled Waste Disposal" (i.e., Class E).

TABLE-3.11.5
IS 10500:2012 LIMITS

Sl. No.	Parameter	Unit	Acceptable Limit of IS:10500:2012	Permissible limit of IS:10500:2012
1	Colour	Hazen unit	5	15
2	Odour		Agreeable	Agreeable
3	Taste		Agreeable	Agreeable
4	Turbidity	NTU	1	5
5	pH	-	6.5 – 8.5	No relaxation
6	Temperature	^{0} C	-	-
7	Conductivity	µS/cm	-	-
8	Free Residual Chlorine	mg/L	0.2	1
9	Total Dissolved Solids	mg/L	500	2000
10	Phenol (as C_6H_5OH)	mg/L	0.001	No relaxation
11	Total Hardness (as $CaCO_3$)	mg/L	200	600
12	Total Alkalinity (as $CaCO_3$)	mg/L	200	600
13	Chloride (as Cl)	mg/L	250	1000
14	Sulphate (as SO_4)	mg/L	200	400
15	Nitrate (as NO_3)	mg/L	45	No relaxation
16	Fluoride (as F)	mg/L	1	1.5
17	Calcium (as Ca)	mg/L	75	200
18	Magnesium (as Mg)	mg/L	30	100
19	Ammonia (as Total NH_3-N)	mg/L	0.5	No relaxation
20	Boron (as B)	mg/L	0.5	2.4
21	Chromium (as Cr)	mg/L	0.05	No relaxation
22	Copper (as Cu)	mg/L	0.05	1.5
23	Manganese (as Mn)	mg/L	0.1	0.3
24	Zinc (as Zn)	mg/L	5	15
25	Cadmium (as Cd)	mg/L	0.003	No relaxation

26	Iron (as Fe)	mg/L	1	No relaxation
27	Lead (as Pb)	mg/L	0.01	No relaxation
28	Silver (as Ag)	mg/L	0.1	No relaxation
29	Nickel (as Ni)	mg/L	0.02	No relaxation
30	Arsenic (as As)	ppb	10	No relaxation
31	Mercury (as Hg)	ppb	1	No relaxation
32	Total Coliforms	MPN/ 100 ml	Shall not be detectable in any 100 ml sample	Shall not be detectable in any 100 ml sample

CONCLUSION FROM GROUND WATER SAMPLE ANALYSIS

Ground water physico-chemical properties in the study area showed that the water strata mainly from Bicarbonate buffer system has appreciable amount of alkalinity & Hardness. Calcium & Magnesium which are beneficial for human health are found satisfactory. The other parameters (i.e. Sulphate, Chloride etc.) fall within satisfactory level. While comparing with IS 10500:2012, it can be concluded that all ground water samples are within permissible limit & can be used as drinking water source.

The plant will be based on Zero Liquid Discharge (ZLD) Concept. Therefore, there will be no impact on any surface or ground water quality of the area.

3.12 NOISE

A total of Ten (10) locations within an area of 10 km radius around the project site have been selected for measurement of ambient noise levels. These locations have been displayed in **Table-3.12.1**.

3.12.1 MAJOR SOURCES OF NOISE IN THE STUDY AREA

The study area is of both industrial & residential in nature. Vehicular movement on the roads is a source of noise in those residential & industrial areas. This increases the ambient noise levels. There are also a number of other domestic noise sources such as television, radio, loud speakers, etc.

3.12.2 AMBIENT NOISE MONITORING

In the present study, a sound level meter has measured sound pressure levels. Since loudness of sound is important for its effects on people, the dependence of loudness on frequency must be taken into account in environmental noise assessment. This has been achieved by using A-weighting filters in the noise measuring instrument which gives a direct reading of approximate loudness. Moreover, A-weighted equivalent continuous sound pressure level (L_{eq}) values have been computed from the values of A-weighted sound pressure level (SPL) measured with the help of a noise meter.

A preliminary reconnaissance survey was undertaken to identify the major noise sources in the area. The sampling location in the area was identified considering location of industry, commercial shopping complex activities, residential areas with various traffic activity and sensitive areas like hospital, court, temple, schools etc.

At each location, readings were taken at uniform interval over a twenty-four hours period, divided into day and night shifts. For a particular location daytime L_{eq} has been computed from the SPL values measured between 6.00 A.M to 10.00 P.M and night time L_{eq} from the SPL values measured between 10.00 P.M to 6.00 A.M, such that comparison could be made with the National Ambient Noise Standards. Name of the locations with their latitude and longitude have been tabulated in **Table-3.12.1**. These locations are presented in **Figure-3.12.1**.

3.12.3 NOISE LEVELS IN THE STUDY AREA

The noise levels were monitored at 10 (Ten) locations. Monitoring was done, covering both day and night time. Noise levels in L_{eq} at the respective locations separately for Day and Night times have been presented in **Table-3.12.2**.

During the day time, the equivalent noise levels were found to vary in the range of (54.1 - 67.8) dB (A) while in the night time, the equivalent noise levels were observed to be varying in the range of (42.9 - 52.9) dB (A). The variation of noise level in day & night time is presented in **Figure-3.12.2**.

As usual, the day time noise levels were found to be higher than those, observed at night level.

TABLE-3.12.1
NOISE LEVEL MONITORING LOCATIONS

SL. NO.	CODE	LOCATIONS	LATITUDE	LONGITUDE	DISTANCE & DIRECTION FROM THE PROJECT SITE
1.	N-1	RTPS DVC Hospital	23°36'36.04"N	86°39'50.95"E	1.1 - SSE
2.	N-2	Raibandh Hospital	23°38'39.75"N	86°40'33.48"E	3.2 - NNE
3.	N-3	Naragoria Durga Dasi High School	23°36'50.72"N	86°38'55.69"E	1.3 - WSW
4.	N-4	Achkoda Primary School	23°37'59.64"N	86°38'18.60"E	2.7 - NW
5.	N-5	Ghutitora Market	23°36'49.84"N	86°40'17.71"E	2.6 - WNW
6.	N-6	Dumurhir Bazar	23°38'24.46"N	86°39'35.19"E	2.3 - N
7.	N-7	Pabra Market	23°36'43.12"N	86°38'11.61"E	2.6 - WSW
8.	N-8	Balarampur Sishu Sikhha Kendra	23°37'42.25"N	86°38'44.65"E	1.8 - NW
9.	N-9	Hansapathar Primary School	23°37'54.51"N	86°39'50.51"E	1.5 - NNE
10.	N-10	Kubana Village	23°37'54.63"N	86°41'0.55"E	2.7 - ENE
11.	N-11	Pathuriadanga Village	23°37'14.28"N	86°41'6.56"E	2.5 - E
12.	N-12	Nabagram Village	23°35'45.02"N	86°39'32.09"E	2.6 - S
13.	N-13	Pratapur Village	23°35'58.95"N	86°38'57.01"E	2.5 - SSW
14.	N-14	Hurara Village	23°35'52.16"N	86°40'37.31"E	2.9 - SE
15.	N-15	Pabra Village	23°37'24.90"N	86°38'8.00"E	2.6 - WNW

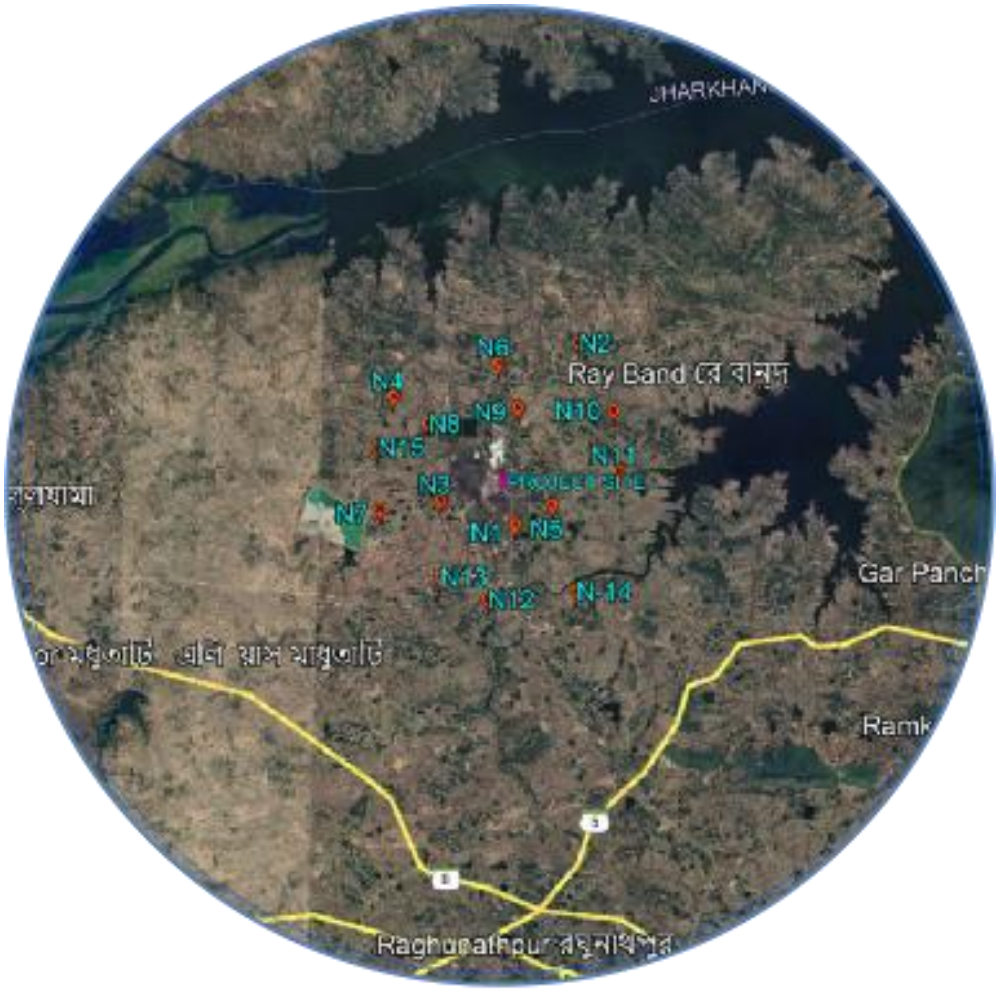


FIGURE-3.12.1

NOISE LEVEL MONITORING LOCATIONS IN THE STUDY AREA

CODE	LOCATIONS
N-1	RTPS DVC Hospital
N-2	Raibandh Hospital
N-3	Naragoria Durga Dasi High School
N-4	Achkoda Primary School
N-5	Ghutitora Market
N-6	Dumurhir Bazar
N-7	Pabra Market
N-8	Balarampur Sishu Sikhha Kendra
N-9	Hansapathar Primary School
N-10	Kubana Village
N-11	Pathuriadanga Village
N-12	Nabagram Village
N-13	Pratapur Village
N-14	Hurara Village
N-15	Pabra Village

TABLE-3.12.2
EQUIVALENT NOISE LEVEL IN THE STUDY AREA, Leq in dB(A)

SL. NO.	LOCATIONS	EQUIVALENT NOISE LEVEL, L_{eq} in dB(A)		SECTOR
		DAY	NIGHT	
1.	RTPS DVC Hospital	50.9	41.7	Silence
2.	Raibandh Hospital	51.2	42.1	Silence
3.	Naragoria Durga Dasi High School	53.2	40.6	Silence
4.	Achkoda Primary School	52.8	42.6	Silence
5.	Ghutitora Market	58.6	45.1	Commercial
6.	Dumurhir Bazar	61.6	46.1	Commercial
7.	Pabra Market	59.5	44.8	Residential
8.	Balarampur Sishu Sikhha Kendra	52.3	41.8	Silence
9.	Hansapathar Primary School	54.5	43.4	Silence
10.	Kubana Village	56.8	44.5	Residential
11.	Pathuriadanga Village	55.3	46.5	Residential
12.	Nabagram Village	58.9	45.2	Residential
13.	Pratapur Village	56.8	46.0	Residential
14.	Hurara Village	58.4	44.9	Residential
15.	Pabra Village	56.2	45.2	Residential

N.B. Day time is reckoned between 0600 HOURS TO 2200 HOURS
Night Time is reckoned between 2200 HOURS TO 0600 HOURS

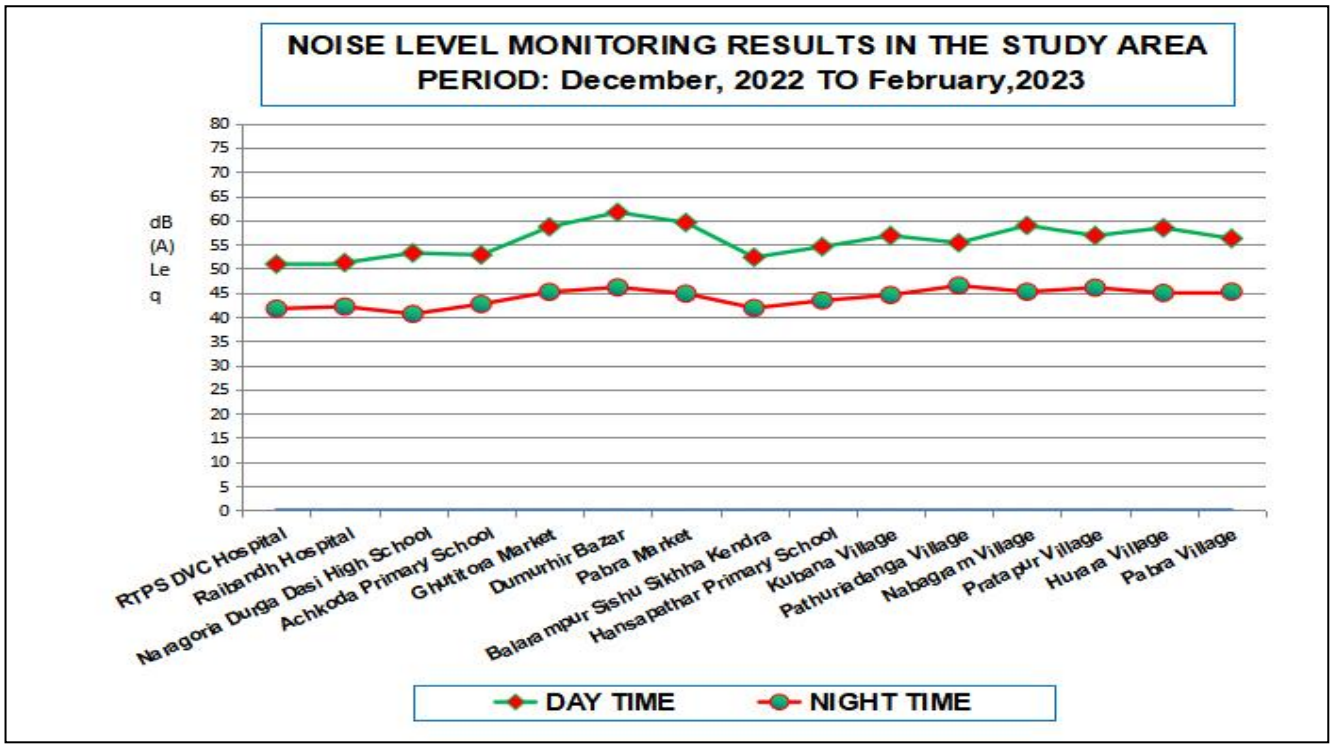


FIGURE: 3.12.2
GRAPHICAL REPRESENTATION OF THE NOISE LEVEL MONITORING RESULTS IN THE STUDY AREA

CONCLUSION OF NOISE LEVEL MONITORING:

The Equivalent Noise Levels in the Industrial locations are within permissible limits. However, the noise level has exceeded the permissible limits for Residential, Commercial and Sensitive locations in the study area. Such high noise levels may be attributed mainly to the noise, generated due to the vehicular traffic.

Trees and shurbs can make a contribution to noise reduction. The attenuation of sound by vegetation is commonly attributed to the processes of reflection, scattering and absorption. Reflection and scattering from the surfaces of leaves, branches, trunks and the ground can alter the phase of sound, which can cause interference in the sound waves and a reduction in noise level. The study area is rich in floral composition with much concentration of large and medium size trees which can effectively reduce noise level in the study area.

3.13 ECOLOGY

Field study was carried out during one season along with literature reviews / desk research to understand the ecological (both terrestrial and aquatic) condition of the study area. Biological environment assessment plays a significant role in environmental impact assessment for any development project. This type of assessment includes evaluation of both the terrestrial & aquatic ecology.

3.13.1 STUDY METHODOLOGY

Biological environment is a good bio-indicator of changing environmental quality. Reconnaissance survey was undertaken around the proposed project site. In the present survey 10 km radius area around the project site was considered as study area. Both terrestrial and aquatic ecological analysis was carried out in the field and in the laboratory. Assessment of flora and fauna was undertaken in the study area. The field study was undertaken during the month of January, 2023.

In addition to the field study, literature review/desk research was carried out to determine the existing conditions within the study area and to identify habitats and species of potential importance that may be affected by the Project.

The following parameters were primarily considered in the study.

- Assessment of present state of vegetation, flora and fauna in the study area.
- Collection of data from literature about the floral and faunal accounts
- Identification of rare endangered plants and animal species (if any).
- Identification of important plants/animal species having diverse economic values.

3.13.2 DESCRIPTION OF THE STUDY AREA

In the present survey, the 10 km radius study area is an alluvial land. The project site and its surrounding area in 10 km radius are located in the Purulia District of West Bengal. The periphery of the study area is mainly rural-urban mixed in nature. There are various large and medium scale industries found within the

study area. One and only major River in the study area is River Damodar.

The soil in the study area is loamy and is rich with high amounts of nutrients having high water retention capacity. The ground water table is moderate in this region. All these factors help in prolific growth of a variety of plants and vegetations in the study area.

Assessment of flora and fauna of both terrestrial and aquatic ecology was undertaken in the study area. Sampling of flora and fauna was done on random basis and were considered separately and their distribution in the above mentioned study area was represented separately.

3.13.2.1 TERRESTRIAL ECOLOGY

The natural trees are combination of both deciduous and evergreen plants mixed with some exotic species.

TERRESTRIAL FLORA:

The natural vegetation of the area has been broadly noted with few natural vegetation and roadside social plantation and avenue trees in the villages. The bio-diversity of such naturally growing plant species would indicate environmental quality.

Vegetation of a particular area depends upon the interaction of various natural factors including plants, animals, micro-organisms of that particular area in which they live and influence one another.

Natural Trees:

The study area is rural-urban mixed in nature. There have sufficient number of natural vegetations all around the study area.

The most common natural tree species found within the study area are Akashmoni (*Acacia auriculiformis*), Siris (*Albizia lebbeck*), Kadam (*Anthocephalus cadamba*), Kathal (*Artocarpus heterophyllus*), Neem (*Azadirachta indica*), Palm Tree (*Borassus flabellifer*), Amaltas (*Cassia fistula*), Radhachura (*Peltophorum pterocarpum*), Mahua (*Madhuca indica*), Devdaru (*Polyalthia longifolia*), Arjun (*Terminalia arjuna*), Eucalyptus (*Eucalyptus*

globules), Mango (*Mangifera indica*) etc. Natural tree species was analyzed and calculated by Quadrat method at different places in the study area like inside and outside of the patchy area, just beside of the project site, roadside land, domestic land, small patchy area etc.

A checklist of natural tree species has been given in **Table-3.13.1** and composite Quadrat analysis & Biodiversity Index of those species have been calculated and tabulated in **Table-3.13.1 (A)** and **Table-3.13.1 (B)** respectively.

The following survey was undertaken in the study area during field trips:

(I) **Forest/Vegetation composition analysis:** Recording and its detail phyto-sociological analysis was done by the following quadrat (10m x 10 m) method.

The following parameters were primarily considered in the study and computed in the following way:

Frequency: The degree of dispersion of individual species in an area is called frequency. It is express as percentage occurrence.

$$\text{Frequency (f)} = \frac{\text{Number of quadrates in which a species occurs}}{\text{Total number of quadrates sampled}} \times 100$$

Abundance: This is the study of number of individual of different species in community per unit area.

$$\text{Abundance (A)} = \frac{\text{Total No. of individuals of a species in all quadrate}}{\text{Total number of quadrates in which the species occurs}}$$

Relative Abundance: It is the determination of the percentage of individual of one genera in composition to the total of all individual as a given area.

$$\text{Relative Abundance (A)} = \frac{\text{Total No. of individuals species in the sample}}{\text{Number of quadrat in which a species occurs}}$$

Density: It is the numerical strength of a species.

(II) Density (D) = $\frac{\text{Total No. of individuals of a species in all quadrates}}{\text{Total No. of quadrat sampled}}$

in expressed by **Shannon-Weiner Index** (1948) in the following way:

$$H = \sum_{i=1}^{s} -(Pi \times \ln Pi)$$

Where,

H = Species diversity index

S = the number of species in a sample

Pi = (ni/N)

N = the total number of individuals of all the species in a sample

ni = the number of individuals of a species.

Shrubs, Herbs & Climbers:

The shrubs and herbs like Mimosa pudica, Adhatoda vasica, Datura metel, Hibiscus rosa sinensis etc. dominate this area.

Some of the species of shrubs, herbs, climbers and ferns recorded during field investigation have been listed in **Tables-3.13.2.**

Table-3.13.1

Checklist of most common terrestrial plants species in the study area

A. TREES :

Sl. No.	Scientific Name	Common Name	Family
1.	*Mangifera indica*	Mango	Anacardiaceae
2.	*Anacardium occidentale*	Cashew nut	Anacardiaceae
3.	*Nephelium litchi*	Litchi	Anacardiaceae
4.	*Bombax malabaricum*	Red Silk Cotton Tree	Bombacaceae
5.	*Eridendron infractuosum*	White Silk Cotton Tree	Bombacaceae
6.	*Cassia fistula*	Indian Laburnum	Caesalpiniae

7.	*Delonix regia*	Gulmohar	Caesalpiniae
8.	*Tamarindus indica*	Tamarind	Caesalpiniae
9.	*Saraca indica*	Ashok	Caesalpiniae
10.	*Bauhinia accuminata*	Camel's foot tree	Caesalpiniae
11.	*Peltophorum inerme*	Radhachura	Caesalpiniae
12.	*Cassia siamea*	Chakunda	Caesalpiniae
13.	*Casuarina equisetifolia*	Jhau	Casuarinaceae
14.	*Trewia nudiflora*	Pituli	Euphorbiaceae
15.	*Tamarix dioeca*	Nona Jhau	Euphorbaceae
16.	*Exocaria agalocha*	Geanoa	Euphorbaceae
17.	*Erythrina indica*	Coraltree	Fabaceae
18.	*Sesbania grandiflora*	Bakful	Fabaceae
19.	*Dalbergia sisso*	Sisso	Fabaceae
20.	*Pongamia glabra*	Karang	Fabaceae
21.	*Gliricidea sepium*	-	Fabaceae
22.	*Acacia auriculiformis*	Akasmoni	Mimosiae
23.	*A. nilotica*	Babul	Mimosiae
24.	*Albizzia lebbeck*	Siris	Mimosiae
25.	*Pitheecolobium dulce*	Manila tamarind	Mimosiae
26.	*Samanea saman*	Rain tree	Mimosiae
27.	*Ficus bengalensis*	Banyan	Moraceae
28.	*Ficus religiosa*	Peepal	Moraceae
29.	*Ficus cunia*	Fig tree	Moraceae
30.	*Ficus elastica*	India Rubber	Moraceae
31.	*Artocarpus integrifolia*	Jackfruit	Moraceae
32.	*Morus indica*	Mulbery	Moraceae
33.	*Syzizium jambos*	Jam	Myrtaceae
34.	*Callistemon speciosus*	Bottle brush tree	Myrtaceae
35.	*Eucalyptus globulus*	Eucalyptus	Myrtaceae
36.	*Cocos nucifera*	Coconut palm	Palmae
37.	*Phoenix sylvestris*	Date palm	Palmae
38.	*Borassus flabellifer*	Plamyra palm	Palmae
39.	*Areca catechu*	Betelnut palm	Palmae
40.	*Trema orientalis*	Jiban	Urticaceae
41.	*Holoptelea integrifolia*	Indian Elm	Urticaceae
42.	*Michella champaca*	Champak	Magnoliaceae
43.	*Polyalthia longifolla*	Debdaru	Anonaceae
44.	*Aegle marmelos*	Wood apple	Rutaceae
45.	*Feronia elephantum*	Elephant apple	Rutaceae
46.	*Azadirachta indica*	Neem	Meliaceae
47.	*Swetenia mahogini*	Mahogany	Meliaceae
48.	*Trewia nudiflora*	Pituli	Euphorbiaceae
49.	*Grewia asiatica*	Phalsa	Tiliaceae

50.	*Thespesia populnea*	Tulip tree	Malvaceae
51.	*Pterospermum acerifolium*	Muchkund	Sterculiaceae
52.	*Calophyllum inophyllum*	Sultan Champa	Guttiferae
53.	*Lagerstroemia flosreginae*	Jarul	Lythraceae
54.	*Terminalla catappa*	Indian Alamond	Combretaceae
55.	*Terminalia arjuna*	Arjun	Combretaceae
56.	*Mimusops elengi*	Bakul	Zapotaceae
57.	*Plumeria acutifolia*	Pagoda tree	Apocynaceae
58.	*Holarrhena antidysenterica*	Kurchi	Apocynaceae
59.	*Morinda citrifolia*	Hurdi	Rubiaceae
60.	*Anthocephalus chinensis*	Kadam	Rubiaceae
61.	*Adina cordifolia*	Haldu	Rubiaceae
62.	*Leucaenea leucocephala*	Subabul	Mimosae
63.	*Gravelia robusta*	Silver fir	Proteaceae
64.	*Spathodea campanulata*	Rudrapalash	Bignoniaceae
65.	*Putranjiva roxburghii*	Putranjiva	Euphorbiaceae
66.	*Alstonia scholaris*	Chatim	Apocyanaceae
67.	*Mellingtonia hortensis*	Indian cork tree	Bignoniaceae
68	*Sizigium jambos*	Jamrul	Myrtaceae
69.	*Dalenia indica*	Chalta	Doleniaceae
70.	*Acras sapota*	Sapeda	Zapotaceae
71.	*Moringa pterigospermum*	Sajina	Moringaceae
72.	*Psidium guajava*	Guava	Myrtaceae
73.	*Sonnaratia apetala*	Keora	Combretaceae
74.	*Gmelina arborea*	Gamar	Verbanaceae
75.	*Tectona grandis*	Teak	Verbanaceae

TABLE - 3.13.1 (B)
QUANTITATIVE ASSESSMENT (BY QUADRAT METHOD) OF NATURAL TREE SPECIES
(Note: Each column of Quadrat Number represents 1 Quadrat of 50m × 50m Size)

Sl. No.	Name of Trees	Quadrat No.										Total	Frequency	Density	Abundance
		1	2	3	4	5	6	7	8	9	10				
1	*Mangifera indica*	1		2		1	1			2		7	50	0.7	140.00
2	*Anacardium occidentale*		1						1			2	20	0.2	100.00
3	*Nephelium litchi*				1			1				2	20	0.2	100.00
4	*Bombax malabaricum*	1					1				1	3	30	0.3	100.00
5	*Eridendron infractuosum*		1		1				1			3	30	0.3	100.00
6	*Cassia fistula*	1				2				1		4	30	0.4	133.33
7	*Delonix regia*		1					1				2	20	0.2	100.00
8	*Tamarindus indica*			1			1				1	3	30	0.3	100.00
9	*Saraca indica*	1										1	10	0.1	100.00
10	*Bauhinia accuminata*							1				1	10	0.1	100.00
11	*Peltophorum inerme*					1						1	10	0.1	100.00
12	*Cassia siamea*			1							1	2	20	0.2	100.00
13	*Casuarina equisetifolia*							2				2	10	0.2	200.00
14	*Trewia nudiflora*	1										1	10	0.1	100.00
15	*Tamarix dioeca*					2						2	10	0.2	200.00
16	*Exocaria agalocha*					1			1			2	20	0.2	100.00
17	*Erythrina indica*		1									1	10	0.1	100.00
18	*Sesbania grandiflora*	2										2	10	0.2	200.00
19	*Dalbergia sisso*								1		1	2	20	0.2	100.00
20	*Pongamia glabra*				1							1	10	0.1	100.00
21	*Gliricidea sepium*	1										1	10	0.1	100.00
22	*Acacia auriculiformis*				2			1				3	20	0.3	150.00
23	*A. nilotica*			1						1		2	20	0.2	100.00
24	*Albizzia lebbeck*						2					2	10	0.2	200.00
25	*Pitheecolobium dulce*	1									2	3	20	0.3	150.00
26	*Samanea saman*					1			1			2	20	0.2	100.00
27	*Ficus bengalensis*		1									1	10	0.1	100.00
28	*Ficus religiosa*							2				2	10	0.2	200.00
29	*Ficus cunia*	1				1						2	20	0.2	100.00
30	*Ficus elastica*			1		1			1			3	30	0.3	100.00
31	*Artocarpus integrifolia*	1										1	10	0.1	100.00
32	*Morus indica*						1					1	10	0.1	100.00
33	*Syzizium jambos*										1	1	10	0.1	100.00
34	*Callistemon speciosus*		1									1	10	0.1	100.00
35	*Eucalyptus*							1				1	10	0.1	100.00

Sl. No.	Name of Trees	Quadrat No.										Total	Frequency	Density	Abundance
		1	2	3	4	5	6	7	8	9	10				
	globulus														
36	*Cocos nucifera*	1		3		1				2		7	40	0.7	175.00
37	*Phoenix sylvestris*				2				1			3	20	0.3	150.00
38	*Borassus flabellifer*			1								1	10	0.1	100.00
39	*Areca catechu*										1	1	10	0.1	100.00
40	*Trema orientalis*	1										1	10	0.1	100.00
41	*Holoptelea integrifolla*							2				2	10	0.2	200.00
42	*Michella champaca*				2							2	10	0.2	200.00
43	*Polyalthia longifolla*		1						1			2	20	0.2	100.00
44	*Aegle marmelos*										1	1	10	0.1	100.00
45	*Feronia elephantum*			1				2				3	20	0.3	150.00
46	*Azadirachta indica*						1					1	10	0.1	100.00
47	*Swetenia mahogini*		2							1		3	10	0.3	300.00
48	*Trewia nudiflora*							1				1	10	0.1	100.00
49	*Grewia asiatica*	1										1	10	0.1	100.00
50	*Thespesia populnea*					1						1	10	0.1	100.00
51	*Pterospermum acerifolium*								1			1	10	0.1	100.00
52	*Calophyllum inophyllum*			2								2	10	0.2	200.00
53	*Lagerstroemia flosreginae*										1	1	10	0.1	100.00
54	*Terminalla catappa*	1				1			1			3	30	0.3	100.00
55	*Terminalia arjuna*							1				1	10	0.1	100.00
56	*Mimusops elengi*			1								1	10	0.1	100.00
57	*Plumeria acutifolia*							1				1	10	0.1	100.00
58	*Holarrhena antidysenterica*								2			2	10	0.2	200.00
59	*Morinda citrifolia*		2									2	10	0.2	200.00
60	*Anthocephalus chinensis*						1					1	10	0.1	100.00
61	*Adina cordifolia*			1								1	10	0.1	100.00
62	*Leucaenea leucocephala*							2				2	10	0.2	200.00
63	*Gravelia robusta*		1									1	10	0.1	100.00
64	*Spathodia campanulata*	1			2							3	20	0.3	150.00
65	*Putranjiba roxburghii*										1	1	10	0.1	100.00
66	*Alstonia scholaris*										1	1	10	0.1	100.00
67	*Mellingtonia hortensis*						2					2	10	0.2	200.00

Sl. No.	Name of Trees	Quadrat No.										Total	Frequency	Density	Abundance
		1	2	3	4	5	6	7	8	9	10				
68	*Sizigium jambos*	1										1	10	0.1	100.00
69	*Dalenia indica*									1		1	10	0.1	100.00
70	*Acras sapota*							1				1	10	0.1	100.00
71	*Moringa pterigospermum*					1			1			2	20	0.2	100.00
72	*Psidium guajava*									2		2	10	0.2	200.00
73	*Sonnaratia apetala*			2								2	10	0.2	200.00
74	*Gmelina arborea*									1		1	10	0.1	100.00
75	*Tectona grandis*								1			1	10	0.1	100.00
	Total	**17**	**12**	**17**	**11**	**14**	**10**	**19**	**14**	**11**	**12**	**137**	**1100**	**13.7**	**9498.33**

TABLE – 3.13.1 (B)
BIODIVERSITY INDEX OF TREE SPECIES

Sl. No.	Name of Trees	Total No. (ni)	Abundance (N)	Pi=(ni/N)	Shannon Index (Pi x lnPi)
1	*Mangifera indica*	7	140.00	0.05	0.15
2	*Anacardium occidentale*	2	100.00	0.02	0.08
3	*Nephelium litchi*	2	100.00	0.02	0.08
4	*Bombax malabaricum*	3	100.00	0.03	0.11
5	*Eridendron infractuosum*	3	100.00	0.03	0.11
6	*Cassia fistula*	4	133.33	0.03	0.11
7	*Delonix regia*	2	100.00	0.02	0.08
8	*Tamarindus indica*	3	100.00	0.03	0.11
9	*Saraca indica*	1	100.00	0.01	0.05
10	*Bauhinia accuminata*	1	100.00	0.01	0.05
11	*Peltophorum inerme*	1	100.00	0.01	0.05
12	*Cassia siamea*	2	100.00	0.02	0.08
13	*Casuarina equisetifolia*	2	200.00	0.01	0.05
14	*Trewia nudiflora*	1	100.00	0.01	0.05
15	*Tamarix dioeca*	2	200.00	0.01	0.05
16	*Exocaria agalocha*	2	100.00	0.02	0.08
17	*Erythrina indica*	1	100.00	0.01	0.05
18	*Sesbania grandiflora*	2	200.00	0.01	0.05
19	*Dalbergia sisso*	2	100.00	0.02	0.08
20	*Pongamia glabra*	1	100.00	0.01	0.05
21	*Gliricidea sepium*	1	100.00	0.01	0.05
22	*Acacia auriculiformis*	3	150.00	0.02	0.08
23	*A. nilotica*	2	100.00	0.02	0.08
24	*Albizzia lebbeck*	2	200.00	0.01	0.05
25	*Pitheecolobium dulce*	3	150.00	0.02	0.08

26	*Samanea saman*	2	100.00	0.02	0.08
27	*Ficus bengalensis*	1	100.00	0.01	0.05
28	*Ficus religiosa*	2	200.00	0.01	0.05
29	*Ficus cunia*	2	100.00	0.02	0.08
30	*Ficus elastica*	3	100.00	0.03	0.11
31	*Artocarpus integrifolia*	1	100.00	0.01	0.05
32	*Morus indica*	1	100.00	0.01	0.05
33	*Syzizium jambos*	1	100.00	0.01	0.05
34	*Callistemon speciosus*	1	100.00	0.01	0.05
35	*Eucalyptus globulus*	1	100.00	0.01	0.05
36	*Cocos nucifera*	7	175.00	0.04	0.13
37	*Phoenix sylvestris*	3	150.00	0.02	0.08
38	*Borassus flabellifer*	1	100.00	0.01	0.05
39	*Areca catechu*	1	100.00	0.01	0.05
40	*Trema orientalis*	1	100.00	0.01	0.05
41	*Holoptelea integrifolla*	2	200.00	0.01	0.05
42	*Michella champaca*	2	200.00	0.01	0.05
43	*Polyalthia longifolla*	2	100.00	0.02	0.08
44	*Aegle marmelos*	1	100.00	0.01	0.05
45	*Feronia elephantum*	3	150.00	0.02	0.08
46	*Azadirachta indica*	1	100.00	0.01	0.05
47	*Swetenia mahogini*	3	300.00	0.01	0.05
48	*Trewia nudiflora*	1	100.00	0.01	0.05
49	*Grewia asiatica*	1	100.00	0.01	0.05
50	*Thespesia populnea*	1	100.00	0.01	0.05
51	*Pterospermum acerifolium*	1	100.00	0.01	0.05
52	*Calophyllum inophyllum*	2	200.00	0.01	0.05
53	*Lagerstroemia flosreginae*	1	100.00	0.01	0.05
54	*Terminalla catappa*	3	100.00	0.03	0.11
55	*Terminalia arjuna*	1	100.00	0.01	0.05
56	*Mimusops elengi*	1	100.00	0.01	0.05
57	*Plumeria acutifolia*	1	100.00	0.01	0.05
58	*Holarrhena antidysenterica*	2	200.00	0.01	0.05
59	*Morinda citrifolia*	2	200.00	0.01	0.05
60	*Anthocephalus chinensis*	1	100.00	0.01	0.05
61	*Adina cordifolia*	1	100.00	0.01	0.05
62	*Leucaenea leucocephala*	2	200.00	0.01	0.05
63	*Gravelia robusta*	1	100.00	0.01	0.05
64	*Spathodia campanulata*	3	150.00	0.02	0.08

65	*Putranjiba roxburghii*	1	100.00	0.01	0.05
66	*Alstonia scholaris*	1	100.00	0.01	0.05
67	*Mellingtonia hortensis*	2	200.00	0.01	0.05
68	*Sizigium jambos*	1	100.00	0.01	0.05
69	*Dalenia indica*	1	100.00	0.01	0.05
70	*Acras sapota*	1	100.00	0.01	0.05
71	*Moringa pterigospermum*	2	100.00	0.02	0.08
72	*Psidium guajava*	2	200.00	0.01	0.05
73	*Sonnaratia apetala*	2	200.00	0.01	0.05
74	*Gmelina arborea*	1	100.00	0.01	0.05
75	*Tectona grandis*	1	100.00	0.01	0.05
	Total	**137**	**9498.33**	**1.10**	**4.51**
BIODIVERSITY INDEX: Shannon – Weiner Index = 4.51					

By 4.51 value of Shannon Wiener index reported during the present study ,it can be concluded that qualitatively vegetation of the project site is quite diverse (44 species). Quantitatively, the frequency (10 to 30), abundance (150 to 400) and density (0.2 to 0.7) of various types of plants indicated a high degree of evenness. Thus, the proposed project site has very rich biodiversity, which must be conserved.

TABLE-3.13.2
CHECKLIST OF NATURAL SHURBS,
HERBS & CLIMBERS IDENTIFIED

Sl. No.	Scientific Name	Common Name	Family
1.	*Adhatoda vasica*	Basaka	Acanthaceae
2.	*Barleria prionitis*	Kantajhinti	Acanthaceae
3.	*Nyctanthas arbortristis*	Siuli	Apocyanaceae
4.	*Anona squamosa*	Custard apple	Anonaceae
5.	*Calotropis procera*	Akando	Asclepiadaceae
6.	*Eupatorium odoratum*	Siam Weed	Compositae
7.	*Ricinus communis*	Castorbean	Euphorbiaceae
8.	*Cestrum diurnum*	Day jasmine	Solanaceae
9	*Datura metel*	Dhutura	Solanaceae
10.	*Solanum suratensis*	Solanum	Solanaceae
11.	*Ixora coccinea*	Rangan	Rubiaceae
12.	*Zizyphus oenoplia*	Kul	Rhamnaceae
13.	*Hyptis suaveolens*	Bantulsi	Labiatae
14.	*Leonurus sibiricus*	Mother wort	Labiatae
15.	*Tecoma stans*	Yellow bells	
16.	*Abutilon indicum*	Indian Mallow	Malvaceae

17.	*Malachra capitata*	Ban bhindi	Malvaceae
18.	*Urena lobata*	Bana okara	Malvaceae
19.	*Hibiscus sabdariffa*	Chukar	Malvaceae
20.	*Glycosmis pentaphylla*	Ash-sheora	Rutaceae
21.	*Murraya exotica*	Kamini	Rutaceae
22.	*Crotalaria alata*	Bandar lathi	Fabaceae
23.	*Capparis spinosa*	Kabra	Capparidaceae
24.	Ipomea lacunosa	White morning-glory	Convolvulaceae
24.	*Bougenvalia spectabilis*	Baganbilas	Nyctaginaceae
25.	*Pluchea indica*	Camphorweed	Compositae
26.	*Phyllanthus emblicus*	Amlaki	Euphorbaceae
27.	*Lippia geminata*	Bushy mat grass	Verbanaceae
28.	*Euphorbia trilobata*	Spurge	Euphorbaceae
29.	*Opuntia delini*	Prickly pear	Opantiaceae
30.	*Acanthus ilicifolius*	Hargoza	Acanthaceae
31	*Ipomea fistulosa*	Morning Glory	Convolvulaceae
32	*Jatropha gossypifolia*	Lal bherenda	Euphorbaceae
33	*Pedilanthus tithymaloides*	Redbird Cactus	Euphorbaceae
34	*Abrus precatorius*	Chunahati	Malvaceae
35	*Lantana camara*	Common lantana	Vervanaceae
36	*Duranta plumieri*	Pigeon Berry	Vervanaceae
37	*Vitex negundo*	Nisenda	Vervanaceae
38	*Clerodendrum infortunatum*	Ghetu	Vervanaceae
39	*Clerodendrum inerme*	Banajai	Verbanaceae

TABLE-3.13.3
LIST OF HERBS & CLIMBERS

Sl. No.	Scientific Name	Family
1.	*Andrographis paniculata*	Acanthaceae
2.	*Justicia simplex*	Acanthaceae
3.	*Ruellia tuberosa*	Acanthaceae
4.	*Rungia parviflora*	Acanthaceae
5.	*Thunbergia grandiflora*	Acanthaceae
6.	*Daemia extensa*	Asclepiadaceae
7.	*Vinca rosea*	Apocynaceae
8.	*Aganosma caryophyllata*	Apocynaceae
9.	*Amaranthus spinosa*	Amaranthaceae
10.	*Celosia cristata*	Amaranthaceae
11.	*Achyranthes aspera*	Amaranthaceae

12.	*Alternanthera sessilis*	Amaranthaceae
13.	*Mikenia scandens*	Compositae
14.	*Eclipta alba*	Compositae
15.	*Blumea lacera*	Compositae
16.	*Tridax procumbens*	Compositae
17.	*Vernonia cinerea*	Compositae
18.	*Ageratum conyzoides*	Compositae
19.	*Grangea maderaspatana*	Compositae
20.	*Gnaphalium indicum*	Compositae
21.	*Cephalandra indica*	Cucurbitaceae
22.	*Gynandropsis gynandra*	Capparidaceae
23.	*Cassia sophera*	Caesalpinae
24.	*Cassia tora*	Caesalpinae
25.	*Acalypha indica*	Euphorbiaceae
26.	*Croton bonplandianum*	Euphorbiaceae
27.	*Chrozophora plicata*	Euphorbiaceae
28.	*Desmodium gyrans*	Fabaceae
29.	*Ocimum sanctum*	Labiatae
30.	*Leucas aspera*	Labiatae
31.	*Anisomeles ovata*	Labiatae
32.	*Oldenlandia corymbosa*	Rubiaceae
33.	*Dentella repens*	Rubiaceae
34.	*Spermacoce hispida*	Rubiaceae
35.	*Solanum nigrum*	Solanaceae
36.	*Solanum trilobatum*	Solanaceae
37.	*Nicotiana plumbajinifolia*	Solanaceae
38.	*Lippia nodiflora*	Verbanaceae
39.	*Evolvulus nummularius*	Convolvulaceae
40.	*Ipomea quamoclit*	Convolvulaceae
41.	*Canscora difusa*	Gentianaceae
42.	*Hydrocotyle asiatica*	Umbeliferae
43.	*Passiflora lunata*	Passifloraceae
44.	*Sida cordifolia*	Malvaceae
45.	*Sida rhombifolia*	Malvaceae
46.	*Triumfetta rhomboidea*	Tiliaceae
47.	*Cardiospermum halicacabum*	Sapindaceae
48.	*Cleome viscosa*	Capparidaceae
49.	*Boerhaavia repens*	Nyctaginaceae
50.	*Xanthium strumarium*	Compositae
51.	*Chenopodium album*	Chenopodiaceae
52.	*Polygonum barbatum*	Polygonaceae
53.	*Rumex maritimus*	Polygonaceae

54.	*Hygrophila spinosa*	Acanthaceae
55.	*Pouzolizia indica*	Uriticaceae
56.	*Cyperus rotundus*	Cyperaceae
57.	*Pennisetum typhoides*	Poaceae
58.	*Saccharum spontaneum*	Poaceae
59.	*Imperata arundinacea*	Poaceae
60.	*Cynodon dactylon*	Poaceae
61.	*Eleusine aegyptiacum*	Poaceae
62.	*Setaria glauca*	Poaceae
63.	*Argemone maxicana*	Papavaraceae
64.	*Potrasia coarctata*	Poaceae
65.	*Flurya interepta*	Urticaceae
66.	*Vitis quadrifida*	Vitaceae
67.	*Physalis peruviana*	Solanaceae
68.	*Oxalis coniculata*	Oxalidaceae
69.	*Parthenium hysterophorus*	Compositae
70.	*Derris pinnata*	Papilionaceae
71.	*Nicotiana plumbajinifolia*	Solanaceae
72.	*Justicea grandarusa*	Acanthaceae

CHECKLIST OF FERNS IN THE STUDY AREA

Sl. No.	Scientific Name	Family
1.	*Pteris longifolia*	Polypodiaceae
2.	*Diplazium sp.*	Polypodiaceae
3.	*Nephrolepis sp.*	Polypodiaceae
4.	*Drinaria sp.*	Polypodiaceae

INVENTORY OF MAJOR USEFUL PLANTS IN THE STUDY AREA

Sl. No.	Species	Plant parts used	Purpose for which used
1.	*Eclipta alba*	Whole plant	Antiseptic
2.	*Sida cordifolia*	Root	Antiseptics
3.	*Alstonia scholaris*	Bark	Gastric ailment
4.	*Terminalia arjuna*	Bark	Gastric ailments
5.	*Aegle marmelos*	Fruits, root, leaves	Gastric ailments
6.	*Holarrhena antidysentrica*	Bark	Gastric ailments
7.	*Butea monosperma*	Root, Bark	Gastric ailment piles
8.	*Clerodendron inerme*	Root, leaves	Rheumatism
9.	*Vitex negundo*	Seed, root	Rheumatism
10.	*Tamarindus indica*	Leaf, fruit	Edible
11.	*Hygrophila spinosa*	Leaves, stem	Gastric complaint

12.	*Hyptis suaveolens*	Leaves	Skin infection
13.	*Nyctanthes arbor-tristis*	Leaves	Fever, Rheumatism
14.	*Daemia extensa*	Whole plant	Cantonal affections
15.	*Datura metel*	Fruit	Cardiac ailment
16.	*Acacia nilotica*	Leaves, buds	Toothache
17.	*Albizia procera*	Root, bark	Eye problems

Terrestrial Fauna

Since there is no eco-sensitive zone like National Park, Wildlife Sanctuary, Reserve Forest etc. in the study area, wild animals in the study area are rare. Only a few wild animals like Fox, Common Langur, and Porcupine etc. could be observed in the study area occasionally.

Survey of terrestrial fauna reveals that in general there has been no impact of pollution on fauna. Destructive habits of human population are the only reason for the declining numbers of animals.

During the present investigation, species were examined include mammals, birds, reptiles and amphibians. A total of 14 species of mammals, 21 species of birds, 11 species of reptiles and 4 species of amphibians were observed during the study and have been presented in **Table-3.13.4** according to their schedule number of The Wildlife (Protection) Act, 1972.

TABLE-3.13.4
CHECKLIST OF AMPHIBIAN SPECIES

Sl. No.	Species	Common Name	Status	Wildlife Schedule
1.	*Bufo melanostrictus* (Schneider)	Common Indian Toad	Common	IV
2.	*Bufo stomaticus* (Lutken)	Marbled toad	Common	IV
3.	*Rana cynophlyctis* (Schneider)	Skipping frog	Common	VI
4.	*Rana limnocharis* (Boie)	Paddy field frog	Common	VI
5.	*Rana tigrina* (Daudin)	Indian bull frog	Common	VI

TABLE-3.13.5
CHECKLIST OF REPTILES SPECIES

Sl. No.	Species	Common Name	Occurrence
1.	*Hemidactylus brooki* (Gray)	Brook's gecko	Common
2.	*Hemidactylus flaviviridis* (Ruppell)	Northern house gecko	Common
3.	*Calotes versicolor* (Daudin)	Common Garden lizard	Common
4.	*Mabuya craniata* (Schneider)	Common or Brahminy skink	Common
5.	*Mabuya macularia* (Blyth)	Little Skink	Common
6.	*Typhlops acutus* (Dummeril & Bibron)	Beaked worm or Blind Snake	Common
7.	*Lycodon aulicus* (Linn.)	Common wolf snake	Common
8.	*Ptyas mucosus* (Linn.)	Dhaman or Common Rat Snake	Common
9.	*Xenochrophis piscator* (Schneider)	Checkered Keel back	Common
10.	*Bungarus caerulus* (Schneider)	Common Indian Krait	Common

TABLE-3.13.6
CHECKLIST OF BIRDS

Sl. No.	Scientific Name	Common Name	Migratory Nature
1.	*Ardea cinerea (Linn.)*	Grey Heron	R
2.	*Ardea purpurea (Meyea)*	Purple Heron	R
3.	*Ardeola grayii (Sykes)*	Pond Heron	R
4.	*Bubulcus ibis coromandra (Boedaert)*	Cattle egret	R
5.	*Ardea alba (Linn.)*	Large Egret	R
6.	*Egretta garzetta (Linn.)*	Little egret	R
7.	*Dendrocygna javanica (Horsefield)*	Lesser Whistling Teal	R/M
8.	*Anas acuta (Linn.)*	Pintail	M
9.	*Nettapus coromandelianus*	Cotton Teal	R
10.	*Sarkidiornis melanotos*	Comb Duck	M
11.	*Tringa ochropus*	Green Sandpiper	M
12.	*Tringa hypoleucos Linn.*	Common Sandpiper	R/M
13.	*Streptopelia decaocto (Frivoldszky)*	Indian Ringed Dove	R
14.	*Streptopelia tranquebarica*	Red Turtle Dove	R

	(Temminck)		
15.	*Streptopelia chinensis (Gmelin)*	Spotted Dove	R
16.	*Eudynamys scolopacea (Linn.)*	Koel	R
17.	*Centropus sinensis (Stephens)*	Coucal	R
18.	*Apus affinis (J. E. Gray)*	House Swift	R
19.	*Cypsiurus parvus (J. E. Gray)*	Palm Swift	R
20.	*Alecdo athis (Linn.)*	Common Kingfisher	R
21.	*Merops orientalis (Latham)*	Green Bee-eater	R
22.	*Coracias benghalensis (Linn.)*	Indian Roller	Lm
23.	*Hirundo rustica Linn.*	Swallow	M
24.	*Oriolus xanthornus (Linn.)*	Black-headed oriole	R
25.	*Dicrurus adsimilis macrocercus (Vieillot)*	Black Drongo	R
26.	*Stunus malabaricus*	Greyheaded Myna	R
27.	*Sturnus contra (Linn.)*	Pied Myna	R
28.	*Acredotheres fuscus (Wagler)*	Jungle Myna	R
29.	*Acredotheres tristis (Linn.)*	Common Myna	R
30.	*Corvus splendens (Vieillot)*	House Crow	R
31.	*Turdoides striatus*	Jungle Babbler	R
32.	*Cisticola juncidis cursitaus (Franklin)*	Streaked Fantail Warbler	R
33.	*Orthotomus sutories patia (Hodgson)*	Tailor bird	R
34.	*Acrocephalus dumetorum (Blyth)*	Blyth's Reed Warbler	M
35.	*Anthus nonaesuleudiae rufulus (Vieillot)*	Paddy Field Pipit	M
36.	*Motacilla alba dukhunensis (Sykes)*	Pied Wagtail	M
37.	*Nectarinia zeylonica sola (Vieilliot)*	Purple-rumped Sunbird	R
38.	*Nectirinia asiatica*	Purple Sunbird	R
39.	*Passer domesticus (Jardine & Selby)*	House Sparrow	R
40.	*Lonchura punctulata (Linn.)*	Spotted Munia	R
41.	*Amaurornis phoenicurus (Boddaert)*	Whitebreasted waterhen	R
42.	*Gallinula chloropus*	Moorhen	R/M
43.	*Porphyrio porphyrio poliocephala (Latham)*	Purple Moorhen	Lm
44.	*Fulica atra (Linn.)*	Coot	M
45.	*Phalacrocorax carbo*	Cormorant	Lm
46.	*Phalacrocorax niger*	Little Cormorant	R
47.	*Anhinga rufa*	Darter	R

48.	*Psittacula eupatria (Linn.)*	Alexandrine Parakeet	R
49.	*Psittacula krameri (Neumann)*	Roseringed Parakeet	R
50.	*Psittacula cyanocephala*	Blossom Headed Parakeet	R

(Key : R=Resident; Lm = Local Migrant; M= Migratory)

TABLE-3.13.7
CHECKLIST OF MAMMALS

Sl. No.	Species	Common Name	Occurrence
1.	*Paradoxurus hermaphroditus*	Palm Civet	Common
2.	*Funumbulus pennanti*	Five Striped Squirrel	Common
3.	*Rattus rattus rufescens (Gray)*	House Rat	Common
4.	*Rattus rattus arboreus (Horsefieeld)*	Tree Rat	Common
5.	*Viverricula india indica (Desmarest)*	Small Indian Civet	Rare
6.	*Mus musculus castaneus (Waterhouse)*	House Mouse	Common
7.	*Mus musculus urbanus (Hodgson)*	House Mouse	Common
8.	*Cynopterus sphinx sphinx (Vahl)*	Short-nosed Fruit-bat	Common
9.	*Rousettus leschenaulti leschenaulty (Desmarest)*	Fulvous Fruit-Bat	Common
10.	*Vulpes bengalensis (Shaw)*	Bengal Fox	Rare
11.	*Mus booduga booduga Gray*		Common
12.	*Bandicota indica nemorivaga (Hodgson)*	Indian Mole Rat	Common

3.13.7 AQUATIC ECOLOGY

The study area has a major river, i.e., Damodar River; several big and small ponds, jheels, beels, tanks, ditches etc which form the ecology of aquatic environment. So, the richness and diversity of aquatic flora and fauna is enough in the study area. The major forms of aquatic biota as recorded during the survey are as follows:

- Macro-phytic flora,
- Planktons, and
- Fishes.

MACRO-PHYTIC FLORA:

There are a number of vegetations found in various water bodies like ponds, beels, Jheels, ditches etc. including Damodar River. All such water bodies are more or less vegetated by different aquatic macrophytic flora and marshy plants in the study area. The details of aquatic macrophytic flora and marshy plants have been summarized in **Table-3.13.5.**

TABLE-3.13.5
CHECKLIST OF AQUATIC MACROPHYTES

Sl. No.	Scientific Name	Family
1.	*Ottelia alismoides*	Alismataceae
2.	*Alternanthera phylloxerodies*	Amaranthaceae
3.	*Colocasia esculenta*	Araceae
4.	*Hygrophilla spinosa*	Acanthaceae
7.	*Ludwigia apscendens*	Onagraceae
5.	*Nymphaea naucheli*	Nympheaceae
6.	*Spirodela polyrhiza*	Lemnaceae
7.	*Lemna purpusila*	Lemnaceae
8.	*Eichornia crassipes*	Hydrocharitaceae
9.	*Vallisneria spiralis*	Hydrocharitaceae
10.	*Pistia stratiotes*	Hydrocharitaceae
11.	*Monochorea hastae*	Hydrocharitaceae
12.	*Hydrolea zeylanica*	Hydrophyllaceae
13.	*Urticularia sp.*	Lentibulariaceae
14.	*Typha domingensis*	Typhaceae
15.	*Enhydra fluctuan*	Compositae
16.	*Ipomea aquatica*	Convolvulaceae
17.	*Ceratophyllum demursum*	Ceratophyllaceae
18.	*Scirpus articulatus*	Cypheraceae
19.	*Salvinea natans*	Salviniaceae
20.	*Azolla pinnata*	Salviniaceae

21.	*Phargmites karka*	Graminae
22.	*Sagittaria sagififolia*	Alismataceae
23.	*Marsilea minuta*	Marseliaceae
24.	*Nymphoides speltatum*	Gentianaceae
25.	*Eclipta prostrata*	Compositae
26.	*Aeschynomene aspera*	Fabaceae
27.	*Limnophila indica*	Scrophulariaceae
28.	*Trapa bispinosa*	Trapaceae
29.	*Jusea repens*	Ongraceae

PLANKTONS

The phytoplanktons are the primary producers and form the base of the food chain. The zooplanktons are the secondary producers and they feed on phytoplanktons. A study of the density, composition, and species diversity of these two organisms gives an idea about the nutrient content, trophic condition of the total aquatic ecosystem and the quality of the water.

Phytoplanktons:

Phytoplankton is the primary producers of an ecosystem and thus helps maintain DO of a water body. Any reduction in number of phytoplankton would ultimately affect the whole ecosystem. Some major phytoplanktons which are found in aquatic ecosystem of the study area are *Euglena sp.*, *Microcystis sp.*, *Diatoma sp.*, *Spirogyra sp.*, *Oedogonium sp.*, *Zygnema sp.*, *Closterium sp.* etc. (Table-3.13.6).

Zooplanktons:

Zooplanktons are animals that occur in the water column of either marine or freshwater ecosystems. Zooplanktons are an important link in the transfer of energy from the algae (the primary producers) to the ecologically and economically important fish community (the consumers).

In the aquatic ecosystem of the study area most species in the small zooplankton community fall into three major groups - Crustacea, Rotifers, and Protozoans. Crustaceans are the most abundant, especially those in the order Cladocera (waterfleas), and the class Copepoda (the copepods), particularly the orders Calanoida and Cyclopoida. Cladocerans are typically most abundant in freshwater, with common genera including *Daphnia* sp. and *Bosmina sp*. The pollution indicator

species like *Brachinous calciflores*, *Filinia terminalis* and *Keratella toopica* etc. (Table-3.13.6).

TABLE-3.13.6
CHECKLIST OF PLANKTON SPECIES

Sl. No.	PHYTOPLANKTON	ZOOPLANKTON
1	*Microcystis sp.*	*Brachionus sp.*
2	*Euglena sp.*	*Daphnia sp.*
3	*Diatoma sp.*	*Cyclops sp.*
4	*Achnanthes sp.*	*Diaptomus sp.*
5	*Zygnema sp.*	*Moina sp.*
6	*Spirogyra sp.*	*Cypris sp.*
7	*Oscillatoria sp.*	*Keratella sp.*
8	*Scenedesmus sp.*	*Mysis sp.*
9	*Cymbella sp.*	*Diaptomus sp.*
10	*Closterium sp.*	*Filinia terminalis*
11	*Oedogonium sp.*	-

FISHES:

Fishes are at the tertiary level of the food chain of aquatic ecology. As the study area having many inland water bodies like several ponds, jheels, beels, ditches and the important river Kangsabati, so the biodiversity of fishes is rich. Types of freshwater fishes of both confined and unconfined (flowing) surface water bodies in the study area were known by talking with local fishermen and local people and have been summarized in Table-3.13.7.

TABLE-3.13.7
CHECKLIST OF FISH SPECIES

CHECKLIST OF FISHES IN THE STUDY AREA			
Sl. No.	Scientific Name	Common Name	Family
1	*Amblypharyngodon mola*	Morala	Cyprinidae
2	*Catla catla*	Catla	Cyprinidae
3	*Cirrhina mrigala*	Mrigal	Cyprinidae
4	*Ctenopharyngodon idella*	Grass carp	Cyprinidae
5	*Cyprinus carpio*	Common carp	Cyprinidae
6	*Esomus danricus*	Dadhikha	Cyprinidae
7	*Hypopthalmicthys molitrix*	Silver carp	Cyprinidae
8	*Hypopthalmicthys nobilis*	Bighead carp	Cyprinidae
9	*Labeo bata*	Bata	Cyprinidae
10	*Labeo Calbasu*	Calbasu	Cyprinidae
11	*Labeo rohita*	Rohu	Cyprinidae
12	*Puntius chola*	Punti	Cyprinidae
13	*Puntius sarana*	Swarna punti	Cyprinidae
14	*Puntius ticto*	Teto Punti	Cyprinidae

15	*Rasbora daniconius*	Dankuni	Cyprinidae
16	*Salmostoma sardinella*	Chela	Cyprinidae
17	*Channam arulius*	Shal	Channidae
18	*Channa orientalis*	Chang	Channidae
19	*Channa punctatus*	Leta	Channidae
20	*Channa striatus*	Shol	Channidae
21	*Chanda nama*	Chanda	Chandidae
22	*Chanda ranga*	Chanda	Chandidae
23	*Clarius batrachus*	Magur	Clariidae
24	*Clarias gariepinus*	Thai magur	Clariidae
25	*Pangasius sutchi*	Pangus	Clariidae
26	*Mystus menoda*	Aarr	Bagridae
27	*Mystus tengara*	Tengra	Bagridae
28	*Mystus vittatus*	Bitengra	Bagridae
29	*Notopterus chitala*	Chital	Notopteridae
30	*Notopterus notopterus*	Falui	Notopteridae
31	*Heteropneustes fossilis*	Singi	Heteropneustidae
32	*Wallago attu*	Boal	Siliridae
33	*Monopterus cuchia*	Ban	Symbranchidae
34	*Anabas testudineus*	Koi	Anabantidae
35	*Colisa fasciata*	Khalsha	Belontidae
36	*Glossogobius giuris*	Beley	Gobiidae
37	*Nandus nandus*	Bheda	Nandidae
38	*Oreochromis sp.*	Tilapia	Cichlidae
39	*Rhinomugil corsula*	Kharsula	Mugilidae
40	*Mastacembelus aculeatus*	Pakal	Mastacembelidae

TABLE-3.13.8
CHECKLIST OF WATER BIRD SPECIES

Sl. No.	Common Name	Scientific Name
1.	Little Grebe	*Podiceps ruficollis*
2.	Cormorant	*Phalacrocorax carbo*
3.	Little Cormorant	*Phalacrocorax niger*
4.	Darter	*Anhinga rufa*
5.	Grey Heron	*Ardea cinerea*
6.	Purple Heron	*Ardea purpurea*
7.	Pond Heron	*Ardeola grayii*
8.	Cattle Egret	*Bubulcus ibis*
9.	Large Egret	*Ardea alba*
10.	Smaller Egret	*Egretta intermedia*
11.	Little Egret	*Egretta garzetta*
12.	Yellow Bittern	*Ixobrychus sinensis*
13.	Lesser Whistling Teal	*Dendrocygna javanica*
14.	Pintail	*Anas acuta*
15.	Garganey	*Anas querquedula*
16.	Cotton teal	*Netapus coromandelianus*
17.	Comb Duck	*Sarkidiornis melanotos*
18.	Whitebreasted Waterhen	*Amaurornis phoenicurus*

19.	Moorhen	*Gallinula chloropus*
20.	Purple Moorhen	*Porphyrio porphyrio*
21.	Coot	*Fulica atra*
22.	Pheasant-tailed jacana	*Hydrophasianus chirurgus*
23.	Bronzewinged Jacana	*Metopidius indicus*
24.	Green Sandpiper	*Tringa ochropus*
25.	Common Sandpiper	*Tringa hypoleucos*
26.	Pintail Snipe	*Gallinago stenura*

Conclusion

The present observation revealed that the terrestrial aquatic vegetation of 10 km radius of the proposed project is very rich and diverse.

Among terrestrial flora qualitatively altogether 75 species of tree, 39 species of Shrubs, 72 species of herbs and climbers were observed. High value (4.51) of shannon –weiner index indicated that biodiversity status of the area is very high.

Terrestrial fauna was also rich. Altogether 12 species of mammals, 50 species of birds, 10 species of reptiles and 5 species of amphibians were recorded.

The aquatic ecology encompasses a major river i.e., Damodar river, several big and small ponds, jheels, beels, tanks and ditches. Altogether 29 species of macrophytes & other marshyplants, 15 species of phytoplankton & zooplanktons each are observed. So, enough richness has been observed in aquatic flora and fauna. Thus, it may be concluded that the water reservoirs of the study area are rich in primary producers (i.e phytoplanktons) and any reduction in their numbers may affect the level of dissolved oxygen in water.

By contrast the zooplanktons constitute a link between primary producers and ecologically important consumers i.e., fish community (21 species). Hence, any destruction of zooplanktons may lead to break in transfer of energy from producers to consumers. It causes imbalance in aquatic ecosystems.

No species were found to be endangered. There were no migratory routes of fauna, presence of breeding grounds and sensitive habitats and absence of protected areas.

The biodiversity index (4.51) is quite high which signifies high species richness and diverse vegetation.

Since the proposed project shall adopt zero discharge concept, no adverse impact on aquatic ecology will be seen. The plant drainage system will be suitably designed so that the storm water does not carry any pollutants.

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3.14 DEMOGRAPHY & SOCIO-ECONOMIC STATUS

3.14.1 GENERAL DESCRIPTION

The growth of industrial sectors and infrastructure development in and around the agriculture dominant areas, village and towns is bound to create its impact on the socio-economic aspects of the local population of the area experiencing development. The impacts may be positive or negative depending upon the development activity. To assess the anticipated impacts of the project and industrial growth on the socio-economic aspects of people, it is necessary to study the existing socio-economic status of the local population, which will be helpful for making efforts to further improve the quality of life in the area under study.

The sociological aspects of this study include human settlements, demography, and social strata such as Scheduled Castes and Scheduled Tribes and literacy levels besides infrastructure facilities available in the study area. The economic aspects include occupational structure of workers.

The Baseline Demographic and Socio economic characteristics with regards to demography, literacy and occupational status have been described based on the Primary Census Abstract, 2011. The proposed expansion project site is located at village Raghunathpur of Purulia district in the state of West Bengal. The 10 km radius study area around the proposed project site comprises of 256 villages. A comparative assessment has been made for the respective demographic aspects, based on the year 2011 Census data, which has been discussed in the following sections.

The study area is rural in nature and Moderate populated with the total population of 1,43,081 (as per 2011 Census). Scheduled Caste (SC) and Scheduled Tribe (ST) population in the study area is about 31.27% and 17.27% w.r.t. the total rural population respectively. The sex ratio in the study area is about 936 females per 1000 males. The overall rural literacy rate is about 55.2% w.r.t. total rural population. The principal language is Bengali and the principal staple food is rice. The primary sources of drinking water are tube wells, Hand pump water in rural areas and tube wells, Hand pump and Supply water.

The study area is little Urban in nature populated with the total population of 36,817 (as per 2011 Census). Scheduled Caste (SC) and Scheduled Tribe (ST) population in the study area is about 21.48% and 1.33% w.r.t. the total urban population respectively. The sex ratio in the

study area is about 915 females per 1000 males. The overall rural literacy rate is about 66.0% w.r.t. total urban population. The principal language is Bengali and the principal staple food is rice. The primary sources of drinking water are tube wells, Hand pump water in rural areas and tube wells, Hand pump and Supply water.

3.14.2 DEMOGRAPHIC ASPECTS

3.14.2.1 Average Household Size:

The Study area has an average family size of around 5.4 persons per household. This is considered to be the average family size in West Bengal.

3.14.2.2 Overall population density and family size:

As per 2011 census, the total population in the study area is 1,79,898. According to this population in the study area Population Density is approximately 573 persons per square kilometer. Total population, population density & family size have been shown below in **Table-3.14.1**.

TABLE-3.14.1
OVERALL POPULATION DENSITY AND FAMILY SIZE

Sl. No.	Particulars	Number
1	No. of Household	33532
2	Population Density	573 Nos./sq.km
3	Family Size	5.4
4	Male Population	93136
5	Female Population	86762
6	**Total Population**	179898

Source: Census of India, 2011

3.14.2.3 Sex Ratio:

According to 2011 census, the sex ratio (female per 1000 male) in the total segment of the study area is 932 sex ratio of the study area is tabulated in **Table-3.14.2**.

TABLE-3.14.2
SEX RATIO OF THE STUDY AREA

Sl. No.	Segment of the area	Females per 1000 males
1	Rural	936
2	Urban	915
3	**Whole**	**932**

Source: Census of India, 2011

3.14.2.4 Population structure:

As per 2011 census total population within the study area is 1,79,898 having 51.77% of male and 48.23% of female population. within the study area.

3.14.2.5 Social Structure:

As per 2011 census, the Scheduled caste (SC) population in the study area is 29.26% of the total population,

As per 2011 census, Scheduled Tribe (ST) population in the study area is 14.01% of the total population Scheduled caste and scheduled tribe population in the study area is shown in **Table-3.14.3**.

TABLE-3.14.3
SOCIAL STRUCTURE OF THE STUDY AREA

Segment of the Area	Number of population								
	Total Population			Scheduled Caste			Scheduled Tribe		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Rural	73907	69174	143081	23056	21680	44736	12638	12076	24714
Urban	19229	17588	36817	4037	3873	7910	228	262	490
Total	**93136**	**86762**	**179898**	**27093**	**25553**	**52646**	**12866**	**12338**	**25204**

3.14.2.6 Literacy Level:

Total literacy rate in study area is 57.5% of the total population whereas male literacy rate is 68.4% of the total male population and female literacy rate is 45.7% of total female population. the total female population). Population classification for literates in the study area is presented **Table-3.14.4.**

TABLE-3.14.4
LITERACY LEVEL IN THE STUDY AREA

Area	No. of Literates		
	Male	Female	Total
Rural	49470	29577	79047
Urban	14211	10099	24310
Total	**63681**	**39676**	**103357**

Source: Census of India, 2011

3.14.3 OCCUPATIONAL STRUCTURE

The occupational structure of population in the study area is studied with reference to main workers and marginal workers. As per Census of India, all persons engaged in 'work' defined as participation in any economically productive activity with or without compensation, wages or profit are workers. The Reference period for determining a person as worker and non-worker is one year preceding the date of enumeration The Census classifies Total Workers into two groups namely, (i) Main workers (ii) Marginal workers. Main Workers are those workers who had worked for the major part of the reference period i.e. 6 months or more. Marginal Workers are those workers who had not worked for the major part of the reference period i.e. less than 6 months.

The main workers include 10 categories of workers defined by the Census Department, which consists of cultivators, agricultural laborers, those engaged in live-stock, forestry, fishing, mining and quarrying; manufacturing, processing and repairs in household industry; and other than household industry, construction, trade and commerce, transport and communication and other services.

3.14.3.1 Workers and Non-workers:

i) Total Workers:

Total Worker in rural areas is 38.9% of the total rural population in the study area according to 2011 Census. The total workers are divided into main and marginal workers.

ii) Main Workers:

Main Worker in rural areas is 46.9% of the total rural population of and Main worker in the study area according to 2011 Census.

iii) Marginal Workers:

Marginal Worker in rural areas is 39.8% of the total rural population in the study area according to 2011 Census.

iv) Non-workers:

Non-Worker in rural areas is 61.% of the total rural population in the study area according to 2011 Census.

i) Total Workers:

Total Worker in Urban areas is 29.9% of the total urban population in the study area according to 2011 Census. The total workers are divided into main and marginal workers.

ii) Main Workers:

Main Worker in urban areas is 70.5% of the total urban population of and Main worker in the study area according to 2011 Census.

iii) Marginal Workers:

Marginal Worker in urban areas is 29.5% of the total urban population in the study area according to 2011 Census.

iv) Non-workers:

Non-Worker in urban areas is 70.1% of the total rural population in the study area according to 2011 Census.

The occupational status of workers and non-workers has been shown in **Table – 3.14.5**.

TABLE – 3.14.5

OCCUPATIONAL STATUS OF THE STUDY AREA

Area	No. of workers						No. of non-workers			Total Population (3)+(6)+(9)
	Main Workers			Marginal Workers						
	Male (1)	Female (2)	Total (3)	Male (4)	Female (5)	Total (6)	Male (7)	Female (8)	Total (9)	
Rural	22528	3568	26096	13936	8231	22167	33871	53559	87430	143081
Urban	6809	940	7749	2155	1087	3242	10265	15561	25826	36817
Total	**29337**	**4508**	**33845**	**16091**	**9318**	**25409**	**44136**	**69120**	**113256**	**179898**

3.14.3.2 Classified Occupational Status:

Cultivators and agricultural workers in rural areas are 5.8% and 10.4% respectively w.r.t. the total rural population in the study area. The classified occupational status in the study area has been tabulated in **Table-3.14.6**.

TABLE-3.14.6

CLASSIFIED OCCUPATIONAL STATUS

Area	Total Workers	Cultivators	Agricultural Workers	Others
Rural	55651	4771	16081	7813
Urban	10991	228	181	6941
Total	**66642**	**4999**	**16262**	**14754**

Graphical presentations of demographical and occupational status have been given below in **FIGURE-3.14.1.**

3.14.4 INFRASTRUCTURE FACILITIES:

Medical Facilities

Medical facility in some form or the other is available to the population residing within the rural segment of the study area. However, medical facilities i.e. Hospital with basic facilities only, is available within the urban segment of the study area.

Drinking Water Facilities

Tap water, ground water and surface water is being used in the different village located in the rural sector of concerned C.D Blocks. In the urban area tube well and tap water are the source of drinking water.

Electricity

Most of the villages have electricity in the Concerned C.D Blocks. Available for domestic purposes.

Communication Transport & Access Facilities

Most of the villages in the concerned C.D Block have Post Office available within study area. Almost all the villages have bus connectivity. Approach paved road is available in the all village areas. In the urban area surface rail, buses and rickshaw etc. are available for communication.

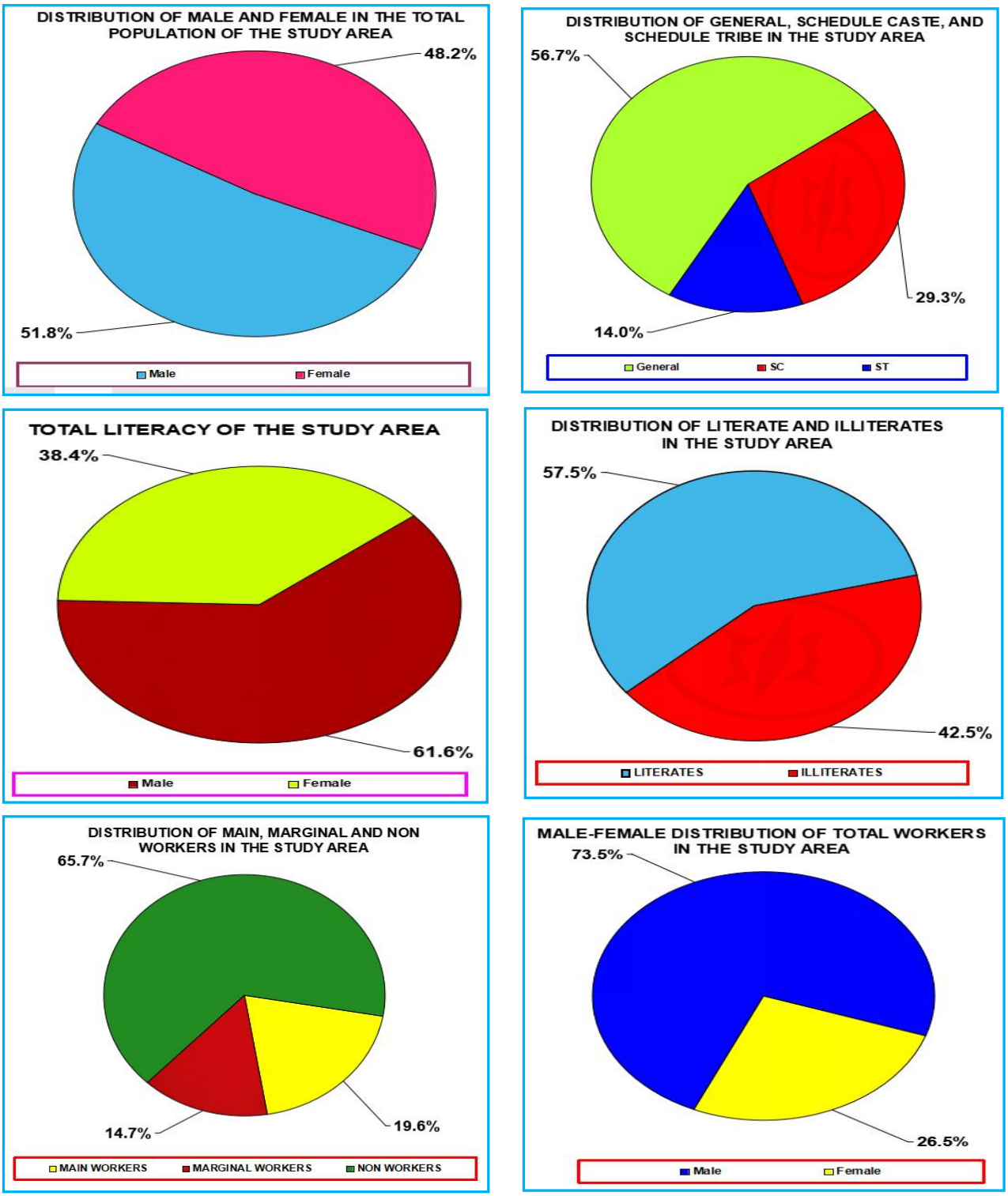


FIGURE-3.14.1
GRAPHICAL PRESENTATION OF DEMOGRAPHIC & SOCIAL STATUS (BASED ON 2011 CENSUS DATA)

3.15 SOCIO-ECONOMIC SURVEY

The 2011 census data have been supplemented and corroborated by a socio-economic sample survey, conducted in January, 2023, covering a sample population size of 6147 numbers covering 1151 number of Households, distributed over 20 villages within the study area through structured questionnaires portraying demographic and socio-economic aspects of the study area population. The names of the villages, considered for the sample survey have been gathered in **Table-3.15.1**. The data of this socio-economic survey including demographic and socio-economic characteristics, income profiles, household amenities, educational status etc. have been presented in **Chapter-7.0**. The salient findings of this sample survey are presented below:

Total Population	6147 (Male: 3165, Female: 2982)
No. of Households	1151 (Distributed over 20 villages)
Family Size	5.34
Sex ratio	942 females per 1000 males
Caste	SC & ST (51.73% w.r.t total Sampling population)
Literacy Level in Area	55.31% w.r.t total Sampling population
Build of House of sample Households	Brick (43.96%), Multistoried Brick (33.97%), Thatched Roof Brick (13.99%), Mud (8.08%)
Lighting source of sample Households	Electricity (95.80%), Kerosene (4.20%), Bio-gas (0.00%), Others (0.00%)
Source of Income	Agriculture (12.36%), Business / Trade (22.0%), Service (14.45%), Labour (36.08%), Forestry/ Plantation (4.71%), Livestock/ Fishery (4.06%), Others (6.45)

Comparison of the findings of the socio-economic sample survey with the 2011 census data are presented in **Table-3.15.2**.

Table-3.15.2
Comparison of the Findings of the Socio-Economic Sample Survey

Particulates	2011 Census	2022 Sample Survey
Family Size (persons per household)	5.36	5.34
Literacy Level in Area (% of total population)	57.5	55.31
Sex ratio in rural area	932 females per 1000 males	942 females per 1000 males
Occupational Status in area of the total worker population	Workers (37.0%), Non-Workers (63.0%)	Workers (40.1%), Non-Workers (59.9%)

It is evident from the above comparison that there has been slight increase in the family size, literacy rate has increased, sex ratio has increased and percentage of workers has slightly increased in the villages under sample survey.

Table-3.15.3 : List of Villages & Census Towns for Sample Survey

S.N	Name of Village / town	No. of Households	Population		
			T	M	F
1	Bagmanmi	33	180	94	86
2	Nanduka	55	266	135	131
3	Barra	126	658	336	322
4	Baragarya	70	383	195	188
5	Pabra	85	452	245	207
6	Kulisara	46	219	112	107
7	Nildi	35	168	85	83
8	Dhanuktor	52	306	158	148
9	Muchkunda	23	133	69	64
10	Hurara	38	199	105	94
11	Salanchi	67	338	173	165
12	Lachhmanpur	41	223	120	103
13	Durmut	116	588	299	289
14	Jorberya	27	149	80	69
15	Dhanibari	20	118	61	57
16	Achkoda	44	233	118	115
17	Dumarhir	54	337	172	165
18	Bhaldubi	15	99	50	49
19	Ray Band	82	479	246	233
20	Lakhipriya Alis Nutandi	122	619	312	307
TOTAL		1151	6147	3165	2982

The detailed data of sample survey has been presented in **Chapter-7.0** of the EIA Report.

3.16 OVERALL SUMMARY & CONCLUSION

The field data were generated for soil, meteorology, air quality, water quality, noise & ecology during three months' period **(1st December, 2022 - 28th February, 2023)** of Winter season along with the relevant secondary data, collected from various agencies on the relevant disciplines like Geology and Geo-hydrology, Land Use, Meteorology and Demography & Socio-Economy.

While analyzing the Landuse Pattern of the 10 km radius study area, it is observed that it contains more than 64% Mixed Crop Land. River & Reservoir (14%) comes next to it. Settlements category (13%) is the next leading category.

The soils are suitable for cultivation of paddy, wheat and seasonal vegetables. As per FAO-UNESCO soil classification, this soil is of Ultisols and is suitable for paddy rice, sesame, ground nut, chillies, mango, rose etc. It is also home for many beneficial biological organisms like bacteria, fungi, lichen, etc. The nutrient status and pH of the soil certainly produces the food and fodder to the end user and retain the sustainability of top soil. No impact of surrounding industry has been found.

The overall mean wind speed during the entire monitoring period was 2.7 Km/hr. The predominant wind direction was North-West.

The values of all the ambient air parameters i.e., PM_{10}, $PM_{2.5}$, SO_2, NO_2 and CO at the respective 8 monitoring locations are within the stipulated limits on all the occasions as per NAAQ Standard. The maximum value of PM_{10} was observed near project site (at Nildih High School) i.e., 88 $\mu g/m^3$, which is considerably on higher side, but is still within the standard. This may be attributed to the wind blown dust due to the unpaved roads and the vehicular emissions in the area.

All the tested parameters of Ground water sources in the study area are complied with the Drinking Water Quality Standards as per IS 10500:2012. The ground water is suitable for drinking purpose as per BIS 10500.

The river water quality (SW1 & SW2) parameters are within the standard for Class C i.e., Drinking water source after conventional treatment and after disinfection.

The Equivalent Noise Levels at the Industrial locations are within permissible limits, but they have exceeded the permissible limits at the Commercial, Residential and Sensitive locations in the study area. Such high noise levels may be attributed mainly to the noise, generated due to the vehicular traffic.

The biodiversity value of the studied ecosystem obtained was 4.51. Thus, the proposed project site has very rich biodiversity, which must be conserved. The terrestrial and aquatic ecological scenarios were richly constituted by various type of trees sbrubs, herbs, climbers, amphibians, reptiles, birds, mammals, fishes etc. The proposed study area has river, canals, beels, ponds and several other categories of water bodies, so the richness and diversity of aquatic flora and fauna is also very high. A good number of water birds noticed in the study area reveals that Damodar River and other water bodies might have attracted the migrating and local birds to form their habitat. Thus, the study area is ecologically rich & diverse.

The study area is rural-urban mixed in nature and moderately populated with the population density of approximately 573 persons per square kilometer. The Study area has an average family size of around 5.36persons per household which is considered to be a normal family size. As a whole, SC & ST population is 29.26% and 14.01% respectively w.r.t. the total population in the study area. The overall literacy rate in the study area is about 57.5% w.r.t. the total population i.e., the literacy level in the study area is quite satisfactory. Total worker is 37.0% of the total population. Presence of water availability in the region is mainly in the form of tube wells and tap water. As far as sanitary and hygiene is concerned in study area, under Swachh Bharat Mission, toilets have been provided in each household.

CHAPTER-4.0 ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

4.1 PROJECT ACTIVITIES

4.1.1 Phases of Impacts

The proposed expansion project will have impacts on the environment in two phases. During the construction phase, which is temporary and short-term, the other during the operation stage, which will have long term effects. The environmental impacts in this study have been discussed separately for the construction phase and the operation stage.

Spatially, the impacts have been assessed over the study area of 10 km radius of the project site.

4.2 IMPACTS DURING CONSTRUCTION PHASE

4.2.1 Activities during Construction Phase

During the construction phase, the following activities are considered to be important towards development of impacts:

a) Site preparation
b) Excavation and backfilling
c) Hauling of earth materials
d) Piling, cutting and drilling
e) Erection of concrete and steel structures
f) Road construction
g) Painting and finishing
h) Clean up operations
i) Landscaping and Afforestation

Construction phase activities will have moderate impacts on land use, demography and socio-economics, on-site soils and on-site noise. It could also develop minor impacts on water use, air and water quality and ecology.

The activities can be divided into two categories, viz. sub-structural and super-structural work. Certain foundation would require pile driving and the machineries would pose noise and gaseous pollution.

Moreover, construction work will involve cutting of trenches, excavation, concreting etc. There may be dust, gaseous and noise pollution from these activities.

Mechanical erection work involves use of mechanical equipment for storage, transportation, erection and on-site fabrication work. These activities generally produce some air contaminants and noise pollution which will be contained by using water sprinkling and noise abatement measures.

4.2.2 Impacts on Air Quality

Particulate matter would be the predominant pollutant affecting the air quality during the construction phase. Dust will be generated mainly during excavation, back filling and hauling operations along with transportation activities.

Sprinkling of water from tankers or other suitable means would be undertaken at the construction sites for the suppression of fugitive dust.

Undesirable gaseous pollutants will be generated mostly by the traffic and use of machineries. However, this would not lead to any tangible effect, as the expected emission volume is low.

It would be ensured that all the vehicles plying during construction are properly tuned and maintained to keep emissions within the permissible limits.

4.2.3 Impacts on Hydrology and Water Use

All construction activities will take place within the project site. Best practices will be followed to ensure least disturbance to the natural drainage pattern of the site and the neighbourhood and thus, is not expected to have any impact on the local hydrology.

4.2.4 Impacts on Water Quality

Wastewater from construction activities would mostly contain suspended impurities. Other pollutants which may find their way into it will be in insignificant concentrations and may be safely disregarded. Drains from different construction sites will be led to sedimentation pits where excess suspended solids will be settled out

and relatively clear supernatant will be discharged into the outside surface drains.

4.2.5 Impacts on Noise

During the construction phase, noise will be generated due to movement of vehicles and operation of light and heavy construction machineries including pneumatic tools and compressors, which are expected to emit sounds with moderate to high decibel value. Careful planning of their operation is required during this period so that minimum disturbances are caused. The construction personnel would be located away from the major road traffic. Moreover, residential areas not being close to the project site, no significant impact is apprehended.

4.2.6 Impacts on Soil and Land Use

All major construction activities tend to create certain changes in the soils of the area. However, this will take place inside the plant premises and as such; there will be no impact on the soil condition outside the plant boundary in terms of fertility.

During storms, some of the excavated soil and construction materials such as sand etc. would be blown up in the air and dispersed around the project site; some would also tend to be driven into the soil and clog inter granular spaces.

However, in order to minimise such impacts, sprinkling of water shall be done.

Preparatory activities like construction of access roads, temporary offices, quarters and godowns, piling, storage of construction materials etc. will be confined within the project area. These will not generally exercise any significant impact except altering the land use pattern of the site. There will be no impact on the adjoining land.

As a result, the impact on land use would be very insignificant and any impact due to construction will be confined within the project area and will not hamper the land use aspects outside.

Overall, it could be easily inferred that there will be no adverse impact on soil quality & land use in the study area.

4.2.7 Impacts on Demography & Socio-economics

It is estimated that a large number of workers, comprising of skilled, semi-skilled and unskilled labourers, shall be employed by various contractors at site during the construction phase. Significant number of semiskilled and unskilled labourers would be recruited from the nearby areas. This would create some employment opportunities in the area.

Since most of sizeable labour force will be drawn from neighbourhood, no change in demographic profile is anticipated. However, there will be increased economic opportunities for the local people.

Most of the construction work is labour intensive. As most of the job will be done by the contractors, it will be ensured that the contractor's workers are provided with proper facilities including sanitation and drinking water supply.

4.3 IMPACTS DURING OPERATIONAL PHASE

The process description including quantum of pollution loads from liquid and gaseous effluents considering their proposed environmental control measures has been discussed in **Chapter 2 - Project Profile.**

The operational impacts in this study have accordingly been evaluated for this project.

4.3.1 Impacts on Air Quality

4.3.1.1 Sources of Emissions

The major source of continuous emission from the existing unit (RTPS, Ph-I) is 01 (one) twin flue stack. In the proposed (RTPS, Ph-II) project there will be another twin flue stack. Hence, there will be total 2 twin flue stacks after the proposed expansion project. Stack emissions would be constituted of mainly SO_2, NOx and Particulate matters (PM).

The major source of emission from the proposed units (RTPS, PH-II) has been presented in **Table-4.1.**

TABLE 4.1
STACKS & EMISSION CHARACTERISTICS (PROPOSED RTPS, PH-II)

Description	2x660 MW
No. of Stacks	1
No. of flues	2
Stack height (m)	100
Internal diameter at Stack Top (m)	4.0
Exit velocity of flue gas (m/sec)	25
Temp. of flue gas degree (^oC)	120
Temp. of flue gas degree (K)	393
Flue gas flow rate (Nm^3/Hr)	785984
PM emission rate(mg/Nm^3) [Stipulated norm]	30
PM emission rate (gm/sec)	6.55
SO_2 emission rate (mg/Nm^3) [Stipulated norm]	100
SO_2 emission rate (gm/sec)	21.83
NOx_2 emission rate (mg/Nm^3) [Stipulated norm]	100
NOx emission rate (gm/sec)	21.83
Pollution Control Equipment	ESP

4.3.1.2 Air Quality Dispersion Modelling

Selection of Model

The plant operation emits gaseous pollutants through stacks, which have the potential to deteriorate the air quality of the area. In order to evaluate the impact on ambient air quality due to such releases, the ground level concentrations (GLCs) as a result of the plant emissions have been evaluated through mathematical modelling using computer aided techniques.

Upon discharge to atmosphere, the emissions from sources are subjected to transport and diffusion processes which together are termed as dispersion. The processes which govern the atmospheric dispersion of pollutants are plume rise, transport by wind and diffusion by turbulence and a number of physico-chemical processes such as gravitational settling, deposition, chemical reactions, transformation, decomposition and wash out.

The computation has been made applying **ISCST3 of USEPA**, which is most widely used and also recommended by **CPCB (PROBES/70/1997-98)**. The model is based on some assumption such as steady state conditions, continuous homogeneous flow, inert passive pollutants, no ground absorption and a Gaussian distribution of the plume in both horizontal and vertical planes.

4.3.1.3 Data Used for Modelling

Various stack and emission data as presented in **Tables–4.1** have been used as input to the model. The prediction of GLCs and corresponding impacts has been made for the emission figures mentioned therein.

The hourly meteorological data like ambient temperature, wind speed and wind direction used for air quality modelling have been taken from such data generated through continuous on-site monitoring during **(1st December, 2022 – 28th February, 2023)**.

The hourly occurrence of various atmospheric stability classes has been determined from the on-site hourly wind speed and cloud cover data using the insolation-based stability classification.

The Mixing Height data were taken from one of the published documents i.e., **"Spatial Distribution of Hourly Mixing Depth over Indian Region"** of **R. N. Gupta**, applicable for the region. The mixing heights considered for modelling are given in **Table 4.2**.

TABLE-4.2
MIXING HEIGHT DATA

Hour of the day	Mixing Height (m)
	December to February
8	50
9	100
10	200
11	500
12	800
13	1000
14	1000
15	1200
16	1200
17	1000
18	800
19	500
20	200
21	100
22	50

4.3.1.4 Modelling Procedure

Modelling exercise has been undertaken for the proposed twin flue stack attached with 2 X 660 MW (RTPS, Ph-II)

As recommended by CPCB, radial pattern of receptor locations has been implemented using the polar (r,θ) co-ordinate system with origin at the Centre of the project site. The locations of the receptors have then been defined with respect to 16 radial directions (N to NNW angle θ of such directions measured clockwise from North) and radial distance 'r' from the origin.

The receptors are selected in such a way that more receptors are located close to the maximum concentration point. The maximum distance covered is 10 km., which has been seen adequate to cover the maximum concentrations for this particular situation.

In order to compute the 24 hourly concentrations due to the operation of the proposed project, the hourly meteorological data recorded at the site meteorological observatory set up near the project site was used. The model was used to compute the 24-hour

concentrations for each day for the monitoring during (1st December, 2022 – 28th February ,2023).

4.3.1.5 Discussion on Modelling Results

The predicted maximum GLCs of SO_2, NO_x & PM are presented in **Table-4.3**. The isopleths of these pollutants have been depicted in **Figures-4.1** to **4.3** respectively.

TABLE – 4.3
PREDICTED MAXIMUM GLCS OF POLLUTANTS

Pollutant	Max. GLCs ($\mu g/m^3$)	Direction	Distance (km)
SO_2	3.16	E	1.2
NOx	3.16	E	1.2
PM	0.95	E	1.2

The maximum incremental value of SO_2, NOx & PM during operation of the proposed (RTPS, PH-II) plant would be about 3.16 $\mu g/m^3$, 3.16 $\mu g/m^3$ and 0.95 $\mu g/m^3$ respectively, which will occur at a distance of 1.2 km in E direction. However, it may be observed that these values have been attained only on one day in the winter season.

The predicted GLCs at the respective ambient air quality monitoring locations have been further superimposed on the corresponding background concentrations to get the resultant concentrations at those locations and have been presented in **Table-4.4**.

Table-4.4
Ambient Air Quality (Baseline + incremental due to additional load of proposed Project) (All values in $\mu g/m^3$)

Location Code	AAQM location	PM		
		Back Ground Maximum value	Predicted GLCs (Max)	Over all scenario/ Net Impact
A1	Near Project Site (Kewabathan)	77	0.70	77.70
A2	Rampur Vivekananda Vidyalaya	66	0.26	66.26
A3	Laldanga Sishu Sikha Kendro	79	0.26	79.26
A4	Mahul Bari Primary School	73	0.25	73.25

A5	Nildih High School (HS)	88	0.29	88.29
A6	Muldi Village	78	0.32	78.32
A7	Barrah Anchal High School (H.S.)	67	0.19	67.19
A8	Achkoda Mallikpara	85	0.19	85.19
Norm		**100.0**		

Location Code	AAQM location	SO_2		
		Back Ground Maximum value	Predicted GLCs (Max)	Over all scenario/ Net Impact
A1	Near Project Site (Kewabathan)	18	2.35	20.35
A2	Rampur Vivekananda Vidyalaya	8	0.85	8.85
A3	Laldanga Sishu Sikha Kendro	13	0.88	13.88
A4	Mahul Bari Primary School	10	0.83	10.83
A5	Nildih High School (HS)	16	0.97	16.97
A6	Muldi Village	14	1.05	15.05
A7	Barrah Anchal High School (H.S.)	9	0.63	9.63
A8	Achkoda Mallikpara	15	0.63	15.63
Norm		**80.0**		

Location Code	AAQM location	NO_X		
		Back Ground Maximum value	Predicted GLCs (Max)	Over all scenario/ Net Impact
A1	Near Project Site (Kewabathan)	38	2.35	40.35
A2	Rampur Vivekananda Vidyalaya	25	0.85	25.85
A3	Laldanga Sishu Sikha Kendro	30	0.88	30.88
A4	Mahul Bari Primary School	27	0.83	27.83
A5	Nildih High School (HS)	40	0.97	40.97

A6	Muldi Village	33	1.05	34.05
A7	Barrah Anchal High School (H.S.)	23	0.63	23.63
A8	Achkoda Mallikpara	35	0.63	35.63
Norm		**80.0**		

It may also be noted that the modelling results depict the worst-case scenario as washout due to rain has not been considered and deposition on other forms of structures as buildings, trees etc. have not been taken into account. Thus, in actuality, the pollutant concentrations are expected to be relatively lower than the predicted value.

4.3.2 Impacts on Water Quality

M/s DVC will follow "the zero wastewater discharge concept" and the entire wastewater will be recycled to the plant for various uses. As no wastewater will be discharged outside the plant premises, there will be no impact on the water quality of any surface water bodies of the area.

Storm Water Discharge: The network of storm water drains and wastewater drains inside the plant are separate. The storm water drain will have be connected with rain water collection pond inside the premises for use in non-critical purposes. The rain water from all nearby Buildings / areas like ADM buildings, Laboratory, Central Stores, Electrical substation building, Canteen and internal roads will be collected to storm water pond through storm water drains.

During the first or second rain of the monsoon season, there is possibility that, rain water will be contaminated due to presence of dust, oil and grease particles on the roof top of industries and within the plot. To prevent flow of such contaminated rain water into storm water drainage system it is proposed that contaminated rain water is collected in a storage tank for required treatment and disposal. If rain water is not contaminated, the same can be bypassed to storm water drains. The contaminated rain water will have to be treated inside industry premises or discharged to low polluting effluent collection network.

Table 4.5: Characteristics of wastewater generated from plant operations

Area/ process	Characteristics
Demineralised (DM) Plant rejects	Effluents from DM plant regeneration and CPU regeneration are acidic from cation units and alkaline from anion units. These effluents are neutralised in neutralisation pit. Neutralised effluent will have suspended solids less than 100 ppm and pH of about 7.0 to 7.5. The neutralised effluent will be sent to settling pond/Central Monitoring Basin (CMB).
Cooling Tower blow down	To optimise water consumption, cooling tower shall be set up with minimum Cycle of Concentration (COC) of 5. CT blow down is expected with TDS value of about 1000 mg/l. The blow down water is sent to ETP.
Oil waste water	Oily waste water from station transformer, switch yard, turbine and boiler area is collated and sent to Tilted Plate Interceptor (TPI) oil- water separator unit. The separated water will have value less than 20 mg/l prescribed limit of oil and grease.
Waste water from ESP, SSF back wash ash silo area	Waste water from ESP area is sent to settling tank and the overflow along with SSF backwash waste and silo wash water are sent to AHP.
FGD waste water	The waste water generated from FGD system shall be collected and neutralized using lime. The neutralized water shall be send to AHP.
Ash pond water	HDPE liner is provided at both ash pond 1 &2 to arrest any leaching of pollutants in ground water. 100% ash water recycling will be achieved from downstream of the ash pond.

4.3.3 Impacts on Hydrology and Water Use

The requirement of water for the overall project will be met from Panchet Dam. No nalla or drains are passing through the plant premises. So, there will be no alteration in existing drainage pattern. The storm water generated from the premises will be diverted to storm water drains, which will be provided with sedimentation tanks of adequate depth (depending on the maximum hourly runoff). Storm water will be disposed in surrounding nallas after collection of silt and sand using the sedimentation tanks.

4.3.4 Impacts on Noise during Operation

Any industrial complex in general consists of several sources of noise in clusters or single. These clusters/single source may be housed in buildings of different dimensions made of different materials or installed in open or under sheds. The material of construction implies different attenuation co-efficient. In this project, noise shall be generated mainly from Fan, Pump, Turbine, Compressor etc. The equipment shall be designed to comply with the stipulated limit of 85 dB(A).

In order to predict ambient noise levels due to the operation of the equipment in the project, the noise modeling has been done. For computing the noise levels at various distances with respect to the plant site, noise levels are predicted using "CUSTIC", a Noise Pollution Modeling Software of Canarina Environmental Software, the details of which are elaborated below:

Model for Sound Wave Propagation during Operation

For an approximate estimation of dispersion of noise in the ambient air from the point source, a standard mathematical model as mentioned above for sound wave propagation is used. The noise generated by equipment decreases with increase in distance from the source due to wave divergence. An additional decrease in sound pressure level with distance from the source is expected due to atmospheric effect or its interaction with objects in the transmission path.

For hemispherical sound wave propagation through homogenous loss free medium, one can estimate noise levels at various locations, due to different sources using model based on first principles, as per the following equation:

$$L_{p2}=L_{p1}-20\text{Log}(r_2/r_1)-A_E-A_M \quad (1)$$

Where,

Sound L_{p2} and L_{p1} are the Sound Pressure Levels (SPL) at points located at a distances of r2 and r_1 from the source. A_E & A_M are attenuations due to Environmental conditions (E) and Machine correction (M). The combined effect of all the sources can be determined at various locations by the following equation.

$$L_{p(total)}= 10\text{Log} (10^{(Lpa)/10} + 10^{(Lpa)/10} + 10^{(Lpa)/10} +. . \ldots\ldots\ldots\ldots) \quad (2)$$

Where L_{pa}, L_{pb}, L_{pc} are noise pressure levels at a point due to different sources.

Input for the model

The designed noise levels for the major noise generating sources during the operation of the plant machineries are given in **Table-4.6.** The values, mentioned in the table are at 1 m. distance from the source.

TABLE-4.6
ESTIMATED NOISE LEVELS DURING PLANT OPERATION

S. No.	SOURCE	Sound Pressure Level* in dB(A) 1m. from source
1	Fan	85
2	Pump	85
3	Turbine	85
4	Compressor	85
Note: *After acoustic enclosure		

The predicted noise levels at various distances are given in **Table-4.7**. The noise level contours are shown in **Figure-4.4**.

TABLE-4.7
PREDICTED NOISE LEVELS

Sr. No.	Distance (m)	Noise level dB (A)
1	50	41.3
2	100	36.1
3	200	28.7
4	300	23.8
5	400	21.0
6	500	18.4
7	600	15.5
8	700	12.8
9	800	10.3
10	900	8.7
11	1000	5.5

The ambient noise level recorded during field studies in the area located near the project site ranges between 45.8 - 55.7 dB(A). As the ambient noise levels are higher than the predicted noise level, due to masking effect, there is no increase in the ambient noise levels during operation phase is envisaged. Hence, there will not be any significant impact on the surrounding areas due to masking effect.

Industrial Noise Standards:

The OSHA has recommended permissible noise exposure limit for Industrial worker which is based on 90 dB(A) for 8 hours exposure a day with 5 dB(A) trading rates. The limits are given in **Table-4.8**.

TABLE-4.8
PERMISSIBLE EXPOSURE NOISE LIMITS

Total time of exposure per day in hours	Sound pressure level in dB(A)
8	90
6	92
4	95
3	97
2	100
1	105
½	110
¼	115

Work Zone Noise Levels

The protective measures need to be provided to the operators and workers working near the high noise generating machinery. As per Occupational Safety and Health Administration (OSHA) Standards, the maximum allowable noise level for the workers is 90 dB (A) for 8 hours exposure a day.

Table 4.9: Proposed noise pollution protection and mitigative measures

Mitigation measures
Noise pollution generated by plant machinery
➢ Properly designed plant and machinery (i.e. by providing inbuilt mechanisms like silencers, mufflers, and enclosures for noise generating parts) and shock absorbing padsin the foundation of vibrating equipment will be provided ➢ To dampen the noise levels at CHP, impact rollers are provided at transfer points. ➢ Height of dust fall at coal handling area/hydro bins/fly ash silos will be minimized byproviding internal lining of bins and chutes ➢ In the high noise intensity working areas / zones personal protective equipment (PPE)like ear plugs/ear muffs etc. will be provided to the workmen ➢ Improvement in design of machine, proper maintenance and tuning of machinery willbe done regularly ➢ Acoustically designed cabins for heavy noise generating boilers, turbines, generators and other equipment will be provided. The inlet air and exhaust gas streams would beprovided with silencers for noise reduction

- Plantation along plant boundary and three tier green belt within plant with a total area not less than 33% would be developed as the greenbelt so that noise emissions at plant boundary are minimized to be maintained within stipulated standards
- Regular noise level monitoring will be done periodically for taking corrective action, wherever required
- Distribution of working hours among personnel working with major noise generating equipment and rotating to non-noisy/ less noisy area
- Periodic medical examination on hearing loss will be carried out for all workers and maintain audiometric record for treatment of any hearing loss

Noise pollution generated by vehicular movement

- All vehicles entering project site will be informed to maintain speed limits, and not toblow horns unless it is required
- One layer plantation will be done on both sides of road for reduction of noise levels

4.3.5 Impacts on Soil

There will be ash generation, but will be managed in the proper manner, which has been discussed in **Chapter-2.0** of the report. This will ensure that there will not be any impact on soil quality due to the disposal or deposition of solid wastes.

4.3.6 Impacts on Land Use

The proposed development will take place on the industrial land. So, there will be no change in the existing land use pattern of the area.

4.3.7 Impacts on Ecology

Impacts on Terrestrial Ecology

The baseline status of terrestrial flora and fauna within the study area have been drawn up earlier. The harmful effects of air pollutants such as SO_2 NO_x, & PM in affecting growth and normal functioning of trees is well known. However, such effects are seen only at high levels. During the operation of the overall project, the significant pollutant is SO_2, NO_x and PM to be discharged from the new stack. The maximum incremental value of SO_2, NOx & PM during operation of the proposed project plant would be about 3.16 µg/m^3, 3.16 µg/m^3 and 0.95 µg/m^3 respectively respectively, which will occur at a distance of 1.2 km in E direction , which is insignificant and is not envisaged to cause any stress on the ecological fabric of the study area. Moreover, the greenbelt would be useful in controlling fugitive emissions and process noise from disturbing ecological environment in the study area.

Impact on Aquatic Ecology

The effluent generated is being / will be totally re-used after necessary treatment. As such, no impact on aquatic ecology is envisaged due to operation of the project.

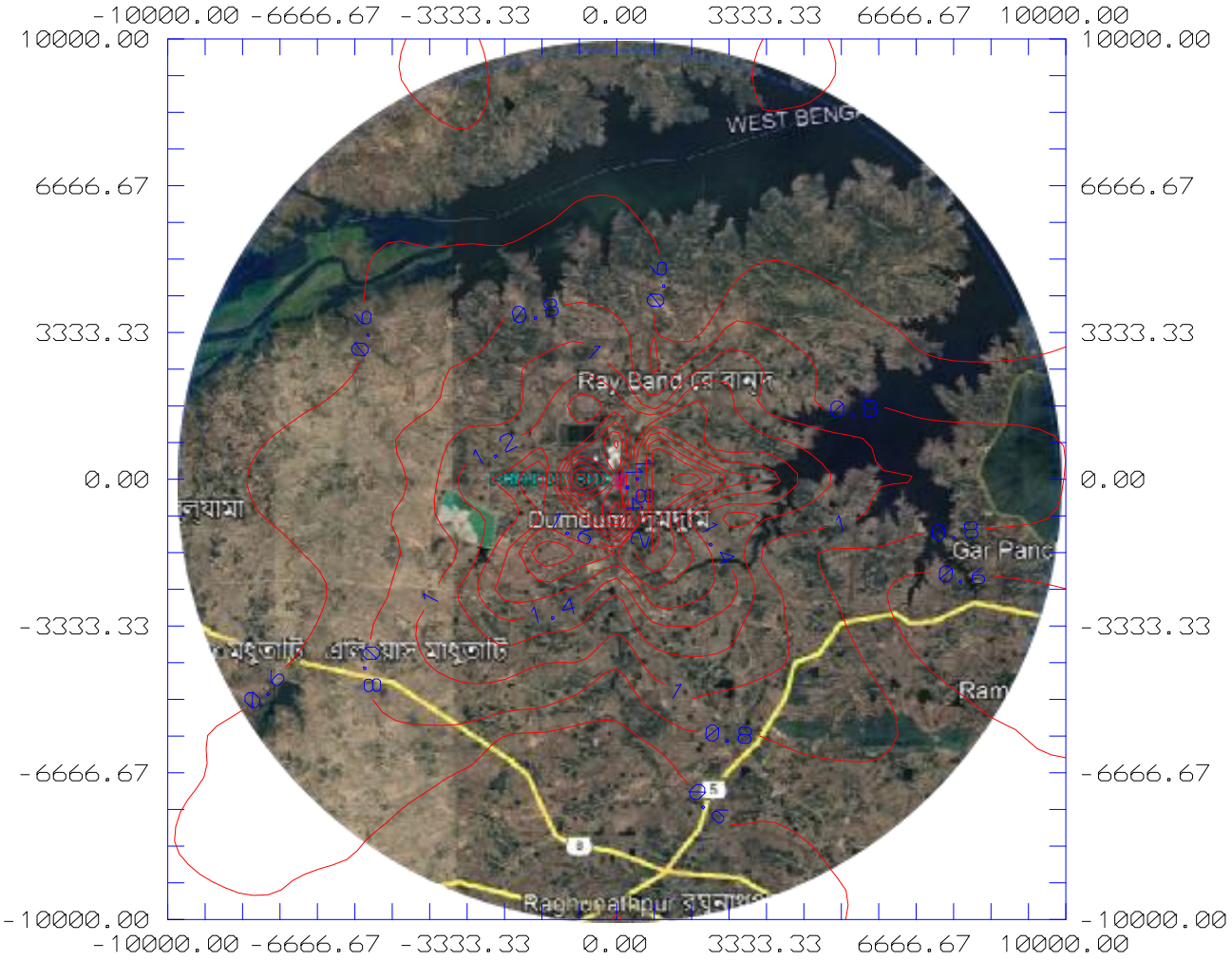
4.3.8 Impacts on Demography and Socioeconomics

The project will create the employment of 1000 Persons during the construction phase and around 350 persons will be employed during operation phase. Preference shall be given to local people depending upon their skill and qualification. The project will create opportunities for indirect employment to persons who shall be employed for the greenery development work in and around the plant site.

Through the proposed project it is expected to improve hospitality services such as hotels/lodgings houses, restaurants, fast food joints, transport services, travel, shopping, communication facilities, hospitals/nursing homes as well as education facilities in the region.

A social impact assessment study was also carried out in the study area to identify the needs of the locals. The following areas have been identified for carrying out developmental activities:

- Sanitation
- Roads
- Common area lighting using solar power
- Rainwater Harvesting and Irrigation Infrastructure
- Drinking Water Supply Facility
- Upgradation & maintenance of ponds
- Garbage Collection & Disposal Facility
- Medical & Educational Facilities
- Facility for Skill Development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WEST BENG
Ray Band রে বান্দ
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Gar Pano
Ram
Raghunathpur রঘুনাথপুর

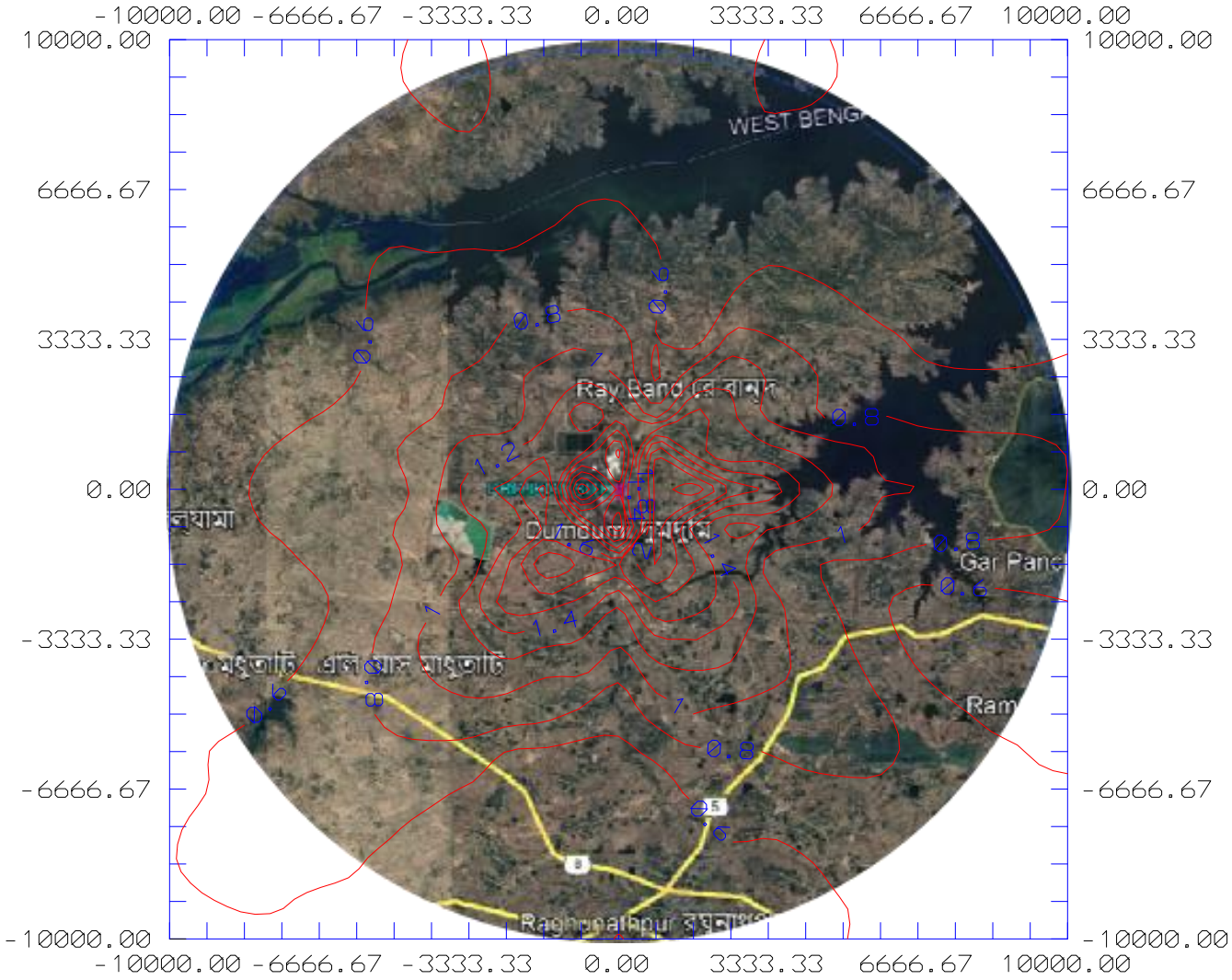


FIGURE - 4.2
ISOPLETHS OF NO_x

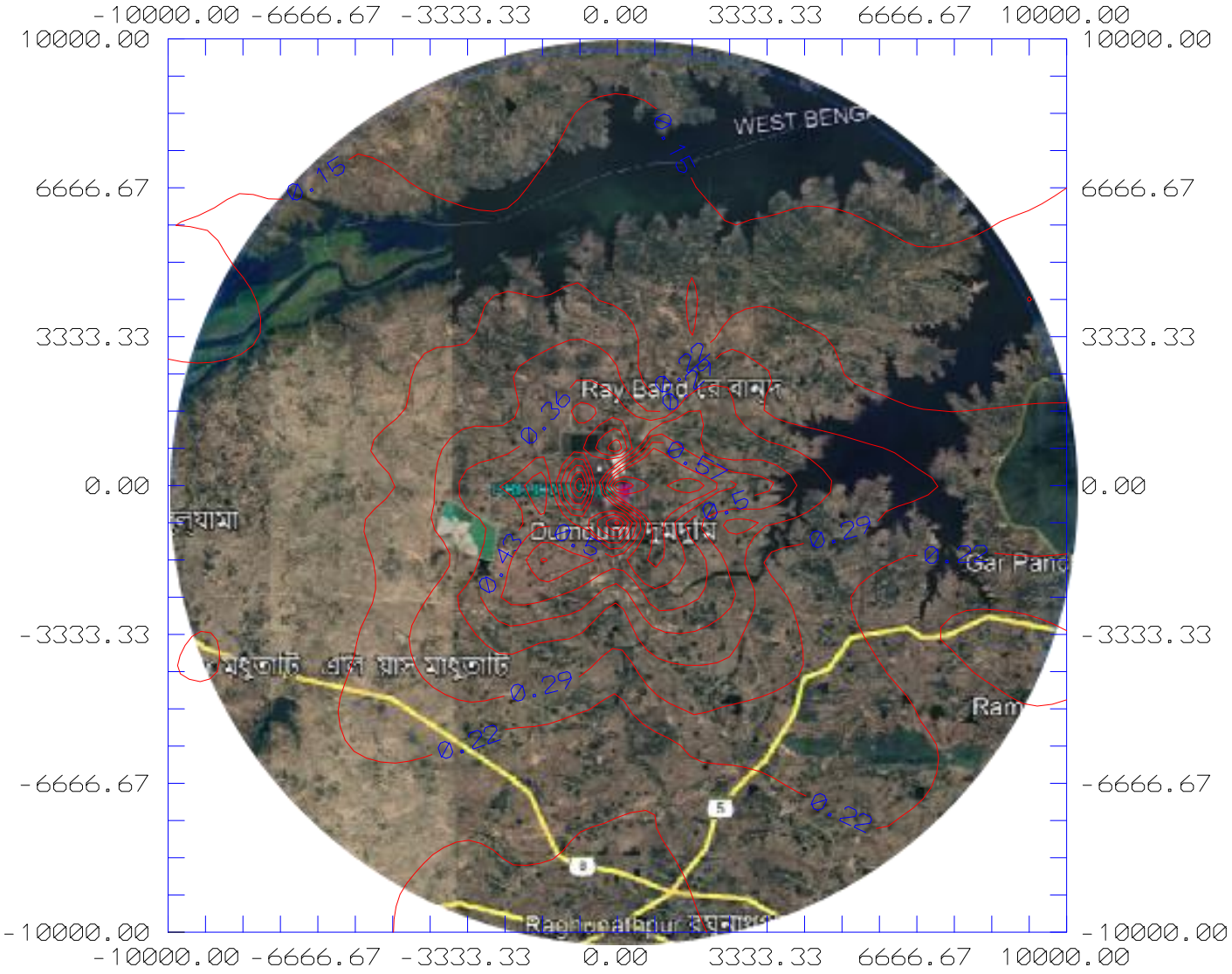


FIGURE - 4.3
ISOPLETHS OF PM

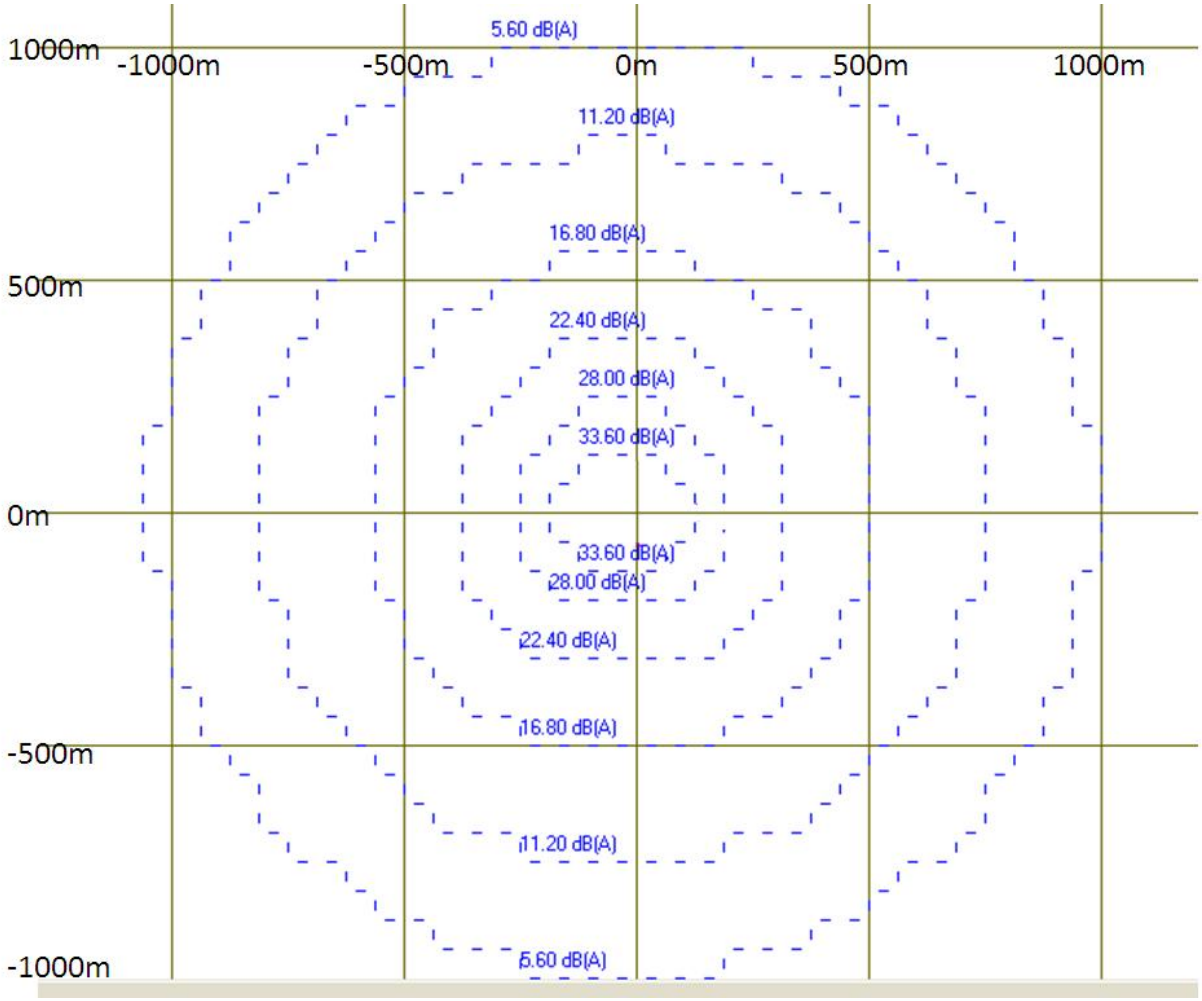


FIGURE – 4.4: NOISE LEVEL CONTOURS

CHAPTER-5.0
ANALYSIS OF ALTERNATIVES
(TECHNOLOGIES & SITES)

5.1 ANALYSIS OF ALTERNATIVES

Raghunathpur TPS Project shall be a coal based thermal power project with Super critical technology. Major components of the power project are Coal Handling and Storage Plant, Fuel Oil Handling and Storage Plant, Water Intake and Treatment Systems, Steam Generator and its auxiliaries, Steam Turbine and its auxiliaries, Water Cooled Condenser, Auxiliary Cooling System, Ash Handling Plant, Electrical Generators, Transformers and Switchyard, various Control and Instrumentation systems etc.

At present, Raghunathpur TPS (RTPS) of DVC has total installed capacity of 1200 MW (2x600 MW) under Ph-I and both units are under commercial operation since March 2016, based on Environmental Clearance, accorded by MoEF&CC on 18th October 2007.

However, considering the demand-supply position and projected growth of load demand in the valley area arising out mainly due to decommissioning of various units of DVC viz... Durgapur TPS, Bokaro TPS-B and Chandrapura TPS, the Board of DVC accorded approval for the revival of erstwhile Raghunathpur TPS Ph-II (2x660 MW) and in principle approval was accorded by Ministry of Power on 25.02.2022.

Raghunathpur Thermal Power Station (RTPS) is located in Raghunathpur Sub-Division of Purulia District of West Bengal. The Project is located at 38 Km from District Head Quarters Purulia and is well connected by Purulia-Barakar State Highway SH-5. Nearest National Highway NH-19, which was previously referred to Delhi–Kolkata Road is about 44 Km from the Site. Nearest town is Raghunathpur located at a distance of 7 Km from the project. The nearest Railway Station Bero on Adra-Asansol

Broad Gauge line of South-Eastern Railway is located at 20 Km. The Site is located at latitudes of 23^0 37' 20" N and longitudes of 86^0 39' 50" E.

Land of 507.480 acres (205.37 Ha.) for the existing Ash disposal system in RTPS (ph-1) comprising of Ash pond, ash pipeline corridor, green belt etc. will be utilised for RTPS (Ph-2) also. The ash dyke is about 3 Km from Plant premises.

Land requirement for RTPS phase – 2 will be 150 acres, which is available within the existing project area of 840.53 Hectares (2077 acres), which is already acquired.

The proposed project is the expansion of the existing project. Hence, it will be well integrated with the existing facilities already developed for the overall sustenance and viability of the project. Moreover, it will also share the existing utilities, resulting in the optimization of the landuse for the project. So, no alternative site has been explored.

The technology for the unit proposed in the project are well proven technology all over the world. **M/s DVC's** proposed expansion project will follow the Best Available Technology.

CHAPTER-6.0 ENVIRONMENTAL MONITORING PROGRAMME

6.1 INTRODUCTION

Environmental monitoring is the repetitive and systematic measurement of the characteristics of environmental components. The post project environmental monitoring program serves as the key tool to check the performance of mitigation measures implemented / adequacy of pollution control technologies installed.

6.2 ENVIRONMENTAL MONITORING PROGRAMME

Monitoring of the following aspects is important to keep a constant check on the environmental performance of the project and also the environmental quality of the area.

- Ambient Air Quality
- Stack Emission
- Work zone Air quality,
- Water Quality
- Wastewater Quality
- Drinking Water Quality
- Noise Level
- Plantation Condition
- Periodic Preventive Maintenance
- Occupational Health & Safety Monitoring
- Fire Safety Monitoring

<u>Ambient Air Quality</u>

Ambient air quality monitoring is being monitored at 4 locations inside the project site for the relevant parameters, as stipulated in NAAQS 2009, by NABL approved Laboratory.

Fugitive emissions of PM_{10} will be monitored with a frequency of once in three months in the project area, where fugitive dust emissions are anticipated like the raw material handling area (unloading and storage), truck movement and parking areas, solid wastes storage area to ensure

that air pollution control measures are working properly.

Table 6.1: Air Pollutant Measurement Technique

Sl. No.	Parameter	Technique	Technical Protocol Minimum Detectable
1	Respirable Particulate Matter (PM_{10})	Respirable Dust Sampler (Gravimetric Method)	IS 5182 (Part 23) : 2006 Reaffirmed 2012
2	$PM_{2.5}$	Fine Respirable Dust Sampler (Gravimetric Method)	CPCB method -
3	Sulphur Dioxide	Modified West & Gaeke method	IS 5182 (Part 2) : 2001 Reaffirmed 2012
4	Oxides of Nitrogen	Jacob & Hochheiser method	IS 5182 (Part-6): 2006 Reaffirmed 2012

Stack Emissions

Emissions from all stacks will be monitored manually using stack monitoring kit. Online Continuous Emission Monitoring System has already installed.

The flue gas from all the stacks will be monitored for PM and the Power Plant stack for PM, SO_2 and NOx.

Table 6.2: Stack Measurement Technique

Sl. No.	Parameter	Technique	Technical Protocol Minimum Detectable
1	Particulate Matter	Gravimetric Method	IS 11255 (Part 1) : 1985 Reaff. 2014
2	Sulphur Dioxide	IPA – Thorin method	IS 11255 (Part 2) :1985 Reaff. 2014
3	Oxides of Nitrogen	Phenol di-sulphonic acid method	IS 11255 (Part 7): 2005 Reaff. 2012

Ground Water Quality

Ground water will be monitored inside the project site, near solid wastes storage area by installing a piezometer. Groundwater quality monitoring will be also done at nearby villages (3 villages located along the boundary of plant). The monitoring will be carried out with a frequency of four times in a year.

Wastewater Quality

Zero wastewater discharge has been planned for the project. There will be wastewater treatment plant and final treated wastewater after treatment will be reused. Yet the treated wastewater quality before use will be regularly monitored on monthly basis.

Meteorology

A meteorological station will be set-up at the project site for the record of meteorological parameters such as wind velocity and direction, ambient temperature, relative humidity, atmospheric pressure, rainfall etc.

Noise

Noise monitoring will be carried out inside the work area of each plant and near the high noise generating areas, at plant boundary and outside the project site at nearby villages twice in a year.

Plantation

The project proponent has trained people to look after and record the conditions of tree plantation and greening of the project area.

Periodic Preventive Maintenance

All instruments installed or used for monitoring and recording of working environment parameters will be regularly tested and calibrated, and the respective records maintained.

Occupational Health & Safety Monitoring

The occupational health and safety monitoring program shall include safety inspection, testing and calibration. Project proponent shall carry out inspection and testing of all safety features and hazard control measures for plant operation. This shall include regular inspection and testing of all safety features and hazard control measures focusing on engineering and personal protective features, work procedures, places of work, installations, equipment, and tools used. The inspection shall verify that issued personal protective equipment (PPE) continues to provide adequate protection and is being worn as required.

Conclusion

The post project monitoring programme, consisting of various disciplines, no. of locations, parameters, frequency of monitoring along with the fund provision for the expansion-cum-modification project has been presented in Table-6.3.

However, the monitoring programme w.r.t. the frequency and the sampling locations will be finally decided in consultation with West Bengal Pollution Control Board and Regional Office of MOEF&CC.

TABLE-6.3
POST PROJECT MONITORING PROGRAMME

Discipline	Locations	Parameters	Frequency	Fund Provision (Annual Cost in Lakhs)
Meteorology (Met Station)	One	Temperature, Rainfall, Relative Humidity, Atmospheric Pressure, Wind Speed and Direction	Hourly	2 lakhs
Ambient Air Quality	3-4 relevant locations	PM_{10}, $PM_{2.5}$, SO_2 & NO_2	Quarterly	12 lakhs
Stack Emission	Each Unit	PM, SO_2 & NO_x	Monthly	3 lakh
Fugitive Emission	3-4 relevant locations	PM	Quarterly	1 lakh
Process Effluent	-	pH, Total Suspended Solid, Temperature, Oil & Grease, Copper, Iron & COD	Every 2 months	1 lakh
STP	-	pH, Total Suspended Solid, Temperature, Oil & Grease, Copper, Iron & COD	Yearly	1 lakh
Ground Water Quality	2-3 Locations	pH, Temperature, Conductivity, Turbidity, Alkalinity, Chlorine, Total Suspended Solid, Total Dissolved Solids, Total Hardness, Ca-hardness, Mg-hardness, Coliform, Fe, Cu, Cd, Cr^{6+}, Pb, As, Hg, Zn	Yearly	1 lakh
Drinking Water Quality	1 Location	pH, Temperature, Conductivity, Turbidity, Alkalinity, Chlorine, Total Suspended Solid, Total Dissolved Solids, Total Hardness, Ca-hardness, Mg-hardness, Coliform, Fe, Cu, Cd, Cr^{6+}, Pb, As, Hg, Zn	Yearly	1 lakh
Noise	Plant Area and Nearby	Day-and Night-Time Noise Levels	Half-yearly	1 lakh

	villages			
Illumination	3-4 relevant locations		Yearly	1 lakh
TOTAL				24 lakhs

6.3 PERFORMANCE MONITORING OF POLLUTION CONTROL DEVICES

M/s. DVC. will continuously monitor performance of pollution control devices through its process, experienced engineers & good preventive maintenance system. Performance of pollution control system will be mainly monitored by operator & maintenance staff through pressure drop measurement system. Maintenance team of the company will continuously work for better performance of APC devices by maintaining proper schedule for maintenance to achieve pollution free working environment.

CHAPTER-7.0
ADDITIONAL STUDIES
(HAZARD IDENTIFICATION & RISK ASSESSMENT AND DISASTER MANAGEMENT PLAN)

7.1 INTRODUCTION

Considering the generic structure of the EIA/EMP report prescribed in EIA Notification dated 14.09.2006, this chapter comprises of public consultation, Risk Assessment, social impact assessment and R&R Action plan.

This chapter deals with identification of the potential hazards and disaster and preventive measures for disaster. The proposed Raghunathpur Thermal Power Project (Ph-II) of DVC may encounter with certain types of hazards which can disrupt normal activities suddenly and lead to disaster like fires, inundation, failure of machinery, electrocution etc. Disaster management plan has been formulated with an aim of taking precautionary step to control the hazard propagation and ward off disaster and also to take such action after the disaster which minimize the damage.

Industrial activities, involved in producing, treating, storing and handling of hazardous substances, have a high hazard potential to safety of man and environment at work place and outside. Recognizing the need to control and minimize the risks posed by such activities, the Ministry of Environment, Forest and Climate Change (MoEF&CC) has notified the “Hazardous and other wastes (Management and Transboundary Movement) Rules in the year 2016 (In super session of the Manufacture, Storage, Handling and Transboundary Movement and Hazardous Waste Rules, 2008). For effective implementation of the rule, Ministry of Environment Forest and Climate Change has provided a set of guidelines. The guidelines, in addition to other aspects, set out the responsibilities/duties needed to be performed by the occupier along with the procedure. The rule also lists out the industrial activities and chemicals, which are needed to be considered as hazardous.

The proposed activities are scrutinized in line with the above referred "Manufacture, storage and import of hazardous chemicals rules" and observations/findings are presented in this document.

Port activities involve hazardous processes, which can result in significant risk to the work environment and hence needs proper assessment.

7.2 RISK ASSESSMENT

An industrial disaster arises when a major accident occurring in the factory becomes uncontrollable and its consequences go out of the factory boundaries. Hazards are inherent to all industrial operations since they involve handling of hazardous materials (flammable, explosive, corrosive and toxic materials). Risk assessment is a methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that could pose a potential threat or harm to people, property, livelihoods and the environment on which they depend.

Risks are inherent in proposed thermal power plant operations since they involve working with

- High pressure super-heaters, re-heaters, economizer units exchanging heat with the hot flue gases;
- Turbines that utilize the HP steam to generate power;
- Fuel oil handling units;
- Hydrogen as a coolant in turbo generators drawn from hydrogen cylinders; and
- Switchyard including transformers, isolators.

Nevertheless, a properly designed and operated plant will have a very low probability (to a level of acceptable risk) of accident occurrence. Subsequently, a properly designed and executed management plan can further reduce the probability of any accident turning into an on-site emergency and/or an off-site emergency.

The four major steps in risk assessment are hazard identification, dose response assessment, exposure assessment, and risk characterization.

Hazard identification is a process that determines the potential human health effects that could result from exposure to a hazard. This process requires a review of the scientific literature. The literature could include information published by the Environmental Protection Agency (EPA), federal or state agencies, and health organizations. Identification of causes and types of hazards is the primary task for planning for risk assessment.

Hazard can happen because of the nature of chemicals handled and also the nature of process involved. So for risk analysis first step is to identify the hazardous chemicals which are to be studied for risk analysis.

Identification of Hazardous Chemicals is done in accordance with The Manufacture, Storage and import of Hazardous Chemical Rules, 1989. Schedule 1, of the Rule provides a list of the Toxic and Hazardous chemicals and the flammable chemicals. It defines the flammable chemicals based on the flash point and boiling point.

"Major accident hazards (MAH) installations" is defined as the isolated storage and industrial activity at a site handling (including transport through carrier or pipeline) of hazardous chemicals equal to or, in excess of the threshold quantities Dose-response or toxicity assessment is the determination of how different levels of exposure to a hazard or pollutant affect the likelihood or severity of health effects.

Responses/effects can vary widely since all chemicals and contaminants vary in their capacity to cause adverse effects. The dose-response relationship can be evaluated for either carcinogenic or no carcinogenic substances.

Exposure assessment is the determination of the magnitude of exposure, frequency of exposure, duration of exposure and routes of exposure by contaminants to human populations and ecosystems. There are three components to this step.

1. Identification of contaminants being released;
2. Estimation of the amounts of contaminants released from all sources or the source of concern; and
3. Estimation of the concentration of contaminants.

Risk characterization is the final step in which toxicology and exposure data/information are combined to obtain a qualitative or quantitative expression of risk.

7.2.1 Scope of the Study

The risk analysis/ assessment study covers the following:

(a) Site assessment;

(b) Identification of potential hazard areas;

(c) Identification of representative failure cases;

(d) Visualisation of the mode of chemical releases and the resulting accident scenarios;

(e) Assess the overall damage potential of the identified hazardous events and impact zones from the accident scenarios;

(f) Furnish specific recommendations on the minimisation of the worst accident possibilities;

(g) Preparation of Disaster Management Plan (DMP), On-site and Off-site Emergency Plan; and

(h) Preparation of the Occupational and Health safety plan.

7.2.2 Brief Description

7.2.2.1 Hazard Identification

Identification of hazards is of primary significance in the analysis, quantification and cost effective control of accidents involving chemicals and processes. A classical definition of hazard states that it is the characteristic of system/process that presents potential for an accident. Hence, all the components of a system/process need to be thoroughly examined to assess their potential for initiating or propagating an unplanned event/sequence of events, which can be termed as an accident.

Estimation of probability of an unexpected event and its consequences form the basis of quantification of risk in terms of damage to property, environment or personnel. Therefore, the type, quantity, location and conditions of release of a toxic or flammable substance have to be identified in order to estimate its damaging effects, the area involved, and the possible precautionary measures required to be taken. Based

on the areas and unit operations involved in generation of power various hazards are identified which are given in Table-7.1.

TABLE - 7.1

POTENTIAL RISK AREAS DUE TO PROPOSED RTPS (PH-II)

Sl. No.	Areas/ Blocks	Hazards Identified
1.	Coal storage in open yard	Fire, Spontaneous Combustion
2.	Coal Handling Plant including bunker area	Fire and/or Dust Explosions
3.	Boilers	Fire (mainly near oil burners), steam; Explosions, Fuel Explosions
4.	TG Building	Fires in - a) Lube Oil systems b) Cable galleries c) Short circuits in i) Control Rooms ii) Switchgears Explosion due to leakage of Hydrogen and fire following it. Fire in Oil Drum Storage
5.	Power Transformer	Explosion & Fire
6.	Switch-Yard Control Room	Fire in cable galleries and Switchgear/Control Room.
7.	LDO	Fire
8.	Water Treatment of Chlorination plants Pre-treatment plants Hydrochloric Acid (HCl) Sodium Hydroxide (NaOH)	Release of Chlorine - Toxicity

		Corrosive
9.	Steam Turbine	Hydrogen and lube oil leak leading to fire/smoke

7.2.2.2 Classification of Major Hazardous Units

Hazardous substances may be classified into three main classes; namely flammable substances, unstable substances and toxic substances. The ratings for a large number of chemicals based on flammability, reactivity and toxicity have been given in NFPA Codes 49 and 345 M. The major hazardous materials to be stored, transported, handled and utilized within the facility have been summarized in the **Table-7.2**. The fuel storage details and properties are given in **Table-7.3** and **Table-7.4** respectively.

TABLE-7.2

HAZARDOUS MATERIALS PROPOSED TO BE STORED/TRANSPORTED

Materials	Hazardous Properties
LDO	UN 1203. Dangerous Goods class 3 – Flammable Liquid

TABLE-7.3

CATEGORY WISE SCHEDULE OF STORAGE TANKS

Sr. No.	Material	No. Of Tank	Design Capacity (KL)	Classification
1	LDO	2	2500	Non-dangerous petroleum

TABLE-7.4

PROPERTIES OF FUELS USED IN THE PLANT

Chemical	Codes/Label	TLV	FBP	MP	FP	UEL	LEL
			°C				
LDO	Flammable	5 mg/m^3	400	-	98	7.5	0.6

TLV : Threshold Limit Value FBP : Final Boiling Point

MP : Melting Point FP : Flash Point

UEL : Upper Explosive Limit LEL : Lower Explosive Limit

7.2.2.3 Identification of Major Hazard Installations Based on GOI Rules, 1989

Following accidents in the chemical industry in India over a few decades, a specific legislation covering major hazard activities has been enforced by Govt. of India in 1989 in conjunction with Environment Protection Act, 1986. This is referred here as GOI Rules 1989. For the purpose of identifying major hazard installations the rules employ certain criteria based on toxic, flammable and explosive properties of chemicals.

A systematic analysis of the fuels/chemicals and their quantities of storage has been carried out, to determine threshold quantities as notified by GOI Rules, 1989 and the applicable rules are identified. Applicability of storage rules are summarized in Table-7.5.

TABLE-7.5

APPLICABILITY OF GOI RULES TO FUEL AND CHEMICAL STORAGE

Sr. No.	Chemical / Fuel	Listed in schedule	Total Quantity (KL)	Threshold Quantity (T) for application of rules	
				5, 7-9, 13-15	10-12
1	LDO	3(1)	2 x 2500`	25 MT	200 MT

7.3 HAZARD ASSESSMENT AND EVALUATION

7.3.1 Methodology

An assessment of the conceptual design is conducted for the purpose of identifying and examining hazards related to feed stock materials, major process components, utility and support systems, environmental factors, proposed operations, facilities, and safeguards.

7.3.2 Preliminary Hazard Analysis (PHA)

PHA is based on the philosophy "Prevention is better than Cure". Safety is relative and implies freedom from danger or injury. But there is always some element of danger or risk associated with anything we do or build. This calls for identification of hazards, quantification of risk and further suggests hazard-mitigating measures, if necessary.

The purpose of the preliminary hazard analysis is to identify at the outset the potential hazards associated with design process, or inherent in a process design, thus eliminating costly and time consuming delays caused by design changes made later. This also eliminates potential hazard points at design stage itself. Hence, preliminary hazard analysis is more relevant when a plant is at design/construction stage. This analysis fortifies the proposed process design by incorporating additional safety factors into the design criteria.

An assessment of the conceptual design has to be conducted for the purpose of identifying and examining hazards related to feed stock materials, major process components, utility and support systems, environmental factors, proposed operations, facilities, and safeguards.

In the proposed plant, Hydrochloric acid, Sodium Hydroxide and Chlorine will be stored in tanks and cylinders to meet its requirement.

Preliminary hazard analysis for fuel storage area and whole plant is given in Table- 7.6 and Table-7.7.

TABLE-7.6

PRELIMINARY HAZARD ANALYSIS FOR STORAGE AREAS

Unit	Total Capacity (KL)	Hazards Identified
LDO	5,000	Fire/Explosion

The major hazards associated with the plant has to be carried out followed by consequence analysis to quantify these hazards. Finally the vulnerable zones have to plotted for which risk reducing measures will be deduced and implemented.

The following scenarios have been considered for the PHA:

- Spillage of chemicals while handling
- Leakage of chlorine

TABLE-7.7

PHA FOR POWER PLANT

PHA Category	Description of Pausible Hazard	Recommendation
Environmental Factors	Spillage of chemicals while handling (HCl, NaOH)	The spillage should be treated as per MSDS of each chemical. A copy of MSDS should be kept in chemical laboratory and stores.
	Spillage of chemicals or baths into trench	• The source of the spillage should be immediately identified and plugged. • The spilled chemical should be washed with copious water and the washed water should be collected in floor wash tank • The washed water in floor wash tank should be treated as per waste treatment procedure till it is exhausted
	Chlorine leakage	• An automatic chlorine leak absorption system should be provided for chlorination plant to neutralise chlorine leakage. • Chlorination plant shall be provided with required chlorine containers, instrumentation, Panels, chlorine leak detectors etc. • Use ammonia spray or swab for identifying leakage. (A white cloud indicates Chlorine leakage) • For persistent leakage connect a flexible hose pipe and put the pipe in the tank containing Caustic soda • Isolate the area until the gas has dispersed

7.3.3 Fire Explosion and Toxicity Index (FE&TI) Approach

Fire, Explosion and Toxicity Indexing (FE & TI) is a rapid ranking method for identifying the degree of hazard. The application of FE & TI would help to make a quick assessment of the nature and quantification of the hazard in these areas. However, this does not provide precise information.

The degree of hazard potential is identified based on the numerical value of F&EI as per the criteria given below:

Sr. No.	F&EI Range	Degree of Hazards
1	0 - 60	Light
2	61 - 96	Moderate
3	97 - 127	Intermediate
4	128 - 158	Heavy
5	159 and above	Severe

By comparing the indices F&EI and TI, the unit in question is classified into one of the following three categories established for the purpose (Table-7.8).

TABLE-7.8

FIRE EXPLOSION AND TOXICITY INDEX

Category	Fire & Explosive Index (F&EI) Range	Toxicity Index (TI)
I	F&EI < 65	TI < 6
II	65 < or = F&EI < 95	6 < or = TI < 10
III	F&EI > or = 95	TI > or = 10

Certain basic minimum preventive and protective measures are recommended for the three hazard categories.

7.3.3.1 Results of FE and TI for Storage/Process Units

Based on the GOI Rules 1989, the hazardous fuels used by the proposed power plant were identified. Fire and explosion are the likely hazards, which may occur due to the fuel storage. Hence, fire and explosion index has been calculated for in plant storage. Estimates of FE&TI are given in **Table-7.9.**

TABLE-7.9

FIRE EXPLOSION AND TOXICITY INDEX

Sr. No.	Fuel/Chemical	Total Capacity (KL)	F&EI	Category	TI	Category
1	LDO	5000	3.6	Light	Nil	-

7.3.4 Conclusion

Results of FE&TI analysis show that the storage of LDO falls into Light category of fire and explosion index with a Nil toxicity index.

7.3.5 Maximum Credible Accident Analysis (MCAA)

Hazardous substances may be released as a result of failures or catastrophes, causing possible damage to the surrounding area. This section deals with the question of how the consequences of the release of such substances and the damage to the surrounding area can be determined by means of models. Major hazards posed by flammable storage can be identified taking recourse to MCA analysis. MCA analysis encompasses certain techniques to identify the hazards and calculate the consequent effects in terms of damage distances of heat radiation, toxic releases, vapour cloud explosion etc. A host of probable or potential accidents of the major units in the complex arising due to use, storage and handling of the hazardous materials are examined to establish their credibility. Depending upon the effective hazardous attributes and their impact on the event, the maximum effect on the surrounding environment and the respective damage caused can be assessed. The reason and purpose of consequence analysis are many folds like:

- Part of risk assessment;
- Plant layout/code requirements;

- Protection of other plants;
- Protection of the public;
- Emergency planning; and
- Design criteria.

The results of consequence analysis are useful for getting information about all known and unknown effects that are of importance when some failure scenario occurs in the plant and also to get information as how to deal with the possible catastrophic events. It also gives the workers in the plant and people living in the vicinity of the area, an understanding of their personal situation.

- Selected Failure Cases

The purpose of this listing (refer **Table 7.10**) is to examine consequences of such failure individually or in combination. It will be seen from the list that a vast range of failure cases have been identified. The frequency of occurrence of failure also varies widely.

7.3.5.1 Damage Criteria

The fuel storage and unloading at the storage facility may lead to fire and explosion hazards. The damage criteria due to an accidental release of any hydrocarbon arise from fire and explosion. The vapors of these fuels are not toxic and hence no effects of toxicity are expected.

Tank fire would occur if the radiation intensity is high on the peripheral surface of the tank leading to increase in internal tank pressure. Pool fire would occur when fuels collected in the dyke due to leakage gets ignited.

Fire Damage

A flammable liquid in a pool will burn with a large turbulent diffusion flame. This releases heat based on the heat of combustion and the burning rate of the liquid. A part of the heat is radiated while the rest is convected away by rising hot air and combustion products. The radiations can heat the contents of a nearby storage or process unit to above its ignition temperature and thus result in a spread of fire.

The radiations can also cause severe burns or fatalities of workers or fire fighters located within a certain distance. Hence, it will be important to know beforehand the damage potential of a flammable

liquid pool likely to be created due to leakage or catastrophic failure of a storage or process vessel. This will help to decide the location of other storage/process vessels, decide the type of protective clothing the workers/fire fighters, the duration of time for which they can be in the zone, the fire extinguishing measures needed and the protection methods needed for the nearby storage/process vessels. The damage effect on equipment and people due to thermal radiation intensity is given in **Table-7.10.** Similarly, the effect of incident radiation intensity and exposure time on lethality is given in **Table-7.11.**

TABLE-7.10

DAMAGE DUE TO INCIDENT RADIATION INTENSITIES

Sr. No.	Incident Radiation (kW/m2)	Type of damage intensity	
		Damage to Equipment	Damage to people
1	37.5	Damage to process equipment	100% lethality in 1 min., 1% lethality in 10 sec.
2	25.0	Minimum energy required to ignite wood at indefinitely long exposure without a flame	100% lethality in 1 min., Significant injury in 10 sec.
3	12.5	Minimum energy required for piloted ignition of wood, melting plastic tubing	1% lethality in 1 min., First degree burn in 10 sec.
4	4.0	--	Causes pain if duration is longer than 20 sec, however blistering is un-likely (First degree burns)
5	1.6	--	Causes no discomfort on long exposures

Source: Techniques for Assessing Industrial Hazards by World Bank.

TABLE-7.11

RADIATION EXPOSURE AND LETHALITY

Radiation Intensity ($kW/m^{2)}$	Exposure time (sec)	Lethality (%)	Degree of burn
1.6	0	0	No Discomfort even after long exposure
4.5	20	0	1st
4.5	50	0	1st
8.0	20	0	1st
8.0	50	<1	3rd
8.0	60	<1	3rd
12.0	20	<1	2nd
12.0	50	8	3rd
12.5	Inst	10	--
25.0	Inst	50	--
37.0	Inst	100	--

7.3.6 Scenarios Considered for MCA Analysis

7.3.6.1 Fuel Storage

The details of storages in the proposed power plant are given **Table-7.2.** In case of fuel released in the area catching fire, a steady state fire will occur. Failures in pipeline may occur due to corrosion and mechanical defect. Failure of pipeline due to external interference is not considered as this area is licensed area and all the work within this area is closely supervised with trained personnel.

7.3.6.2 Modeling Scenarios

Based on the storage and consumption of various fuels the following failure scenarios for the proposed power plant have been identified for MCA analysis and the scenarios are discussed in **Table-7.12.** The fuel properties considered in modeling are given in **Table-7.13.**

TABLE-7.12

SCENARIOS CONSIDERED FOR MCA ANALYSIS

Sr. No.	Fuel/Chemical	Total Quantity	Scenario Considered
1	LDO	2 X 2500 KL	Pool Fire

TABLE-7.13

PROPERTIES OF FUELS CONSIDERED FOR MODELING

Sr. No.	Fuel/Chemical	Mol. Wt. (kg/kg mol)	Boiling Point (^oC)	Density (kg/m^3)
1	LDO	114.24	400	880

7.3.7 Pool Fire Models used for MCA Analysis

Heat Radiation program 'RADN' has been used to estimate the steady state radiation effect from storage of fuel at different distances. The model is based on the equations compiled from various literatures.

7.3.8 Results and Discussion

The results of MCA analysis are tabulated indicating the distances for various damages identified by the damage criteria, as explained earlier. Calculations are done for radiation intensities levels of 37.5, 25, 12.5, 4.5 and 1.6 kW/m2 , which are presented in **Table-7.14** for different scenarios. The distances computed for various scenarios are from the center of the pool fire.

TABLE-7.14

OCCURRENCE OF VARIOUS RADIATION INTENSITIES- POOL FIRE

Radiation and effect	Radiation Intensities (kW/m2)/ Distances (m)					
	37.5	25.0	19.0	12.5	4.5	1.6
Failure of LDO tank of 2500 KL each	21.7	27.3	31.9	40.5	72.5	130.7

7.3.9 Conclusions on MCA Analysis

LDO Tank Farm

There will be LDO storage tank of 2 x 2500 KL capacity will be provided in the LDO tank farm. The results of MCA analysis indicate that the maximum damage distances for 12.5 Kw/m2 thermal radiations extends upto 40.5 m in the case of full tank of 2500 KL on fire during worst meteorological conditions. As the fire resistant dyke walls will be created, no cumulative effect of one tank form on fire to create fire on other tank farm is envisaged. The damage contours for tank on fire of LDO tank is shown in Figure-7.1.

Pool Fire Due to Failure of LDO Storage Tank

The maximum capacity of storage of LDO in each tank will be 2500 KL. The most

credible failure is the rupture of the largest pipe connecting to the storage tank. As the worst case, it is assumed that the entire contents leak out into the dyke forming a pool, which may catch fire on finding a source of ignition. A perusal of the above table clearly indicates that 37.5 kW/m2 (100% lethality) occurs within the radius of the pool which is computed at 21.7 m tank on pool fire. This vulnerable zone will damage all fuel storage equipment falling within the pool radius.

Similarly, the threshold limit for first degree burns is 1.6 kW/m2 , this vulnerable zone in which the thermal fluxes above the threshold limit for first degree is restricted to 130.7 m in case tank on pool fire.

7.3.10 Coal Handling Plant - Dust Explosion

Coal dust when dispersed in air and ignited would explode. Crusher house and conveyor systems are most susceptible to this hazard. To be explosive, the dust mixture should have:

- Particles dispersed in the air with minimum size (typical figure is 400 microns);
- Dust concentrations must be reasonably uniform; and
- Minimum explosive concentration for coal dust (33% volatiles) is 50 gm/m3 .

Failure of dust extraction and suppression systems may lead to abnormal conditions and may increase the concentration of coal dust to

the explosive limits. Sources of ignition present are incandescent bulbs with the glasses of bulkhead fittings missing, electric equipment and cables, friction, spontaneous combustion in accumulated dust.

Dust explosions may occur without any warnings with maximum explosion pressure upto 6.4 bar. Another dangerous characteristic of dust explosions is that it sets off secondary explosions after the occurrence of the initial dust explosion. Many a times the secondary explosions are more damaging than primary ones. The dust explosions are powerful enough to destroy structures, kill or injure people and set dangerous fires likely to damage a large portion of the Coal Handling Plant including collapse of its steel structure which may cripple the lifeline of the power plant.

Stockpile areas shall be provided with automatic garden type sprinklers for dust suppression as well as to reduce spontaneous ignition of the coal stockpiles. Necessary water distribution network for drinking and service water with pumps, piping, tanks, valves etc will be provided for distributing water at all transfer points, crusher house, control rooms etc.

A centralized control room with microprocessor based control system (PLC) has been envisaged for operation of the coal handling plant. Except for locally controlled equipment like traveling tripper, dust extraction/ dust suppression / ventilation equipment, sump pumps, water distribution system etc, all other in line equipment will be controlled from the central control room but will have provision for local control as well. All necessary interlocks, control panels, MCC's, mimic diagrams etc will be provided for safe and reliable operation of the coal handling plant

7.3.10.1 Control Measures for Coal Yards

The total quantity of coal shall be stored in separate stockpiles, with proper drains around to collect washouts during monsoon season. Water sprinkling system shall be installed on stocks of coal in required scales to prevent spontaneous combustion and consequent fire hazards. The stock geometry shall be adopted to maintain minimum exposure of stock pile areas towards predominant wind direction.

7.4 FIRE DETECTION & PROTECTION SYSTEM

A comprehensive fire detection and protection system is envisaged for the complete power station. This system shall generally be as per the recommendations of TAC (INDIA)/ IS: 3034 & NFPA- 850.

The following protection systems are envisaged:

1) Hydrant system for complete power plant covering main plant building, boiler area, turbine and its auxiliaries, coal handling plant, all pump houses and miscellaneous buildings of the plant. The system shall be complete with piping, valves, instrumentation, hoses, nozzles, hose boxes/stations etc.

2) Automatic high velocity water spray system for all transformers located in transformer yard and transformers having oil capacity above 2000 ltrs located within the boundary limits of plant, main and unit turbine oil tanks and purifier, Oil canal, generator seal oil system, lube oil system for turbine driven boiler feed pumps, boiler burner fronts,etc. This system shall consist of QB detectors, deluge valves projectors, valves, piping & instrumentation.

- Automatic medium velocity water spray system for cable vaults and cable galleries of main plant, switchyard control room and ESP control room consisting of smoke detectors, linear heat sensing cable detectors, deluge valves, isolation valves, piping, instrumentation, etc.;

- Automatic medium velocity water spray system for coal conveyors, coal galleries, transfer points, Stacker reclaimer, etc. This system shall consist of QB detectors, linear heat sensing cables, deluge valves, nozzles, piping, instrumentation, etc.;

- Automatic medium velocity water spray system for un-insulated fuel oil tanks storing fuel oil having flash point 65o C and below consisting of QB detectors, deluge valves, nozzles, piping, instrumentation, etc.;

- Automatic fire detection cum sprinkler system for crusher house along with alarm valves, sprinkler nozzles, piping, instrumentations etc.;

- Automatic Foam injection system for fuel oil / storage tanks consisting of foam concentrate tanks, foam pumps, in-line inductors, valves, piping & instrumentation, etc.;

- For protection of central control room, Control equipment room, Programmer room and UPS, Inert Gas extinguishing system as per NFPA- 2001 (edition 2004 or latest) would be opted.;
- Fire detection and alarm system - A computerized analogue, addressable type Fire detection and Alarm system shall be provided to cover the complete power plant. Following types of fire detection shall be employed.;
- Multi-sensor type smoke detection system;
- Photo electric type smoke detection system;
- Combination of both multisensor type and photo electric type smoke detection systems;
- Linear heat sensing cable detector;
- Quartzoid bulb heat detection system;
- Infra red type heat detectors (for selected coal conveyors);
- Portable and mobile extinguishers, such as pressurized water type, carbon dioxide type, foam type, dry chemical powder type, will be located at strategic locations throughout the plant;
- CW blow down shall be used for supply of fire water. An alternate connection from clarified water make-up line shall also be provided as a back-up source for fire water. It is proposed to provide two numbers of Steel tanks for storage of fire water system. Fire water pumps shall be located in the fire water pump house and horizontal centrifugal pumps shall be installed in the pump house for hydrant and spray system and the same shall be driven by electric motor and diesel engines as per the regulations of TAC. The water for foam system shall be tapped off from the hydrant system network;
- For the above fire water pumping station, automatic pressurization system consisting of jockey pumps shall be provided; and
- Complete Instrumentation and Control System for the entire fire detection and protection system shall be provided for safe operation of the complete system.

7.5 DISASTER MANAGEMENT PLAN (DMP)

Disaster: A serious disruption of the functioning of a community or a society causing widespread human, material, economic, or environmental losses that exceed the ability of the affected community or society to cope using its own resources.

Disasters could be categorized into

1. Natural Disasters:

A natural disaster is the result of a natural phenomenon (e.g., flood, tornado, earthquake, land slide etc). It leads to financial, environmental or human losses. The resulting loss depends on the vulnerability of the affected population to resist the hazard, also called their resilience.

2. Man-made disasters

Man-made disasters are of an anthropogenic origin, and exemplify some of the terrible accidents that have resulted from human beings interaction with artificial environment, which they themselves have created.

Industrial accidents are one good example of manmade disasters.

7.5.1 Industrial Disasters

Industrial hazards are threats to people and life-support systems that arise from the mass production of goods and services. When these threats exceed human coping capabilities or the absorptive capacities of environmental systems they give rise to industrial disasters. Industrial hazards can occur at any stage in the production process, including processing, manufacture, transportation, storage, use, and disposal. Losses generally involve the release of damaging substances (e.g. chemicals, radioactivity, and genetic materials) or damaging levels of energy from industrial facilities or equipment into surrounding environments. This usually occurs in the form of explosions, fires, spills, leaks, or wastes. Releases may occur because of factors that are internal to the industrial system (e.g. engineering flaws) or they may occur because of external factors (e.g. extremes of nature).

Disasters occur throughout the world, but their economic and social impacts have been increasing and are generally much greater in developing countries than in developed ones. The disproportionate effect on developing countries has many explanations. Lack of development itself contributes to disaster impacts, both because the quality of

construction often is low and building codes, land registration processes, and other regulatory mechanisms are lacking, as well as because numerous other development priorities displace attention from the risks presented by natural or man-made events.

7.5.2 Objectives of DMP

The objective of the industrial DMP is to make use of the combined resources of the plant and the outside services to achieve the following:

1. Effect the rescue and medical treatment of casualties;

2. Safeguard other people;

3. Minimize damage to property and the environment;

4. Initially contain and ultimately bring the incident under control;

5. Identify any dead;

6. Provide for the needs of relatives;

7. Provide authoritative information to the news media;

8. Secure the safe rehabilitation of affected area;

9. Preserve relevant records and equipment for the subsequent inquiry into the cause and circumstances of the Emergency.

In effect, it is to optimise operational efficiency to rescue, rehabilitate and render medical help and to restore normalcy.

7.6 DISASTER MANAGEMENT PLAN OF RTPS, DVC EXISTING

Disaster Control Measures

Events like explosion pool fire, toxic release and fireball are such calamities, which had never been foreseen, and for the persons working in the plant doing routine type of operations, the procedure becomes so monotonous that they forget that such type of events could occur any moment. Under these circumstances, as the people are unaware, they flee in all directions by vehicles or on foot. Although the traffic is halted, it leads to a massive jam making access to the site impossible for the rescue team. Due to explosions and smoke leading to confusion of common people, coordination becomes difficult and without the cooperation of these persons, the situation becomes uncontrollable, Though the probability values of occurrence of major hazards

considered yet give a message of not to panic, but at the same time asks us to keep ourselves ready to face such type of eventualities.

Emergency preparedness planning can be divided in two subsections:

1) On-site emergency planning

2) Off-site emergency planning

The On-site and Off-site emergency plans cover personnel employed at Raghunathpur Thermal Power Station (RTPS) Stage-I (2X600 MW) and the population of various localities around Raghunathpur Thermal Power Plant Stage-I (2X600 MW).

7.6.1 On-Site Disaster Management Plan

a) Preventive and predictive system

b) Protective systems

c) Personnel protective equipment

d) Mock drill and simulation exercises

e) Mutual aid scheme

f) Communications

g) Medical facilities

h) Reporting to external agencies

7.6.2 Off-Site Disaster Management Plan

a) Educating the people around

b) Mock drills

c) Communication

d) Transport

e) Medical facilities

f) Coordination

g) Evacuation

h) Mutual aid scheme

7.6.3 On-Site Disaster Management Plan

The On site Disaster Management Plan is aimed to ensure safety of life, protection of environment, protection of installation, restoration of production and salvage operation in this same order of priorities. The objective of the emergency plan is to make use of the combined resources of the plant and the outside services to achieve the following:

1) Affect the rescue and medical treatment of casualties.

2) Safeguard other people.

3) Minimize damage to property and the environment.

4) Initially contain and ultimately bring the incident under control.

5) Identify the affected.

6) Provide for the needs of relatives.

7) Provide authoritative information to the news media.

8) Secure the safe rehabilitation of affected area.

9) Preserve relevant records and equipments for the subsequent enquiry into the cause and circumstances of Emergency.

RTPS, DVC is having the facility to store various hazardous chemicals (such as liquid chlorine, hydrochloric acid, sodium hydroxide, hydrogen gas, liquid ammonia) and flammables! Combustible materials (such as furnace oil, light diesel oil, lubricants, petrol, diesel, coal etc.). Considering the process and the material to be used at RTPS, the following hazards are identified along with the probable areas of occurrence.

Nature of Hazards	Potential Areas / Locations of Occurrences
Fire Hazards (Slow Isolated or Fast Spreading)	➢ Coal Handling Plan Coal Conveyor ➢ Cable Galleries! Cable Trays in all plant sections.Fuel Oil Handling and Storage Areas Transformer and Switch Yard Areas ➢ Oil and Lubricants Stores ➢ Boiler area
Explosion Hazard	➢ Hydrogen Plant ➢ Turbo generators ➢ Transformers

	➢ Boiler ➢ Coal dust in mills and boilers
Bursting of Pipe Lines & Vessels	➢ Steam pipes due to high pressure & Temperature ➢ Water pipes due to high pressure ➢ Hydrogen Lines and Chlorine Lines
Release of Gases / Dust	➢ Chlorine in Water Treatment Plant ➢ Hydrogen in Turbo Generator area of main plant and H2 plant ➢ Flue gases from ducts ➢ Coal dust in transfer points, CHP Crusher & Mill area
Release of Liquid	➢ Chemicals tanks in Water Treatment Plant ➢ Fuel Oil tanks in Fuel oil handling section ➢ Chlorine from Chlorine toners

7.6.4 Control Requirement of an On-site Emergency Plan

The Disaster Management Plan includes the way in which designated people at the site of the incident can initiate supplementary action both inside and outside the works at an appropriate time. An essential element of the plan is to make safe the affected unit, for example by shutting down. The plan includes the full sequence of key personnel to be called in from other sections or form off-site. Management will ascertain that sufficient resources exist at their works to carry out the plan for various assessed incidents in conjunction with preliminary services, for example, sufficient water for cooling and fire fighting.

7.6.5 Alarm and Communication Mechanism

Communication is crucial factor in handling an emergency. As a general practice, all employees will be able to raise an emergency alarm so that the earliest possible action can be taken to control the situation. There will be an adequate number of points from where the alarm can be raised either directly by activating an audible warning or indirectly, viz. a signal or message to the permanently manned location.

7.6.6 Emergency Control Center

The Emergency Control Center is the place from where the operations to handle the emergency are coordinated. An Emergency Control Centre (ECC) is already in operation and equipped with relevant data and equipment to assist the control center personnel in disaster management. The Emergency Control Centre is managed by Deputy General Manager / Senior General Manager in charge of Operation and Maintenance of plant, Safety Officer and the senior officers of the other services. Other personnel not having access to the control center. Emergency Control Center will be sited in an area of minimum risk and preferably close to a main road to allow for easy access to a radio-equipped vehicle for use if other systems fail or extra communication facilities are needed. An alternate center, similarly equipped, will also be available at a different location. Emergency Control Center will contain.

- Master plan of the facility.
- Layout of facility, equipment and storage.
- Layout of Fire water system and other sources of water supply.
- Availability and location of fire fighting equipment and material.
- Layout of fire extinguishers indicating their types and numbers.
- First aid boxes.
- Availability and location of personal protective equipment.
- Self Contained Breathing Apparatus sets and the spare cylinders.
- External telephones.
- List of important telephone numbers, both internal and external, displayed on the wall.
- Stretchers.
- Transport facility.
- Assembly points along with escape routes to be highlighted.
- Extra copies of the facility layout to be used for spot marking of affected areas, movement of vehicles, problem areas, evacuated areas, etc.

- Details of hazardous substances along with the material safety data sheets.
- Telephone directory both local as well as of the surrounding district.
- General stationery like paper, pencil, etc.
- Nominal roll and addresses of all permanent employees.
- List of employees especially with those with are blood groups.
- Details of all contractors and their employees.
- List of first aiders and emergency squad members.
- Public address system.
- Two copies of the Risk Assessment Report and On-site Emergency Plans.

7.6.7 Action Plan for On-site Emergency Identification of Responsibilities

The on-site disaster management plan identifies Main Controller (General Manager), Incident Controller (AGM / DGM), Field Operation Controller (next in Command), Designated Key Personnel of Emergency Control Center (Sr. Supdts / Engineer - in Charge of Operation, Electrical Maintenance, Mechanical Maintenance, Control and Instrumentation and Chemistry; Heads of Personnel / Industrial Relations / Labour Welfare/ Safety/ Technical Services; Chief Medical Officer; Commandant / Asst. Commandant/ Fire Officer from CISF; Engineer-in-Charge of Auto Base; Public Relation Officer etc.). The plan also specifies responsibilities of these personnel in case of an emergency and draws an action plan to be followed. It also specifies the responsibilities for Declaration of Emergency and giving All Clear Signal. The list of key personnel and their phone numbers will be informed to all concerned suitably.

As necessary they decide the actions needed to shut down plant, evacuate personnel, carry out emergency repair works, arrange supplies of equipment & personnel, carry out atmospheric tests, provide catering facilities, liaison with police, informing relative of the victims, briefing press media etc. Main Controller and Incident Controller will be assisted by two support teams as follows:

Support Team to Main	Consisting of Heads of Personnel, Materials and Finance Divisions; to function in

Controller (MC)	consultation with MC for the following. ● Contacting statutory authorities. ● Arranging for relieves and catering facilities. ● Giving information to media. ● Contacting medical centers and nursing homes. ● Providing all other support, as necessary. ● Arranging for urgently required materials through cash purchase or whatever means. ● Arranging funds for various relief measures as well as emergency purchase of materials, sending his ● representative for emergency purchase
Support Team to Work Incident Controller (IC)	Consisting of Sr. Manager (Admn.), Sr. Supdt. (Operation), Sr.Supdt. (Elect. Maintenance), Sr. Supdt. (Mech. Maintenance) and any more persons depending upon the need to assist the IC in manning communication and passing instructions to the teams. One Steno Secretary shall also be available with IC for recording all information coming in and instructions going out.

In addition to the support teams mentioned above, there will be a team for each functional area, as described below:

- Task Force
- Maintenance Team
- Fire Fighting Team

- Auto base Team
- Communication Team
- Security Team
- Administrative Team
- Safety Team
- Medical Team
- Monitoring Team

7.6.8 Emergency Response Facilities (Proposed)

Preliminary facilities envisaged are -

a) Emergency shut down procedure

b) A dedicated and pressurized fire fighting ring-main with adequate number of fire hydrants, fixed position monitors, water curtains, fog nozzles located strategically throughout the site.

c) A number of fire fighting pumps with both electric and diesel prime movers backed by adequate supply of raw water.

d) Dedicated fire alarm networks with adequate number of fire alarm call points and emergency telephone handsets throughout the site.

e) A two-way Public Address (PA) system installed independently in all production units and also in important service areas.

f) Adequate supply of protective clothing & breathing apparatus will be made available to all personnel of emergency team.

g) On-site first aid and treatment center with round the clock medical attendance.

7.6.9 Outline of Key emergency Actions

The on-site emergency will in all probability commence with a major spill of hazardous chemical like Chlorine etc. or its uncontrolled release into the plant atmosphere.

In accordance with the detail on-site emergency plan, the following key personnel will immediately take control of the emergency.

- On-site fire crew led by a fire marshal will arrive at the scene of incident with fire fighting equipment as necessary.
- Emergency Security Controller will commence his role from the main gate office.
- Incident Controller will rush to the scene of emergency.
- Works Main Controller will arrive at the ECC with members of Emergency
- Control team and will assume absolute control of the site. He will receive information continuously from Incident Controller & Emergency Security Controller and give directions to:
    - Incident Controller
    - All plant control rooms
    - Emergency Security Controller
    - Site or Shift Medical Officer
    - Personnel Manager
- As soon as key emergency personnel will take up positions in their respective locations, the management of the incident will commence with the site main controller performing the lead functions.
- At the site of incident, the incident controller will directly handle the emergency with the help of specific support groups.
- At the security gate office the emergency security controller and personnel manager will be in contact with various external agencies as per requirements.
- At the site medical center the shift/site medical officer will take control of medical support services. Works main controller, will be directing and deciding a wide range of issues. In particular, WMC will decide and direct:
- Whether the incident controller requires reinforcement both in terms of manpower and other resources.
- Whether staffs in different locations are to be remaining indoors or are to be evacuated and assembled at the designated collection centers.

- Whether and when district emergency services are to be called to supplement the resources of plant's emergency crew, intimation to district authority should be given.
- How to deal with fatalities reported either by incident controller or by shift medical officer.
- These are some of the key emergency decisions and actions, the Works Main Controller will have to take. When the incident has eventually been brought under control as declared by the incident controller, WMC will send two of his assisting managers for inspection of:
- Site of the incident for an assessment of total damage and prevailing conditions, with particular attention to possibility of re escalation of the emergency now under control.
- Other parts of the site which might have been affected by impacts of the incident.
- Personnel collection and roll call centers to check if all persons on duty have been accounted for.
- All plant control rooms to assess and record the status of respective plants and any residual actions deemed necessary.
- Site's first aid and medical center to inspect any casualty (ies), their state of treatment and also to get a report on off-site hospitalization, for subsequent follow-up.

The post-emergency inspectors will return to ECC with their observations and report their findings to WMC.

Based on these reports WMC will communicate further directive to all sub-centers of emergency management and will finally declare and communicate termination of emergency and authorize step by step restoration of normal operation of the site. The sirens will be sounded giving all clear signal.

7.7 Evacuation and Assembly Points

In an emergency, it may be necessary to evacuate Personnel from affected areas and as precautionary measure, non-essential workers

from areas likely to be affected should the emergency escalate. The evacuation will be effected on getting necessary message from Incident Controller. On evacuation, all the persons shall assemble at pre-identified and notified Assembly Points.

7.7.1 Conducting Evacuation

Once WMC will decide that an area is to be evacuated, the evacuation will be conducted in a well-coordinated and safe manner. Evacuation involves a number of steps, which include assigning tasks to evacuation assistance personnel, informing potential evacuees, providing transportation, emergency medical care and security for evacuated areas and sheltering evacuees as necessary.

7.7.2 Evacuation Tasks

The first step is to assign tasks to evacuation assistance personnel. These tasks include information concerning:

- The specific area to evacuate;
- Route of evacuation;
- Protective gear to be worn
- Instructions to be given to evacuees
- Transportation of evacuees who are without private transportation.
- Assistance to specific population
- Shelter locations
- Traffic and pedestrian control
- Communication procedures

The progress of the evacuation efforts will be monitored by WMC who will also provide continuous direction to evacuation assistance personnel.

7.7.3 Security in Evacuated Areas

Once an area is evacuated, law enforcement personnel will guard the area to prevent looting and other unauthorized sections. Security forces

operating in or around an evacuated area will be dressed in appropriate protective gear.

7.7.4 Re-entry into Evacuated Areas

Before making the decision to authorize re-entry, data collected by the monitoring crews will be verified and the advice of health officials to be considered.

7.7.5 Updating of On-site Plan

On-site plan will be updated based on modifications in the factory or at-least once a year on specific authorization of Works Manager. Safety Officer will maintain a record to this effect.

7.7.6 Mock Drill for Rehearsing On-site Plan

A mock drill to rehearse on-site plan at-least once in a year with a view to train and make the personnel aware of the procedure in case of emergency will be carried out by Works Manager. The drill will be conducted seriously and lessons learnt will be analyzed and corrective actions will be taken. The record of rehearsal will be maintained.

There are two types of mock drills recommended in Disaster Management Plan - Full Mock Drill (to be conducted at least once in 6 months) and Disaster Management Efficacy Drill (to be conducted at least once in 3 months).

7.7.7 Full Mock Drill

This shall be conducted with Plant Head as Chairman; Head of O&M as Vice Chairman; Heads of Operation, Maintenance, Medical, Personnel, CISF, Auto Base and Materials as Members and Head of Safety as Convener and it shall test the following:

- Functioning of Emergency Control Center, specifically availability of all facilities etc as mentioned in the DMP and its functional healthiness.
- To evaluate communication of the DMP to all segments of employees, to familiarize them about their responsibilities in case of any disaster including evaluation of behaviour of employees and others.

- To ensure that all facilities as required under the plan from within or from nearby industries I aid center under mutual assistance scheme or otherwise are available.
- To ensure that the necessities under material assistance scheme is properly documented and the concerned employees are fully aware in this regard.
- To ensure that employees are fully aware to fight any emergency like sealing of chlorine leakage, fire fighting other such cause.

7.7.8 Disaster Management Efficacy Drill

This shall be conducted with Head of O&M as Chairman and Heads of Personnel, Communication, CISF and Medical as Members and Head of Safety as Convener and it shall test the following:

- All employees are trained about their responsibilities I duties. They all are aware about evacuation routes, direction of evacuation, equipment to be used during evacuation or the method of evacuation;
- All employees are fully trained to rescue their colleagues, who may be affected due to cause of disaster. In case they are unable to rescue their colleagues, they should know to whom they have to inform about such persons;
- All employees are fully trained in first aid & use of desired equipments including breathing apparatus. First Aid boxes etc are available at the desired location;
- All warning alarms are functional. Public Address System is in healthy condition;
- All telephone lines I communication systems are provided in control rooms and there is no removal of the facilities (as prescribed) for the control rooms;
- It is very clear amongst the concerned managers who shall call for assistance under mutual aid scheme or the facilities from within; •
- It is clear at the plant, who shall declare emergency; and •
- It is clear at the plant, who shall inform the District Authorities, State Authorities and Corporate Center.

The Disaster Management Plan shall be periodically revised based on experiences gained from the mock drills.

7.8 OFF SITE EMERGENCY PLAN

The off-site emergency plan is an integral part of a hazard control system. It will be based on the identified accident scenario, which could affect people and environment outside the works. Thus, the off-site plan follows logically from the analysis to provide the basis for the on-site plan and the two plans will therefore complement each other. During preparation of off-site emergency plan, the district authorities and other organization in the vicinity and pollution control board would be consulted. The key feature of a good off-site emergency plan is the flexibility in it's an application to emergencies

In Raghunathpur TPS, the following conditions can ordinarily constitute an off-site emergency:

- Heavy release of chlorine, due to rupture of valve or rupture of the shell, explosion in chlorine cylinder due to fire, terrorist activities or otherwise; resulting in its spread to neighbouring areas; and
- Major fire involving combustible materials like oil, and other facilities.

Under the Environmental Protection Act, the responsibility of preparation of Off- Site Emergency Plan lies with the State Government. The Collector I Deputy Collector are ordinarily nominated by State Government to prepare Off-Site Emergency Plan.

The District Collector or his nominated representative would be the team leader of planning team, who shall conduct the planning task in a systematic manner. The members of planning team for off site emergencies are Collector I Deputy Collector, District Authorities, In-charge of Fire Services, Police and members drawn from Medical Services, Factory Inspectorate, Pollution Control Board, Industries and Transport. In addition to these members, there are co-opted members from district authorities concerned, civil defence, publicity department, Municipal Corporation, and non officials such as elected representative (MPs, MLAs, voluntary organization, nongovernmental organizations etc)

7.8.1 Post Emergency Relief to the Victims

The Public Liability Insurance Act, 1991 provides for the owner who has control over handling hazardous substances to pay specified amount of money to the victims as interim relief by taking insurance policy for this purpose. The District Collector has definite role in implementation of this act. After proper assessment of the incident, he shall invite applications for relief, conduct an enquiry into the claims and arrange payment of the relief amount to the victims.

7.8.2 Disaster Prevention and Reduction

DVC recognizes, and accepts its responsibility for establishing and maintaining a safe working environment for all its employees. This responsibility arises from: •

- Company's moral responsibility to its employees, to provide the best practicable conditions of work from the point of view of health and safety;
- The obligation to consult with its staff and their representative to implement policies and procedures developed as a result of discussions; and
- Statutory responsibility in respect of health, safety and welfare of employees emanating from relevant legislations such as the Factories Act. The Indian Electricity Act. The Explosive Act, the Boiler Act etc.

7.8.3 Responsibilities of the DVC

DVC shall take all such steps which are reasonably practicable to ensure best possible conditions of work, and with this end in view the company shall do the following :-

- To allocate sufficient resources to provide and maintain safe and healthy conditions of work;
- To take steps to ensure that all known safety factors are taken into account in the design, construction, operation and maintenance of plants, machinery and equipment;
- To ensure that adequate safety instructions are given to all employees;
- To provide wherever necessary protective equipment, safety appliances and clothing, and to ensure their proper use;

- To inform employees about materials, equipment or processes used in their work which are known to be potentially hazardous to health or safety;
- To keep all operations and methods of work under regular review for making necessary changes from the point of view of safety in the light of experience and up to date knowledge;
- To provide appropriate facilities for first aid, prompt treatment of injuries and illness at work;
- To provide appropriate instruction, training, retraining and supervision in health and safety and first aid and ensure that adequate publicity is given to these matters;
- To ensure proper implementation of fire prevention and an appropriate fire fighting service, together with training facilities for personnel involved in this service;
- To ensure that professional advice is made available wherever potentially hazardous situations exist or might arise;
- To organize collection, analysis and presentation of data on accident, sickness and incident involving personal injury or injury to health with a view to taking corrective, remedial and preventive action;
- To promote through the established machinery, joint consultation in health and safety matters to ensure effective participation by all employees;
- To publish/notify regulations, instructions and notices in the common language of employees;
- To prepare separate safety rules for each type of occupation/process involved in a project;
- To ensure regular safety inspection by a competent person at suitable intervals of all buildings, equipments, work places and operations; and
- To co-ordinate the activities of the company and of its contractors working on the Company's premises for the implementation and maintenance of safe systems of work, to comply with their legal obligations with regard to the health, safety and welfare of their employees.

7.8.4 Responsibilities of the Employees

The establishment and maintenance of best possible conditions of work is, no doubt, the responsibility of management. However, it is also necessary that each employee follows prescribed safe methods of work. He should take reasonable care for the health and safety of himself and his fellow employees and of other persons who may be affected by his action at work. With this in mind, employees should be health and safety conscious.

7.9 OCCUPATIONAL HEALTH AND SAFETY

Large industries, in general, and power plants in particular where multiple activities are involved during construction, erection, testing, commissioning, operation and maintenance, employ men, materials and machines as the basic inputs. Occupational Health needs attention both during construction and erection and operation and maintenance phases. However, the problem varies both magnitude and variety in the above phases.

7.9.1 Construction and Erection Phase

The problems envisaged at Construction and Erection stage can mainly be due to accident and noise. To overcome these hazards, the contractors in charge of construction and erection activities have to maintain noise levels within threshold limit values and the workers should be provided with personnel protective equipment.

7.9.2 Operation and Maintenance Phase

The problems envisaged during the operation and maintenance phase are accident, exposure to heat, noise, arc lights, chemicals etc. Suitable personnel protective equipments should be provided to all employees, likely to be exposed to these situations. The working personnel should be given the personnel protective equipment as brought out in **Table-7.15.**

Workplace Hazards		Suggested PPE
Eye and face protection	Flying particles, gases or vapors, light radiation	Safety glasses with side-shields, protective shades, etc.
Head	Falling objects, inadequate	Safety helmets for top and side

protection	height clearance, and overhead power cords	impact protection
Hearing protection	Noisy Areas	Hearing protectors (ear plugs and ear muffs)
Foot protection	Failing or rolling objects, points objects. Corrosive or hot liquids	Safety shoes and boots for protection against moving and failing objects, liquids and chemicals
Hand protection	Hazardous materials, cuts or lacerations, vibrations, extreme temperatures	Gloves made of rubber or synthetic material (Neoprene), leather, steel, insulation materials, etc.
Respiratory protection	Dust, fogs, fumes, mists, gases, smokes, vapors	Face masks with appropriate filters for dust removal and air purification (chemical, mists, vapors and gases). Single or multi-gas personal monitors
	Oxygen deficiency	Portable or supplied air (fixed lines).Onsite rescue equipment
Body / leg protection	Extreme temperatures, hazardous materials, biological agents, cutting and laceration	Insulating clothing, body suits, aprons etc. of appropriate materials
Fly Ash	Fly ash handling and storage	For handling, dust-proof goggles and rubber or PVC gloves. For large quantities or where heavy Contamination is likely, wear: coveralls.

		For high dust levels, wear: a Full-face Class P3 (Particulate) or an Air-line respirator. For inhalation risk exists, wear: a Class P1 (Particulate) respirator.

In addition, medical facilities should be made available round the clock for attending any medical emergency during construction and operation phases.

7.9.3 Safety and Emergency Plan

Safety of both men and materials during construction and operation phases is of prime concern. Safety requirement during construction & erection, operation andmaintenance phases should be covered in the safety policy with the following requirements:

- To allocate sufficient resources to maintain safe and healthy conditions of work;
- To take steps to ensure that all known safety factors are taken into account in the design, construction, operation and maintenance of plants, machinery and equipment.
- To ensure that adequate safety instructions are displayed at all appropriate places and explained to all employees in English, Hindi & Bengali;
- To provide wherever necessary protective equipment, safety appliances and clothing, and to ensure their proper use;
- To inform employees about materials, equipments or processes used in their work, which are known to be potentially hazardous to health or safety;
- To keep all operations and methods of work under regular review for making necessary changes from the point of view of safety in the light of experience and aptitude knowledge;
- To provide appropriate instruction, training, retraining and supervision to employees in health & safety, first aid and to ensure that adequate publicity is given to these matters;

- To ensure proper implementation of fire prevention methods and an appropriate fire fighting service together with training facilities for personnel involved in this service;
- To organize collection, analysis and presentation of data on accident, sickness and incident involving personal injury or injury to health with a view to taking corrective, remedial and preventive action;
- To organize collection, analysis and preventive action;
- To promote through the established machinery, joint consultation in health and safety matters to ensure effective participation by all employees; and
- To publish/notify regulations, instructions and notices in the common language of employees.

Separate safety rules should be prepared for each type of occupation / processes involved in the project in consultation with manufacturer / supplier of equipment and materials and regular safety inspection should be ensured by a competent person of all buildings, equipments, work places and operations.

7.9.4 Safety Organization

7.9.4.1 Construction and Erection Phase

A qualified and experienced Safety Officer from Phase - 1 will be posted at site. The responsibilities of the safety officers include identification of the hazardous conditions and unsafe acts of workers and advise on corrective action, organize training programmes and provide professional expert advice on various issues related to occupational safety and health. He is also responsible to ensure compliance of Safety Rules/Statutory provisions.

7.9.4.2 Operation & Maintenance Phase

When the construction is completed the posting of safety officers shall be in accordance with the requirement of Factories Act and their duties and responsibilities shall be as defined thereof.

7.9.5 Safety Circle

In order to fully develop the capabilities of the employees in identification of hazardous processes and improving safety and health,

Safety Circles should be constituted in each area of work, consisting of 5-6 employees from that area and it should meet for about an hour every week.

7.9.5.1 Safety Training

Safety training should be provided by the safety officers with the assistance of professionals in the area (e.g., Safety Experts at Corporate Centre & other Projects of DVC, Safety Institutions, Academic Institutions etc.).

7.9.5.2 Health and Safety Monitoring Plan

All the potential occupational hazardous workplace such as chlorine storage area, acid and alkali storage areas will be monitored regularly. The health of employees working in these areas should be monitored regularly for early detection of any ailment due to exposure to hazardous chemicals.

7.10 PREVENTIVE MEASURES AND PLANS

Based on the preliminary identification, the major hazardous installation at power plant are storage of hydrogen, LDO and chlorine. LDO are the secondary fuel for combustion support at low load and for start up. Following are the important considerations for loading/unloading of hazardous chemicals.

1) Written instructions will be given which clearly define responsibilities for all personnel involved in loading/unloading operations;

2) A responsible person normally a section supervisor on site will check that the quantity and type of fuel oil being transferred is suitable for the receiving tanks. Tanks will be checked to see how full they are before filling, and also during filling using the contents gauge. The maximum level device will be used to ensure overfilling does not occur;

3) The point of transfer, where connections and disconnection are made will be sited in a well-ventilated position;

4) Flexible hoses used for conveying fuel oil to and from truck into fixed vessels will:-

Have a means of identification. Be examined for kinks and wear on every occasion prior to use. Hose fittings will be similarly examined.

- Be periodically checked for electrical continuity and written records of the tests should be maintained;
- Be properly used so that the hose will not be physically damaged or adversely affected by the weather when not in use or when being conveyed;
- Have means for protecting and fittings against damage or ingress of foreign material;
- Loading hoses should be earth and should also be bonded with the wagon;
- Be replaced or repaired when damaged or worn-out;
- Be properly used so that the hose will not be physically damaged or adversely affected by the weather when not in use or when being conveyed;
- Have means for protecting and fittings against damage or ingress of foreign material;
- Loading hoses should be earth and should also be bonded with the wagon; and
- Be replaced or repaired when damaged or worn-out.

5) In order to minimize the risk of accidental movement, the tanker will stand on a level site during loading or unloading. Checks will be placed against the vehicles wheels or other means provided to prevent vehicle movement prior to loading/unloading. These will only be removed when transfer is complete. The ground beneath the tanker will have a shallow gradient to a safe place to prevent any spillage from remaining under the vehicle;

6) The loading/unloading operation will only be carried out when it is safe to do so and where practical be separated from other traffic movement. Where vehicles or pedestrian are likely to pass by, physical barrier will be provided to deter them approaching the transfer operation; and '

7) Consideration will be given to the provision of a driveway protection device such as self-sealing, breakaway, coupling connected to the flexible hose, means to shut emergency isolation valves on the fixed plant, etc.

7.11 PREVENTIVE MEASURES

For the safety of man and material, various preventive measures will be taken. These are:

1. Periodical checking of electrical wiring, fittings, and equipment;

2. Immediate removal of all combustible and flammable material from the vicinity of sources of ignition;

3. All welding/cutting operations will be carried out taking suitable precautions under permit procedure in consultation with the office-in-charge of the plant and the Fire and Safety division;

4. All the pipelines and vessels will be clearly marked for its content and quantity and will also be colour coded for easy identification;

5. All plant equipment, lines, vessels and storages will be inspected in all shifts for leakage and release of inflammable liquids. Any such leakage, if found will be stopped and attended to at once;

6. All the hazardous areas will be marked with prominent display symbols;

7. Areas where spontaneous combustion is possible due to storage of material or in scrap yard will be inspected regularly for immediate control of fire on its outbreak;

8. Stacked material, which can generate heat or can spontaneously ignite, will be inspected regularly to detect any fire. Material will be stacked with sufficient space in between the rows to permit free circulation of air and remove any heat if generated;

9. Plant and machinery will be operated under close supervision. Any malfunction will be attended to at once before it can lead to breakdown, fire or any such dangerous occurrence;

10. Air-conditioning equipment will be inspected regularly and defects are to be attended at once;

11. Dry grass and vegetation will be cut as and when required;

12. Smoking will be prohibited in the plant premises. It may be allowed in the safe locations outside the plant area. All persons will be checked at plant gate for matches, lighters, beedi, cigarettes and other smoking materials; and

13. Safety display boards should be provided wherever hazardous chemicals are used.

7.12 PUBLIC HEARING

The Public Hearing shall be conducted by West Bengal Pollution Control Board (WBPCB). The point-wise compliance to the issues, raised during this meeting shall be kept in mind. An action plan shall be formulated along with budgetary provision and this shall be included in the Final EIA Report.

7.13 REHABILITATION & RESETTLEMENT

The proposed units will be set up on the available land within the existing plant premises of Raghunathpur Thermal Power Station (RTPS), which is already acquired. Hence it is envisaged that there is no R&R obligations. However, as per current extant policies & procedures for granting clearances for new project a comprehensive Community Development (CD) plan will be formulated as per need & requirement in consultation with Stakeholders & District Administration for taking up community development activities, mainly in the area of Education, Vocational Training, Health, Drinking Water, Sanitation, Village Infrastructure, Women Empowerment, Welfare etc. in the periphery of the project site in a defined geographic area.

7.14 CONCLUSION

It can be concluded that there will be no major risk involved in the proposed expansion project. Suitable risk control measures and management with respect to Risk Assessment will be implemented to minimize any risk. Regular training, implementation of SOPs and use of relevant Personal Protective Equipment (PPE) shall help to minimize the health hazards and incidental casualties. Damodar Valley Corporation will continue to work for development of the society in future. Thus, the proposed project will have a positive impact on society. It also does not involve discharge of any effluent and shall follow zero discharge concept; thus, the society will not be impacted. Therefore, it is safe to say that any risk involved due to the activities within the premises of proposed project will be controlled and managed by plant personnel.

CHAPTER-8.0
PROJECT BENEFITS

8.0 PROJECT BENEFITS

8.1 Introduction

This section of the report describes the direct and indirect benefits that the proposed power plant is expected to have at the local, regional or even national scale. The benefits from the project on the infrastructure in general and on the socio-economic status are listed.

8.2 Benefits to the Infrastructure

The construction of the proposed power plant envisages construction of additional connecting roads for ensuring the timely movement of required men and material. These roads will also benefit the population in the surrounding villages and improve their communication with each other and the district headquarters.

The construction and operation of the power plant will attract influx of large number of persons in labours in the area in the form of equipment suppliers, material suppliers, maintenance technicians, etc. For their accommodation, the infrastructural facilities like lodging, eateries and transport facilities on the outskirts of Ramagundam town or at nearby villages up to the plant area is expected to improve significantly. These will also benefit the local population.

8.3 Benefits to the Socio- Economic Status

The setting up of the proposed project will lead to direct and indirect benefits to the overall socio-economic status of the region also. During construction phase, there will be opportunities for local skilled and unskilled workers to be employed in the various construction related activities like material handling, operation of construction machinery, actual construction, painting, installation of plant machinery, etc.

At the same time, local small contractors, vehicle owners, machinery owners will get substantial amount of business for providing their

services to the proponents and EPC contractors. The construction activity and influx of visitors will also open up opportunities for setting up establishments like lodging, telephone, kiosks, small shops, vehicle and machinery maintenance, etc in the vicinity of the plant or outskirts of Ramagundam. These establishments will be viable during the operation phase also, with the advent of employees from outside regions. These may be considered indirect benefits due to the setting up of the project in the area. However, the power generated from this plant will benefit the West Bengal & Jharkhand States to larger extent leading to agricultural and industrial development and also to the country.

Apart from the temporary employment during construction phase, the setting up of the project will also open up indirect employment opportunities, especially for the skilled workers.

8.4 Status of CSR - CD Activities at Raghunathpur

8.4.1 CSR - CD Cell at Raghunathpur

As a part of Corporate Social Responsibility (CSR), DVC has already established its Corporate Social Responsibility, Community Development (CSR-CD) cell at Raghunathpur of Purulia District in West Bengal.

Various activities undertook to improve socioeconomic status of surrounding area as follows:

SOCIAL & ECONOMICAL DEVELOPMENT ACTIVITIES

- Promotion of Primary and Non formal Education
- Primary Health, Health awareness & Family Welfare
- Vocational Training and Self-Employment
- Development of Agricultural & Non-farming Activities
- Sports, Entertainment and Cultural Activities
- Social Forestry & Fisheries

INFRASTRUCTURE DEVELOPMENT ACTIVITIES

- Tube wells & water tap Points installed.
- Drinking Water wells constructed & renovated

- During summer, supply of drinking water to villages through tankers.
- Primary School buildings, Boundary walls, school toilets, urinals and drinking water points constructed and renovated.
- Community & Health Centers constructed & renovated.
- Bathing/ Washing Ghats, Burning Ghats, Toilets/ Urinals etc. construction/renovation
- Roads, Culverts, Guard Walls and road side Drain etc. constructed.
- Water Harvesting Structures excavation and renovation

ACTIVITIES DURING COVID-19 PANDEMIC

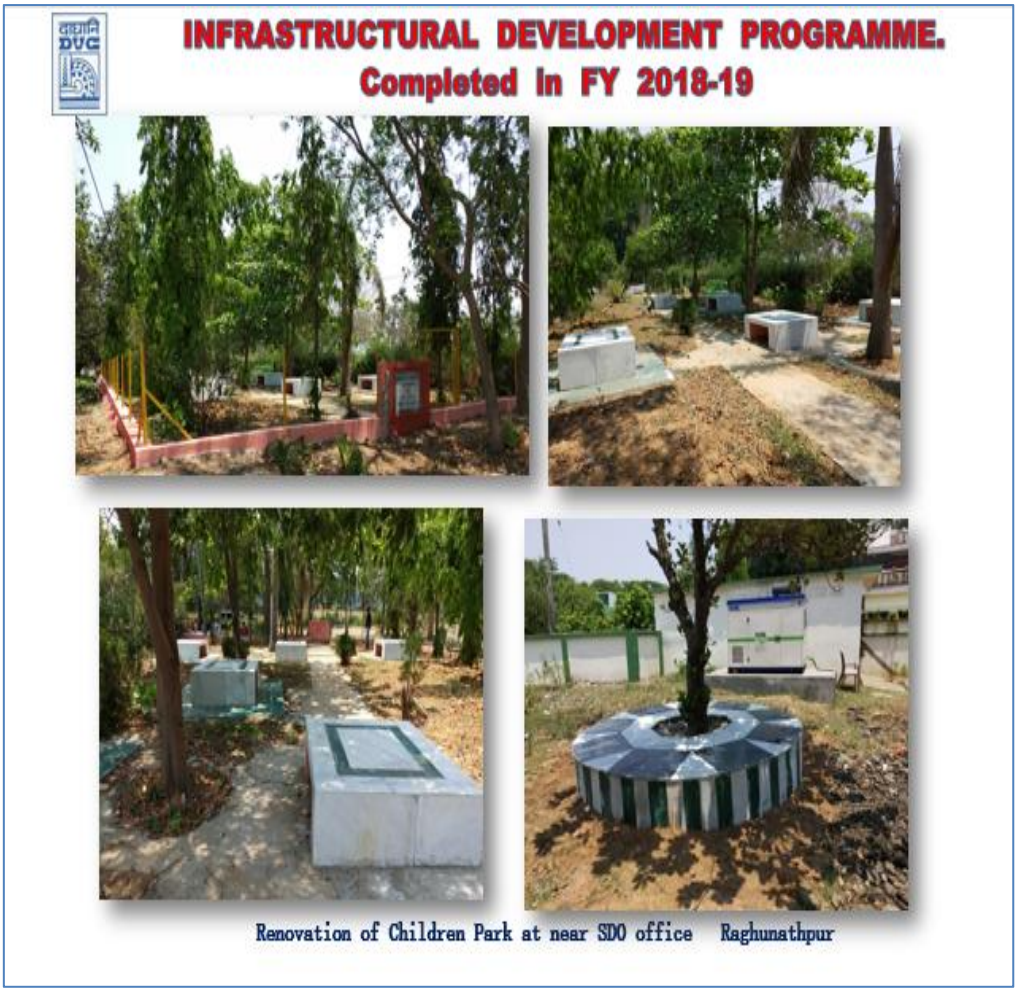
To fight against national Pandemic COVID-19, DVC had taken several steps such as distribution of Mask, sanitizer, soap, hand gloves and food packets to the poor residing adjacent to the project ara. Some of Public Buildings such as Banks, Post Offices, market area etc. had been sanitizrd by spraying chemicals. Some of the DVC buildings have been allowed to make Quarantine Centres. Bleaching powder has been spread to Drinking Water Wells. drains and roadside as disnfectant.

CSR-CD COMMAND AREA

Name of the Block	Number of Panchayata	Villages covered under CSR Command Area
Raghunathpur - I	1	Nutandihi Panchayat - 22 villages
Raghunathpur - II	3	1. Nidis Panchayat - 25 villages 2. Barrah Panchayat - 17 villages 3. Moutphr Panchayat - 10 villages
Neturia	2	1. Raibandh Panchayat - 22 villages 2. Guniara Panchayat - 23 villages
TOTAL COVERED		
Blocks 3	Panchayats 6	Villages 119


INFRASTRUCTURAL DEVELOPMENT PROGRAMME.
Completed in FY 2018-19
Classroom at Naragoria Primary Schoool
PCC road at Naragoria village
Boundary wall at Kudrathan village Bhurkundabari
PCC road at Ghutitora village


INFRASTRUCTURAL DEVELOPMENT PROGRAMME.
Completed in FY 2018-19
PCC road at Mahalpara
PCC road at Salanchi village
Boundary wall at Jaharthan village Bhurkundabari
PCC road at Durmut village


INFRASTRUCTURAL DEVELOPMENT PROGRAMME.
Completed in FY 2018-19
Renovation of Children Park at near SDO office Raghunathpur


SANITATION
Toilet for Boys' and Girls' at Nildih High School in village Nildih

CHAPTER-9.0
ENVIRONMENTAL COST BENEFIT ANALYSIS

Damodar Valley Corporation (DVC) is a government-owned power generator which operates in the Damodar River area of West Bengal and Jharkhand states of India to handle the Damodar Valley Project. The statutory corporation operates both thermal power stations and hydel power stations under the ownership of Ministry of Power, Government of India. DVC is headquartered in the Kolkata city of West Bengal, India.

On the basis of approval from Ministry of Power, DVC proposes for Expansion of Raghunathpur Thermal Power Station by installing capacity 1320 (2x660) MW (Phase- II) in an area of 341.81 ha (844.63 acres) at village Raghunathpur, District Purulia (West Bengal).

Implementation of the proposed project with an investment of Rs. 11,554.29 Crores will certainly be a boon to the region and will give various benefits to society of the region.

Such project is expected to improve living conditions by providing better employment opportunities and thereby, result in further reduction of population below poverty line, which is one of the prime policy objectives of the Government.

It is expected that by creation of good employment potential and industrialization of this area, poor/weaker sections of the society will enjoy higher earning power and quality of life.

The project is expected to accelerate the infrastructure development in and around the area, such as rail, road, transport and communication facilities.

Trading of equipment and materials such as plates, pipe fittings, valves, pumps, compressors, electrical machinery and construction materials provide employment and income to a large number of people.

Therefore, the project proposal would not only generate a huge amount of govt. revenue but also will provide a considerable number

of direct/indirect employment opportunities followed by peripheral development.

It is noteworthy that no forest land will be required for the expansion purpose. Therefore, there will no environmental loss due to conversion of forest land to non-forest (industrial) land.

Therefore, it is very clear that from the environmental point of view loss is very minimal due to the proposed project expansion at Haldia Industrial Growth Centre of WBIIDC.

In this context, Environmental Cost Benefit Analysis for the proposed project expansion shall consider all these parameters.

History of Cost-Benefit Analysis (CBA)

It was originated in the area of research called welfare economics. It helps to answer questions about the benefit of one outcome over another, from a societal standpoint. Welfare economics uses criterion from the Utilitarian philosophy of the eighteenth century. These researchers tried to "compare outcomes on the basis of what gives the greatest benefit to the greatest number of people. Benefit here means utility: thus, welfare economics looks at ways of comparing outcomes in terms of their contribution to the utility of the population as a whole". The value of environmental costs and benefits are most clearly understood when represented in monetary units, and then balanced against one another.

Benefits are defined as increases in human well-being (utility) and costs are defined as reductions in human wellbeing. For a project or policy to qualify on cost-benefit grounds, its social benefits must exceed its social costs.

Environmental cost-benefit analysis (CBA) is **the application of CBA to projects or policies that have the deliberate aim of environmental improvement or actions that somehow affect the natural environment as an indirect consequence.**

Methodology

Different internationally famous research organisations have come with useful publications dealing with the problem of measuring social costs and social benefits. It may be noted, in this context, that the actual cost or revenues from the goods and/or services to the organization do not necessarily reflect the monetary measurement of the cost and or benefit to the society. This is because these figures are grossly distorted on account of restriction and controls imposed by the government. Hence a different yardstick has to be used for evaluating a particular in terms of cost and sacrifice on the part of the society. Such payments are easily valued at opportunity cost or shadow prices to judge their real impact in terms of cost to society for the purpose of social cost benefit evaluation.

One of the most acceptable approaches is a five-stage methodology:

1. Calculation of financial profitability measured at market prices.

2. Obtaining the net benefit of the project measured in terms of economic prices.

3. Adjustment for the impact of the project on savings and investment.

4. Adjustment for the impact of the project on income distribution.

5. Adjustment for the impact of the project on merit goods and demerit goods.

It is imperative to mention that Social Cost Benefit Analysis is a model based on the theory of welfare economics, according to which the welfare of a society depends on the aggregate individual utility levels of all members of that society.

The objective of cost-benefit analysis is, in its widest sense, to secure and achieve the value of money in economic life by simply evaluating the costs and benefits of alternative economic choices and selecting an alternative which offers the largest net benefit.

Therefore, it can be said that the main focus of Social Cost Benefit Analysis is to determine:

1. Economic benefits of the project in terms of a price (shadow price) that reflect social value;

2. The impact of the project on the level of savings and investments in the society;

3. The benefit of the project in the society;

4. The Cost of the project in the society.

Net Present Value (NPV)

Net Present Value (NPV) equals the sum of the benefits in present value minus the sum of the costs in present value.

EVALUATION OF COST OF PRESENT VALUES		
S.N.	**Parameters**	**Value**
1.	Loss of value of timber, fuelwood and minor forest produce on an annual basis, including loss of manhours per annum of people who derived livelihood & wages from the harvest of these commodities	**NIL** Since expansion of the project will be located within the existing plant boundary of DVC, Raghunathpur, hence no loss of man hours as no one depends for livelihood on this land.
2.	Loss of animal husbandry productivity, including loss of fodder	**NIL** There is no loss of animal husbandry productivity and loss of fodder.
3.	Cost of human resettlement	**NIL** There is no loss involved on account of human resettlement.
4.	Loss of public facilities and administrative infrastructure (Roads, buildings, schools, dispensaries, electric lines, railway etc) on forest land, or which would require forest land if these facilities were diverted due to the project	**NIL** No administrative infrastructures such as roads, buildings, schools, dispensaries, electric line, railway, etc shall be affected due to the proposed project. There will be no loss involved on this account.
5.	Environmental losses : (Soil erosion, effect on hydrological cycle, wildlife habitat, microclimate	**NIL** Impact assessment has been done in all aspects and

	upsetting of ecological balance).	incorporated in draft EIA report
6.	Suffering of oustees	**NIL** No land oustees
7.	Capital Investment	Rs. 11,554.29 Crores
	TOTAL	**Rs. 11,554.29 Crores (A)**

EVALUATION OF BENEFITS OF PRESENT VALUES		
S.N.	**Parameters**	**Value**
1.	Total Profit realization expected (in first 10 years of operation)	Rs. 590 Crores X 10 years **= Rs. 5,900 Crores**
2.	Benefits of economy (govt. revenue/cess etc.) in first 10 years of operation. @12% of the annual turnover.	Rs. 708 Crores X 10 years **= Rs. 7,080 Crores**
3.	Employment potential	<u>During construction (5 yrs.):</u> No. of employment – 1,000 (Approx. 18,25,000 man days in 5 years) <u>During operation (5 yrs.):</u> No. of Direct employment - 350 (Approx. 6,38,750 man days in 5 years) Therefore, in first 10 years [5 years (construction) + 5 years (operation)] = approx. 24,63,750 man days will be created. Considering average value @ Rs. 600 per man day, 24,63,750 man days X Rs. 600 = Rs. 148 Crores (approx.) shall be considered as direct employment potential of the project proposal. Another Rs. 100 Crores (approx.) should be considered towards indirect employment.

		Thus, in terms of project benefit Rs. 148 crores (direct) plus Rs. 100 crores (indirect) = **Rs. 248 crores** shall be considered in employment generation head.
4.	Estimated Cost towards EMP	Approx. Rs. 1280.20 crores (capital cost) Rs. 92.05 Crores per annum (recurring) So, recurring cost in 5 years (cumulative) Rs. 460.25 crores. Total benefits (capital investment + recurring) – **Rs. 1740.45 Crores.**
5.	Captive Power generation utilising waste heat from flue gases	N.A.
6.	Green Belt Development	Cost already considered in EMP
7.	Corporate Environment Responsibility (CER) - it will be determined on the basis of issues raised in public hearing to be arranged. However, 1% of the project cost is estimated at this Draft EIA stage.	**Rs. 110 crores** (assumed)
	TOTAL	**Rs. 15,078.45 Crores, Say Rs. 15,078 Crores (B)**

Therefore, **Net Present Value (NPV)** equals to **B** minus (-) **A**
= Rs. 15,078 Crores – Rs. 11,554.29 Crores
= **Rs. 3,523.71 Crores**

Therefore, **Benefit Cost ratio (B : A)** = Rs. 15,078 Crores / Rs. 11,554.29 Crores = **1.3**

Cost Effectiveness Analysis:

Cost Effectiveness Analysis (CEA) is an alternative form of CBA. It assesses the net cost of a project or service relative to the outcomes (benefits) generated. CEA is used where the need for a project has already been established, but uncertainty remains over the best method for achieving it.

1. It does not require all costs and benefits to be put into monetary terms.

2. It acknowledges that a measure may not represent all of the benefit that is accrued.
3. It may be analysing intermediate goods (outcomes may not be clear).

As such it does not constrain the researcher into having to apply monetary values to certain variables. For example, the development of a new hospital would likely result in a number of saved lives in an area, but whereas standard forms of CBA would require a monetary value be placed on the value of a life saved, CEA does not require this.

CEA considers alternatives in reference to the ratio between the costs associated with each alternative and a single quantified, but not monetary, effectiveness measure. This represents a complication of CEA as costs are represented by monetary values, while effectiveness may be measured in terms of saved lives, time savings or other similar quantifiable measures.

For this reason, in CEA a ratio is calculated. Two forms of ratio can be expressed:

1. Cost-Effectiveness Ratio: dividing costs of an alternative by the measure of effectiveness.

2. Effectiveness-Cost Ratio: dividing effectiveness measured by costs of alternative.

In case of the project proposal of **M/s Damodar Valley Coroporation**, apart from the project cost, the other costs are negligible, as because:

- ✓ There will be no loss of value of timber, fuelwood and minor forest produce on an annual basis, including loss of manhours per annum of people who derived livelihood & wages from the harvest of these commodities

- ✓ There will be no loss of animal husbandry productivity, including loss of fodder.

- ✓ Cost of human resettlement is zero.

- ✓ No Loss of public facilities and administrative infrastructure (Roads, buildings, schools, dispensaries, electric lines, railway etc) on forest land, or which would require forest land if these facilities were diverted due to the project

- ✓ No Environmental losses due to soil erosion, effect on hydrological cycle, wildlife habitat, microclimate upsetting of ecological balance.

- ✓ There will be no suffering of oustees.

On the other hand, the project proposal would be effective in number of ways by generating a considerable number of direct/indirect employment opportunities, govt. revenues. On account of CSR of the company, peripheral development will also take place.

Therefore, it can be concluded that the cost-effectiveness ratio in terms of the proposed expansion will certainly be favourable.

CHAPTER-10.0 ENVIRONMENTAL MANAGEMENT PLAN

10.0 INTRODUCTION

Environmental Management Plan is the key to ensure a safe and clean environment. Various pollutants' generation, their control & disposal for the proposed units have been discussed in **Chapter-2.0**. In this chapter, various management measures taken by **M/s Damodar Valley Corporation** to check, monitor and manage the performance of various pollution control equipment and improvement of environment is discussed.

10.1 AIM OF EMP

Aim of Environmental Management Plan (EMP) is to ensure identified adverse impacts are mitigated and positive impacts are enhanced by adopting most effective and economical methods. EMP is developed based on EIA studies to provide input for design of project in accordance with applicable standards & guidelines of State & Central Government agencies.

EMP requires multidisciplinary approach with mitigation, management, monitoring and institutional measures. EMP can be upgraded from time to time by taking advice from experts in respective fields. To ensure sustainable development, it needs to be an all encompassing plan for which plant authorities, government, regulating agencies and population of study area need to extend their cooperation & contribution. EMP includes:

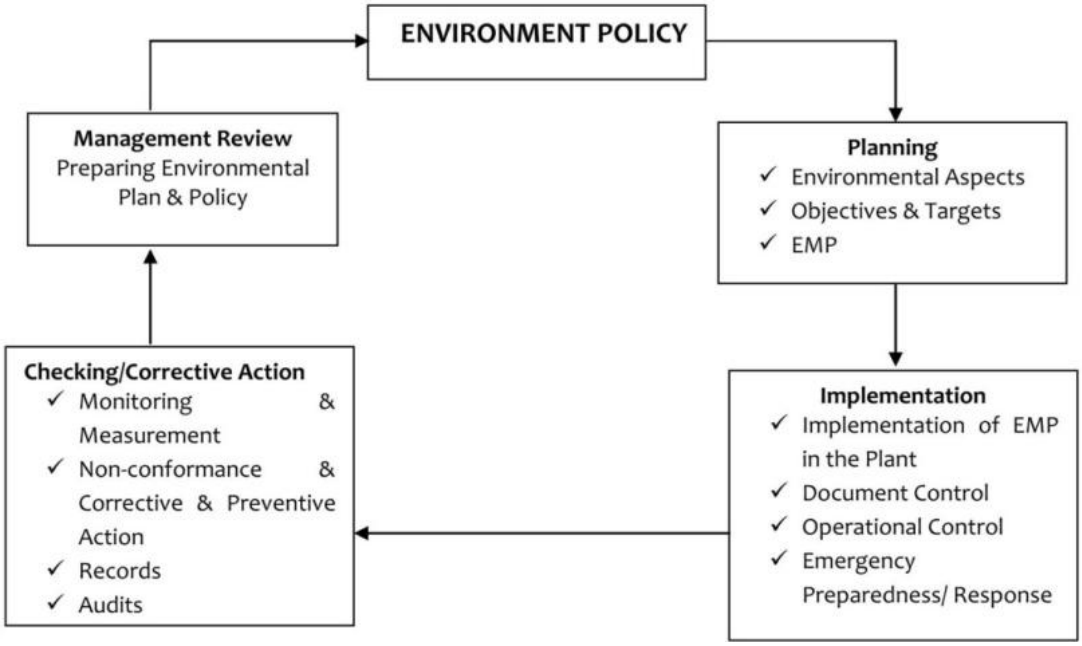
- Institutional set-up for implementation of protective and preventive measures
- Resources required and estimated costs (capital expenses & operational expenses)
- Schedule for implementation along with responsibilities

10.2 ADMINISTRATIVE MANAGEMENT AND POLICIES

The company has certain employees dedicated towards environment to implement the environmental management plan effectively and also has

certain policies depicting the various goals towards sustainable environment.

The working concept of environment management of the Company is given below:



10.2.1 ENVIRONMENTAL MANAGEMENT GROUP

The company has an environmental management group (EMG) dedicated towards protection of environment. The existing environmental management cell will be strengthened by adding qualified and experienced Engineers and Scientists. The Head of the EMG reports directly to the Plant Head.

The environmental management group performs the following functions:

Functions of Environmental Management Group

a) Responsible for operation related to collection, treatment and disposal facilities for air emissions, waste water and solid wastes.
b) Routine monitoring of relevant parameters to determine pollution levels.
c) Ecological monitoring and green belt maintenance.
d) Implementation of environmental management plan.
e) Data handling, reporting, liaison with statutory bodies and future planning regarding environment management.

10.3 CORPORATE ENVIRONMENT POLICY

The Company has set goals and objectives laid by its board of Directors. Corporate Environment Policy (CEP) prescribes for standard operating process / procedures to bring into focus any infringement / deviation / violation of the environmental or forest norms / conditions. It also constitutes the hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance with the environmental clearance conditions. The company has system of reporting of non-compliances / violations of environmental norms of the Board of Directors of the company and / or shareholders or stakeholders at large. All the above statements are mentioned in CEP and company has its working based on its concern towards Environment.

For point wise Compliance to "Standard TOR condition 53" of ToR **F. No. J-13011/22/2007-IA.II(T) dated 10th May, 2023** issued by MoEF&CC, New Delhi, details of Corporate Environment Policy of Damodar Valley Corporation has been given below.

CORPORATE ENVIRONMENT POLICY

1. Does the company have a well laid Environment Policy by its Board Of Directors ? if so , it may be detailed in the EIA report.

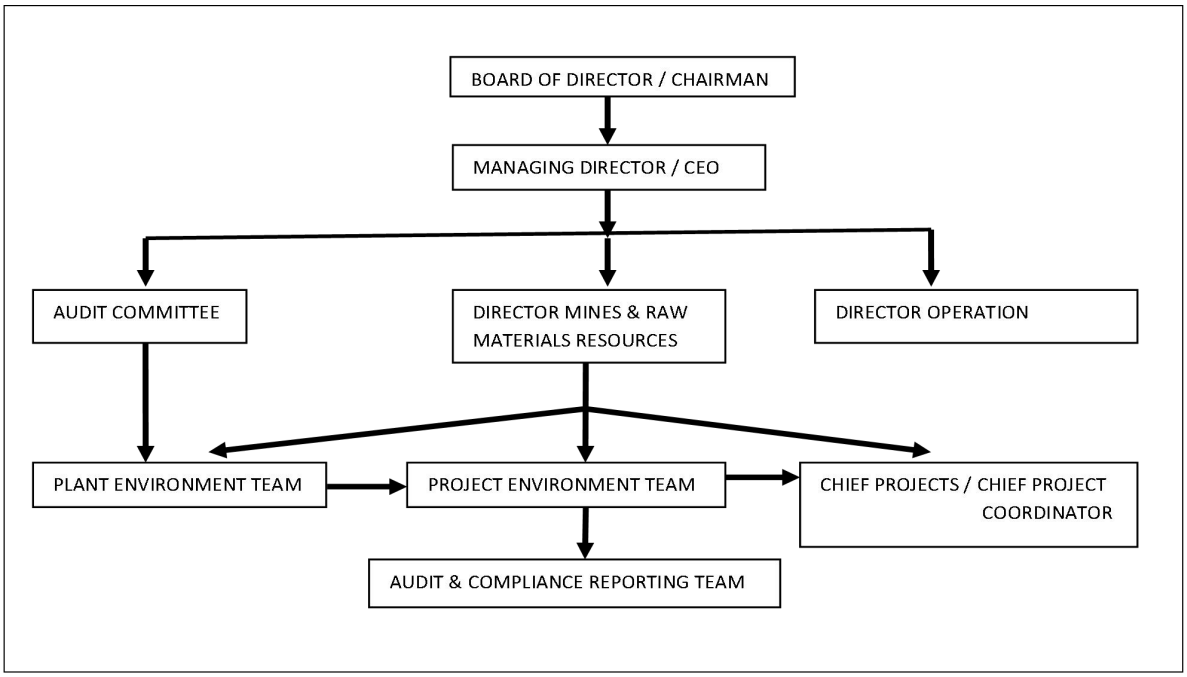
Yes. The company has a well laid down environment policy approved by the Boards of Directors and the same is enclosed as appendix – 1

2. Does the Environment Policy prescribe for standard operating process / procedures to bring in to focus any infringement /deviation / violation of the environmental or forest norms / conditions ? if so, it may be detailed in the EIA.

Yes. Environment Policy clearly mentions that in case of emergency (non compliance /deviation / violation / major accident) immediate reporting to be done to directors / chairman of the company and the same is enclosed as appendix -1

3. What is the hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance with the environment clearance conditions ?. Details of this system may be given.

The Board of Directors has constituted a Cell called as Corporate Environment Cell (CEC). The CEC and Head of Environment Department of plant is committed to conduct the company operations in an environmentally sound manner . The hierarchical system or Administrative Order of the company to deal with environmental issues and for ensuring compliance with the environmental clearance conditions is passed in the Board meeting and the same is enclosed as Appendix . The details hierarchical system is :-



4. Does the company have system of reporting of non compliances / violations of environmental norms to the Board of Directors of the company and / or shareholders or stakeholders at large ? .This reporting mechanism shall be detailed in the EIA Report.

Yes. To have proper checks and balances, the company has a well laid down system of reporting on non-compliances / violations of environmental norms to the Board of Directors of the Company . The corporate Environment Cell (CEC) will formally review environment performance of the company and report environmental performance to the board of directors /chairman of the company directly once every quarter . in case of emergency (no-compliance / deviation / violation / major accident) immediate reporting to be done to the Directors / Chairman of the Company .

Also the Head of Environment Department will Ensure implementation of Policy on environment at plant level and review , report environment performance of the plant to the board of directors /chairman of the company through CEC Cell once every quarter . In case of emergency (non-compliance/deviation/violation /major accident) Head of Environment Department will do immediate reporting to the Directors / Chairman of the Company.

Corporate Environment Policy

Addendum - 10.1

Environment Policy approved by the Board of Directors

APPENDIX-1

DAMODAR VALLEY CORPORATION

CORPORATE ENVIROMENT POLICY

Damodar Valley Corporation (DVC) was formed in 1948 with the central government and the governments of Bihar (later Jharkhand) and West Bengal participating in it. The main aims of the corporation were flood control, irrigation, generation and transmission of electricity, and year-round navigation.

DVC adopts environmentally sustainable power generation measures in its thermal power plants and follows the directives & stipulations of Ministry of Environment & Forests (MoEF), Central Pollution Control Board (CPCB), State Pollution Control Board (SPCB) etc. In old units of DVC at Bokaro, Chandrapura & Durgapur which were commissioned before pollution control standards has become stringent in norms. DVC has taken steps to combat the pollution nuisance in new commissioned units of KTPS, Koderma; DSTPS, Andal; MTPS, Mejia; CTPS, Chandrapura besides the old units of DVC. The major steps, taken by DVC in its thermal plants, are as follows:

- Installation of high efficient ESPs in new units/ retrofitting of additional fields of ESPs in old units to bring down the emission within permissible limit.
- Utilization of ash water from Ash Ponds through Ash Water Recovery System & recycling of effluent to conserve land & water.
- Evacuation of ash from Ash Ponds followed by transportation in a fully mechanised steel covered container dumper, introduced first time in India as per Order of Hon'ble Supreme Court of India & finally dumped into the abandoned open cast coal mines of CIL. After filling up the abandoned mines, the top surface is covered with earth to facilitate growth of plantation.

THE VISION

The vision of the Damodar Valley Corporation (DVC) is to "be a leading power utility and a catalyst of growth and development in the Damodar Valley region through sustainable and innovative practices."

ENVIRONMENT POLICY

DVC strongly believes that excellence in the environmental fields is of prime importance. DVC strives to work with environmental issues in a consistent & systematic manner. DVC's environmental management programme consists of the following prime activities:

- Monitoring & compliance of environmental parameters of the thermal power stations i.r.o stack emission, effluent & ambient air quality etc.
- Management of solid waste generated from thermal units i.e. utilization of fly ash in ash based industries (cement, bricks, blocks etc.) & reclamation of abandoned open cast mines & low lying area.
- Creation & maintenance of greenbelt, afforestation, landscaping & beautification work in & around thermal power stations.
- Combating soil erosion & soil decay in order to restore & preserve the quality of the land.
- Creating awareness & encouraging manufacturers, local entrepreneurs & others for value added utilization of fly ash in making cement, bricks & other ash based products.
- Ensure safety of its products and operations for the environment by using standards of environmental safety , which are scientifically sustainable and commonly acceptable .
- Develop , introduce and maintain environmental management systems across the company to meet the company standards as well as statutory requirements for environment. Verify compliance with these standards through regular auditing .

- Conduct all our operations in an environmentally responsible manner that is better than statutory environment compliances and applicable standards.

- Involve all employees in the implementation of this policy and provide appropriate training .

- Work in partnership with external bodies and Government agencies to promote environmental care, increase understanding of environmental issues and disseminate good practices.

CORPORATE RESPONSIBLITIES

The Directors / Chairman of the Company is responsible for the compliance of the Policy . The Directors / Chairman shall constitute a Cell celled as Corporate Environment Cell (CEC) . The CEC is committed to conduct the company operations in an environmentally sound manner . The CEC will :-

- Set standards and establish environmental improvement objectives and targets for DVC as a whole and for individual units, and ensure these are included in the annual operating plans.

- Formally review environment performance of the company and report environmental performance to the Board of Directors / Chairman of the company directly once every quarter.

- In case of emergency (non compliance / deviations / violation / major accident) immediate reporting to be done to the Directors / Chairman Of the company .

- Review environment performance on monthly basis and recognize exemplary performance.

The overall responsibility for environment management at plant level rest with Head of Environment Department. The Head of Environmental Department will :

- Ensure implementation of policy on environment at plant level and review, report environment performance of the plant to the Board of Directors / Chairman of the company through CEC cell once every quarter.

- In case of emergency (non compliance / deviation / violation /major accident) Head of environment department will do immediate reporting to THE Directors / Chairman of the company.

The Corporate Environmental Cell in coordination with Head of Environmental Department will :-

- Ensure implementation of policy on environmental and compliance with the company's environmental standards and the standards stipulated as per law.

- Prevention of incidents or accidents that might result from abnormal operating conditions .

- Reduction of adverse effects that results from normal operating conditions.

- Establish appropriate management system for environment management and ensure regular auditing to verify compliance.

- Establish system for appropriate training in implementation of environment management system at work .

- Ensure periodic 3rd party environment audits through certification bodies to check efficacy of the Environment Management system.

- Participate ,wherever possible with appropriate industry and Government bodies advising on environmental legislation and interact with national and local authorities with protection of environment

INDIVIDUAL UNITS RESPONSIBLITIES

The overall responsibility for environment management at each unit will be rest with the units head which will ensure implementation of policy on Environment at unit level and report to head of Environment Department on CEC Cell as the case may be on monthly basis . Concerned line managers / heads of departments are responsible for environmental performance at department levels

In order to full fill the requirement of the policy at each site , the Unit head will :-

- Designate a unit environment coordinator who will nbe responsible for co-ordinating environmental activities at unit ,collecting environmental data and providing expert advice and reporting environmental performance to the unit head on day to day or weekly basis as the case may be

- Agree with the coordinator responsible for the unit specific environmental improvement objectives and targets for the unit and ensure that these are incorporated in the annual objectives of the concerned manageress and officers and are reviewed periodically

- Ensure that the unit complies with DVC environments standard and the relevant national and state regulations with respect to environment.

- Ensure that all new operations are subjected to a systematic and formal analysis to assess environmental impact . Findings of such exercises should be implemented prior to commencement of the activity .

- Regularly review environment performance of the unit against set of objective and targets and strive for continual improvement .

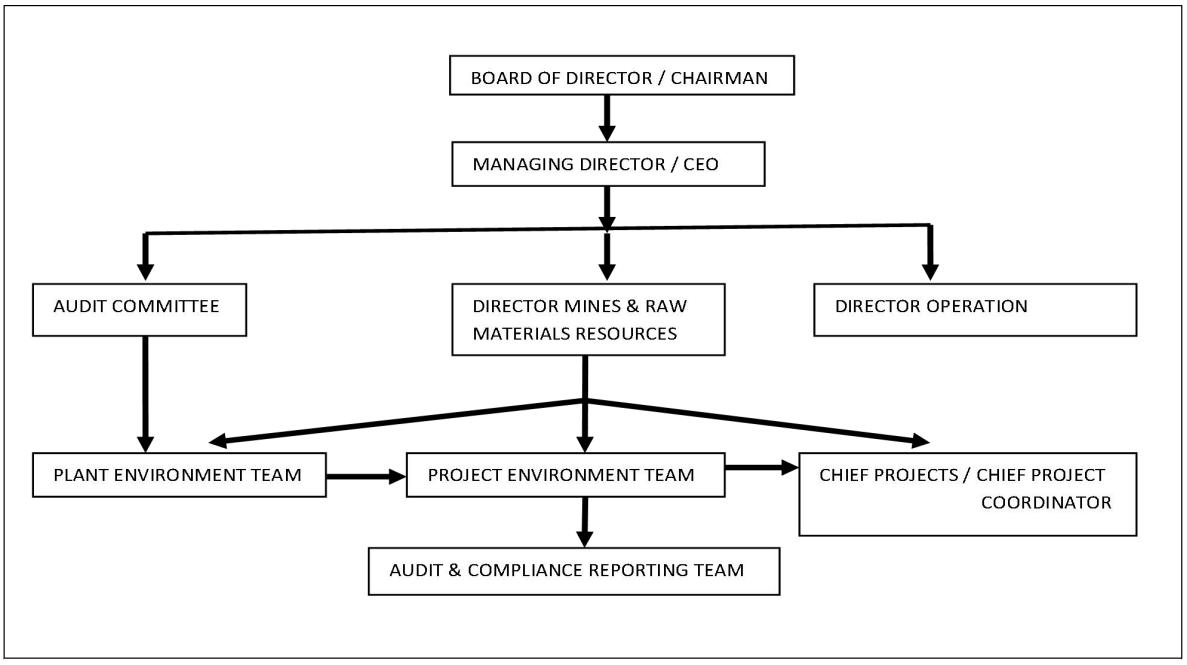
The unit Head, through the Designate unit environment coordinator will :-

- Ensure periodic audits to verify compliance with environment management systems.

- Ensure dissemination of relevant information on environment within the unit and to outside bodies and regularly interact with Government authorities concerned for protection of environment.

- Maintain appropriate emergency procedures consistent with available technologies to prevent / control environmental incidents.
- Also ensure periodic 3rd party environment audits through certification bodies to check efficacy of the environmental management systems.
- Sustain a high degree of environmental awareness through regular promotional campaigns and employee participation through training safety committees emergency drills etc.
- Provide appropriate training to all employees .
- Report environmental performance to corporate environment cell on monthly basis.

The hierarchy of our Corporate Environment management cell that is being strictly followed is :-



10.4 MITIGATORY MEASURES DURING CONSTRUCTION

About 1000 persons will be involved during the construction phase of the proposed expansion project. The impacts of the proposed construction phase on the environment would be basically transient in nature and are expected to wear out gradually on completion of the construction programme. However, once the construction of the units is completed and the operational phase starts, the impacts of the operational stage would overlap the impacts due to construction activities.

The impacts on different aspects of environment due to the construction programmes have been elucidated in Chapter-4.0. In order to mitigate such impacts and restrict them within tolerable levels, the Authorities would adopt the following measures:

TABLE-10.1
PROPOSED MITIGATION MEASURES TO BE IMPLEMENTED DURING CONSTRUCTION PHASE

Proposed Mitigation Measures	Target to Achieve	Risks/consquences of failure, if any
Air Pollution Control		
Water sprinkling in vulnerable areas	Control of fugitive dust from construction areas	Increase in PM emissions
Proper maintenance of vehicles & construction equipment	Control of NOx Emissions	Increase in gaseous pollutant
Transportation of construction material in covered trucks, wherever possible	Control of fugitive dust during transportation.	Increase in PM emissions
Noise Pollution Control		
Proper maintenance of vehicles, equipment and machinery	Control of ambient and in plant noise levels	Increase in noise levels
Provision of acoustic covers/ enclosures on equipment and machinery, wherever possible	Control of ambient and in plant noise levels	Increase in noise levels
Provision of earmuffs/ earplugs to the workers in high noise areas and enforcement of its use	Protection of workers	Health effects on individual workers.
Water Pollution Control		

Channelization and Construction of temporary sedimentation tanks for effluents from construction area through network of drains. Construction of temporary sedimentation tanks for the effluents from construction area.	Control of suspended solids in effluents from construction area.	Increase in total suspended solids in effluents.
Solid Waste Management		
Disposal of surplus earth and construction debris	Control of pollution	Air/ Water Pollution
Reclaiming of un-built area with appropriate vegetation/ land scaping	Create a good visual environment. Aesthetics improvement.	Unpleasant surroundings
Socio-Economic Environment		
Provision of environmentally safe camping area for the migrant laborers	To provide clean & healthy living environment to work force	Unhealthy living conditions, spread of diseases

10.5 MITIGATORY MEASURES DURING OPERATION

As part of EIA study, quantification of positive and negative impacts due to operational activities on environmental attributes was carried out. Based on magnitude and significance of the impact protective/ preventive and mitigative measures were proposed to minimise adverse impacts within the applicable standards and enhance positive impacts to increase
benefits from the project. Any new impacts identified or in effective measures notices shall to reported and suitable action taken as part of EMP.

The impacts of operation phase will be long term in nature. Table-9.2 describes various mitigation measures, proposed to be implemented during operation phase.

TABLE-10.2
PROPOSED MITIGATION MEASURES TO BE IMPLEMENTED DURING OPERATION PHASE

Proposed Mitigation Measures	Target to Achieve	Risks/consquences of failure, if any
Air Pollution Control		
High efficiency ESPs	To reduce the emission levels of particulate matter	Increase in PM emissions
Stack (as per norms)	Wider dispersion of emitted	Increase in ground level

	air Pollutions	concentration of pollutants
Coal Dust Extraction/ Suppression Systems	Control of fugitive dust during in CHP	Increase of fugitive emissions
Sprinklers in ash pond dry areas	Control of Fugitive emission	Increase of fugitive emissions
Reclamation of ash pond after abandonment	Control of Fugitive emission in ash pond area	Increase of fugitive emissions
Noise Pollution Control		
Design of equipment	To control noise levels to 90 dB(A) at 1 m distance	Increase in in-plant and ambient noise levels
Provision of acoustic enclosures/ barriers/ shields to reduce noise	Attenuation of noise in source receptor pathway	Increase in in-plant and ambient noise levels
Provision of personal protective equipment like ear plugs and ear muffs	Protection of sensitive receptor	Health impact on workers in high noise areas
Water Pollution Control		
Cooling Towers	Cooling of hot water coming out of condenser and auxiliary cooling systems for recycle	Increase in temp. of water coming out of cooling systems
Main Plant Effluent Treatment Plant including Central Monitoring Basin	Removal of suspended solids, oil and grease and neutralization of pH, to conform to regulatory standards shall be utilized for plantation.	Increase in concentration / value of physico chemical & Biological Parameters
Ash Water Treatment and Recycle	Removal of suspended solids for recycle of effluents into ash water system	Increase in quantity of ash pond overflow
Sewage Treatment Plant	Removal of suspended solids, oil and grease and organic matter to conform to regulatory standards shall be utilized for plantation.	Increase in concentration of pollutants specifically Biological parameters.
Solid Waste Management		
Dry collection of fly ash and supply of ash to entrepreneurs	Facilitate supply of dry ash to entrepreneurs	Reduction in quantity of ash utilized.
Ash utilization	Reduce land requirement for ash disposal and pollution from ash disposal site.	Increased land requirement
Disposal of Unused Ash	Environmentally safe disposal of unused ash	Degradation of land environment
Domestic Solid Waste	Environmentally safe disposal of municipal waste	Air and water pollution, spread of disease vectors
Others		
Afforestation and Green Belt Development	Ecological improvement Attenuation of air pollutants (SPM, SO2 and NOx) and noise in source receptor pathway	Reduction in aesthetics and living space. Higher pollutants in the ambient air.
Control of Fire and Explosion Hazards	Safety	Increased risk of fire and explosion

Implementation Schedule of Mitigation Measures

The mitigation measures suggested as above shall be implemented so as to reduce the impact on environment due to the operations of the proposed project. In order to facilitate easy implementation of mitigation measures, the priority of implementation is given in Table-9.3.

TABLE-10.3
IMPLEMENTATION SCHEDULE

S.No.	Recommendation	Time Requirement	Schedule
1	Air pollution control measures	Before commissioning of respective units	Immediate
2	Water Pollution Control Measures	Before commissioning of the plant	Immediate
3	Noise control measures	Alongwith commissioning of the plant	Immediate
4	Ecological preservation and upgradation	Stage wise implementation	Immediate & Progressive

10.6 GREEN BELT DEVELOPMENT PLAN

Implementation of afforestation program is of paramount importance for any industrial development. In addition to augmenting present vegetation, it will also check soil erosion, make the ecosystem more complex and functionally more stable, make the climate more conductive and restore water balance. It can also be employed to bring areas with special problems under vegetal cover and prevent further land deterioration.

The main objective of the greenbelt is to provide a barrier between the plant and the surrounding areas. The greenbelt helps to capture the fugitive assimilation of toxic gases and to attenuate the noise generated in the plant apart from improving the aesthetics of the plant site. Plantation program is undertaken in all available areas. This includes plantation in the plant premises, along the internal and external roads, along the administrative buildings and the stacking yards.

The plant species selected for greenbelt is including the native species. These saplings are planted in 2-3 rows with 10m to 15m width with a tree density of about 2500 trees/ha for the already developed greenbelt area .

M/s Damodar Valley Corporation has earmarked earmarked for green belt development 222.97 Hectares (551 Actes.) i.e. 33% of 840.5 hactares / 2077 acres for its thremal power plant located at Raghunathpur.

Out of which 80.93 hectares (200 acres) of greenbelt has already been developed all around the plant boundary area within the plant premises where around 141951 number trees (@1754 number trees per hectare) have been planted. As per guidelines of MoEFCC, green belt density shall be 2,500 trees per hectare. Therefore, to make-up the existing short fall (2500 - 1754 = 746), DVC will carry out additional plantation on existing 80.93 hectares green belt area @ 746 number of trees per hectare.

Therefore, proposed green belt will be as follows:

1. 3,55,100 number trees on 142.04 Hectares (@2500 number of trees per hectare) plus
2. 60,374 number tress on 80.93 hectares (@746 number of trees per hectare)

Hence, 4,15,474 (3,55,100 + 60,374) number of trees will be planted in total for Stage - II project.

TOTAL LAND FOR GREEN BELT	GREEN BELT AREA		NUMBER OF TREES		TOTAL
	EXISTING	PROPOSED	EXISTING	PROPOSED	
222.97 Hectares (551 acres) of land (33% of 840.5 hactares / 2077 acres)	80.93 hectares (200 acres)	142.04 Hectares (351 acres)	1,41,951 Trees on 80.93 Ha. **[@1754 trees per hectare]**	3,55,100 (@2500 number of trees per hectare for 142.04 hectares)	**557,425** (1,41,951 + 60,374 + 3,55,100) number of trees on 222.97 Ha i.e. (@2500 number trees per hectare
				Plus Balance 60,374 trees on 80.93 Ha @746 number of trees per hectare.	

Rs. 3 lakhs has been estimated for every 2500 no. Of trees.

Therefore, budgetary estimate of Rs. 498 lakhs have been kept for the expansion proposal of RTPS.

Time Schedule and Approximate Capital Cost of the Proposed Green Belt

Year of establishment / formation	No. of trees to be planted	Expenditure on Formation/ Establishment @Rs. 3 lakh per 2500 trees
1st Year	1,15,474	Rs. 1,38,56,800
2nd Year	1,50,000	Rs. 1,80,00,000
3rd Year	1,50,000	Rs. 1,80,00,000
Total Initial Cost	**4,15,474**	**Rs. 4,98,56,800**

Sufficient green belt has already been developed within the existing plant premises. The tree species selected for green belt is presented in Table-10.4.

Table-10.4
Tree Species Recommended for Greenbelt Plantation

SR. NO.	TREE SPECIES	COMMON NAME
1.	*Pongamia pinnate*	Karanja
2.	*Mimusops elengi*	Bakul
3.	*Butea monosperma*	Palash
4.	*Cassea fistula*	Amaltas
5.	*Dalbergia sissoo*	Sissoo
6.	*Ficus Bengalensis*	Banyan
7.	*Ficus Religiosa*	Peepal
8.	*Acacia auriculiformis*	Sonajhuri
9.	*Terminalia Arjuna*	Arjun
10.	*Azadirachta Indica*	Neem
11.	*Mangifera Indica*	Mango
12.	*Albizzia Lebbeck*	Siris
13.	*Artocarpus Heterophyllium*	Jackfruit
14.	*Polyathia longifolia*	Ashoka
15.	*Alstinia scholaris*	Saptaparni
16.	*Peltophorum pterocarpum*	Radhachura

Criteria for Selection of Species:

- Large crown volume

- Rapid growth
- Capacity to endure water stress and climatic conditions
- Difference in height and growth habits
- Mixed plantation will be carried out keeping optimum spacing between saplings
- Native Species will be preferred for plantation in consultation with local Horticulturists and Forest Officials.

The trees may be watered using the treated effluent. They will be manured using sludge from the sewage treatment plant (STP). In addition, kitchen waste from the plant canteen can be used as manure either after composting or by directly putting the manure at the base of the plants. The data on area of green cover, survival rate etc. will be compiled for periodic review. However, following plan shall be made for green belt development:

- Annual plans for tree plantation with specific number of trees to be planted shall be made. The fulfillment of the plan shall be monitored by the Horticulture department every six months.
- A plan for post plantation care will be reviewed in the monthly meetings. Any abnormal death rate of planted trees shall be investigated.
- Watering of the plants, manuring, weeding, hoeing will be carried out for minimum 2 years.

TECHNIQUES FOR PLANTATION

Choice of Species and Quality planting materials :

Quality Planting Materials of Indigenous and natural species as mentioned above will be planted in 2-3 rows in the greenbelt. Planting materials will have following quality parameters:

- Seedlings will be raised from very good quality seeds from good and proven provenance. Seeds are to be under professional certification.
- Multiple seed germination in the poly pot will be undertaken to select the best germinant to grow as a seedling. The fittest and ablest germinant is retained to grow as a seedling in the poly pot.
- No root coiling will allowed for the seedlings by adopting continuous shifting and grading procedures in the nursery.
- Only the seedlings having height 900-1000 mm. or more shall be used. (Height is measured from collar to tip)
- Only the seedlings having collar diameter more than 20-25 mm shall be used.
- Age of the seedlings shall be 12 month or more.

- Non-succulent, Hardened, vigorous, healthy and morbidity free seedlings shall be used.
- Seedlings which must not have grown under the influence of Nitrogenous fertilizers shall be used.
- Average height of the seedlings of a given species shall be 90% of the Maximum height of that species.
- Native Species/seeds will be considered for plantation in consultation with local Horticulturists and Forest department.

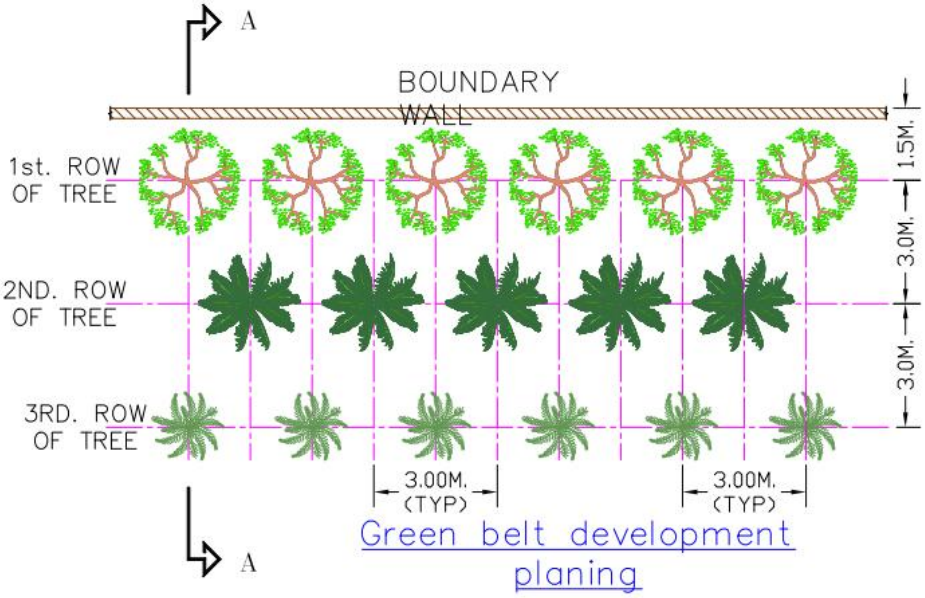
Planting techniques and methods (Technical standards):

- Dimension of the pits shall be 1000mm x 1000mm x 1000mm to promote immediate and appropriate roots establishment. This dimension of the pits is chosen to avoid heat shocks to the roots due to refractory nature of the soil and extreme climatic condition. Better pit dimension makes aeration better and it improve edaphic factors.
- Pit should be filled with dug out soil mixed with sand and manure with a ratio of soil: sand: manure = 2:1:1. This mixture is to be treated with appropriate fungicides and
- Insecticides as per the site condition to enhance the conducive edaphic factors in order to promote faster growth and better survival of the plants.
- Staggered trenched are to be provided within the rows for better moisture conservation.
- Major plantation will be done in the Monsoon season.

Post Planting Maintenance Operations:

- Regular watering as and when required. In summer season, watering twice daily (morning and evening) will be mandatory.
- Without prejudice to any other definition of summer; for the present work, summer is defined as the climatic condition in which maximum diurnal temperature exceeds 35 degree Celsius.
- Regular watch & ward through out the year.
- In a year, minimum 3-nos. of weeding, soil working backed by nutrient, fertilizer and pesticides application is to be carried out without fail.
- Every year, there should be 100% casualty replacement as per field requirements.
- Plant hygiene will be maintained round the year without fail.
- Morbid plants will be treated as casualty and will be replaced every year along with casualty replacement.
- Officer in charge of environmental management will evaluate every month all Planting and other Afforestation work.

- Appropriate textual and visual documentation will be maintained. Chronological log of the afforestation work is to be thoroughly maintained and preserved.
- Quarterly progress and status report is to be transmitted to Pollution Control board and F & E Department regularly.



10.7 HAZARODOUS WASTE MANAGEMENT

The hazardous waste generation from the plant will be used oil / spent oil. Used oils removed from machinery, gear boxes, compressors etc. and sludge will be collected in drums and temporarily stored in specifically earmarked areas. They will be disposed through the approved agencies.

10.8 FIRE AND SAFETY MANAGEMENT

Full-fledged fire fighting facilities will be provided in the plant to tackle any fire contingency. Regular safety audits will be carried out for improving safety performance. Onsite and offsite Disaster Management Plans shall be developed and mock drills will be conducted at regular intervals to keep the disaster management team in a state of full preparedness.

10.9 ENVIRONMENTAL AWARENESS CAMPAIGN

In addition to training of employees in various aspects of pollution control activities of the plant, programmes like celebration of World Environment Day, World Safety Day, screening of films on environment, tree plantation

etc. will be regularly carried out in order to create greater awareness towards environment protection amongst employees and the people in the neighbouring areas.

10.10 LEGAL AND STATUTORY COMPLIANCE

All the environmental standards/ stipulations will be fully maintained by DVC. The plant shall obtain authorization from the State Pollution Control Board for solid & hazardous wastes disposal. Specific information in prescribed forms will be submitted as per Water (Prevention & Control of Pollution) Act, Air (Prevention & Control of Pollution) Act, etc. It shall be ensured that all requirements under these Acts and Rules are met. The engineer-in-charge for the Environmental Cell will prepare these reports with the help of the production engineers.

10.11 DOCUMENTATION

All the monitoring data, environmental and health related shall be stored in systematic manner so that the specific records will be easily available as required.

10.12 OCCUPATIONAL HEALTH ACTIVITIES

10.12.1 Introduction

Occupational Health and Safety Management System exists in DVC. In this, Management of Health and Safety are taken into consideration. The purpose of the Occupational Health and Safety Management System is as follows:

- Minimize risk to employees and others
- Improve business performance
- Assist the organization to establish a responsible image for health and safety.

10.12.2 Approach

The basic approach of the occupational health and safety management system involves the following steps:

- Identify the hazards involved in the activities of the organization.
- Evaluate the risks which are involved in the performance of these activities.
- Control these risks to an acceptable level.

All contractor personnel and temporary staff will be compelled to use safety equipment. Even the visitors will be advised to use helmet and safety shoes during plant visit. The list of PPE is given in **Table 10.5**.

TABLE: 10.5
PERSONAL PROTECTIVE EQUIPMENTS

Protection for	Equipment	Protection Against
Head	Safety helmet	Fall of objects/hitting against objects during construction, maintenance, etc.
	Electrical resistance helmet	Electrical shock.
	Welder's leather cap	Splashing of liquid etc.
Eye	Panorama goggles with clear plastic vision	Oil and paint splashes, dust and chips.
	Spectacle-type goggles with blue lens	High temperature flame during furnace work.
Ear	Ear plugs or muffs	High noise level.
Nose	Dust, fume mask Oxygen musk & Air musk	Fine dust particles, fumes & gas
Face	Welding helmet and shield	Welding fumes, sparks and UV rays.
Body	Apron	Falling of hot chips, slag's, etc.
	Safety belt	Falling of persons from height.
	Hand gloves	Heat radiation.
	Electrical resistance gloves	Electric shock.
	Canvas gloves	Contact with oil, grease, etc.
Leg	Safety Shoe	Striking by objects, fall of objects and stepping on sharp or hot objects.

10.12.3 STANDARDS FOR THE OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM

As per ISO 45001:2018, the following specification is applicable to the organization as given below:

- The establishment of an Occupational Health and Safety Management System to eliminate risk to employees and other interested parties.
- Implement, Maintain and continually improve the occupational health and safety management system.
- Assign itself of its conformance with its stated occupational health and safety policy.

10.12.4 CORE ELEMENTS OF THE OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT

The basic core elements are:

- Occupational Health and Safety Policy
- Planning
- Implementation and operation
- Checking and corrective action
- Management review

10.12.5 OCCUPATIONAL HEALTH AND SAFETY POLICY

It sets an overall direction of the system. It lays down the principles involved as responsibilities, performance requirement, commitments, framework for setting objective and targets.

- In DVC, the hazards' places shall be identified and the nameplates will also be placed for the safety precaution to the relevant equipment.
- All the operational parts of the various departments will be identified and assessed.
- In the operational area, the broad categories of hazards could be mechanical, electrical, substance fire and explosions, which will be carefully monitored.

10.12.6 STRUCTURE AND RESPONSIBILITIES

In DVC, the following structure and responsibilities will form occupational health and safety management system.

- All HOD of respective departments will lay down the safety rules and safety status of their work places and they will have the authority to place the manpower accordingly.
- The communication between the worker and management will be clear about the position of hazards situation.
- The top management of the company provides resources such as human resources, technological resources and financial resources for the implementation and control of the situation.
- There is a quarterly evaluation of the improvement of the safety and occupational health of the employees.
- Safety officer monitors the compliance of safety rules.

10.12.7 TRAINING AWARENESS

In DVC, the workers, selected by their departmental head, training will be given. During training, the following topics will be discussed

- The occupational health and safety consequences of their activities.
- The emergency preparedness and response
- Importance of the occupational health and safety management system.
- Training to be taken into account the responsibility, ability and literacy of the person concerned and the nature and the extent of risk involved.

10.12.8 AUDIT OF OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT

In DVC, there will be a periodic internal audit, the main elements of which are given below:

- The planned arrangement and implemented system conforms to the specification.
- The Occupational Health and Safety Management system has been properly implemented and maintained.
- The audit status is provided to top management.
- There must be external auditor to evaluate the present status of monitoring.

10.12.9 MANAGEMENT REVIEW

In DVC there will be continuing suitability adequacy and effectiveness of the established Occupational Health and Safety Management System. The necessary information about the system will be collected and reviewed.

During First-Aid training programme, classes on occupational health & hygiene will be held for the officers & staff. All employees will be exposed to this training.

10.13 INFORMATION DISSEMINATION

Everybody now a days is concerned about environmental pollution. A Thermal Power Plant is therefore susceptible to people as a source of local pollution. It is, therefore, needed that people should be provided with environmental data related to the plant so that wrong apprehensions can be removed. This requires a well-planned public relation and information dissemination process so that unnecessary public intervention is avoided. In this connection, the Company will organize different programmes with participation from local bodies, encouraging local community in environmental projects (like tree plantation) etc.

10.14 ENVIRONMENTAL COST

Environmental Cost Component

The total project cost for the proposed expansion project has been estimated to be Rs. 11554.29 Crores. The capital cost of environmental mitigation measures is estimated to be Rs. 880 Crores. Rs. 88 Crores have been estimated as recurring per year for EMP.

CHAPTER-11.0
SUMMARY & CONCLUSION

11.1 INTRODUCTION

Damodar Valley Corporation (DVC) is a government-owned power generator which operates in the Damodar River area of West Bengal and Jharkhand states of India to handle the Damodar Valley Project. The statutory corporation operates both thermal power stations and hydel power stations under the ownership of Ministry of Power, Government of India. DVC is headquartered in the Kolkata city of West Bengal, India.

The existing Raghunathpur Thermal Power Station (RTPS) of DVC is located at village Raghunathpur, having total installed capacity of 1200 MW (2x600 MW) under Ph-1 and both units are under commercial operation since March 2016, based on Environmental Clearance, accorded by MoEF&CC on 18th October 2007.

However, considering the demand-supply position and projected growth of load demand in the valley area arising out mainly due to decommissioning of various units of DVC viz. Durgapur TPS, Bokaro 4"PS-B and Chandrapura TPS, the Board of DVC accorded approval for the revival of erstwhile Raghunathpur TPS Ph-II (2x660 MW) and in principle approval was accorded by Ministry of Power on 23.02.2022.

On the basis of approval from Ministry of Power, DVC proposes for Expansion of Raghunathpur Thermal Power Station by installing capacity 1320 (2x660) MW (Phase- II) in an area of 341.81 ha (844.63 acres) at village Raghunathpur, District Purulia (West Bengal).

M/s Envirotech East Pvt. Ltd. have conducted an Environmental Impact Assessment (EIA) for the proposed expansion project and formulated an appropriate Environmental Management Plan (EMP) for such project.

The proposed expansion project will be installed on the available land within the existing plant premises, comprising total 34.8 hectares (86 acres) of land.

The plant layout showing the proposed facilities with Greenbelt area has been shown as **Figure-11.1**.

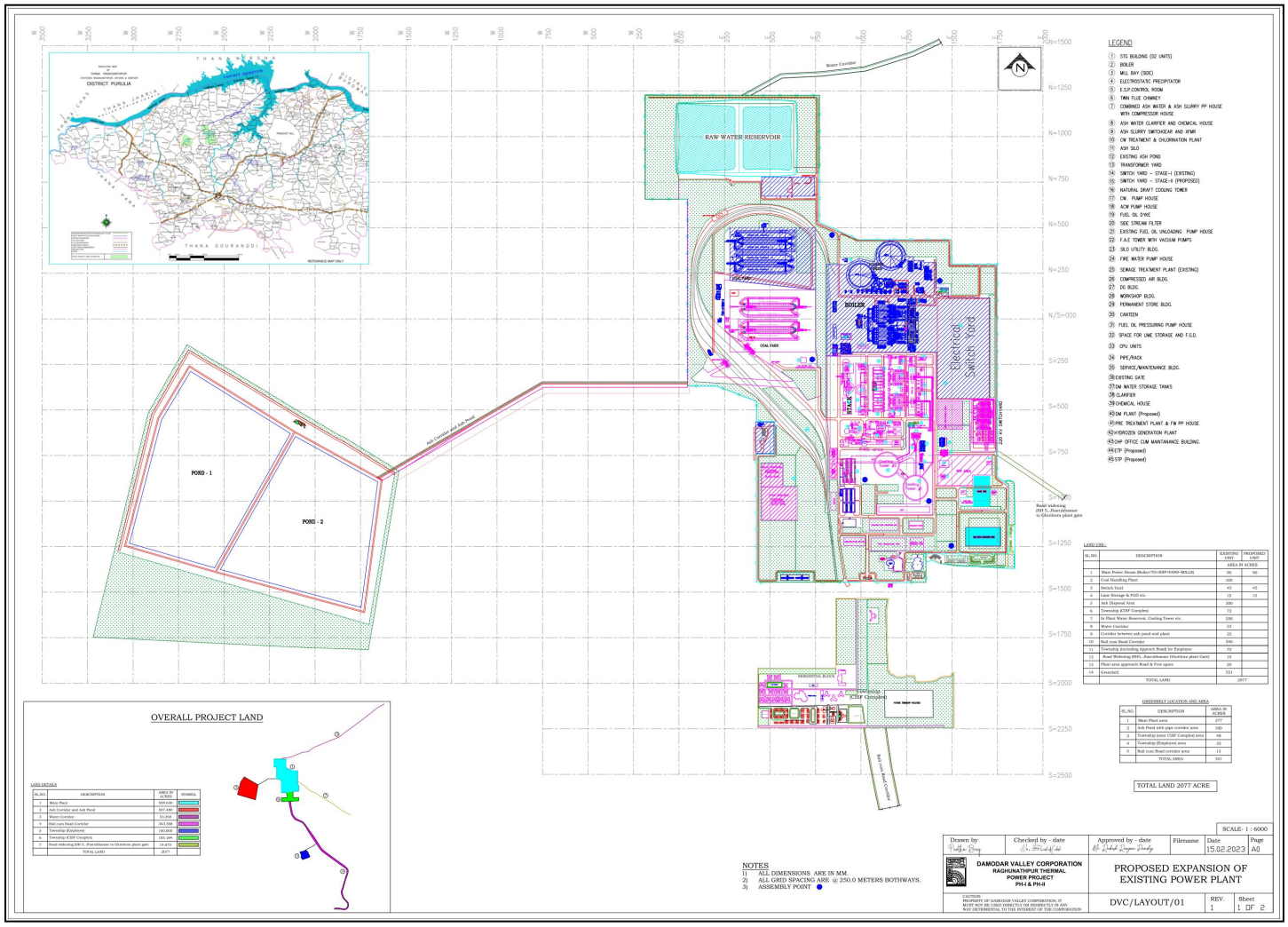


FIG. 11.1 - PLANT LAYOUT

Coal requirement for the project is estimated at 6.60 MTPA corresponding to 85% PLF considering GCV of 3200 Kcal/Kg.

M/s Central Coalfields Limited (CCL) on 03.01.2011 issued a Letter of Assurance (LOA) for 4.69 MTPA of E-Grade Coal for Ph-II. DVC vide its letter ref. no- ED(Fuel)/MOP/RTPS, Ph-II/2021-22/559 dated: 21.03.2022 to Ministry of Power has requested extension of validity of LOA for a further period of 4 years with effect from 31.03.2022 towards fuel security of RTPS Ph-II.

Further, SLC-LT, in its meeting held on 08.08.2022, has recommended the grant of coal linkage under Para B (i) of SHAKTI Policy to Raghunathpur TPS Ph-II from Coal India Limited.TABLE-11.2

Mode of transportation of raw materials and finished products:

The Company has its own captive railway siding connected to Kharagpur, which is being used for transportation of raw materials and finished goods. Most of the materials is being / to be transported by railways.

The project site is connected to the highway. NH-60 is passing adjacent to the Eastern side of the project boundary which provides easy and good transport connectivity.

While referring the above table, only 2% of the total raw materials shall be transported by road after the implementation of the proposed project.

11.2 SITE LOCATION

Raghunathpur Thermal Power Station (RTPS) is located in Raghunathpur Sub-Division of Purulia District of West Bengal. The Project is located at 38 Km from District Head Quarters Purulia and is well connected by Purulia-Barakar State Highway SH-5. Nearest National Highway NH-19, which was previously referred to Delhi–Kolkata Road is about 44 Km from the Site.

Nearest town is Raghunathpur located at a distance of 7 Km from the project. The nearest Railway Station Bero on Adra-Asansol Broad Gauge line of South-Eastern Railway is located at 20 Km.

The geographical co-ordinates of the project area is Latitude 23°36'6.90"N to 23°37'59.54"N and Longitude 86°38'51.12"E to 86°40'5.07"E with above mean sea level (AMSL) as 30 m. (98.43 ft).

The four points on the boundary of the project site are as follows:

1. Latitude - 23°37'28.76"N & Longitude - 86°40'0.87"E (TRC)
2. Latitude - 23°37'59.54 N & Longitude - 86°38'51.12" E (TLC)
3. Latitude - 23°36'6.90"N & Longitude - 86°39'13.82"E (BLC)
4. Latitude - 22°36'8.71"N & Longitude - 86°40'5.07"E (BRC)

(Where, T: Top, B: Bottom, L: Left, R: Right, C: Corner, M: Middle)

The four points on the boundary of the ash pond are as follows:

1. Latitude - 23°37'28.76"N & Longitude - 86°40'0.87"E (TRC)
2. Latitude - 23°37'12.74" N & Longitude - 86°37'22.83" E (TLC)
3. Latitude - 23°36'25.18"N & Longitude - 86°37'3.97"E (BLC)
4. Latitude - 23°36'11.23"N & Longitude - 86°37'56.92"E (BRC)

(Where, T: Top, B: Bottom, L: Left, R: Right, C: Corner, M: Middle)

The geographical co-ordinates of the ash pond is Latitude 23°36'11.23"N to 23°37'12.74"N and Longitude 86°37'3.97"E to 86°38'4.73"E.

The location of the proposed project site on Google Map are presented in Figure-11.3.

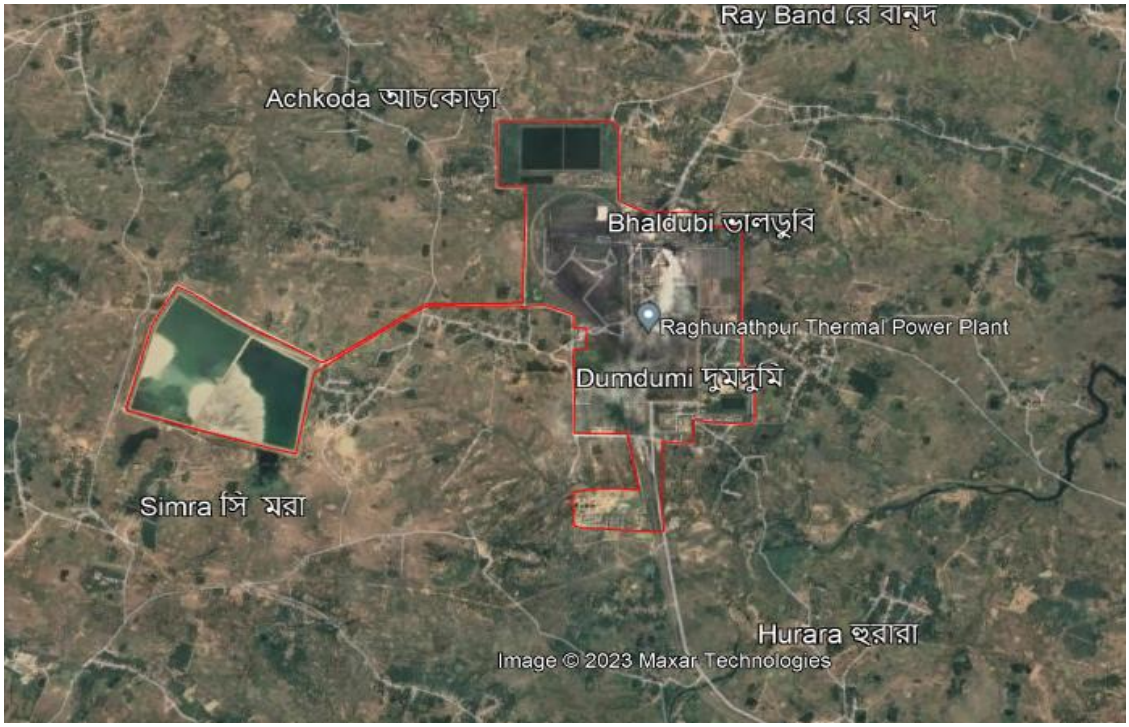


FIGURE-11.3: GOOGLE MAP PROJECT SITE & ITS SURROUNDING AREA

Project Site Location:
Village - Raghunathpur, District – Purula
Geographical co-ordinates: Latitude: 23°36'5.53"N to 23°37'59.06"N & Longitude: 86°38'51.38"E to 86°40'2.18"E (for project site)
Latitude 23°36'11.23"N to 23°37'12.74"N and Longitude 86°37'3.97"E to 86°38'4.73"E (for ash pond)

Above Mean Sea Level (AMSL): 511.8 ft (156 m)

11.3 PROJECT HIGHLIGHTS

The principal features or highlights of the proposed expansion of existing steel plant of **M/s Damodar Valley Corporation (DVC),** under study are as follows:

PROPOSED PROJECT HIGHLIGHTS	
Location	Village - Raghunathpur, P.S. - Raghunathpur, District - Purulia, West Bengal.
Toposheet No.	**73N/7 & 73N/8**
Site Co-ordinates	The geographical co-ordinates of the project area Latitude 23°36'6.90"N to 23°37'59.54"N and Longitude 86°38'51.12"E to 86°40'5.07"E
Ash pond co-ordinates	The geographical co-ordinates of the ash pond is Latitude 23°36'11.23"N to 23°37'12.74"N and Longitude 86°37'3.97"E to 86°38'4.73"E.
Plant site elevation above MSL	30 m. (98.43 ft).
Nearest Highway	The Project is well connected by Purulia-Barakar State Highway SH-5. Nearest National Highway NH-19, which was previously referred to Delhi–Kolkata Road is about 44 Km from the Site.
Nearest Railway Station	The nearest railway station to the site is Bero on Adra-Asansol Broad Gauge line of South-Eastern Railway is located at 20 Km
Nearest Airport	Kazi Nazrul Islam Airport, Andal, Durgapur – 60 km in E direction from the project site.
Nearest Sea port	Kolkata Port is located approx. 206 km distance to the project site in SE direction.
Nearest major water body	Damodar River is passing about 20 km distance in E direction w.r.t the project site.
Nearest village/town	Nearest town is Raghunathpur located at a distance of 7 Km from the project.
Land requirement	Land requirement for RTPS phase – 2 will be 150 acres, which is available within the existing project area of 840.53 Hectares (2077 acres), which is already acquired.
Ash pond area	Land of 507.480 acres (205.37 Ha.) for the existing Ash disposal system in RTPS (ph-1) comprising of Ash pond, ash pipeline corridor, green belt etc. will be utilised for RTPS (Ph-2) also.
Raw water requirement & source	Water to the tune of 207591 KLD will be needed for the overall project. (Existing: 112542 KLD * Proposed: 95049 KLD) Source: Panchet Dam

Power requirement	82.5 MW (Source : Captive)
Fuel requirement	6.60 MTPA Coal, sourced from Central Coalfield Limited (CCL). Coal linkage with CCL is available.
Effluent generation & disposal	The plant will be designed as a zero liquid discharge plant. The process water will be recirculated through cooling and treatment. The entire wastewater will be recycled for various purposes inside the plant. Domestic waste water will be treated in Sewage Treatment Plant (STP). Treated domestic waste water will be used for greenbelt purpose inside the plant premises.
Air pollution control	Dust Suppression and Extraction Systems, Electrostatic Precipitators (ESP), Flue Gas Desulphurisation System and NOx Control System at relevant points will be installed.
Ash Generation & Management	29,70,000 TPA ash will be generated from Boiler. <u>Management:</u> Efforts will be made with authorities of coal mines and other minerals mines for ash in filling of abandoned mines/stone query areas and also used in construction of National/State Highway located within 300 km of proposed power station. Construction of Varanasi Expressway: around 200 kms. Stretch falls under Purulia district where significant quantum of ash shall be utilized. Fly ash will also be utilized as a raw material for the cement grinding unit / brick manufacturing Shree cement & ACC Cement plants are located in nearby' areas where considerable quantity of fly ash shall be utilized.
Manpower	350 persons (both regular and contractual)
Project cost	Rs. 11,554.29 Crores

11.4 BASELINE ENVIRONMENTAL SCENARIO

The area falling within the radius of 10 km around the proposed expansion of existing Steel Plant at Village : Raghunathpur, Dist.-Purulia in the state of West Bengal has been considered as study area. This chapter presents the detailed discussion on the field data for soil, meteorology, water quality, air quality, noise, ecology and socio-economic, which were generated during the period **(1st December, 2022 – 28th February, 2023).**

11.4.1 Meteorology

The monthly maximum and minimum temperatures recorded on-site during the aforesaid Study period **(December, 2022 – February, 2023)** varied between (26.0 - 30.5)°C and (9.5 - 11.0)°C respectively with overall maximum and minimum temperatures being 30.5°C and 9.5°C respectively.

The monthly maximum and minimum relative humidity recorded on-site during the said Study period varied between (62 - 71)% and (44 - 56)% respectively, the overall maximum and minimum being 71.0% and 44.0% respectively.

The overall mean wind speed during the monitoring period was 2.7 Km/hr. The predominant wind direction is North, North-East.

11.4.2 Ambient Air Quality

Ambient air quality was monitored at ten (10) locations in and around the project site.

The overall mean values of PM_{10}, $PM_{2.5}$, SO_2, NO_2 and CO in the area (mean of all the 10 locations) were 65.9 $\mu g/m^3$, 30.1 $\mu g/m^3$, 9.3 $\mu g/m^3$, 22.7 $\mu g/m^3$ and 0.45 mg/m^3 respectively.

11.4.3 Water Quality

Water samples were collected and analyzed at ten (10) locations to assess the surface water quality in the study area. Water samples were collected from nine (9) locations to assess the baseline status of the ground water quality of the study area.

River Water

The pH values of the collected two water samples from the River Kelighai were found pH 6.83 - 7.33 Value of Dissolved Oxygen were observed (7.1-7.2) mg/lit. Total Dissolved Solids were found (236 - 245) mg/lit while value of total Hardness (as $CaCO_3$) & total Alkalinity (as $CaCO_3$) were found (127 - 135) mg/lit & (132 - 140) mg/lit respectively. Calcium (as Ca) & Magnesium (as Mg) were found (34 - 36) mg/lit and (11 - 11) mg/lit respectively. Oil and grease was below detection limit (<1.4 mg/lit) in these sample. Sulphate (as SO_4), Nitrate (as NO_3) and Chloride (as Cl) were observed (25 - 27) mg/lit, (5.5 - 5.8) mg/lit and (36 - 39) mg/lit respectively. Iron (as Fe) contents were found (0.16 - 0.18) mg/lit and BOD were found (2 - 2) mg/lit respectively.

Heavy metals like Copper (as Cu), Lead (as Pb), Cadmium (as Cd), Chromium (as Cr), Manganese (as Mn), Arsenic (as As) and Mercury (as Hg) in these two (2) river water samples were below their respective detection limits.

Pond Water

The pH values of the collected pond water samples were found in the range of (7.02 – 7.82). Dissolved Oxygen was observed in the ranges of (6.08 – 7.19) mg/lit. Total Dissolved Solids were found in the ranges of (290 – 394) mg/lit while total Hardness (as $CaCO_3$) & total Alkalinity (as $CaCO_3$) were found (131 - 172) mg/lit & (109 - 119) mg/lit respectively. Calcium (as Ca) & Magnesium (as Mg) were found varying in the ranges of (30 – 52) mg/lit and (8 – 17) mg/lit respectively. Oil and grease was below detection limit (<1.4 mg/lit) in these samples. Sulphate (as SO_4), Nitrate (as NO_3) and Chloride (as Cl) were observed varying in the ranges of (13 – 36) mg/lit, (3.8 – 6.6) mg/lit and (64 – 112) mg/lit respectively. Values of Iron (as Fe) were found in the ranges of (0.16 – 0.25) mg/lit .

Heavy metals like Copper (as Cu), Lead (as Pb), Cadmium (as Cd), Chromium (as Cr), Manganese (as Mn), Arsenic (as As) and Mercury (as Hg) of these pond water samples were below their respective detection limits.

Ground Water

The pH values of collected ground water samples were found in the range of (6.6 – 7.5). Total Dissolved Solids (TDS) was found in the range of (336 – 552) mg/lit, while Total Hardness (as $CaCO_3$) was found in the ranges of (158 – 222) mg/lit. Alkalinity (as $CaCO_3$) was found in the ranges of (135 – 251) mg/lit. Calcium (as Ca) and Magnesium (as Mg) were found varying in the ranges of (43 – 70) mg/lit and (8 – 16) mg/lit respectively. Sulphate (as SO_4), Nitrate (as NO_3) and Chloride (as Cl) were observed in the ranges of (10 – 38) mg/lit, (3.0 – 5.7) mg/lit and (778 – 145) mg/lit respectively. Iron (as Fe) content was found in the range of (0.23 – 0.43) mg/lit and Zinc (as Zn) content was found (0.08 – 0.11) mg/lit.

Other heavy metals like Copper (as Cu), Lead (as Pb), Cadmium (as Cd), Chromium (as Cr), Manganese (as Mn), Arsenic (as As) and Mercury (as Hg) were below their respective detection limits.

11.4.4 Noise

A total of 10 locations around the proposed project were selected for the measurement of ambient noise levels.

During the day time, the equivalent noise levels were found to vary in the range of (54.1 - 67.8) dB (A) while in the night time, the equivalent noise levels were observed to be varying in the range of (42.9 - 52.9) dB (A).

11.4.5 Ecology

The study area is found to have a good vegetation cover due to helpful climatic conditions and good soil quality in the area. There are naturally growing plants, vegetation and grasses. The overall floral composition in the whole study area is quite rich.

11.4.6 Demography and Socio-economy

The study area is rural-urban mixed in nature and moderately populated with the population density of approximately 573 persons per square kilometer. The Study area has an average family size of around 5.36persons per household which is considered to be a normal family size. As a whole, SC & ST population is 29.26% and 14.01% respectively w.r.t. the total population in the study area. The overall literacy rate in the study area is about 57.5% w.r.t. the total population i.e., the literacy level in the study area is quite satisfactory. Total worker is 37.0% of the total population. The principal language is Bengali and the principal staple food is rice. The primary sources of drinking water are tube wells, Hand pump water in rural areas and tube wells, Hand pump and Supply water.

11.5 ENVIRONMENTAL IMPACTS OF PROPOSED PROJECT

11.5.1 Impacts on Air Quality

The major source of continuous emission from the existing unit (RTPS, Ph-I) is 01 (one) twin flue stack. In the proposed (RTPS, Ph-II) project there will be another twin flue stack. Hence, there will be total 2 twin flue stacks after the proposed expansion project. Stack emissions would be constituted of mainly SO_2, NOx and Particulate matters (PM).

Stack emissions would be constituted of mainly SO_2, NOx and Particulate matters (PM).

As recommended by CPCB, GLCs at various receptor locations within 10 km radius have been computed for the three months' period (1st December, 2022 – 28th February, 2023), based on the hourly meteorological data of this period. The computation has been made applying Industrial Source Complex (ISC3) model, developed by United States Environmental Protection Agency (USEPA), which is most widely used and also recommended by CPCB (PROBES/70/1997-98).

The maximum incremental value of SO_2, NOx & PM during operation of the proposed (RTPS, PH-II) plant would be about 3.16 µg/m^3, 3.16 µg/m^3 and 0.95 µg/m^3 respectively, which will occur at a distance of 1.2 km in E direction. However, it may be observed that these values have been attained only on one day in the winter season.

The predicted maximum GLCs of SO_2, NOx & PM due to the operation of the proposed project is well within the prescribed limits. Therefore, there will be insignificant impact on the Air Quality of the area due to the operation of the project.

Mitigation measures

- Fume extraction system with appropriate Air pollution control System to control the emissions from the process and fugitive emissions at furnace has been installed. Particulate matter emission from de-dusting units will be maintained below 30 mg/Nm^3.
- Periodic checking of vehicles and construction machinery to ensure compliance to emission standards.
- Material carrying vehicles will be covered.
- All the raw material storage yards will be under covered roof/ shed.
- Dust extraction system, Mobile water sprinklers, water sprinkling systems will be installed to minimize fugitive dust emissions. Regular vigilant inspection at the site will suggest furthermore no of mobile water sprinkling system.

11.5.2 Impacts on Water Quality

Company will follow "the zero wastewater discharge concept" and the entire wastewater will be recycled to the plant for various uses. As no wastewater will be discharged into any outside water body, there will be no impact on the water quality of any surface water bodies of the area.

Mitigation measures

- Rain water harvesting will be practiced in plant area.
- The plant effluent water will be treated in ETP and reused in the process.
- Domestic wastewater generated from plant will be treated in proposed STP. Treated wastewater will be used for greenbelt purpose inside the plant premises.

11.5.3 Impacts on Soil

There will be solid waste generation, but will be managed in the proper manner. This will ensure that there will not be any impact on soil quality due to the disposal or deposition of solid waste.

Table 11.3 : Solid Wastes Generation & their Utilization for Overall Project

Total Ash generation	29,70,000 TPA
Fly Ash (80%)	23,76,000
Bottom Ash(20%)	5,94,000

11.5.4 Impacts on Land Use

The proposed development will be confined within the boundary of the plant area, earmarked for the industrial purpose, so there will not be any significant impact on the land use pattern of the area. However to mitigate the impact of the proposed plant there will be development of green belt nearby plant vicinity.

11.5.5 Impacts on Biological Environment

The surrounding area has substantial vegetation in the form of village orchards, roadside trees and agriculture. There will be sufficient plantation of trees at the plant site. All these measures, if implemented properly will ensure insignificant impact on the local vegetation from the proposed project and may improve the vegetation scenario of the area.

No wastewater will be discharged outside the plant premises. There is, therefore, no impact on the aquatic ecology of the water bodies.

11.5.6 Impacts on Socio-Economic Environment

The project will offer substantial employment potential during construction phase and operation phase. This results in a rise in economic status of the area in terms of wages. Hence, this plant created positive impacts on socio-economic conditions of the area, which will have beneficial impact.

M/s Damodar Valley Corporation fully understands and acknowledges that better education and health care facilities, road infrastructure and drinking water facilities are basic social amenities for better living standard of any human being. The above activities shall be initiated either by providing or by improving the facilities in the area, which will help in uplifting the living standards of local communities. Some activities have been selected based on public hearing conducted and need based assessment.

Occupational Health and Safety

Occupational health problem may arise from worker exposure to dust and gases. Prolonged exposure to noise may also pose as a critical occupational health concern.

- Respiratory diseases due to exposure to dust, SOx, NOx.
- Noise induced hearing loss
- Noise due to crushing operations
- Heat stress around Induction and blast furnace area
- Accident prone areas including Blast furnace, Induction furnace, slag disposal area and casting areas.
- Accident due to movement of internal vehicles and due to machineries.

Mitigation measures

- Provide dust collector equipment
- Maintain dust levels less prescribed standards
- Provide dust masks when levels are exceeded
- All the workers will be provided with PPEs as per requirement.
- Provision of worker camps with proper sanitation and medical facilities, as well as making the worker camps self- sufficient with resources like water supply, power supply, etc.
- Arrangement of periodic health check-ups for early detection and control of communicable diseases.

11.6 ENVIRONMENTAL MONITORING PROGRAMME:

Details of the environmental monitoring schedule / frequency, which will be undertaken for various environmental components, as per are given in Table 11.4.

Table 11.4
POST PROJECT MONITORING PROGRAMME

Discipline	Locations	Parameters	Frequency	Fund Provision (Annual Cost in Lakhs)
Meteorology (Met Station)	One	Temperature, Rainfall, Relative Humidity, Atmospheric Pressure, Wind Speed and Direction	Hourly	2 lakhs
Ambient Air Quality	3-4 relevant locations	PM_{10}, $PM_{2.5}$, SO_2 & NO_2	Quarterly	12 lakhs
Stack Emission	Each Unit	PM, SO_2 & NO_x	Monthly	3 lakh
Fugitive	3-4	PM	Quarterly	1 lakh

Emission	relevant locations			
Process Effluent	-	pH, Total Suspended Solid, Temperature, Oil & Grease, Copper, Iron & COD	Every 2 months	1 lakh
STP	-	pH, Total Suspended Solid, Temperature, Oil & Grease, Copper, Iron & COD	Yearly	1 lakh
Ground Water Quality	2-3 Locations	pH, Temperature, Conductivity, Turbidity, Alkalinity, Chlorine, Total Suspended Solid, Total Dissolved Solids, Total Hardness, Ca-hardness, Mg-hardness, Coliform, Fe, Cu, Cd, Cr^{6+}, Pb, As, Hg, Zn	Yearly	1 lakh
Drinking Water Quality	1 Location	pH, Temperature, Conductivity, Turbidity, Alkalinity, Chlorine, Total Suspended Solid, Total Dissolved Solids, Total Hardness, Ca-hardness, Mg-hardness, Coliform, Fe, Cu, Cd, Cr^{6+}, Pb, As, Hg, Zn	Yearly	1 lakh
Noise	Plant Area and Nearby villages	Day-and Night-Time Noise Levels	Half-yearly	1 lakh
Illumination	3-4 relevant locations		Yearly	1 lakh
TOTAL				**24 lakhs**

11.7 ENVIRONMENTAL MANAGEMENT PLAN

M/s Damodar Vally Corporation, will develop various management activities for the Environmental Management Programme which will meet all statutory requirements and help to improve environmental quality.

In order to improve the aesthetic look of the area and enhance the land use as well as to compensate for any loss in ecology during construction, adequate plantation programmes around the project site have been planned and will be adopted. Development of green belt will include plantation of trees along boundary of the factory, roads, raw material yard and other available spaces.

M/s Damodar Valley Corporation has earmarked earmarked for green belt development 222.97 Hectares (551 Actes.) i.e. 33% of 840.5 hactares / 2077 acres for its thremal power plant located at Raghunathpur.

Out of which 80.93 hectares (200 acres) of greenbelt has already been developed all around the plant boundary area within the plant premises where around 141951 number trees (@1754 number trees per hectare) have been planted. As per guidelines of MoEFCC, green belt density shall be 2,500 trees per hectare. Therefore, to make-up the existing short fall (2500 - 1754 = 746), DVC will carry out additional plantation on existing 80.93 hectares green belt area @ 746 number of trees per hectare.

11.8 OVERALL CONCLUSION OF THE PROJECT

All the impacts likely to have an effect on the environment have been identified and efficient / adequate mitigation measures have been proposed for Sustainable Environment.

Considering the probability of likely impacts, the proponent has planned adequate mitigation measures and Environmental Management Plan. Further, the proponent has been undertaking various activities which have beneficial impacts on the socioeconomic environment. Measures like 100% rainwater harvesting, energy conservation and greenbelt development are also commendable for mention. Looking to the overall project scenario, employment potential and allied development plans will be a great impetus to the development of the society and the economy.

The best environment savvy technology including all safety aspects shall be adopted in the proposed project. All the above safe guards and the respective mitigation measures shall ensure sustainable environment.

CHAPTER-12.0 DISCLOSURE OF CONSULTANT ENGAGED

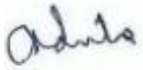
Brief Profile of M/S. Envirotech East Pvt. Ltd.

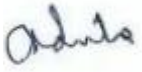
M/s. Envirotech East Pvt. Ltd., Kolkata has acquired the status of one of the Prime organizations of the country in undertaking various assignments in the areas like Environmental Impact Assessment, Environment Management Plan, Risk Analysis, Detailed Project Report, Environmental Audit / Statement, Geo-Technical Statement etc., since it was formed in 1988 by Prof. G. D. Agarwal, former Dean, IIT Kanpur and Member Secretary, Central Pollution Control Board.

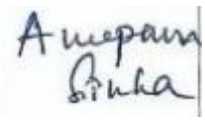
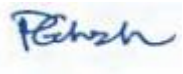
The company owes in its name a list of eminent & well-qualified experts to execute various assignments with the desired degree of perfection. The manpower, engaged for EIA study for Environmental Impact Assessment for Proposed Expansion cum Modification of the existing Steel Plant of **M/s Damodar Valley Corporation** at Village : Raghunathpur, Dist.-Purulia, West Bengal. However, considering the demand-supply position and projected growth of load demand in the valley area arising out mainly due to decommissioning of various units of DVC viz. Durgapur TPS, Bokaro TPS-B and Chandrapura TPS, the Board of DVC accorded approval for the revival of erstwhile Raghunathpur TPS Ph-II (2x660 MW) and in principle approval was accorded by Ministry of Power on 25.02.2022.

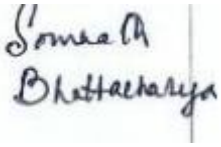
The company has a well-equipped laboratory, which is recognized by West Bengal Pollution Control Board and Ministry of Environment, Forest & Climate Change, Govt. of India.

TABLE-12.1
MANPOWER ENGAGED FOR EIA STUDY FOR PROPOSED EXPANSION OF RAGHUNATHPUR THERMAL POWER STATION BY INSTALLING UNIT OF 1320 (2X660) MW THERMAL POWER PLANT (PHASE - II) AT VILLAGE RAGHUNATHPUR, DISTRICT PURULIA (WEST BENGAL)

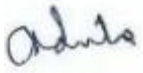
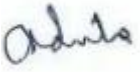
Discipline	Name of Expert	Key Qualifications indicating area of specialization relevant to the respective discipline	Involvement (Period & Task)	Signature
EIA Coordinator : Mr. A. K. Sinha		P.G. Diploma in Environmental Science and Technology	February, 2023 to till date Assessment & identification of the overall project, co-ordination with respective functional area experts, finalisation of action plans for the overall preparation of EIA/EMP report	
Functional Area Experts involved:				
Air Pollution	Mr. T. Kundu	Bachelor of Technology (Chemical Engineering)	February, 2023 to till date Finalization of monitoring locations for Ambient Air Quality Monitoring, evaluation of Ambient Air Quality results, suggestions & finalization of air pollution control measures, with client and contribution to overall EIA/EMP report preparation.	

Meteorology	Mr. A K. Sinha	P.G. Diploma in Environmental Science and Technology	February, 2023 to till date Identification of air emission sources and their inventorisation, prediction of cumulative impacts on ambient air quality due to all identified point & mobile sources, suggestions & finalization of mitigation measures with project proponent and contribution to overall EIA/EMP report preparation.	
Water Pollution Control	Mr. Asoke Kumar Banerjee	M.Sc. (Chem.)	February, 2023 to till date Finalization of sampling locations for surface water and ground water quality monitoring, evaluation of water quality results, analysis of water balance, identification of sources for wastewater generation and give suggestions on suitable water pollution control, exploring the ways for conservation of water, identification & assessment of impacts, finalization of mitigation measures with project proponent and contribution to overall EIA/EMP report preparation.	
Geology	Dr.	Ph.D in	February, 2023	

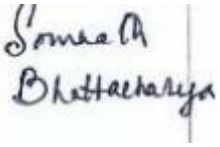
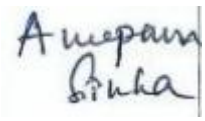
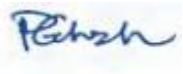
Hydrology	Somenath Bhattacharya	Geology	to till date Assessment of existing Geology and hydrology of the area, Understanding and representing groundwater conditions, finalization of groundwater sampling locations, finalization of survey findings, identification of probable impact due to proposed industrial activity, suggestion of mitigation measures and contribution to overall EIA/EMP report preparation.	
Ecology & Bio-diversity	Dr. (Mrs.) Anupam Sinha	Ph.D in Botany	February, 2023 to till date Assessment of the existing Ecology & Bio-diversity with proper emphasis on eco-sensitive locations, assessment of possible impacts to the biological and ecological environment of the area due to the proposed industrial activity and EIA/EMP report preparation.	
	Ms. Puja Ghosh (TM)	M.Sc in Environmental Science		
Noise & Vibration	Mr. R.K. Dasgupta	Bachelor of Engineering (Mechanical)	February, 2023 to till date Finalization of noise sampling location and analysis of data, identification of impacts, suggestions & finalization of suitable mitigation measures with client and contribution to overall	

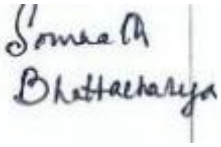
			EIA/EMP report preparation.	
Land Use	Dr. Somenath Bhattacharya	Ph.D in Geology	February, 2023 to till date Site visit, supervising development of land use maps of study area using GIS tools, finalization of landuse maps, based on ground truth verification, identification of any probable changes due to the proposed industrial activity and contribution to EIA/EMP report preparation.	
Solid & Hazardous Waste	Mr. Asoke Kumar Banerjee	M.Sc. (Chem.)	February, 2023 to till date Identification of potential solid & hazardous waste generating sources and their inventorisation, finalization of waste management strategies, identification of impacts, finalization of mitigation measures with project proponent and contribution to overall EIA/EMP report preparation.	
Soil Conservation	Mr. Asoke Kumar Banerjee	M.Sc. (Chem.)	February, 2023 to till date Finalization of soil sampling locations, identification of potential sources of impacts due to project, finalization of suitable mitigation measures with project proponent and contribution to overall EIA/EMP report	

			preparation.	
Risk & Hazard	Mr. T. Kundu	Bachelor of Technology (Chemical Engineering)	February, 2023 to till date Identification of major hazards, assessment of risks associated with the proposed project, quantification of the identified risks with the help of the standard software. preparation of on-site and off-site emergency plan and contribution to overall EIA/EMP report preparation.	
Socio-economics	Prof. Pabitra Sengupta	M.Sc. (Economics)	February, 2023 to till date Field survey, assessment of the existing socio-economic scenario of the area, assessment of possible changes to socio-economics of the area due to the proposed project and contribution to overall EIA/EMP report preparation.	

Discipline	Name of Expert	Key Qualifications indicating area of specialization relevant to the respective discipline	Involvement (Period & Task)	Signature
EIA Coordinator : Mr. A. K. Sinha		P.G. Diploma in Environmental Science and Technology	February, 2023 to till date Assessment & identification of the overall project, co-ordination with respective functional area experts, finalisation of action plans for the overall preparation of EIA/EMP report	
Functional Area Experts involved:				
Air Pollution	Mr. T. Kundu	Bachelor of Technology (Chemical Engineering)	February, 2023 to till date Finalization of monitoring locations for Ambient Air Quality Monitoring, evaluation of Ambient Air Quality results, suggestions & finalization of air pollution control measures, with client and contribution to overall EIA/EMP report preparation.	
Meteorology	Mr. A K. Sinha	P.G. Diploma in Environmental Science and Technology	February, 2023 to till date Identification of air emission sources and their inventorisation, prediction of cumulative impacts on ambient air quality due to all	

			identified point & mobile sources, suggestions & finalization of mitigation measures with project proponent and contribution to overall EIA/EMP report preparation.	
Water Pollution Control	Mr. Asoke Kumar Banerjee	M.Sc. (Chem.)	February, 2023 to till date Finalization of sampling locations for surface water and ground water quality monitoring, evaluation of water quality results, analysis of water balance, identification of sources for wastewater generation and give suggestions on suitable water pollution control, exploring the ways for conservation of water, identification & assessment of impacts, finalization of mitigation measures with project proponent and contribution to overall EIA/EMP report preparation.	
Geology	Dr.	Ph.D in	February, 2023	

Hydrology	Somenath Bhattacharya	Geology	to till date Assessment of existing Geology and hydrology of the area, Understanding and representing groundwater conditions, finalization of groundwater sampling locations, finalization of survey findings, identification of probable impact due to proposed industrial activity, suggestion of mitigation measures and contribution to overall EIA/EMP report preparation.	
Ecology & Bio-diversity	Dr. (Mrs.) Anupam Sinha	Ph.D in Botany	February, 2023 to till date Assessment of the existing Ecology & Bio-diversity with proper emphasis on eco-sensitive locations, assessment of possible impacts to the biological and ecological environment of the area due to the proposed industrial activity and EIA/EMP report preparation.	
	Ms. Puja Ghosh (TM)	M.Sc in Environmental Science		
Noise & Vibration	Mr. R.K. Dasgupta	Bachelor of Engineering (Mechanical)	February, 2023 to till date Finalization of noise sampling location and analysis of data, identification of impacts, suggestions & finalization of suitable mitigation measures with client and contribution to overall	

			EIA/EMP report preparation.	
Land Use	Dr. Somenath Bhattacharya	Ph.D in Geology	February, 2023 to till date Site visit, supervising development of land use maps of study area using GIS tools, finalization of landuse maps, based on ground truth verification, identification of any probable changes due to the proposed industrial activity and contribution to EIA/EMP report preparation.	
Solid & Hazardous Waste	Mr. Asoke Kumar Banerjee	M.Sc. (Chem.)	February, 2023 to till date Identification of potential solid & hazardous waste generating sources and their inventorisation, finalization of waste management strategies, identification of impacts, finalization of mitigation measures with project proponent and contribution to overall EIA/EMP report preparation.	
Soil Conservation	Mr. Asoke Kumar Banerjee	M.Sc. (Chem.)	February, 2023 to till date Finalization of soil sampling locations, identification of potential sources of impacts due to project, finalization of suitable mitigation measures with project proponent and contribution to overall EIA/EMP report	

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Socio-economics	Prof. Pabitra Sengupta	M.Sc. (Economics)	February, 2023 to till date Field survey, assessment of the existing socio-economic scenario of the area, assessment of possible changes to socio-economics of the area due to the proposed project and contribution to overall EIA/EMP report preparation.	

Water Pollution Control	Mr. Asoke Kumar Banerjee	M.Sc. (Chem.)	October, 2021 to till date Finalization of sampling locations for surface water and ground water quality monitoring, evaluation of water quality results, analysis of water balance, identification of sources for wastewater generation and give suggestions on suitable water pollution control, exploring the ways for conservation of water, identification & assessment of impacts, finalization of mitigation measures with project proponent and contribution to overall EIA/EMP report preparation.	A K Banerjee
Geology Hydrology	Dr. Somenath Bhattacharya	Ph.D in Geology	October, 2021 to till date Assessment of existing Geology and hydrology of the area, Understanding and representing groundwater conditions, finalization of groundwater sampling locations, finalization of survey findings, identification of probable impact due to proposed industrial activity, suggestion of mitigation measures and contribution to overall EIA/EMP report preparation.	Somenath Bhattacharya
Ecology & Bio-diversity	Dr. (Mrs.) Anupam Sinha	Ph.D in Botany	October, 2021 to till date Assessment of the existing Ecology & Bio-diversity with proper emphasis on eco-sensitive locations, assessment of possible impacts to the biological	Anupam Sinha
	Ms. Puja Ghosh (TM)	M.Sc in Environmental Science		

			and ecological environment of the area due to the proposed industrial activity and EIA/EMP report preparation.	
Noise & Vibration	Mr. R.K. Dasgupta	Bachelor of Engineering (Mechanical)	October, 2021 to till date Finalization of noise sampling location and analysis of data, identification of impacts, suggestions & finalization of suitable mitigation measures with client and contribution to overall EIA/EMP report preparation.	
Land Use	Dr. Somenath Bhattacharya	Ph.D in Geology	October, 2021 to till date Site visit, supervising development of land use maps of study area using GIS tools, finalization of landuse maps, based on ground truth verification, identification of any probable changes due to the proposed industrial activity and contribution to EIA/EMP report preparation.	
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QUALITY COUNCIL® OF INDIA
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National Accreditation Board for Education and Training

Certificate of Accreditation

Envirotech East Pvt. Ltd., Kolkata

Bengal Ambuja Coml. Complex, UN-F-13, 1050/1, Survey Park, Kolkata -700075

*The organization is accredited as **Category-A** under the QCI-NABET Scheme for Accreditation of EIA Consultant Organization, Version 3: for preparing EIA-EMP reports in the following Sectors –*

S.No	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1	Thermal power plants	4	1 (d)	A
2	Metallurgical industries (ferrous & non-ferrous)	8	3 (a)	A
3	Cement plants	9	3 (b)	A
4	Petroleum refining industry	10	4 (a)	A
5	Coke oven plants	11	4 (b)	A
6	Petrochemical based processing	20	5 (e)	A
7	Synthetic organic chemicals industry	21	5 (f)	A
8	Distilleries	22	5 (g)	A
9	Pulp & paper industry excluding manufacturing of paper from wastepaper and manufacture of paper from ready pulp without bleaching	24	5 (i)	A
10	Ports, harbours, break waters and dredging	33	7 (e)	A
11	Building and construction projects	38	8 (a)	B
13	Townships and Area Development projects	39	8 (b)	B

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in RAAC minutes dated Feb 24, 2023 and posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no QCI/NABET/ENV/ACO/23/2722 dated March 31, 2023. The accreditation needs to be renewed before the expiry date by Envirotech East Private Limited, Kolkata following due process of assessment.

Sr. Director, NABET
Dated: March 31, 2023

Certificate No.
NABET/EIA/2225/RA 0279

Valid up to
Sept 12, 2025

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to the QCI-NABET website.

रजिस्ट्री सं० डी० एल०-33004/99 REGD. NO. D. L.-33004/99

भारत का राजपत्र
The Gazette of India

असाधारण
EXTRAORDINARY
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PART II—Section 3—Sub-section (ii)
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PUBLISHED BY AUTHORITY

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पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय

अधिसूचना

नई दिल्ली, 15 नवम्बर, 2018

का.आ. 5768(अ).—केन्द्रीय सरकार, पर्यावरण (संरक्षण) नियम, 1986 के नियम 10 के साथ पठित, पर्यावरण (संरक्षण) अधिनियम, 1986 (1986 का 29) की धारा 12 की उपधारा (1) के खंड (ख) और धारा 13 द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए भारत सरकार के तत्कालीन पर्यावरण और वन मंत्रालय की अधिसूचना सं. का.आ. 1174 (अ), तारीख 18 जुलाई, 2007 में निम्नलिखित और संशोधन करती है, अर्थात् :-

2. उक्त अधिसूचना से संलग्न सारणी में,

(i) क्रम संख्यांक 29, 31, 38, 54 और 73 तथा उससे संबंधित प्रविष्टयों के स्थान पर, निम्नलिखित क्रम संख्यांक और प्रविष्टियां रखी जाएंगी, अर्थात् :-

(1)	(2)	(3)	(4)
"29	मैसर्स महाबल ईनवायरो इंजीनीयरस प्राइवेट लिमिटेड, प्लाट नं. 13,17, 18, ग्रामपंचायत बोखारा, नागपुर शहर से 8 कि.मी. की दूरी पर, पटेल पैट्रोल पंप के सामने छिंदवाड़ा रोड, पोस्ट कोराडी, जिला नागपुर-441111, महाराष्ट्र	(i) श्री हरीश प्रभाकर मेंधी (ii) श्री किशोर चंद्रभान जी येओल (iii) श्री सचिन सुभाष गोरे	15 नवंबर, 2018 से 14 नवंबर, 2023
31	मैसर्स ईनवायरो ईस्ट प्राइवेट लिमिटेड, बंगाल अंबूजा कमर्शल कम्पलेक्स, यू एन-एफ-13, 1050/1, सर्वे पार्क, कोलकाता-700075	(i) श्री असोक कुमार बंदोपाध्याय (ii) श्री तापस कुंडु (iii) डा.शिबम मित्रा	15 नवंबर, 2018 से 14 नवंबर, 2023
38	मैसर्स ईनवायरोकेयर लैबस प्राइवेट लिमिटेड, ईनवायरो हाउस, ए-7, एम आई डी सी, वागले	(i) डा.प्रीती एन अमृतकर (ii) कुमारी स्नेहा औंकार मेथर	15 नवंबर, 2018 से 14 नवंबर, 2023

	इडस्ट्रीयल ईस्टेट, मेन रोड, थाने -400604, महाराष्ट्र	(iii) कुमारी मनीषा खराडे	
54	मैसर्स इको प्रो ईंजीनीयर्स प्राइवेट लिमिटेड, 32/41, जी टी रोड से पश्चिम की ओर, यू पीएस आई डी सी इंडस्ट्रीयल एरिया, गाजियाबाद-201009, उत्तर प्रदेश	(i) श्री अमित सक्सेना (ii) सुश्री दिव्या सक्सेना (iii) सुश्री पूर्णिमा चौहान	15 नवंबर, 2018 से 14 नवंबर, 2023
73	मैसर्स के के बी माइक्रो टेस्टींग लैबस प्राइवेट लिमिटेड, तरूण प्लाजा, 3-5-244, दूसरा तल, एन एफ सी मेन रोड, कृष्णा नगर कालोनी, मौला अली, हैदराबाद-500040	(i) श्री चौ रामाकृष्णा (ii) श्रीमती पी. राजेश्वरी (iii) श्रीमती अमृता नलिनी	15 नवंबर, 2018 से 14 नवंबर, 2023"

(ii) क्रम सं. 168 उससे संबंधित प्रविष्टयों के पश्चात्, निम्नलिखित क्रम सं. और प्रविष्टियां रखी जाएंगी, अर्थात् :-

"169	मैसर्स ईकोसिस्टम रिसोर्स मैनेजमैंट प्राइवेट लिमिटेड, ए-अशोका पैविलियन, कपाड़िया हैल्थ क्लब के सामने न्यू सिविल रोड, सूरत-295001, गुजरात	(i) श्री सुनील कुमार पांडे (ii) श्री पटेल नीरव कुमार भागवत प्रसाद (iii) श्री पटेल शिरीश धीरुभाई	15 नवंबर, 2018 से 14 नवंबर, 2023
170	मैसर्स एस सी एसईनवायरो सविर्स प्राइवेट लिमिटेड. 7 केसरविहार, खाटू श्यामजी मंदिर के सामने रामन्नागरिया रोड, जगतपुरा, जयपुर-302017, राजस्थान	(i) डा. डी एस परीहार (ii) श्री जितेन्द्र दीक्षित (iii) श्री अभिषेक गौतम	15 नवंबर, 2018 से 14 नवंबर, 2023
171	मैसर्स एपेक्स इनवायरो लेबोरटरी, 3-डेबर कालोनी, आई टी आई के पास, प्रताप नगर, उदयपुर, राजस्थान	(i) डा. वाई एल मेहता (ii) श्री अमित सक्सेना (iii) श्री किशनलाल अग्रवाल	15 नवंबर, 2018 से 14 नवंबर, 2023
172	मैसर्स पोलीटेस्ट लेबोरटरीज, 22 सोनी इंडस्ट्रीयल ईस्टेट, पीरांनगुट, पुणे-412115, महाराष्ट्र	(i) श्रीमती स्मिता अजय कपाडने (ii) श्री सचिन हरि कापडे (iii) श्रीमती स्वाती महेन्द्र उमारानी	15 नवंबर, 2018 से 14 नवंबर, 2023
173	मैसर्स इंडस्ट्रीयल रिसर्च एंड डवेलपमैंट हाउस प्राइवेट लिमिटेड, सी-10,सेक्टर-6, नौएडा-201306, उत्तर प्रदेश	(i) डा. एस एन ए रिजवी (ii) सुश्री वंदना गुप्ता (iii) सुश्री कविता शर्मा	15 नवंबर, 2018 से 14 नवंबर, 2023
174	मैसर्स विनमैट टैकनोलोजीस प्राइवेट लिमिटेड, प्लाट नं. आ-65, साईट- यूपी एस आई डी सी, ग्रेटर नौएडा-201306, उत्तर प्रदेश	(i) श्री कुलदीप सिंह तेवतिया (ii) श्रीमती उपासना (iii) श्री सुनील कुमार बंसल	15 नवंबर, 2018 से 14 नवंबर, 2023
175	मैसर्स नेक्सस टेस्ट लैबस प्राइवेट लिमिटेड 29, दूसरा तल, तीसरा मेन सींगेहनापलाया, महादेवपुरा, बैंगलोर-560048	(i) श्रीविजया सिंहा रेड्डी पीआर (ii) श्रीमती के कृष्णावेनी (iii) श्रीमती एस मल्लेस्वरी	15 नवंबर, 2018 से 14 नवंबर, 2023
176	मैसर्स इको टैक लैबस प्राइवेट लिमिटेड, 48 ए, दूसरी मेन रोड, रामनगर, साउथ एक्सटेंशन, पालीकरनई, चेन्नई-600100	(i) श्री ए. दामोधरन (ii) सुश्री एस कोकिला (iii) डा. आर रेणुका	15 नवंबर, 2018 से 14 नवंबर, 2023
177	मैसर्स एलकेटी रिसर्च लेबोट्रीज इंडिया प्राइवेट लिमिटेड, प्लाट नं. 1652, एम आई ई, पार्ट-बी, बहादुरगढ़-124507, हरियाणा	(i) डा. राजेश कुमार शर्मा (ii) श्री संजय कुमार पांडे	15 नवंबर, 2018 से 14 नवंबर, 2023

178	मैसर्स रोबस्ट मैटीरियल टेकनोलोजी प्राइवेट लिमिटेड, सं. 94, दूसरा तल, थिरूमाला कमपलेक्स, एन जी ई एफ लेआउट, नागराभावी, बैंगलौर-560072	(i) डा. के. आर रवीकुमार (ii) डा. ममता एस एन (iii) श्री संदेशा के एस	15 नवंबर, 2018 से 14 नवंबर, 2023"

[फा. सं. क्यू 15018/21/2017-सीपीडब्ल्यू]

बृजेश सिक्का, सलाहकार

टिप्पण : मूल अधिसूचना भारत के राजपत्र, असाधारण, में अधिसूचना संख्यांक का. आ. 1174(अ), तारीख 18 जुलाई, 2007 द्वारा प्रकाशित की गई थी और अधिसूचना संख्यांक का.आ.1539(अ), तारीख 13 सितम्बर, 2007, का.आ. 1811(अ), तारीख 24 अक्तूबर, 2007, का.आ. 55(अ), तारीख 9 जनवरी, 2008, का.आ. 428(अ) तारीख 4 मार्च, 2008, का.आ. 865(अ), तारीख 11 अप्रैल, 2008. का.आ. 1894 (अ) तारीख 31 जुलाई, 2008, का.आ. 2728(अ) 25 नवम्बर, 2008, का.आ. 1356 (अ) तारीख 27 मई, 2009, का.आ.1802(अ) तारीख 22 जुलाई, 2009, का.आ.2399 (अ) तारीख 18 सितम्बर, 2009, का.आ.3122(अ) तारीख 7 दिसम्बर, 2009, का.आ. 3123(अ), 7 दिसम्बर, 2009, का.आ. 142(अ) तारीख 21 जनवरी, 2010, का.आ.619(अ) तारीख 19 मार्च, 2010, का.आ. 1662(अ) तारीख 13 जुलाई, 2010, का.आ. 2390(अ) तारीख 30 सितम्बर, 2010, का.आ. 2904(अ) तारीख 8 दिसम्बर, 2010, का.आ.181(अ) तारीख 28 जनवरी, 2011, का.आ. 692(अ) तारीख 5 अप्रैल, 2011, का.आ. 1537(अ) तारीख 6 जुलाई, 2011, का.आ.1754(अ) तारीख 28 जुलाई, 2011, का.आ. 2609(अ) तारीख 22 नवम्बर, 2011, का.आ. 264(अ) तारीख 13 फरवरी, 2012, का.आ. 1150(अ) तारीख 22 मई, 2012, का.आ. 1295(अ), 6 जून, 2012 का.आ.2039(अ) तारीख 5 सितम्बर, 2012, का.आ. 2850(अ) तारीख 7 दिसम्बर, 2012, का.आ.592(अ) तारीख 8 मार्च, 2013, का.आ. 945(अ) तारीख 8 अप्रैल, 2013, का.आ. 2287(अ) तारीख 27 जुलाई, 2013, का.आ. 3489(अ) तारीख 26 नवम्बर, 2013, का.आ.21(अ) तारीख 3 जनवरी, 2014, का.आ. 561(अ) तारीख 26 फरवरी, 2014, का.आ. 1190(अ) तारीख 2 जून, 2014, का.आ. 2003(अ) तारीख 9 अगस्त, 2014, का.आ.137 (अ) तारीख 12 जनवरी, 2015, का.आ. 1783(अ) तारीख 30 जून, 2015, का.आ. 2453(अ) तारीख 7 सितम्बर, 2015 का.आ. 1953(अ), तारीख 2 जून, 2016 और का.आ.388(अ) तारीख 10 फरवरी, 2017 और का.आ.सं. 857(अ) तारीख 26 फरवरी, 2018 द्वारा उनका अन्तिम संशोधन किया गया।

MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

NOTIFICATION

New Delhi, 15th November, 2018

S.O. 5768 (E).— In exercise of the powers conferred by clause (b) of sub-section (1) of section 12 and section 13 of the Environment (Protection) Act, 1986 (29 of 1986), read with rule 10 of the Environment (Protection) Rules, 1986, the Central Government hereby makes the following further amendments in the notification of the Government of India in the erstwhile Ministry of Environment and Forests, vide number S.O. 1174(E), dated the 18th July, 2007, namely: -

in the said notification, in the table, -

(i) for serial numbers 29, 31, 38, 54 and 73 the entries relating thereto, the following serial numbers and entries shall be substituted, namely: -

(1)	(2)	(3)	(4)
"29	M/s. Mahabal Enviro Engineers Pvt. Ltd. Plot No. 13,17,18, Grampanchayat Bokhara, 8 KM from Nagpur City, Opp. Patel Petrol Pump, Chhindwara Road, Post Koradi, Distt. Nagpur-441111, Maharashtra	(i) Mr. Harish Prabhakar Mendhi (ii) Mr. Kishor Chandrabhanji Yeole (iii) Mr. Sachin Subhash Gore	15th November, 2018 to 14th November, 2023
31	M/s. Envirotech East Pvt. Ltd. Bengal Ambuja Commercial Complex, UN-F-13, 1050/1, Survey Park, Kolkata-700075	(i) Mr. Asoke Kumar Bandyopadhyay (ii) Mr. Tapas Kundu (iii) Dr. Shibam Mitra	15th November, 2018 to 14th November, 2023
38	M/s. Envirocare Labs Pvt. Ltd. Enviro House, A-7, MIDC, Wagle Industrial Estate, Main Road, Thane-400604, Maharashtra	(i) Dr. Priti N. Amritkar (ii) Ms. Sneha Omkar Methar (iii) Ms. Manisha Kharade	15th November, 2018 to 14th November, 2023
54	M/s. Eko Pro Engineers Pvt. Ltd., 32/41, South Side of G.T. Road, UPSIDC Industrial Area, Ghaziabad-201009, Uttar Pradesh	(i) Mr. Amit Saxena (ii) Ms. Divya Saxena (iii) Ms. Purnima Chauhan	15th November, 2018 to 14th November, 2023
73	M/s. KKB Micro Testing Labs Pvt. Ltd. Tarun plaza, #3-5-244, 2nd Floor, NFC Main Road, Krishna Nagar Colony, Moula Ali, Hyderabad-500040	(i) Mr. Ch. Ramakrishna (ii) Mrs. P. Rajeswari (iii) Mrs. Amrutha Nalini	15th November, 2018 to 14th November, 2023

(ii) after serial number 168 and the entries relating thereto, the following serial numbers and entries shall be inserted, namely: -

(1)	(2)	(3)	(4)
"169	M/s. Ecosystem Resource Management Pvt. Ltd. A`-Ashoka Pavillion, Opp. Kapadia Health Club, New-Civil Road, Surat-395001, Gujarat	(i) Mr. Sunil Kumar Pandey (ii) Mr. Patel Niravkumar BhagvatPrasad (iii) Mr. Patel Shirish Dhirubhai	15th November, 2018 to 14th November, 2023
170	M/s. SCS Enviro Services Pvt. Ltd. 7 Kesar Vihar, Opposite Khatu Shyamji Temple, Ramnagariya Road, Jagatpura, Jaipur-302017, Rajasthan	(i) Dr. D.S Parihar (ii) Mr. Jitendra Dixit (iii) Mr. Abhishek Gautam	15th November, 2018 to 14th November, 2023
171	M/s. Apex Enviro Laboratory 3-Dhebar Colony, Near I.T.I Pratapnagar, Udaipur, Rajasthan	(i) Dr. Y.L. Mehta (ii) Mr. Amit Saxena (iii) Mr. Kishan Lal Agrawal	15th November, 2018 to 14th November, 2023
172	M/s. Polytest Laboratories 22 Sonaee Industrial Estates, Pirangut, Pune-412115, Maharashtra	(i) Mrs. Smita Ajay Kapadne (ii) Mr. Sachin Hari Kapade (iii) Mrs. Swati Mahendra Umarani	15th November, 2018 to 14th November, 2023
173	M/s. Ind Research & Development House Pvt. Ltd. C-10, Sector-6, Noida-201301, Uttar Pradesh	(i) Dr. SNA Rizvi (ii) Ms. Vandana Gupta (iii) Ms. Kavita Sharma	15th November, 2018 to 14th November, 2023
174	M/s. Winmet Technologies Private Ltd. Plot No. E-65, Site-IV, UPSIDC, Greater Noida-201306, Uttar Pradesh	(i) Mr. Kuldeep Singh Teotia (ii) Mrs. Upasna (iii) Mr. Sunil Kumar Bansal	15th November, 2018 to 14th November, 2023
175	M/s. Nexus Test Labs Pvt. Ltd. #29, Second Floor, 3rd Main,	(i) Mr. Vijaya Simha Reddy P.R (ii) Mrs. K. Krishnaveni	15th November, 2018 to

	Singaiahnaplaya, Mahadevapura, Bangalore-560048	(iii) Mrs. S. Malleswari	14th November, 2023
176	M/s. Eco Tech Labs Pvt. Ltd. 48A, 2nd Main Road, Ram Nagar , South Extension, Pallikaranai, Chennai-600100	(i) Mr. A. Dhamodharan (ii) Ms. S. Kokila (iii) Dr. R. Renuka	15th November, 2018 to 14th November, 2023
177	M/s. Alcatec Research Laboratories India Pvt. Ltd. Plot No. 1652, M.I.E , Part-B, Bahadurgarh-124507, Haryana	(i) Dr. Rajesh Kumar Sharma (ii) Sh. Sanjay Kumar Pandey	15th November, 2018 to 14th November, 2023
178	M/s. Robust Materials Technology Pvt. Ltd. No. 94, 2nd Floor, Thirumala Complex, NGEF Layout, Nagarabhavi, Bangalore-560072	(i) Dr. K.R. Ravikumar (ii) Dr. Mamatha S.N. (iii) Mr. Sandesha K.S	15th November, 2018 to 14th November, 2023"

[F. No. Q. 15018/21/2017-CPW]

BRIJESH SIKKA, Advisor

Note.- The principal notification was published in the Gazette of India, Extraordinary vide number S.O. 1174 (E), dated the 18th July, 2007 and subsequently amended vide notification numbers S.O. 1539 (E), dated the 13th September, 2007, S.O.1811(E), dated the 24th October, 2007, S.O.55(E), dated the 9th January, 2008, S.O. 428(E), dated the 4th March, 2008, S.O. No. 865(E), dated the 11th April, 2008, S.O.No.1894(E), dated the 31st July,2008, S.O. No. 2728(E), dated the 25th November, 2008, S.O.1356(E), dated the 27th May, 2009, S.O.No.1802(E), dated the 22nd July, 2009, S.O.No. 2399(E), dated the 18th September, 2009, S.O.No. 3122(E), dated the 7th December, 2009, S.O.No. 3123(E), dated the 7th December, 2009, S.O.No. 142(E), dated the 21st January, 2010, S.O. 619 (E), dated the 19th March, 2010, S.O.No. 1662(E), dated the 13th July, 2010, S.O.No. 2390(E), dated the 30th September, 2010, S.O.No. 2904 (E), dated the 8th December, 2010 , S.O.No. 181(E), dated the 28th January, 2011, S.O.No. 692(E) dated the 5th April, 2011, S.O No. 1754 (E), dated the 28th July, 2011, S.O. No. 2609, dated the 22nd November, 2011, S.O No. 264(E) , dated the 13th February, 2012, S.O No. 1150 (E) dated the 22nd May, 2012, S.O No. 1295(E), dated the 6th June, 2012, S.O. No. 2039 (E), dated the 5th September, 2012, S.O No. 2850 (E), dated the 7th December, 2012, S.O. No. 592 (E), dated the 8th March, 2013, S.O. No. 945(E), dated the 8th April, 2013, S.O. No. 2287 (E), dated the 26th July, 2013, S.O No. 3489(E) dated the 26th November, 2013, S.O No. 21(E), dated the 3rd January, 2014, S.O No. 561 (E), dated the 26th February, 2014, S.O. No. 1190(E), dated the 1st June, 2014, S.O. No. 2003(E), dated the 9th August, 2014, S.O. No. 137 (E), dated the 12th January, 2015, S.O. No. 1783(E), dated the 30th June, 2015, S.O. No. 2453(E), dated the 7th September, 2015 , S.O. No. 1953(E), dated the 2nd June, 2016, S.O. No. 388(E), dated the 10th February, 2017, S.O No. 2836 (E), dated the 30th August, 2017 and S.O. 857(E) dated the 26th February, 2018

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WEST BENGAL POLLUTION CONTROL BOARD

(Department of Environment, Government of West Bengal)
Paribesh Bhawan
Bldg. No. 10A, Block – LA, Sector – III, Bidhannagar, Kolkata – 700 106
Tel: 2335-9088 / 5076 / 5079 / 8861 / 7428 / 8211
Fax: (0091) (033) 2335-2813 / 8073 / 5272
Website: www.wbpcb.gov.in

Memo No: 0920 -5/WPB-S/99 (Part-VI) Date: 29 .03.2022
[E-File: WBPCB-15012(14)/1/2021-SEC(WBPCB)-WBPCB]

ORDER

In exercise of the power conferred under section 17(2) of the Water (Prevention and Control of Pollution) Act 1974 and under section 17(2) of the Air (Prevention and Control of Pollution) Act 1981, the West Bengal Pollution Control Board (hereinafter referred as the "State Board") recognizes Private/Government Laboratories for the purposes of environmental monitoring within the State of West Bengal.

The validity of recognition of the Private/Government Laboratories would expire on 31.03.2022. The State Board has decided to **extend the validity of recognition up to 30.06.2022** i.e. for another three (3) months.

Sl. No.	Name & address of the Laboratory	Reference order(s) of WBPCB	Processing fees payable
1.	M/s. Asansol Mines Board of Health, Court Compound, Katchari Road, P.O.- Asansol Court, Dist- Paschim Bardhaman	147-5/WPB-S/99 (Part-V) dated 31.12.2019 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 2000/-
2.	M/s. Bharat Foundation 25/11A, K. P. Roy Lane, Kolkata- 700031	147-5/WPB-S/99 (Part-V) dated 31.12.2019 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 3000/-
3.	CSIR- Central Mechanical Engineering Research Institute Mahatma Gandhi Avenue, Durapur-713209, Paschim Bardhaman	147-5/WPB-S/99 (Part-V) dated 31.12.2019 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 2000/-
4.	M/s. Eco Care Manoj Talkies Basement, Asansol, Burdwan	147-5/WPB-S/99 (Part-V) dated 31.12.2019 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 3000/-
5.	M/s. Edward Food Research and Analysis Centre Limited Subhash Nagar, PO-Nilgunj Bazar, Barasat, Kolkata -700121	147-5/WPB-S/99 (Part-V) dated 31.12.2019 0989-5/WPB-S/99 (Part-V) dated 27.05.2020 2342-5/WPB-S/99 (Part-V) dated 28.12.2020 0922-5/WPB-S/99 (Part-VI) dated 13.04.2021 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 3000/-
6.	M/s. Envirocheck 189 & 190, 192 &63B, Rastraguru Avenue, Kolkata- 700028	147-5/WPB-S/99 (Part-V) dated 31.12.2019 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 3000/-
7.	M/s. Envirotech East (P) Ltd. 100, Kalikapur, Madurdaha, Kolkata- 700107	147-5/WPB-S/99 (Part-V) dated 31.12.2019 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 3000/-
8.	M/s. Fresh Environment Consultancy 123, R. N. Tagore Road, Berhampore, Murshidabad Pin-742101	147-5/WPB-S/99 (Part-V) dated 31.12.2019 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 2000/-
9.	M/s. Good Earth Enviro Care S. D. Park, Kusumba, P.O.- Narendrapur, Kolkata-700103	147-5/WPB-S/99 (Part-V) dated 31.12.2019 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 3000/-
10.	M/s. Green Vision Urvashi Malhar, Phase II, MEAV-25, Bengal Ambuja Housing Complex, City Centre, Durgapur-713216	147-5/WPB-S/99 (Part-V) dated 31.12.2019 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 3000/-
11.	M/s. Indicative Consultant India HPL Link Road, Basudevpur, Khanjanchak, Haldia, Dist- Purba Medinipur, Pin-721602	147-5/WPB-S/99 (Part-V) dated 31.12.2019 0868-5/WPB-S/99 (Part-V) dated 13.03.2020 1220-5/WPB-S/99 (Part-V) dated 21.09.2020 0697-5/WPB-S/99 (Part-VI) dated 08.03.2021 1680-5/WPB-S/99 (Part-VI) dated 01.09.2021 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 3000/-

Sl. No.	Name & address of the Laboratory	Reference order(s) of WBPCB	Processing fees payable
12.	M/s. J. M. Biotech (Pvt) Ltd. Sipta, P.O.- Amila, PS. Raina, Purba Bardhaman-713423	147-5/WPB-S/99 (Part-V) dated 31.12.2019 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 3000/-
13.	M/s. Mitra S. K. Pvt. Ltd. Udyan Industrial Estate, P-48, 3- Pagla Danga Road, Kolkata- 700015	147-5/WPB-S/99 (Part-V) dated 31.12.2019 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 3000/-
14.	M/s. N. D. International 107B, Block-F, New Alipore Kolkata- 700053	147-5/WPB-S/99 (Part-V) dated 31.12.2019 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 3000/-
15.	M/s. Pollution Analizer Consultant 10, Sourin Roy Road, (2nd & 3rd Floor) Behala Kolkata-700034	147-5/WPB-S/99 (Part-V) dated 31.12.2019 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 3000/-
16.	M/s. Pollution and Project Consultants P- 145, Bangur Avenue Block A, Kolkata-700055	147-5/WPB-S/99 (Part-V) dated 31.12.2019 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 3000/-
17.	M/s. Qualissure Laboratory Services 361, Prantik Pally, 45/361, Bose Pukur Road, Kolkata- 700107	147-5/WPB-S/99 (Part-V) dated 31.12.2019 0623-5/WPB-S/99 (Part-VI) dated 26.02.2021 1021-5/WPB-S/99 (Part-VI) dated 04.05.2021 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 3000/-
18.	M/s. Quality Control Laboratory, PO: Haldia Oil Refinery, Dist: Purba Medinipur, Pin-721606	147-5/WPB-S/99 (Part-V) dated 31.12.2019 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 2000/-
19.	M/s. R.V. Briggs & Co. Pvt Ltd. 9, Bentinck Street, 1st Floor, Taher Mansion, Kolkata- 700001	147-5/WPB-S/99 (Part-V) dated 31.12.2019 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 3000/-
20.	M/s. S. M. Scientific Service 486, Dumdum Park, Kolkata-700055	147-5/WPB-S/99 (Part-V) dated 31.12.2019 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 3000/-
21.	M/s. Scientific Research Laboratory 90, Lake East (4th Road), Santoshpur, Jadavpur, Kolkata - 700075	147-5/WPB-S/99 (Part-V) dated 31.12.2019 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 3000/-
22.	M/s. SGS India Pvt. Ltd. CS Plot No.- 512(P), Mauza - Hanspukuria, Diamond Harbour Road, P.O. - Joka, Dist.- South 24 Paraganas, Kolkata- 700104	147-5/WPB-S/99 (Part-V) dated 31.12.2019 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 3000/-
23.	M/s. Superintendence Co. of India Pvt Ltd Plot- y-23, Block-EP, Sector-V, Salt Lake City, Kolkata- 700091	147-5/WPB-S/99 (Part-V) dated 31.12.2019 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 3000/-
24.	M/s. Unitech Environmental Services Pvt. Ltd. 52D/12/1A, Babu Bagan Lane, Kolkata-700031	147-5/WPB-S/99 (Part-V) dated 31.12.2019 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 2000/-
25.	M/s West Bengal Waste Management Limited (A division of Ramky Enviro Engineers Ltd) J. L. No. -103, Mouza - Purba Srikrishnapur, P.S.- Sutahata, Haldia, Dist. -Purba Midnapur, Pin- 721635	147-5/WPB-S/99 (Part-V) dated 31.12.2019 2600-5/WPB-S/99 (Part-VI) dated 15.12.2021	Rs. 3000/-

The terms and conditions and the recommended parameters as mentioned in the above referred respective order(s) of the State Board will remain same and unaltered.

The Laboratories are requested to deposit the requisite processing fees mentioned against respective laboratory, to the State Board, within 30.04.2022.

Roshni Sen
Member Secretary, WBPCB

F.No. J-13011/22/2007-IA.II (T)
Government of India
Ministry of Environment, Forest & Climate Change
(Impact Assessment Division)

Indira Paryavaran Bhavan
2nd Floor, Vayu Wing
Jor Bagh Road
New Delhi - 110003
Dated: 10th May, 2023

To,

M/s Damodar Valley Corporation,
DVC Headquarters, DVC Towers,
VIP Road, **Kolkata** – 700054 (West Bengal)

Sub: Expansion of Raghunathpur Thermal Power Station by installing unit of 1320 (2x660) MW Thermal Power Plant (Phase-II) at village Raghunathpur, District Purulia (West Bengal) by M/s Damodar Valley Corporation - Terms of Reference (ToR) - reg.

Sir,

This has reference to your online proposal no. IA/WB/THE/420393/2023 dated 6th March, 2023 submitted to the Ministry for grant of terms of reference to the project cited in the subject.

2. The Ministry of Environment, Forest and Climate Change has considered the application. It is noted that the proposal is for Expansion of Raghunathpur Thermal Power Station by installing unit of 1320 (2x660) MW Thermal Power Plant (Phase-II) in an area of 341.81 ha at village Raghunathpur, District Purulia (West Bengal) by M/s Damodar Valley Corporation.

3. The proposal was considered by the Expert Appraisal Committee (EAC) for Thermal Power Projects in its 39th EAC Meeting held on 31st March, 2023. The comments and observations of EAC on the project may be seen in the Minutes of the meeting which are available on the web-site of this Ministry.

4. The project/activity is covered under category A of item 1 (d) 'Thermal Power Plant' of the Schedule to the Environmental Impact Assessment Notification, 2006 and requires appraisal at Central level by the sectoral EAC in the Ministry.

5. The details of the project submitted by project proponent and ascertained from the document submitted are mentioned below:

i. The proposal is for grant of Terms of Reference to the project for Expansion of Raghunathpur Thermal Power Station by installing capacity 1320 (2x660) MW (Phase-II) in an area of 341.81 ha at village Raghunathpur, District Purulia (West Bengal) by M/s Damodar Valley Corporation.

ii. At present, Raghunathpur TPS (RTPS) of DVC has total installed capacity of 1200 MW (2x600 MW) under Ph-I and both units are under commercial operation since March 2016, based on Environmental Clearance, accorded by MoEF&CC on 18th October 2007.

iii. Earlier RTPS was accorded Environment Clearance on 23.05.2012 by MOEF&CC for 2x660 MW under Phase II. Public Hearing for this project was successfully conducted. However, due to one or more reasons, activities of Ph-II could not be taken up further and the project was dropped by DVC in 2014-15 and contracts for different packages were terminated. However, considering the demand-supply position and projected growth of load demand in the valley area arising out mainly due to decommissioning of various units of DVC viz... Durgapur TPS, Bokaro TPS-B and Chandrapura TPS, the Board of DVC accorded approval for the revival of erstwhile Raghunathpur TPS Ph-II (2x660 MW) and in principle approval was accorded by Ministry of Power on 25.02.2022.

iv. The silent features of the project is as under:

Location	Vill: Raghunathpur, Dist: Purulia, in West Bengal
Land requirement	The main plant will be installed on total 341.81 hectares (844.63 acres) of land, which is available within the existing plant premises of total 840.53 Hectares (2077 acres), which has been acquired.
Raw water requirement & source	Water to the tune of 207591 KLD will be needed for the overall project. (Existing: 112542 KLD + Proposed: 95049 KLD) Source: Panchet Dam
Power requirement & Source	82.5 MW (for Phase -II) Source : DVC, Phase I
Effluent generation & disposal	The plant will be designed as a zero liquid discharge plant. The water will be recirculated through cooling and treatment. The entire wastewater will be recycled for various purposes inside the plant. Domestic wastewater will be treated in Sewage Treatment Plant (STP). Treated wastewater will be used for greenbelt purpose inside the plant premises.
Air pollution control	Dust Suppression and Extraction Systems, FGD, Electrostatic Precipitators, Flue Gas Desulphurisation System and NOx Control System at relevant points will be installed.
Fuel requirement (Coal)	6.60 MTPA Coal, sourced from Central Coalfield Limited (CCL), coal linkage with CCL is available.
Ash generation	29,70,000 TPA ash will be generated from Boiler.
Ash Management	i. DVC shall make efforts with authorities of coal mines and other minerals mines for use of ash in filling of abandoned mines/stone query areas and also used in construction of National/State Highway located within 300 km of proposed power station.

	ii. Construction of Varanasi Expressway: around 200 kms. stretch falls under Purulia district where significant quantum of ash shall be utilized. iii. Fly ash will also be utilized as a raw material for the cement grinding unit / brick manufacturing iv. Shree cement & ACC Cement plants are located in nearby areas where considerable quantity of fly ash shall be utilized.
Domestic Solid waste Management	Domestic solid waste from the plant and staff quarters will be disposed of suitably in consultation with the concerned Authority.
Manpower	350 persons (both regular and contractual)
Project cost	Rs. 11554.29 Crores

6. The sectoral Expert Appraisal Committee considered the proposal in its 39th meeting held on 31st March, 2023. The EAC after detailed deliberation on the information submitted recommended the proposal for grant of Standard ToR with public hearing for conducting EIA study to the project for expansion of Raghunathpur Thermal Power Station by installing unit of 1320 (2x660) MW Thermal Power Plant (Phase-II) in an area of 341.81 ha at village Raghunathpur, District Purulia (West Bengal) by M/s Damodar Valley Corporation, under the provisions of EIA Notification, 2006 and as amended along with the certain additional/specific ToR.

7. Based on recommendation of EAC, the Ministry is hereby accords approval for Standard ToR for conducting EIA study to the project for proposed expansion of Raghunathpur Thermal Power Station by installing unit of 1320 (2x660) MW Thermal Power Plant (Phase-II) in an area of 341.81 ha at village Raghunathpur, District Purulia (West Bengal) by M/s Damodar Valley Corporation, under the provisions of EIA Notification, 2006, as amended along with the following additional ToR:

[A] Environmental Management and Biodiversity Conservation

i. Public Hearing shall be conducted as per the provisions contained in EIA Notification, 2006 as amended.
ii. No construction shall be done on the waterbodies located around the project area. Submit a proposal for conservation of waterbodies located around the plant.
iii. Details of Ash management of existing and proposed project shall be submitted keeping in view that the fly ash disposal area for existing plant shall not be used for proposed expansion.
iv. Details of Dry Ash handling system along with supplementary coal handling system shall be submitted.
v. Proper protection measures like HDPE lining, appropriate height of bund and adequate distance between proposed Ash pond and water body (minimum 60 meter) etc. shall be planned so as to reduce the possibility of mixing of leachate with any fresh water body. High Density Slurry disposal plan shall be prepared.
vi. Pond and ground water quality (10 locations within 2 km radius of the plant boundary) shall be studied and report be submitted along with EIA/EMP. Action plan for Ground water monitoring stations on all hotspots like schools/hospitals within 2 km radius of the plant boundary be submitted.
vii. Baseline Study for Heavy metals in Ground water, Surface water and soil to be carried

out and incorporated in EIA/EMP report.

viii. Details pertaining to water source, treatment and discharge should be provided.

ix. Revise water balance shall be submitted with Zero Liquid Discharge plan.

x. Action plan for development of green belt (33% of total project cover area) across the periphery of the project boundary shall be provided with a video clip of existing green belt.

xi. PP shall submit action plan for using treated Sewage/Domestic wastewater for its operations.

xii. Project proponent to prepare Environmental Cost Benefit Analysis for the project in EIA/EMP Report.

xiii. An action plan shall be prepared for Water shed development within 10 km radius of the plant boundary in consultation with reputed government institution.

xiv. Provision to left the space for installing SCR.

xv. Site specific wildlife conservation plan duly approved by DFO shall be submitted and no vehicle purchase to be done/ proposed in the said plan.

xvi. Details of nos. of tree along with their density and nomenclature of the tree species required to be felled for project components and ash pond area and afforestation plan inside or outside the plant boundary shall be studied.

xvii. Plan for transportation of coal through closed conveyor belt shall be prepared and be submitted.

xviii. Site location map duly authenticated by the PCCF (wildlife) indicating distance of ESZ/boundary of protected area located in the vicinity.

xix. Permission from concerned regulatory authority for withdrawal of water.

[B] Disaster Management

xx. Disaster Management Plan shall be prepared and incorporated in EIA/EMP report.

[C] Miscellaneous

xxi. PP shall submit details of court cases and its status for the project (if any).

xxii. The PP should submit the photograph of monitoring stations & sampling locations. The photograph should bear the date, time, latitude & longitude of the monitoring station/sampling location. In addition to this PP should submit the original test reports and certificates of the labs which will analyze the samples.

xxiii. Arial view video of project site shall be recorded and to be submit.

xxiv. Certified compliance report of existing project shall be submitted.

8. You are requested to kindly submit the final EIA/EMP prepared as per ToRs to the Ministry for considering the proposal for environmental clearance within validity of ToR as per the extent rule of the Ministry notified time to time.

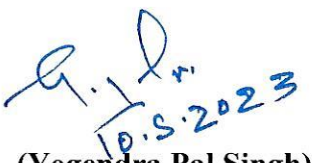
9. The consultants involved in the preparation of EIA/EMP report after accreditation with Quality Council of India/National Accreditation Board of Education and Training (QCI/NABET) would need to include a certificate in this regard in the EIA/EMP reports prepared by them and data provided by other Organization(s)/Laboratories including their status of approvals etc.

10.5.2023

(Yogendra Pal Singh)
Scientist 'E'

Copy to:

1. The Secretary, Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi - 110 001.
2. The Chairman, Central Electricity Authority, Sewa Bhawan, R. K. Puram, New Delhi - 110 066.
3. The Secretary, Department of Environment, Govt. of West Bengal, **Kolkata** (West Bengal)
4. Deputy Director General of Forests (C), Integrated Regional Office, Kolkata, IB-198, Sector-III, Salt Lake City, Kolkata – 700106
5. The Member Secretary, Central Pollution Control Board, Parivesh Bhawan, East Arjun Nagar, Delhi - 110 032.
6. The Member Secretary, West Bengal Pollution Control Board, Paribesh Bhavan, 10A, LA Block, Sector-III, Bidhan Nagar, Kolkata - 700106
7. Guard file/Monitoring file
8. Website of MoEF&CC.



(Yogendra Pal Singh)
Scientist 'E'

WEST BENGAL POLLUTION CONTROL BOARD

'Paribesh Bhawan'
Bldg. No. - 10A, Block - LA, Sector-III
Salt Lake City, Kolkata-700 098

apply for renewal of consent 60 (Sixty) days before expiry

Consent Letter Number : CO110174

Memo Number : 2097 -WPBA/Red(Prl)/Cont(380)/2015

Date : 31-10-18

Consent to Operate

under

Section 25 & 26 of the **Water (Prevention and Control of Pollution) Act, 1974** and
Section 21 of the **Air (Prevention and Control of Pollution) Act, 1981**

The West Bengal Pollution Control Board (hereinafter referred to as State Board) under the provisions of Section 25 & 26 of the Water (Prevention and Control of Pollution) Act, 1974, as amended and Section 21 of the Air (Prevention and Control of Pollution) Act, 1981, as amended and Rules and Orders made thereunder, hereby grants its consent to :

M/S. Raghunathpur Thermal Power Station

(Address of Regd. office/Head/Office/City Office)

(hereinafter referred to as Applicant) for its unit located at Vill- Dumdumi, P.O. Nildih, P.S. Raghunathpur, Dist- Purulia

(Detailed address of the manufacturing unit)

for a period from ..... to Upto 31-10-2023

to operate the industrial unit and to discharge liquid effluent and to emit gaseous effluent from the premises/land of the industrial unit, in accordance with the conditions as mentioned in the Annexure to this consent letter provided on any day at any instance the quantity and quality of liquid discharge and gaseous emission shall not exceed the permissible limit as specified in the Table I & II of this consent letter and in the Environmental (Protection) Act, 1986.

Breach of the conditions and / or failure to comply with the directions as set out in the Annexure shall render the applicant liable for prosecution under the provisions of the Water (Prevention and Control of Pollution) Act, 1974 and Air (Prevention and Control of Pollution) Act, 1981.

The State Board reserve the right to revoke, withdraw or make any reasonable variation / change / alter the conditions of this consent letter giving one month's notice to the applicant.

West Bengal Pollution Control Board
Asansol Regional Office
Seal

For and on behalf of the State Board

31/10/18

(Member Secretary/Chief Engr./ Sr. Env. Engr. / Env. Engr. / Asst. Env. Engr.)

ANNEXURE

Consent to M/S. Raghunathpur Thermal Power Station

for its unit at Vill- Dumdumi, P.O. Nildih, P.S. Raghunathpur, Dist- Purulia

Conditions :

01. This Consent is valid for the manufacture of :-

Sl. No.	Name of major products and by-products	Quantity manufactured per month
01	Electricity (2 X 600 MW)	864 MU
02		
03		
04		
05		
06		
07		
08		
09		
10		
11		
12		

02. The *Applicant* shall remain responsible for quantity and quality of liquid effluent and air emissions.

03. **Daily** discharge of industrial liquid effluent shall not exceed – KL.

04. **Daily** discharge of domestic liquid effluent shall not exceed – KL.

05. **Daily** discharge of mixed (industrial & domestic) liquid effluent shall not exceed – KL.

06. The *Applicant* shall discharge liquid effluent to – (place of discharge) through – nos. outlets / outfalls.

07. To bring into any altered or new outlet/outfall or to change the place of discharge, the Applicant shall have to inform the Board and obtain prior permission of the Board in this effect.

08. The *Applicant* shall provide comprehensive facility for treatment of industrial liquid waste and domestic liquid waste (sewage, sullage and liquid effluent generated from canteen), and operate and maintain the same continuously so that the quality of final effluent conforms to the *Standard* as given in Table-I in page 03.

31/10/18

(Member Secretary/Chief Engr./ Sr. Env. Engr. / Env. Engr. / Asst. Env. Engr.)

Continued.....

Consent to M/S. Raghunathpur Thermal Power Station

for its unit at Vill- Dumdumi, P.O. Nildih, P.S. Raghunathpur, Dist- Purulia

Table-I

Outlet No.	Nature of effluent	Parameters	Standard	Frequency of effluent sampling
01	Domestic	pH	Between : 5.5 to 9.0	Yearly
		Total Suspended Solids	Not to exceed : 100 mg/l.	
		Biochemical Oxygen Demand (3day at 27°C)	Not to exceed : 30 mg/l.	
		Chemical Oxygen Demand	Not to exceed : 250 mg/l.	
		Oil & Grease	Not to exceed : 10 mg/l.	

09. The *Applicant* falls in the .....Category of the Water (Prevention and Control of Pollution) Cess Act, 1977 and Rules made thereunder and the Applicant shall comply with the provisions of the said Act and Rules made thereunder.

10. **Daily** water consumption for the following purposes should not exceed :-

- Industrial cooling, spraying in mine pits and boiler feed water → 95400 KL
- (Water used for gardening should be included in this category of use) → 600 KL
- Domestic purpose
- Processing whereby water gets polluted and the pollutants are easily biodegradable → - KL
- Processing whereby water gets polluted and the pollutants are not easily biodegradable → - KL

The *Applicant* shall regularly submit to the Board the Returns of Water Consumption in the prescribed form and pay the Cess as specified under Section 3 of the said Act.

31/10/18

(Member Secretary/Chief Engr./ Sr. Env. Engr. / Env. Engr. / Asst. Env. Engr.)

Continued.....

Consent to M/S. Raghunathpur Thermal Power Station

for its unit at Vill.- Dumdumi, P.O.- Nildih, P.S. Raghunathpur, Dist- Purulia

11. The *Applicant* shall install suitable device for measuring the volume of water consumed for different purposes as mentioned above giving correct result to the satisfaction of the *State Board.*

12. All the stacks connected to various sources of emissions must be designated by numbers such as S-1, S-2, S-3, etc., and this must be painted/displayed to faciliate identification.

13. The *Applicant* shall install comprehensive control system consisting of pollution control equipment as is warranted with reference to generation of air emissions and operate and maintain the same continuously so as to achieve the level of pollutants of the *Standard* as given in Table-II below :

Table-II

Stack No.	Stack height from G.L., (in mts.)	Stack attached to (sources and control system, if any):	Volume $Nm^3/hr.$	Velocity of gas emission m/sec	Concentrations of parameters not to exceed					Frequency of emission sampling
					SPM (mg/Nm^3)	CO_2 (%v/v)				
S-I	275	02 nos. Coal fired Boiler		-	100	1	-	-	-	Quarterly
S-2	14.75	03 nos. D.G Set (3 X 1500 KVA)		-	150	1	-	-	-	Yearly
S-3										
S-4										
S-5										
S-6										
S-7										
S-8										
S-9										
S-10										

31/10/18

(Member Secretary/Chief Engr./ Sr. Env. Engr. / Env. Engr. / Asst. Env. Engr.)

Continued.....

Consent to M/S. Raghunathpur Thermal Power Station

for its unit at Vill- Dumdumi. P.O. Nildih, P.S. Raghunathpur, Dist- Purulia

14. The *Applicant* shall provide ports in the stack(s) and other necessary permanent facilities such as ladder, platform, etc. for monitoring/sampling the air emissions and the same shall be made available for inspection and use by the *State Board's* staff as well as *State Board's* authorised agencies.

15. The *Applicant* shall observe the following fuel consumption pattern :-

Sl. No	Type of fuel	Quantity consumed per day	Fuel burning operation where the fuel is used
01	Coal	425000 MT/month	02 nos. Coal Fired Boiler
02	LDO / HFO	500 KL/month	02 nos. Boiler
03			
04			
05			

16. The *Applicant* shall maintain the generation and treatment/disposal of non-hazardous solid waste as specified below :-

Type of waste	Quantity	Treatment	Disposal
Fly Ash & Bottom Ash	200000 MT/month		Dry Ash Collection System.

17. The *Applicant* shall take adequate measures for control of noise levels from its own sources within the premises within the limit given below :-

Time	Limit in dB(A) L_{eq}
Day Time (06 a.m. to 09 p.m.)	65
Night Time (09 p.m. to 06 a.m.)	55

18. The *Applicant* shall at all times maintain good house-keeping, proper working order, and operate efficiently for control of pollution from all sources so as not to cause nuisance to surrounding areas/inhabitants and to achieve compliance with the terms and conditions of the consent.

19. The *Applicant* shall bring about at least 33% of the available open land under the green coverage / plantation.

20. The *Applicant* shall provide for an alternate electric power source sufficient to operate all pollution control facilities installed by the *Applicant* to maintain compliance with the terms and conditions of the consent. In absence of such an alternate electric power source, the *Applicant* shall stop, reduce or otherwise control production to abide by the terms and conditions of the Consent regarding pollution level.

21. The *Applicant* shall install a separate energy meter showing the consumption of energy for operation of pollution control devices.

22. The *Applicant* shall ensure that fugitive emissions from the activity are controlled so as to maintain clean and safe environment in and around the factory premises.

23. The *Applicant* shall provide drainage system for conveying industrial and domestic liquid waste. Storm-water drain shall be kept separate from the drainage system meant for industrial and domestic liquid waste

31/10/18

(Member Secretary/Chief Engr./ Sr. Env. Engr. / Env. Engr. / Asst. Env. Engr.)

Continued.....

Consent to M/S. Raghunathpur Thermal Power Station

for its unit at Vill- Dumdumi, P.O. Nildih, P.S. Raghunathpur, Dist- Purulia

24. The *Applicant* shall maintain a separate register showing consumption of chemicals used in pollution control systems.

25. The *Applicant* shall get the samples of hazardous wastes/leachates analysed at least once in ..... from the laboratory recognised of the West Bengal Pollution Control Board and ensure that they conform to the limits stipulated. Test reports shall be sent to the Board.

26. The *Applicant* shall provide adequate and safe facility for collection of air, waste water and solid waste samples by the *State Board's* staff as well as *State Board's* authorised agencies.

27. The *Applicant* shall submit to the *State Board* by the 30th September of every year the Environmental Statement Report for the financial year ending 31st March of the current year in the prescribed form (Form -V) as required under the provisions of rule 14 of the Environment (Protection) [Second Amendment] rules, 1992.

28. The *Applicant* shall allow the Officers of the *State Board* to enter into the applicant's premises at any reasonable time to inspect the pollution control systems as well as monitoring and measuring devices in connection with prevention & control of pollution.

29. The *Applicant* shall maintain an Inspection Book in the factory premises which shall be made available to Officers & employees of the *State Board* for inspection, review and to write down any direction or observation as is deemed necessary during the inspection from time to time.

30. The *Application* shall furnish to the *State Board* all information in respect of quality, quantity, rate of discharge, place of discharge of liquid effluent and air emissions.

31. The *Applicant* shall maintain adequate number of qualified and trained personnel among his staff for proper maintenance and operation of the effluent treatment and / or emission control devices and for overall environment management of the industry.

32. The *Applicant* shall have to make registration for the use of groundwater if any, with Central Ground Water Authority.

33. The *Applicant* shall intimate to the *State Board* immediately of any occurrence or apprehension of occurrence of discharge of any poisonous, noxious or pollutants in excess of quality as well as quality as mentioned earlier to any receiving water body/receiving system or to atmosphere owing to accident or other unforeseen incident/event including natural disaster. The *Applicant* Shall (i) take all steps adequate to prevent such accident discharge/release of poisonous, noxious or pollutants and to limit their consequences to persons and the environment, (ii) provide to the persons working on the site with the information, training and equipment including antidotes necessary to ensure their safety and mitigate the accidental release of poisonous noxious or pollutants to the environment.

34. The *Applicant* shall make an application to the *State Board* in the prescribed form for renewal of the consent at least 60 (sixty) days before the date of expiry of this Consent.

35. The *Applicant* shall not make any alternation/modification/expansion in the existing manufacturing process and equipment as well as the pollution control system without prior approval of the Board.

36. The *Applicant* shall comply with the conditions as laid down in the Manufacture, Storage and Import of hazardous Chemicals Rules, 1989 and Hazardous Wastes (Management & Handling) Rules, 1989.

Additional Conditions

31/10/18

(Member Secretary/Chief Engr./ Sr. Env. Engr. / Env. Engr. / Asst. Env. Engr.)

RTPS file ANNEXURE IIA

BY SPEED POST

No. J-13011/22/2007-IA.II(T)
Government of India
Ministry of Environment & Forests

Paryavaran Bhawan
CGO Complex, Lodi Road
New Delhi-110 003

Dated: 18th October, 2007

To

The Chief Environment Officer (EM&PC)
Damodar Valley Corporation,
Electricity Department, 10th Floor
DVC Towers, VIP Road
Kolkata □ 700 054.

Sub: 2x600 MW Thermal Power Project at Raghunathpur, District Purulia, West Bengal by M/s Damodar Valley Corporation - Environmental Clearance regarding.

Sir,

The undersigned is directed to refer to your communication no. EM&PC/ RTPS/2902 dated 23rd May, 2007 regarding the subject mentioned above. Subsequent information furnished vide letter no. EM&PC/ RTPS-3/ 3040 dated 4th August, 2007 has also been considered.

2. The proposal is for grant of environmental clearance for setting up of a 2x600 MW coal based thermal power plant at Raghunathpur, District Purulia, West Bengal. The total land requirement for the four units of 600 MW each to be implemented in two phases will be 1820 acres. As such out of 1820 acres, 1511 acres of land is required for phase-I and only 309 acres would be phase-II. The environmental clearance for phase-II will be obtained subsequently. The coordinates of the proposed project site are 23^0 36′ N to 23^0 39; N latitude and 86^0 37′ E to 86^0 41′E longitude. Coal will be obtained from captive coal mine in District Dumka, Jharkhand. Water requirement is estimated as 4000 m3/hr and will be obtained from Panchet Reservoir on Damodar river. Sub critical technology will be adopted for phase-I. No ecologically sensitive area is reported within 10 Km. Public hearing was held on 30.04.2007. Total cost of the project is Rs. 3394.76 crores.

3. The project has been considered by the Expert Appraisal Committee (EAC) for Thermal Power and Coal Projects. Based on the recommendations of the Expert

Appraisal Committee, the Ministry of Environment & Forests hereby accords environmental clearance to the said project (2x600 MW, Phase-I) under the provisions of EIA Notification 2006, subject to implementation of the following terms and conditions:-

(i) Land requirement for phase – I & II shall not exceed 1820 acres including all facilities/utilities for the power project.

(ii) Ash and sulphur content in the coal to be used in the project shall not exceed 40% and 0.32% respectively.

(iii) A bi-flue stack of 275 m shall be provided with continuous online monitoring equipments.

(iv) High efficiency Electrostatic Precipitators (ESPs) with efficiency not less than 99.9% shall be installed to ensure that particulate emission does not exceed 100 mg/Nm3.

(v) Space provision shall be made for Flue Gas De-sulphurisation (FGD) unit, if required at a later stage.

(vi) Adequate dust extraction and dust suppression system and water spray system in dusty areas such as coal and ash handling areas, transfer areas and other vulnerable areas of the plant shall be provided.

(vii) Fly ash shall be collected in dry form and ash generated shall be used in a phased manner as per provisions of the notification on Fly Ash Utilization issued by the Ministry in September, 1999 and its amendment. By the end of 9th year full fly ash utilization should be ensured.

(viii) The abandoned mine to be used for backfilling of ash shall be lined with suitable lining material and its efficacy duly tested in terms of permeability before backfilling of ash into the same, so as to ensure that no leaching of heavy metals take place in the ground water regime.

(ix) Re-circulating type of cooling system with cooling towers shall be provided.

(x) There shall be zero discharge outside the plant boundary. The treated effluents conforming to the prescribed standards shall be re-circulated and reused within the plant boundary.

(xi) Rain water harvesting shall be practiced. A detailed scheme of rain water harvesting to recharge the ground water aquifer shall be prepared in consultation with Central Ground Water Authority/State Ground Water Board and a copy of the same shall be submitted within three months to the Ministry.

(xii) Regular monitoring of ground water quality in and around the ash pond area and the mines after their backfilling with ash shall be carried out, records maintained and periodic reports shall be furnished to the Regional Office of this Ministry.

(xiii) The land to be initially used for fabrication and storage area admeasuring 80 acres shall also be covered under greenbelt. The total area under greenbelt shall not be less than 480 acres.

(xiv) First aid and sanitation arrangements shall be made for the drivers and other contract workers during construction phase.

(xv) Leq of Noise level should be limited to 75 dBA and regular maintenance of equipment be undertaken. For people working in the high noise areas, personal protection devices should be provided.

(xvi) Regular monitoring of the ambient air quality shall be carried out in and around the power plant and records maintained. The location of the monitoring stations and frequency of monitoring shall be decided in consultation with SPCB. Periodic reports shall be submitted to the Regional Office of this Ministry.

(xvii) Half yearly report on the status of implementation of the stipulated conditions and environmental safeguards should be submitted to this Ministry/ Regional Office/CPCB/SPCB.

(xviii) Regional Office of the Ministry of Environment & Forests located at Bhubaneswar will monitor the implementation of the stipulated conditions. A complete set of documents including Environmental Impact Assessment Report and Environment Management Plan along with the additional information submitted to the ministry from time to time shall be forwarded to the Regional Office for their use during monitoring.

(xix) Separate funds should be allocated for implementation of environmental protection measures along with item-wise break-up. This cost should be included as part of the project cost. The funds earmarked for the environment protection measures should not be diverted for other purposes and year-wise expenditure should be reported to the Ministry.

(xx) Full cooperation should be extended to the Scientists/Officers from the Ministry/Regional Office of the Ministry at Bhubaneswar/the CPCB/the SPCB who would be monitoring the compliance of environmental status.

4. The Ministry reserves the right to revoke the clearance if conditions stipulated are not implemented to the satisfaction of the Ministry.

5. The environmental clearance accorded shall be valid for a period of 5 years for the start of production operations by the power plant.

6. In case of any deviation or alteration in the proposed project from that submitted to this Ministry for clearance, a fresh reference shall be made to the Ministry to assess the adequacy of the condition(s) imposed and to incorporate additional environmental protection measures required, if any.

7. The above stipulations shall be enforced along with others as under the Water (Prevention and Control of Pollution) Act, 1974, the Air (Prevention and Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986 and rules there under, The Manufacture, Storage and Import of Hazardous Chemical Rules, 1989, Hazardous Wastes (Management and Handling) Rules, 1989, the Public Liability Insurance Act, 1991 and rules there under.

(Dr. S.K. Aggarwal)
DIRECTOR

Copy to:-

1. The Secretary, Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi-110001.
2. The Secretary, Forests & Environment Deptt., Government of West Bengal, Writer's Building, Kolkata- 700001.
3. The Chairman, Central Electricity Authority, Sewa Bhawan, R.K. Puram, New Delhi-110066.
4. The Chairman, West Bengal Pollution Control Board, Parivesh Bhawan, Bldg. No. 10A, Block-LA, Sector-III, Salt Lake City, Kolkata-700098 - with request to display a copy of the clearance letter at the Regional Office, District Industries Centre and Collector□s office for 30 days.
5. The Chairman, Central Pollution Control Board, Parivesh Bhawan, CBD-cum-Office Complex, East Arjun Nagar, Delhi-110032.
6. The Chief Conservator of Forests, Eastern Regional Office, Ministry of Environment & Forests, 194, Kharvela Nagar, Bhubaneswar-751001.
7. Director (EI), MOEF.
8. Guard file.
9. Monitoring file.

(Dr. S.K. Aggarwal)
DIRECTOR

TABLE: - I

Onsite Ambient Air Quality Monitoring Results

Location: Near Project Site (Kewabathan)

Period: 1st December,2022 to 28th February,2023

DATE	PM_{10} (µg/m3)	$PM_{2.5}$ (µg/m3)	SO_2 (µg/m3)	NO_2 (µg/m3)
05.12.2022	59	27	8	21
08.12.2022	65	29	10	24
12.12.2022	57	24	11	20
15.12.2022	70	32	13	25
19.12.2022	75	35	18	30
22.12.2022	56	24	11	27
26.12.2022	71	32	12	23
29.12.2022	65	28	9	29
02.01.2023	57	25	11	20
05.01.2023	68	31	14	24
09.01.2023	60	26	12	31
12.01.2023	57	24	8	22
16.01.2023	77	38	10	28
19.01.2023	65	31	13	21
24.01.2023	60	26	9	38
27.01.2023	66	30	14	24
30.01.2023	75	35	17	23
02.02.2023	75	35	18	30
06.02.2023	56	24	11	27
09.02.2023	57	25	11	20
13.02.2023	68	31	14	24
16.02.2023	60	26	12	31
20.02.2023	75	35	18	30
23.02.2023	56	24	11	27
27.02.2023	71	32	12	23

TABLE: - 2

Onsite Ambient Air Quality Monitoring Results

Location: Rampur Vivekananda Vidyalaya

Period: 1st December,2022 to 28th February,2023

DATE	PM_{10} (µg/m3)	$PM_{2.5}$ (µg/m3)	SO_2 (µg/m3)	NO_2 (µg/m3)
05.12.2022	52	24	8	14
08.12.2022	64	28	6	18
12.12.2022	50	20	4	11
15.12.2022	63	30	7	16
19.12.2022	58	27	4	22
22.12.2022	53	26	8	17
26.12.2022	62	25	5	23
29.12.2022	57	26	8	15
02.01.2023	54	23	4	20
05.01.2023	61	29	7	13
09.01.2023	57	26	5	21
12.01.2023	62	30	8	12
16.01.2023	58	26	6	14
19.01.2023	66	29	4	25
24.01.2023	53	22	8	20
27.01.2023	61	29	7	18
30.01.2023	50	19	6	15
02.02.2023	63	30	7	16
06.02.2023	58	27	4	22
09.02.2023	53	26	8	17
13.02.2023	62	25	5	23
16.02.2023	57	26	8	15
20.02.2023	54	23	4	20
23.02.2023	61	29	7	13
27.02.2023	58	27	4	22

TABLE: - 3

Onsite Ambient Air Quality Monitoring Results

Location: Laldanga Sishu Sikha Kendro

Period: 1st December,2022 to 28th February,2023

DATE	PM_{10} (µg/m3)	$PM_{2.5}$ (µg/m3)	SO_2 (µg/m3)	NO_2 (µg/m3)
05.12.2022	67	31	10	21
08.12.2022	63	26	6	16
12.12.2022	70	32	9	20
15.12.2022	79	36	11	17
19.12.2022	67	33	8	15
22.12.2022	74	36	6	19
26.12.2022	65	30	7	14
29.12.2022	58	24	12	18
02.01.2023	77	37	6	22
05.01.2023	62	28	8	15
09.01.2023	70	32	13	25
12.01.2023	61	29	6	15
16.01.2023	72	34	8	18
19.01.2023	60	26	11	24
24.01.2023	67	30	6	30
27.01.2023	64	27	9	21
30.01.2023	73	32	7	26
02.02.2023	69	31	9	20
06.02.2023	79	38	11	17
09.02.2023	67	33	8	15
13.02.2023	65	30	7	14
16.02.2023	58	24	12	18
20.02.2023	77	37	6	22
23.02.2023	62	28	8	15
27.02.2023	74	34	6	22

TABLE: - 4

Onsite Ambient Air Quality Monitoring Results

Location: Mahul Bari Primary School

Period: 1st December,2022 to 28th February,2023

DATE	PM_{10} (µg/m3)	$PM_{2.5}$ (µg/m3)	SO_2 (µg/m3)	NO_2 (µg/m3)
05.12.2022	71	33	6	25
08.12.2022	55	22	9	16
12.12.2022	66	32	7	22
15.12.2022	56	26	10	17
19.12.2022	61	28	8	15
22.12.2022	66	32	9	22
26.12.2022	73	33	6	19
29.12.2022	57	27	8	24
02.01.2023	65	31	7	18
05.01.2023	62	29	5	23
09.01.2023	70	32	6	27
12.01.2023	59	27	10	21
16.01.2023	63	31	8	19
19.01.2023	58	27	10	26
24.01.2023	63	30	7	17
27.01.2023	56	23	6	22
30.01.2023	65	31	8	16
02.02.2023	73	33	6	19
06.02.2023	57	26	8	24
09.02.2023	65	31	7	18
13.02.2023	71	33	6	25
16.02.2023	55	22	9	16
20.02.2023	66	32	7	22
23.02.2023	62	29	5	23
27.02.2023	70	32	6	27

TABLE: - 5

Onsite Ambient Air Quality Monitoring Results

Location

Nildih High School (HS)

Period: 1st December,2022 to 28th February,2023

DATE	PM_{10} (µg/m3)	$PM_{2.5}$ (µg/m3)	SO_2 (µg/m3)	NO_2 (µg/m3)
06.12.2022	67	28	13	31
09.12.2022	82	39	9	28
13.12.2022	65	29	14	34
16.12.2022	71	33	12	27
20.12.2022	75	35	15	23
23.12.2022	70	30	10	36
27.12.2022	74	34	13	30
30.12.2022	80	38	9	27
03.01.2023	65	28	15	23
06.01.2023	81	39	11	40
10.01.2023	73	34	9	28
13.01.2023	65	29	14	34
17.01.2023	88	43	12	32
20.01.2023	75	33	10	29
25.01.2023	83	40	16	38
28.01.2023	72	32	9	25
31.01.2023	68	29	13	30
03.02.2023	82	39	9	28
07.02.2023	65	29	14	34
10.02.2023	71	33	12	27
14.02.2023	65	29	14	30
17.02.2023	88	43	12	32
21.02.2023	75	33	10	28
24.02.2023	83	40	16	38
28.02.2023	68	29	13	31

TABLE: - 6

Onsite Ambient Air Quality Monitoring Results

Location Muldi

Village

Period: 1st December,2022 to 28th February,2023

DATE	PM_{10} (µg/m3)	$PM_{2.5}$ (µg/m3)	SO_2 (µg/m3)	NO_2 (µg/m3)
06.12.2022	73	33	9	23
09.12.2022	65	31	14	31
13.12.2022	67	31	12	26
16.12.2022	63	30	10	20
20.12.2022	78	35	8	29
23.12.2022	67	32	13	18
27.12.2022	76	39	12	27
30.12.2022	69	32	10	32
03.01.2023	62	27	9	23
06.01.2023	73	34	13	30
10.01.2023	65	31	11	21
13.01.2023	78	37	9	29
17.01.2023	62	25	12	20
20.01.2023	70	32	10	33
25.01.2023	66	29	13	22
28.01.2023	75	36	8	30
31.01.2023	64	29	10	24
03.02.2023	67	31	12	26
07.02.2023	63	28	10	20

10.02.2023	78	35	8	29
14.02.2023	69	32	10	32
17.02.2023	62	27	9	23
21.02.2023	73	34	13	30
24.02.2023	65	31	11	21
28.02.2023	76	39	12	27

TABLE: - 7
Onsite Ambient Air Quality Monitoring Results
Location | Barrah Anchal High School (H.S.)
Period: 1st December,2022 to 28th February,2023

DATE	PM_{10} (µg/m3)	$PM_{2.5}$ (µg/m3)	SO_2 (µg/m3)	NO_2 (µg/m3)
06.12.2022	52	20	6	17
09.12.2022	63	30	8	12
13.12.2022	59	28	4	20
16.12.2022	66	30	9	16
20.12.2022	64	29	6	23
23.12.2022	52	21	9	20
27.12.2022	55	24	4	14
30.12.2022	61	29	6	22
03.01.2023	63	29	8	15
06.01.2023	58	27	5	21
10.01.2023	52	24	9	18
13.01.2023	56	25	4	22
17.01.2023	52	21	7	20
20.01.2023	60	28	6	13
25.01.2023	57	25	9	19
28.01.2023	54	23	5	21
31.01.2023	66	31	7	14
03.02.2023	59	28	4	20
07.02.2023	67	31	9	16
10.02.2023	64	29	6	23
14.02.2023	52	21	9	20
17.02.2023	56	25	4	22
21.02.2023	55	23	7	20
24.02.2023	60	28	6	13
28.02.2023	57	25	9	19

TABLE: - 8
Onsite Ambient Air Quality Monitoring Results
Location | Achkoda Mallikpara
Period: 1st December,2022 to 28th February,2023

DATE	PM_{10} (µg/m3)	$PM_{2.5}$ (µg/m3)	SO_2 (µg/m3)	NO_2 (µg/m3)
06.12.2022	70	32	12	25
09.12.2022	66	28	8	18
13.12.2022	73	33	11	22
16.12.2022	80	37	13	29
20.12.2022	70	34	10	17
23.12.2022	74	36	8	24
27.12.2022	68	31	9	16
30.12.2022	64	31	14	20
03.01.2023	75	34	8	24
06.01.2023	65	29	10	35
10.01.2023	70	32	15	27
13.01.2023	64	30	8	22
17.01.2023	75	35	10	19
20.01.2023	66	29	13	26
25.01.2023	70	34	8	34
28.01.2023	85	42	11	23
31.01.2023	67	29	9	28
03.02.2023	73	33	11	22
07.02.2023	80	37	13	29
10.02.2023	69	34	10	17
14.02.2023	74	36	8	24
17.02.2023	67	31	9	16
21.02.2023	64	29	14	20
24.02.2023	75	34	8	24
28.02.2023	85	42	11	23

TABLE: - 9
Onsite Ambient Air Quality Monitoring Results
Location | Sulanga Village
Period: 1st December,2022 to 28th February,2023

DATE	PM_{10} (µg/m3)	$PM_{2.5}$ (µg/m3)	SO_2 (µg/m3)	NO_2 (µg/m3)
06.12.2022	66	30	7	19
09.12.2022	62	26	5	12
13.12.2022	69	31	8	16
16.12.2022	76	35	9	14
20.12.2022	66	32	7	20
23.12.2022	73	35	5	18
27.12.2022	64	29	6	10
30.12.2022	57	28	11	14
03.01.2023	76	39	5	18
06.01.2023	61	27	7	12
10.01.2023	69	32	8	21
13.01.2023	60	28	5	16
17.01.2023	71	33	6	13
20.01.2023	59	26	10	20
25.01.2023	66	32	5	11
28.01.2023	75	37	8	17
31.01.2023	62	27	6	22
03.02.2023	70	32	9	14
07.02.2023	66	29	7	20
10.02.2023	73	35	5	18
14.02.2023	64	28	6	10
17.02.2023	76	39	5	18
21.02.2023	61	27	7	12
24.02.2023	69	32	8	21
28.02.2023	73	35	5	18

TABLE: - 10
Onsite Ambient Air Quality Monitoring Results
Location | Sarak Para Nanduara Village
Period: 1st December,2022 to 28th February,2023

DATE	PM_{10} (µg/m3)	$PM_{2.5}$ (µg/m3)	SO_2 (µg/m3)	NO_2 (µg/m3)
05.12.2022	63	30	11	18
08.12.2022	74	33	9	25
12.12.2022	67	31	13	17
15.12.2022	65	30	11	22
19.12.2022	70	34	9	20
22.12.2022	63	30	12	27
26.12.2022	72	34	17	22
29.12.2022	60	27	15	17
02.01.2023	67	31	12	24
05.01.2023	73	32	9	31
09.01.2023	64	30	11	18
12.01.2023	67	32	10	26
16.01.2023	71	33	12	21
19.01.2023	74	35	10	23
24.01.2023	60	29	12	19
27.01.2023	64	27	13	24
30.01.2023	70	33	11	30
02.02.2023	60	27	15	17
06.02.2023	67	31	12	24
09.02.2023	73	32	9	31
13.02.2023	61	27	13	17
16.02.2023	65	30	11	22
20.02.2023	70	34	9	20
23.02.2023	63	30	12	27
27.02.2023	60	27	12	19

TABLE: - I
Onsite Ambient Air Quality Monitoring Results
Location | Near Project Site (Kewabathan)
Period: 1st December,2022 to 28th February,2023

DATE	Shit - 1 (mg/m3)	Shit - 2 (mg/m3)	Shift-III (mg/m3)
05.12.2022	0.348	0.475	0.650
08.12.2022	0.768	0.378	0.479
12.12.2022	0.233	0.856	0.259
15.12.2022	0.654	0.586	0.551
19.12.2022	0.638	0.471	0.333
22.12.2022	0.342	0.362	0.653
26.12.2022	0.577	1.045	0.367
29.12.2022	0.301	0.453	0.418
02.01.2023	0.846	0.773	1.027
05.01.2023	0.429	0.804	0.362
09.01.2023	0.677	0.315	0.567
12.01.2023	0.821	1.143	0.758
16.01.2023	0.346	0.694	1.037
19.01.2023	0.417	0.466	0.287
24.01.2023	0.776	1.083	0.874
27.01.2023	0.520	0.386	0.439
30.01.2023	0.744	0.696	0.761
02.02.2023	0.233	0.856	0.259
06.02.2023	0.654	0.586	0.551
09.02.2023	0.638	0.471	0.333
13.02.2023	0.342	0.362	0.653
16.02.2023	0.577	1.045	0.367
20.02.2023	0.346	0.694	1.037
23.02.2023	0.417	0.466	0.287
27.02.2023	0.776	1.083	0.874

TABLE: - 2	
Onsite Ambient Air Quality Monitoring Results	
Location Rampur Vivekananda Vidyalaya	
Period: 1st December,2022 to 28th February,2023	

DATE	Shit - 1 (mg/m3)	Shit - 2 (mg/m3)	Shift-III (mg/m3)
05.12.2022	0.311	0.354	0.324
08.12.2022	0.148	0.170	0.140
12.12.2022	0.424	0.390	0.360
15.12.2022	0.217	0.297	0.267
19.12.2022	0.358	0.256	0.226
22.12.2022	0.414	0.601	0.521
26.12.2022	0.402	0.503	0.273
29.12.2022	0.144	0.458	0.428
02.01.2023	0.217	0.697	0.167
05.01.2023	0.458	0.356	0.326
09.01.2023	0.196	0.301	0.271
12.01.2023	0.238	0.653	0.523
16.01.2023	0.352	0.271	0.241
19.01.2023	0.297	0.398	0.268
24.01.2023	0.523	0.369	0.339
27.01.2023	0.398	0.541	0.111
30.01.2023	0.313	0.431	0.401
02.02.2023	0.217	0.297	0.267
06.02.2023	0.358	0.256	0.226
09.02.2023	0.414	0.601	0.521
13.02.2023	0.402	0.503	0.273
16.02.2023	0.144	0.458	0.428
20.02.2023	0.458	0.356	0.326
23.02.2023	0.196	0.301	0.271
27.02.2023	0.238	0.653	0.523

TABLE: - 3

Onsite Ambient Air Quality Monitoring Results

Location Laldanga Sishu Sikha Kendro

Period: 1st December,2022 to 28th February,2023

DATE	Shit - 1 (mg/m3)	Shit - 2 (mg/m3)	Shift-III (mg/m3)
05.12.2022	0.440	0.485	0.455
08.12.2022	0.277	0.301	0.268
12.12.2022	0.553	0.521	0.491
15.12.2022	0.346	0.428	0.398
19.12.2022	0.487	0.387	0.354
22.12.2022	0.729	0.532	0.562
26.12.2022	0.531	0.634	0.604
29.12.2022	0.273	0.589	0.504
02.01.2023	0.346	0.828	0.298
05.01.2023	0.587	0.487	0.357
09.01.2023	0.325	0.432	0.402
12.01.2023	0.367	0.784	0.654
16.01.2023	0.481	0.402	0.372
19.01.2023	0.426	0.329	0.399
24.01.2023	0.652	0.500	0.442
27.01.2023	0.527	0.472	0.338
30.01.2023	0.442	0.562	0.532
02.02.2023	0.346	0.428	0.398
06.02.2023	0.487	0.387	0.357
09.02.2023	0.729	0.532	0.562
13.02.2023	0.531	0.634	0.604
16.02.2023	0.487	0.487	0.357
20.02.2023	0.325	0.432	0.402
23.02.2023	0.367	0.284	0.654
27.02.2023	0.481	0.402	0.372

TABLE: - 4

Onsite Ambient Air Quality Monitoring Results

Location Mahul Bari Primary School

Period: 1st December,2022 to 28th February,2023

DATE	Shit - 1 (mg/m3)	Shit - 2 (mg/m3)	Shift-III (mg/m3)
05.12.2022	0.595	0.431	0.431
08.12.2022	0.342	0.361	0.378
12.12.2022	0.271	0.403	0.332
15.12.2022	0.369	0.480	0.271
19.12.2022	0.443	0.379	0.379
22.12.2022	0.214	0.533	0.450
26.12.2022	0.365	0.329	0.218
29.12.2022	0.583	0.244	0.335
02.01.2023	0.181	0.424	0.424
05.01.2023	0.344	0.491	0.172
09.01.2023	0.233	0.361	0.385
12.01.2023	0.205	0.429	0.258
16.01.2023	0.483	0.644	0.435
19.01.2023	0.356	0.190	0.581
24.01.2023	0.288	0.424	0.174
27.01.2023	0.364	0.559	0.388
30.01.2023	0.555	0.316	0.207
02.02.2023	0.271	0.403	0.332
06.02.2023	0.369	0.480	0.271
09.02.2023	0.443	0.379	0.379
13.02.2023	0.181	0.424	0.424
16.02.2023	0.344	0.491	0.172
20.02.2023	0.233	0.361	0.385
23.02.2023	0.205	0.429	0.258
27.02.2023	0.583	0.244	0.335

TABLE: - 5

Onsite Ambient Air Quality Monitoring Results

Location Nildih High School (HS)

Period: 1st December,2022 to 28th February,2023

DATE	Shit - 1 (mg/m3)	Shit - 2 (mg/m3)	Shift-III (mg/m3)
06.12.2022	0.654	0.597	0.340
09.12.2022	0.259	0.487	0.630
13.12.2022	0.686	1.071	1.014
16.12.2022	1.101	0.561	0.504
20.12.2022	0.645	0.883	0.906
23.12.2022	0.335	1.057	0.700
27.12.2022	0.486	0.371	1.024
30.12.2022	0.301	0.561	0.504
03.01.2023	0.645	0.862	0.205
06.01.2023	1.139	0.796	0.243
10.01.2023	0.862	0.281	0.424
13.01.2023	0.501	0.386	1.078
17.01.2023	0.271	1.158	0.747
20.01.2023	0.668	0.411	0.354
25.01.2023	0.595	0.542	1.085
28.01.2023	0.501	0.337	0.301
31.01.2023	0.696	0.457	0.400
03.02.2023	0.335	1.057	0.700
07.02.2023	0.486	0.371	1.024
10.02.2023	0.301	0.561	0.504
14.02.2023	0.654	0.597	0.340
17.02.2023	0.259	0.487	0.630
21.02.2023	0.686	1.071	1.014
24.02.2023	1.101	0.561	0.504
28.02.2023	0.645	0.883	0.906

TABLE: - 6

Onsite Ambient Air Quality Monitoring Results

Location Muldi Village

Period: 1st December,2022 to 28th February,2023

DATE	Shit - 1 (mg/m3)	Shit - 2 (mg/m3)	Shift-III (mg/m3)
06.12.2022	0.423	0.441	0.429
09.12.2022	0.260	0.257	0.245
13.12.2022	0.536	0.477	0.465
16.12.2022	0.329	0.384	0.372
20.12.2022	0.470	0.343	0.331
23.12.2022	0.312	0.588	0.436
27.12.2022	0.514	0.590	0.578
30.12.2022	0.256	0.545	0.533
03.01.2023	0.329	0.784	0.272
06.01.2023	0.570	0.443	0.531
10.01.2023	0.308	0.388	0.376
13.01.2023	0.350	0.740	0.628
17.01.2023	0.464	0.358	0.346
20.01.2023	0.409	0.585	0.373
25.01.2023	0.635	0.456	0.444
28.01.2023	0.510	0.528	0.516
31.01.2023	0.425	0.518	0.306
03.02.2023	0.329	0.384	0.372
07.02.2023	0.470	0.343	0.331
10.02.2023	0.312	0.588	0.436
14.02.2023	0.514	0.590	0.578
17.02.2023	0.350	0.740	0.628
21.02.2023	0.464	0.358	0.346
24.02.2023	0.409	0.585	0.373
28.02.2023	0.635	0.456	0.444

TABLE: - 7

Onsite Ambient Air Quality Monitoring Results

Location Barrah Anchal High School (H.S.)

Period: 1st December,2022 to 28th February,2023

DATE	Shit - 1 (mg/m3)	Shit - 2 (mg/m3)	Shift-III (mg/m3)
06.12.2022	0.477	0.416	0.231
09.12.2022	0.516	0.258	0.327
13.12.2022	0.238	0.382	0.401
16.12.2022	0.125	0.483	0.431
20.12.2022	0.347	0.286	0.168
23.12.2022	0.420	0.382	0.452
27.12.2022	0.123	0.588	0.278
30.12.2022	0.446	0.138	0.331
03.01.2023	0.516	0.458	0.527
06.01.2023	0.478	0.382	0.131
10.01.2023	0.281	0.512	0.326
13.01.2023	0.416	0.322	0.327
17.01.2023	0.519	0.225	0.489
20.01.2023	0.430	0.408	0.284
25.01.2023	0.210	0.470	0.401
28.01.2023	0.399	0.361	0.431
31.01.2023	0.142	0.412	0.278
03.02.2023	0.420	0.382	0.452
07.02.2023	0.123	0.588	0.278
10.02.2023	0.446	0.138	0.331
14.02.2023	0.516	0.458	0.527
17.02.2023	0.281	0.512	0.326
21.02.2023	0.416	0.322	0.327
24.02.2023	0.519	0.225	0.489
28.02.2023	0.430	0.408	0.284

TABLE: - 8

Onsite Ambient Air Quality Monitoring Results

Location Achkoda Mallikpara

Period: 1st December,2022 to 28th February,2023

DATE	Shit - 1 (mg/m3)	Shit - 2 (mg/m3)	Shift-III (mg/m3)
06.12.2022	0.527	0.386	0.440
09.12.2022	0.384	0.826	0.397
13.12.2022	0.766	0.353	0.636
16.12.2022	0.251	0.505	0.384
20.12.2022	0.679	0.338	0.692
23.12.2022	0.456	0.498	0.469
27.12.2022	0.423	0.310	0.213
30.12.2022	0.773	0.672	0.517
03.01.2023	0.466	0.925	0.379
06.01.2023	0.197	0.705	0.736
10.01.2023	0.423	0.510	0.293
13.01.2023	0.688	0.777	0.617
17.01.2023	0.538	0.237	0.729
20.01.2023	0.619	0.861	0.632
25.01.2023	0.641	0.528	0.511
28.01.2023	0.386	0.770	0.185
31.01.2023	0.824	0.363	0.348
03.02.2023	0.251	0.505	0.384
07.02.2023	0.679	0.338	0.692
10.02.2023	0.456	0.498	0.469
14.02.2023	0.423	0.310	0.213
17.02.2023	0.197	0.705	0.736
21.02.2023	0.423	0.510	0.293
24.02.2023	0.688	0.777	0.617
28.02.2023	0.538	0.237	0.729

TABLE: - 9

Onsite Ambient Air Quality Monitoring Results

Location Sulanga Village

Period: 1st December,2022 to 28th February,2023

DATE	Shit - 1 (mg/m3)	Shit - 2 (mg/m3)	Shift-III (mg/m3)
06.12.2022	0.375	0.467	0.411
09.12.2022	0.419	0.354	0.355
13.12.2022	0.288	0.308	0.481
16.12.2022	0.338	0.555	0.290
20.12.2022	0.405	0.397	0.541
23.12.2022	0.259	0.434	0.395
27.12.2022	0.326	0.346	0.319
30.12.2022	0.572	0.289	0.364
03.01.2023	0.198	0.190	0.234
06.01.2023	0.288	0.563	0.154
10.01.2023	0.405	0.397	0.347
13.01.2023	0.259	0.234	0.495
17.01.2023	0.161	0.173	0.258
20.01.2023	0.264	0.439	0.411
25.01.2023	0.399	0.619	0.392
28.01.2023	0.465	0.279	0.417
31.01.2023	0.304	0.596	0.240
03.02.2023	0.338	0.555	0.290
07.02.2023	0.405	0.397	0.541
10.02.2023	0.259	0.434	0.395
14.02.2023	0.326	0.346	0.319
17.02.2023	0.259	0.234	0.195
21.02.2023	0.161	0.173	0.258
24.02.2023	0.264	0.439	0.168
28.02.2023	0.337	0.219	0.392

TABLE: - 10

Onsite Ambient Air Quality Monitoring Results

Location Sarak Para Nanduara Village

Period: 1st December,2022 to 28th February,2023

DATE	Shit - 1 (mg/m3)	Shit - 2 (mg/m3)	Shift-III (mg/m3)
06.12.2022	0.264	0.347	0.184
09.12.2022	0.367	0.695	0.566
13.12.2022	0.330	0.314	0.288
16.12.2022	0.388	0.416	0.337
20.12.2022	0.581	0.569	0.495
23.12.2022	0.445	0.472	0.416
27.12.2022	0.596	0.454	0.295
30.12.2022	0.353	0.218	0.318
03.01.2023	0.330	0.322	0.284
06.01.2023	0.688	0.663	0.181
10.01.2023	0.484	0.453	0.410
13.01.2023	0.187	0.753	0.672
17.01.2023	0.398	0.339	0.367
20.01.2023	0.406	0.530	0.358
25.01.2023	0.367	0.695	0.614
28.01.2023	0.328	0.317	0.288
31.01.2023	0.588	0.516	0.435
03.02.2023	0.445	0.472	0.416
07.02.2023	0.596	0.454	0.295
10.02.2023	0.353	0.218	0.318
14.02.2023	0.330	0.322	0.284
17.02.2023	0.484	0.453	0.410
21.02.2023	0.187	0.753	0.672
24.02.2023	0.398	0.339	0.367
28.02.2023	0.406	0.530	0.358

Table-1
Tolerance Limits for Inland Surface Waters (as per IS:2296)

SN	Parameter and Unit	Class-A	Class-B	Class-C	Class-D	Class-E
1	Colour (Hazen Units)	10	300	300	-	-
2	Odour	Unobject	-	-	-	-
3	Taste	Tasteless	-	-	-	-
4	pH (max) (min:6.5)	8.5	8.5	8.5	8.5	8.5
5	Conductivity (25°C) (μmhos/cm)	-	-	-	1000	2250
6	DO (mg/L)(min)	6	5	4	4	-
7	BOD (3 days at 27°C) (mg/L)	2	3	3	-	-
8	Total Coliforms (MPN/100 mL)	50	500	5000	-	-
9	TDS (mg/L)	500	-	1500	-	2100
10	Oil and Grease (mg/L)	-	-	0.1	0.1	-
11	Mineral Oil (mg/L)	0.01	-	-	-	-
12	Free Carbon Dioxide (mg/L CO_2)	-	-	-	6	-
13	Free Ammonia (mg/L as N)	-	-	-	1.2	-
14	Cyanide (mg/L as CN)	0.05	0.05	0.05	-	-
15	Phenol (mg/L C_6H_5OH)	0.002	0.005	0.005	-	-
16	Total Hardness (mg/L as $CaCO_3$)	300	-	-	-	-
17	Chloride (mg/L as Cl)	250	-	600	-	600
18	Sulphate (mg/L as SO_4)	400	-	400	-	1000
19	Nitrate (mg/L as NO_3)	20	-	50	-	-
20	Fluoride (mg/L as F)	1.5	1.5	1.5	-	-
21	Calcium (mg/L as Ca)	80	-	-	-	-
22	Magnesium (mg/L as Mg)	24.4	-	-	-	-
23	Copper (mg/L as Cu)	1.5	-	1.5	-	-
24	Iron (mg/L as Fe)	0.3	-	50	-	-
25	Manganese (mg/L as Mn)	0.5	-	-	-	-
26	Zinc (mg/L as Zn)	15	-	15	-	-
27	Boron (mg/L as B)	-	-	-	-	2
28	Barium (mg/L as Ba)	1	-	-	-	-
29	Silver (mg/L as Ag)	0.05	-	-	-	-
30	Arsenic (mg/L as As)	0.05	0.2	0.2	-	-
31	Mercury (mg/L as Hg)	0.001	-	-	-	-
32	Lead (mg/L as Pb)	0.1	-	0.1	-	-
33	Cadmium (mg/L as Cd)	0.01	-	0.01	-	-
34	Chromium (VI) (mg/L as Cr)	0.05	0.05	0.05	-	-
35	Selenium (mg/L as Se)	0.01	-	0.05	-	-
36	Anionic Detergents (mg/L MBAS)	0.2	1	1	-	-
37	PAH (mg/L)	0.2	-	-	-	-
38	Pesticides (μg/L)	Absent	-	-	-	-
39	Insecticides (mg/L)	-	-	Absent	-	-
40	Alpha Emitters (10^{-6}μc/mL)	0.001	0.001	0.001	0.001	0.001
41	Beta Emitters (10^{-6}μc/mL)	0.01	0.01	0.01	0.01	0.01
42	Percent Sodium (%)	-	-	-	-	60
43	Sodium Absorption Ratio	-	-	-	-	26

Class-A: Drinking water source without conventional treatment but after disinfection.
Class-B: Outdoor bathing.
Class-C: Drinking water source with conventional treatment followed by disinfection.
Class-D: Fish culture and wild life propagation.
Class-E: Irrigation, industrial cooling and controlled waste disposal.

Table-2
Drinking Water Quality Standards (as per IS:10500)

Sl No	Parameter and Unit	Desirable Limit	Permissible Limit in Absence of Alternate Source
1	Colour (Hazen units)	5	25
2	Odour	Unobjectionable	-
3	Taste	Agreeable	-
4	Turbidity (NTU)	5	10
5	PH	5-8.5	No relaxation
6	Total Coliforms (MPN/100 mL)	nil	-
7	Pathogenic Organisms or Virus	nil	-
8	TDS (mg/L)	500	2000
9	Mineral Oil (mg/L)	0.01	0.03
10	Free Residual Chlorine (mg/L)	0.2	-
11	Cyanide (mg/L as CN)	0.05	No relaxation
12	Phenol (mg/L C_6H_5OH)	0.001	0.002
13	Total Hardness (mg/L as $CaCO_3$)	300	600
14	Total Alkalinity (mg/L as $CaCO_3$)	200	600
15	Chloride (mg/L as Cl)	250	1000
16	Sulphate (mg/L as SO_4)	200	400
17	Nitrate (mg/L as NO_3)	45	100
18	Fluoride (mg/L as F)	1	1.5
19	Calcium (mg/L as Ca)	75	200
20	Magnesium (mg/L as Mg)	30	100
21	Copper (mg/L as Cu)	0.05	1.5
22	Iron (mg/L as Fe)	0.3	1
23	Manganese (mg/L as Mn)	0.1	0.3
24	Zinc (mg/L as Zn)	5	15
25	Boron (mg/L as B)	1	5
26	Aluminium (mg/L as AL)	0.03	0.2
27	Arsenic (mg/L as As)	0.05	No relaxation
28	Mercury (mg/L as Hg)	0.001	No relaxation
29	Lead (mg/L as Pb)	0.05	No relaxation
30	Cadmium (mg/L as Cd)	0.01	No relaxation
31	Chromium (VI) (mg/L as Cr)	0.05	No relaxation
32	Selenium (mg/L as Se)	0.01	No relaxation
33	Anionic Detergents (mg/L MBAS)	0.2	1
34	PAH (mg/L)	nil	-
35	Pesticides (μg/L)	Absent	0.001
36	Alpha Emitters ($10^{-6}\mu$c/mL)	nil	0.0001
37	Beta Emitters ($10^{-6}\mu$c/mL)	nil	0.001

Table-3
General Standards for Discharge of Effluents
[as per Environment (Protection) Rules, 1986]

Sl No	Parameter and Unit	Inland Surface Water	Public Sewers	Land for Irrigation	Marine Coastal Water
1	Temperature (^oC)	#	-	-	#
2	Colour and Odour	$	-	$	$
3	PH	5.5-9.0	5.5-9.0	5.5-9.0	5.5-9.0
4	BOD (3 days at 27^oC) (mg/L)	30	350	100	100
5	COD (mg/L)	250	-	-	250
6	Bio-assay (% 96-hrs Survival)	@	@	@	@
7	TSS (mg/L)	100	600	200	100*
8	SS Particle size(pass IS Sieve)	850	-	-	&
9	Oil and Grease (mg/L)	10	20	10	20
10	Total Residual Chlorine (mg/L)	1	-	-	1
11	Nitrate Nitrogen (mg/L as N)	10	-	-	20
12	Ammonia Nitrogen (mg/L N)	50	50	-	50
13	Kjeldahl Nitrogen (mg/L as N)	100	-	-	100
14	Free Ammonia (mg/L as N)	5	-	-	5
15	Cyanide (mg/L as CN)	0.2	2	0.2	0.2
16	Phenol (mg/L C_6H_5OH)	1	5	-	5
17	Fluoride (mg/L as F)	2	15	-	15
18	Sulphide (mg/L as S)	2	-	-	5
19	Dissolved Phosphate (mg/L P)	5	-	-	-
20	Copper (mg/L as Cu)	3	3	-	3
21	Iron (mg/L as Fe)	3	3	-	3
22	Manganese (mg/L as Mn)	2	2	-	2
23	Zinc (mg/L as Zn)	5	15	-	15
24	Nickel (mg/L as Ni)	3	3	-	5
25	Vanadium (mg/L as V)	0.2	0.2	-	0.2
26	Arsenic (mg/L as As)	0.2	0.2	0.2	0.2
27	Mercury (mg/L as Hg)	0.01	0.01	-	0.01
28	Lead (mg/L as Pb)	0.1	1	-	1
29	Cadmium (mg/L as Cd)	2	1	-	2
30	Chromium (VI) (mg/L as Cr)	0.1	2	-	1
31	Chromium (Total) (mg/L as Cr)	2	2	-	2
32	Selenium (mg/L as Se)	0.05	0.05	-	0.05
33	Alpha Emitters ($10^{-6}\mu c$/mL)	0.1	0.1	0.01	0.1
34	Beta Emitters ($10^{-6}\mu c$/mL)	1	1	0.1	1

Shall not exceed 5^oC above the receiving water temperature.
$ All efforts should be made to remove colour and unpleasant odour as far as practicable.
@ 90% survival of fish after 96 hours in 100% effluent.
* For cooling water effluent 10% above TSS of influent.
& (a) Floatable solids 3 mm, (b) Settleable solids 850 micron.

Table-4
National Ambient Air Quality Standards

S. No.	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, Residential, Rural and Other Area	Ecologically Sensitive Area (notified by Central Government)	Methods of Measurement
(1)	(2)	(3)	(4)	(5)	(6)
1	Sulphur Dioxide (SO_2), $\mu g/m^3$	Annual*	50	20	- Improved West and Gaeke
		24 hours**	80	80	-Ultraviolet fluorescence
2	Nitrogen Dioxide (NO_2), $\mu g/m^3$	Annual*	40	30	- Modified Jacob & Hochheiser (Na-Arsenite)
		24 hours**	80	80	- Chemiluminescence
3	Particulate Matter (size less than 10µm) or PM_{10} $\mu g/m^3$	Annual*	60	60	- Gravimetric - TOEM
		24 hours**	100	100	- Beta attenuation
4	Particulate Matter (size less than 2.5µm) or $PM_{2.5}$ $\mu g/m^3$	Annual*	40	40	- Gravimetric - TOEM
		24 hours**	60	60	- Beta attenuation
5	Ozone (O_3) $\mu g/m^3$	8 hours**	100	100	- UV photometric - Chemilminescence
		1 hour**	180	180	- Chemical Method
6	Lead (Pb) $\mu g/m^3$	Annual*	0.50	0.50	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper - ED-XRF using Teflon filter
		24 hours**	1.0	1.0	
7	Carbon Monoxide (CO) mg/m^3	8 hours**	02	02	- Non Dispersive Infra Red (NDIR) spectroscopy
		1 hour**	04	04	
8	Ammonia (NH_3) $\mu g/m^3$	Annual*	100	100	-Chemiluminescence
		24 hours**	400	400	-Indophenol blue method

(1)	(2)	(3)	(4)	(5)	(6)
9	Benzene (C_6H_6) $\mu g/m^3$	Annual*	05	05	- Gas chromatography based continuous analyzer - Adsorption and Desorption followed by GC analysis
10	Benzo(a)Pyrene (BaP) - particulate phase only, ng/m^3	Annual*	01	01	- Solvent extraction followed by HPLC/GC analysis
11	Arsenic (As), ng/m^3	Annual*	06	06	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper
12	Nickel (Ni), ng/m^3	Annual*	20	20	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper

* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

** 24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

Note. — Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.

SANT PRASAD GAUTAM, Chairman
[ADVT-III/4/184/09/Exty.]

Note: The notifications on National Ambient Air Quality Standards were published by the Central Pollution Control Board in the Gazette of India, Extraordinary vide notification No(s). S.O. 384(E), dated 11th April, 1994 and S.O. 935(E), dated 14th October, 1998.

[as per Noise Pollution (Regulation and Control) Rules, 2000]

Area Code	Category of Area	Limits in dB(A) L_{eq}*	
		Day Time	Night Time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Notes: 1. Day time shall mean from 6.00 a.m. to 10.00 p.m.

2. Night time shall mean from 10.00 p.m. to 6.00 a.m.

3. Silence zone is defined as an area comprising not less than 100 metres around hospitals, educational institutions and courts. The silence zones are zones which are declared as such by the competent authority.

4. Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

* dB(A) L_{eq} denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.