FINAL ENVIRONMENT IMPACT ASSESSMENT REPORT

NABINAGAR SUPER THERMAL POWER PROJECT, STAGE-II (3X800 MW) AT VILLAGE MAJHIYAN, TALUKA NABINAGAR DIST. AURANGABAD IN BIHAR

ToR No.: J-13012/127/2007-IA.II(T), dated: 15.04.2024
Baseline monitoring Period: March to May, 2024

PROJECT PROPONENT

NTPC LIMITED
(A Government of India Enterprise)

January, 2025

ENVIRONMENT CONSULTANT

GREENCINDIA CONSULTING (P) LTD
(Certificate No. NABET/EIA/2326/RA 0297 valid upto Feb 22, 2026)

NABET DISCLOSURE

DECLARATION BY EXPERTS CONTRIBUTING TO DRAFT EIA REPORT FOR PROPOSED EXPANSION OF NABINAGAR SUPER THERMAL POWER PROJECT, STAGE-II (3X800 MW) MW AT VILLAGE MAJHIYAN, TALUKA NABINAGAR DIST. AURANGABAD IN BIHAR

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

EIA COORDINATOR	:	**1(d) Thermal Power Plant**
Name of EC	:	**Nandini Choudhury, Category A**
Signature & Date	:	
Period of Involvement	:	**MARCH 2024 TO TILL DATE**
Contact Information	:	**608-611, Level-5, Shopprix Mall, Vaishali, Ghaziabad**

Functional Area Experts:

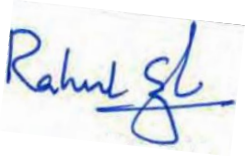
Sl. No.	Functional Area	Name of Expert	Task	Signature
CORE FUNCTIONAL AREAS				
1	Water Pollution (WP)	Dr. Subinoy Mondol	• Identification of sources of waste water generation. • Techniques and requirements of sampling of water and waste water including type of samples and parameters to be monitored • Supervision in monitoring of water parameters required for EIA studies including preservation of samples. • Plan for recirculation of treated sewage in process and other uses. • Preparation of water balance for 'zero liquid discharge'. • Prediction of impacts of	

Sl. No.	Functional Area	Name of Expert	Task	Signature
			accidental discharge into receiving water bodies.	
3	Socio-economy (SE)	Nandini Choudhury & Rahul Singh	• Collection of secondary data from various sources. • Methodologies on extrapolation of census data to project an up-to date status including selected ground validation of the same	Nandini Choudhury
4	Land-use (LU)		• Generation and analysis of data related to land use pattern. • Developing land use map of urban, semi-urban, rural and mixed areas using GIS. • GIS based land use analysis and development.	

Sl. No.	Functional Area	Name of Expert	Task	Signature
			• Integration of land use related data/information for assessing environmental impacts of development projects	
5	Soil Conservation (SC)		• Baseline data generation for soil sampling analysis and characterization of soil. • Assessment of fertility/productivity of soil. • Suggesting soil conservation measures.	
6	Air Pollution Monitoring Prevention Control (AP)	Shyam Sundar Earanti	• Identification of the sources of emissions. • Control measures identification. • Identification of probable impacts of the air emissions. • Development of Management Plan to control the air	

Sl. No.	Functional Area	Name of Expert	Task	Signature
			pollution & its mitigation	
	Water Pollution-WP		• Assessment of Impact associated with the project operation activities • Preparing cost estimate for treatment of waste water. • Development of Water Management Plan	
	Air quality modeling-AQ		▪ Study of wind pattern & wind conditions.	

Sl. No.	Functional Area	Name of Expert	Task	Signature
			▪ Developing micro-meteorological data for use in modeling. ▪ Quantitative assessment of project impact associated with project activities using AERMOD.	
	Solid & Hazardous Waste (SHW)		• Methodologies for segregation and collection. • Methodologies for gainful utilization of MSW, handling non-hazardous solid wastes. • Identification of types of wastes, developing storage and disposal methodologies	

Sl. No.	Functional Area	Name of Expert	Task	Signature
6	Risk & Hazard (RH)	Gokul Chandra Pattnaik	• Identification of hazards from fuel storage. • Prediction and control of hazards. • Preparation of Disaster Management Plan	
7	Ecology & Biodiversity (EB)	Dr. Sangeeta Verma	• Supervision of survey of existing flora & fauna in the study area • Assessment of impact associated with project • Selection of species for green belt development	
10	Noise & Vibration (NV)		• Supervision in monitoring of noise levels using specific instruments, data processing and analysis of data. • Prediction of Noise & vibration by using relevant	

Sl. No.	Functional Area	Name of Expert	Task	Signature
			models from the project. • Probable impacts of noise on communities and of vibration on buildings, structures etc	
	Geology-Geo	Nirzar Ajay Lakhia	• Study of geological and rock structure of the study area based on secondary data and literature survey.	
	Hydrogeology-HG		• Study of hydrogeological study of the study area. • Study rainwater harvesting and groundwater fluctuation	

Sl. No.	Functional Area	Name of Expert	Task	Signature
			in the study area.	

Declaration by the Head of the Accredited Consultant Organization

I, **Nandini Choudhury, hereby, confirm that the above-mentioned experts were involved in preparation of DRAFT EIA REPORT FOR PROPOSED EXPANSION OF NABINAGAR SUPER THERMAL POWER PROJECT, STAGE-II (3X800 MW) MW AT VILLAGE MAJHIYAN, TALUKA NABINAGAR DIST. AURANGABAD IN BIHAR.I also confirm that I shall be fully accountable for any misleading information mentioned in this statement.**

Signature:

Name : **Nandini Choudhury**

Designation : **Managing Director**

Name of the EIA Consultant Organization : **Greencindia Consulting Private Limited**

NABET Certificate No. & Issue Date : **NABET/EIA/2326/RA 0297, August, 2023**

CIN: U93000UP2011PTC047863, 2011-12
ARN: AA090417023350J, PIN:09AAECG4958Q1ZQ
(An ISO:9001 QMS, ISO: 14001 EMS & OHSAS: 18001 H&S MS Certified by BSI)
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Certificate No. NABET/EIA/2326/RA 0297, Valid up to February, 2026
MINING, THERMAL POWER PLANTS, CHEMICAL FERTILIZERS, RIVER VALLEY, HYDEL, DRAINAGE & IRRIGATION PROJECTS, CEMENT PLANT, COAL WASHERIES, METALLURGICAL INDUSTRIES, AIRPORTS, INDUSTRIAL ESTATE PLANNING, HIGHWAYS & RAILWAYS, COMMON MUNICIPAL SOLID WASTE MANAGEMENT, BUILDING & LARGE CONSTRUCTION PROJECTS AND TOWNSHIP & AREA DEVELOPMENT PROJECTS

Undertaking

Subject: Nabinagar Super Thermal Power Project, Stage-II (3x800) MW at village Majhiyan, Taluka Nabinagar, District Aurangabad, Bihar.

This is to inform you that we, M/s Greencindia Consulting Pvt. Ltd. has undertaken the Environmental Impact Assessment Study for the subject job, as per the EIA Notification, 2006 amended till date in compliance with the Terms of Reference (TOR) issued by MOEF&CC, vide its letter dated 15th April, 2024. We hereby undertake that prescribed TORs have been complied with and the data submitted are factually correct to the best of our knowledge.

For Greencindia Consulting Private Limited

(Nandini Choudhury)
Managing Director

CIN: U93000UP2011PTC047863, 2011-12
ARN: AA090417023350J, PIN:09AAECG4958Q1ZQ
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Date: 25.01.2025

Subject: Plagiarism Check Certificate for EIA Report of Nabinagar Super Thermal Power Plant Stage-II

This is to certify that the Environmental Impact Assessment (EIA) Report for *Nabinagar Super Thermal Power Plant Stage-II*, prepared by *Greencindia Consulting Pvt. Ltd.*, has been thoroughly checked for plagiarism.

The report is original and has been developed by our team based on extensive primary and secondary data collection, scientific analyses, and research. The plagiarism level has been verified and is below 10%, meeting the requirements for originality and authenticity. Proper citations and references have been included wherever external sources have been utilized.

We confirm that the report complies with ethical standards and is free from any form of plagiarism. Any resemblance to other reports or documents is purely coincidental and unintentional.

Authorized Signatory

Nandini Choudhury

Managing Director,

Greencindia Consulting Private Limited

एनटीपीसी NTPC
A Maharatna Company

एन टी पी सी लिमिटेड
(भारत सरकार का उद्यम)
NTPC Limited
(A Govt. of India Enterprise)
केन्द्रीय कार्यालय / Corporate Centre

Ref.No.: CC: ESE: 9565:2025: EIA **Date: 24.01.2025**

UNDERTAKING BY PROJECT PROPONENT

NTPC Limited has complied with all the prescribed Terms of Reference (ToRs) issued by Ministry of Environment, Forest & Climate Change (MoEF&CC) vide letter no. J-13012/127/2007-IA.II(T) dated 15.04.2024 for Nabinagar Super Thermal Power Project Stage-II (3x800 MW) at Village Majhiyan in Aurangabad district of Bihar.

We undertake that the information and data provided in the EIA report and submitted to the Ministry are factually correct and project proponent is fully accountable for the same.

For NTPC Limited.

R. Malik

(Rajesh Malik)
AGM & Group Head (Env. Engg.)

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1. Introduction

1.1 BACKGROUND & INTRODUCTION

NTPC Limited, a Government of India enterprise, stands as India's largest power generating company, established in November 1975 with the aim of coordinating and advancing thermal power development nationwide. Recognized as a "Navratna" by the Government of India in 1997 and subsequently as a "Maharatna" in 2010, NTPC has evolved into a diversified entity venturing into hydro, solar, coal mining, power trading, equipment manufacturing, power distribution, and renewable energy. The company is also exploring nuclear power development.

Presently, NTPC Group operates coal, gas, solar, hydro and wind projects, boasting an installed capacity of 76,733.18 MW, making it the leading power generator in India. Additionally, NTPC Group has around 30,026 MW under construction across various locations in the country as on date 21.01.2025, along with expanding ventures into coal mining, power equipment manufacturing and trading, positioning itself as an Integrated Power Major in the evolving power sector.

3x660 MW Super-Critical Technology Coal Based Nabinagar Thermal Power Plant was initially conceived and constructed by Nabinagar Power Generation Company Private Limited (NPGCL), a joint venture company of NTPC Limited and Bihar State Power Generation Company Limited (BSEB), Government of Bihar. Subsequently, NPGCL was merged with NTPC Limited in Aug, 2022. MOEF&CC was accorded Environmental Clearance (EC) for Nabinagar STPP vide letter no. J-13012/127/2007-IA.III(T) dated 27th Dec, 2010 and subsequently extension of Validity of EC on 20th March 2018 and 14th Jan 2020. Copies of ECs are enclosed as Annexure-1. All three units of Nabinagar Super Thermal Power Project, Stage-I (3x660 MW) have been commissioned and in commercial operation since 06.09.2019, 23.07.2021 and 01.06.2022 respectively. EC transfer application was submitted on 29.07.2024 vide proposal no IA/BR/THE/490112/2025 for Transfer of Environmental Clearances from NPGCL to NTPC Limited. The proposal is in under examination with MOEF&CC as on 21.01.2025. EC Amendment application for of Nabinagar Super Thermal Power Project, Stage-I (3x660 MW) was submitted on 30.11.2024 vide Proposal No IA/BR/THE/509675/2024 for inclusion of 7.3875 ha of Forest land. Proposal was discussed in 17th EAC meeting held on 30.12.2024. As per MOM uploaded on 07.01.2025, EAC has recommended the EC amendment proposal for inclusion of 7.3875 ha of Forest Land.

Proposed Nabinagar Super Thermal Power Project, Stage-II (3x800 MW) project has been identified by the Ministry of Power (MOP) to fulfil India's power demand by 2030, serving as a base load station for Bihar and other states in the Eastern Region (ER).

A total of 1202.88 hectares of land was acquired, in which approximately 607.28 hectares of land was utilized to accommodate Nabinagar STPP Stage-I project components i.e. Main Plant, Ancillary Facilities, Ash Disposal Area and Township. Remaining 597.16 hectares of land shall be used for development of Nabinagar STPP Stage-II (3x800 MW) project components i.e. Main Plant, Ancillary Facilities and Ash Disposal. 7.3875 ha of Forest land was involved for "Makeup Water and Storm Drain Scheme" in Nabinagar STPP Stage-I of the project, for which the Stage-I Forest Clearance was accorded on 03rd May 2019 and Stage-II Forest Clearence was accorded by MOEF&CC vide letter no FP/BR/THE/32163/2018/3594dated 15th Nov 2019.

1.2 IDENTIFICATION OF PROJECT AND PROPONENT

1.2.1 THE PROJECT

The Ministry of Power, through an Office Memorandum dated April 12, 2023, reported a meeting chaired by the Honourable Minister of Power and NRE on March 10, 2023, to assess the construction of an additional 25 GW thermal capacity. In this context, the Nabinagar STPP Stage-II has been identified as a potential coal plant for future development under the non-pithead category of the central sector.

The current proposal aims to establish Nabinagar STPP Stage-II (3x800 MW) as a regional power project to serve the Eastern Region's states and union territories.

Table 1.1: Details of the Project

Particulars	Details		
	Existing	**Proposed**	**Total**
Plant Capacity	1980 MW (3x660) MW	2400 MW (3x800) MW	4380 MW (1980+2400) MW
Adopted Technology	Super Critical Technology with water Cooled condenser system	Ultra Super Critical Technology with Air Cooled Condenser System	
Land Area	607.28 Ha	595.60 Ha	1202.88 Ha
Greenbelt Area	121.20 Ha	275.96 Ha	397.16 Ha
Land Type & Ownership	Land is already in possession of NTPC. The proposed expansion is within the existing plant boundary.		
Main Fuel/ Coal Consumption	11.25 MTPA (with GCV of 3400 kcal/kg at 90% PLF)	10.24 MTPA (with GCV of 4000 Kcal/kg at 85% PLF considering)	21.49 MTPA
Source of Fuel	Standing Linkage Committee (Long-Term) in its meeting held on 03.01.2024 have recommended for the grant of coal linkage to the project. Coal linkage source allocated from ECL & BCCL for Nabinagar STPP Stage-II vide CIL letter dated 20.06.2024		
Coal Transportation	The transportation of coal from the coal mines to the power plant is envisaged by Indian Railways. For handling additional rakes for Stage-II, augmentation of existing railway siding will be undertaken.		
Water Requirement	1,42,560 KLD	72,000 KLD	2,14,560 KLD
Condenser Cooling System	Water Cooled Condenser System	Air Cooled Condenser System	-
Water Source	The source of water for the project is Indrapuri Barrage on River Sone located about 3 Km from the site. WRD, Govt. of Bihar, have accorded water commitment of 305,821.95 KLD (125 Cusecs) from River Sone to the Nabinagar project. The combined water demand for the project amounts to 2,14,560 KLD (1,42,560 KLD from the existing plant and 72,000 KLD from the proposed plant), which is within the permitted total allocation. So, no additional water commitment is required for the expansion project i.e. water requirement for Stage-II would be met from existing allocation		

Particulars	Details
Ash Utilization & Gypsum	The Ministry of Environment, Forests, and Climate Change (MOEF&CC) Notification dated December 31, 2021, mandates that every coal or lignite-based thermal power plant (including captive or co-generating stations) must ensure utilization of ash (fly ash and bottom ash) in specified compliance cycles & annual basis generated in station in environmentally friendly manner. Stage-I Units are complying with the Notification. Stage-II units shall also be designed to comply with the notification. Gypsum generated from FGD system shall also be utilized/disposed-off in an environmentally suitable manner.

Table 1.2: Environmental Setting around the Project

Location	The Nabinagar Super Thermal Power Project (Nabinagar STPP) is situated on the right bank of the Sone River Majhiyan village in Aurangabad district, Bihar. The site is approximately 15 km away from Barun Village and can be accessed via a 20 km-long paved road from NH-2.

Co-ordinates

Point	Latitude	Longitude
A	24°48'35.57"N	84°09'47.58"E
B	24°48'34.21"N	84°09'52.61"E
C	24°48'39.56"N	84°09'55.84"E
D	24°48'17.02"N	84°11'15.34"E
E	24°47'59.75"N	84°11'9.987"E
F	24°48'0.185"N	84°10'46.68"E
G	24°47'32.53"N	84°10'24.82"E
H	24°47'8.849"N	84°10'28.90"E
I	24°45'26.45"N	84°09'55.77"E
J	24°45'46.45"N	84°08'44.21"E
K	24°45'56.10"N	84°08'48.88"E
L	24°45'58.59"N	84°08'44.87"E
M	24°46'04.74"N	84°08'48.99"E
N	24°46'03.25"N	84°08'51.79"E
O	24°46'47.46"N	84°09'06.40"E
P	24°46'58.97"N	84°08'42.99"E

	Q: 24°47'0.578"N, 84°08'44.19"E R: 24°46'47.69"N, 84°09'08.26"E S: 24°48'14.60"N, 84°09'37.91"E
Site Elevation (Approx) / Topography	Main Plant: 140 m–145 m The topography of land is plain without any major nallah
Distance from the HFL of the river	HFL in Sone River, Indrapuri, Sone Barrage is (+)110.90m. Approx distance from HFL point to Plant is 5685.00 m.
Nearest village	Ankorha village, approx. distance 200m.
Nearest Town (Road Distance)	Aurangabad town (District HQ) lies around 55 Km from the project location in East direction.
Railway Connectivity	The nearest railway station is Ankorha, which is part of the Sone-Garwa Road Section of the East Central Railway and 1 km away from the site
Nearest Sea port	Nearest Seaport is at Syama Prasad Mookerjee Port, Kolkata, 554 km away from the site on south-east direction.
Nearby Airports	The closest commercial airport is Gaya, positioned about 120 Km away
Approach Road	The site can be accessed via a well-constructed road that spans 20 Km that connects to NH-2.
Water Bodies within 10 km radius of the mine site.	

S.N.	Name	Distance in Km	Direction
Water Bodies			
1	Main Eastern Canal	0.30	NNW
2	Son River	0.80	WNW
3	Punpun Nadi	3.30	E
4	Eastern Son High level canal	3.60	NNE
5	Ramrekha Nadi	4.50	SE
6	Barki Nala	5.20	E
7	Main western canal	5.80	NW
8	Western Son high level canal	9.80	NNW
9	Patna Canal	11.20	NE
10	Batane Nadi	13.10	ENE

<table>
<tr><td>Reserved / Protected Forests</td><td>
<table>
<tr><th>S.N.</th><th>Name</th><th>Distance in Km</th><th>Direction</th></tr>
<tr><td colspan="4">Forests</td></tr>
<tr><td>11</td><td>Protected forest n/v Surar</td><td>9.40</td><td>SSW</td></tr>
<tr><td>12</td><td>Protected forest n/v Koiridih</td><td>10.00</td><td>NW</td></tr>
<tr><td>13</td><td>Protected forest n/v Guraila</td><td>11.20</td><td>NNW</td></tr>
<tr><td>14</td><td>Kaimur Wildlife Sanctuary</td><td>11.20</td><td>NW</td></tr>
</table>
</td></tr>
<tr><td>National Park, Wild Life Sanctuaries, Biosphere Reserves, Wildlife corridors, Tiger / Elephant Reserves, etc. within 10 km radius study Area</td><td>None</td></tr>
<tr><td>Archaeological Sites within 10 km radius study area</td><td>None</td></tr>
<tr><td>Other Industries within 10-km aerial radius</td><td>Nabinagar Thermal Power Project (4x250 MW) of M/s BRBCL, 7.49 km, SW</td></tr>
<tr><td>Seismic Zone</td><td>Zone III: Moderate Damage Risk Zone</td></tr>
<tr><td>CRZ within 10 km radius study area</td><td>None</td></tr>
</table>

1.2.2 THE PROJECT PROPONENT

The proposed project Nabinagar STPP, Stage-II shall be constructed and operated by NTPC Limited, a Govt. of India Enterprises.

1.3 LOCATION OF THE PROJECT

The Nabinagar Super Thermal Power Project (Nabinagar STPP) is situated on the eastern bank of the Sone River near Majhiyan village in Aurangabad District, Bihar. Proposed project is expansion of existing project (3x660 MW) by addition of three units of 800 MW with Ultra-Super Critical technology having Air Cooled Condenser system, within the land owned by NTPC adjacent to the existing plant site. The details of the proposed locations are provided in **Table 1.1**and the location map is given as **Figure 1.2** &Co-ordinate map as **Figure 1.3**.

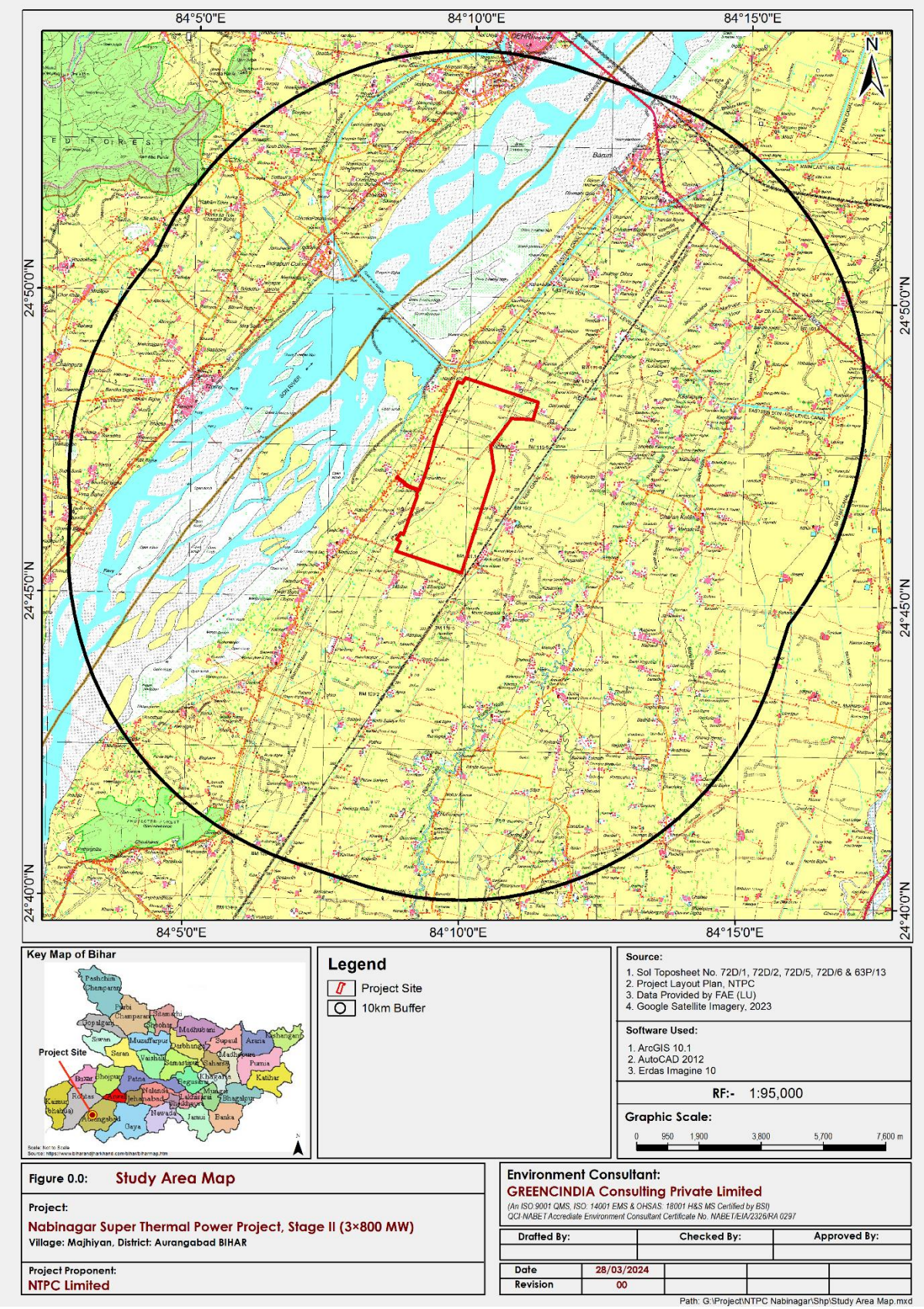


Figure 1.1: Site on Toposheet

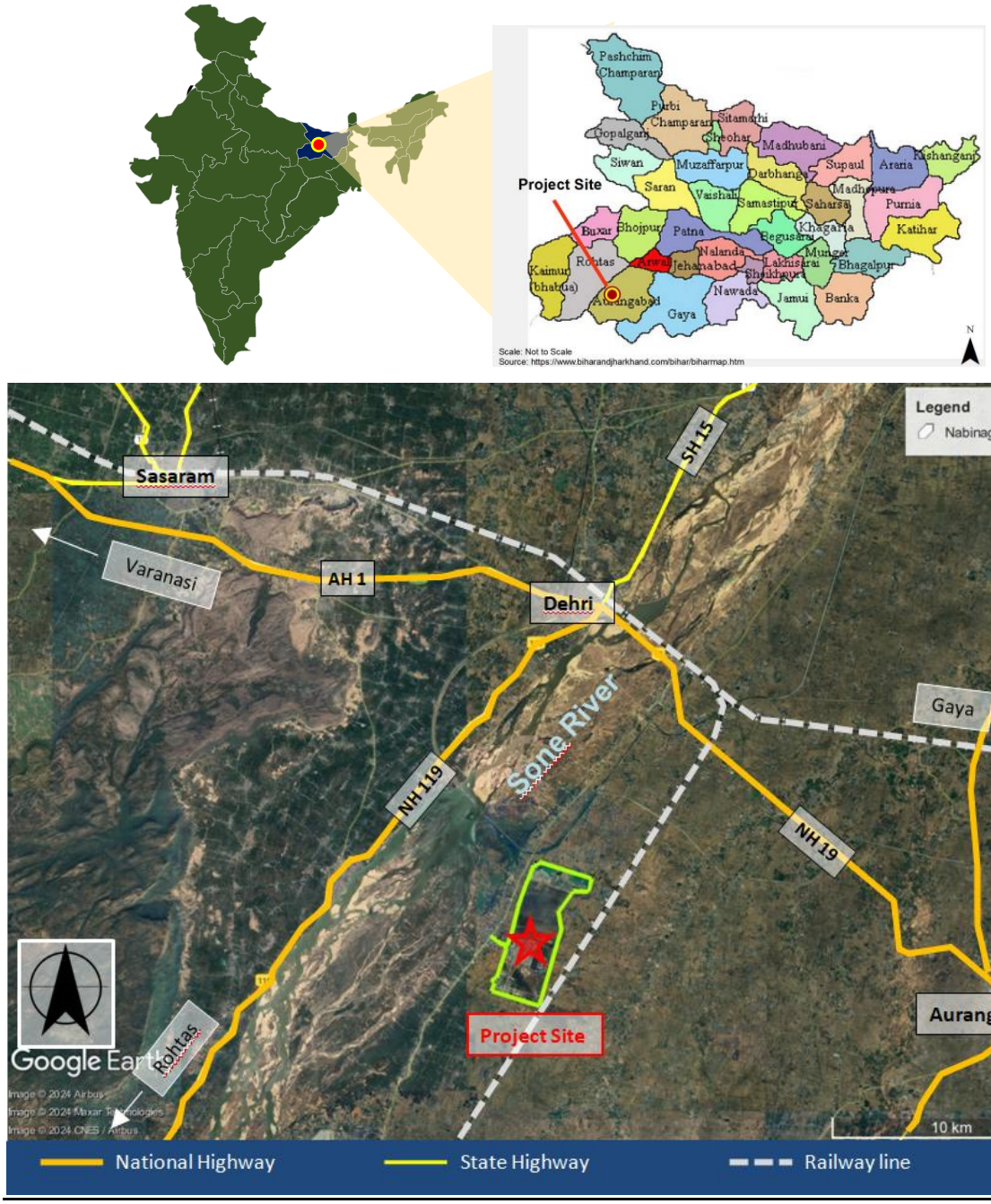


Figure 1.2: Location Map for the Proposed Project

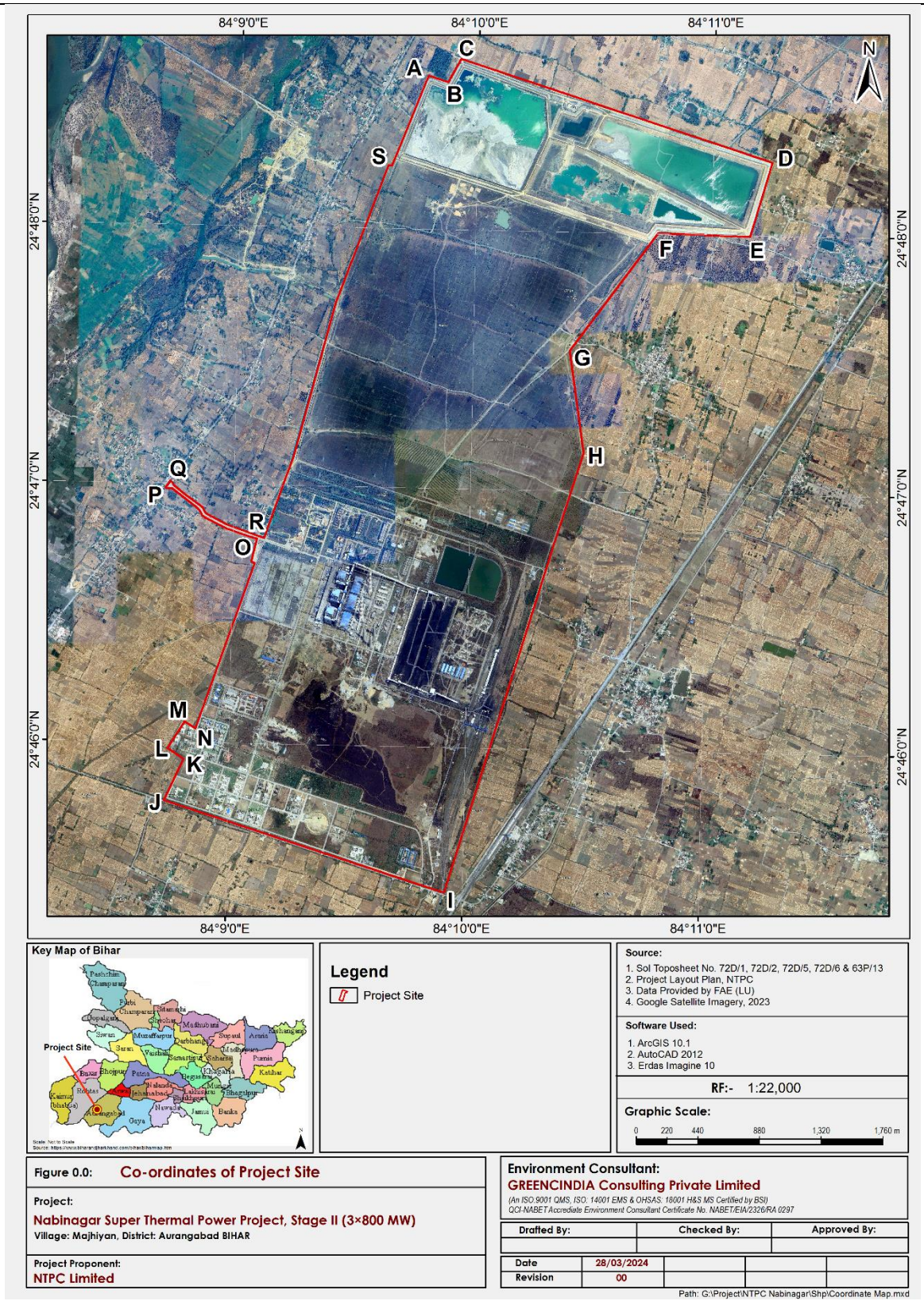
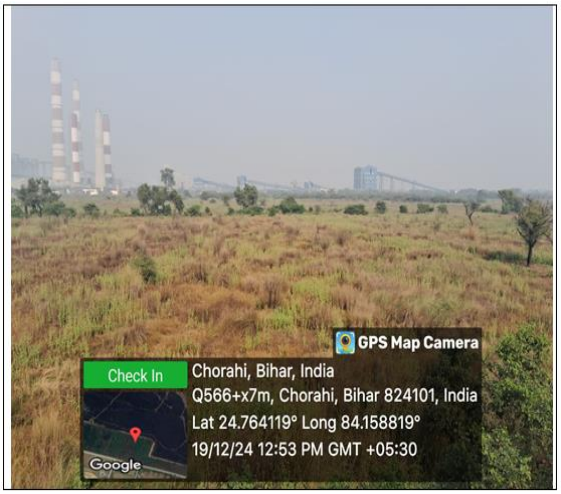


Figure 1.3: Coordinate Map for the Proposed Project

STAGE-II - MAIN PLANT AREA



STAGE-II - SWITCHYARD AREA

Figure 1.4: Proposed Area for Nabinagar STPP Stage-II

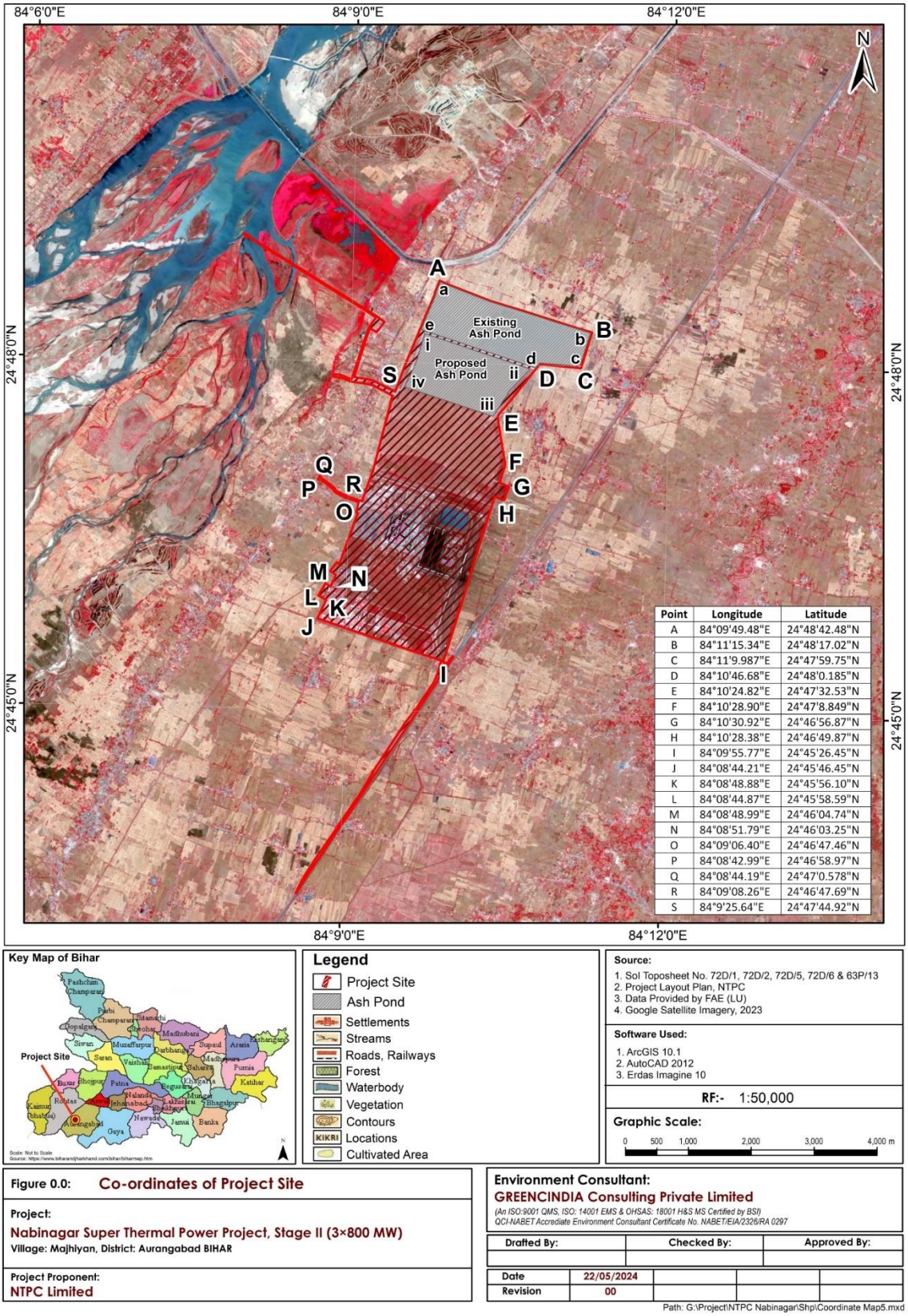


Figure 1.5: Coordinate Map including existing and proposed ash dyke, water intake point and railway siding for the Proposed Project

Table 1.2: Ash dyke coordinates

Existing ash dyke		
a	84°9'49.884"E	24°48'41.85"N
b	84°11'15.29"E	24°48'17.20"N
c	84°11'09.72"E	24°47'59.98"N
d	84°10'44.66"E	24°47'58.59"N
e	84°09'39.59"E	24°48'17.15"N
Proposed ash dyke		
i	84°9'41.799"E	24°48'15.03"N
ii	84°10'41.41"E	24°47'57.94"N
iii	84°10'21.18"E	24°47'33.14"N
iv	84°9'31.145"E	24°47'47.46"N

1.4 DEMAND JUSTIFICATION

Electricity is a crucial component of a country's infrastructure, essential for economic growth. The proposed Nabinagar STPP Stage-II (3x800 MW) is planned as a base load power station to fulfil the electricity demand of the Eastern Region as well as other regions of the country.

1.4.1 DEMAND SUPPLY

As of 31st May 2024, the installed capacity of India (classified by fuel type) is as follows:

Table 1.3: All India Installed Generation Capacity (Fuel-Wise) *

Category			Installed Generation Capacity (MW)
Fossil Fuel (A)	Coal		2,05,235
	Lignite		6,620
	Gas		24,824
	Diesel		589
	Total		**2,37,269**
Non-Fossil Fuel	**RES (Incl. Hydro) (B+C) = D**		**1,73,219**
	Hydro (B)		**46,850**
	Wind, Solar & Other RE (C)		
	Wind	42,868	
	Solar	67,078	
	Bio-Mass Power/Cogen.	10,248	
	Waste to Energy	554	
	Small Hydro Power	4,994	
	Total (Wind, Solar & Other RE)		**1,25,692**
	Nuclear (E)		**6,780**
	Total Non-Fossil Fuel: (D+E)		**1,79,322**
	Total Installed Capacity (A+D+E) (Fossil Fuel & Non-Fossil Fuel)		**4,17,668**

* Source: MOP Website, based on data gathered by the Central Electricity Authority (CEA), power generation has shown an increase over the past years, as outlined below:

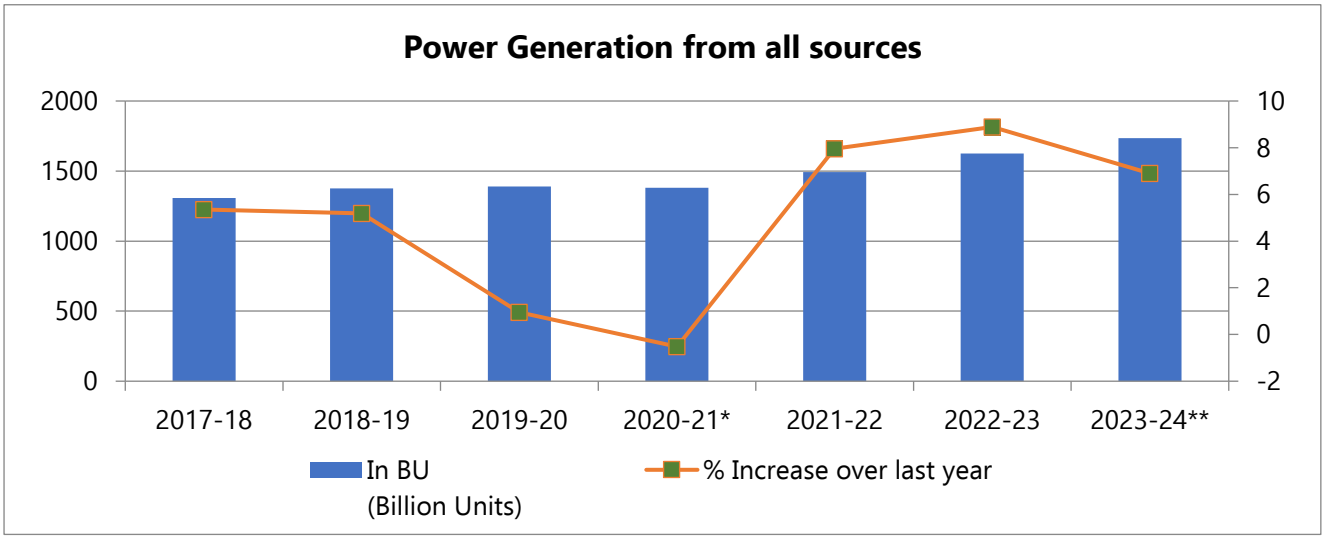


Figure 1.6: Power Generation from all sources over previous five years

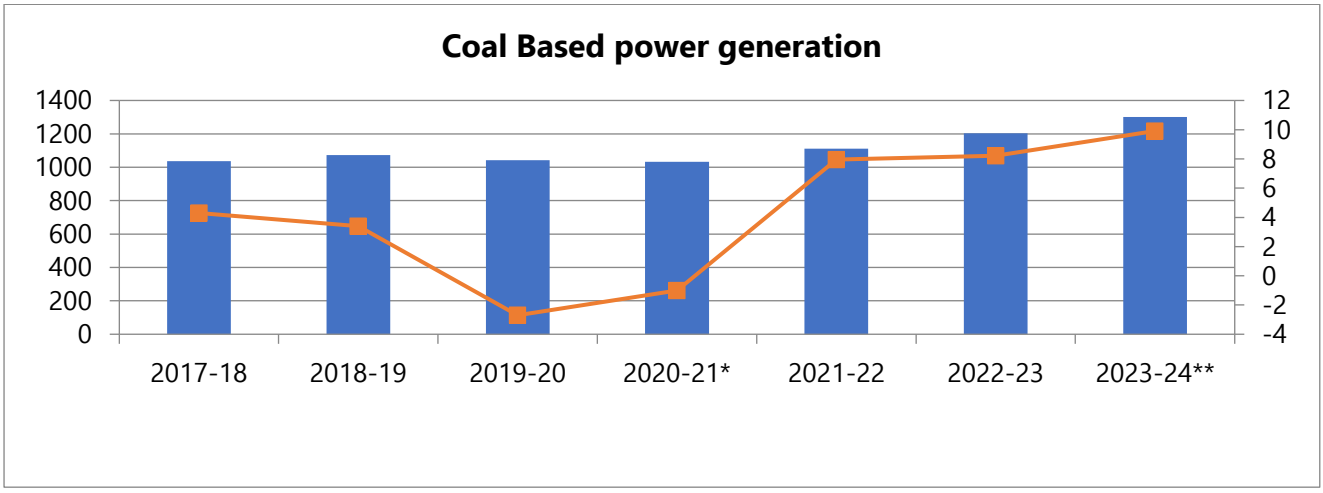


Figure 1.7: Coal Based power generation over previous five years

Table 1.4: All India power generation over previous five years

Year	Power Generation from all sources		Coal Based power generation	
	In BU (Billion Units)	% Growth over last year	In BU	% Growth over last year
2017-18	1308.1	5.35	1037.1	4.3
2018-19	1376	5.19	1072.2	3.4
2019-20	1389.1	0.95	1042.7	(-) 2.7
2020-21*	1381.8	(-) 0.52	1032.5	(-) 1.0
2021-22	1491.8	7.96	1111.8	7.96
2022-23	1624.4	8.89	1202.9	8.21
2023-24**	1736	6.90	1301.7	9.91

** In the year 2020-21, power generation was affected mainly due to less demand during the Covid-19 pandemic*

*** Up to December (Provisional)*

1.4.2 PEAK DEMAND AND ENERGY REQUIREMENT FORECAST FOR 2029-30

The studies have incorporated the projections from the 20th Electric Power Survey (EPS) regarding peak electricity demand and electrical energy requirement for the country. The table below presents the projected region-wise and national peak electricity demand (in gigawatts, GW) and electrical energy requirement (in billion units, BU) for the year 2029-30.

Table 1.5: Peak Demand and Energy requirement forecast for 2029-30

Region	Peak Demand (GW)	Electrical Energy Requirement (BU)
Northern	116.7	707.55
Western	107	713.08
Southern	97.4	547.4
Eastern	45.7	282.26
North-Eastern	5.8	29.35
All India	334.8*	2279.64

** Summation of al regional peaks to all india peak may differ due to diversity factor*

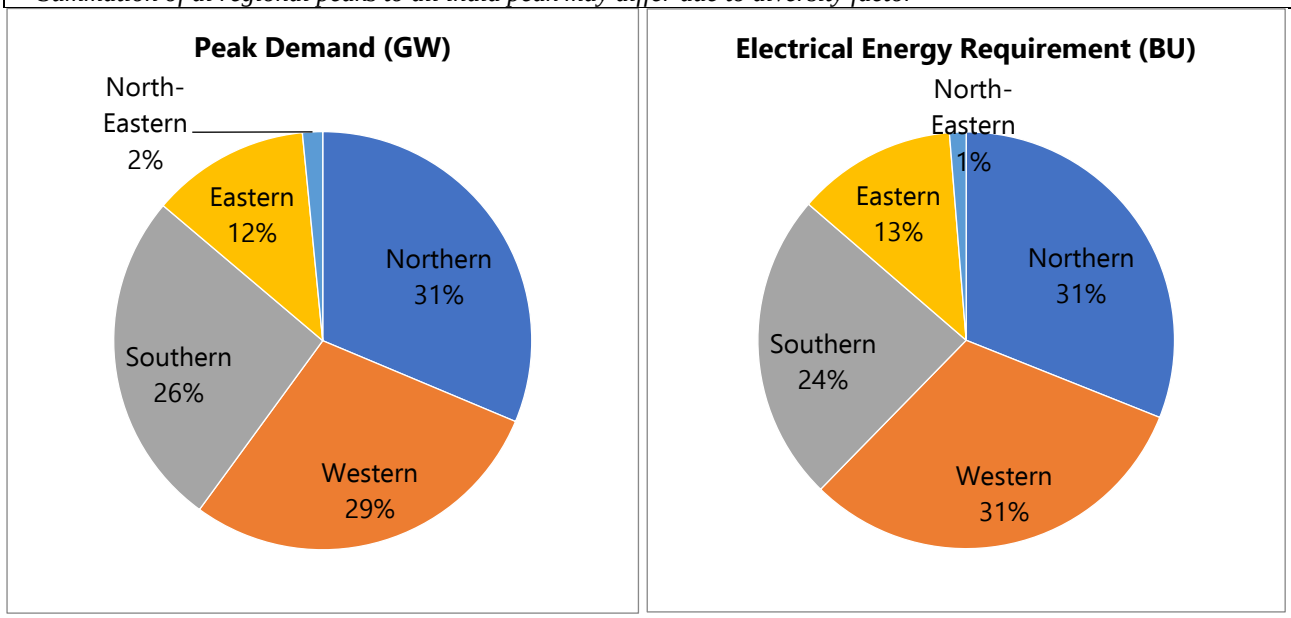


Figure 1.8: Peak Demand and Energy requirement forecast for 2029-30

According to a recent study conducted by the Central Electricity Authority (CEA) on the optimal generation capacity mix for the year 2029-30, the estimated total installed capacity for India in 2029-30 is projected to be 7,77,144megawatts (MW).

Fuel Type	Capacity (MW) by 2029-30
Hydro	53,860
PSP	18,986
Small Hydro	5,350
Coal + Lignite	2,51,683

Gas	24,824
Nuclear	15,480
Solar	2,92,566
Wind	99,895
Biomass	14,500
Total	**7,77,144**

According to the Central Electricity Authority (CEA), the likely installed capacity for Coal & Lignite based power generation is estimated to be 266.9 GW by end of year 2029-30, which was about 211 GW by May 2024.

1.4.3 SAUBHAGYA' SCHEME

The Government of India (GOI) initiated the Pradhan Mantri Sahaj Bijli Har Ghar Yojana – Saubhagya in October 2017 with the aim of achieving universal household electrification. This program seeks to provide electricity connections to all willing unelectrified households in rural areas and all willing poor households in urban areas across the country. Since the launch of Saubhagya, a total of 2.817 crore households, including tribal households, have been electrified up to 31.03.2021.

1.4.4 CONCLUSIONS

Electricity is a cornerstone of national infrastructure, driving economic development and enhancing quality of life. The proposed Nabinagar STPP Stage-II (3x800 MW) aims to support this growth by providing a significant boost to the power supply in the Eastern Region and beyond. As of May 2024, India's total installed power generation capacity stands at 417,668 MW, with substantial contributions from both fossil fuels and renewable sources.

The Central Electricity Authority (CEA) has observed a consistent increase in power generation, with notable growth in both overall and coal-based electricity production over recent years. Projections for 2029-30 indicate that India's installed capacity could reach approximately 777,144 MW, with significant expansions in solar and wind energy, alongside traditional coal and hydro power.

Programs like the Pradhan Mantri Sahaj Bijli Har Ghar Yojana (Saubhagya) have been instrumental in expanding electricity access, achieving significant milestones in household electrification. These developments underscore the crucial role of electricity in supporting India's economic progress and the need for continued expansion and diversification of the energy sector to meet future demands.

1.5 PURPOSE OF THE REPORT

As per Environment Impact Assessment Notification dated 14thSeptember 2006, as amended from time to time, commissioning or operation of thermal power plants (>500 MW) falls under category 'A' under project type 1(d) and requires prior Environmental Clearance (EC) from MoEF&CC before the commencement of ground activity.

In line with the said Notification, TOR application for Environmental Clearance (EC) was submitted to MOEF&CC vide proposal no. IA/BR/THE/462996/2024 dated 16/02/2024. MoEF&CC has accorded Standard Terms of Reference along with Specific/additional ToR vide TOR Identification No. TO24A0601BR5124391N Dated 15.04.2024 to NTPC Ltd for expansion of Nabinagar Super Thermal Power Project, Stage-II 3X800 MW **(A copy of MOEF&CC Approved TOR is enclosed as Annexure-1.1).** Based on the TOR conditions stipulated by MoEF&CC vide TOR ID No as mentioned above, the present EIA/EMP report has been prepared. This report has been prepared for assessing the environmental impacts on the study area (10-km radius around the plant) due to the proposed power plant on the basis of approved ToR issued by MoEF&CC. The TOR compliance is enclosed as **Annexure 1.2**. This includes a Cumulative Impact Assessment Study, considering a buffer area of 15 km, to

assess the potential impacts of the proposed expansion activities. Draft EIA-EMP Report including ToR Compliances. Bihar State Pollution Control Board (Bihar SPCB), Bihar has conducted Public Hearing on 13th November 2024. MoM of Public Hearing is issued on 30th December, 2024 and is enclosed as **Annexure- 1.3.** The Public Hearing Action Plan is enclosed in Chapter-7.

1.6 SCOPE OF THE STUDY

NTPC Limited has appointed Greencindia Consulting Private Limited (GCPL) Ghaziabad to prepare the Environment Impact Assessment report for the proposed expansion project to facilitate & obtain Environment Clearance for the same from Ministry of Environment, Forest& Climate Change (MoEF&CC), Government of India. The report is prepared for various environmental components including air, noise, water, land and biological components along with parameters of human interest which may be affected and to prepare an EIA & EMP for mitigating adverse impacts. The steps involved in conducting the EIA&EMP Study are as follows:

- Conduct literature review, collate and compile secondary data including socio-economic data from published literature / government publications.
- Undertake environmental monitoring through field sampling so as to establish the baseline environmental status of the study area.
- Identify existing pollution source and load due to various activities in the ambient levels.
- Identify the basic environmental status including the meteorological parameters and socioeconomic environment of the proposed study area.
- Predict incremental levels of pollutants in study area due to the proposed plant activities.
- Evaluate the predicted impact on the various environmental attributes in the study area by using scientifically developed and widely accepted environmental impact methodologies.
- Prepare an environmental management and monitoring plan outlining the measures for improving the environmental quality for environmentally sustainable development.
- Prepare Risk Assessment and Disaster Management Plan and undertake Additional studies if required.
- Undertake Cumulative Impact Assessment Study

1.7 METHODOLOGY OF THE STUDY

M/s Greencindia Consulting Private Limited, NCR, Ghaziabad and officials of Nabinagar STPP along with the officials of M/s Eco Care, Asansol had conducted a reconnaissance survey and sampling locations were identified on the basis of:

- Predominant wind directions in the study area as recorded by India Meteorological Department (IMD) at Dehri;
- Existing topography;
- Location of surface water bodies like ponds, canals and rivers;
- Location of villages/towns/sensitive areas;
- Accessibility, power availability and security of monitoring equipment; pollution pockets in the area;
- Areas which represent baseline conditions; and
- Collection, collation and analysis of baseline data for various environmental attributes.

Primary Environmental Baseline Data survey was conducted by M/s Eco Care, Asansol which is an NABL accredited and MoEF&CC approved laboratory.

The study also provides framework and institutional strengthening for implementing the mitigation measures. Field studies were conducted for a period of three months representing Pre-Monsoon Season to determine the existing conditions of various environmental attributes as outlined in **Table-1.6**.

Table 1.6: Baseline Study Parameters & their frequency

Attributes	Parameters	Source and Frequency
Ambient Air Quality	SO_2, NO_X (NO_2), PM_{10}, $PM_{2.5}$, CO, O_3 & Hg and other AAQ parameters as per NAAQS standard.	24 hourly samples twice a week for one season at 10 locations. For CO, O_3 & Hg, 8 hourly standard is being considered
Meteorology	Wind speed and direction, temperature, relative humidity and rainfall	Near project site continuous for one season with hourly recording and from secondary sources of IMD station at Raipur.
Water quality	Physical parameters: Temperature, Turbidity, Colour, Electrical Conductivity, TSS, TDS etc., pH, DO, Alkalinity, Hardness, BOD, COD, NO_3, PO4, Cl, F, SO_4, Na, K, Ca, Mg, Silica, Oil & Grease, Phenolic compounds., Bacteriological: MPN and Total coliform, Heavy Metals (As, Hg, Pb, Cd, Cr^{-6}, Total Cr, Cu, Zn, Se, Fe).	Samples were collected at 06 ground water (including locations within 2 km radius of site) and 06 surface water locations once in a month.
Ecology	Existing terrestrial and aquatic flora and fauna within 10-Km radius circle.	Primary Survey conducted by ecological experts. Secondary data was collected from the Forest Department.
Noise levels	Noise levels in dB(A)	At 10 locations data monitored once for 24 hours during study season
Soil Characteristics	Classification, Texture, pH, Conductivity, Cation Exchange Capacity (CEC), N, P, K, Heavy Metals etc., Phreatic Surface/ Ground water level	Grab sample once at 10 locations
Land use of India topo-sheet and latest satellite imagery	Trend of land use change for different categories	Based on Survey of India topo-sheet and latest satellite imagery
Socio-Economic aspects	Socio-economic and demographic characteristics, worker characteristics	Based on primary limited survey and secondary sources data like primary census abstracts of Census of India 2001 & 2011.
Need-assessment & CSR Plan	Village-level information Village Level Survey and	Village Level Survey and Public Consultation for villages within 10-km radius
Hydrology	Drainage area and pattern, nature of streams, aquifer characteristics, recharge and discharge areas	Based on data collected from secondary sources as well as hydrology, hydro-geology study report prepared separately

Risk Assessment and Disaster Management Plan	Identify areas where disaster can occur by fires and explosions and release of toxic substances	Based on the findings of Risk Modelling done for the risk associated with LDO / HFO Fire and chlorine leakage

1.8 PROCESS OF OBTAINING THE ENVIRONMENT CLEARANCE

As per the EIA Notification 2006, projects are classified into Category A or Category B projects based on spatial extent of potential impacts on human health and natural and man-made resources. 'Category A' projects require prior environmental clearance by the Expert Appraisal Committee, MoEF&CC, and Government of India while Category B projects have to get prior environmental clearance from the State level Expert Appraisal Committee. The environmental clearance process for new projects will comprise of a maximum of four stages. The four stages in sequential order are: -

- Stage (1) Screening (only for Category 'B' projects and activities)
- Stage (2) Scoping
- Stage (3) Public Consultation
- Stage (4) Appraisal

1.8.1 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 is done at State level to categorize project in 'B1' or 'B2'. The 'B2' projects do not require detailed EIA study and preparation of EIA Reports. Since the present project comes under category 'A' so it doesn't need screening.

Table 1.7: Project Categorization

Project or Activity		Category with threshold limit		Conditions if any
		A	B	
1 (d)	Thermal Power Plants	≥ 500 MW (coal/lignite/naphtha & gas based);	Not required as the project falls in Category A	General Condition shall apply Note: 1. Thermal Power plants up to 25 MW based on biomass or non-hazardous municipal solid waste using auxiliary fuel such as coal, lignite / petroleum products up to 15% are exempted. 2. Thermal power plants using waste heat boilers without any auxiliary fuel are exempted.

1.8.2 STAGE (2)

Scoping: It refers to the process by which the Expert Appraisal Committee (for Category 'A' projects) and State level Expert Appraisal Committee (for Category 'B1' projects), determines detailed and comprehensive Terms of Reference (TOR) for all Greenfield or expansion projects. The ToR addresses all relevant environmental concerns for the preparation of an Environment Impact Assessment (EIA) report in respect of the project or activity for which prior environmental clearance is sought.

1.8.3 STAGE (3)

Public Consultation: It refers to the process by which the concerns of local affected persons and others who have plausible stake in the environmental impacts of the project or activity are ascertained with a view to taking into account all the material concerns in the project or activity design as appropriate. The public consultation takes part in two steps: Pubic Hearing and written responses.

1.8.4 STAGE (4)

Appraisal: This process refers to the detailed scrutiny of the application for environment clearance, EIA Report and other related documents by the Expert Appraisal Committee or State-level Expert Appraisal Committee.

1.9 ENVIRONMENT LEGISLATIONS

The environmental regulations, legislations and policy guidelines and control that may impact the project are the responsibility of a variety of Government agencies. The principal environmental regulatory agency in India is the MoEF&CC, Govt. of India. MoEF&CC formulates environmental policies and also accords environmental clearance for different category projects.

Many State and Central legislations have a bearing on environment but laws on environment protection have been notified recently. These legal enactments can be broadly classified in the terms of focus areas, viz. pollution, natural resources and linkages between pollution and natural resources. The important environment legislations related to new project and expansion projects are briefly described in the **Table 1.7.**

Table 1.8: List of Environment Legislations

Name	Scope and Objectives	Key Areas	Operational Agencies
Wildlife Protection Act 1972	To provide for protection of wild animals, birds and plants; and for matters connected therewith	Wildlife protection in forest areas	Central Govt., nodal agencies MOEF&CC
Water (Prevention and Control of Pollution) Act 1974	To provide for prevention & control of water pollution and enhancing water quality	Control of sewage and industrial effluent discharges	Central and State Pollution Control Boards
Forest Conservation Act 1980	To halt rapid deforestation and resulting in environmental degradation	Restriction on de-reservation & using forest for non-forest purpose	Central and State Government
Air (Prevention and Control of Pollution) Act 1981	To provide for prevention and control of air pollution	Controls emission and air pollutants	Central and State Pollution Control Boards
Environment Protection Act 1986; Environment Protection Rules 1989.	To provide for protection and improvement of environment	An umbrella legislation; supplements pollution laws	Central Govt. MoEF&CC, can delegate power to Department of Environment
Manufacture, Storage and import of Hazardous Chemical Rules, 1989 and their amendments	To impose restrictions and prescribe procedures for manufacture, storage & import of hazardous chemical	To Any facility manufacture, storage & import of hazardous chemical	Central and State Pollution Control Boards

Name	Scope and Objectives	Key Areas	Operational Agencies
Public Liability Insurance Act, 1991	To provide for public liability insurance for the purpose of providing immediate relief to the persons affected by accident occurring while handling any hazardous substance and for matters connected therewith or incidental thereto.	To provide public liability insurance during risk material handling	Central Government, Nodal Agencies MoEF&CC, State Govt.
Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996 and their amendments.	To effectively deal with Chemical emergency. Emergency Planning, Preparedness & accident reporting	Any facility using hazardous chemicals	Central and State Govt.
Noise Pollution (Prevention & Control) Rules 2000 and their amendments	To control and take measures for abatement of noise and ensure that level remain within standard	Noise in urban area and around industrial sites	Central Government, nodal agencies MoEF&CC, State governments
Environment Impact Assessment. (EIA) notification, 2006 and their amendments	To grant environmental clearance for the establishment or expansion of an industry on the basis of the potential environmental impact of the project.	To apply all new projects or activities and Expansion and modernization of existing projects or activities listed in its Schedule	MoEF&CC& SEIAA
Hazardous Waste Management and Handling Rules 2016 and their amendments	To impose restrictions and prescribe procedures for management, handling and disposal of hazardous waste	Any facility producing hazardous waste	Central and State Pollution Control Boards
Solid Waste Management Rules, 2016 and their amendments	To impose restrictions and prescribe procedures for management, handling and disposal of solid waste	To apply every waste generator	Central & State Pollution Control Board
Plastic Waste Management Rules, 2016 and their amendments	To impose restrictions and prescribe procedures for management, handling and disposal of plastic waste	To apply every waste generator	Central & State Pollution Control Board
Construction & Demolition Waste Management Rules, 2016	To impose restrictions and prescribe procedures for management, handling and disposal of construction &demolition Waste	To apply everyone who generates construction and demolition waste.	Central & State Pollution Control Board

Name	Scope and Objectives	Key Areas	Operational Agencies
Bio-medical Waste Management Rules, 2016 and their amendments	To impose restrictions and prescribe procedures for management, handling and disposal of Bio-medical Waste	To apply everyone who generates Bio-medical waste	Central & State Pollution Control Board
E-Waste (Management) Rules, 2016 and their amendments	To impose restrictions and prescribe procedures for management, handling and disposal of E-waste	To apply everyone who generates e-waste	Central & State Pollution Control Board
Ash Utilisation Notification, 2021 and their amendments	To impose restrictions and prescribe procedures for Management& Utilization of Fly Ash	To apply every coal or lignite based thermal power plant (including captive or co-generating stations or both)	Central & State Pollution Control Board
Battery Waste Management Rules, 2022 and their amendments	To impose restrictions and prescribe procedures for management, handling and disposal of Bio-medical Waste	To apply everyone who generates batteries waste	Central & State Pollution Control Board

1.9.1 POLLUTION STANDARDS

The MoEF&CC is the nodal agency to set up policy, Guidelines, and standards for the protection of environment, along with Central Pollution Control Board (CPCB). This includes air, noise, water, solid waste, e-waste, battery waste and hazardous waste standards etc. NTPC Nabinagar shall follow all the acts, its rules, pollution/emission standards guidelines prescribed by MoEF&CC and Bihar State Pollution Control of Board/CPCB as applicable.

1.10 STATUTORY CLEARANCES

The list of statutory clearances, NOC, approvals of existing Nabinagar Super Thermal Power Project, Stage-I (3X660) MW is given in **Table-1.8.**

Table 1.8: List of Statutory Clearances

Sr. No.	Statutory Clearances	Issuing Authority	Letter No	Date of Issue	Remarks
1	3x660 MW Super-critical Technology Coal Based Nabinagar Thermal Power Plant at village Majhiyan, in Nabinagar Taluk, in Aurangabad District in Bihar, **Environmental Clearance**	MOEF&CC	J-13012/127/2007-IA.II(T)	27.12.2010	**Annexure-1.3**
2	3x660 MW Super-critical Technology Coal Based Nabinagar Thermal Power Plant	MOEF&CC	J-13012/127/2007-IA.II(T)	20.03.2018	**Annexure-1.4**

Sr. No.	Statutory Clearances	Issuing Authority	Letter No	Date of Issue	Remarks
	Extension of validity of EC				
3	3x660 MW Super-critical Technology Coal Based Nabinagar Thermal Power Plant **Extension of validity of EC**	MOEF&CC	J-13012/127/2007-IA.II(T)	14.01.2020	**Annexure-1.5**
4	"Makeup Water and Storm Drain Scheme" for Nabinagar Super Thermal Power Project (STPP) **Forest Clearance-Stage-I**	MOEF&CC	FP/BR/THE/32163/2018/3115	03.05.2019	**Annexure-1.6**
5	"Makeup Water and Storm Drain Scheme" for Nabinagar Super Thermal Power Project (STPP) **Forest Clearance-Stage-II**	MOEF&CC	FP/BR/THE/32163/2018/3594	15.11.2019	**Annexure-1.7**
6	**NOC/Consent to Establish** for Stage-I	Bihar SPCB	PT(NOC)-1008/09	08.04.2011	**Annexure-1.8**
7	**Emission Consent Order** for Stage-I	Bihar SPCB	1839	15.06.2022	**Annexure-1.9**
8	**Discharge Consent Order** for Stage-I	Bihar SPCB	1840	15.06.2022	**Annexure-1.10**
9	**Hazardous Waste Authorization** for Stage-I	Bihar SPCB	HW/B-2977	03.07.2020	**Annexure-1.11**
10	**Bio-Medical Waste Authorization**	Bihar SPCB	BMW/1794/20/B-3403	19.08.2020	**Annexure-1.12**

1.11 ORGANISATION & CHAPTERIZATION OF REPORT

The chapters of the Final EIA&EMP Report are based on EIA Notification, 2006 & amendments.

Chapter 1: Introduction: The present chapter gives brief outline of the project and its proponent, power scenario in India, brief description of the nature, size, and location of the project and its importance, and extent of the EIA study, including the scope of the study.

Chapter 2: Project Description: The description of the power generation process and the various features of the proposed power plant incorporating utilities, water, fuel requirements are described in this chapter.

Chapter 3: Description of the Environment: This chapter presents the methodology and finding of the field studies covering physical, biological and socio-economic environments, carried out to ascertain the baseline environmental condition of the study area. It includes the information regarding physical condition, water and air environment, soil characteristics, noise level, ecology and the socio-economic status of the area.

Chapter 4: Impacts Assessment & Mitigation Measures: This chapter provides details of the impact assessment of the project during construction and operational phase. It expresses the impacts of the proposed project on the various components of environment. The mathematical modelling exercise pertaining to prediction of ground level concentration of air pollutants have also been dealt in this chapter. Mitigation measures are suggested along with the impact prediction.

Chapter 5: Analysis of Alternatives: This chapter describes systematic comparisons of feasible alternatives for the proposed project site, technology, and operational alternatives. Alternatives have been compared in terms of their potential environmental impacts, suitability under local conditions, and institutional training and monitoring requirements.

Chapter 6: Environmental Monitoring Programme: The monitoring of environmental parameters in construction as well as in operation phase of the project for assessing the impact and the organization structure, which will be responsible for environment monitoring have been detailed in this chapter.

Chapter 7: Additional Studies: This chapter provides details of the additional studies conducted as per the stipulation of the ToR as well as the details of the public hearing. The risk assessment included in this chapter provides information regarding the activities associated with the project likely to pose a risk to man, environment or property. Computation of risk assessment has been covered in this chapter. It also provides details regarding precautionary measure to be taken. This section also presents a brief outline of Wildlife Conservation Plan, Hydrogeology Study and Socio-economic Needs Assessment Study conducted separately as per the requirement of this study.

Chapter 8: Project Benefits: This chapter includes the benefits likely to accrue and improve the physical & social infrastructures for the local community in particular and region in general.

Chapter 9: Environmental Cost Benefit Analysis: This chapter evaluates the economic pros and cons of projects affecting the environment by comparing costs like pollution with benefits such as improved air quality.

Chapter 10: Environment Management Plan: This chapter deals with the management plan and enhancement measures incorporating recommendations to mitigate the adverse impact likely to occur on environmental parameters during construction and operation phase. Post project monitoring and organization structure for environment management have been also provided in the chapter.

Chapter 11: Summary & Conclusion: This chapter will constitute the summary & conclusion of the EIA& EMP Report

Chapter 12: Disclosure of the Consultant Engaged: The detailed profile of the consultants along with their capabilities and experience are highlighted in this chapter.

Chapter 13: Cumulative Assessment Study: This chapter addresses the combined impact of the proposed project and other potential sources of environmental pollution, as well as their management strategies.

2. Project Description

2.1 PROJECT FEATURES

NTPC Limited is planning to expand the Nabinagar Super Thermal Power Station by adding 2400 MW (3x800 MW) of Ultra Super Critical Technology to the existing 1980 MW (3x660 MW) capacity at the available land of project site at Majhiyan village, Nabinagar taluka, Aurangabad district, Bihar. Details of the project features and related information are provided in **Table 2.1**, and the layout for the existing and proposed plant is illustrated in **Figure 2.1**.

Table 2.1: Project Design Features

Item	Main Design Parameters
Capacity & Unit Configurations:	Under Operation: Stage-I: 1980 MW (3x660 MW) Super Critical Technology Proposed Expansion: Stage-II: 2400 MW (3x800 MW) Ultra Super Critical Technology
Location of the Project	Nabinagar Super Thermal Power Project (Nabinagar STPP) is located on the right bank of Sone River near Majhiyan Aurangabad District of Bihar.
Land	A total of 1202.88 hectares of land has been acquired to accommodate the Nabinagar Super Thermal Power Plant. Approximately 607.28 Ha of this land has been utilized for Stage-I. The remaining 595.60 ha of land will be utilized for Stage-II Units, its Ancillary Facilities, and Ash Disposal Area.
Primary Fuel & Requirement	• Nabinagar STPP Stage-I operates with Super Critical Technology. The annual coal requirement for Stage-I is 11.25 million tonnes, based on a Gross Calorific Value (GCV) of 3400 kcal/kg and a Plant Load Factor (PLF) of 90%. • Nabinagar STPP Stage-II shall utilise Ultra Super Critical Technology, offering higher efficiency compared to Super Critical Technology. The estimated coal requirement for Stage-II is approximately 10.24 million tonnes per annum (MTPA), with an 85% Plant Load Factor (PLF) and a Gross Calorific Value (GCV) of 4000 kcal/kg. • Standing Linkage Committee (Long-Term) in its meeting held on 03.01.2024 have recommended for the grant of coal linkage to the project. Coal linkage source allocated from ECL & BCCL for Nabinagar STPP Stage-II vide CIL letter dated 20.06.2024.
Fuel Transportation	• The transportation of coal from the coal mines to the power plant is envisaged by Indian Railways. • Augmentation of existing railway siding shall be done for handling additional rakes for Stage-II.
Support Fuel	• Light Diesel Oil (LDO) will be used for initial startup and as secondary fuel for pulverized coal flame stabilization during low

Item	Main Design Parameters
	load operations. An oil supply system with pumps, filters, and valves will be installed. • Burners and air registers will operate independently with automatic purging and sequencing. Ignition will be direct with igniters. • The LDO system will support up to 30% of the Steam Generators' capacity. Oil firing for flame stabilization will not exceed 40% of the TMCR for Steam Generators.
Water Requirement	• The water requirement for Stage-I of the project is approximately 1,42,560 KLD (5940m^3/hour) based on water cooled condenser system. • For the Nabinagar-II (3x800 MW) project, the water requirement is expected to be around 72,000 KLD (3000 m^3/hour) with an ash water recirculation system and Air Cooled Condenser (ACC) system.
Source of Water	The Water Resources Department (WRD), Government of Bihar, granted a water commitment of 125 cubic feet per second (Cusecs) (305821.95 KLD) from the River Sone to the Nabinagar project vide a letter dated June 6, 2007. No additional requirement is envisaged
Cooling System	Nabinagar STPP Stage-I utilizes a water cooled condenser system with cooling towers for the condenser and auxiliary cooling. In Nabinagar STPP Stage-II, an Air-Cooled Condenser (ACC) System is planned, significantly reducing water usage.
Coal Handling System	Coal handling facility, which comprises receipt of coal through Rail, with on- line crushing and stacking by stacker-cum-reclaimer in the coal yard and finally feeding the bunker level conveyors.
Ash Disposal System	The ash produced by the project comprises 80% fly ash and 20% bottom ash. Fly ash is collected in dry form from the electrostatic precipitator hoppers, whereas bottom ash is collected in wet form. The disposal system is designed to accommodate the entire ash output. Similar system shall be designed for Stage-II also.
Power Evacuation	The Stage-II project proposes using a 765 kV step-up voltage, consistent with Stage-I. In Stage-I, two 400 kV double-circuit lines were implemented to connect to Patna and Gaya substations for power evacuation. Another 400 kV line to BRBCL is under implementation. For Stage-II, a single 765 kV double-circuit line is proposed for power evacuation.
Rehabilitation Requirement	Nil. Proposed Expansion is within the land owned by NTPC. No additional land will be acquired.
Seismological Information	Zone-III (Moderate Risk Zone)
Project Time Frame	Commercial Operation Date (COD) of first 800 MW unit of Nabinagar STPP Stage-II will be in 60 months from the Investment approval and subsequent units after an interval of 9 months thereafter.

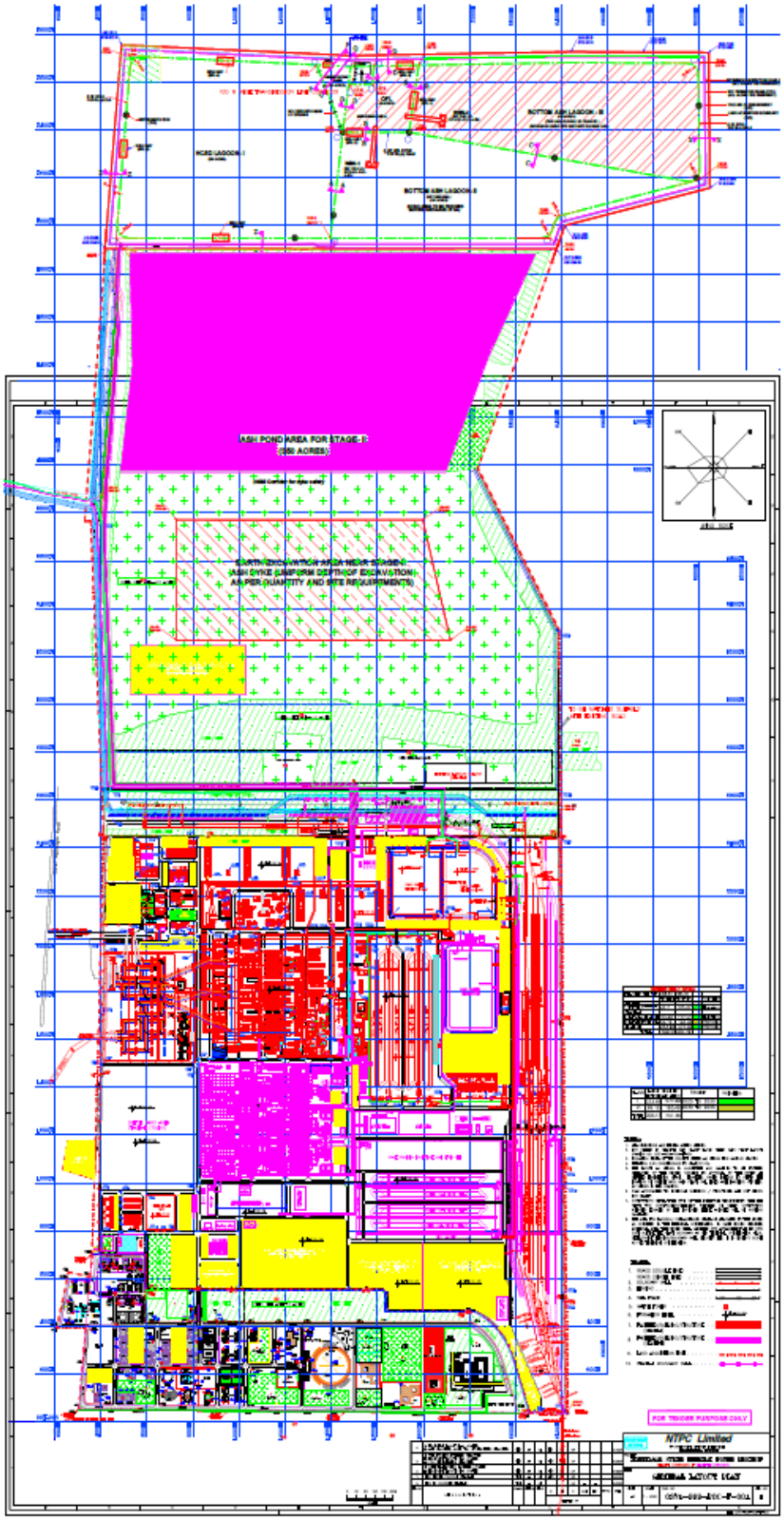


Figure 2.1: Plant Layout (Existing & Proposed)

2.2 BASIC RESOURCE- REQUIREMENT, SOURCE AND AVAILABILITY

2.2.1 LAND REQUIREMENT AND AVAILABILITY

A land area of 1202.88 Ha. has been acquired for the project which includes the existing 3x660 MW unit, land area for accommodation of coal stockyard, water reservoir, township and roads, green verge, etc. The land requirement envisaged for the expansion project considers installation of 3 x 800 MW pulverized coal based Ultra Super-Critical Thermal Power Project. Detailed land breakup is furnished in Table 2.2.

Table 2.2: Land details for Nabinagar STPP (Stage-I & Stage-II)

Sr. No.	Description	Land Utilization (Ha)		
		3x660MW Ph-I	3x800MW Ph-II	Total (Ph-I & II)
A	**Main-Plant Facility**			
i	Main Plant (Ha): BTG, CTs/ACC, Coal Stockpile, WTP, Sw. Yard etc.	115.99	104.85	220.84
ii	Other & Misc Make-up water corridor, Railways siding, Raw Water Reservoir, etc.	112.11	73.15	185.26
iii	Township	58.74	0.00	58.74
iv	Ash Dyke	199.24	141.64	340.88
B	**Green Belt**	121.20	275.96	397.16
C	**Other & Miscellaneous**			
i	Future Plan	0.00	0.00	0
	Grand Total (A+B+C)	**607.28**	**595.60**	**1202.88**

2.2.2 FUEL REQUIREMENT AND SOURCE

2.2.2.1 COAL

Nabinagar STPP Stage-I utilizes Super Critical Technology. The annual coal requirement for Stage-I was calculated at 11.25 million tonnes based on a Gross Calorific Value (GCV) of 3400 kcal/kg and a Plant Load Factor (PLF) of 90%. The maximum daily coal requirement is approximately 35,250 tonnes, calculated based on a GCV of 3400 kcal/kg and a PLF of 100%. Raw coal serves as the primary fuel, sourced from the North Karanpura Coalfields of Central Coalfields Limited.

The coal requirement for Stage-II of the project is projected to be approximately 10.24 million metric tonnes per annum (MTPA) assuming an 85% Plant Load Factor (PLF) with a Gross Calorific Value (GCV) of 4000 Kcal/kg. The daily coal requirement for 3x800 MW units shall be about 33,005 tones based on average gross calorific value of about 4000 Kcal/kg, 100% plant load factor and 2292 Kcal/Kwh unit heat rate. SLC (LT) in its meeting held on 03.01.2024 have recommended for the grant of coal linkage to the project. Coal linkage source allocated from ECL & BCCL for Nabinagar STPP Stage-II vide CIL letter dated 20.06.2024 (**Copies are enclosed as Annexure-2.1 & 2.2).** This coal will be instrumental in meeting the energy requirements of the project, ensuring a reliable and sustainable source of fuel for power generation. Coal Analysis is given in Table 2.3 and are enclosed as **Annexure-2.3** & radio activity analysis as **Annexure-2.4**

Table 2.3: Coal Analysis & Design Parameters

Parameters	Units	Coal Yard (S1)	CHP (S5)
Ash Content	%	40.11	40.54
Sulphur	%	0.48	0.46
Hexavalent Chromium	mg/kg	10.4	11.23
Total Chromium (as Cr)	mg/kg	19	22.99
Zinc (as Zn)	mg/kg	63.73	75.62
Lead (as Pb)	mg/kg	16.65	18.06
Arsenic (as As)	mg/kg	1.46	1.39
Cadmium (as Cd)	mg/kg	0.2	0.17
Mercury (as Hg)	mg/kg	BLQ	BLQ
Copper (as Cu)	mg/kg	23.51	23.48
Iron	mg/kg	9771.1	8357.82
Selenium	mg/kg	2.09	1.94

*BLQ – Below Limit of Quantification

2.2.2.2 AUXILIARY FUEL:

Light Diesel Oil (LDO) will be utilized for initial start-up, low-load operation, and as a secondary fuel for stabilizing the pulverized coal flame during start-ups and low-load operations. The necessary oil supply system, including pumps, filters, and valves, will be provided. Each burner and air register will be equipped with independent pneumatic drives, enabling automatic operation for purging, insertion, and fuel and air sequencing. Ignition of the oil will be carried out directly by igniters. The LDO system will be sized to support up to 30% BMCR (Boiler Maximum Continuous Rating) capacity of the Steam Generators. The design of the Steam Generators will ensure that oil firing for flame stabilization is not required beyond 40% TMCR (Total Maximum Continuous Rating).

Year-wise reduction in the specific diesel consumption (LDO)

The specific oil consumption for Light Diesel Oil (LDO) has shown a consistent reduction over the years, remaining well within the prescribed CERC norms. This improvement highlights the effectiveness of ongoing efforts to optimize fuel usage and enhance operational efficiency. Additionally, a focused plan has been implemented to achieve further reductions in specific oil consumption, demonstrating a strong commitment to sustainability and resource efficiency.

Figure 2.2: Year-wise reduction in the specific diesel consumption (LDO)

Description	CERC Norms	LDO consumption detail		
FY		**FY 2022-23**	**FY 2023-24**	**FY 2024-25 (upto Dec'24)**
Secondary Fuel consumption (KL)		5337.07	4681.47	3488.03
Specific Oil consumption (ml/KWH)	0.5	0.42	0.32	0.33 (Internal plan 0.3 ml/KWH in FY 24-25)

2.2.2.3 Fuel Transportation:

Nabinagar STPP is linked to the Indian Railway network via Barkisalaiya and Ankorah railway stations. Coal supply for Nabinagar Stage-II (3x800 MW) is planned from ECL & BCCL vide CIL letter dated 20.06.2024 with transportation by rail. Augmentation of existing railway siding to accommodate additional rakes for Stage-II coal transportation, shall be done.

The secondary fuel for the proposed Power Project i.e. LDO/HSD shall be sourced from the refineries located nearer to the Project by railway wagons/road tankers.

2.2.3 WATER REQUIREMENT AND SOURCE

In a conventional fossil fuel-fired thermal power Project, water is used to meet the following consumptive requirements: -

a) To meet cooling requirement for steam condenser which acts as a heat sink for the thermodynamic cycle and other auxiliary cooling such as, bearing/lube oil coolers, compressors, generator stator, etc.
b) To meet the heat cycle make-up and other process requirements.
c) To meet the water requirement of Flue Gas Desulfurization (FGD)
d) For miscellaneous services viz.
   - Firefighting.
   - General services viz. A/C and ventilation, floor washing etc.
   - Sealing and cooling water for equipment of ash handling system
   - Dust extraction and dust suppression in coal yard
   - Potable use in the Project and housing complex
   - Transport media for ash in case of wet disposal of ash
   - Horticulture

Nabinagar Super Thermal Power Plant (STPP) Stage-I employs a Water-Cooled Condenser System (WCC) integrated with Cooling Towers, necessitating a substantial water demand of approximately 1,42,560 KLD (5940 m^3/ hour).

Conversely, for Nabinagar STPP Stage-II, an Air-Cooled Condenser (ACC) System is proposed, significantly reducing the water requirement. The projected water demand for Nabinagar-II, a 3x800 MW expansion, is estimated at around 72,000 KLD (3000 m^3/ hour) with use of existing ash water recirculation system.

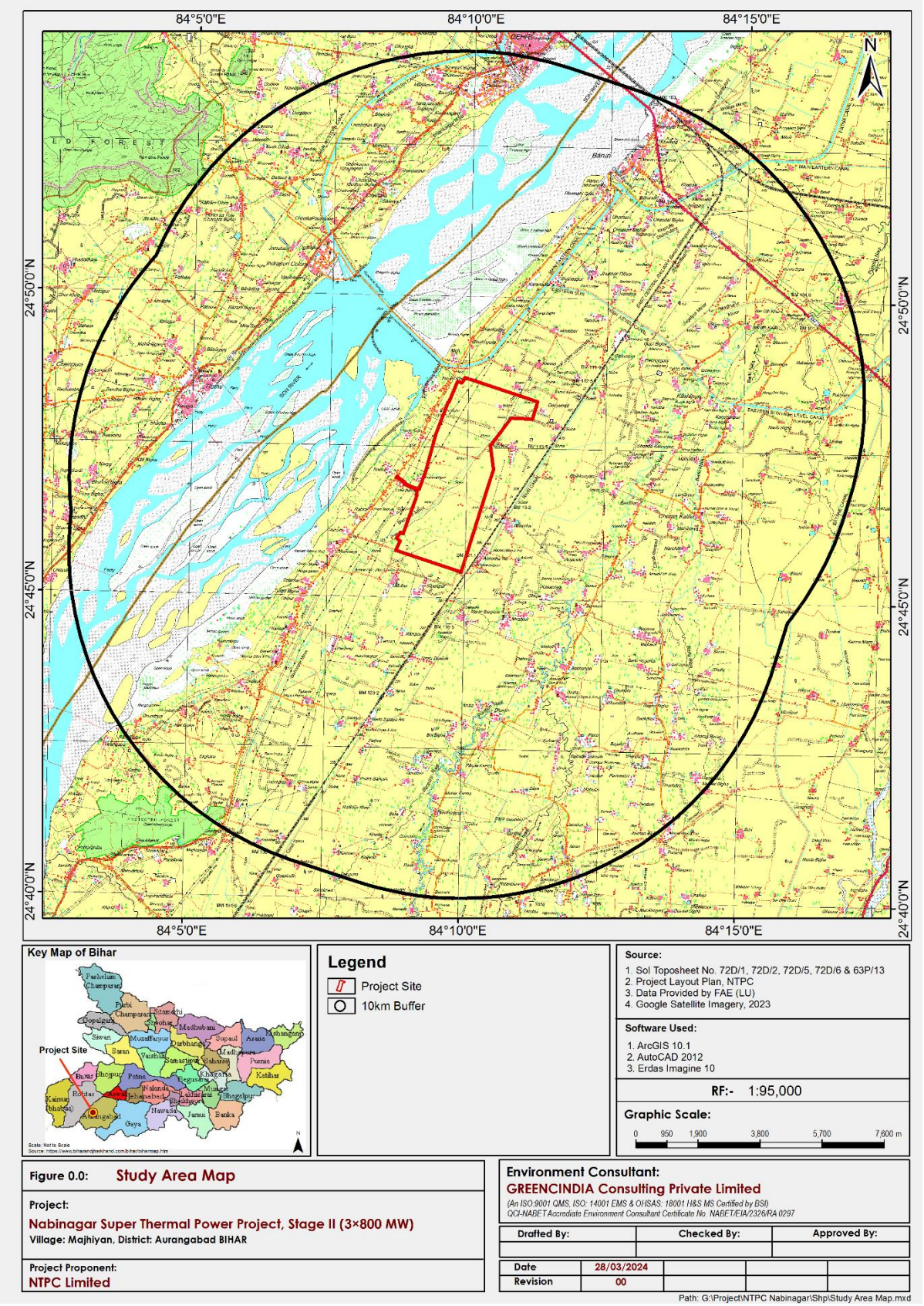


Figure 2.3: Site map on toposheet

The site is located at a distance within 3 km from existing intake point at Indrapuri Barrage on the Sone River. The Water Resources Department (WRD), Government of Bihar, in a communication dated 06.06.2007 **(Copy is enclosed as Annexure-2.5)**, has granted a commitment of 305821.95 KLD (125 cubic feet per second (Cusecs)) from River Sone to the Nabinagar project. Concurrence from the Central Water Commission (CWC) has also been accorded for the entirety of the allocated water. Notably, the water requirements for Stage-II expansion (3x800 MW) will be met through the existing allocation, without necessitating any additional water commitments for the project's expansion.

2.2.4 POWER EVACUATION

Stage-I of the project operates at 765 kV for power evacuation. Under this stage, two 400 kV double-circuit lines to Patna and Gaya Substations have been completed. Another 400 kV line to BRBCL is in progress. Stage-II will include three additional 800 MW units. A proposed 765 kV double-circuit line will evacuate power from Stage-II. Two-line bays will be added for Stage-II. Connectivity and LTA applications will determine the final transmission system.

2.3 PROJECT COST

As per Investment Approval (Nov 2024) Cost of the proposed Expansion Project is Rs. 29,947.91 Crores. The specific project cost appears to be Rs. 12.48 Crores per MW based on the estimated Project Cost. This cost includes cost of FGD for both existing plant and proposed project.

2.4 TECHNOLOGY & PROCESS DESCRIPTION

In a coal-based thermal power plant, the fuel (coal) undergoes a series of conversions to produce electricity. Initially, the chemical energy stored in coal is transformed into thermal energy through combustion. This thermal energy is then utilized to generate mechanical energy by driving a turbine. Finally, the mechanical energy is converted into electrical energy via a generator. The process flow of power generation in a coal-based thermal power plant is illustrated in **Figure 2.4** and involves the following sequential steps:

Coal Preparation and Combustion:

- Coal is transferred to coal bunkers from the coal handling plant via conveyor belts.
- It is then ground into a fine powder in pulverizing mills and mixed with air.
- The coal-air mixture is blown into the boiler by a fan, where it burns, releasing thermal energy.

Steam Generation and Turbine Rotation:

- High-quality demineralized water, known as boiler feed water, lines the boiler tubes.
- The heat from combustion converts boiler feed water into steam at high pressure and temperature.
- The steam is directed through nozzles onto turbine blades, causing the turbine to rotate.
- The rotating turbine drives a generator, producing electrical energy.

Ash Handling:

- During combustion, non-combustible parts of coal form ash.
- About 20% of ash forms lumps, known as bottom ash, which are collected in ash pits.
- Bottom ash is quenched with water, ground, and disposed of or sold.
- The remaining 80% of ash, called Fly Ash, is carried out with flue gas.

Flue Gas Treatment and Ash Collection:

- Flue gas, along with Fly Ash, passes through electrostatic precipitators (ESPs) for ash removal.
- Further flue gases are treated in Flue Gas Desulphurisation (FGD) System and released through a chimney.
- Ash collected in ESP hoppers is conveyed to dry ash storage silos for disposal or industrial use.

Steam Condensation and Reuse:

- Steam, after passing through turbines, is condensed back into water in air-cooled condensers.
- Condensed water is reused as boiler feed water for steam generation.
- Condensing steam lowers the temperature at the turbine exit, enhancing turbine efficiency.

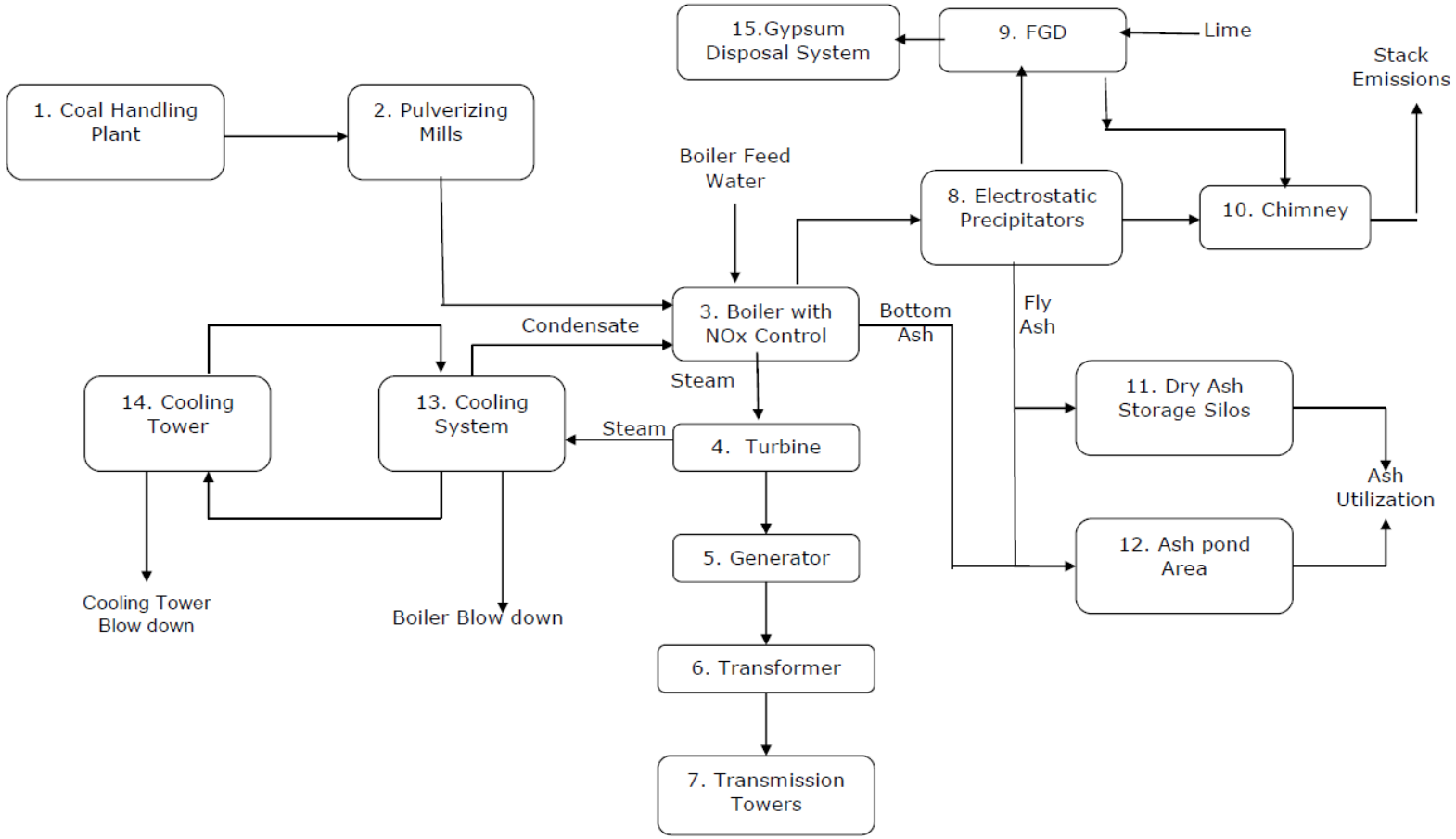


Figure 2.4: Process Diagram for Coal Based Thermal Power Plant

2.5 TURBINE AND ITS AUXILIARIES

Each 800 MW TG unit scope includes the steam turbine and its systems: lube oil, control fluid, condensers, HP & LP bypass, feed heating, condensate pumps, boiler feed water pumps, turbine run-up system, instrumentation, supervisory devices, protection systems, testing system, and EOT cranes in the turbine hall.

2.5.1 STEAM TURBINE

The steam turbine will be a tandem compound, single reheat, regenerative, condensing design with separate HP, IP, and LP casings or combined HP-IP and separate LP casings, directly coupled with the generator for indoor installation. The plant is intended for base load operation with flexibility for two-shift and cyclic modes. The turbine will facilitate quick start-up and loading to full capacity, operating in variable pressure or modified sliding pressure modes. Design specifications include optimizing HRH temperature and ensuring turbine protection against water induction, with details specified for maximum continuous and variable working output capacities.

2.5.2 CONDENSER

For Stage-II, dry cooling will be used with a direct Air-Cooled Condensers (ACC) featuring inclined roof-like finned cooling tubes. Each module includes a roof and fan for air circulation. Tubes will be carbon steel due to cost efficiency over stainless steel. The condenser's hot well will store condensate for 5 minutes of turbine operation. Design follows Heat Exchange Institute (HEI) standards for Air Cooled Condensers (ACC), optimizing surface area based on site data. The ACC includes fin tube bundles, steam distribution manifold, condensate collection headers, and all necessary accessories for efficient operation.

2.5.3 AIR EXTRACTION SYSTEM

Each unit will include 2x100% vacuum pumps, motors, accessories, piping, valves, fittings, duplex filter, and instrumentation for condenser air evacuation. Additionally, a startup air evacuation system with pumps and accessories will be provided. These vacuum pumps remove air and non-condensable gases from the steam condenser during operation, complying with the latest HEI requirements.

2.5.4 LUBE OIL SYSTEM

Each turbine generator will feature a comprehensive self-contained lubrication oil system that meets the bearings' needs, turbine turning gear requirements during startup and shutdown, and jacking oil requirements during gear operation. The system will also supply oil to generator seals under emergency conditions if applicable. Key components include:

- A main oil pump (MOP) driven by the turbine for bearing lubrication and emergency seal oil, with additional AC auxiliary oil pumps (AOP) for turbine startup, shutdown, and standby.
- Alternatively, two 100% AC oil pumps (AOP) can be provided for bearing lubrication and emergency seal oil, capable of startup, shutdown, and standby operations.
- A DC motor-driven emergency oil pump (EOP) to meet bearing lubrication needs during emergencies.
- AC and DC motor-driven jacking oil pumps (as applicable) with interlocks to prevent operation until proper oil pressure is established.
- Each unit's lube oil tank will have sufficient capacity, equipped with non-corrodible strainers, level measuring devices, and necessary accessories.
- Oil coolers with adequate capacity for lubricating oil cooling, using demineralized water as the cooling medium.
- Permanent connection of a lube oil purification unit to continuously purify 20% of the total oil charge per hour.

- Centralized lube oil storage and purification system with tanks, transfer pumps, and backup capabilities for maintenance.
- All piping, fittings, valves, and components in contact with lubricating oil will be made of stainless steel to ensure durability and corrosion resistance.

2.5.5 TURBINE CONTROL FLUID SYSTEM

The turbo-set's governing and control system will include a self-contained control fluid system using fire-resistant fluid to minimize fire risks. Components will consist of a reservoir for fluid storage, AC motor-driven pumps for fluid circulation, and coolers for fluid cooling. Each turbo-set will have a purification unit for continuous fluid cleaning. Stainless steel components will be used for all parts in contact with the control fluid.

2.5.6 GLAND STEAM SEALING SYSTEM

Each turbine generator set and turbine drives for Boiler Feed Pumps (BFPs) will feature an automatic gland sealing steam supply system. High Pressure (HP) and Intermediate Pressure (IP) turbine shaft glands will be sealed to prevent steam escape, while Low Pressure (LP) turbine glands will prevent atmospheric air leakage. Seal steam will be used in labyrinth glands with spring backing. During start-up and low loads (up to 40% load), seal steam will come from the auxiliary steam header via a regulating valve. Above 40% load, HP and IP turbines will self-seal, cutting off auxiliary steam. Excess leak-off steam will condense in a gland steam condenser and return to the cycle, aided by 2x100% capacity vapor exhausters positioned above the TG Hall roof.

2.5.7 GOVERNING / REGULATION SYSTEM

The turbine will feature throttle or nozzle-controlled type governing. Its governing and protection system will include an electrohydraulic governor with appropriate backup, meeting manufacturer standards. This system will ensure precise speed control, stability, and safety across all operating conditions, with an adjustable steady-state regulation of +3% to +8% of the rated speed and a dead band not exceeding 0.06% of the rated speed.

2.5.8 HP/LP BYPASS

The HP and LP Bypass stations will meet key operational needs:

- Enabling quick startup of the steam generator from cold, warm, and hot conditions.
- Allowing parallel operation with the turbine during significant load changes.
- Facilitating house load operation followed by complete external load throw-off.
- Maintaining steam generator operation to prevent fire out after full load rejection. The HP/LP Bypass system will be designed for approximately 65% of BMCR steam flow capacity (exact size to be determined) with rated main steam parameters at valve upstream. The LP bypass will match steam inlet conditions (pressure and temperature) of HRH line at around 60% TMCR.

2.5.9 REGENERATIVE FEED HEATING CYCLE

The regenerative feed heating plant is designed to handle various operating conditions, including load fluctuations and operational changes like HP-LP Bypass. Condensate is pumped from the condenser through LP heaters to the deaerator, with flow regulation to support load cycling. In the deaerator, condensate is heated to saturation before entering the boiler feed pump to match steam generator needs. The feed water is further heated in two sets of 50% capacity HP heaters before entering the boiler.

2.5.10 HP & LP HEATERS

The regenerative feed heating cycle will include LP heaters, drain coolers, a deaerator, and HP heaters optimized for feed heating. A minimum configuration will consist of 4 LP heaters, 1 deaerator, and 3 HP heaters. Feed water will be heated by turbine extraction steam from inter-stage tap-offs and cold reheat lines. The deaerator will

operate with variable pressure using turbine extraction steam. Each feed water heater will handle drains from the preceding heater. The design will comply with standards like Heat Exchanger Institute, ASME, IBR, featuring U-tube heat exchangers with stainless steel tubes, and HP heaters will include a de-superheating zone.

2.5.11 DEAERATOR

The design will include a Spray-cum-tray deaerator with an integral direct contact vent condenser, either mounted on a horizontal storage tank or accommodated inside the Feed Storage Tank as standard practice. Stainless steel cladding above the Low-Low level is required for compliance with HEI standards. Alternatively, a Spray type STORK with two disc-type spray control valves will ensure effective deaeration of incoming condensate and HP heater drains, removing dissolved oxygen and carbon dioxide. The feed water storage tank will have a minimum capacity of 6 minutes of TMCR flow between normal and low-low levels, with a 0.66 filling factor. The deaerator will operate smoothly across all load conditions, maintaining dissolved oxygen levels below 0.005ml/litre in the feed water outlet.

2.5.12 BOILER FEED PUMPS

The proposal includes installing 2x50% turbine-driven and 1x30% motor-driven boiler feed pumps per unit, with booster pumps on a common shaft. Each pump is tailored to meet steam generator needs, ensuring two turbine-driven pumps handle full load with the motor-driven pump as backup. Pumps can manage feed water at pH 8.5-9.5 and 210°C. The design features horizontal, centrifugal pumps with a removable barrel casing for ease of maintenance, including a recirculation control valve for pump protection during low flow. Automatic operation is prioritized, activating standby pumps in case of primary pump failure or low discharge pressure. Turbine-driven pump flow is regulated by turbine control valve, while motor-driven pumps use hydraulic coupling for speed control, with warm-up provisions for standby pumps as needed.

2.5.13 CONDENSATE EXTRACTION PUMPS

Each unit will be equipped with three motor-driven condensate extraction pumps, each at 50% capacity, with two in operation and one on standby. These pumps, designed for condensate extraction service, will handle condensate from the condenser and feed heater drains during maximum unit output, discharging through specified systems to the Deaerator. They are engineered to accommodate adverse operational conditions, including HP & LP bypass and HP heater outages during peak loads with minimum variable frequency drive speeds.

2.5.14 TURBINE HALL EOT CRANES

Two electric overhead travelling cranes will be installed in the turbine hall to facilitate the erection and maintenance of turbogenerators and associated equipment. Each crane will have a lifting capacity of at least 105% of the heaviest component's weight (excluding the generator stator), with an auxiliary hook capacity of at least 20 tons. Additionally, tandem operation of two cranes will enable handling of the generator stator, with combined lifting capacity meeting the stator's weight requirements, including necessary lifting accessories.

2.5.15 EOT CRANE FOR BOILER FEED PUMP

Each unit will be equipped with an Electrically Operated Travelling crane (Double Girder Type) in the BC bay for Boiler Feed Pump (BFP) erection and maintenance. The crane's main hook capacity will exceed 10% of the heaviest component's weight or 25 tons, whichever is higher. The EOT crane will include lifting beams and slings for equipment maintenance.

2.5.16 ON-LINE INTEGRATED BLADE VIBRATION MONITORING SYSTEM

If free-standing blades are included for the last or penultimate stage of low-pressure turbines, the bidder must supply an integrated blade vibration monitoring system. This system will use non-contact sensors like eddy current or inductive types to detect and monitor blade health, focusing on vibration amplitude and frequency for these critical turbine stages.

2.5.17 DEAERATOR LEVEL CONTROL STATION

Each unit will be equipped with a deaerator level control station to manage condensate water flow. This includes a 30% capacity pneumatically operated low-load control valve, motor-operated gate valves upstream and downstream, and a 100% capacity motor-operated regulating valve. Deaerator level will be controlled by a variable frequency drive system for condensate extraction pumps, with a pneumatically operated condensate control valve utilized during low-load operation to maintain deaerator levels.

2.6 PLANT WATER SYSTEM

Nabinagar STPP Stage-II proposes an Air-Cooled Condenser (ACC) System, which significantly reduces the water demand. The estimated water requirement for Nabinagar STPP Stage-II, an expansion project generating 3x800 MW, is around 72,000 KLD (3000 m^3/ hour), incorporating an ash water recirculation system.

The project site is conveniently situated within 3 kilometres of the existing intake point at Indrapuri Barrage on the Sone River. The Water Resources Department (WRD) of the Government of Bihar, through a communication dated 06.06.2007, has approved a commitment of 305,821.95 KLD (equivalent to 125 cubic feet per second) from the River Sone to the Nabinagar project. This approval has garnered full concurrence from the Central Water Commission (CWC) for the entire allocated water volume. Notably, the water demands of the Stage-II expansion (3x800 MW) will be satisfied using the current allocation, obliviating the need for additional water commitments for the project's expansion.

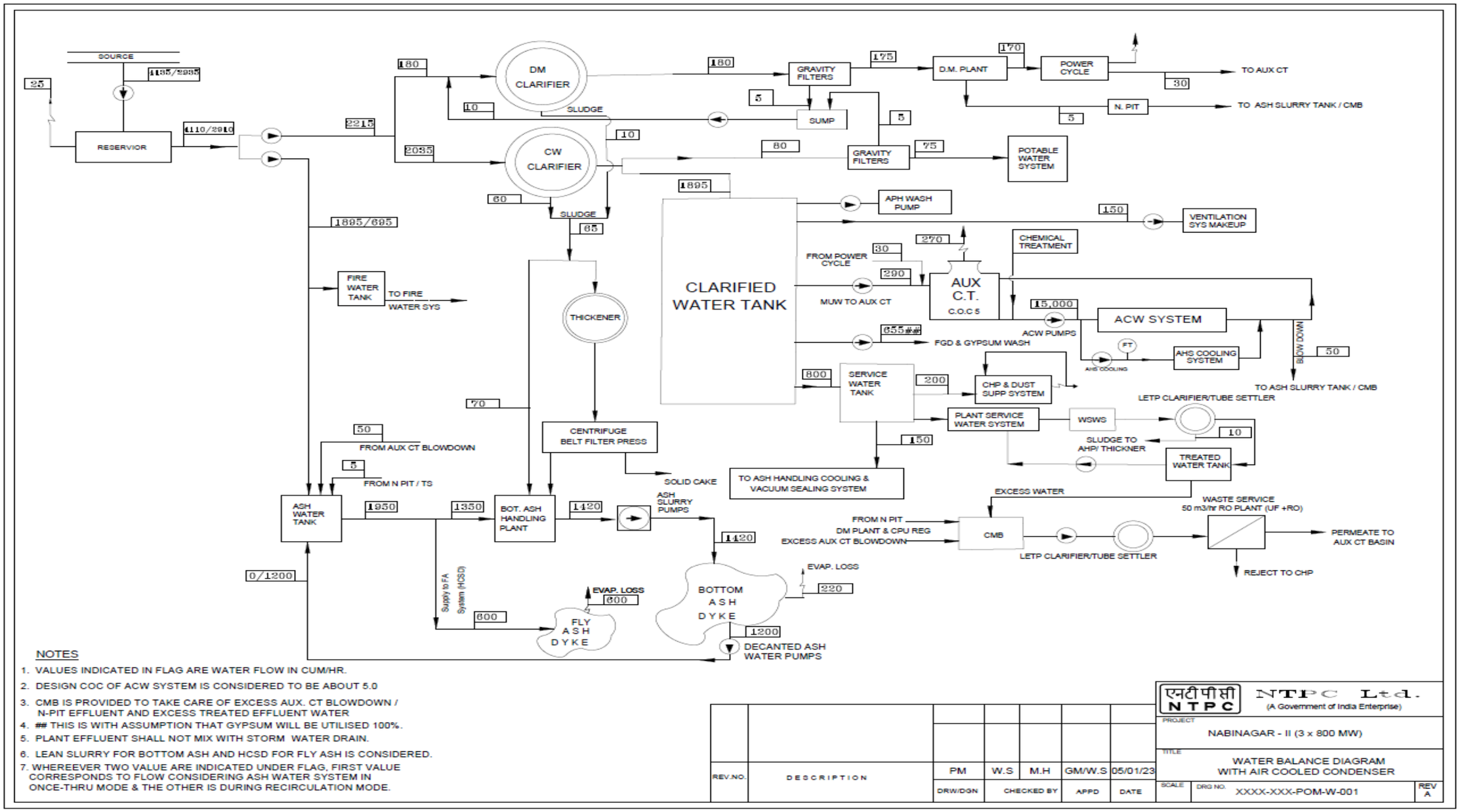
2.6.1 MAKE-UP WATER SYSTEM

The water requirements for this project include a make-up water demand of approximately 72000 KLD or 3000 cubic meters per hour (m^3/hr) with the ash water re-circulation system. A water balance diagram is provided in **Figure 2.3**.

To meet these demands, the make-up water will be sourced from the aforementioned supply and pumped to a new Raw Water reservoir. A single (1x100%) Make-up Water Pump will be installed at the existing intake pump house of Stage-I. A pipeline (1x100%) will be laid to transport water from the Make-up Water Pump house to the new Raw Water reservoir. These pipelines will be constructed of mild steel, buried underground, and coated with a suitable external anti-corrosive 3 LPE (three-layer polyethylene) coating. Additionally, the pipes will be protected against galvanic corrosion using a Cathodic Protection System.

A separate closed Raw Water Pump house will be constructed for Stage-II near the proposed Raw Water reservoir. This pump house will house three (3x50% capacity) raw water pumps for the PT (Pulverized Technology) plant and an additional three (3x50% capacity) raw water pumps for supplying water to the ash handling plant. The pump house will be equipped with handling devices such as EOT (Electric Overhead Travelling) cranes, Electrical Hoists, and monorail hoists as required.

Both the make-up water and raw water systems will be equipped with necessary instrumentation, interlocks, PLC (Programmable Logic Controller) based controls, and control panels to ensure safe and reliable operation of the entire water supply system for the project. These measures aim to efficiently manage the water requirements while ensuring the longevity and reliability of the infrastructure components.



NOTES

1. VALUES INDICATED IN FLAG ARE WATER FLOW IN CUM/HR.
2. DESIGN COC OF ACW SYSTEM IS CONSIDERED TO BE ABOUT 5.0
3. CMB IS PROVIDED TO TAKE CARE OF EXCESS AUX. CT BLOWDOWN / N-PIT EFFLUENT AND EXCESS TREATED EFFLUENT WATER
4. ## THIS IS WITH ASSUMPTION THAT GYPSUM WILL BE UTILISED 100%.
5. PLANT EFFLUENT SHALL NOT MIX WITH STORM WATER DRAIN.
6. LEAN SLURRY FOR BOTTOM ASH AND HCSD FOR FLY ASH IS CONSIDERED.
7. WHEREEVER TWO VALUE ARE INDICATED UNDER FLAG, FIRST VALUE CORRESPONDS TO FLOW CONSIDERING ASH WATER SYSTEM IN ONCE-THRU MODE & THE OTHER IS DURING RECIRCULATION MODE.

REV.NO.	DESCRIPTION					
		PM	W.S	M.H	GM/W.S	05/01/23
		DRW/DGN	CHECKED BY		APPD	DATE

NTPC Ltd. (A Government of India Enterprise)
PROJECT: NABINAGAR - II (3 x 800 MW)
TITLE: WATER BALANCE DIAGRAM WITH AIR COOLED CONDENSER
SCALE | DRG NO. XXXX-XXX-POM-W-001 | REV A

Figure 2.5: Water Balance Diagram

2.6.2 EQUIPMENT COOLING WATER (ECW) SYSTEM & AUX COOLING SYSTEM

A closed circuit cooling water system will be implemented for unit auxiliaries of the steam generator and turbine generator. Demineralized (DM) water will circulate in the primary cooling water circuit to cool various unit auxiliaries and plant and instrument air compressors. These station auxiliaries will be further cooled in a secondary circuit using plate-type heat exchangers. The closed circuit ECW (Equipment Cooling Water) system will utilize DM water in the primary circuit. A recirculating type ACW (Auxiliary Cooling Water) system with an Auxiliary Cooling Tower (Aux CT) will be employed in the secondary circuit to cool the primary DM water. The ECW system will meet the cooling water demands of the turbine generator (TG), steam generator (SG), and their respective auxiliaries, including station auxiliaries. The primary cooling circuits for TG and SG will operate independently, while the secondary cooling water circuit will be shared between both primary systems.

Makeup water for the closed-loop primary circuit will come from normal makeup pumps located in the DM plant and emergency makeup from condensate transfer pumps, both feeding into an overhead storage tank. Secondary cooling water from the Auxiliary Cooling Tower (Aux CT) will be pumped by auxiliary cooling water pumps through plate-type heat exchangers and back to the Aux CT. Hot water from the ACW system of the units will return through common hot water header pipes to the Aux CT for further cooling. To minimize clarified water consumption, the cycle of concentration in the ACW system will not be less than 5. Blowdown from the ACW system to maintain proper concentration in the closed system will be directed to the Ash handling system, Coal Handling Plant (CHP) for dust suppression, and ACW chemical treatment, with excess water discharged to the Combined Mixing Basin (CMB) for further treatment in the Wastewater Treatment Plant.

2.6.3 AUXILIARY WATER SYSTEMS

The plant will feature a comprehensive water distribution system for potable and service water needs. Potable water will be distributed via a dedicated pipe network from overhead storage tanks, with sufficient pumps to meet plant demand. For cleaning purposes, a separate pipe network covering the entire plant area will be established, utilizing service water drawn from designated tanks through service water pumps. Additionally, specific systems like ACW Makeup, DM water makeup, Boiler fill pumping, Air-preheater wash, HVAC makeup, and FGD Process water & Gypsum wash systems will be integrated based on operational requirements to ensure optimal water supply and management throughout the plant.

2.6.4 WATER TREATMENT SYSTEMS

The project's water treatment system includes several components designed to ensure water quality throughout various stages of the process. These components consist of a Water Pre-treatment Plant, Water Demineralization Plant, Chlorine Dioxide Plant, Condensate Polishing Plant, Air Cooled Water (ACW) Treatment Plant, and Effluent Treatment Plant (ETP). Each of these plants serves a specific function within the overall water treatment process to maintain optimal operational conditions and environmental compliance.

2.6.4.1 WATER PRE-TREATMENT PLANT

The pre-treatment plant will be designed to eliminate suspended and colloidal matter from the raw water supply. Separate pre-treatment facilities will be dedicated to meeting the needs of the ACW (Auxiliary Cooling Water) system and the Demineralization (DM) Plant. A centralized chemical house will store necessary chemicals like chlorine, lime, alum, and coagulant aid, with individual chemical preparation tanks and dosing pumps allocated for each pre-treatment system.

For the ACW system, the pre-treatment setup will include an aerator cum stilling chamber, two reactor-type clarifiers, and two 100% gravity filters. Meanwhile, the DM Plant's pre-treatment configuration will feature an

aerator cum stilling chamber, a reactor-type clarifier, and two 100% gravity filters. Both systems will be equipped for dosing alum, lime, coagulant aid, chlorine dioxide, etc.

After clarification, water will be directed to storage tanks or filters based on requirements. Clarified water will be pumped to various systems including HVAC makeup, FGD (Flue Gas Desulfurization) process water, FGD Gypsum wash, and Service water. Additionally, the ACW system's makeup water will be supplied either by pumps or gravity.

Filtered water from the gravity filters will flow into respective reservoirs and then be pumped to the DM plant and potable water system. The installation will include necessary hoists, cranes, and weighing scales for handling equipment and chemicals. Comprehensive instrumentation, interlocks, controls, and panels will ensure safe and reliable operation of the water pre-treatment plant.

2.6.4.2 WATER DEMINERALIZATION PLANT

The Demineralization (DM) plant will be configured to fulfil the water needs of the steam cycle, closed circuit auxiliary systems, and stator water cooling system. The DM plant can be either two streams (2x100%) based on Ion-Exchange technology or three streams (3x50%) using a combination of Ultrafiltration (UF), Reverse Osmosis (RO), and Mixed Bed (MB) processes.

For Ion Exchange-based systems, the setup will include Activated Carbon Filter, Cation Exchangers, Degasser System (comprising towers, tanks, pumps, and blowers), Anion Exchangers, Mixed Bed Exchanger, and Polishing Ultrafiltration (UF). RO-based DM streams will consist of UF systems, micron cartridge filters, RO systems, degassers, and MB units.

Cation resins will be regenerated using hydrochloric acid, while anion resins will use sodium hydroxide. Regeneration facilities will feature bulk acid and alkali storage tanks, preparation systems, measuring tanks, and dosing equipment. The plant will operate semi-automatically with PLC-based controls.

Three DM water storage tanks will store the demineralized water, and one neutralization pit will be available to adjust pH levels and discharge effluent water. The system will allow interconnection between Stage-I and Stage-II DM water storage tanks with requisite pumps, piping, valves, and fittings for seamless operation.

2.6.4.3 CHLORINE DI-OXIDE PLANT

Two separate Chlorine Dioxide (ClO_2) plants will be installed for the Auxiliary Cooling Water (ACW) system and the pretreatment plant. The ACW-ClO_2 system will consist of two ClO2 generators, while the PT-ClO2 system will include one ClO2 generator and one sodium chlorate generator. Each system will be equipped with chemical storage tanks, unloading systems, instrumentation, panels, chlorine dioxide leak sensors, and other necessary components for efficient operation and safety.

2.6.4.4 CONDENSATE POLISHING PLANT

To maintain feed water purity, a condensate polishing plant will be integrated into the feed water cycle downstream of condensate extraction pumps, following standard practice. Each turbine-generator (TG) unit will feature 4x33% or 3x50% capacity service vessels comprising Cation and Mixed Bed Vessels. Cartridge pre-filters (3x50%) will be installed for each Condensate Polishing Unit (CPU), utilizing strongly acidic cation and strongly basic anion resins suitable for condensate polishing. An external regeneration system with two regeneration streams will facilitate resin regeneration and reuse. Resins from the service vessels will be transferred to the regeneration vessel for regeneration and reuse. Additional resin will be procured for startup. Separate facilities for acid, alkali, deionized water storage, and wastewater neutralization will support external regeneration.

2.6.4.5 ACW TREATMENT SYSTEM

A comprehensive chemical treatment program involving acid dosing and the use of scale and corrosion inhibitors is planned for the ACW (Auxiliary Cooling Water) system to manage water chemistry effectively. Acid and chemical storage tanks, along with dosing pumps, will be installed as part of this treatment system. The plant will also feature neutralization pits, disposal pumps, corrosion measurement equipment, and instrumentation for interlocks and controls to ensure safe and reliable operation.

2.6.4.6 LIQUID EFFLUENT TREATMENT SYSTEM

Liquid effluents will be managed according to the following design principles:

i) Filter backwash water from the PT Plant will be recycled to the DM clarifier.
ii) Clarifier sludge will be pumped to the ash handling system for reuse; a dry ash system will be used to achieve zero liquid discharge.
iii) Waste effluents from neutralization pits will be neutralized before being pumped to the ash handling system or discharged for further treatment.
iv) ACW system blow-down will be reused in various plant systems; excess blow-down will undergo further treatment.
v) Coal settling and clarifying systems will remove particles from coal handling plant waste, with decanted water reused for dust suppression.
vi) Service water effluents will be treated in clarifiers and sent back for reuse; excess water will undergo further treatment.
vii) A wastewater treatment plant will be provided for treating wastewater and reusing it in the plant.
viii) FGD wastewater treatment and reuse will be implemented for ash conditioning and coal dust suppression in a dry ash handling system.

2.6.5 FIRE PROTECTION SYSTEM

The power station will be equipped with a comprehensive fire detection and protection system based on the guidelines of TAC (India), IS: 3034, NFPA-850, or equivalent standards. Various protective measures are planned:

Fire Water Supply System: Fire water will be sourced from ACW blow down and raw water lines, with backup storage in steel tanks. Horizontal centrifugal pumps in the fire water pump house (FWPH) and pump houses will be driven by electric motors or diesel engines, complying with TAC regulations. Foam system water will be sourced from the hydrant network.

Automatic Pressurization System: Jockey pumps driven by electric motors will maintain pressure in the fire water pumping station.

Hydrant System: The entire power plant will be covered by a hydrant system, including main plant buildings, boiler area, turbine and auxiliaries, coal handling plant, switchyard, air cooled condenser, biomass handling plant, pump houses, and miscellaneous buildings.

Automatic High Velocity Water Spray System: Transformers, turbine oil tanks, purifiers, generator seal oil systems, boiler burner fronts, and fuel oil stations will be equipped with automatic high velocity water spray systems featuring QB detectors, deluge valves, projectors, and instrumentation.

Automatic Medium Velocity Water Spray System: Cable vaults, galleries, ESP control rooms, FGD buildings, cable trestles, coal conveyors, biomass conveyors, crusher house, and stacker reclaimers will have medium velocity water spray systems with detectors, valves, nozzles, and instrumentation.

Fixed Foam System: Bladder tank foam proportioning systems will be installed for fuel oil tanks, comprising foam bladder tank assemblies, foam makers, discharge outlets, and interconnection piping.

Inert Gas Extinguishing System: Central Control Room (CCR), Control Equipment Room (CER), Programmer Room, and UPS Room will be protected by an inert gas extinguishing system following NFPA-2001 standards.

Portable and Mobile Extinguishers: Various types of portable extinguishers (pressurized water, carbon dioxide, foam, dry chemical powder) will be strategically placed throughout the plant.

Instrumentation and Control System: The fire detection and protection system will feature comprehensive instrumentation and control for safe operation.

Fire Protection for Biomass Silos: Gaseous-based fire protection systems will be installed for biomass storage silos.

These measures aim to ensure the safety and integrity of the power station, covering all critical areas with advanced fire detection, suppression, and control systems in adherence to industry standards and regulations.

2.6.5.1 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.

1. Multi sensor type smoke detection system, CO detectors
2. Linear heat sensing cable detector.
3. Quartzoid bulb heat detection system.
4. Infra-red type heat detectors (for all coal/Biomass conveyors)

2.7 FUEL HANDLING SYSTEM

2.7.1 COAL HANDLING SYSTEM

The proposed design incorporates a coal handling plant with a rated capacity of 3700 MTPH, featuring parallel double-stream belt conveyors (one operational and one standby) to manage receiving, unloading, crushing, and conveying of coal to boiler bunkers. Additionally, it includes facilities for stacking and reclaiming coal from the crushed coal stockyard. The coal stockyard management will utilize three rail-mounted, bucket wheel type, unidirectional travelling stacker-reclaimers.

The coal unloading terminal is dedicated, equipped with two Twin wagon tipplers and one Single Wagon Tippler for unloading BOX-N wagon rakes, along with one Track Hopper for unloading BOBR wagon rakes. The plant will operate for 16 hours daily over two shifts, reserving the third shift exclusively for routine inspection and maintenance.

To meet peak daily coal requirements, the coal handling plant will complete two bunker filling cycles in 12 hours of effective operation. Coal received via underground RCC hoppers from wagon tipplers and the Track Hopper will be transported to the crusher house for coal sizing to (-) 20mm.

From the crusher house, crushed coal will either be directly conveyed to coal bunkers using a series of conveyors or stacked onto crushed coal stockpiles via stacker-reclaimers. Motorized travelling trippers will feed crushed coal into the raw coal bunkers of the boilers.

The coal handling plant will be equipped with a comprehensive dust suppression and service water system. Ventilation systems will be installed for underground buildings/tunnels, MCC rooms, and bunker buildings. A

centralized main control room (DDCMIS based) will facilitate control and monitoring of plant operations. Wagon tippler control rooms adjacent to the wagon tipplers and the main control room will manage receiving and unloading operations for BOX-N and BOBR wagon rakes respectively.

The Stage-II CHP will be interconnected with Stage-I CHP to ensure efficient coordination and operation between the two stages of the coal handling plant.

2.7.1.1 MILL REJECT SYSTEM

To efficiently manage Mill Rejects continuously, a Mill Reject system will be implemented with a capacity of at least 1% of the mill design capacity or based on the worst coal scenario, whichever is higher, considering the maximum number of working mills. Each mill will be equipped with a mill reject pyrite hopper. Mechanical conveying via a mill reject conveyor system will transport the rejects from the mill area to a storage silo. The storage silo will have a capacity of storing rejects for 16 hours for all units. Finally, the stored Mill Rejects will be disposed of into trucks from the storage silo.

2.7.2 FUEL OIL HANDLING SYSTEM

Light Diesel Oil (LDO) will be transported to the power station via road tankers and unloaded into existing facilities using gravity. The current LDO unloading cum transfer pumps housed in the existing pump house will be utilized to transfer LDO to storage tanks, with provisions for augmentation if fuel demand increases. LDO will be directed into one existing 3000 M^3 storage tank originally designated for Heavy Fuel Oil (HFO), and two additional 2000 KL LDO tanks will be installed, each with a dyke for containment. LDO pressurizing pumps will convey the oil to the boilers through piping. Modifications will be made to integrate with the existing fuel oil system, including the installation of new piping from Stage I to the Stage II pressurizing pump house.

The Auxiliary Oil System and its facilities will be designed as per Pollution Control/Petroleum Rules/Explosion Acts/Fire Rules of Govt. of India.

2.7.3 BIOMASS HANDLING SYSTEM

In line with the regulation of MOEF&CC and MOP, a provision has been kept for use of biomass, a carbon neutral fuel up to 10% of coal required. Biomass will arrive in the form of biomass pellets via road transport. Upon arrival, biomass will be unloaded using a truck tippler and biomass receiving unit (BRU). After unloading, the biomass will be stored in storage silos or bins using a bucket elevator. From the storage silo or bin, the biomass will be blended with coal and conveyed together via coal conveyors to the bunkers for further processing and utilization.

2.8 LIMESTONE & GYPSUM HANDLING SYSTEM

2.8.1.1 LIMESTONE HANDLING SYSTEM

The transportation and handling of limestone to the power plant will be managed through both road transport by trucks and Indian railway wagons. Limestone delivered via rail will be unloaded at the wharf wall and stored in sheds. For limestone delivered by road, two Truck Tipplers with a minimum capacity of 40 tons (Gross vehicle weight 60 tons minimum) will be used to discharge limestone onto Box Feeders, Surface Feeders, or Truck Unloading Hoppers.

To facilitate unloading from trucks, two Box Feeders/Bulk-material Receiving Units/Surface Feeders will be installed. Limestone will then be conveyed to the Crusher House using a double stream conveyor with a capacity of 150 TPH for crushing and further conveying. Two bucket elevators will transport the crushed limestone to storage silos, of which there will be two covered silos provided.

These storage silos will have the capacity to store limestone equivalent to the consumption of at least 7 days at the Design Point (considering the generation of all units). Belt feeders with regulating mechanisms will be installed below the main storage silos to control the feed of crushed limestone. A single stream conveyor will further transfer limestone to day storage silos.

For the limestone crusher house, storage silos, conveyors, and other associated equipment, a comprehensive infrastructure will be established, including dry type dust extraction systems, ventilation systems, drinking water systems, drainage systems, and motorized travelling tripper/flow diverter ploughs on feeding conveyors.

A limestone sampling unit will be provided along with sump pumps in limestone storage silos and ventilation equipment for switchgear rooms, MCC rooms, battery rooms, and toilets. Additionally, conventional enclosure type passenger cum goods elevators, suspended magnets, metal detectors, and electronic belt scales for continuous weighing will be installed.

The plant will feature a service water and potable water system, as well as dust extraction systems for the entire limestone handling plant. Furthermore, a pit-less type weighing bridge with a capacity of 100 MT will be provided in the limestone unloading area and gypsum loading area, totalling two weighing bridges for road trucks/tipplers.

2.8.1.2 GYPSUM HANDLING SYSTEM

The gypsum handling system entails conveying gypsum from the vacuum belt filter to a storage shed using double stream conveyors and transfer points/junction towers. A flap gate beneath the filter facilitates gypsum feeding into the conveyor. A covered storage shed floor lining, capable of storing a minimum of 7 days' gypsum generation, will be constructed, featuring a 2.0 m wide corridor for equipment movement and emergency access. The shed will enable gypsum transfer to trucks through a telescopic chute system within the shed. Dust suppression measures with water fogging, service water, and potable water systems will be installed to manage dust emissions. Motorized travelling trippers or flow diverters will facilitate gypsum distribution within the shed. Truck bays will allow for efficient loading, with entry and exit points designed for smooth truck traffic flow. Additionally, exhaust fans will maintain optimal conditions inside the storage shed. The entire gypsum handling system will be centrally controlled using PLC-based controls, ensuring efficient operation and auxiliary facilities such as equipment handling arrangements and service water systems will be integrated as needed.

2.9 ASH HANDLING SYSTEM

The disposal and handling of ash from the power plant involve different methods based on the type of ash produced. Bottom ash, economizer ash, and air preheater ash will be extracted and disposed of in wet form as High Concentration Slurry. Fly ash, on the other hand, will be conveyed in dry mode from electrostatic precipitator hoppers to buffer hoppers. From there, it will be transported in dry form to storage silos near the plant boundary for potential utilization. If not utilized, both bottom ash and fly ash will be disposed off as a High Concentration Slurry using bottom ash disposal pumps and high concentration slurry disposal (HCSD) pumps to the ash disposal area.

The capacity of the ash handling plant has been determined based on specific parameters: an ash content of 44% (from the worst coal scenario) and a calorific value of the worst coal being 3000 Kcal/Kg. This sizing ensures efficient management and disposal of ash produced during power generation operations.

Rail Loading Silo

2.9.1 BOTTOM ASH REMOVAL SYSTEM

a) **Extraction and Disposal of Bottom Ash, Economizer Ash, and Air Preheater Ash in Wet Form:** Bottom ash is extracted using a submerged scraper chain conveyor system or intermittently with jet pumps alongside water impounded hoppers. Dry bottom ash hoppers are employed with the submerged scraper chain conveyor system. Continuous extraction systems transport bottom ash to a common disposal pump house via water impounded hoppers (using jet pump systems) or by slurry transportation pumps (in submerged scraper chain conveyor systems). Intermittent jet pump systems convey bottom ash slurry from water impounded hoppers to the slurry sump of the disposal pump house. Economizer ash and air preheater ash are also handled in wet form, with coarse ash slurry directed to water impounded hoppers or the slurry sump of the disposal pump house. From the disposal pump house, bottom ash and coarse ash slurry are pumped to dewatering bins by slurry duty pumps, with provisions for pumping to existing ash dykes if bottom ash is not utilized through dewatering.

b) **Extraction of Bottom Ash, Economizer Ash, and Air Preheater Ash in Dry Form with Wet Disposal:** Bottom ash is collected in dry bottom ash hoppers. Economizer and air preheater ash (including duct hopper ash if applicable) are conveyed in dry form to an intermediate bottom ash silo using pneumatic or mechanical conveying systems. The collected ash in the intermediate silo is then transported either to a main bottom ash silo for dry ash utilization near the plant boundary or to the ash dyke in wet form if ash utilization is not feasible. A dry bottom ash transportation system, utilizing troughed conveyors, is used to transport ash from the intermediate silo to the main silo.

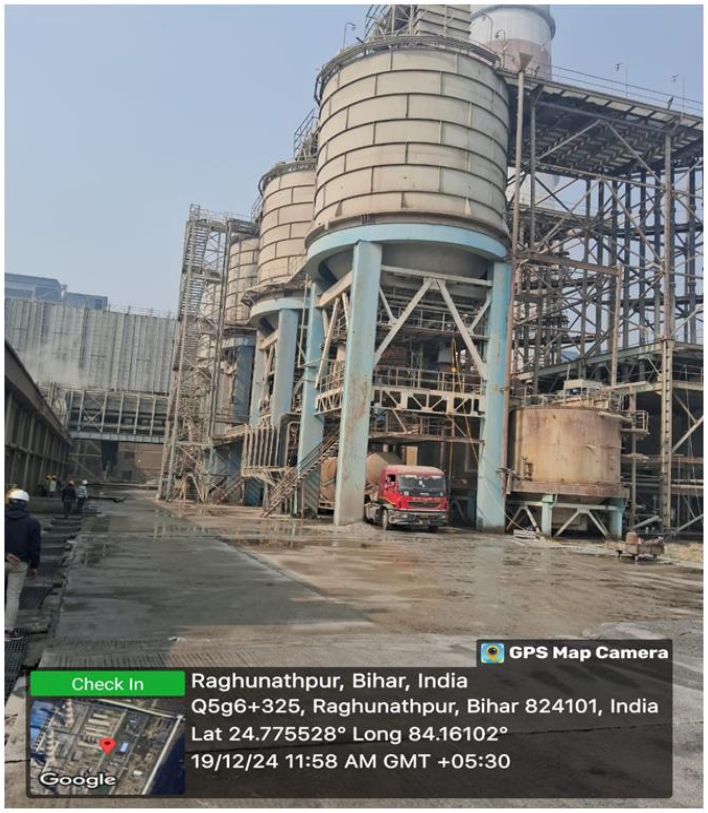
2.9.2 FLY ASH HANDLING SYSTEM

A pneumatic conveying system, either utilizing vacuum or pressure, will be implemented to transfer dry fly ash from electrostatic precipitator hoppers. In the vacuum system, the ash will be directed to buffer hoppers within each unit, situated near the ESP. Conversely, with the pressure conveying system, the ash will be transported to Intermediate Silos. From the buffer hoppers or Intermediate Silos, the dry ash will be conveyed to a dry fly ash classification and bagging system, then onward to main fly storage silos cum HCSD (High Concentration Slurry Disposal) Silos equipped with rail and road loading facilities. Each unit will be outfitted with five screw-type transport air compressors, refrigerant-type air dryers, and air receivers. User industries will collect dry fly ash from the main storage silos using closed or open tankers. If ash is not utilized, it will be disposed of in concentrated form by HCSD system into ash dyke.

2.9.3 ASH SLURRY DISPOSAL SYSTEM

The disposal area, located approximately 2.5 km from the plant, will receive ash slurry from the operation. For bottom ash disposal, slurry containing bottom ash and coarse ash from all units will be transported via slurry duty pumps either to an Ash Pond (for dry bottom ash extraction) or Ash Pond/dewatering bins (for wet bottom ash extraction). There will be two working streams and two standby streams, each equipped with individual disposal pipes to prevent crossover within the piping system.

Regarding fly ash disposal, the fly ash collected in Main Fly Ash cum HCSD (High Concentration Slurry Disposal) silos will be mixed with water in an agitator tank to achieve a desired high concentration slurry, which will then be pumped to the ash disposal area. This process will involve four working and four standby HCSD streams across all units, with each stream utilizing one HCSD pump. Each pumping stream will have dedicated disposal pipes. Additionally, all HCSD pumps and HCSD silo aeration blowers will be housed within the HCSD pump house for efficient operation and maintenance.



HCSD silo

2.9.4 ASH WATER SYSTEM

All the water pumps namely BALP, BAHP, FAHP, Flushing water pumps etc., shall be provided.

2.9.5 ASH WATER RECIRCULATION SYSTEM

A proposed ash water re-circulation system is designed to comply with environmental regulations. Decanted water from the ash pond will be pumped using two 100 % capacity pumps to the plant area through a pipeline from the ash dyke. This water will then be utilized in the ash handling system. Regular blow down of the ash water will be conducted to prevent scaling. Makeup water for the ash water system will primarily come from cooling water blow down. However, provisions will also be kept for operation of the system in "Once Through"

mode when recirculation is not feasible, with additional makeup water sourced from the plant's raw water supply. Additionally, a fugitive dust suppression facility is proposed for the ash dyke area to control airborne dust particles.

2.9.6 ASH CLASSIFICATION AND BAGGING SYSTEM

The ash handling system will segregate fine and coarse ash based on their source fields. Fine ash (less than 45 microns, 95% size) will originate from the 4th field onwards, while coarse ash will be from the initial three fields in service. The fly ash from ESP hoppers or buffer hoppers of all units will be directed to a 250-ton classifier silo. From there, the ash will undergo further classification and storage in separate silos, each with a capacity of 500 tons for fine and coarse ash respectively.

For efficient loading into closed tankers, each silo will feature outlets equipped with telescopic chutes and rotary feeders. To mitigate dust and maintain air quality, the silos and hoppers will be equipped with target boxes, bag filter assemblies, pulse jetting mechanisms, and fan units. Aeration blowers will ensure proper air circulation.

The bagging plant will handle 50% of the fine ash production, including classified fine ash and direct fine ash from the 4th field onwards. This plant will be equipped for mechanized bagging, packaging the fine ash into 1-ton and 50-kg bags. A closed storage area will accommodate these bags, ensuring storage flexibility for both bag sizes produced daily.

2.9.7 ASH DYKE

The Stage-II ash dyke will be positioned adjacent to the existing Stage-I ash dyke, covering a total proposed area of approximately 141.64 Ha (350 acres). For the disposal of fly ash (FA) from Stage-II, a high concentration slurry disposal (HCSD) system will be used, while bottom ash (BA) will be handled via lean slurry. The project, operating at an average Plant Load Factor (PLF) of 80%, is expected to generate about 47 Lakhs cum of coal ash annually. According to the latest MOEF&CC guidelines, full utilization of fly ash is required within three years of the plant's commissioning.

As per the MOEF&CC notification dated December 30, 2022, new or expanded thermal power plants are permitted to use 0.1 hectares per megawatt for ash dykes. For Stage-II, the identified 141.64 ha/350 acres of land, adjacent to Stage-I, complies with this regulation. The ash disposal plan typically includes two lagoons for bottom ash with a shared overflow lagoon and one lagoon for fly ash with a sedimentation basin. To optimize land use, the plan will feature one FA lagoon and two BA lagoons, along with a common overflow lagoon, with provisions for future expansion to support ongoing power generation.

Based on experience of Stage-I ash dyke and pending topographical survey & geotechnical investigations, for estimating the storage capacity in proposed new ash dyke area, starter dyke of varying height is considered. Accordingly, in HCSD lagoon, starter dyke of 7.5m height with nil raising and in BA lagoons starter dyke of 7.5m height with nil raisings been considered. Based on the same, out of the 141.64 ha (350 acres) land, the ash storage area for FA will be about 52.61 ha (130 acres) and BA will be 52.61ha(130 acres),which will create total coal-ash storage capacity of 64 lakh cum. Considering disposal requirement of Stage-II of approximately 47 lakh cum per annum, the storage capacity of the Stage-II dyke is sufficient for stage-II operation up to 1.5 years (with nil coal-ash utilization). HDPE lining system is envisaged in OLF and Bentonite blended lining in ash storage lagoons (BA and FA).To prevent fugitive dust emissions water sprinklers will be provided.

The balance 36.42 ha (90 acres) of land will be occupied by OFL, starter dyke, ash slurry pipeline corridor in dyke area, peripheral road for maintenance all along the periphery of the dyke, peripheral drain, AWRS & SWPH system facilities etc.

Figure 2.6: Ash Dyke area

2.10 Resource Requirement

2.10.1 LAND

The Nabinagar Super Thermal Power Project spans a total land area of 1202.88 hectares, comprising 607.28 hectares utilized for the existing plant and an additional 595.60 hectares designated for the proposed expansion. This expansion is planned within the boundaries of the existing facility, ensuring efficient land utilization and streamlined development.

2.10.2 Coal

The coal consumption for the Nabinagar Super Thermal Power Project is projected to total 21.49 MTPA, with the existing plant consuming 11.25 MTPA at a gross calorific value (GCV) of 3400 kcal/kg and 90% plant load factor (PLF). The proposed expansion will require 10.24 MTPA with an improved GCV of 4000 kcal/kg at 85% PLF. Coal transportation is facilitated by Indian Railways, and to accommodate the additional demand from the Stage-II expansion, an augmentation of the existing railway siding is planned, ensuring seamless and efficient fuel logistics.

2.10.3 Manpower requirement

The operational phase of the Nabinagar Super Thermal Power Project is supported by a permanent workforce tailored to meet the facility's technical and operational requirements. The existing plant currently employs 263

permanent personnel, ensuring efficient management of operations at the current capacity. With the proposed expansion, an additional 216 permanent positions will be added, bringing the total operational workforce to 479. This increase aligns with the enhanced capacity and the integration of advanced technologies such as Ultra Super Critical systems in the expansion phase. The manpower augmentation is designed to optimize resource allocation, maintain high operational efficiency, and ensure robust oversight of the expanded infrastructure, reflecting the project's commitment to sustainable and efficient operation.

Table 2.4: Details of resource requirement

Description	Existing for Stage -I	Proposed for Stage -II	Total after expansion
Land (in Ha.)	607.28	595.60	1202.88
Coal requirement	11.25 MTPA	10.24 MTPA	21.49 MTPA
Manpower requirement during operation phase	263	216	479

2.11 POLLUTION CONTROL SYSTEM

The Nabinagar Super Thermal Power Project, Stage-I (3x660 MW), received Environmental Clearance (EC) on 27th December 2010 and is currently in commercial operation. The proposed expansion of the project involves installing three additional units of 800 MW each within the same premises used for Stage-I. This expansion is deemed environmentally compatible, as the site adheres to the environmental guidelines set forth by the Ministry of Environment, Forests & Climate Change (MOEF&CC) for the siting of thermal power projects. Given that much of the groundwork and infrastructure development occurred during Stage-I, the environmental impact of Stage-II construction is expected to be significantly less compared to starting from a greenfield site owing to the low ecological footprint.

The various environmental measures, pollution control systems and mitigation measures proposed to be adopted for the proposed project are as follows:

2.11.1 AIR POLLUTION CONTROL SYSTEM

The Stage-II units (3x800 MW) will be engineered to comply with the emission standards mandated by the Ministry of Environment, Forest and Climate Change (MOEF&CC) as specified in the notifications dated 07.12.2015 and its subsequent amendment on 26.06.2018. The design will incorporate the necessary systems to achieve these standards.

Electrostatic Precipitators (ESP):

The Stage-II units (3x800 MW) will incorporate high-efficiency (with 99.99%) Electrostatic Precipitators (ESP) to control ash particle emissions. These ESPs will design to limit particulate emissions to 30 mg/Nm^3. Additionally, a chimney of 275-m height, complying with MOEF&CC guidelines (dated 28.06.2018), will be erected to disperse emissions effectively. The chimney will include personal access for regular stack emission monitoring.

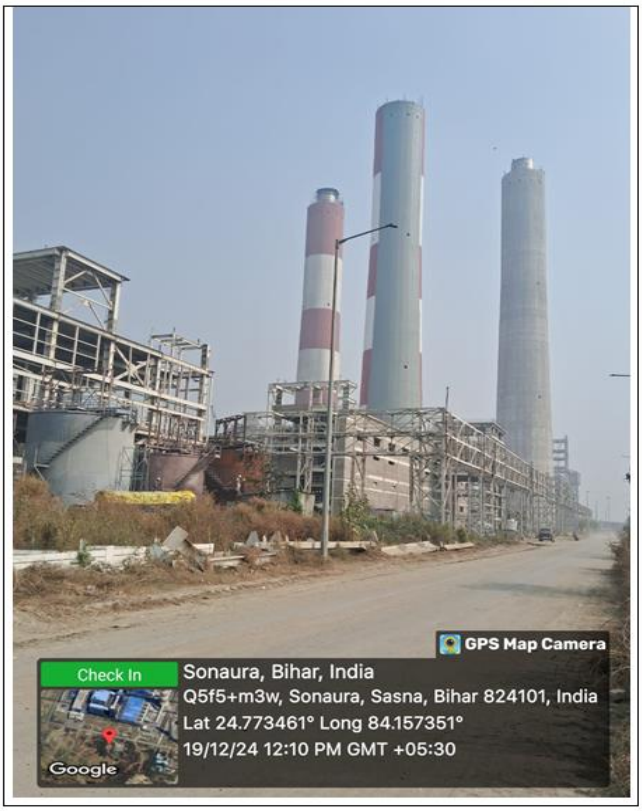
ESP

Dust Extraction (DE)/ Dust Suppression (DS) System:

To mitigate fugitive dust emissions within and around the coal handling plant, systems for coal dust extraction and suppression will be implemented. Dust suppression systems will cover critical areas such as the Coal unloading area, Coal Handling Plant (CHP), coal stack yard, and ash handling facilities including silos and ash ponds, coal conveying systems and coal transfer points. These measures aim to ensure stringent control and reduction of environmental impact associated with plant operations. The DE/ DS systems typically include Dry Fogging, dry extraction (with suction) and water sprinkling systems.

Flue Gas Desulphurization System (FGD):

A wet limestone-based flue gas desulphurization (FGD) system will be installed downstream of the electrostatic precipitator (ESP) at the tail end of the steam generator to limit SO_2 emissions to 100 mg/Nm^3.This system is designed to capture SO_2 gas by reacting it with limestone slurry to produce gypsum. The FGD system will include a bypass system for operational flexibility. Various auxiliary equipment and systems such as crushers, cyclones, vacuum filters, belt conveyors, pumps, storage vessels for different liquids, piping and fittings, and zero liquid discharge (ZLD) capabilities will be integrated to support the FGD plant. Additionally, there will be provisions for gypsum storage to manage the by-product efficiently. The details were described in Section 2.8



FGD CONSTRUCTION SITE

NO_X Control System:

To control NO_x emissions from the steam generator, a combination of low NOx burners (LNB) and combustion staging techniques will be implemented. Low NO_x burners are designed to minimize the formation of nitrogen oxides during the combustion process by controlling the air-fuel mixture and flame temperature. Additionally, combustion staging involves dividing the combustion process into multiple stages, which helps in reducing peak flame temperatures and hence lowering thermal NO_X generation thereby lowering NO_x emissions. This integrated approach will effectively mitigate NOx emissions from the steam generator, ensuring compliance with environmental regulations and promoting cleaner air quality.

Chimney:

To enhance the dispersion of emissions over a broader area, the project proposes the installation of three chimneys, each with a height of 275 meters and featuring a single flue. These chimneys will be designed to include personal access points for routine monitoring of stack emissions. This setup aims to promote effective and efficient management of emissions by ensuring proper monitoring and dispersal of pollutants into the atmosphere. Each of the chimney is provided with Continuous Emissions Monitoring Systems as per CPCB Guidelines for CEMS dated August 2018.

2.11.2 WATER POLLUTION CONTROL SYSTEM

The project will incorporate Air Cooled Condensers with a makeup water demand of approximately 3000 m^3/hour, including an ash water recirculation system. It operates at about 4110 m^3/hour in once-through ash water operation. Air-Cooled Condenser technology offers advantages in reducing raw water consumption compared to traditional water-cooling systems.

Effluent management will be a key focus, aiming to optimize water systems to minimize intake water needs and achieve zero wastewater discharge. This involves comprehensive collection, treatment, and recycling or disposal of effluents. Various treatment facilities will be implemented to manage waste streams from the power plant. Additionally, the project's existing sewage treatment plant will be enhanced as needed to produce treated sewage meeting prescribed standards for use in plantation or horticulture purposes. This integrated effluent management strategy aims to ensure environmental compliance and resource efficiency throughout the project's operations.

The Nabinagar Super Thermal Power Project (STPP) has an existing Effluent Treatment Plant (ETP) with a capacity of 3600 KLD and a Sewage Treatment Plant (STP) with a capacity of 3000 KLD. The STP employs the Moving Bed Biofilm Reactor (MBBR) technology for efficient sewage treatment. For Stage-II of the project, it is proposed to enhance the treatment facilities by adding an ETP with a capacity of 1200 KLD and an STP with a capacity of 1000 KLD, ensuring effective management and treatment of wastewater generated during the expansion phase.

2.11.3 NOISE POLLUTION

The primary sources of noise in the facility include turbines, generators, compressors, pumps, fans, and the coal handling plant. To mitigate noise levels, acoustic enclosures will be installed to keep noise below 90 dB(A). Additionally, personnel working in high-noise areas will be supplied with appropriate personal protective equipment for hearing protection.

2.11.4 SOLID WASTE MANAGEMENT

During the construction phase, solid waste management will adhere to the guidelines set forth by the Construction and Demolition Waste Management Rules, 2016. The primary solid wastes anticipated from the project are ash and gypsum. Ash will result from coal combustion, with approximately 80% as fly ash and 20% as bottom ash. Our ash management strategy entails dry collection of fly ash and dewatering bin-based collection of bottom ash. The collected ash will be supplied to entrepreneurs for various uses, actively promoting its utilization and ensuring safe disposal of any surplus. NTPC is committed to maximizing ash utilization. Any unused fly ash and bottom ash will be disposed of in the ash dyke, where a water blanket will control dust emissions. Once the ash dyke is no longer in use, it will undergo reclamation through green vegetation. Gypsum from the FGD system will also be handled in an environmentally responsible manner and efforts will be made for 100 % utilization.

2.11.5 AFFORESTATION AND GREEN BELT DEVELOPMENT

Significant afforestation efforts have been undertaken within and around the plant site. Existing area of the greenbelt is 121.20 Ha. A total of 1,73,049 trees (since commissioning) have been planted on the existing land. Further, 275.96 Ha of greenbelt development is proposed to achieve the 33% green belt development (397.16 Ha) of the total project area (1202.88 Ha). The greenbelt shall have 3-tier plantation as per the CPCB guidelines with re-densification & strengthening of existing greenbelt. In addition to the above app 25,000 tree plantation is also carried out on the different occasion i.e. on birthday of employees, on supernation & on World environment day etc. Miyawaki Tree plantation of 20,000 saplings shall be carried out during 2024-25 through forest department.

Details of tree plantation in Stage-I is given in **Table 2.5** and a green belt development plan for During Stage-II is given **Table-2.5**

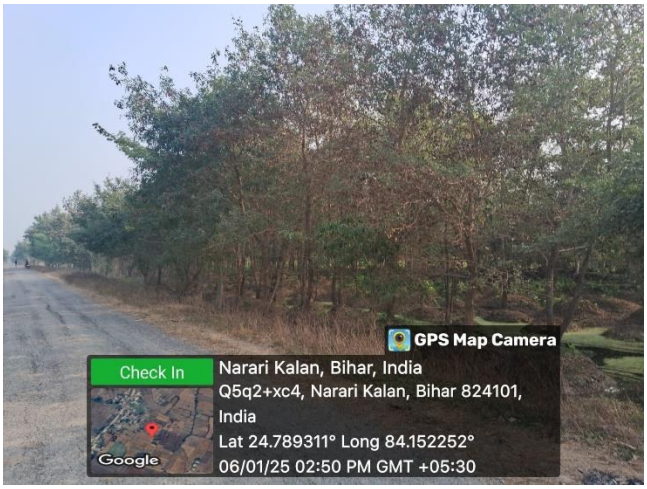
Table 2.5: Tree Plantation from 2019-20 up to 2023-2024

Sl. No	P.O No. & Date	Name of Agency	Period	No. of Plantation
1	5500033511 dtd.01.07.2019	Forest Deptt.	01.07.2019 to 30.06.2021	33650.00
2	5500040756 dtd.16.06.2020	Forest Deptt.	21.06.2022 to 31.03.2025	20000.00
3	5500036612 dtd.25.08.2020	M/s Jai Mata Dee	01.08.2020 to 31.10.2020	6000.00
4	5500036550 dtd.28.07.2020	Forest Deptt.	28.07.2020 to 31.03.2024	50000.00
5	5500036611 dtd.31.07.2020	M/s Prabhat Constn.	01.08.2020 to 31.10.2021	8000.00
6	5500036614 dtd.25.08.2020	M/s Ranjay Kr Singh	01.08.2020 to 31.10.2021	6000.00
7	Misc Plantation	By departmental	2022-23	23301.00
8	Misc Plantation	By departmental	2023-24	1322.00
9	Misc Plantation	By departmental	2024-25	4227.00
10	Misc Plantation	By departmental (plant for Mother Earth)	2024-25	549.00
11	4000317136 date 28.11.2024	Forest Deptt.	2024-25(under Execution)	20000.00
Total :				**173049.00**

Table 2.6: Green Belt Development Plan from 2024-25 up to 2032-2033

Action Plan for Green Belt development in NTPC Nabinagar					
S no	**Financial Year**	**Area in Acres**	**Green Belt proposed In Ha (2500 no/Ha)**	**Tentative budget In Crores**	**Remarks**
1	2024-25	4.94	2	1.77	Miyawaki Plantation including 3 yrs maintenance in Township area work under Execution
2	2025-26	111.15	45	10.0	Above rates includes 3 Yr Maintenance of Green Belt for 5000 No's(Considered 2 Ha) Amount Rs 4444250
3	2026-27	111.15	45	10.0	
4	2027-28	123.5	50	11.1	
5	2028-29	123.5	50	11.1	
6	2029-30	74.1	30	6.7	

7	2030-31	74.1	30	6.7	
8	2031-32	74.1	30	6.7	
9	2032-33	40.9279	16.57	3.7	
	Total	737.468	298.57	67.67	



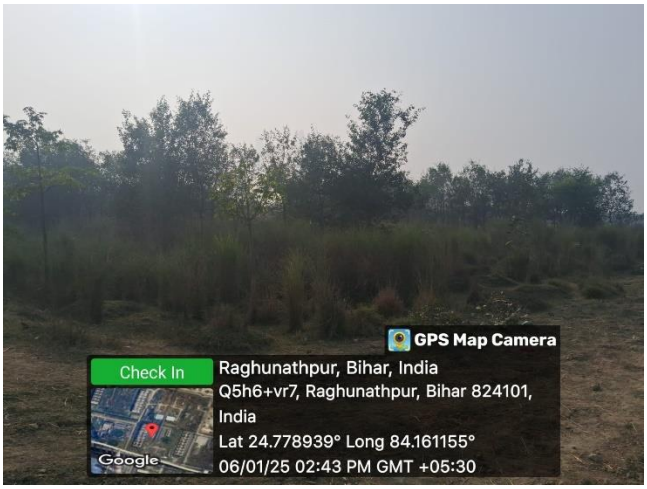


Figure 2.7: Greenbelt Photographs

Additional afforestation initiatives will continue to be implemented across all feasible areas within and surrounding the project site. This includes the identification and utilization of any available spaces for planting trees and promoting green cover to enhance environmental sustainability and biodiversity in the region.

2.11.6 SUSTAINABLE DEVELOPMENT MECHANISM (SDM)

The Kyoto Protocol, part of the United Nations Framework Convention on Climate Change (UNFCCC), took effect in February 2005. The Clean Development Mechanism (CDM) within Article 12 of the protocol allowed industrialized countries to implement or purchase emission reductions from projects in developing nations and receive Certified Emission Reductions (CERs) as credit. However, the Kyoto Protocol's validity ended with the completion of its second commitment period on December 31, 2020.

Subsequently, the Paris Agreement, a legally binding international treaty on climate change, was adopted at COP 21 in December 2015 and came into force on November 4, 2016. This agreement united nations in combatting climate change and adapting to its impacts by striving for global peaking of greenhouse gas emissions as soon as possible to achieve a climate-neutral world by mid-century. The Paris Agreement operates on a 5-year cycle of increasingly ambitious climate actions declared by countries through their nationally determined contributions (NDCs), out their commitments to reducing greenhouse gas emissions to align with the agreement's goals.

Article 6 of the Paris Agreement introduces mechanisms to promote efficiency gains based on countries' varying marginal costs of abatement. Article 6.4 envisages a new international carbon mechanism, like the Sustainable Development Mechanism (SDM), under the guidance of bodies such as the UNFCCC, for trading emissions reductions worldwide. This mechanism aims to replace the CDM. Meanwhile, Article 6.2 allows countries to engage in joint market cooperation, facilitating the trading of emission reductions or other climate-related achievements to meet their respective climate targets.

As of now, Article 6 of the Paris Agreement is undergoing finalization and negotiation, anticipated to be operational in coming year. The SDM under Article 6.4 or Bilateral/Multilateral crediting mechanisms under Article 6.2 offer opportunities to earn revenue through greenhouse gas emission reductions. This revenue is crucial in enhancing the Internal Rate of Return (IRR) of climate projects. Therefore, this project intends to leverage the benefits of the SDM or crediting mechanisms under Article 6.2 to improve its IRR once these mechanisms are operationalized.

2.11.7 POST OPERATIONAL MONITORING PROGRAMME

Ongoing monitoring of various environmental parameters, including air and water quality, is currently conducted for existing units with data submitted to the Bihar State Pollution Control Board. These units are equipped with Continuous Emission Monitoring System (CEMS) in stacks, Automatic Ambient Air Quality Monitoring Stations (AAQMS), and Effluent Quality Monitoring System (EQMS). The monitoring program will be expanded to include the new units, and any additional monitoring locations needed will be determined in collaboration with the Bihar State Pollution Control Board.

ENVIRONMENT LABORATORY

AAQMS STATION

AAQMS STATION

CEMS & AAQMS DISPLAY BOARD AT MAIN GATE NO.1

2.11.8 INSTITUTIONAL SET-UP

The Nabinagar Super Thermal Power Plant (STPP) is currently operational and has an established Environmental Management Group (EMG) in place. The environmental monitoring program during construction and operation phase will be managed by the existing EMG at the project site. This EMG will oversee all monitoring activities using the necessary instrumentation, equipment and environmental skilled personnel to ensure effective environmental monitoring. Additionally, the on-site EMG will co-ordinate with the State Pollution Control Board and other regulatory bodies to address any environmental issues that may arise during the project's operation. This collaborative approach ensures comprehensive oversight and compliance with environmental regulations throughout the station's operational phase.

3. Baseline Environment

3.1 INTRODUCTION

Baseline environment data forms a part of the Environmental Impact Assessment study and helps to evaluate the predicted impacts on the various environmental attributes in the study area by using scientifically developed and widely accepted environmental impact assessment methodologies. Baseline data is also required in preparing an Environmental Management Plan (EMP) outlining the measures for improving the environment quality and scope of future expansions for environmentally sustainable development.

3.2 STUDY AREA AND PERIOD

An area of 10km radius (aerial distance) from the boundary of the project is considered as the study area for the EIA Study. The project site is located at Villages Majhiyan, Tehsil Nabinagar in Aurangabad District. Features of the project site as seen on toposheet are shown in **Figure 3-1**.

The data collected are used to understand the existing environment scenario around the proposed power project against which the potential impacts of the project can be assessed. The study area is divided into two zones viz core zone and buffer zone where core zone is the Project site and buffer zone is of 10km radius around the project boundary. The environmental baseline data collection was undertaken during pre-monsoon 2024 spanning **March 2024 to May, 2024**.

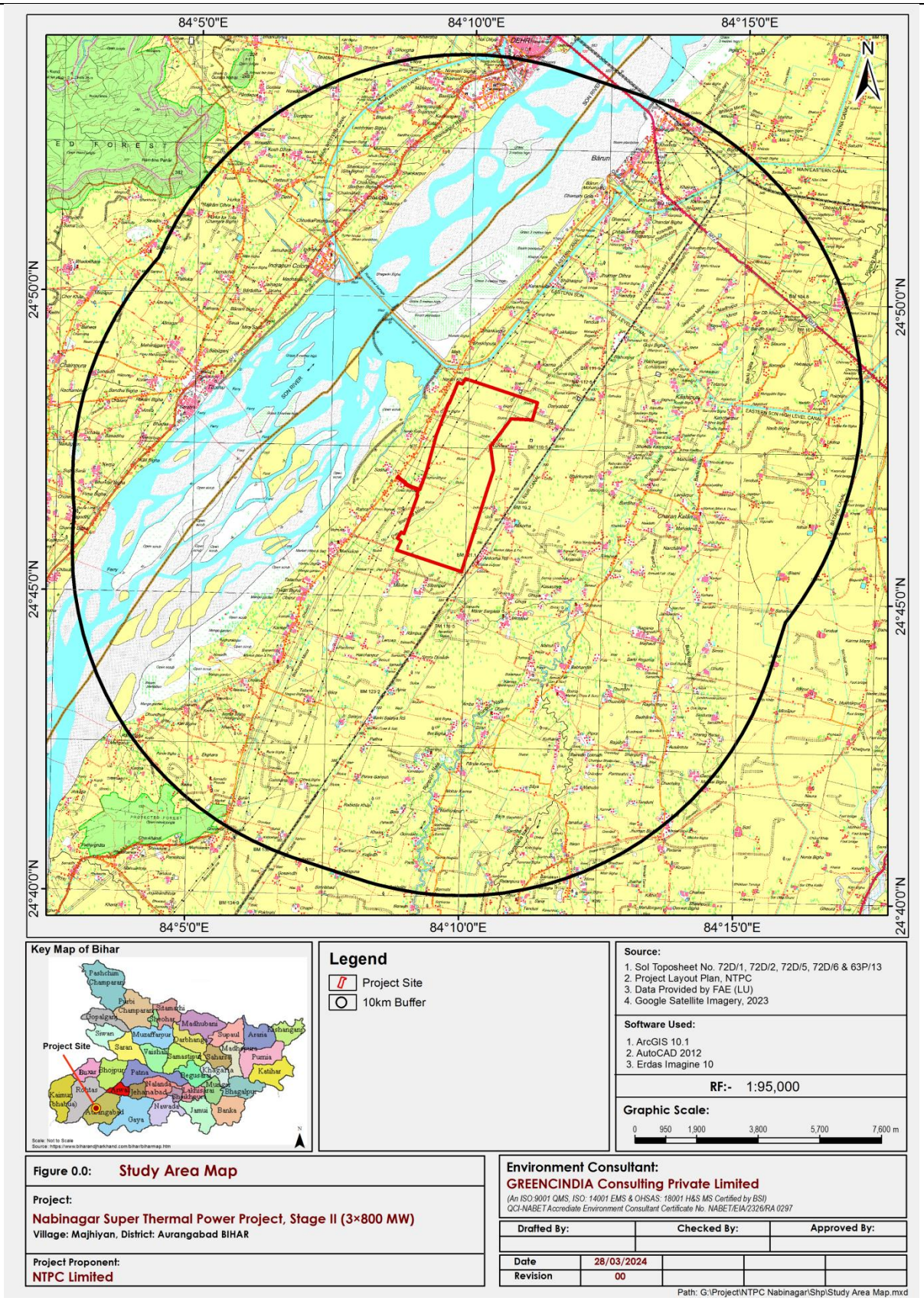


Figure 3.1: Toposheet indicating project site and 10-km radius study area

3.3 METHODOLOGY ADOPTED

The baseline study was conducted during the pre-monsoon season, 2024 i.e. March to May, 2024. A detailed field monitoring study of the project study area was carried out for baseline environment assessment of the project area.

Baseline data was generated for various environmental parameters including air, water (surface and groundwater), land and soil, ecology and socio-economic status to determine quality of the prevailing environmental settings. Sampling of soil and water, monitoring of air quality and noise level and other field data collection were carried out by the team operating from this field station. The field team consisted of technical personnel viz. environmental scientists and social experts along with the field staff. The noteworthy activities completed during the field visit were as follows:

- A meteorological station was setup at project site. Wind speed, wind direction, solar radiation, atmospheric pressure, storm, dry and wet bulb temperature, relative humidity and general weather conditions were recorded throughout the study period in an automated data logger.
- In order to assess the Ambient Air Quality (AAQ), samples of ambient air were collected by installation of Respirable Dust Sampler with gas samplers and Fine Particulate Sampler at different locations from the study area during study period and analyzed for primary air pollutants to work out the existing status of air quality.
- Groundwater samples were collected during the study period from the existing hand-pumps, while surface water was collected from rivers. The samples were analyzed for parameters necessary to determine water quality (based on IS: 10500:2012 criteria for groundwater and CPCB classification for surface water) and those which are relevant from the point of view of environmental impact of the proposed site.
- Soil samples were collected and analyzed for relevant physical and chemical characteristics in order to assess the impact of the proposed plant on soil.
- The noise level measurements were also made at eight locations in different intervals of time with the help of sound level meter to establish the baseline noise levels in the impact zone.
- Ecological data was procured from both primary and secondary sources. A primary data was collected through survey and walkover by ecological experts.
- Socio-economic data was collected from field studies and secondary sources like Census of India 2011, BPL Lists, Revenue Department data, etc.

3.4 REGIONAL AND LOCATIONAL SETTING

3.4.1 PROJECT LOCATION

The project site is connected to NH 19 via Japla-Barun Road (in W direction). The 10 km radius buffer zone falls in Aurangabad District of Bihar state the location of study area is presented in **Figure 3.1**. The co-ordinates of the study area are given in the **Table 3.1** and shown in **Figure 3.2**.

Table 3.1: Co-ordinates of the Study Area

Point	Latitude	Longitude
A	24°48'35.57"N	84°09'47.58"E
B	24°48'34.21"N	84°09'52.61"E
C	24°48'39.56"N	84°09'55.84"E
D	24°48'17.02"N	84°11'15.34"E

Point	Latitude	Longitude
E	24°47'59.75"N	84°11'9.987"E
F	24°48'0.185"N	84°10'46.68"E
G	24°47'32.53"N	84°10'24.82"E
H	24°47'8.849"N	84°10'28.90"E
I	24°45'26.45"N	84°09'55.77"E
J	24°45'46.45"N	84°08'44.21"E
K	24°45'56.10"N	84°08'48.88"E
L	24°45'58.59"N	84°08'44.87"E
M	24°46'04.74"N	84°08'48.99"E
N	24°46'03.25"N	84°08'51.79"E
O	24°46'47.46"N	84°09'06.40"E
P	24°46'58.97"N	84°08'42.99"E
Q	24°47'0.578"N	84°08'44.19"E
R	24°46'47.69"N	84°09'08.26"E
S	24°48'14.60"N	84°09'37.91"E

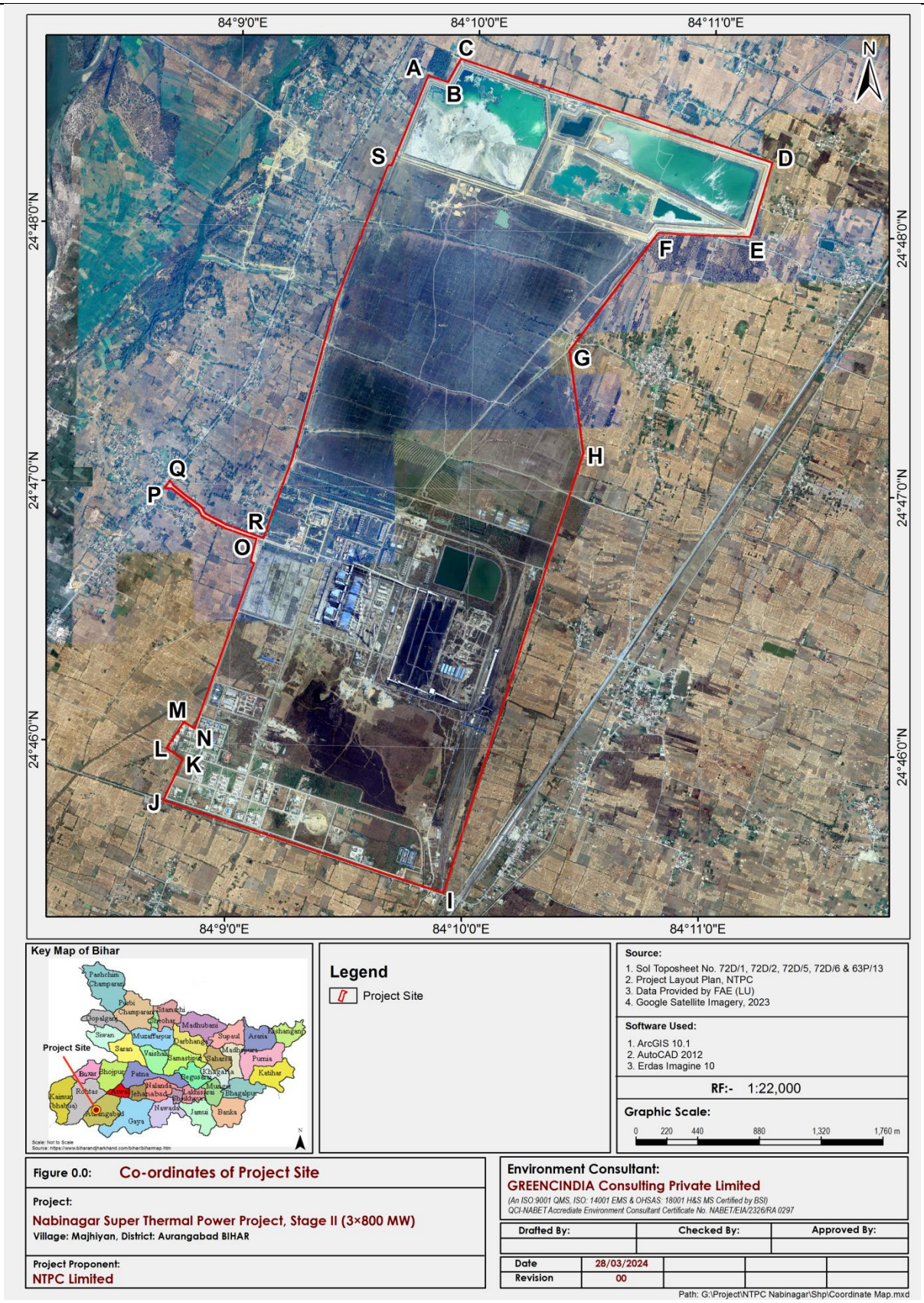


Figure 3.2: Coordinates of Project Site

3.4.2 SITE CONNECTIVITY

The nearest Railway Station is Ankorha Railway station which is at an approx. distance of 1 km E from the project site. The nearest airport is the Gaya Airport, which is around 120 km from the proposed site connecting it to many cities in the country and, by regular flights operated by private and govt. pliers. (**Figure 3-3**)

Figure 3.3: Location Connectivity of Project Site

3.4.3 ENVIRONMENT SENSITIVITY

There is no National Park, Wildlife Sanctuary or Ecologically sensitive area within 10km of the project site. The sensitivity analysis of the site is given **Table 3.2 & Figure 3.4** is showing the locations of environment sensitivity.

Table 3.2: Environmental Sensitivity Locations

Sno.	Name	Distance in Km	Direction
1	Main Eastern Canal	0.30	NNW
2	Son River	0.80	WNW
3	Punpun Nadi	3.30	E

4	Eastern Son High level canal	3.60	NNE
5	Ramrekha Nadi	4.50	SE
6	Barki Nala	5.20	E
7	Main western canal	5.80	NW
8	Western Son high level canal	9.80	NNW
9	Patna Canal	11.20	NE
10	Batane Nadi	13.10	ENE
11	Protected forest n/v Surar	9.40	SSW
12	Protected forest n/v Koiridih	10.00	NW
13	Protected forest n/v Guraila	11.20	NNW
14	Kaimur Wildlife Sanctuary	11.20	NW

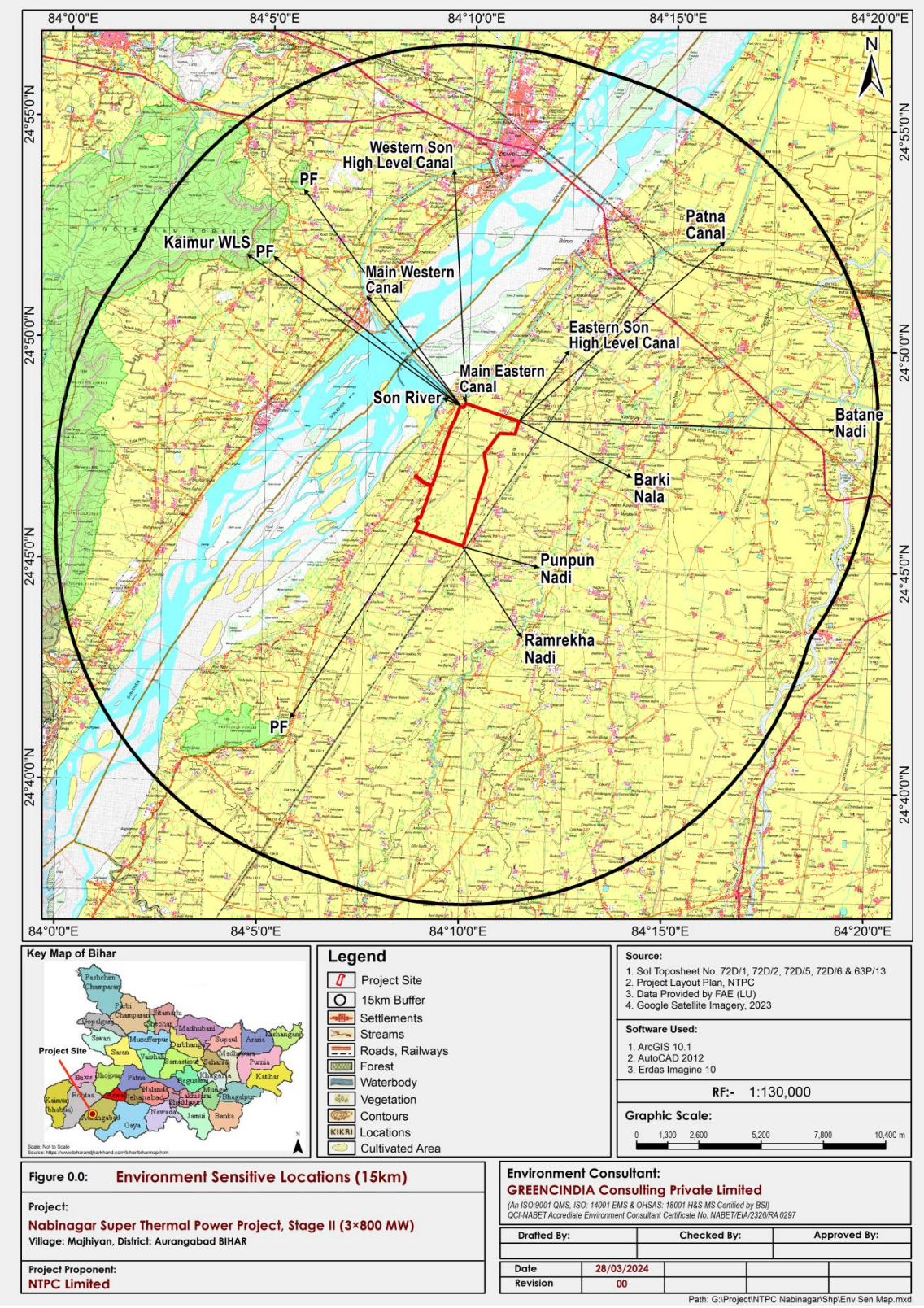


Figure 3.4: Environmental-sensitivity Map of 15 km radius of project site

3.5 LAND USE

3.5.1 LAND USE/ LAND COVER DETAILS OF THE STUDY AREA

The land-use mapping of the study area is carried out based on Survey of India Toposheet, recent satellite imagery) and site visit by FAE (LU) which is given in **Table 3.3**. The pie-diagram depicting land use pattern of the study area is shown in **Figure 3.5** while the land-use map is given in **Figure 3.6**.

3.5.2 METHODOLOGY OF LAND USE/ LAND COVER

3.5.2.1 DATA PROCESSING

For the creation of the Land use/Land cover maps, the IRS Resourcesat2A LISS IV Multispectral satellite imageries for buffer zone is used.

ArcGIS Desktop and ArcGIS Pro software tools have been used to carry out the digital image processing, classification and on-screen digitization. At the end, a polygon map was created, with each polygon standing for a different class. Thereafter, the classes were matched with the appropriate attributes. Using high resolution photos from independent sources, accuracy was verified.

For the purpose of creating the land use/land cover map, both remote sensing and the visual image interpretation technique of classification were used. It is a process of recognising the characteristics that appear in photographs and conveying the knowledge gathered from these images to others for the purpose of assessing their importance.

For the study area, the remote sensing and visual interpretation method was used. It includes the following six crucial steps:

1. Selection and acquisition of data
2. Pre-Processing
3. Classification
4. Ground data collection and verification
5. Post-field Interpretation and Modification
6. Computation of area
7. Final cartographic Map preparation.

Each endeavour to map the earth's natural resources must begin with a reconnaissance of the area under consideration. In order to adopt a suitable categorization scheme and interpretation key for the final map production, the preliminary survey of the area helped in familiarising with the various classes of LULC types that are present in the field.

Using the spectral properties of the classes and with reference to other sources, a final Interpretation key for the different classes was created. Table 3.4 contains the LULC classification's interpretation key.

3.5.2.2 FLOWCHART OF THE STUDY

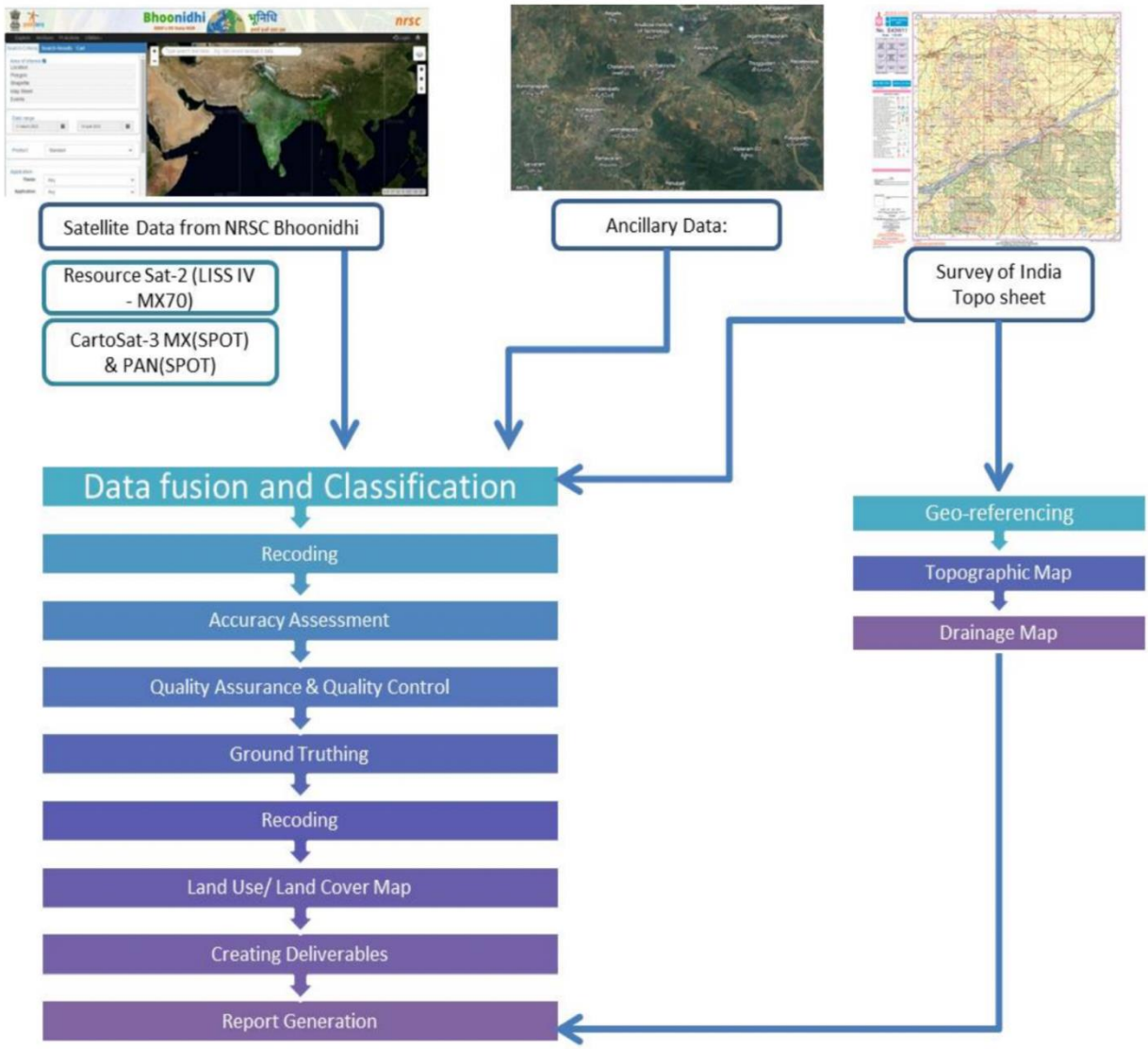
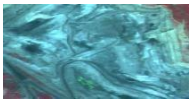
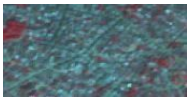
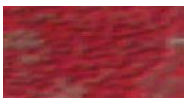
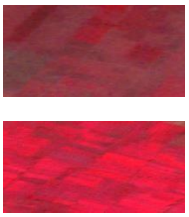


Table 3.3: Image Interpretation techniques.

S. no	LULC Class	Tone	Texture	Shape	Spectral Signature	Description
1	Water Bodies	Dark Blue or Light Blue	Smooth	Irregular /Regular		Rivers, Streams and Ponds

S. no	LULC Class	Tone	Texture	Shape	Spectral Signature	Description
2	Mining area	Light Blue or Light Cyan with white spots	Smooth	Irregular		Place where Mining Operations are taken.
3	Industrial Establishments	Cyan or Whitish	Rough	Irregular /Regular		Large footed building in Urban and Rural Areas
4	Built-up Land	Cyan	Rough	Irregular		Urban and Rural Areas
5	Open Forest	Light Red	Smooth	Irregular		Tree Cover (If Forest Canopy Density is between10-40%)
6	Dense Forest	Dark Red to Light Red	Rough	Irregular		Tree Cover (If Forest Canopy Density>40%)
7	Roads	Cyan	Rough	Linear		Major and other roads used for transportation
8	Barren Land	Light Blue or Light Cyan	Smooth	Irregular		Areas are sparse, stunted and contain limited biodiversity
9	Fallow Land	Light Cyan or Whitish	Medium Smooth	Regular		Fields without any Crop surrounded by small to Medium Size settlements

S. no	LULC Class	Tone	Texture	Shape	Spectral Signature	Description
10	Plantation	Blackish Red to Dark Red	Medium Smooth/ Medium Coarse	Irregular/Regular/Rectangular		Mature or Young Plants
11	Agricultural land	Pinkish or Light Green or Light Blue Or Light Cyan or Dark Red to Light Red	Medium Smooth	Regular		Crops/Current Fallow Lands surrounded by small to Medium Size Settlements

ArcGIS Desktop and ArcGIS Pro were used for classification and on-screen digitisation. At the end, a polygon map was created, with each polygon standing for a different class. Afterwards, the classes were matched with the appropriate attributes. During the field visit, a handheld GPS device was used to verify the ground truth. It was discovered that the satellite image's points were highly accurate. Ultimately, a color-coded classification map and area statistics for the various LULC categories were developed.

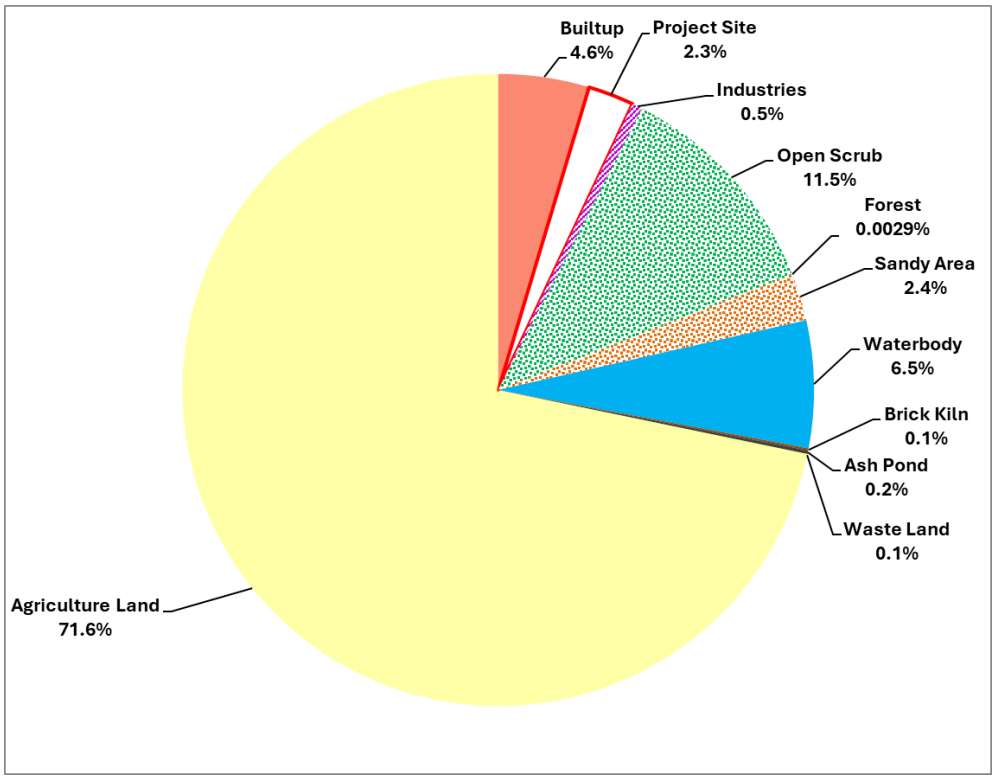


Figure 3.5: Statistical Representation of Land use of study area

Study Area: A site visit was carried out for the entire project site and the land features were compared with the satellite images and SOI Toposheet for data verification.

From **Table-3.4** Land Used of the study Area has been analyzed based on SOI Toposheet, it can be seen that majority of the land in the study area *i.e.,* buffer zone of the mine lease area is agricultural area is 35089.63 Ha. (71.6%) total study area. The forest land 1.42 Ha. (0.0028%), open scrub is 5641.59 (11.5%), industrial area (0.54%), sandy area is 1186.38 Ha i.e 2.42%, Ash pond area 89.21 ha (0.18%), waste land cover 0.14% and brick kline area 51.51ha. (0.11%) are also crucial land use characters of the study area. About 6.50% of the study area is covered by the water body which covers primarily rivers, channels, ponds and reservoirs. Built up area (2273.39 Ha) of the study area is which is 4.64% of the total study area.

Table 3.4: Land Use of Study Area

S.No.	Land use	Area in ha	Area in %
1	Built up	2273.39	4.64
2	Project Site	1149.52	2.35
3	Industries	262.49	0.54
4	Open Scrub	5641.59	11.51
5	Forest	1.42	0.0029
6	Sandy Area	1186.38	2.42
7	Waterbody	3186.46	6.50
8	Brick Kiln	51.51	0.11
9	Ash Pond	89.21	0.18
10	Waste Land	69.00	0.14
11	Agriculture Land	35089.63	71.61
	Total Area	**49000.60**	**100**

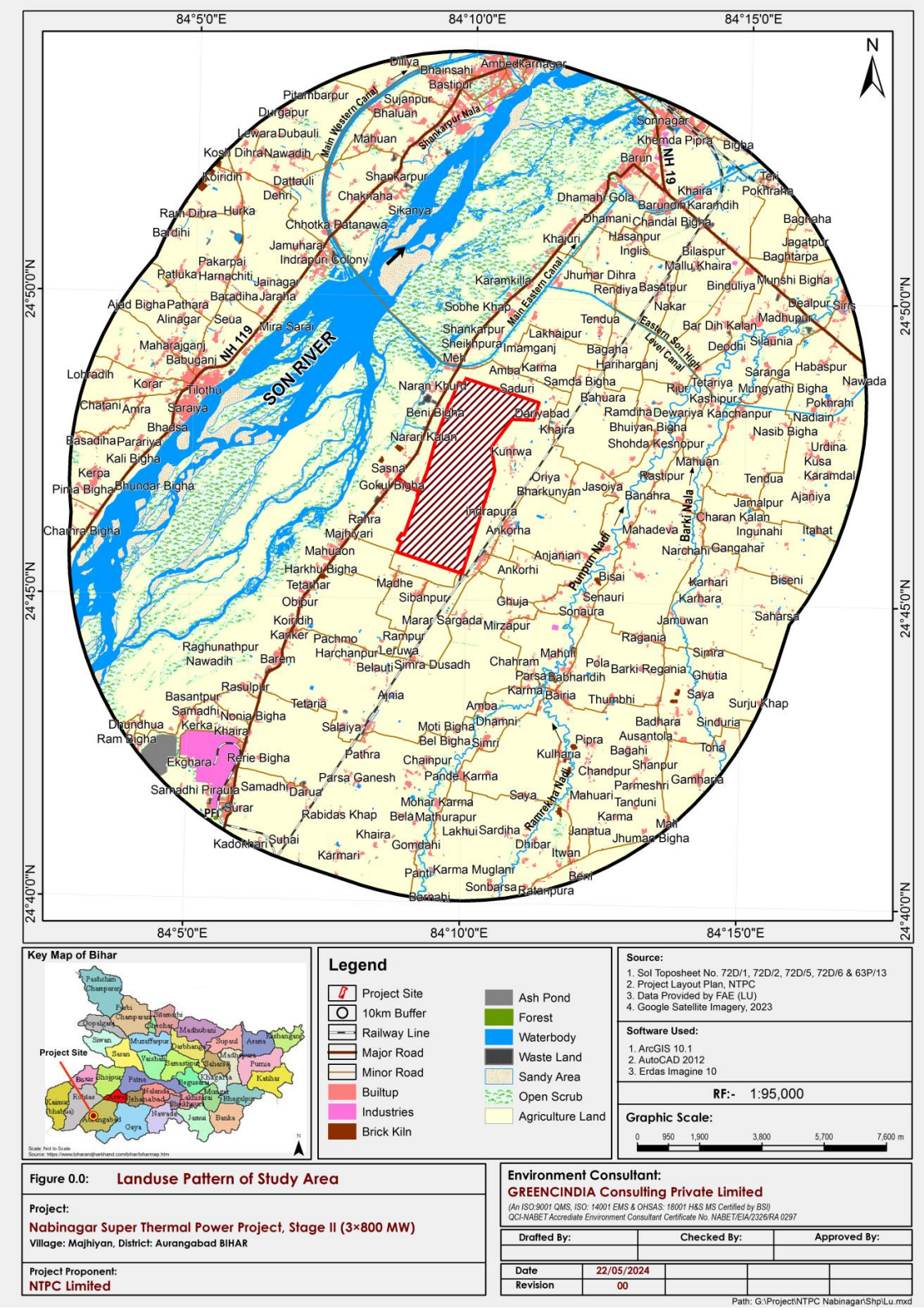


Figure 3.6: Land use of Study Area

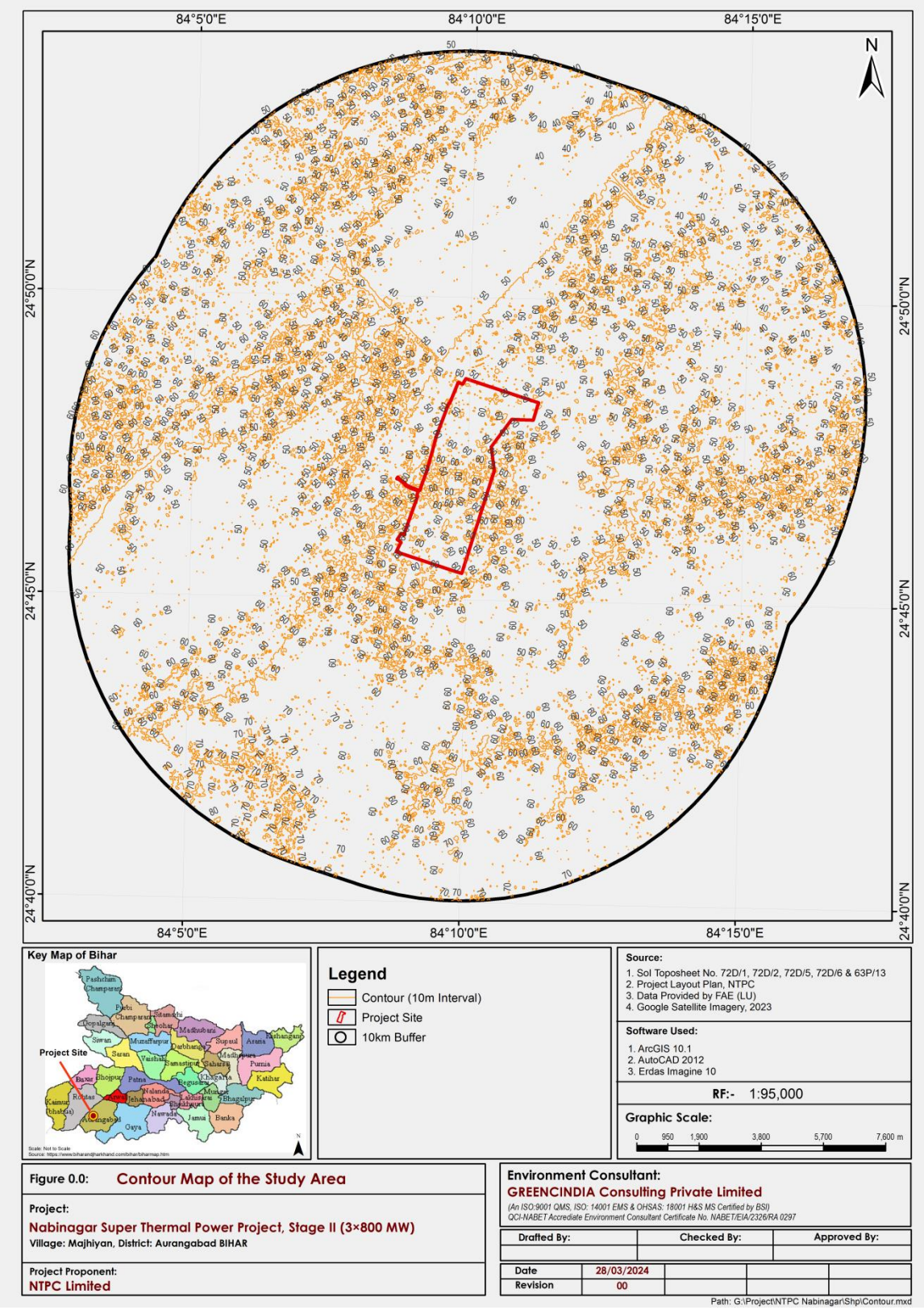


Figure 3.7: Contour map of Study Area

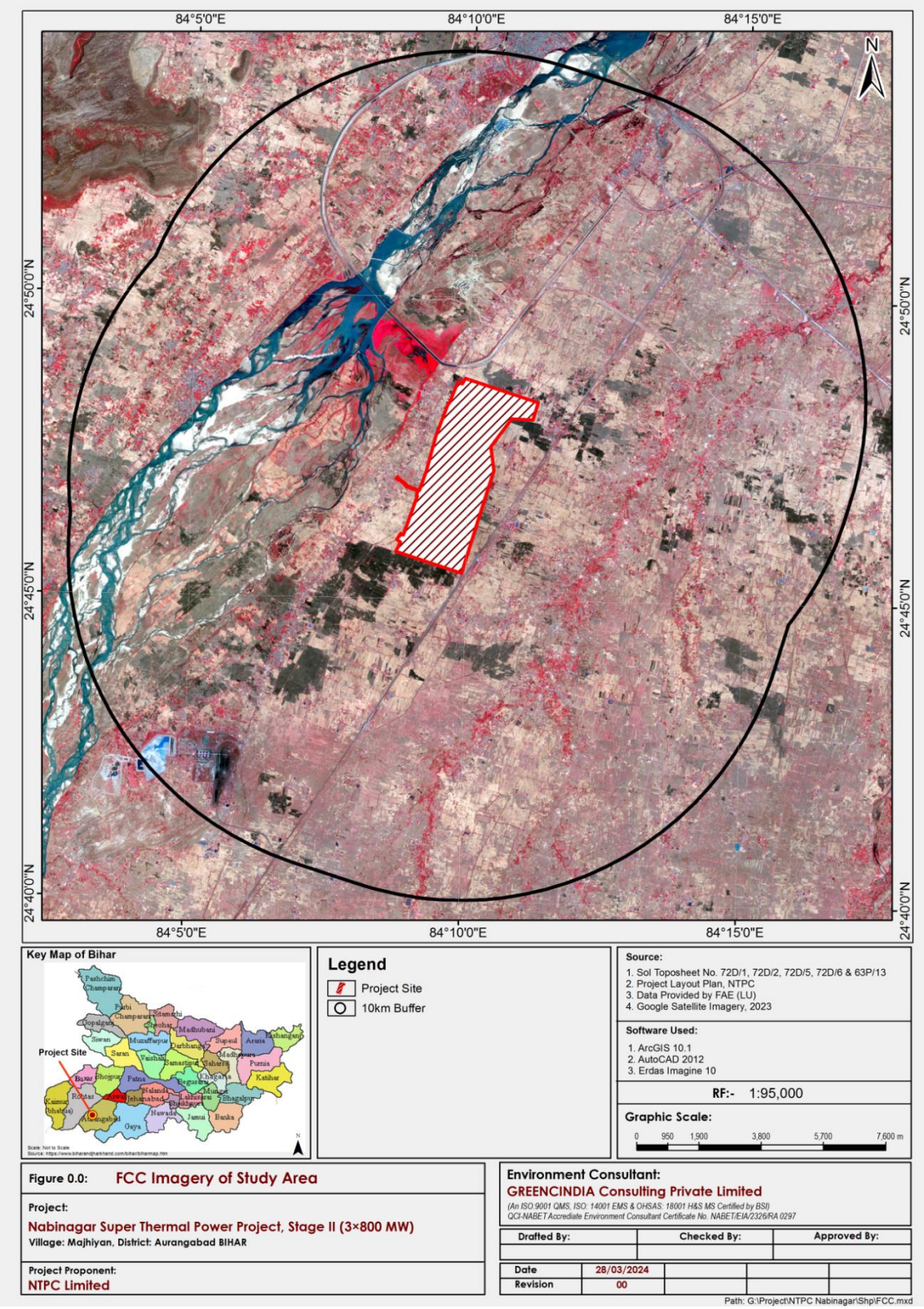


Figure 3.8: False Colour Composite map of Study Area

3.6 PHYSICAL ENVIRONMENT

3.6.1 TOPOGRAPHY& DRAINAGE

The southern hilly ranges and the northern Gangetic Plains form two physiographic units of the Aurangabad district. The southern hilly unit is undulating in character, occupied by high mountain ranges and low valleys covering parts of Kutumba, Nabinagar, Deo and Madanpur blocks. The constituting rocks of the hills dip northward and form the basement of the northern lying Gangetic Plain. The northern alluvial plain slopes NNE. The maximum elevation is attained to heights of 411.48 m above mean sea level by the hills located south of Deo. The minimum elevation of ~80 m amsl runs at the northeastern parts around Goh[1]. The district is covered in the elevation range of 80-140 m amsl.

Figure 3.9: Surface Elevation Contour Map of Aurangabad

DRAINGAE: The Aurangabad district falls in the Punpun River Sub-basin. The craton-origin Punpun River is a 3rd order stream, forming a southern tributary of the Ganga River. It forms the major drainage and the entire Aurangabad district falls in the watershed of the river. There are other drainages namely Batane, Batre, Adri,

[1] GWIB, Aurangabad

Ramrekha, Kasman, Madar, Dhawa etc, which merge with Punpun at different points within the district and the trunk river flows out of the district as a single thread. Major stretches of the river seem to follow the palaeo-channels of Sone. The river in its northern stretches is highly incised and often braided. The northwestern peripheral part is drained by the river Sone, flowing from south-west to north-east. Though, the Sone and the Punpun bear little flow during non-monsoon periods, most of the other streams in the district remain almost dry during the same period[2].

Drainage of Study area: There is no natural drain passing through the project boundary. The Sone River, an important right bank tributary of the Ganges, is a perennial river flowing through central India flows at a distance of 0.80 km in WNW direction from the project. It originates near Amarkantak Hill in the Gaurela-Pendra-Marwahi district of Chhattisgarh and finally merges with the Ganges River near Patna in Bihar. It exhibits a dendritic drainage pattern, which is typical in regions with relatively uniform geological material. With a large catchment area of 70,055 square kilometers, the Sone River receives water from various tributaries. It ultimately merges with the Ganges about 16 kilometers upstream of Patna. The river Sone has a total length of 784 km of which about 500 km lie in MP, 82 km in UP and the balance 202 km in Bihar. The first stream merge in of Sone River in south west direction and first and second order stream of northeastern direction merge in main river, also Shankarpur nala 1st order stream in NNW merge in Sone and it is flow southwest to northern direction. The river is a major source of irrigation for the agricultural lands in Aurangabad

Whereas The Punpun River originates in the Palamu district of Jharkhand at an elevation of 442 meters and flows through Bihar, covering a total length of about 235 kilometers. The river has four major right bank tributaries: the Morhar, the Dardha, the Madar, and the Batane. It exhibits a dendritic drainage pattern, with smaller tributaries feeding into the main river channel, resembling the branches of a tree. In southern direction first order and second order stream merge to main river while in SE direction. The Ramrekha nadi, Barkhi nala and another 1st order stream from the east also join the Punpun river. The river flows from south to northeast before finally joining the Ganges River near Patna.

[2]GWIB Aurangabad

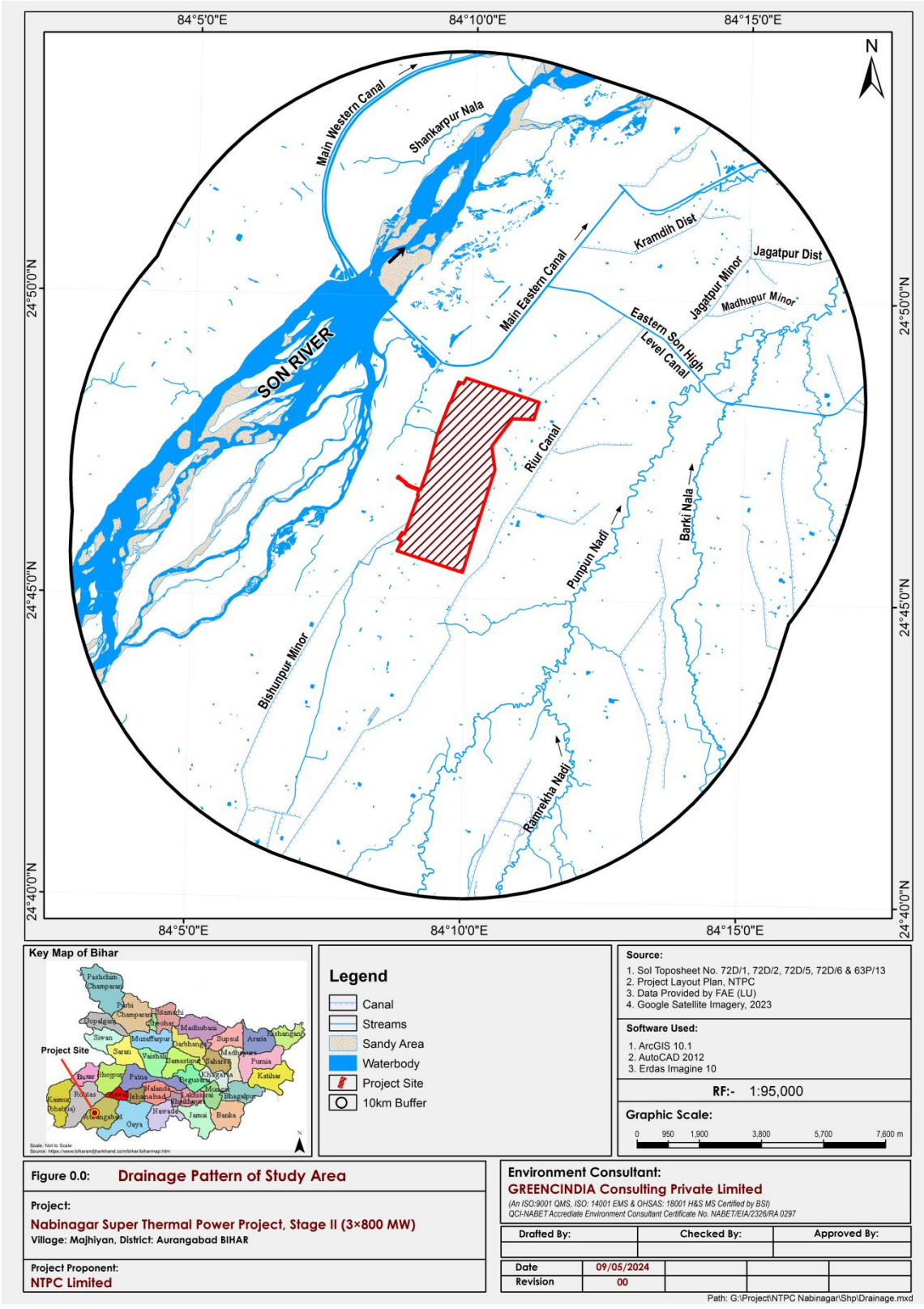


Figure 3.10: Drainage of Study Area

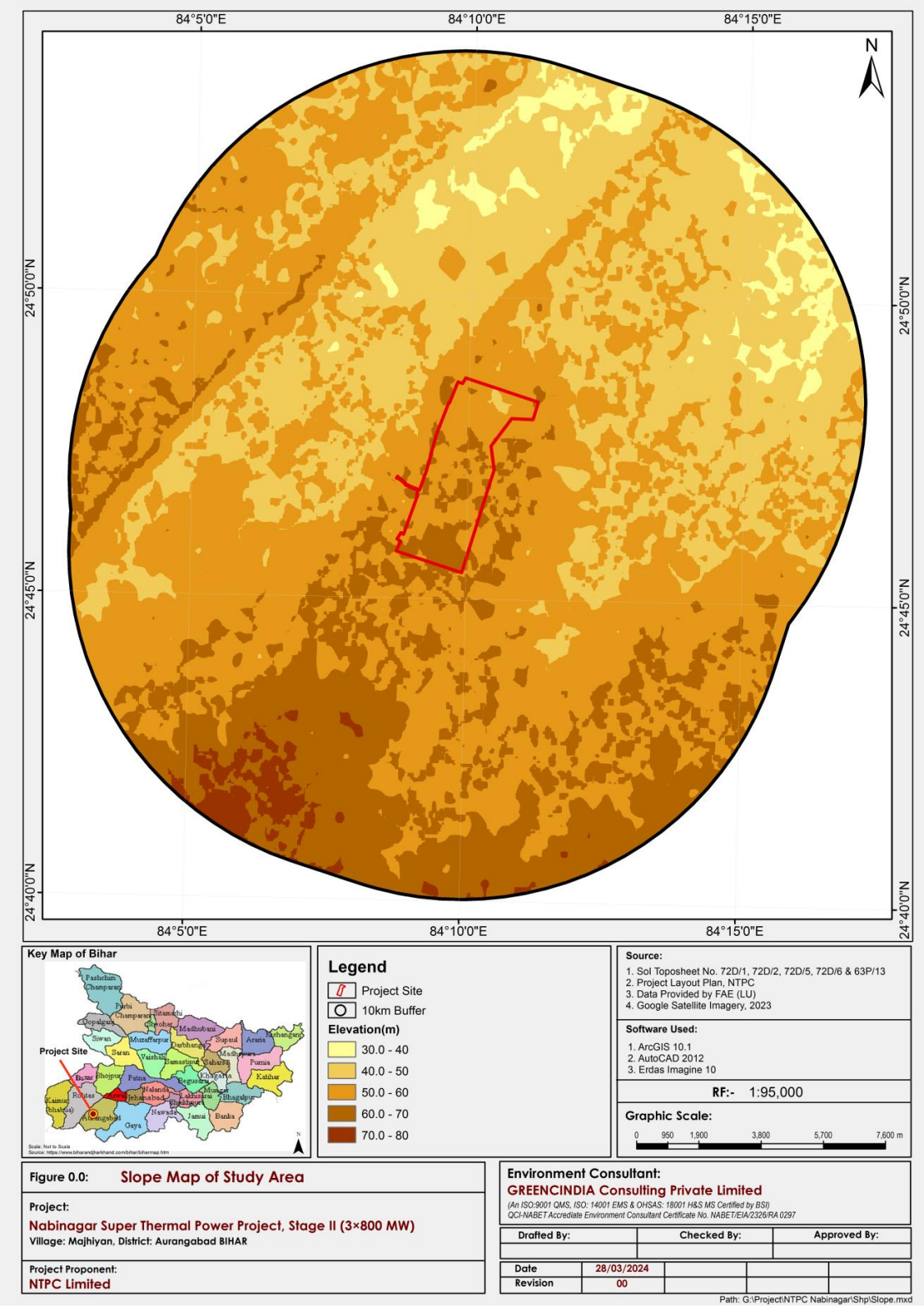


Figure 3.11: Slope Map of Study Area

3.6.2 GEOLOGY

The Nabinagar Super Thermal Power Project is located on Sone River valley porcellanites which are exposed in the bed of the Sone River. The study area comes under the Southern Gangetic plain. The Kaimur range passes through the study area from Rohtas district south of the alluvial plain of Gangetic plain. It is far older than Himalayas and is formed essentially of the ancient igneous rocks comes under Gondwana land. The western part of Narmada valley was covered with lava. The eastern part of this range, which is not covered with lava, is known as Kaimur hill.

The Kaimur hills form the eastern limit of the Vindhyan Range. The Vindhyan rocks, constituting the great sedimentary series, are even geologically speaking very old. No definite fossils have been found in the districts of Aurangabad and Rohatas (earlier Shahabad district) though coaly matter found in the carbonaceaous shale indicates existence of vegetative matter at the time during which the Vindhyans were laid down. The age of these rocks as told by radioactive minerals in igneous rocks intruded into equivalent systems in other parts of the world, may be of the order of 600 million years. The Vindhyan system may be divided into four series, the youngest being placed uppermost[3].

The general stratigraphic succession of different formations is given below:

Age	Formation	Broad Lithology
Quaternary	Alluvial Deposits	Sand, clay, silt and occasional gravel
Tertiary	Siwaliks	Sandstone, conglomerate, clay stone, gravel
L-Cambrian	Vindhyan Super Group	Sandstone, limestone
Proterozoic	Chotanagpur Granite Gneiss	Granite, granitic-gneiss, schist, phyllites, dolomites, basic rocks, amphibolites
Archean	Bihar Mica belt	Gneiss, Pegmatites etc.,

[3]Department of Water Resources, River Development & Ganga Rejuvenation, CGWB, Bihar

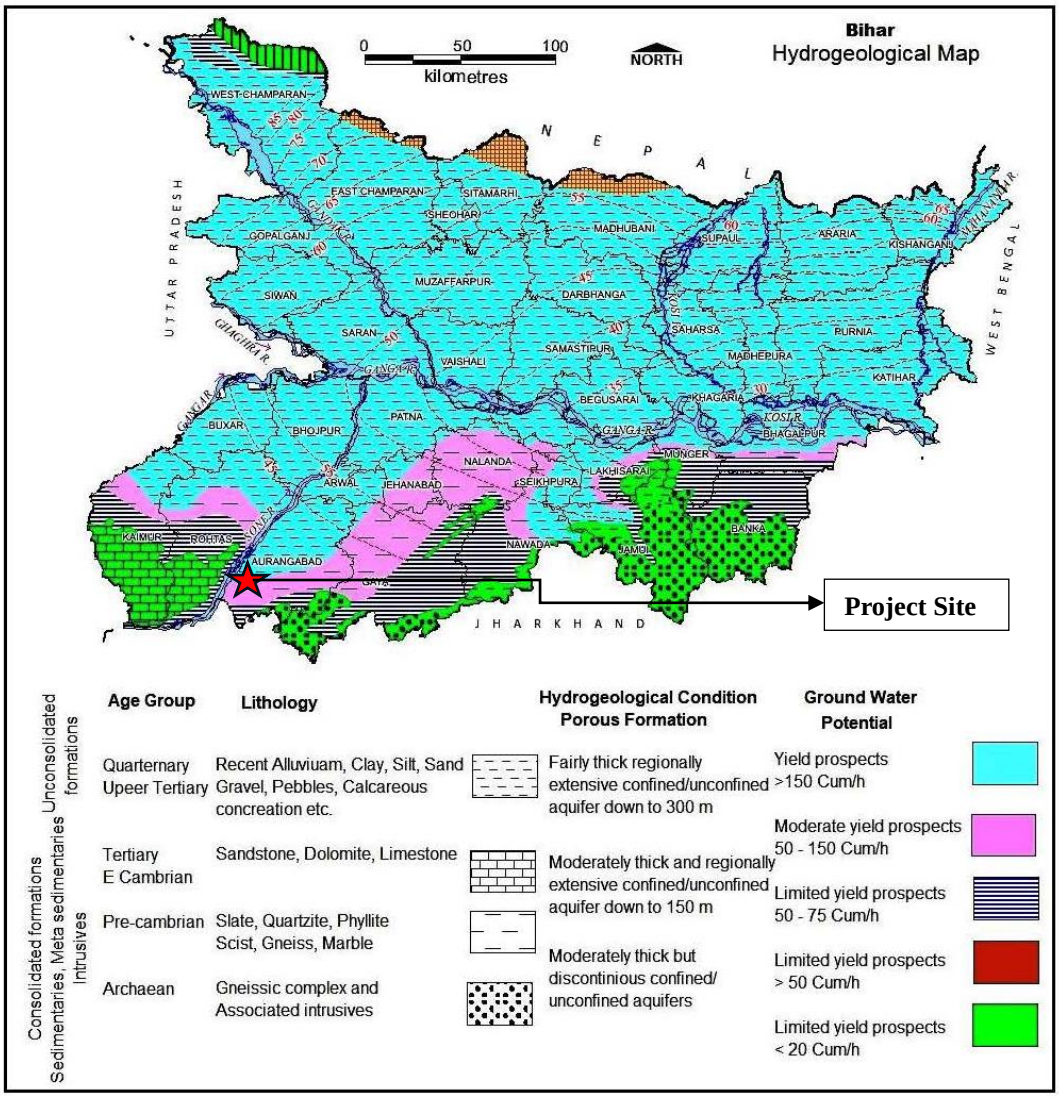


Figure 3.12: Hydrogeological Map of Bihar

Source: Department of Water Resources, River Development & Ganga Rejuvenation, CGWB2023

Unconsolidated Quaternary Alluvium, weathered zone and consolidated (fissured) formation-Granite gneiss form three hydrogeological units in the district **(Figure3.13)**. About 95% of the geographical area of the Aurangabad district is covered with Quaternary Gangetic alluvial deposits[4].

Formation	Lithology	Thickness
Unconsolidated	Alluvium Marginal Alluvium	50-100m 30-50m
Consolidated	Weathered zone	10-15m

[4]GWIB Aurangabad

	Granite gneiss	Fractured and joint

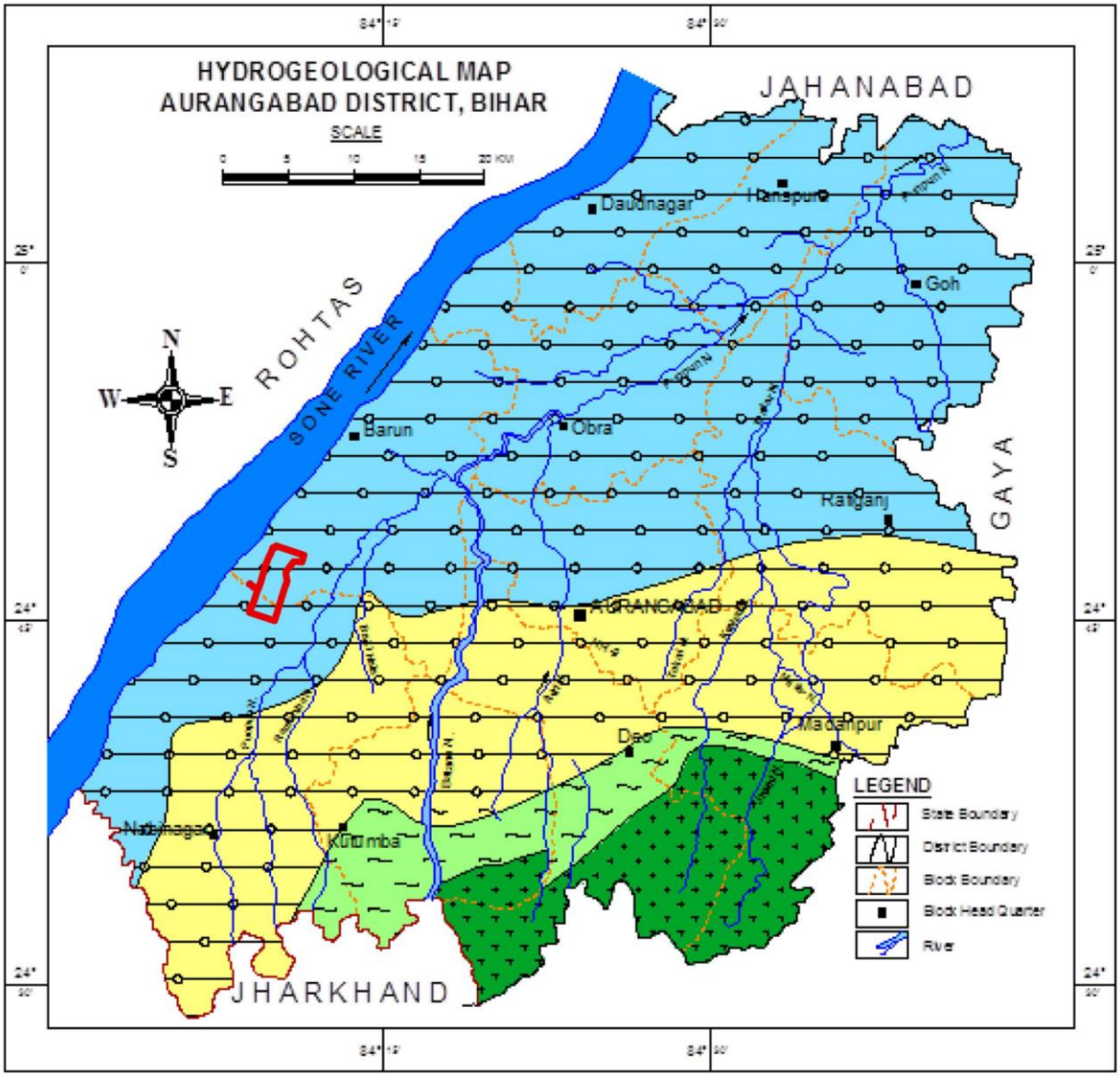


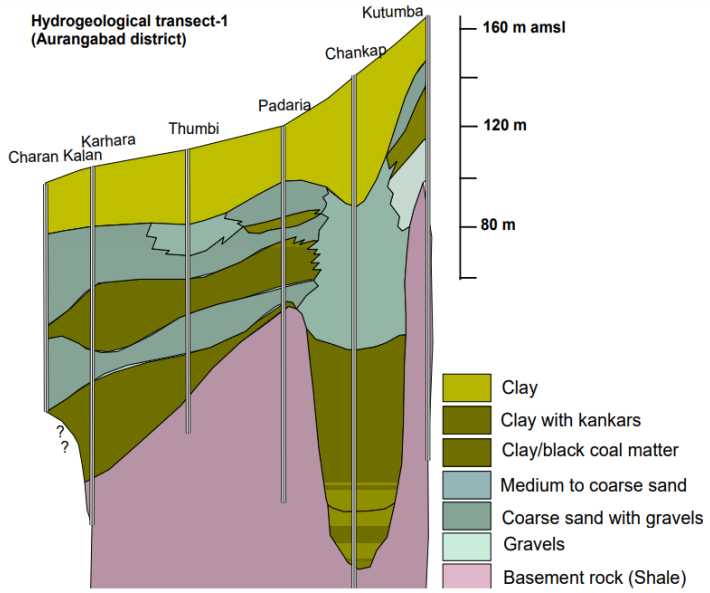
Figure 3.13: Hydrogeological Map of Aurangabad

3.6.2.1 HYDROGEOLOGY

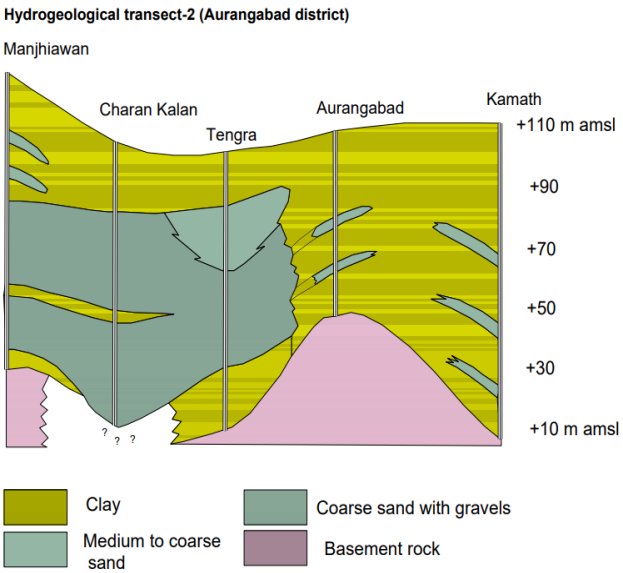
The hydrogeological transects (**Figure3.14)** indicate the existence of prolific aquifers in the northern and northwestern parts of the district thick deposits of sand of size varying between fine to coarse in the areas. The lithology becomes more clayey towards south. The central and southwestern parts of the district are clayey in

character with infrequent minor sand zones. The Sone River has played an important role in building the stratigraphic succession in the Aurangabad district.[5].

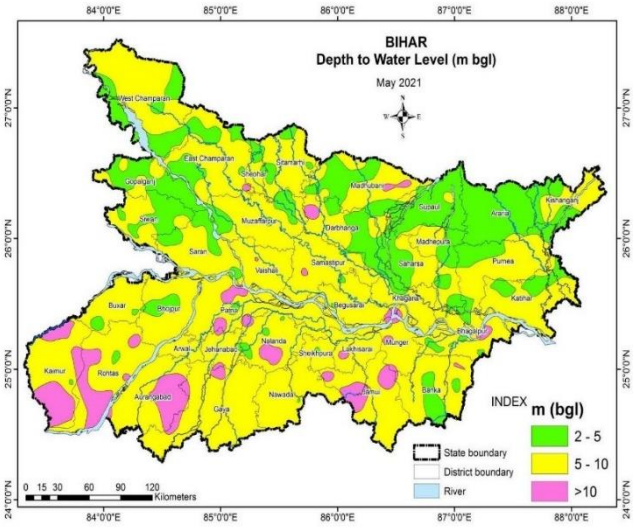
The maximum water level of 20.68 mbgl has been observed in the Aurangabad district during pre-monsoon period. Whereas during post monsoon it is 5-10 mbgl.[6]



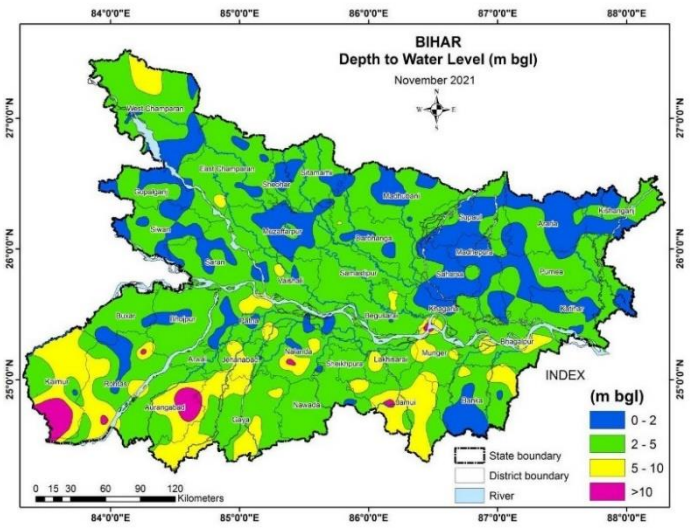
Hydrogeological transect in north-south direction



Hydrogeological transect in west-east direction



Depth to water level map of pre-monsoon periods



Depth to water level map of post-monsoon periods

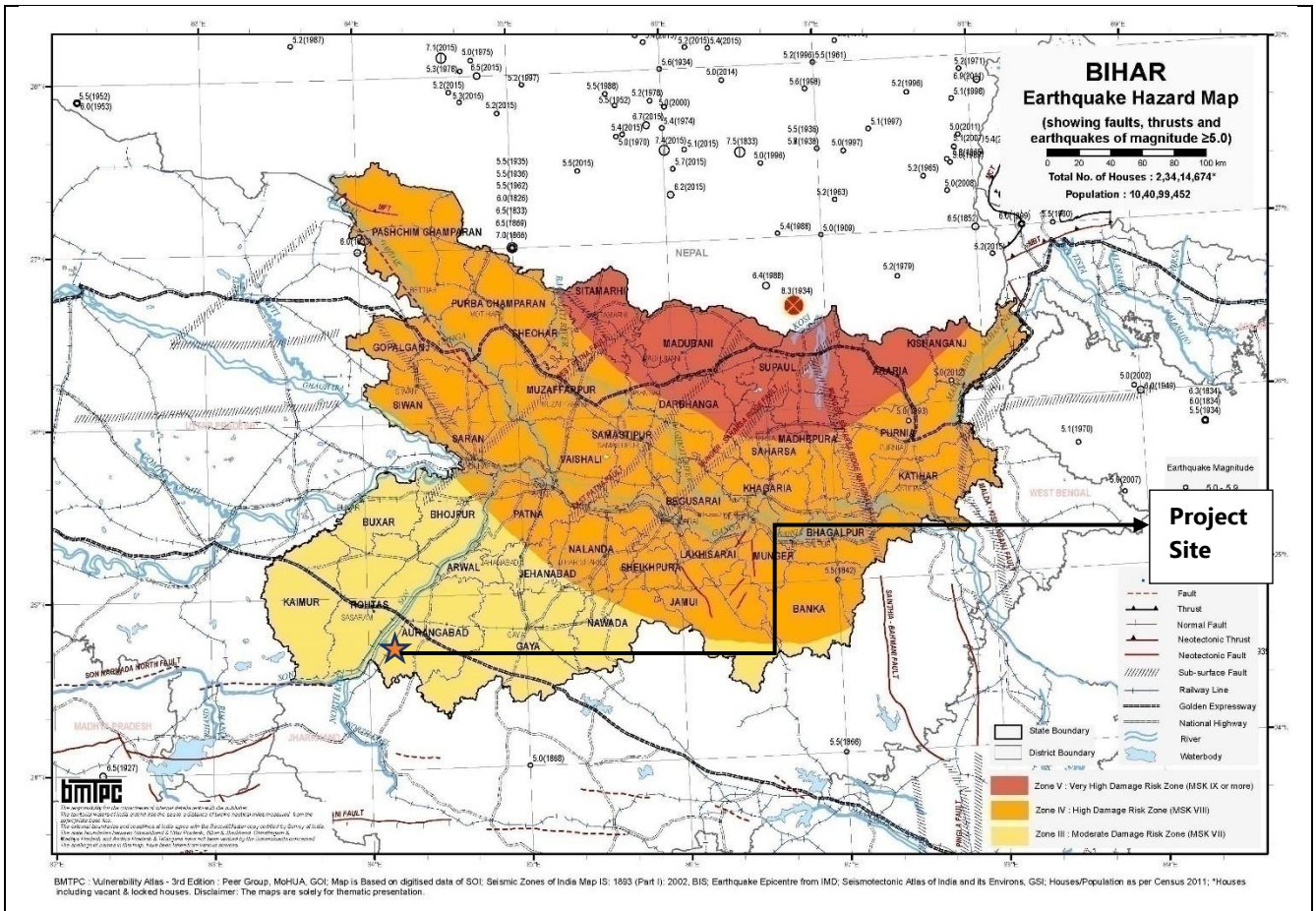
[5]GWIB | Aurangabad, 2013
[6]Dynamic Ground Water Resources of Bihar, 2022

Figure 3.14: Water level during pre and post monsoon season

3.6.3 VULNERABILITY OF STUDY AREA

The earthquake vulnerability atlas and wind vulnerability atlas of Bihar are provided in **Figures 3-15** and **Figure 3-16** respectively. The entire state of Bihar falls in seismic zones according to the vulnerability atlas of India[7] viz., Zone V: Very High Damage Risk Zone (MSK IX or more). The district Aurangabad has fall under Zone III: Moderate Damage Risk Zone. The project site falls in moderate damage risk zone.

According to the wind vulnerability atlas, Bihar falls in High Damage Risk Zone - A (Vb=47 m/s), where Vb is the basic wind speed. Aurangabad district as well as the project site fall in Moderate Damage Risk Zone B (Vb= 39 m/s).



BMTPC : Vulnerability Atlas - 3rd Edition : Peer Group, MoHUA, GOI; Map is Based on digitised data of SOI; Seismic Zones of India Map IS: 1893 (Part I): 2002, BIS; Earthquake Epicentre from IMD; Seismotectonic Atlas of India and its Environs, GSI; Houses/Population as per Census 2011; *Houses including vacant & locked houses. Disclaimer: The maps are solely for thematic presentation.

Figure 3.15: Earthquake Hazard Map of Bihar

[7] https://vai.bmtpc.org/th.html

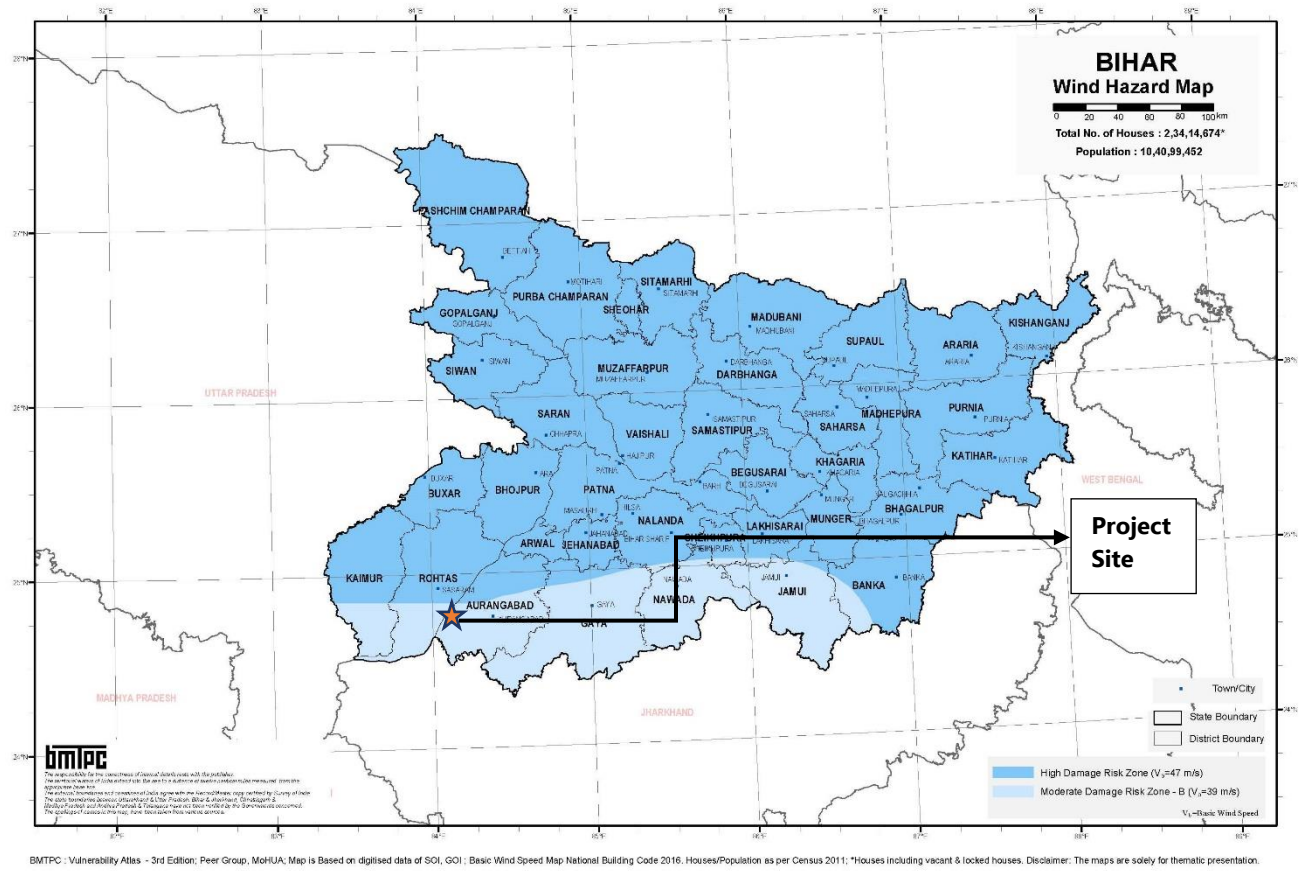


Figure 3.16:Wind Hazard Map of Bihar

Flood: Bihar is one of the most flood affected States in the country, accounting around 17.2% of the flood prone area of the country. It is reported that the plains of north Bihar have recorded the highest number of floods in the years 1998, 2004, 2007, 2008, 2012, 2013, 2016, 2017, 2018 and 2019 Bihar witnessed high magnitudes of flood. The total area affected by floods has also increased during last few years. Bihar also faces waterlogging problem. Fig 3.8 and 3.9 shows the flood hazard map and flood hazard index map respectively.

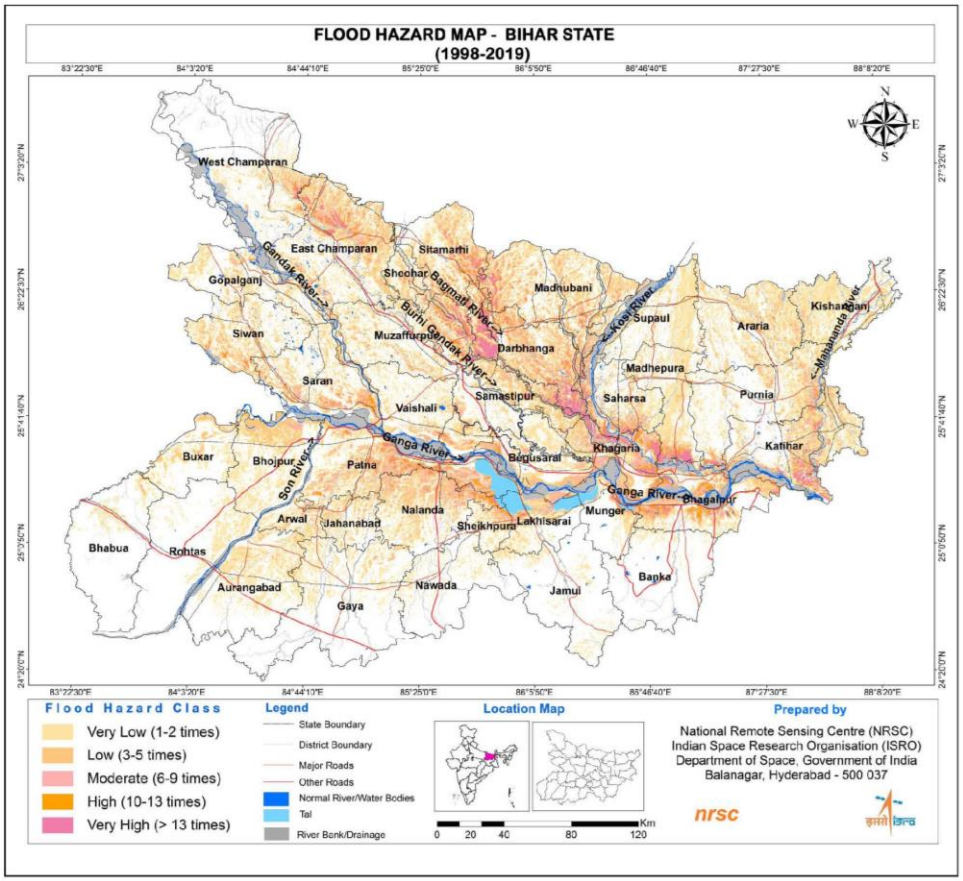


Figure 3.17: Flood Hazard Map

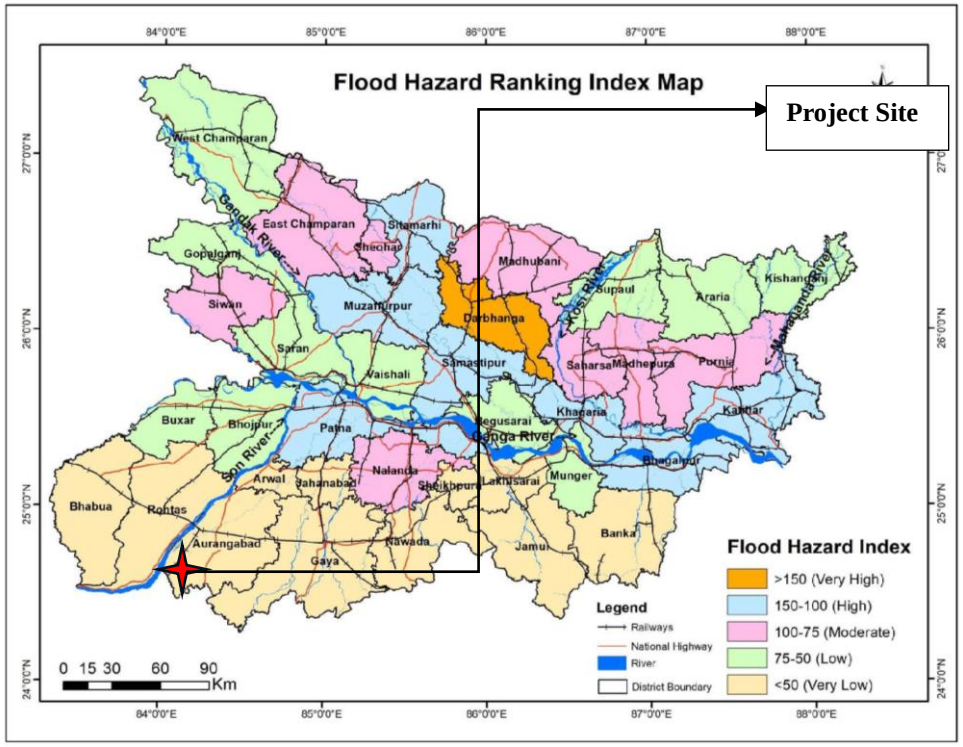


Figure 3.18: Flood Hazard Ranking index

3.6.4 SOIL QUALITY

Soil is a thin layer of earth's crust and is a living media, which is one of the important factors of crop production and serves as a natural nutrient source for the growth of plants. The components of the soils are mineral material, organic matter, water and air, the proportions of which vary and which together form a system for plant growth.

Soil quality of the study area is one of the important components for Environment Impact Assessment (EIA). The composite soil samples were collected from the study area and analyzed for different parameters. **Table 3.5** depicts the location of soil sampling in the study area. **Figure 3-19** shows the soil sampling locations on map.

Table 3.5: Soil Sampling Locations

Name	Latitude	Longitude	Villages	Distance in km	Direction	Category
S1	24°45'48.87"N	84° 11' 8.43"E	Ankhori Village	1.75	E	Agriculture land
S2	24°46'10.16"N	84°13'39.89"E	Mahdeva Village	5.76	E	Agriculture land
S3	24°45'11.41"N	84° 8' 39.68"E	Madhe Village	1.05	S	Agriculture land
S4	24° 47' 9.39"N	84° 9' 55.91"E	Ash Dyke Stage-II	0.0	--	Industrial use
S5	24°43'22.78"N	84°12'49.59"E	Thumbhi Village	6.24	SE	Agriculture land
S6	24°42'46.06"N	84°7' 46.13"E	Salaiya Village	5.78	SSW	Agriculture land
S7	24°44'28.27"N	84°7' 4.91"E	Kanker	3.70	SW	Agriculture land
S8	24°48'16.29"N	84°11'34.89"E	Khaira Village	0.56	ENE	Agriculture land
S9	24°50'12.85"N	84°10'58.90"E	Karamkila Village	3.50	N	Agriculture land
S10	24°48'17.94"N	84°4'33.40"E	Tilouthu Village	8.29	W	Agriculture land

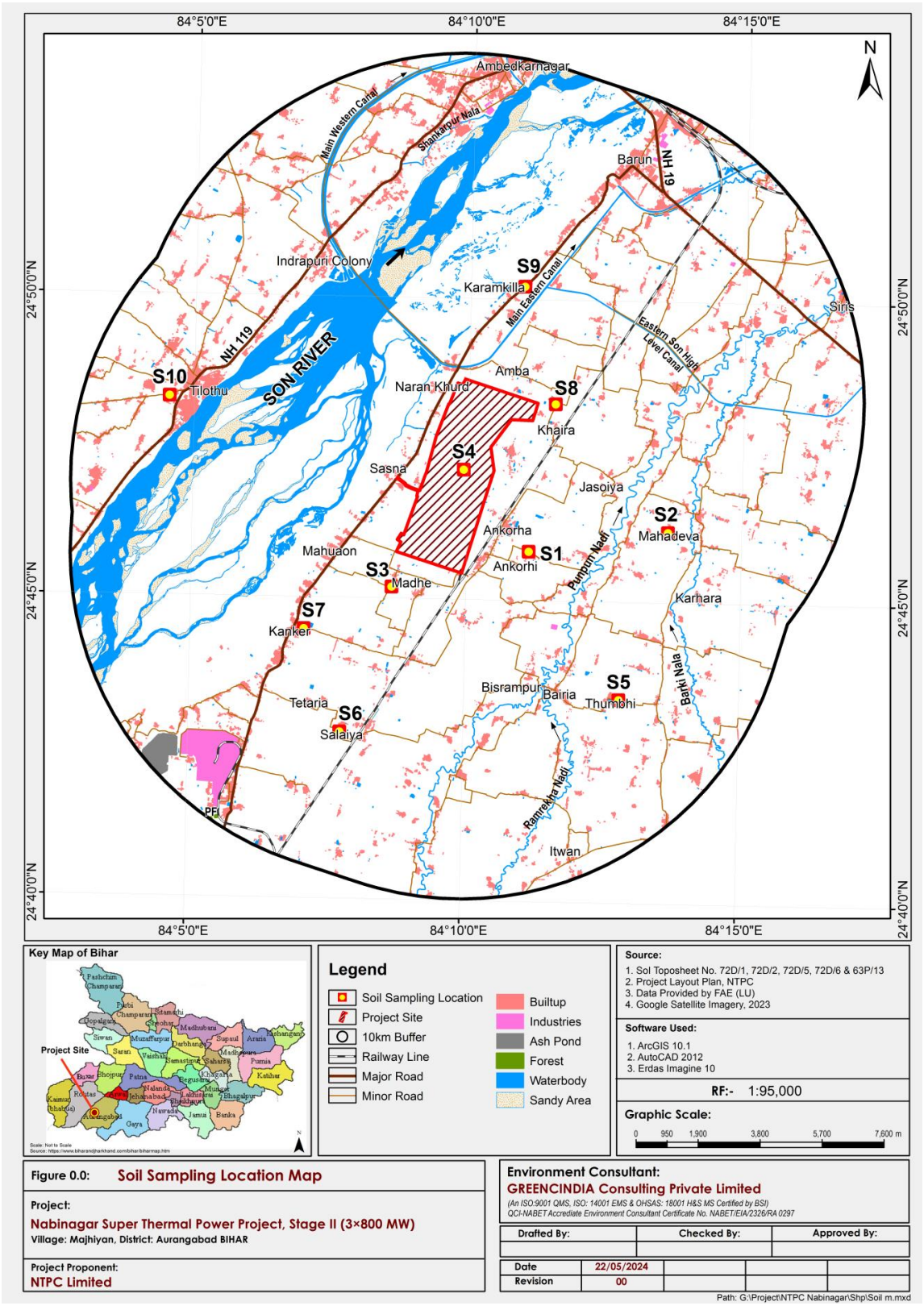


Figure 3.19: Soil Sampling Locations

3.6.4.1 Sampling Frequency & Analysis Method

The sealed samples were sent to laboratory for analysis. Soil samples were analyzed as per the standard methods prescribed in "Soil Chemical Analysis" (M.L. Jackson, 1967). The samples of soil were collected in study period. The physical and chemical characteristics of the soil of the study area have been assessed by analyzing various parameters as per the methods described in "Soil Chemical Analysis" (M.L Jackson, 1967) and Department of Agriculture and Cooperation. Standard classification of Soil as per Indian Council of Agriculture Research, New Delhi was followed to identify the soil types and soil composition in the study area.

Table 3.6: Analytical Technique for Soil Sample

Sl. No.	Parameters	Analytical Method	Reference
1	Texture	Sieve analysis & Hygro meter	------
2	pH	pH meter	IS2720- Part 26, 1987 by pH meter
3	Conductivity (1:2)	Conductivity meter	Department of Agriculture & Cooperation, Govt of India Page No. 81-82:2011
4	Potassium	Flame Photometric	TM-S/13
5	Phosphorus	Spectrophotometric	TM-S/11
6	Nitrogen	Distillation & Titration	TM-S/17
7	Infiltration Rate		TM-S/40
8	Cation Exchange Capacity (CEC)		Department of Agriculture & Cooperation, Govt of India
9	Organic Matter	Black method	IS2720-(Part 22),1972, Reaffirmed 2001
10	Organic Carbon	Calculation	IS2720-(Part 22),1972, Reaffirmed 2001 (By Calculation)
11	Bulk Density	Sand replacement, core cutter	TM-S/34
12	Porosity		TM-S/33
13	Copper	Spectrophotometer	Department of Agriculture & Cooperation, Govt of India
14	Iron	Spectrophotometer	Department of Agriculture & Cooperation, Govt of India
15	Manganese	Spectrophotometer	Department of Agriculture & Cooperation, Govt of India
16	Zinc	Spectrophotometer	Department of Agriculture & Cooperation, Govt of India

3.6.4.2 ANALYSIS OF SOIL QUALITY

It is essential to determine the potentials of soil in the area to identify the current status of soil quality and also to predict the impacts that may arise due to the project. Accordingly, a study for assessment of the baseline soil quality has been carried out in the region. The physico-chemical characteristics of soil samples collected is provided in **Table 3-7**.

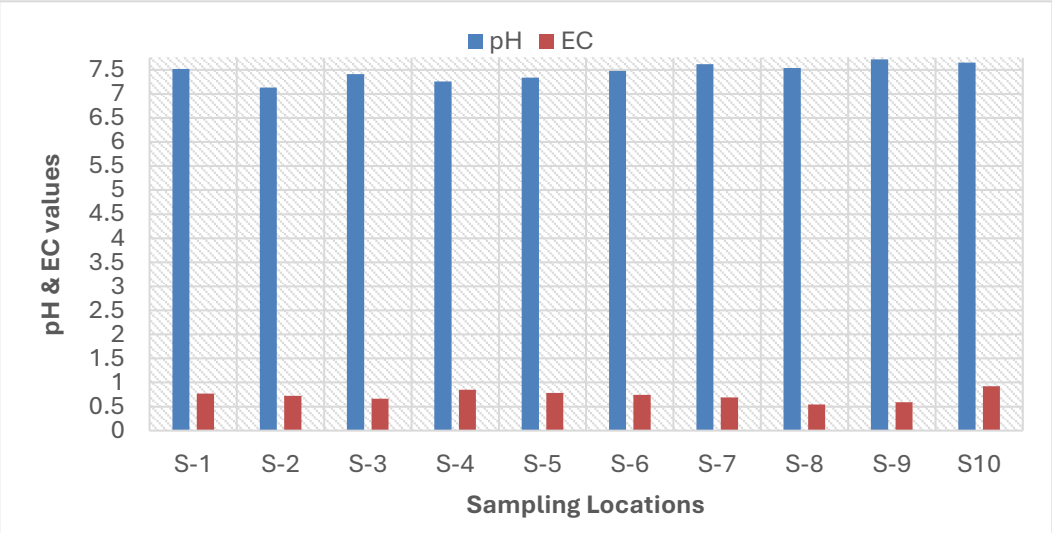
Table 3.7: Physico-chemical parameters of soil samples

S.No	Parameters	S-1 Ankhori Village	S-2 Mahdeva Village	S-3 Madhe Village	S-4 Ash Dyke Stage-II	S-5 Thumbhi Village	S-6 Salaiya Village	S-7 Kanker	S-8 Khaira Village	S-9 Karamkila Village	S-10 Tilouthu Village
1	pH	7.52	7.13	7.41	7.26	7.34	7.48	7.62	7.54	7.72	7.65
2	Electrical Conductivity, mS/cm	0.77	0.72	0.66	0.85	0.78	0.74	0.68	0.54	0.59	0.92
	Electrical Conductivity µmhos/cm	770	720	660	850	780	740	680	540	590	920
3	Cation Exchange Capacity (CEC), meq/100g	11.3	141	14.9	15.7	13.4	12.6	13.2	12.9	14.3	15.2
4	Available Nitrogen, mg/Kg	240.20	144.60	314.80	190.80	178.60	167.40	221.40	268.40	27.20	311.40
4a	Available Nitrogen, Kg/Ha	538.05	323.90	705.15	427.39	400.06	374.98	495.94	601.22	60.93	697.54
5	Available Phosphorus, mg/Kg	5.74	5.86	5.1	4.05	5.37	5.44	6.72	4.88	5.51	6.21
5a	Available Phosphorus, Kg/Ha	12.86	13.13	11.42	9.07	12.03	12.19	15.05	10.93	12.34	13.91
6	Available Potassium, mg/Kg	188.60	229.40	180.70	204.60	192.80	177.20	194.60	184.20	191.40	186.40
6a	Available Potassium, Kg/Ha	422.46	513.86	404.77	458.30	431.87	396.93	435.90	412.61	428.74	417.54

S.No	Parameters	S-1 Ankhori Village	S-2 Mahdeva Village	S-3 Madhe Village	S-4 Ash Dyke Stage-II	S-5 Thumbhi Village	S-6 Salaiya Village	S-7 Kanker	S-8 Khaira Village	S-9 Karamkila Village	S-10 Tilouthu Village
7	Organic Carbon, %	0.67	0.72	0.58	0.62	0.51	0.58	0.64	0.54	0.59	0.48
8	Organic Matter, %	1.15	1.24	0.99	1.07	0.88	0.99	1.10	0.93	1.01	0.83
9	Bulk Density, gm/cc	108	1.11	1.09	1.14	1.15	1.07	1.16	1.19	1.18	1.21
10	Available Moisture, %	7.86	6.54	8.24	7.24	5.62	6.84	5.43	7.34	5.76	4.72
11	Water Holding Capacity, %	41.6	35.7	39.4	32.6	36.2	40.4	44.6	41.6	37.5	38.1
12	Calcium, meq/100g	11.85	9.30	4.85	9.10	22.2	8.55	7.16	8.64	7.64	9.26
13	Magnesium, meq/100g	1.90	1.49	0.77	1.45	3.55	1.37	1.15	1.38	1.22	1.48
	Macronutrients										
14	Copper, mg/kg	0.24	0.22	0.28	0.29	0.23	0.18	0.16	0.24	0.16	0.14
15	Iron,mg/kg	1.68	2.64	3.22	1.18	2.46	1.87	2.65	2.74	3.13	1.64
16	Zinc, mg/kg	0.45	0.42	0.51	0.46	0.55	0.74	0.82	0.61	0.73	0.44
17	Lead, mg/kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Texture		**Sandy Loam**					**Loamy Sand**			**Sandy Loam**	
18	Sand, % by mass	68.6	70.5	71.2	70.6	65.2	76.4	72.4	74.8	71.4	69.4
19	Silt,% by mass	11.8	17.3	11.2	15.4	14.1	13.4	14.2	14.6	12.7	11.4
20	Clay,% by mass	19.6	12.2	17.6	14.0	20..7	10.2	13.4	10.6	15.9	19.2

3.6.4.3 OBSERVATION:

pH: The pH value recorded in the study area varies from "Neutral to Slightly Alkaline" as per ICAR report. pH has been found to be lowest in S2: Mahdeva Village (Agriculture land) which is neutral in nature. Alkaline soils have a high saturation of base cations (K^+, Ca^{2+}, Mg^{2+} and Na^+). This is due to an accumulation of soluble salts which are classified as either saline soil or alkaline soil. In the study area S1, S3, S5, S6, S7, S8, S9 & S10 show slightly alkaline pH in soil. Other samples remain in neutral pH range. In other classification changes of soil nutrients mainly NPK with pH has been represented in **Figure 3.20.** Graphical representation and soil pH classification has been represented in **Table 3.7** and result in **Table 3.8.**



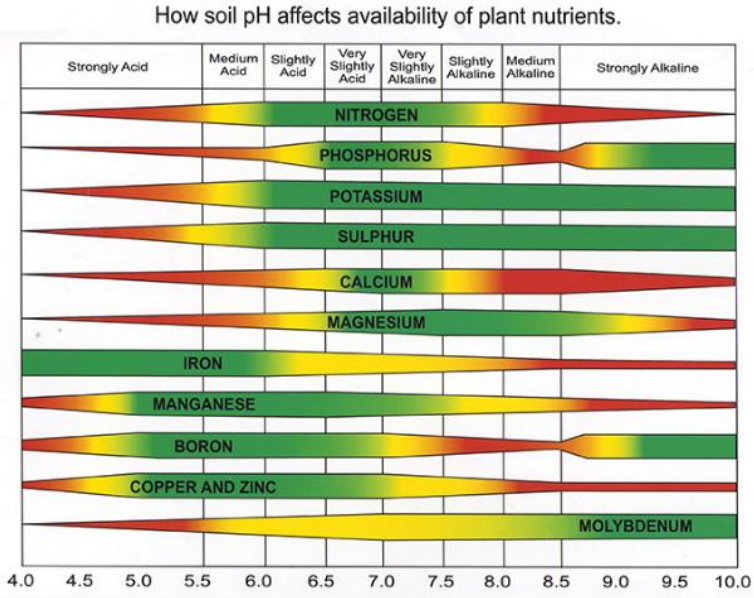


Figure 3.20: Changes of Soil Nutrients (NPK) status with pH class

Green: available; yellow: low availability; red: not availability

Table 3.8: Standard Classification of Soil pH as per ICAR, New Delhi

Standard Classification of Soil pH as per ICAR, New Delhi	
<4.5	Extremely acidic
4.51- 5.50	Very strongly acidic
5.51-6.0	Moderately acidic
6.01-6.50	Slightly acidic
6.51-7.30	Neutral
7.31-7.80	Slightly alkaline
7.81-8.50	Moderately alkaline
8.51-9.0 Strongly alkaline	
9.01 Very strongly alkaline	

Electrical Conductivity (EC): The electrical conductivity of soil is actually a measure of salinity. Excessively high salinity can affect plants in the following ways: Specific toxicity of a particular ion (such as Sodium), higher osmotic pressure around the roots prevents an efficient water absorption by the plant. Some plants are more susceptible to electrical conductivity than others and each species has an electrical conductivity threshold, beyond which yield decreases. In the study area soil conductivity varies between 540 µmhos/cm at S8 to 920 µmhos/cm at S10. ICAR classification has been represented in Table 3.9 and the graphical representation of soil EC and its relation with pH has been shown in Figure 3.21 respectively.

Table 3.9: Standard Classification of Soil EC as per ICAR, New Delhi

Parameter	Classification
Salinity Electrical Conductivity (ppm) (1 ppm = 640 µmhos/cm)	• Up to 1.00 Average • 1.01-2.00 harmful to germination • 2.01-3.00 harmful to crops (sensitive to salts)

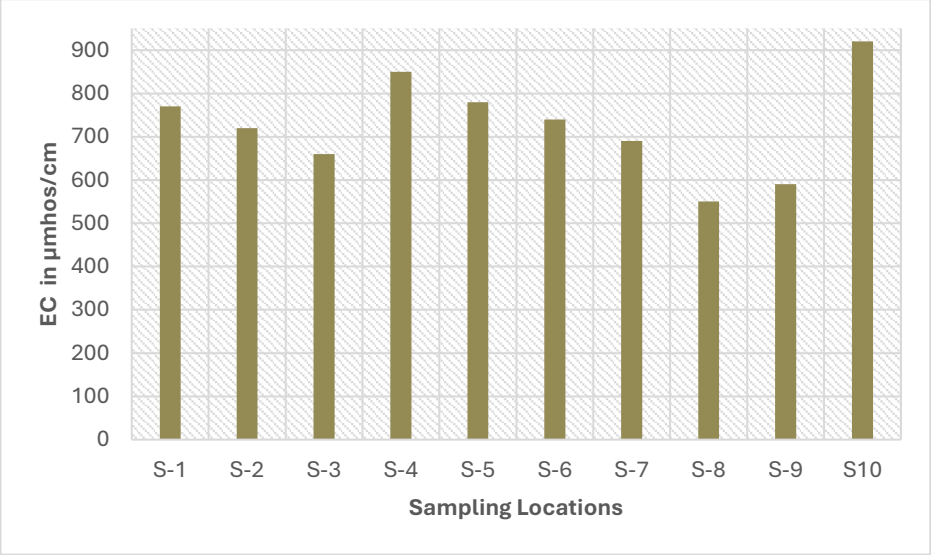


Figure 3.21: Conductivity of the Soil Sample

Soil Texture: According to the study of soil texture, the soil of the study area varies from 70% sandy loam (S1, S2, S3, S4, S5, S9 & S10) and 30% loamy sand (S6, S7 & S8). Loam soil is ideal for growing crops because it retains nutrients well and retains water while still allowing the water to flow freely. These soils allow for better water penetration than clays, better water holding capacity and better nutrient retention than sands and silts, and more of the soil moisture and nutrients available to the plants than in clays. In Figure-3.22 the textural triangle showing the 12 classes and points of different sample in it has been shown which represents the textural classification of the sample in the study area.

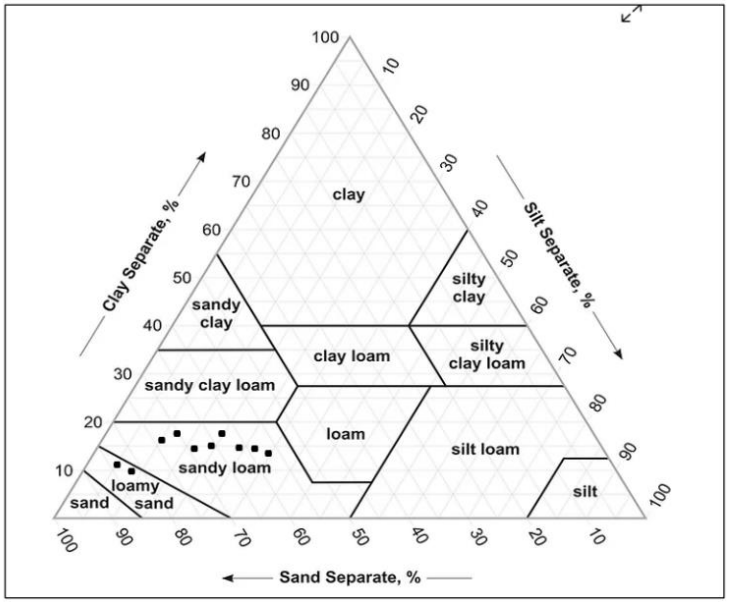


Figure 3.22: The textural triangle showing the 12 classes with black dots pointing to the classified soil sample. (Reprinted from USDA-NRCS, 1999)

Bulk Density: Bulk density of a soil is a dynamic property that varies with the soil structural conditions. In general, it increases with profile depth, due to changes in organic matter content, porosity and compaction. It is required for gaseous exchange, such as high bulk density would pose restriction to the growth of deeper rooted plants and may be one of the reasons of cessation of plant growth (Ghose *et al.,* 2004).

Bulk density of the study area ranges between 1.07 gm/cm3 at S6 to 1.21 gm/cm3 at S10. A normal range of bulk densities for clay is 1.0 to 1.6 mg/m3 and a normal range for sand is 1.2 to 1.8 mg/m3 with potential root restriction occurring at ≥ 1.4 mg/m3 for clay and ≥1.6 mg/m3 for sand. Bulk density of a soil is a dynamic property that varies with the soil structural conditions. In general, it increases with profile depth, due to changes in organic matter content, porosity and compaction.

Moisture: Soil moisture is important for hydrological, biological and biogeochemical processes. The field moisture of all the samples range between 4.72% at S10 to 8.24% at S3. The moisture content of the study area, however, remains lower than the wilting point.

Table 3.10: Average available water content for various soil textural classes

Textural class	Wilting point	Field capacity	Available water
	(% moisture)		
Sand	5	12	7
Sandy loam	9	21	12
Loam	16	36	20
Silt loam	18	39	21
Clay loam	24	39	15
Silty clay	24	39	13

Clay	27	39	12

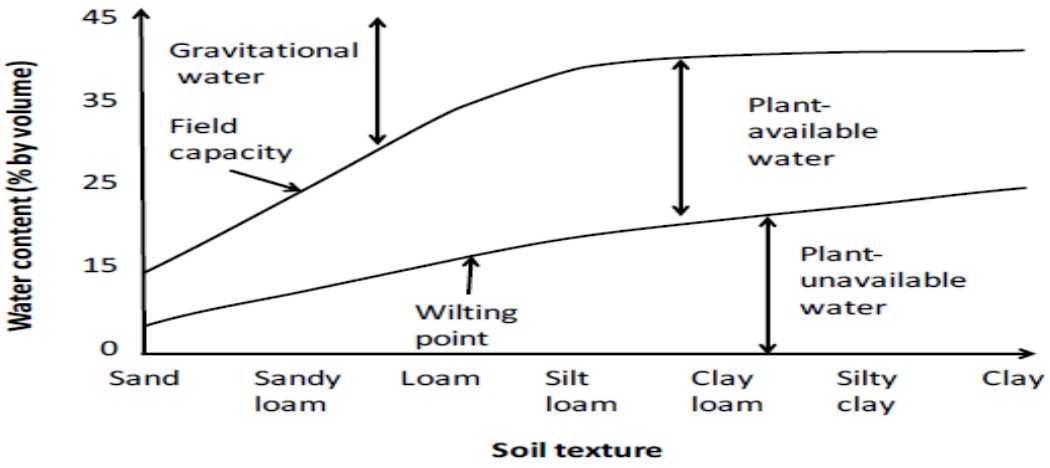


Figure 3.23: Gravitational, plant-available and plant- unavailable water content for various soil textures

- ***Wilting Point: Moisture level at which plants will begin to suffer***
- ***Field Capacity: Highest moisture level at which do not exceed to avoid runoff***

The water available to support plant growth is called plant available water and is the difference between field capacity and the wilting point. Field capacity is the amount of water remaining in the soil profile after 48-72 hours of free drainage following saturated conditions. Water moving downward in the soil following a saturating event can be effectively used by growing plant. The relation between water content and soil texture has been represented in **Figure 3.23.**

Soil nutrients refer to the inherent capacity of the soil to supply nutrients in adequate amounts and in suitable proportions for crop growth and crop yield. The trend in increasing the yield by adopting high yielding varieties has resulted in deficiency of nutrients in soils and has reflected as deficiency symptoms in plants. Hence, it is required to know the fertility (NPK) status of the soils of the State for applying the required dosage of fertilisers and planning the regional distribution of fertilisers.

a) Phosphorus: Phosphorus is the key content which plays an important role in the photosynthesis, respiration, energy storage and transfer, cell division, cell enlargement and several other properties in the living plant. Available Phosphorus ranges between 9.07 kg/ha at S4 site to 15.05 kg/ha at S7. As per ICAR classification the phosphorus in the study area present is classified as "very less" to "less".

b) Potassium: Potassium is an essential plant nutrient and is required in large amounts for proper growth and reproduction of plants. Potassium is considered second important after nitrogen, when it comes to nutrients needed by plants, and is commonly considered as the "quality nutrient. It affects the plant shape, size, colour, taste and other measurements attributed to healthy produce. Potassium content in the study area ranges between 396.93 kg/ha at S6 to 513.86 kg/ha at S2. As per ICAR classification the potassium in the study area present is classified as "more than sufficient".

c) Nitrogen: Nitrogen is important because it is a major component of chlorophyll, the compound by which plants use sunlight energy to produce sugars from water and carbon dioxide during photosynthesis. It is

also a major component of amino acids. Soil nitrogen exists in three general forms: organic nitrogen compounds, ammonium (NH_4^+) ions and nitrate (NO_3^-) ions. The majority of plant-available nitrogen is in the inorganic forms NH_4^+ and NO_3^- (called mineral nitrogen). Nitrogen content in the surface soil of the study area varies between 323.90 kg/ha to 705.15 kg/ha. As per ICAR classification the nitrogen in the study area present as "sufficient" in the study area. At S9 Nitrogen content is mentioned as 60.93 Kg/Ha which can be considered as an outlier. The Classification of NPK as per ICAR in soil are given in **Table 3.11**.

Table 3.11: Classification of NPK as per ICAR

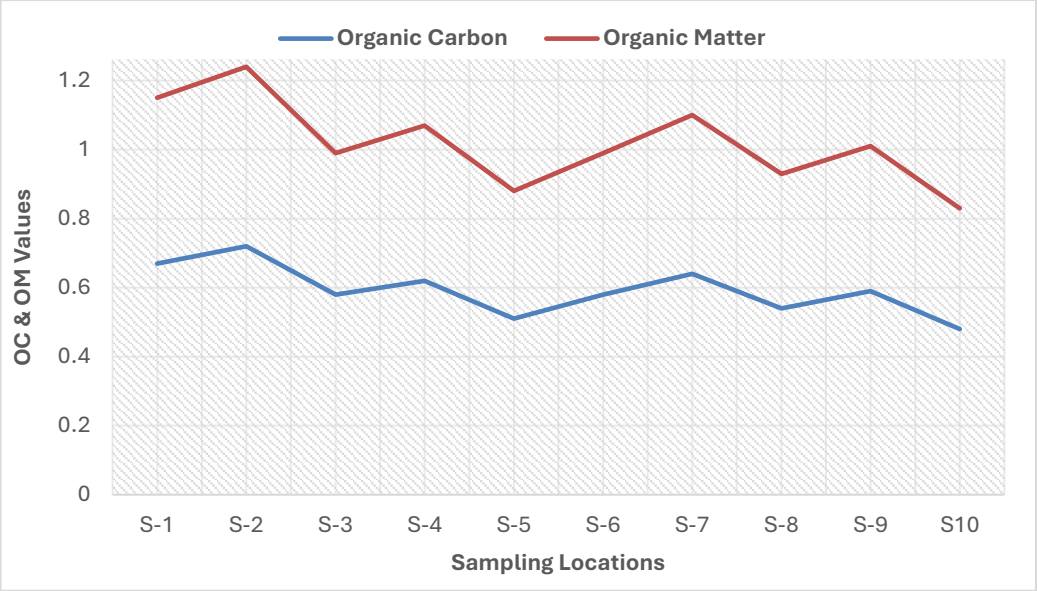
Sl. No.	Parameter	Classification
1	Phosphorus (kg/ha.)	• Up to 15 very less • 16-30 less • 31-50 medium, • 51-65 on an average sufficient • 66-80 sufficient • >80 more than sufficient
2	Potassium (kg/ha.)	• 0 -120 very less • 120-180 less • 181-240 medium • 241-300 average • 301-360 better • >360 more than sufficient
3	Nitrogen (kg/ha.)	• Up to 50 very less • 51-100 less • 101-150 good • 151-300 Better • >300 sufficient

Organic Matter: The organic matter of the soil has its origin in the decay of dead plants and animals Research on soil and plants have received considerable impetus in connection with the role of organic matter in regulating the growth of plants. But it must be remembered that all organic matters are not beneficial to higher plants. In the coastal region soil organic matter also rise by soil salt. The soil organic matter plays an important role as the store house of plants nutrients. In the study area organic matter varies between 0.51% to 0.72%. As per ICAR classification as given in **Table 3.12**, the organic matter found in the study area is "on an average sufficient". The quality of soil is rather dynamic and can affect the sustainability and productivity of land use.

Table 3.12: Classification of Organic Matter as per ICAR

Parameter	Classification
Organic Matter (%)	• Up to 0.2: very less • 0.21-0.4: less • 0.41-0.5 medium, • 0.51-0.8: on an average sufficient • 0.81-1.00: sufficient

Parameter	Classification
	• >1.0 more than sufficient



3.24: Organic carbon (OC) and Organic carbon (OM) status of soil samples

Micronutrients

Copper: Copper has an essential function for plant growth. Its essential status for plant nutrition. Cu content in study area varied between 0.14mg/kg (S10) to 0.29 mg/kg (S4)

Zinc: It is an essential micronutrient that has significant role in basic plant metabolic processes and enhances the growth, yield and quality by stimulating chlorophyll production, photosynthetic activity, nutrient uptake and protein biosynthesis. Zn varied from 0.42 mg/kg (S2) to 0.82 mg/kg (S7).

Iron: Iron (Fe) plays a significant role in physiological and biochemical pathways in plants. It involved in the synthesis of chlorophyll and is essential for the maintenance of chloroplast structure and function. Fe varied from 1.18 mg/kg (S4) to 3.22 mg/kg (S3).

Inferences: The NPK content was found to be satisfactory for growth of plants. Therefore, it can be concluded that the soil quality in terms of fertility is good for growth of vegetation in study area.

Figure 3.25: Soil sample collection for summer season

3.7 CLIMATOLOGY AND METEOROLOGY

3.7.1 IMD METEOROLOGICAL DATA

Meteorology is the key to understand the air quality. The essential relationship between meteorological condition and atmospheric dispersion involves the wind in the broadest sense. Other factors such as variation in temperature, humidity etc. also plays a direct role in dispersion and dilution of pollutants. Wind fluctuations over a very wide range of time, accomplish dispersion and strongly influence other processes associated with them. This section makes a comparative analysis of the meteorological data of the study area collected by project team in 2024. The data used for the purpose are the 30 years average IMD data from 1991 to 2020 taken from Meteorological Station, Dehri. The area has irregular and erratic rainfall. The winter starts in December when day and night temperatures fall rapidly. January is the coldest month. The highest rainfall occurs in the month of August. The summary of the 30 years meteorological data of Dehri IMD Station from 1991-2020 is shown in **Table 3.13**.

Table 3.13: Meteorological Data of Dehri IMD from 1991-2020

Sl. No.	Parameters	Season	Months	Monthly Total		
1	Rainfall in mm	Winter (Dec to Feb)	December	21.6		
			January	43.8		
			February	55.0		
			Total	**120.2**		
		Summer (Mar to May)	March	43.7		
			April	43.2		
			May	96.0		
			Total	**182.9**		
		Monsoon (Jun to Sep)	June	220.0		
			July	202.4		
			August	254.5		
			September	218.4		
			Total	**895.3**		
		Post-Monsoon (Oct to Dec)	October	153.7		
			November	100.8		
			December	21.6		
			Total	**276.1**		
2	Temperature		**Month**	**Max**	**Min**	**Average**
		Winter (Dec to Feb)	December	28.6	6.1	17.35
			January	27.8	4.3	16.05
			February	31.3	7.1	19.2
			Average	**29.23**	**5.83**	**17.53**
		Summer (Mar to May)	March	38.3	10.8	24.55
			April	43.0	16.7	29.85
			May	44.8	18.5	31.65
			Average	**42.03**	**15.3**	**28.665**
		Monsoon (Jun to Sep)	June	43.4	20.9	32.15
			July	38.4	21.2	29.8
			August	35.9	22.6	29.25
			September	35.2	20.2	27.7
			Average	**38.23**	**21.2**	**29.73**
		Post-Monsoon (Oct to Dec)	October	34.2	15.0	24.6
			November	32.2	9.9	21.05
			December	28.6	6.1	17.35
			Average	**31.6**	**10.3**	**41.9**
3	Relative Humidity in (RH) %		**Month**	**08:30 Hrs**		**17:30 Hrs**
		Winter (Dec to Feb)	December	86		64
			January	84		66
			February	77		60

Sl. No.	Parameters	Season	Months	Monthly Total	
			Average	**82.3**	**63.3**
		Summer (Mar to May)	March	62	44
			April	52	32
			May	55	37
			Average	**56.3**	**37.6**
		Monsoon (Jun to Sep)	June	68	56
			July	82	74
			August	85	79
			September	85	81
			Average	**80**	**72.5**
		Post-Monsoon (Oct to Dec)	October	81	74
			November	81	65
			December	86	64
			Average	**82.6**	**67.6**
4	Wind pattern		**Months**	**Wind Speed (Kmph)**	
		Winter (Dec to Feb)	December	2.0	
			January	2.5	
			February	2.5	
			Average	**1.6**	
		Summer (Mar to May)	March	2.5	
			April	3.0	
			May	3.5	
			Average	**3.0**	
		Monsoon (Jun to Sep)	June	3.0	
			July	2.5	
			August	1.5	
			September	1.5	
			Average	**2.13**	
		Post-Monsoon (Oct to Dec)	October	2.5	
			November	2.0	
			December	2.0	
			Average	**2.16**	

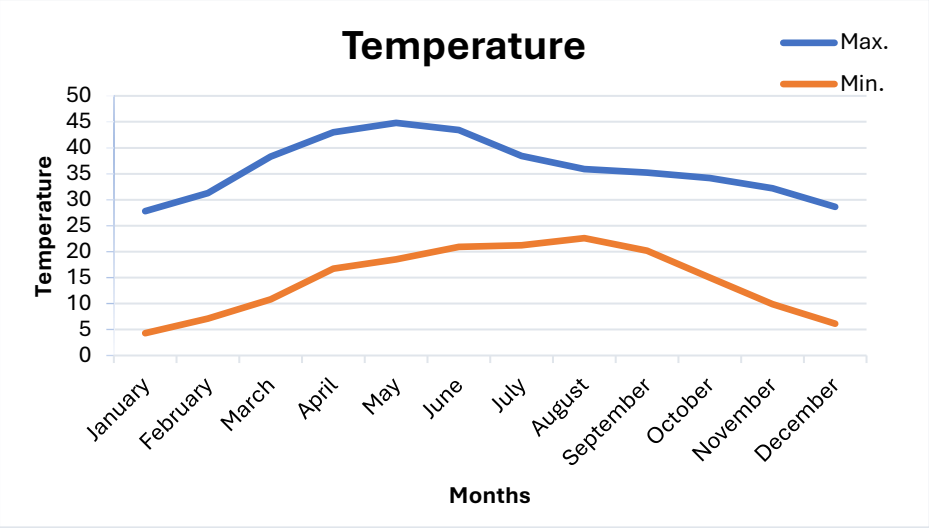


Figure 3.26: Temperature as per IMD

Temperature: Temperature of the study area is generally high during April to June. As per the IMD Climatological table (1991 – 2020) the maximum temperature was recorded in the month of May & minimum temperature is recorded in the month of January. (Refer **Figure 3.26**)

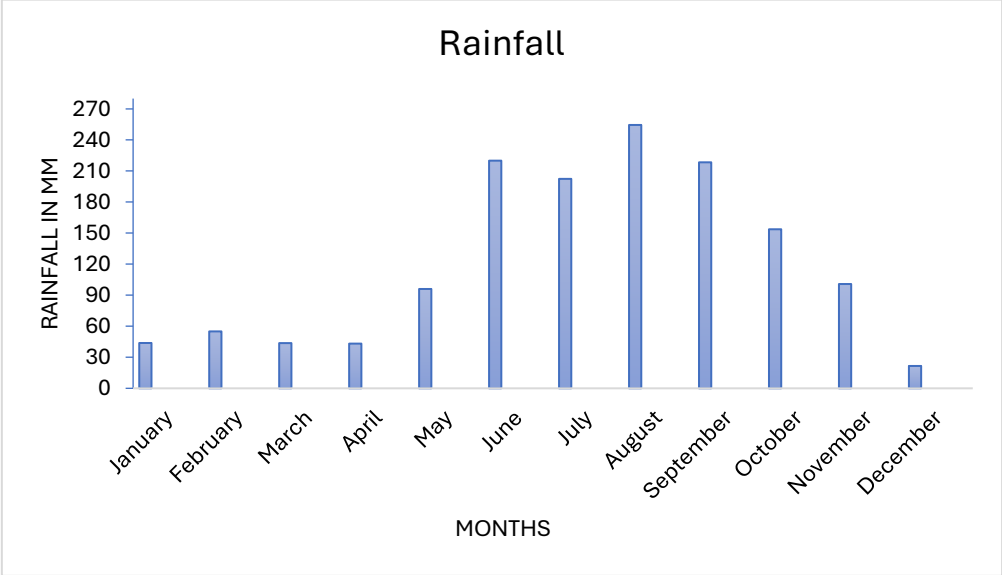


Figure 3.27: Rainfall as per IMD

Rainfall: The annual rainfall is 1400mm. It rains 12 months and the intensity varies from 21.6 mm to 254.5 mm per month. The maximum annual rainfall is received during the months from June to September. The 30-years average monthly rainfall data is furnished in **Figure 3.27**.

Relative Humidity: The humidity is highest in July to December with average relative humidity of 75.1%. The annual mean relative humidity of 30 years is furnished in **Figure 3.28**.

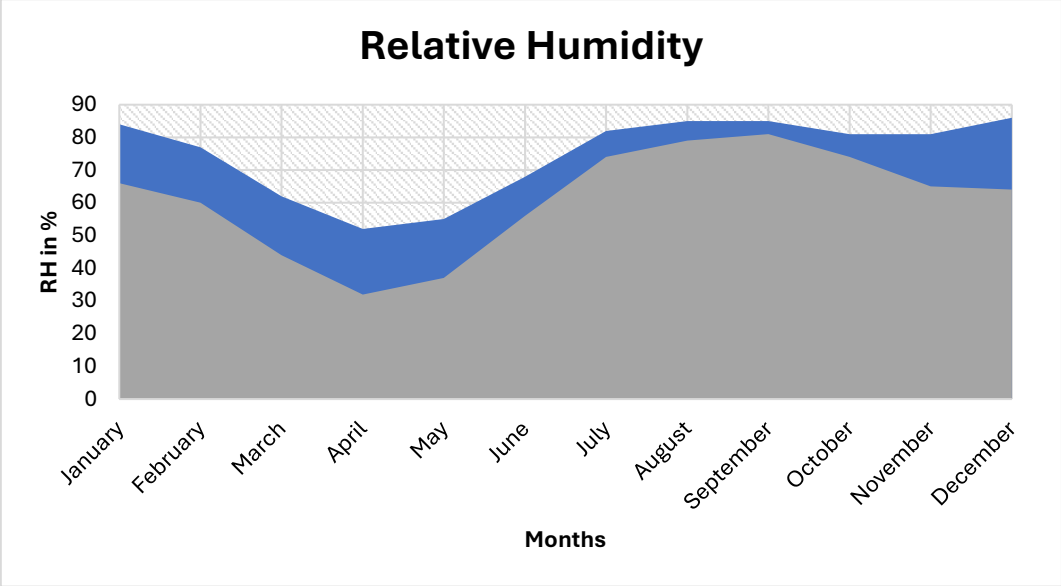


Figure 3.28: Relative Humidity as per IMD

As per IMD station at Dehri, the dominant wind direction throughout the year is from NW and during the pre-monsoon the pre-dominant wind direction is from WNW. The wind-speed was found to be highest during the monsoon month of Mar-May with the average wind speed of 3.0 m/s. The IMD wind rose diagrams are shown in **Figure 3.29.**

3.7.2 Methodology of Data Generation

During the study a continuous automatic weather monitoring station was established at site to record Wind speed, Wind Direction, Solar radiation, Relative Humidity and Temperature at 2 m and 10 m above ground. Atmospheric pressure was recorded twice a day at 0830 and 1730 hrs. Cumulative Rainfall was monitored by rain gauge on daily basis. This station is in operation since March, 2024 and the present report incorporates the data from March, 2024 to May, 2024. The methodology adopted for monitoring meteorological observations is as per the standard norms laid down by Bureau of Indian Standards (BIS) and the India Meteorological Department (IMD). Hourly maximum, minimum and average values of wind speed, direction and temperature are recorded continuously at site.

Meteorological Observation at Site

A fully instrumented continuous recording meteorological observatory is established and operating at Dehri from March,2024 and this report presents the data from March,2024 to May,2024. The following parameters are being measured: -

- Temperature at 2 m and 10 m level
- Relative humidity
- Wind speed and direction
- Rainfall

The brief details of instruments, parameter and frequency are presented in Table-3.14

Table 3.14: Instruments, Parameters and Frequency of Meteorological Monitoring at Site

S. No.	Parameters	Instruments	Frequency
1.	Wind Speed	Automatic Weather station (Envirotech AWS10B)	Continuous (averaging time of 1 hour)
2.	Wind Direction		
3.	Ambient Temperature at Two Heights 2m & 10m		
4.	Max. & Min Temperature	Wet & Dry Bulb Thermometer	Daily at 08:30 & 17:30 IST
5.	Humidity	RH senser	Daily at 08:30 & 17:30 IST
6.	Atmospheric Pressure	Barometer senser	Daily at 08:30 & 17:30 IST
7.	Storm	Visual observation	Daily
8.	Rainfall	Rain Gauge	Daily
9.	Solar radiation	Solar radiation senser	Continuous (averaging time of 1 hour)

The aforesaid meteorological parameters will be monitored over a period of 12 months starting from March 2024. The meteorological data for three months i.e. from March, 2024 to May, 2024, recorded at site is given in **Table- 3.15**.

Table 3.15: Onsite Meteorology Data

Month	Temperature, °C			Relative Humidity, %		Rainfall (mm)		Monthly Mean Station level Pressure, hPA		Wind Speed, km/hr
	Min	Max	Monthly average	At 08:30	At 17:30	Rainy Days	Monthly Total	At 08:30	At 17:30	Mean
March	32.5	42.1	27.3	48.4	45.1	0.00	0.00	958	951	2.10
April	32.3	43.5	26.4	51.6	47.2	0.00	0.00	958	950	2.20
May	33.4	45.8	26.0	52.9	48.4	0.00	0.00	959	956	2.53

The analysis of the field observation is given below

3.7.2.1 Ambient Temperature

The observed seasonal minimum and maximum temperatures were 32.3ºC and 45.8 ºC where the minimum temperature was observed 32.3ºC to 33.4ºC. Whereas the average temperature ranges between 26.0ºC to 27.3ºC respectively.

3.7.2.2 Relative Humidity

The seasonal average relative humidity varies from 48.4% to 52.9% at 08:30 hrs and 45.1% to 48.4% at 17:30 hrs.

3.7.2.3 Barometric Pressure

The minimum atmospheric pressure was found to be 958hPa at 8:30 hrs in the month of March and May and maximum atmospheric pressure was found to be 956hPa at 17:30 hrs in the month of May.

3.7.2.4 Rainfall

No Rainfall was observed during the months of March to May 2024.

3.7.2.5 Wind Speed

Analysis of hourly wind speed shows that the winds are generally light to moderate in this area. The monthly mean wind speed varies from 2.10 to 2.53 km/hr.

3.7.2.6 Wind Pattern

The wind-rose diagram for pre monsoon season has been drawn on the basis of hourly wind speed and direction data. The wind rose shows that the dominant directions of the wind flow are west north westfor the months of March to May.

Wind Rose (Pre-Monsoon) – March 2024 to May 2024

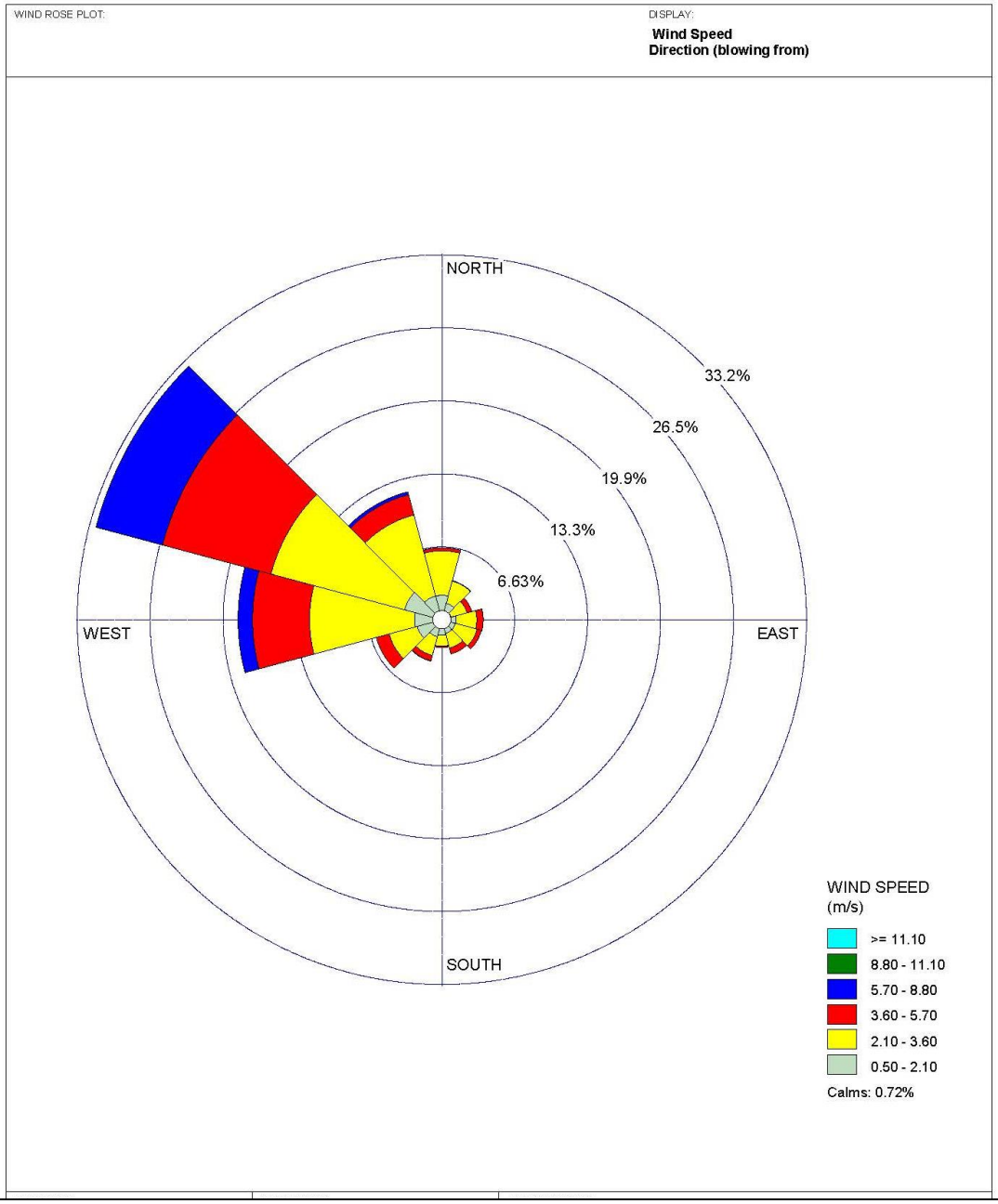


Figure 3.29: Wind Rose Diagram (PRE-MONSOON)

3.8 AIR ENVIRONMENT

3.8.1 FREQUENCY AND PARAMETERS OF MONITORING

Transport and domestic activities are main generation sources of pollution. Ambient air quality monitoring has been carried out with a frequency of two samples per week at Ten locations for three months (March – May 2024). The monitoring of ambient air has been carried out for the following parameters as mentioned below:

- Particulate Matter10 (PM_{10})
- Particulate Matter2.5 ($PM_{2.5}$)
- Sulphur dioxide (SO_2)
- Nitrogen Oxide (NO_x)
- Carbon monoxide (CO)
- Ozone (O_3)
- Mercury (Hg)
- Lead (Pb)
- Nickel (Ni)
- Ammonia (NH3)

3.8.2 INSTRUMENT USED FOR SAMPLING

In order to assess the Ambient Air Quality (AAQ), samples of ambient air were collected by installation of Respirable Dust Sampler and Fine Particulate Sampler at different locations within the study area and analyzed to find out the existing status of air quality. The samples for CO were collected in bladder.

3.8.3 SAMPLING AND ANALYTICAL TECHNIQUE

With a view to collecting the samples, Envirotech/SSCE made Fine Particulate Sampler and Respirable Dust Samplers along with Gaseous attachment have been used. Filter papers were used for the collection of PM10 & PM2.5. SO2 was collected by drawing air at a flow-rate of 0.2 litres per minute (lpm) through an absorbing solution (TCM). The NOX and Ozone were collected by drawing air at a flow rate of 0.2 liters per minute (lpm) through the mixture of absorbing solutions. Carbon monoxide was collected 8 hourly and analyzed by Non-Dispersive Infra-Red Spectroscopy (NDIR). The particulate matter for analysis of Mercury/Lead/Nickel was collected on EPM2000 filter paper.

3.8.4 SELECTION OF SAMPLING LOCATIONS

Ten monitoring locations have been selected based on predominant wind direction. All probable directions, which may be affected due to expansion of the project, have been considered. Also, the effort was made to collect the representative baseline conditions of all the project affecting villages.

The monitoring stations have been setup to locate the locations as close as feasible to the anticipated maximum pollutant concentration areas. Logistic considerations such as accessibility, security, and availability of reliable power supply etc. were also examined while finalizing the stations. The monitoring locations are depicted in **Table 3-16** and **Figure 3-30**.

A Coverage Factor concept was used for determining the location of AAQ monitoring stations (R E Munn). A large number of stations were identified as potential monitoring stations all around the project. A Coverage Factor (C) was calculated by the following equation:

$Cij = Fj/(1+Di)$

Where, Cij=Coverage Factor of ith. station in jth. direction
Fj = Frequency of wind in jth. direction
Di = Distance of ith. station

The stations having high values of Cij were selected as final monitoring stations. The monitoring locations are depicted in **Table 3-16** and **Figure 3-30**

Table 3.16: Air Monitoring Locations

Name	Latitude	Longitude	Village	Distance	Directions	Category
AAQ1	24° 46' 16.93" N	84° 9' 36.80" E	Nabinagar STPP	Inside the Project Boundary	0.0	Industrial
AAQ2	24° 47' 11.48" N	84° 8' 30.64" E	Sasna	0.5	WNW	Residential/ Located in 1st upwind direction
AAQ3	24° 46' 10.85" N	84° 10' 43.13" E	Akorhi	0.85	ESE	Residential/ Located in 1st downwind direction
AAQ4	24° 45' 16.57" N	84° 8' 40.66" E	Madhe	0.90	SW	Residential
AAQ5	24° 46' 55.75" N	84° 12' 24.88" E	Jasoiya	3.32	E	Residential/ Located in 2nd downwind direction
AAQ6	24° 48' 31.32" N	84° 5' 15.13" E	Tilouthu Village	6.55	WNW	Residential/ Located in crosswind/ Populated
AAQ7	24° 46' 24.69" N	84° 14' 10.53" E	Charan Kalan	6.31	E	Residential/ Located in crosswind
AAQ8	24° 43' 33.90" N	84° 11' 7.32" E	Bisrampur	4.01	SE	Residential/ Located in crosswind
AAQ9	24° 50' 14.43" N	84° 11' 1.05" E	Karamkila Village	3.30	N	Residential/ Located in crosswind
AAQ10	24° 42' 53.67" N	84° 7' 52.79" E	Salaiya Village	5.60	SSW	Residential/ Located in crosswind

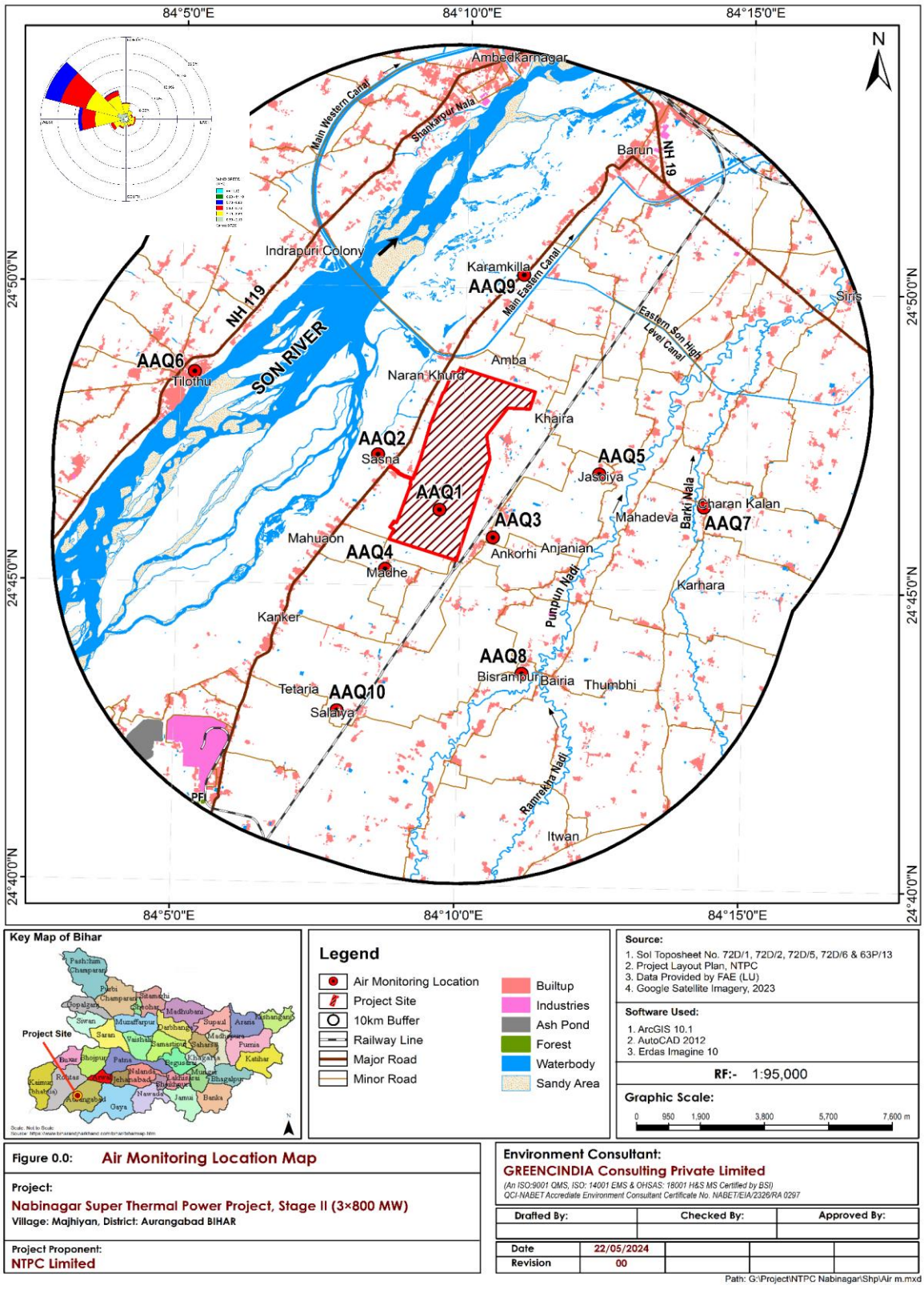


Figure 3.30: Air Sampling Locations

3.8.5 Instruments Used for Sampling and Analytical Techniques

With a view to collecting the samples, Envirotech/SSEC Make Calibrated Respirable Dust Samplers (RDS-APM 460 BL) along with Gaseous attachment and Fine Particulate Matter (FPS-APM 550) have been used. The RDS is capable of drawing air at a flow rate of 0.95 to 1.1 m^3/min with very little pressure drop for RDS and FPS is designed to operate at an air flow rate of 1.6 lpm. Filter papers (EPM 2000, Whatman & Whatman 46.2 mm dia.) were used for the collection of samples to analyze them for particulate matters and heavy metals. Samples for analyzing SO_2 & NO_2 were collected by drawing air at a flowrate of 0.2 liters per minute (lpm) through an absorbing solution for the duration of 24 hrs. Sampling of Ozone (O_3) has been performed using 10 ml of absorbing solution in a standard impinger and sample for eight hour at the flow rate of 0.2 lpm. After sampling measure the volume of sample and transfer to a sample storage bottle without exposing the absorbing reagent to direct sunlight. Sampling and analysis methodology adopted is given in **Table 3-17**.

Table 3.17: Sampling & Analysis Methodology

Sl. No.	Parameter	Methodology	Protocol
1	Particulate Matter (PM_{10}) (µg/m^3)	Gravimetric method	IS-5182; Part-4
2	Particulate Matter ($PM_{2.5}$) (µg/m^3)	Gravimetric	IS-5182; Part-24
3	Sulphur Dioxide as SO_2 (µg/m^3)	West and Gaeke Method	IS-5182; Part-2
4	Nitrogen dioxide as NO_2(µg/m^3)	Jacob & Hochheiser modified	IS-5182; Part-6
5	Carbon monoxide (mg/m^3)	Chemical Method	IS-5182; Part-10
6	Ozone (µg/m^3)	Chemical Method	As per CPCB
7	Mercury	AAS method	As per CPCB

3.8.6 AMBIENT AIR QUALITY RESULT

The analysis was carried out as per the method described in the applicable IS codes. Various statistical parameters like 98th percentile, average, standard deviation, maximum and minimum values have been computed from the observed raw data for all the AAQ monitoring locations. The results are shown in **Table 3-18 and** the monitoring photographs are shown in **Figure 3.36.**

Table 3.18: Results of Ambient Air Quality Data

Parameters	AAQ 1	AAQ 2	AAQ 3	AAQ 4	AAQ 5	AAQ 6	AAQ 7	AAQ8	AAQ9	AAQ10
	Nabinagar STPP	Sasna	Akorhi	Madhe	Jasoiya	Tilouthu Village	Charan Kalan	Bisrampur	Karamkila Village	Salaiya Village
PM10 NAAQ Limit 100 µg/m³										
Min	78.3	70.2	71.8	61.2	54.9	71.5	62.4	60.4	68.6	67.8
Max	92.4	88.4	83.4	78.5	70.2	85.2	70.9	77.6	84.0	84.0
98%	91.6	87.1	83.0	76.6	69.8	84.9	70.6	77.0	83.3	83.3
PM2.5 NAAQ Limit 60 µg/m³										
Min	42.5	40.6	35.6	27.8	26.0	37.4	30.5	26.7	31.0	33.0
Max	54.8	52.6	52.6	43.9	40.0	51.8	39.4	40.5	53.2	52.7
98%	53.7	52.5	51.6	42.6	39.1	51.5	39.2	40.1	52.4	52.6
SO2 NAAQ Limit 80 µg/m³										
Min	14.6	11.6	11.6	11.4	8.6	11.8	9.1	9.1	10.5	10.5
Max	22.6	22.1	18.4	17.7	13.1	20.1	17.8	17.5	16.4	14.6
98%	22.5	20.5	18.4	17.2	12.4	19.5	17.1	17.4	16.4	14.6
NO2 NAAQ Limit 80 µg/m³										
Min	24.5	18.6	13.5	12.6	7.7	11.5	11.5	10.8	9.8	8.2
Max	36.2	27.0	24.5	22.6	17.1	26.1	22.4	22.7	21.2	19.0
98%	35.9	26.6	24.0	22.5	16.1	25.4	22.3	22.6	21.2	18.8
CO NAAQ Limit 2.0mg/m³										
Min	0.74	0.74	0.74	0.69	0.69	0.74	0.69	0.74	0.76	0.75
Max	0.94	0.93	0.97	0.97	0.97	0.97	0.96	0.97	0.96	0.96
98%	0.94	0.93	0.96	0.96	0.96	0.96	0.95	0.96	0.95	0.95
O_3 NAAQ Limit 100 µg/m³										
Min	28.3	15.8	17.8	20.8	20.9	24.6	21.0	17.5	20.0	21.8

Parameters	AAQ 1	AAQ 2	AAQ 3	AAQ 4	AAQ 5	AAQ 6	AAQ 7	AAQ8	AAQ9	AAQ10
	Nabinagar STPP	Sasna	Akorhi	Madhe	Jasoiya	Tilouthu Village	Charan Kalan	Bisrampur	Karamkila Village	Salaiya Village
Max	39.3	30.2	28.1	28.1	25.7	34.9	38.3	28.0	44.2	38.4
98%	38.9	29.6	28.1	27.4	25.3	34.5	37.9	27.4	43.9	37.5
Mercury, µg/m^3										
Min	BDL (DL 1.0)									
Max	BDL (DL 1.0)									
98%	BDL (DL 1.0)									
Lead,µg/m^3										
Min	BDL (<0.1)									
Max	BDL (<0.1)									
98%	BDL (<0.1)									
Nickel,µg/m^3										
Min	BDL (<0.001)									
Max	BDL (<0.001)									
98%	BDL (<0.001)									
Ammonia, µg/m^3										
Min	BDL (<20.0)									
Max	BDL (<20.0)									
98%	BDL (<20.0)									

Source: Monitoring/sampling/testing by GCPL and Envirotech East Private Limited, Kolkata

Source: Monitoring/sampling/testing by Envirotech East Private Limited, Kolkata, Gazette of India Notification, dated 18thNov, 2009

** For CO, O3 & Hg, 8 hourly standard is being considered*

3.8.7 Observation

The 98th percentile value of PM_{10} varies between 91.6 µg/m^3 at AAQ1 to 69.8 µg/m^3 at AAQ5 and the 98th percentile value of $PM_{2.5}$ varies between 53.73 µg/m^3 at AAQ1 to 39.08 µg/m^3 at AAQ5. The higher concentration of PM_{10} may be due to its proximity to industrial area and vehicular pollution and the dominant wind direction. Anthropogenic sources including fuel combustion, domestic cooking in some area and fuel combustion for vehicles in the study area. Concentration of $PM_{2.5}$ were observed in all sites remain within the limits.

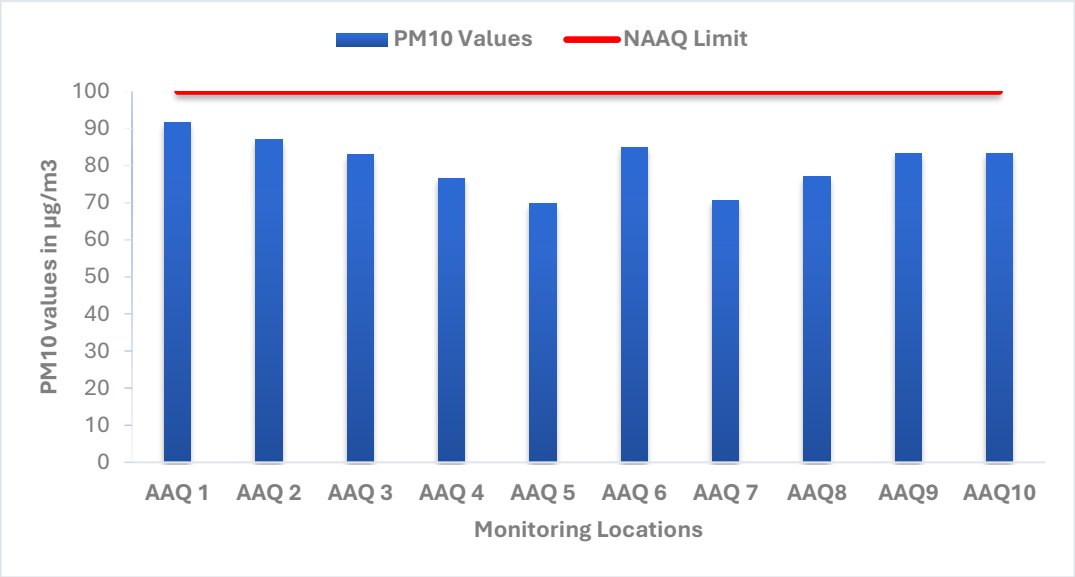


Figure 3.31: 98 Percentile of PM10 in µg/m3

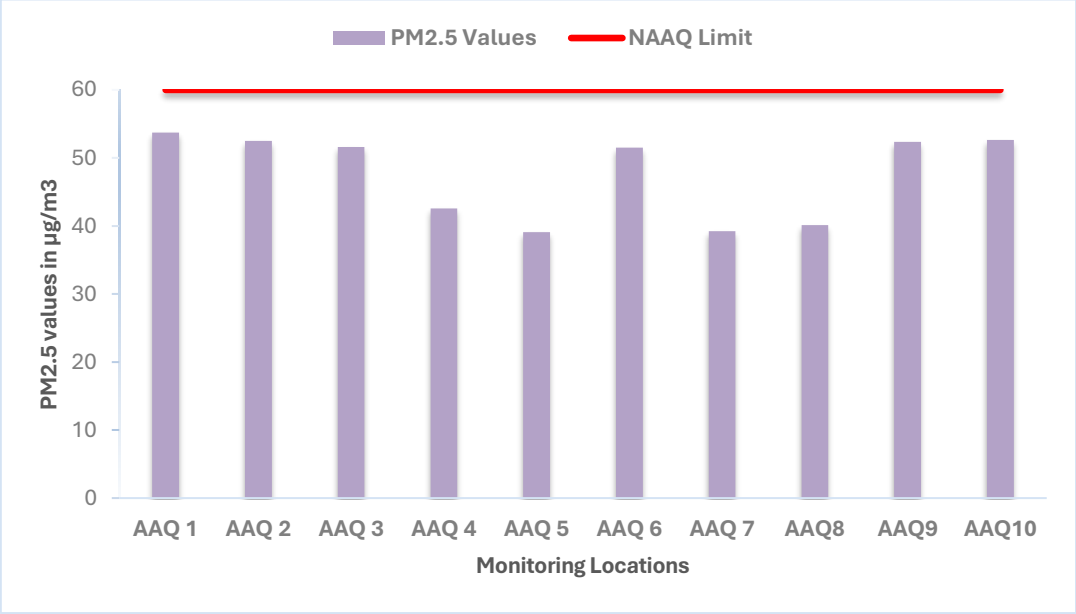


Figure 3.32: 98 Percentile of PM2.5 in µg/m3

The source of SO_2 in the study area is mainly from burning fuels containing sulphur or emissions from coal combustion depending on the Sulphur content in the coal. Sulphur dioxide reacts with other substances in the atmosphere to form sulphate aerosols (USEPA, 1982)[8]. Since most sulphate aerosols are part of $PM_{2.5}$, they may have an important role in the health impacts associated with fine particulates (WHO, 1979)[9]. However, the values of Sulphur pollutants in this case were found well below the NAAQ standard. The 98th percentile value of SO_2in the study area ranges from 22.5µg/m^3 in AAQ1 to 12.40µg/m^3 in AAQ5.

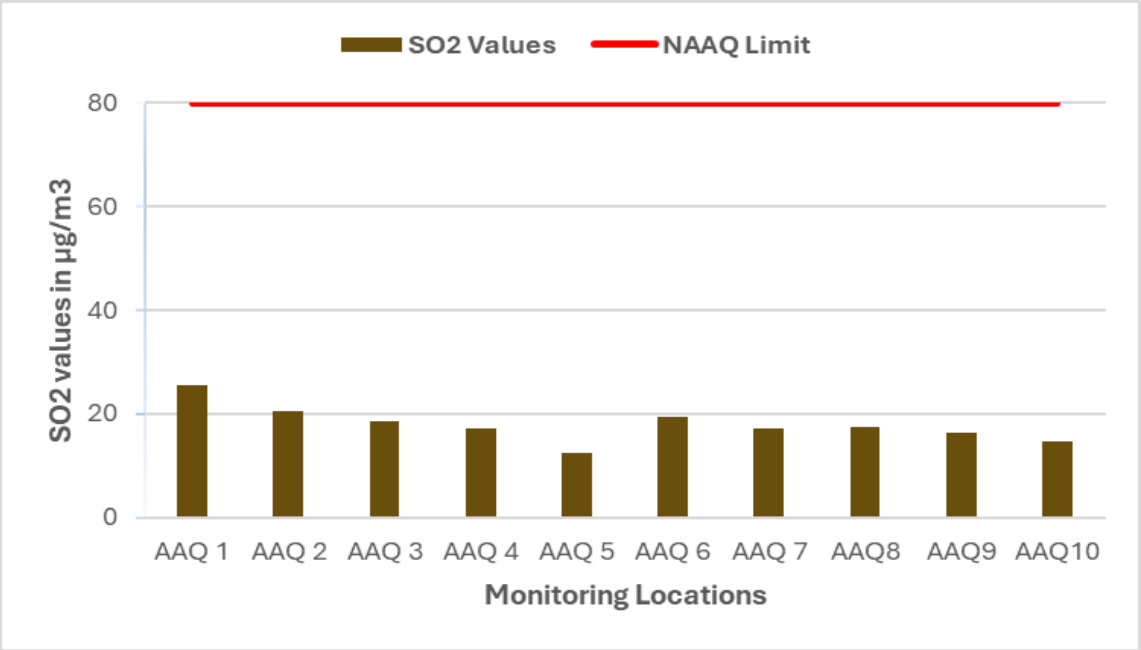


Figure 3.33: 98 Percentile of Sulphur Dioxide (SO2) in µg/m3

In the study area, the 98th percentile of NO_2 varies between 35.89 µg/m^3 at AAQ1 to 16.15 µg/m^3 at AAQ5. The values of Oxides of Nitrogen were found well below the NAAQ standard. The primary sources of NO_2 are motor vehicles, electric utilities and residential sources that burn fuels. NO_2 is one of the main ingredients involved in the formation of ground level ozone, which can trigger serious respiratory problems. It reacts to form nitrate particles, acid aerosols, as well as NO_2, which also cause respiratory problems (NAPAP 1991)[10].

[8]USEPA (United States Environmental Protection Agency). 1982. *Air Quality Criteria for Particulate Matter and Sulfur Oxides.* EPA-600/8-82-029, December, Research Triangle Park, N.C.

[9]WHO (World Health Organization) 1979, "Sulfur Oxides and Suspended Particulate Matter," *Environmental Health Criteria* 8Geneva

[10]NAPAP (National Acid Precipitation Assessment Program).Various years, 1987–91, Washington, D.C.: Government Printing Office.

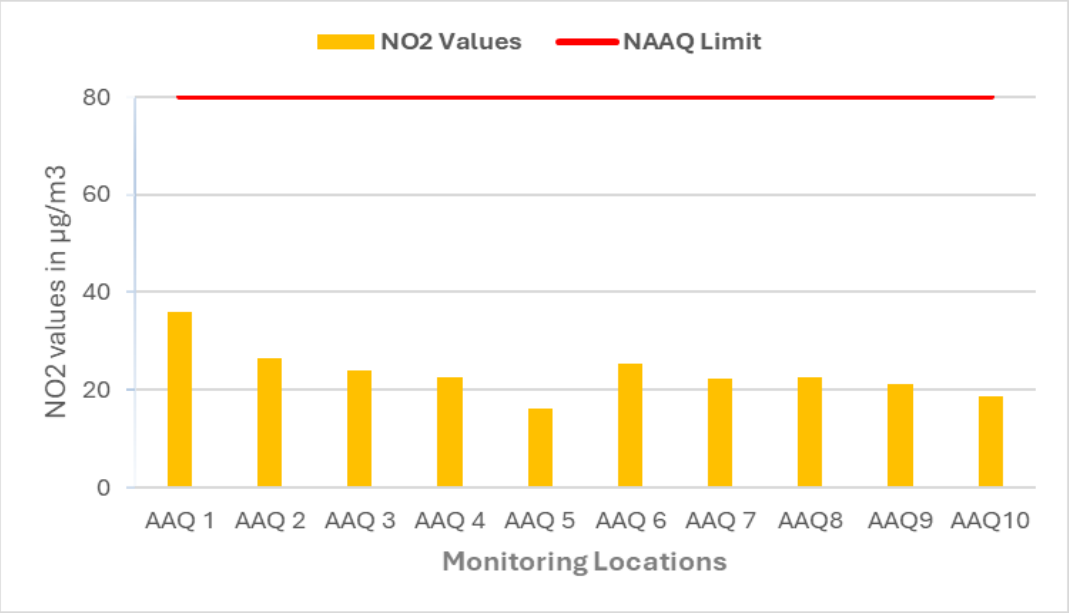


Figure 3.34: 98 Percentile of Nitrogen Dioxide (NO2) in µg/m3

The 98thpercentile values of CO in the study area varies from 0.96 mg/m^3 at AAQ3,4,5,8 to 0.93 mg/m^3 at AAQ2. The values recorded were below the prescribed standard of NAAQ.

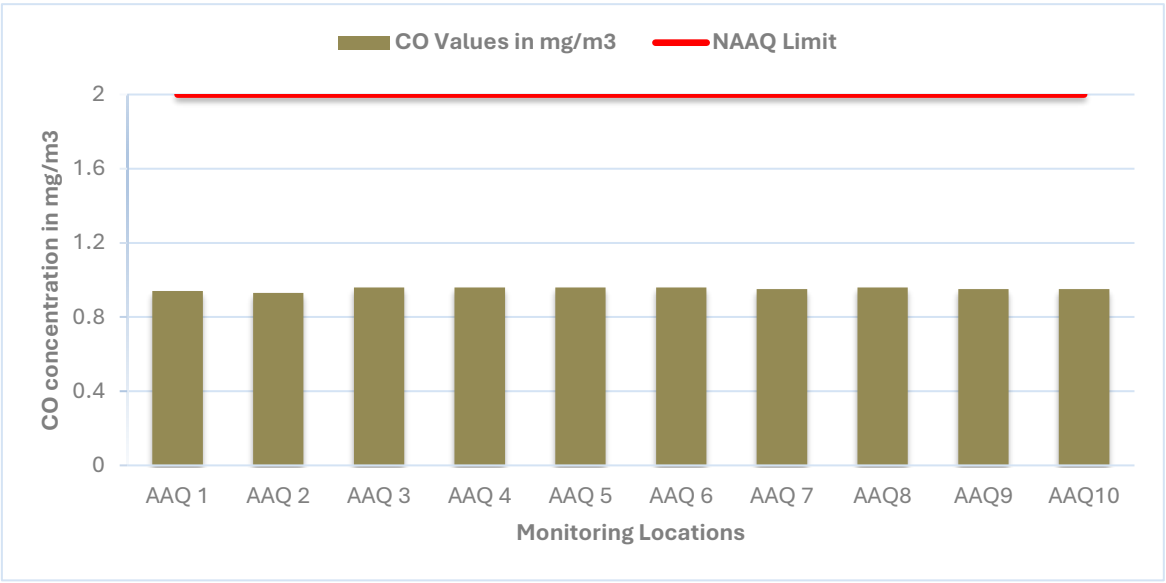


Figure 3.35: 98 Percentile of Carbon Monoxide (CO) in mg/m3

Mercury, Lead, Ammonia and Nickel was below detection limit at all locations.

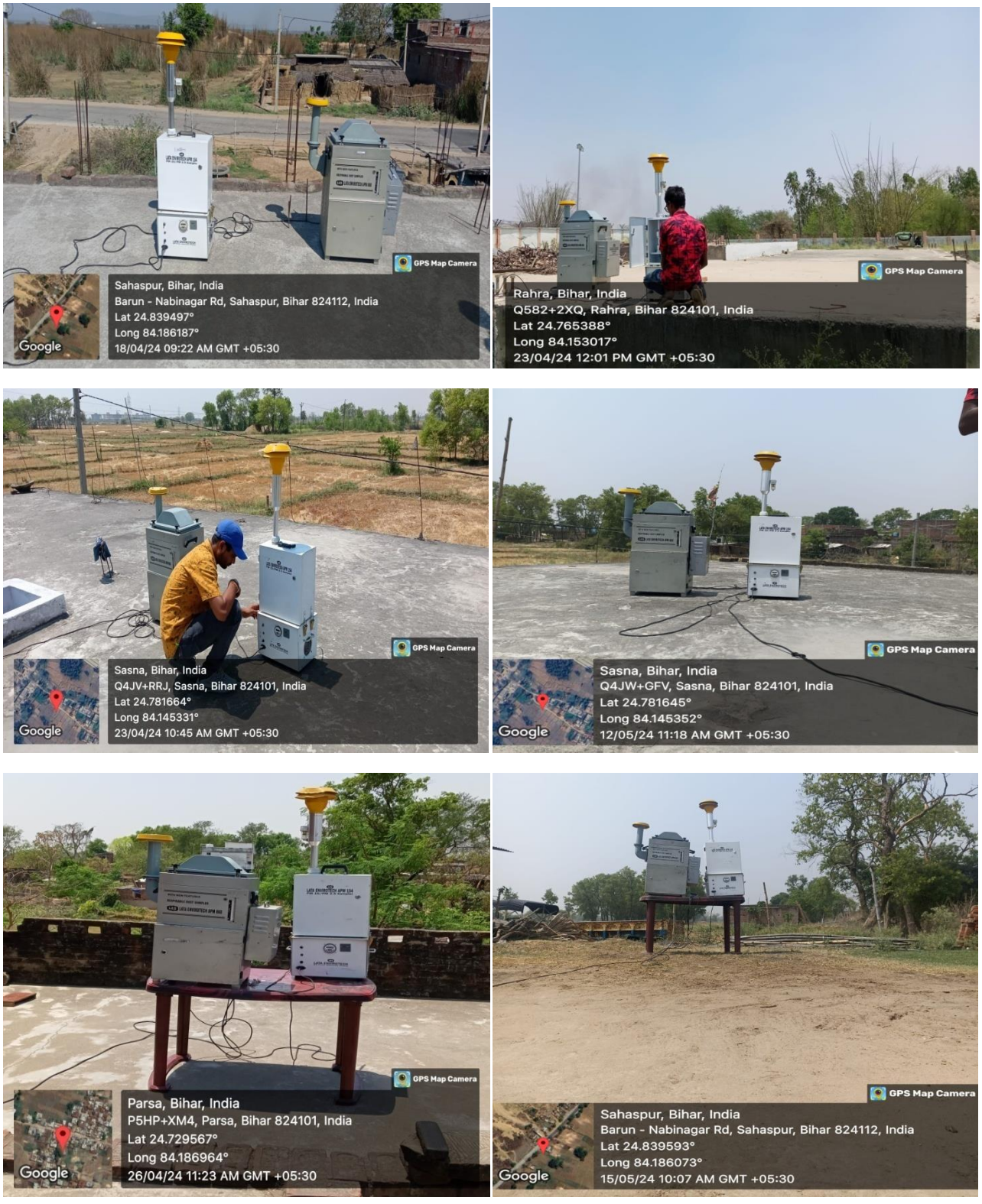


Figure 3.36: Air sample collection for summer season

3.9 NOISE ENVIRONMENT

3.9.1 FREQUENCY AND PARAMETERS OF SAMPLING

Noise levels were recorded at an interval of 60 minutes during the day and night times to compute the day equivalent, night equivalent and day-night equivalent level. The noise level was recorded continuous for 24 hours at an interval of 1 hour. The noise level was monitored once during the study period at each monitoring location. The noise level is recorded in dB(A).

3.9.2 INSTRUMENT USED FOR SAMPLING

Sound level meter (SL 4033) was used for measuring the noise levels. This instrument measures sound pressure level (SPL), maximum sound pressure level (max) and equivalent continuous noise level (Leq).

The SL4033 is a "Type 1" Sound Level Meter used is designed to meet the requirements of IS 9989:1981 RA 2023. The instrument has a frequency weighting of "A" type and allows the user to select Slow or Fast mode of measurement. A built-in Data Logger/SD card can record all the important Sound Level parameters in Non-Volatile Flash memory for 24 hours making detailed field data collection very simple. Each record consists of the Leq, Lmin and Lmax Sound Pressure Level and Sound Exposure Level (SEL) observed during the recording interval. A built-in Real Time Clock maintains a date and time stamp in the recorded data. **Table 3-18** shows the ambient noise quality standards as per CPCB.

Table 3.19: Ambient Noise Quality Standards as per CPCB

Type of Area	Limits in dB(A) Leq*	
	Day Time	Night Time
Industrial Area	75	70
Commercial Area	65	55
Residential Area	55	45
Silence Zone	50	40

**dB (A) Leq denotes the time weighted average of the level sound in decibels on scale A which is relatable to human hearing*

Source: The Noise Pollution (Regulation and Control) Rules, 2000

Day and Night time shall mean from 6:00 a.m. to 10:00 p.m. and 10:00 p.m. to 6:00 a.m. respectively.

3.9.3 SELECTION OF MONITORING LOCATIONS

Assessment of ambient noise levels is an important parameter in preparation of impact assessment report. Noise levels are more annoying in the night time particularly in the residential area. The environmental impact of noise can have several effects varying from annoyance to hearing loss depending on loudness of noise levels. The monitoring for noise levels were done in 10 locations keeping considering the population and traffic of the area. **Figure 3-37** is showing the noise monitoring locations. **Table 3-20** shows the values recorded from these locations.

Table 3.20: Description of noise sampling locations

Name	Latitude	Longitude	Location	Distance& Directions	Category
N1	24° 46' 43.29"N	84° 9' 21.63"E	Nabinagar STPP	0.00	Industrial Area
N2	24° 47' 52.12"N	84° 11' 34.28"E	Khaira Village	0.55 km, E	Residential Area
N3	24° 46' 20.73"N	84° 10' 43.74"E	Ankorha Village	0.85 km, E	School Area
N4	24° 45' 11.41"N	84° 8' 39.68"E	Madhe Village	1.05 km, S	Residential Area
N5	24° 48' 32.11"N	84° 9' 36.41"E	Narari Khurd	0.25 km, W	Silent Zone
N6	24° 43' 33.90"N	84° 11' 7.32"E	Bisrampur	4.01 km, SE	Residential Area
N7	24° 44' 28.27"N	84° 7' 4.91"E	Kanker	3.70 km, S	Temple Area
N8	24° 46' 10.16"N	84° 13' 39.89"E	Mahdeva Village	5.76 km, E	Residential Area
N9	24° 46' 2.34"N	84° 7' 54.18"E	Mahuwan Village	1.42 km, W	Medical Area
N10	24° 47' 11.48"N	84° 8' 30.64"E	Sasna	0.50 km, WNW	Residential Area

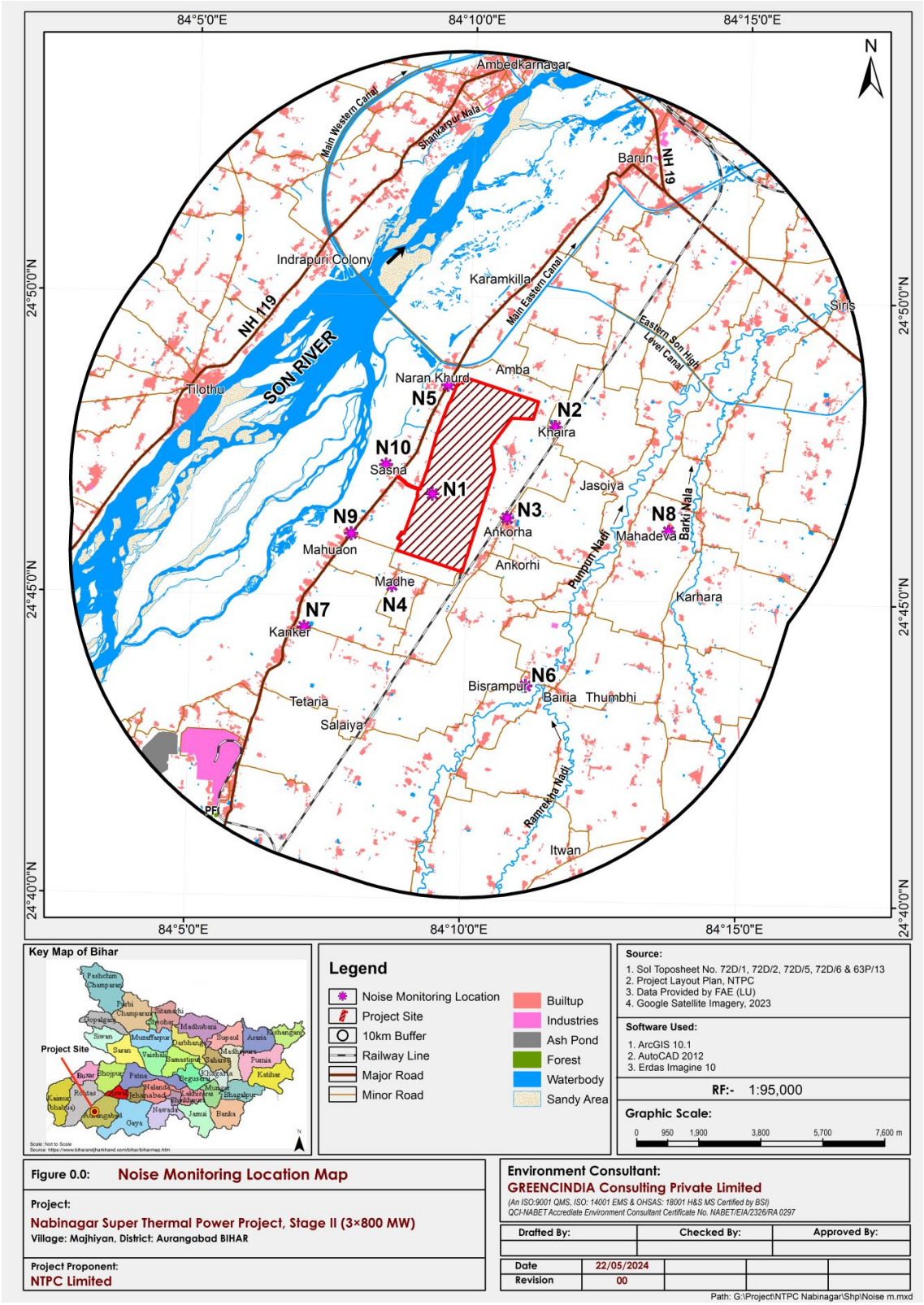


Figure 3.37: Noise Monitoring Locations

Table 3.21: Noise parameters recorded at different locations

Name	Location/Village	Day - Leq-dB(A)	Night - Leq-dB(A)
N1	Nabinagar STPP	66.5	44.1
N2	Khaira Village	53.8	41.5
N3	Ankorha Village	66.3	46.2
N4	Madhe Village	54.8	42.9
N5	Narari Khurd	52.8	41.7
N6	Bisrampur	54.2	43.6
N7	Kanker	55.4	41.9
N8	Mahdeva Village	52.8	40.8
N9	Mahuwan Village	54.6	42.0
N10	Sasna	61.2	43.6

DISCUSSION & CONCLUSION

Day Time: The day time noise levels showed maximum 66.5 dB(A) at Nabinagar STPP to minimum 52.8 dB(A) at Narari Khurd and Mahdeva Village. Whereas in study area two locations (N3 and N10) are observed to be above prescribed limits for residential zones. The minimum noise level observed as 52.8 dB(A) at Mahdeva Village(N8) and Narari Khurd(N5) and maximum noise level is observed as 66.5 dB(A) at Nabinagar STPP (N1). It is observed that the day time noise levels are high because Nabinagar STPP is an industry and it is nearest to railway line, so noise level observed high. The prescribed limit is 55 dB (A) for rural / residential areas and 75 dB (A) for industrial zones.

Night Time: The night time noise levels showed maximum 46.2 dB(A) Ankorha village to minimum 40.8 dB(A) at Mahdeva Village. In study area, at location (N3) noise levels observed to be above prescribed limits for residential zones. The minimum noise level observed 40.8 dB(A) at Mahdeva Village (N8) and maximum noise level is observed 46.2 dB(A) at Ankorha village (N3). It is observed that the night time noise level observed high at Ankorha village due to nearest to railway line. The prescribed limit is 45 dB (A) for rural / residential areas and 70 dB (A) for industrial zones.

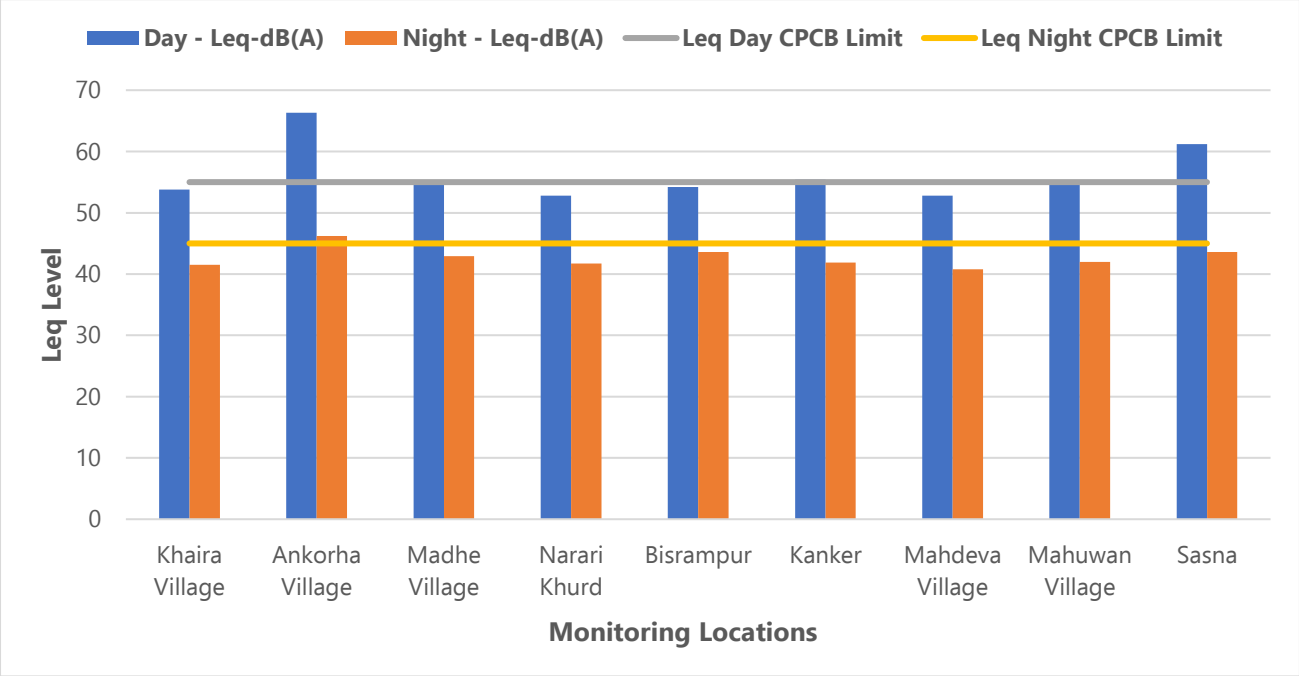


Figure 3.38: Sound Pressure Levels Recorded at the Monitoring Stations

Figure-3.39: Noise sample collection for summer season

3.10 WATER ENVIRONMENT

3.10.1 FREQUENCY AND PARAMETERS

Water samples were collected once in every month during the study period and analyzed for following selected physico chemical and biological parameters.

- **Physical Parameters-**Temperature, Turbidity, Colour, Electrical Conductivity, TSS & TDS
- **Chemical parameters-**pH, DO, Alkalinity, Hardness, BOD, COD,NO_3, PO_4, Cl, F, SO_4, Na,K, Ca, Mg, Silica, Oil &Grease, Phenoliccompounds
- **Heavy metals-**As, Hg, Pb, Cd, Cr^{-6}, Total Cr, Cu, Zn, Se, Fe
- **Bacteriological-** MPN and Total coliform

3.10.2 SAMPLE COLLECTION TECHNIQUE

The samples were collected as per IS standard procedures. The parameters such as Temperature, Turbidity, Colour, Electrical Conductivity, TSS & TDS were analyzed at the site at the time of collection of samples (with the help of handy sampler) while for other parameters, samples were collected, preserved and analyzed in laboratory. Samples were collected, preserved and analyzed as per methods given in Standard Methods for the Examination of Water and Waste Water (APHA & IS standard).

3.10.3 SAMPLING LOCATIONS

Six/Six samples each of surface and ground water have been collected to assess the water quality. The details of water quality sampling locations are given in **Table 3-22** and shown in **Figure 3-40**.

Table 3.22: Description of sampling locations for surface water and ground water

Name	Latitude	Longitude	Location	Distance& Directions	Source
GW1	24° 43' 12.77" N	84° 07' 7.32" E	Bara Tetariya	5.47, SSW	Hand pump
GW2	24° 43' 28.53"N	84° 11' 47.28" E	Bairiya	4.74, SE	Hand pump
GW3	24° 45' 44.80"N	84° 12' 11.19" E	Anjaniya	3.5 km, E	Hand pump
GW4	24° 47' 52.13" N	84° 11' 34.27" E	Khaira	0.55 km, E	Hand pump
GW5	24° 48' 48.86" N	84° 10' 43.10" E	Amba	0.68 km, N	Hand pump
GW6	24° 47' 11.48" N	84° 08' 30.64" E	Sasna	0.50 km, WNW	Hand pump
SW1	24° 49' 50.19" N	84° 08' 34.20" E	Indrapuri Barrage (Source of Water)	3.13 km, NNW	River
SW2	24° 48' 15.96" N	84° 05' 12.26" E	Sone River-Tilouthu village (Left bank)	7.40 km, WNW	River
SW3	24° 43' 27.31" N	84° 12' 48.00" E	Thumbi village	6.13 km, ESE	Pond
SW4	24° 43' 14.03" N	84° 07' 8.68" "E	Bara Tetariya	5.45 km, SSW	Pond
SW5	24° 45' 4.91" N	84° 06' 7.15" E	Right bank-Sone River	4.60 km, SW	River
SW6	24° 47' 58.08" N	84° 11' 29.80" E	Khaira	0.56 km, NE	Pond

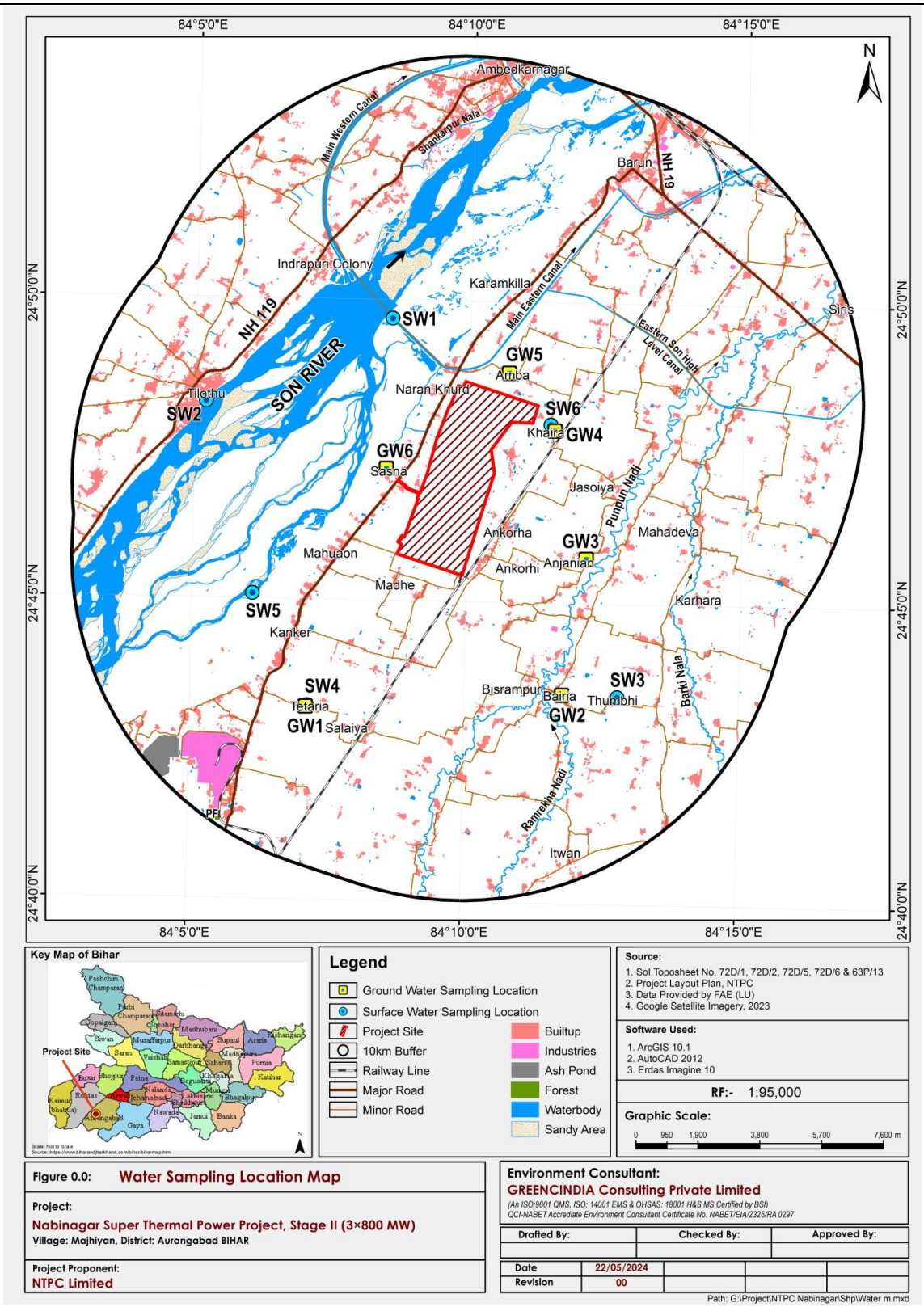


Figure 3.40: Water Sampling Locations

3.10.4 ANALYSIS OF WATER QUALITY

Water quality parameters of surface and ground water resources within the study area has been studied for assessing the water environment and evaluate anticipated impact of the project. Understanding the water quality is essential in preparation of environmental impact assessment and to identify critical issues with a view to suggest appropriate mitigation measures for implementation.

The purpose of this study is to:

- Assess the water quality characteristics for critical parameters;
- Evaluate the impacts on agricultural productivity, habitat conditions, recreational resources and aesthetics in the vicinity; and
- Predict impact on water quality by this project and related activities

The information required has been collected through primary surveys in March to May, 2024 and secondary sources. Six ground water and six surface water samples were collected and analyzed for physico-chemical, heavy metals and bacteriological parameters in order to assess the effect of industrial and agriculture activities. The location of ground water and surface water sampling is shown in **Figure 3-40**.

The samples were analyzed as per the procedures specified in 'Standard Methods for the Examination of Water and Wastewater' published by American Public Health Association (APHA) and IS 10500:2012. Samples for physico-chemical analysis were collected in polyethylene and glass bottle and preserved as per standard procedure (APHA 22ndedn.). Samples collected for metal content were acidified with 1ml HNO_3. Samples for bacteriological analysis were collected in sterilized bottles (**Table 3-22**). The analytical procedures are described in **Table 3-23.**

Table 3.23: Parameter wise Water Sampling Procedure, Sample Size and Storage/Preservation

Sl. No	Parameter	Sample collection	Sample Size	Storage/ preservation
1	pH	Grab sampling, Plastic /glass container	100 ml	On site analysis
2	Conductivity	Grab sampling, Plastic /glass container	100 ml	On site parameter
3	TDS	Grab sampling, Plastic /glass container	100 ml	Refrigeration, can be stored for 7 days
4	Oil & Grease	Wide mouth glass container	500 ml	Add HCl to pH>2, refrigeration, 28 days
5	Hardness	Grab sampling, Plastic /glass container	100 ml	Add HNO_3 to pH<2, refrigeration; 6 months
6	Chlorides	Grab sampling, Plastic/ glass container	100 ml	Not required; 28 days
7	Sulphates	Grab sampling, Plastic /glass container	100 ml	Refrigeration; 28 days
8	Na^+ and K^+	Plastic container	100 ml	Not required; 6 months
9	Nitrates	Plastic containers	100 ml	Refrigeration; 48 hrs
10	Alkalinity	Plastic/ glass containers	100 ml	Refrigeration; 14 days
11	Heavy Metals	Plastic/ Glass rinsed with 1+1 HNO_3	500 ml	HNO_3 to pH>2; Grab sample; 6 months
12	Silica	Plastic/ Glass rinsed with 1+1 HNO3	500ml	HNO3 to pH>2; Grab

Sl. No	Parameter	Sample collection	Sample Size	Storage/ preservation
				sample; 6 months
13	COD	Plastic/ Glass	100	Cooling between 2 to 5˚C and store in dark
14	BOD	Plastic/ Glass	1000	Cooling between 2 to 5˚C and store in dark
15	DO	Plastic/ Glass	300	As soon as possible

Source: Standard Methods for the Examination of Water and Wastewater, Published By APHA, 22nd Edition, 2012 and 3025-Part 1.

Table 3.24: Standard National and International Analytical Procedure and Methods for Different Water Quality Parameters

Sl. No.	Parameters	Analytical Method	Reference
1	pH	pH Electrode	IS: 3025 (Part-11)
2	Turbidity	Nephelometric	IS: 3025 (Part-10)
3	Conductivity (at 25 °C)	Conductivity Electrode	APHA 22nd edition, 2510 B:2012
4	Total Dissolve Solids	Gravimetric	IS: 3025 (Part-16)
5	Alkalinity as $CaCO_3$	Titrimetrically	IS: 3025 (Part-23)
7	Total Hardness as $CaCO_3$	Titrimetrically	IS: 3025 (Part-21)
8	Calcium as Ca	Titrimetrically	IS: 3025 (Part-40)
9	Magnesium as Mg	Calculation	APHA 22nd edition,3500 Mg B:2012
10	Sodium	Flame Photometric	APHA 22nd edition, 3500 Na B:2012
11	Potassium	Flame Photometric	APHA 22nd edition,3500 K- B:2012
12	Chloride as Cl	Argenometric	IS: 3025 (Part-32)
13	Sulphate as SO_4	Tubidimetric	IS: 3025 (Part-24)
14	Nitrate as NO_3	Spectrophotometric	IS: 3025 (Part-34)
15	Phosphate	Spectrophotometric	IS: 3025 (Part-31)
16	Fluoride as F	Ion-meter	APHA 22nd edition,4500 F- D:2012
17	Phenolic compound	Spectrophotometric	IS: 3025 (Part-43)
18	Cyanide	Spectrophotometric	IS: 3025 (Part-27)
19	Dissolve Oxygen	Winkler Method	IS:3025 (Part-38), Reaffirmed 2009
20	Oil & Grease	Gravimetric	IS:3025 (Part 39), Reaffirmed 2003
21	Arsenic	AAS	IS: 3025 (Part-37)
22	Cadmium	AAS	IS: 3025 (Part-41)
23	Total Chromium	AAS	IS: 3025 (Part-52)
24	Iron	AAS	IS:3025 (Part-53), Reaffirmed 2009
25	Copper	AAS	IS: 3025 (Part-42)
26	Lead	AAS	IS: 3025 (Part-47)
27	Manganese	AAS	IS: 3025 (Part-59)
28	Mercury	AAS	IS: 3025 (Part-48)

Sl. No.	Parameters	Analytical Method	Reference
29	Zinc	AAS	IS: 3025 (Part-49)
30	Silica	Molibdosilicate Method	APHA 22nd edition,4500-SiO2:2012
31	Selenium	Colorimetric Method	APHA 22nd edition,3500-Se:2012
32	Total Coliform	MPN Method	IS: 1622: 1981

3.10.4.1 SURFACE WATER QUALITY

Water pollution is the contamination of water bodies such as rivers, lakes and pollution occur when pollutants are directly or indirectly discharged into water bodies without adequate treatment to remove harmful compounds. There are many factors which lead to water pollution. It is essential that firstly understand the sources which contribute to the problem. There are point sources of water pollution that the contaminants which enter a waterway from a single source and non-point sources of water pollution that are diffused contaminants which do not originate from a single discrete source, both that raise the problem of water pollution.

Table 3.25: Physico-chemical characterisation of surface water, March.2024

S. No	Parameters	SW-1 Indra puri Barrage Downstream	SW-2 Sone River-Tilouthu village (Left bank) Upstream	SW-3 Pond n/v Thumbi village	SW-4 Pond n/n Bara Tetariya	SW-5 Sone River-Right bank Upstream	SW-6 Pond n/v Khaira
1	Temperature, ˚C	27.16	26.70	27.88	26.42	26.41	27.62
2	Colour, Hazen	<5	<5	<5	<5	<5	<5
3	Turbidity, NTU	4	4	5	1	8	3
4	pH	7.21	7.34	7.11	7.41	7.38	7.44
5	Conductivity, µS/cm	447	364	568	475	412	253
6	Total Dissolve Solids, mg/l	299.49	243.88	386.24	318.25	276.04	169.51
7	Alkalinity as $CaCO_3$, mg/l	204.61	142.61	278.63	174.52	144.80	110.56
8	Total Hardness as $CaCO_3$, mg/l	141.80	149.43	194.80	155.00	152.21	101.82
9	Calcium as Ca, mg/l	36.24	31.33	42.86	37.54	36.41	23.41
10	Magnesium as Mg, mg/l	12.43	17.26	21.28	14.86	14.86	10.52
11	Sodium as Na, mg/l	36.76	38.63	40.25	28.60	42.62	11.11
12	Potassium as K, mg/l	1.62	2.64	1.14	1.24	2.31	0.75

S. No	Parameters	SW-1 Indra puri Barrage Downstream	SW-2 Sone River-Tilouthu village (Left bank) Upstream	SW-3 Pond n/v Thumbi village	SW-4 Pond n/n Bara Tetariya	SW-5 Sone River-Right bank Upstream	SW-6 Pond n/v Khaira
13	Total Suspended Solids	2.10	2.10	3.00	3.10	2.20	3.10
14	Chloride as Cl, mg/l	20.76	47.63	23.68	31.41	54.22	16.21
15	Sulphate as SO_4, mg/l	15.92	34.61	20.16	19.62	40.62	8.63
16	Nitrate as NO_3	5.76	9.62	5.86	4.80	11.41	7.62
17	Fluoride as F, mg/l	0.28	0.34	0.25	0.28	0.36	0.44
18	Phenolic compound as C_6H_5OH	BDL	BDL	BDL	BDL	BDL	BDL
19	Phosphate, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
20	Silica as Si, mg/l	7.60	8.51	3.73	6.28	14.20	7.11
21	Arsenic as As, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
22	Cadmium As Cd, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
23	Chromium as Cr^{+6}	BDL	BDL	BDL	BDL	BDL	BDL
24	Iron as Fe, mg/l	0.36	0.22	0.31	0.16	0.24	0.26
25	Copper as Cu, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
26	Lead as Pb, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
27	Selenium as Se, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
28	Mercury as Hg, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
29	Zinc as Zn, mg/l	0.22	0.42	0.26	0.22	0.46	0.32
30	Dissolved Oxygen, mg/l	5.51	5.70	6.13	5.60	5.60	5.80
31	COD, mg/l	32	22	46	16	26	26
32	BOD, 27°C 3 days, mg/l	8	6	14	5	8	6
33	Oil & Grease, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
34	Total Chromium, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
35	Total Coliforms, MPN/100ml	32	21	29	35	38	38

Table 3.26: Physico-chemical characterisation of surface water, April.2024

S.No	Parameters	SW-1 Indra puri Barrage	SW-2 Sone River-Tilouthu village Upstream	SW-3 Pond n/v Thumbi village	SW-4 Pond n/n Bara Tetariya	SW-5 Sone River Downstream	SW-6 Pond n/v Khaira
1	Temperature, ˚C	26.17	28.20	27.23	28.20	28.20	27.84
2	Colour, Hazen	<5	<5	<5	<5	<5	<5
3	Turbidity, NTU	6.00	5.00	6.00	5.00	4.00	4.00
4	pH	7.21	7.51	7.15	7.51	7.56	7.32
5	Conductivity, µS/cm	455	393.12	545	393.12	444.96	410
6	Total Dissolve Solids, mg/l	304.85	263.39	410.00	263.39	298.12	274.71
7	Alkalinity as $CaCO_3$, mg/l	184.82	154.01	250.46	154.01	156.38	117.42
8	Total Hardness as $CaCO_3$, mg/l	124.91	161.34	199.29	161.34	164.38	109.63
9	Calcium as Ca, mg/l	34.11	33.84	39.91	33.84	39.32	24.63
10	Magnesium as Mg, mg/l	9.64	18.64	24.18	18.64	16.05	11.68
11	Sodium as Na, mg/l	40.64	41.69	32.86	41.69	46.01	13.21
12	Potassium as K, mg/l	2.10	2.85	1.62	2.85	2.49	1.63
13	Total Suspended Solids	2.10	2.10	3.00	3.10	2.20	3.10
14	Chloride as Cl, mg/l	24.62	51.41	21.68	51.41	58.54	17.32
15	Sulphate as SO_4, mg/l	18.64	37.37	23.17	37.37	43.87	11.61
16	Nitrate as NO_3	6.63	10.39	7.11	10.39	12.31	8.24
17	Fluoride as F, mg/l	0.37	0.37	0.29	0.37	0.39	0.58
18	Phenolic compound as C_6H_5OH	BDL	BDL	BDL	BDL	BDL	BDL
19	Phosphate, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
20	Silica as Si, mg/l	8.20	9.18	4.11	9.18	15.34	8.80
21	Arsenic as As, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
22	Cadmium As Cd, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
23	Chromium as Cr^{+6}	BDL	BDL	BDL	BDL	BDL	BDL
24	Iron as Fe, mg/l	0.36	0.24	0.28	0.24	0.26	0.32
25	Copper as Cu, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
26	Lead as Pb, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
27	Selenium as Se, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
28	Mercury as Hg, mg/l	BDL	BDL	BDL	BDL	BDL	BDL

S.No	Parameters	SW-1 Indra puri Barrage	SW-2 Sone River-Tilouthu village Upstream	SW-3 Pond n/v Thumbi village	SW-4 Pond n/n Bara Tetariya	SW-5 Sone River Downstream	SW-6 Pond n/v Khaira
29	Zinc as Zn, mg/l	0.52	0.45	0.72	0.45	0.50	0.78
30	Dissolved Oxygen, mg/l	5.21	5.10	5.40	5.20	6.20	5.72
31	COD, mg/l	18.00	23.00	62.00	23.00	28.00	20.00
32	BOD, 27°C 3 days, mg/l	6.21	7.00	18.00	7.00	8.00	6.00
33	Oil & Grease, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
34	Total Chromium, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
35	Total Coliforms, MPN/100ml	26.00	32.00	21.00	Absent	35.00	38.00

Table 3.27: Physico-chemical characterisation of surface water, May.2024

S. No	Parameters	SW-1 Indra puri Barrage	SW-2 Sone River-Tilouthu village Upstream	SW-3 Pond n/v Thumbi village	SW-4 Pond n/n Bara Tetariya	SW-5 Sone River Downstream	SW-6 Pond n/v Khaira
1	Temperature, ˚C	27.41	28.40	27.22	28.60	28.50	28.20
2	Colour, Hazen	<5	<5	<5	<5	<5	<5
3	Turbidity, NTU	5.00	5.00	3.00	1.00	5.00	1.00
4	pH	7.34	7.44	7.21	7.38	7.46	7.58
5	Conductivity, µS/cm	427.00	377.40	512.00	492.48	427.16	385.00
6	Total Dissolve Solids, mg/l	286.559	252.85	385.4	329.96	286.20	258.218
7	Alkalinity as $CaCO_3$, mg/l	173.73	147.85	235.43	180.92	150.13	110.35
8	Total Hardness as $CaCO_3$, mg/l	117.42	154.88	187.30	160.73	157.80	103.01
9	Calcium as Ca, mg/l	32.054	32.48	37.506	38.92	37.75	23.124
10	Magnesium as Mg, mg/l	9.06	17.90	22.73	15.41	15.41	10.97
11	Sodium as Na, mg/l	38.20	40.02	30.89	29.65	44.17	12.41
12	Potassium as K, mg/l	1.97	2.74	1.52	1.29	2.40	1.53
13	Total Suspended Solids	2.10	2.10	3.00	3.10	2.20	3.10

S. No	Parameters	SW-1 Indra puri Barrage	SW-2 Sone River-Tilouthu village Upstream	SW-3 Pond n/v Thumbi village	SW-4 Pond n/n Bara Tetariya	SW-5 Sone River Downstream	SW-6 Pond n/v Khaira
14	Chloride as Cl, mg/l	23.12	49.35	20.37	32.56	56.19	16.26
15	Sulphate as SO_4, mg/l	17.52	35.87	21.77	20.34	42.11	10.90
16	Nitrate as NO_3	6.20	9.97	6.67	4.98	11.82	7.74
17	Fluoride as F, mg/l	0.34	0.35	0.27	0.29	0.37	0.54
18	Phenolic compound as C_6H_5OH	BDL	BDL	BDL	BDL	BDL	BDL
19	Phosphate, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
20	Silica as Si, mg/l	7.70	8.81	3.85	6.51	14.72	8.27
21	Arsenic as As, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
22	Cadmium As Cd, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
23	Chromium as Cr^{+6}	BDL	BDL	BDL	BDL	BDL	BDL
24	Iron as Fe, mg/l	0.33	0.23	0.26	0.17	0.25	0.30
25	Copper as Cu, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
26	Lead as Pb, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
27	Selenium as Se, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
28	Mercury as Hg, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
29	Zinc as Zn, mg/l	0.48	0.44	0.67	0.23	0.48	0.73
30	Dissolved Oxygen, mg/l	5.80	5.71	5.80	5.53	6.12	5.61
31	COD, mg/l	16.92	22.00	58.28	20.00	26.00	21.00
32	BOD, 27°C 3 days, mg/l	5.83	6.00	16.92	6.00	8.00	8.00
33	Oil & Grease, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
34	Total Chromium, mg/l	BDL	BDL	BDL	BDL	BDL	BDL
35	Total Coliforms, MPN/100ml	22.00	26.00	33.00	38.00	45.00	35.00

BDL Below detection limit

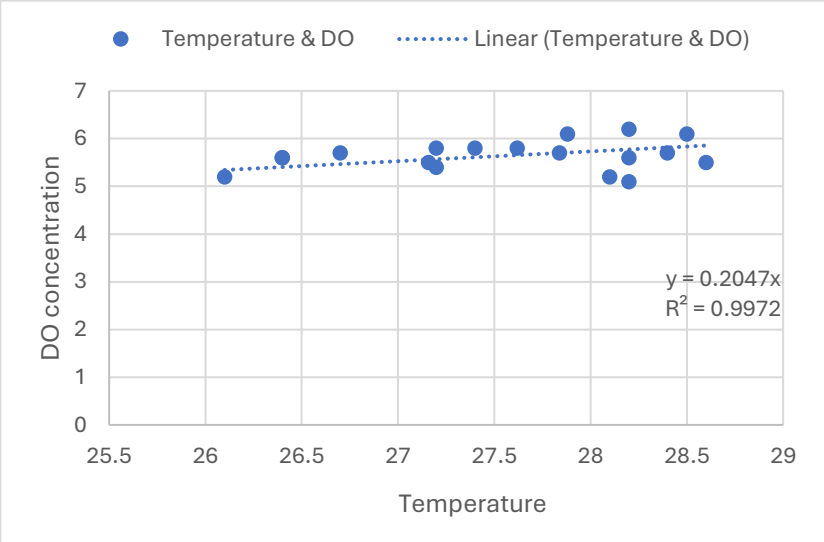
Table 3.28: Water Quality Criteria as per CPCB

Designated Best Use	Class of Water	Criteria
Drinking water source without conventional treatment but after disinfection	A	• Total Coliform 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 20°C 2mg/l or less

Designated Best Use	Class of Water	Criteria
Outdoor bathing (Organized)	B	• Total Coliform 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 20°C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	• Total Coliform Organism MPN/100ml shall be 5000 or less • pH between 6 to 9 • Dissolved Oxygen 4mg/l or more • Biochemical Oxygen Demand 5 days 20°C 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 between 6.0 to 8.5 • Electrical Conductivity at 25°C micro mhos/cm Max.2250 • Sodium absorption Ratio Max. 26 • Boron Max. 2mg/l
	Below-E	• Not Meeting A, B, C, D & E Criteria

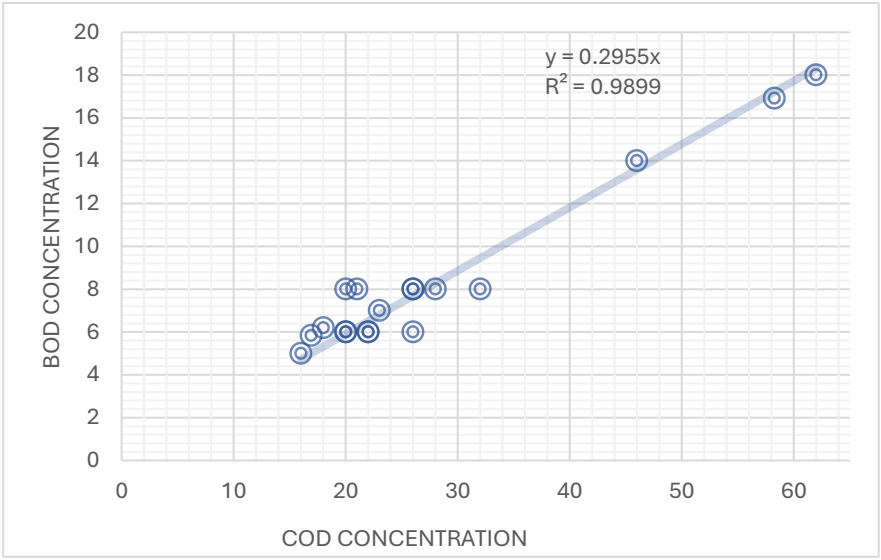
Discussion

pH is an important chemical parameter that determines the suitability of water for various purposes. pH of water is very important for the biotic communities because an average pH is adopted by most of the aquatic organism. pH of the study area varied from 7.11 (SW3) in month of March and 7.15 in April to 7.58 (SW6) in the month of May which is slightly alkaline in nature. TDS was observed in the range of 169.51 mg/l at SW6 in the month of March to max. 410 mg/l at SW3 in the month of April. Value of Total suspended solids ranges from 2.1 to 3.1 Conductivity of water samples indicated non saline in nature it was varied between 253 µS/cm at SW6 in March to 568 µS/cm at SW3 in March. Nitrate and fluoride was under limit in pre-monsoon season i.e March to May.2024.



Dissolve oxygen is one of the key factors of natural or wastewater; it is influenced by the physico-chemical parameter and biological activity in the water body such as rivers, lake. DO is a general indicator of water quality which shows the health and ability of the water body. It is source of Oxygen for respiration of aquatic organisms. A minimum concentration of 5 mgL^{-1} was considered necessary to maintain the fauna of the

waterbody. Dissolved oxygen was recorded sufficient in the study area i.e min 5.20 mg/l (SW1 & SW4) in April month to max. 6.20 mg/l (SW6) in April month. During summer, the value of dissolved Oxygen was found to be low because DO is Directly or indirectly dependent on water temperature, a partial pressure of air etc.



BOD in surface water found high which is varied between 6 mg/l in SW2, SW4 and SW6 to 16.92 mg/l in SW3 during may month. High BOD in surface water is due to decaying plants, animal waste, and other organic compounds added to water. Whereas COD also found high is surface water sample and it was observed min. 16 mg/l in SW4 during march month to max. recorded 62 mg/l in SW3 during April month. Reason behind high COD may be due to accumulation of solid waste, soluble organic compounds, residual food waste, emulsified oils and the dying bacterial cells.

Comparing the values of pH, DO, BOD and total coliform with 'Use based classification of surface waters' published by Central Pollution Control Board given in **Table 3-28** and majority of the surface water samples meet the criteria C, D and E.

Hard water makes it difficult for domestic water users. Hardness is defined as the concentration of calcium and magnesium in water expressed as the equivalent of calcium carbonate ($CaCO_3$). The maximum total hardness of surface water samples in study area was found to be 199.29 mg/l in sample at SW3 in April month and the minimum was observed as 101.8 mg/l in the sample at SW6 during month of march which is low. The range of $Ca^{2+}$and Mg^{2+} are also remaining within the acceptable limits 23.12-42.86 mg/l and 9.06-24.18 mg/l respectively.

Alkalinity: The alkalinity of water is caused mainly due to OH^-, CO_3^-, HCO_3^- ions. Alkalinity is an estimate of the ability of water to resist change in pH upon addition of acid. The maximum alkalinity of water bodies samples was found to range between 110.35-278.6 mg/l in the study area.

Chloride: The maximum chloride concentration (58.54 mg/l) was found at SW5 and the minimum (16.2 mg/l) was recorded at SW6.

Fluoride: The level of fluoride ranged between 0.25 mg/l at SW3 to 0.58 mg/l at SW6 were found to be within the tolerance limit of surface water.

Nitrate: The nitrate in surface water ranged between 4.8 mg/l at SW4 to 12.31 mg/l at SW5 and were found to be within the tolerance limit of surface water.

Inferences: BOD and COD of the samples showed above limit as per class C of CPCB norms. High BOD is due to decaying plants, human or animal waste and other organic compounds added to water and high COD is may be due to accumulation of solid waste, soluble organic compounds, residual food waste, emulsified oils and the dying bacterial cells.

Figure 3.41: Surface water sample collection for first three months

3.10.4.2 GROUND WATER QUALITY

Selection of groundwater sampling location: Several types of wells can be available for groundwater monitoring:

- Monitoring wells (wells with single or multiple piezometers);
- Water supply wells (tube wells or dug wells used for domestic, municipal, agricultural or industrial water supply)

Reconnaissance survey was undertaken and monitoring locations were finalized based on:

- Drainage pattern and surface water bodies;
- Location of residential areas representing different activities/likely impact areas; and
- Likely areas, which can represent baseline conditions

Table 3.29: Physico-chemical characterisation of ground water samples, March.2024

S. No	Parameters	GW-1 Bara Tetariya	GW-2 Bairiya	GW-3 Anjaniya	GW-4 Khaira	GW-5 Amba	GW-6 Sasna	IS 10500:2012 Acceptable limit	IS 10500:2012 Permissible limit
1	Temperature, ˚C	27.20	27.86	26.70	27.24	28.04	27.14	--	--
2	Colour, Hazen	<5	<5	<5	<5	<5	<5	5	15
3	Turbidity, NTU	1	2	1	1	3	4	1	5
4	pH	7.29	7.41	7.31	7.36	7.32	7.26	6.5-8.5	No Relaxation
5	Conductivity, µS/cm	578	702	625	554	732	878	--	--
6	Total Dissolve Solids, mg/l	387.26	470.34	418.75	371.22	490.44	588.31	500	2000
7	Alkalinity as $CaCO_3$, mg/l	225.60	294.24	210.63	241.42	277.64	344.81	200	600
8	Total Hardness as $CaCO_3$, mg/l	162.80	215.62	196.91	175.20	255.00	262.33	200	600
9	Calcium as Ca, mg/l	47.62	57.24	54.68	46.6	78.22	81.45	75	200
10	Magnesium as Mg, mg/l	10.63	17.62	14.62	14.26	14.44	14.26	30	100
11	Sodium as Na, mg/l	51.62	61.24	32.68	46.62	48.76	80.62	--	--
12	Potassium as K, mg/l	1.62	2.40	1.88	0.86	4.34	1.44	--	--
13	Total Suspended Solids	BDL	BDL	BDL	BDL	BDL	BDL	--	--
14	Chloride as Cl, mg/l	34.23	41.26	36.80	20.61	50.64	61.24	250	1000
15	Sulphate as SO_4, mg/l	37.62	51.62	35.54	41.32	45.61	45.26	200	400
16	Nitrate as NO_3	4.61	12.76	5.10	6.21	7.46	8.65	45	No Relaxation
17	Fluoride as F, mg/l	0.26	0.32	0.22	0.48	0.47	0.51	1.0	1.5
18	Phenolic compound as C_6H_5OH	BDL	BDL	BDL	BDL	BDL	BDL	0.001	0.002
19	Phosphate, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	--	--

S. No	Parameters	GW-1 Bara Tetariya	GW-2 Bairiya	GW-3 Anjaniya	GW-4 Khaira	GW-5 Amba	GW-6 Sasna	IS 10500:2012 Acceptable limit	IS 10500:2012 Permissible limit
20	Silica as Si, mg/l	5.24	5.80	5.51	6.81	6.64	5.23	--	--
21	Arsenic as As, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.01	0.05
22	Cadmium As Cd, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.003	No Relaxation
23	Chromium as Cr^{+6}	BDL	BDL	BDL	BDL	BDL	BDL	--	--
24	Iron as Fe, mg/l	0.18	0.21	0.12	0.18	0.28	0.38	0.3	No Relaxation
25	Copper as Cu, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.05	1.5
26	Lead as Pb, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.01	No Relaxation
27	Selenium as Se, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.01	No Relaxation
28	Mercury as Hg, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.001	No Relaxation
29	Zinc as Zn, mg/l	0.21	0.24	0.14	0.86	0.34	0.54	5	15
30	Dissolved Oxygen, mg/l	6.72	7.10	8.11	7.12	6.82	6.83	--	--
31	COD, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	--	--
32	BOD, 27°C 3 days, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	--	--
33	Oil & Grease, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.5	No Relaxation
34	Total Chromium, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.05	No Relaxation
35	Total Coliforms, MPN/100ml	Absent	Absent	Absent	Absent	Absent	Absent	Shall not be detectable in any 100 ml sample	

BDL Below detection limit

Table 3.30: Physico-chemical characterisation of ground water samples, April.2024

S. No	Parameters	GW-1 Bara Tetariya	GW-2 Bairiya	GW-3 Anjaniya	GW-4 Khaira	GW-5 Amba	GW-6 Sasna	IS 10500:2012 Acceptable limit	IS 10500:2012 Permissible limit
1	Temperature, ˚C	27.80	27.62	27.50	27.44	28.81	26.48	--	--
2	Colour, Hazen	<5	<5	<5	<5	<5	<5	5	15
3	Turbidity, NTU	1.00	1.00	2.00	2.00	1.00	1.00	1	5
4	pH	7.36	7.07	7.45	7.12	7.32	7.14	6.5-8.5	No Relaxation
5	Conductivity, µS/cm	624.24	870.00	675.00	640.00	712.00	875.00	--	--
6	Total Dissolve Solids, mg/l	418.24	582.90	452.25	428.82	477.04	586.31	500	2000
7	Alkalinity as $CaCO_3$, mg/l	243.65	356.72	227.45	280.60	264.42	357.81	200	600
8	Total Hardness as $CaCO_3$, mg/l	175.84	247.93	212.64	212.41	240.62	274.11	200	600
9	Calcium as Ca, mg/l	51.43	65.83	59.05	57.68	73.82	84.81	75	200
10	Magnesium as Mg, mg/l	11.48	20.26	15.79	16.57	13.63	15.09	30	100
11	Sodium as Na, mg/l	55.75	86.61	35.29	50.52	46.00	76.4	--	--
12	Potassium as K, mg/l	1.75	4.72	2.03	1.84	4.11	2.48	--	--
13	Total Suspended Solids	BDL	BDL	BDL	BDL	BDL	BDL	--	--
14	Chloride as Cl, mg/l	36.94	49.30	39.74	24.43	51.58	72.62	250	1000
15	Sulphate as SO_4, mg/l	40.63	58.61	38.38	43.22	55.40	47.26	200	400
16	Nitrate as NO_3	4.97	15.12	5.51	7.45	10.52	9.65	45	No Relaxation
17	Fluoride as F, mg/l	0.28	0.35	0.24	0.52	0.50	0.62	1.0	1.5
18	Phenolic compound as C_6H_5OH	BDL	BDL	BDL	BDL	BDL	BDL	0.001	0.002
19	Phosphate, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	--	--
20	Silica as Si, mg/l	5.66	6.24	5.95	5.24	7.62	5.54	--	--
21	Arsenic as As, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.01	0.05

S. No	Parameters	GW-1 Bara Tetariya	GW-2 Bairiya	GW-3 Anjaniya	GW-4 Khaira	GW-5 Amba	GW-6 Sasna	IS 10500:2012 Acceptable limit	IS 10500:2012 Permissible limit
22	Cadmium As Cd, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.003	No Relaxation
23	Chromium as Cr^{+6}	BDL	BDL	BDL	BDL	BDL	BDL	--	--
24	Iron as Fe, mg/l	0.19	0.26	0.13	0.24	0.34	0.42	0.3	No Relaxation
25	Copper as Cu, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.05	1.5
26	Lead as Pb, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.01	No Relaxation
27	Selenium as Se, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.01	No Relaxation
28	Mercury as Hg, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.001	No Relaxation
29	Zinc as Zn, mg/l	0.23	0.36	0.15	1.24	0.42	0.66	5	15
30	Dissolved Oxygen, mg/l	7.24	7.72	8.75	6.81	7.11	7.33	--	--
31	COD, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	--	--
32	BOD, 27°C 3 days, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	--	--
33	Oil & Grease, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.5	No Relaxation
34	Total Chromium, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.05	No Relaxation
35	Total Coliforms, MPN/100ml	Absent	Absent	Absent	Absent	Absent	Absent	Shall not be detectable in any 100 ml sample	

BDL Below detection limit

Table 3.31: Physico-chemical characterisation of ground water samples, May.2024

S. No	Parameters	GW-1 Bara Tetariya	GW-2 Bairiya	GW-3 Anjaniya	GW-4 Khaira	GW-5 Amba	GW-6 Sasna	IS 10500:2012 Acceptable limit	IS 10500:2012 Permissible limit
1	Temperature, ˚C	28.10	28.11	27.90	27.60	27.81	28.62	--	--
2	Colour, Hazen	<5	<5	<5	<5	<5	<5	5	15
3	Turbidity, NTU	1.00	1.00	1.00	1.00	2.00	3.00	1	5
4	pH	7.41	7.51	7.38	7.62	7.38	7.38	6.5-8.5	No Relaxation
5	Conductivity, µS/cm	599.27	817.00	648.00	601.00	669.00	822.00	--	--
6	Total Dissolve Solids, mg/l	401.51	547.92	434.16	403.07	448.41	551.08	500	2000
7	Alkalinity as $CaCO_3$, mg/l	233.90	335.31	218.35	263.72	248.53	336.33	200	600
8	Total Hardness as $CaCO_3$, mg/l	168.81	233.00	204.14	199.71	226.22	257.74	200	600
9	Calcium as Ca, mg/l	49.37	61.85	56.69	54.21	69.37	79.71	75	200
10	Magnesium as Mg, mg/l	11.02	19.04	15.16	15.57	12.81	14.18	30	100
11	Sodium as Na, mg/l	53.52	81.40	33.88	47.47	43.24	71.81	--	--
12	Potassium as K, mg/l	1.68	4.41	1.95	1.72	3.85	2.33	--	--
13	Total Suspended Solids	BDL	BDL	BDL	BDL	BDL	BDL	--	--
14	Chloride as Cl, mg/l	35.46	46.34	38.15	22.93	48.48	68.26	250	1000
15	Sulphate as SO_4, mg/l	39.00	55.08	36.85	40.60	52.07	44.42	200	400
16	Nitrate as NO_3	4.77	14.19	5.29	7.01	9.88	9.07	45	No Relaxation
17	Fluoride as F, mg/l	0.27	0.33	0.23	0.49	0.47	0.58	1.0	1.5
18	Phenolic compound as C_6H_5OH	BDL	BDL	BDL	BDL	BDL	BDL	0.001	0.002
19	Phosphate, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	--	--
20	Silica as Si, mg/l	5.43	5.86	5.71	4.88	7.16	5.17	--	--
21	Arsenic as As, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.01	0.05

S. No	Parameters	GW-1 Bara Tetariya	GW-2 Bairiya	GW-3 Anjaniya	GW-4 Khaira	GW-5 Amba	GW-6 Sasna	IS 10500:2012 Acceptable limit	IS 10500:2012 Permissible limit
22	Cadmium As Cd, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.003	No Relaxation
23	Chromium as Cr^{+6}	BDL	BDL	BDL	BDL	BDL	BDL	--	--
24	Iron as Fe, mg/l	0.19	0.24	0.12	0.22	0.31	0.39	0.3	No Relaxation
25	Copper as Cu, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.05	1.5
26	Lead as Pb, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.01	No Relaxation
27	Selenium as Se, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.01	No Relaxation
28	Mercury as Hg, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.001	No Relaxation
29	Zinc as Zn, mg/l	0.22	0.33	0.15	1.10	0.39	0.62	5	15
30	Dissolved Oxygen, mg/l	6.95	7.23	8.40	6.39	6.67	6.86	--	--
31	COD, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	--	--
32	BOD, 27°C 3 days, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	--	--
33	Oil & Grease, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.5	No Relaxation
34	Total Chromium, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.05	No Relaxation
35	Total Coliforms, MPN/100ml	Absent	Absent	Absent	Absent	Absent	Absent	Shall not be detectable in any 100 ml sample	

BDL Below detection limit

Discussion:

pH: The data revealed that the pH value of ground water samples varied from 7.14 to 7.62. The water samples are slightly alkaline. The reasons for such conditions may be due to different types of buffers that may be present in the ground water and presence of weak basic salt in the soil.

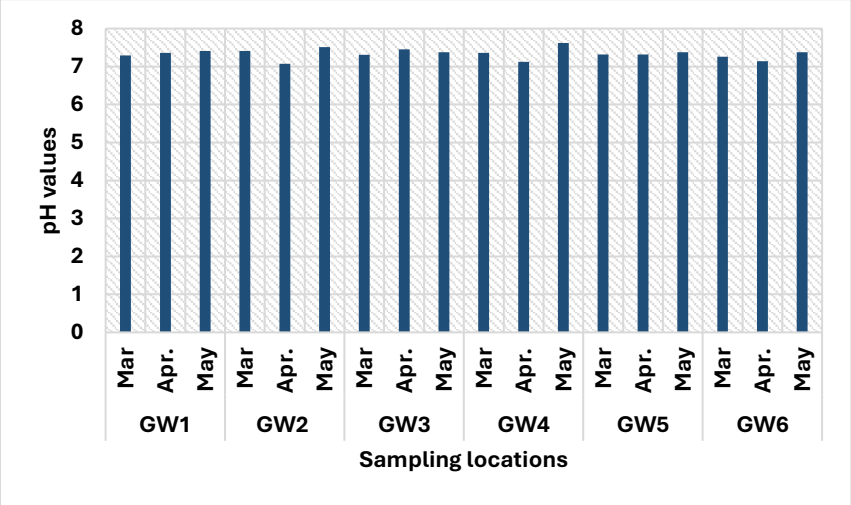


Figure 3.42: pH of the groundwater sample of study area

Electrical Conductivity (EC): Electrical conductivity of ground water ranged between 554 µS/cm to 878 µS/cm during March. The maximum value of EC was observed in at GW6 and the minimum value found in the sample at village at GW4. All samples showed non saline ground water.

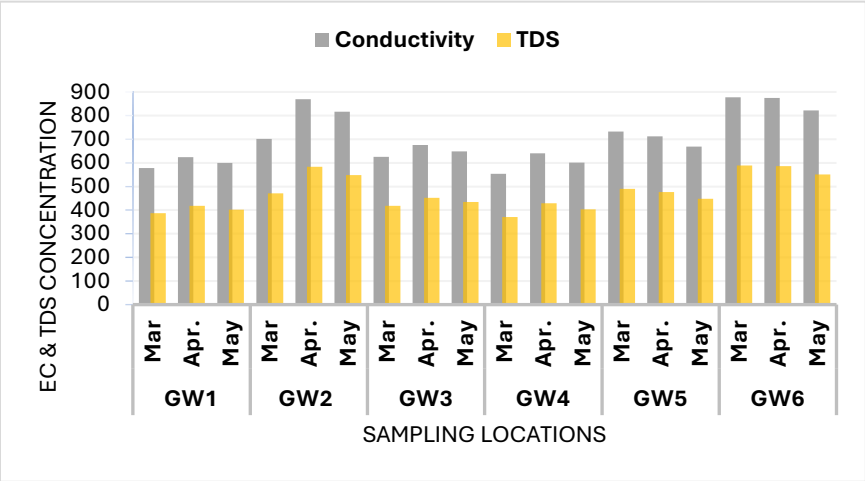


Figure 3.43: EC & TDS of the groundwater sample of study area

Total Dissolved Solid (TDS):
The total suspended solids are composed of carbonates, bicarbonates, chlorides, phosphates and nitrates of calcium, magnesium, sodium, potassium, manganese, organic matter, salt and other particles (Mahananda *et al,* 2010). The study of ground water sample shows a strong positive correlation between TDS and EC **(Figure-3.44)**. All samples is within the permissible limits of the IS10500:2012.

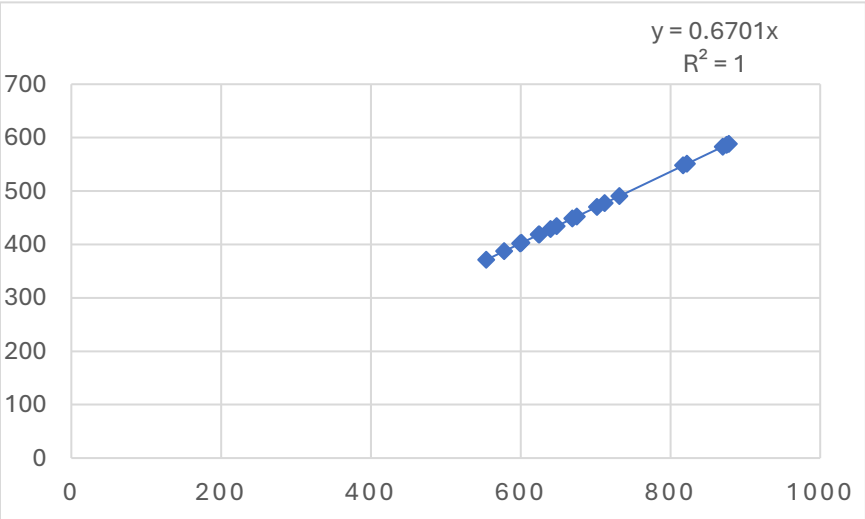


Figure 3.44: Correlation between EC and TDS

Total Hardness (TH), Calcium (Ca^{2+}) and Magnesium (Mg^{2+}): Hard water makes it difficult for domestic water users. Hardness is defined as the concentration of calcium and magnesium in water expressed as the equivalent of calcium carbonate ($CaCO_3$). The maximum total hardness of ground water was found to be 274.1 mg/l in sample at GW6 and the minimum was observed as 162.8 mg/l in the sample at GW1. 100% of the samples were within the permissible limit recommended by BIS (600 mg/l). The range of $Ca^{2+}$and Mg^{2+} are also remaining within the acceptable limits 46.6-84.8 mg/l and 10.63 mg/l (GW1) during March to 20.26 mg/l (GW2) during April respectively **(Figure- 3.45)**

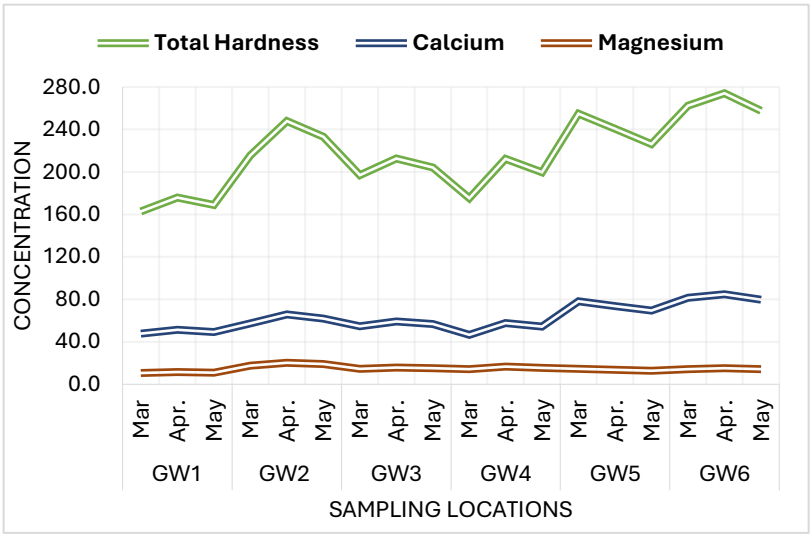


Figure 3.45: TH, Ca2+ and Mg2+ of the GW sample

Calcium or Magnesium salts or both cause almost all Hardness of water (Nirmala *et. al.,* 2012). High value of hardness during summer can be attributed to decrease in water volume and increase of rate of evaporation of water (Sahoo *et al.,* 2016).

Alkalinity: The alkalinity of water is caused mainly due to OH^-, CO_3^-, HCO_3^- ions. Alkalinity is an estimate of the ability of water to resist change in pH upon addition of acid. The alkalinity of Hand pump water was found to be 356.72 mg/l at GW2 in April and the minimum was observed as 210.6 mg/l at GW3 in March. The higher alkalinity may be due to low water table and lower temperature bringing down the rate of decomposition of salts to a minimum there by increasing the alkalinity. The correlation between pH-Alkalinity shows strong positive with the R2 value 0.9669 **(Figure-3.46).** In the present study, all the samples analyzed are within the prescribed range as per drinking water quality standard (IS: 10500).

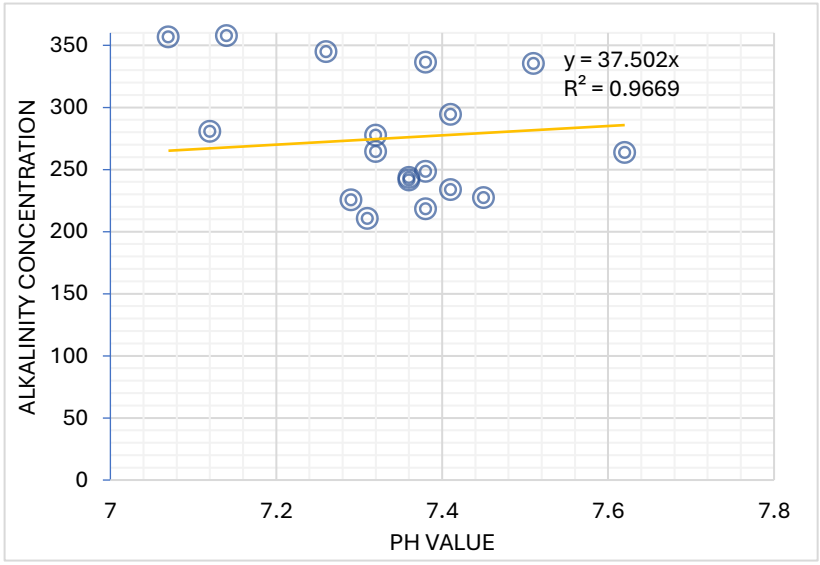


Figure 3.46: Correlation between pH and Alkalinity

Chloride: The maximum chloride concentration (72.62 mg/l) was found at GW6 in April and the minimum (20.6 mg/l) was recorded at GW4 in March. The samples were compared with the BIS standard and all the samples were within the acceptable limit of 250 mg/l.

Fluoride: Fluoride in groundwater has drawn worldwide attention due to its considerable impact on human physiology. Though fluoride is considered as an essential element at very lower concentration for human beings, higher concentration leads to health defects. The minimum level of fluoride (0.22 mg/l) was found in GW3 in March and the maximum value (0.62 mg/l) was found at GW6 in April. All samples were within permissible limits of 1.5 mg/l.

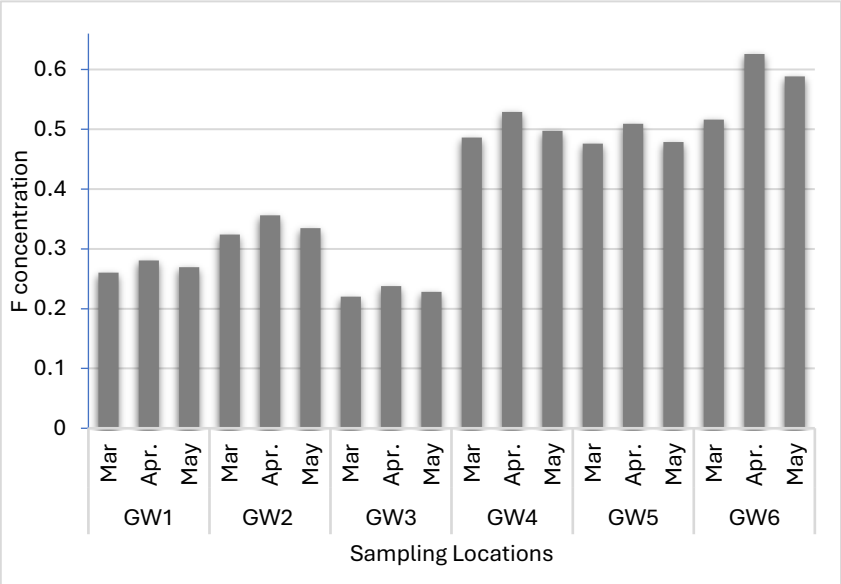


Figure 3.47: Fluoride conc. of the groundwater sample

Nitrate: The concentration of nitrate in ground water samples ranged from 4.60 mg/l at GW1 during March to 15.1 mg/l at GW2 in April. All the samples were compared with the BIS standard and found within the acceptable limit of 45 mg/l.

Heavy Metals: Some of the metals are essential to sustain life - calcium, magnesium, potassium and sodium must be present for normal body functions. However, excess exposure to heavy metals can result in toxicity.

Zinc concentration in the ground water samples were within the acceptable limit of 5 mg/l prescribed by BIS. Other heavy metals like arsenic, cadmium, chromium, copper, lead and selenium were recorded below detection limit.

Dissolved oxygen in groundwater varied between 6.3 mg/l in GW4 during May to 8.75 mg/l in GW3 during April. Nevertheless, measurement of DO is critical to the scientific understanding of the potential for chemical and biochemical processes in groundwater. Organic matter or oxidisable minerals present in different zone in soil profile rapidly deplete the dissolved oxygen. Besides, in deeper aquifers the dissolved organic matter concentration is very less except the shallow aquifers. Therefore, in aquifers where organic materials are less plentiful, groundwater contains not measurable concentrations of DO for deeper aquifers.

Groundwater is an important source of drinking water throughout the world (Chilton and Seiler, 2006) and it is often consumed with little or no treatment (Pedley *et al.,* 2006). Total coliform presence in groundwater sources can be used to indicate that the groundwater source may be vulnerable to contamination. But as on our study indicated absent of total coliforms was found in all groundwater samples in study area.

Hydrogeological Baseline study:

Seven samples were collected within study area. Details of location in given in Table 3.21A, figure no. 3.40A

Table 3.31A: Description of sampling locations for ground water

Name	Latitude	Longitude	Location	Distance& Directions	Source
GW1	24°47'30.54"N	84°10'47.60"E	Kundwa	0.56 km, NE	Hand pump
GW2	24°49'28.56"N	84° 9'56.88"E	Indrapuri	1.54 km N	Hand pump
GW3	24°48'7.36"N	84°11'18.55"E	Near Ash Dyke	0.17 km NE	Hand pump
GW4	24°47'55.94"N	84° 9'17.54"E	Narari Kalan	0.35 km NW	Hand pump
GW5	24°46'17.43"N	84° 8'9.18"E	Rahra	1.17 km SW	Hand pump
GW6	24°46'9.34"N	84°10'44.89"E	Ankhora	0.98 km SE	Hand pump
GW7	24°48'28.58"N	84° 9'16.85"E	Narai Khurd	0.74 Km NW	Hand pump

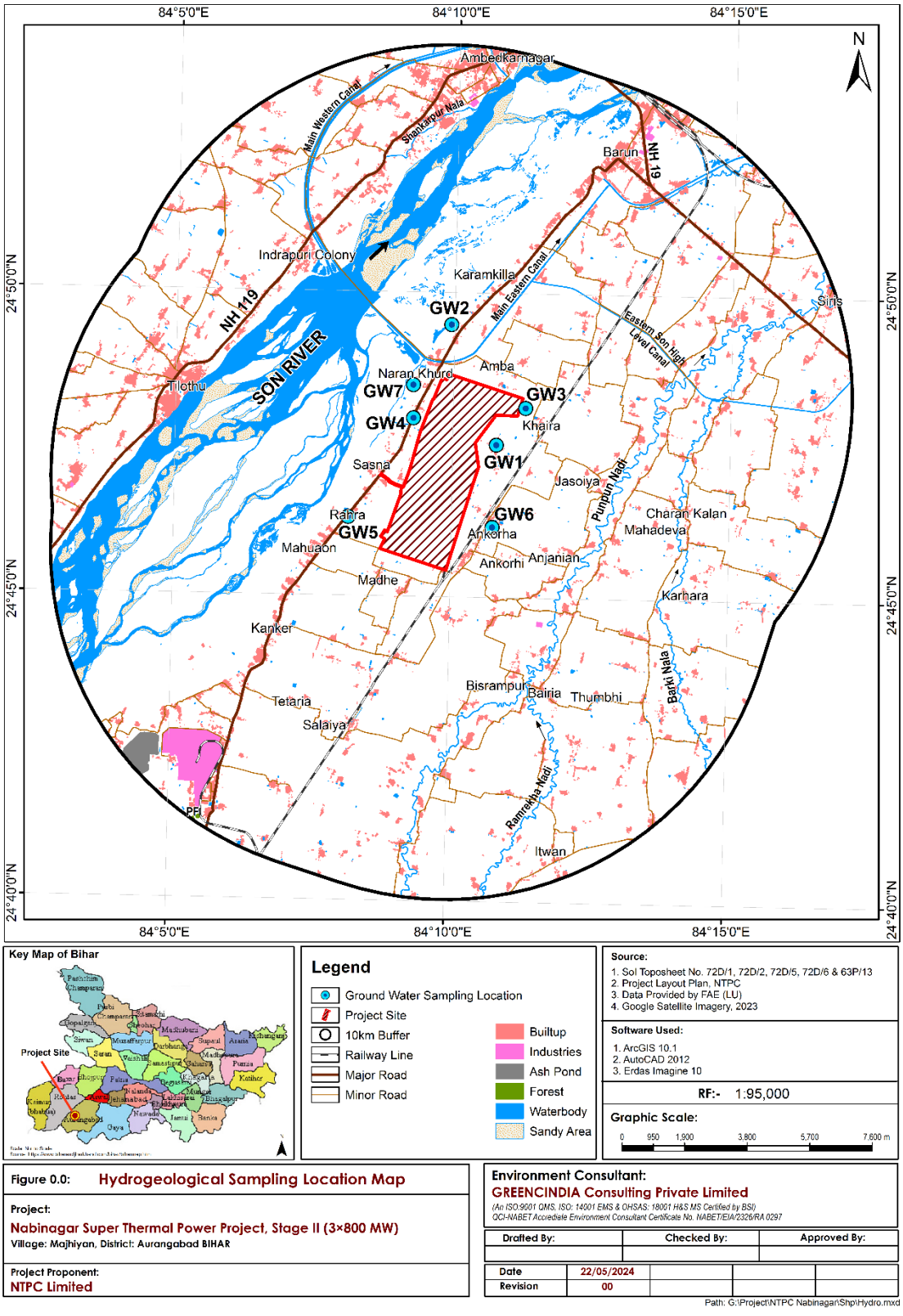


Figure 3.40A: Water Sampling Locations

Table 3.31B: Physico-chemical characterisation of Ground water

S.No	Parameters	GW-1 Kundwa	GW-2 Indrapuri	GW-3 Near Ash Dyke	GW-4 Narari Kalan	GW-5 Rahra	GW-6 Ankhora	GW-7 Narai Khurd	IS 10500:2012 Acceptable limit	IS 10500:2012 Permissible limit
1	Temperature, ˚C	29.7	28.9	30.1	29.8	30.3	30.1	30.4	--	--
2	Colour, Hazen	<5	<5	<5	<5	<5	<5	<5	5	15
3	Turbidity, NTU	3.3	<1	1.1	3.3	2.1	<1	<1	1	5
4	pH	7.16	7.03	7.30	7.22	7.15	6.95	7.29	6.5-8.5	No Relaxation
5	Conductivity, µS/cm	769.40	1456	782.90	824.10	725.10	681.00	778.40	--	--
6	Total Dissolve Solids, mg/l	515.50	975.52	524.54	552.15	485.82	456.27	521.53	500	2000
7	Alkalinity as $CaCO_3$, mg/l	336.84	421.80	330.42	388.24	290.60	270.40	320.56	200	600
8	Total Hardness as $CaCO_3$, mg/l	249.3	350.4	249.3	224.4	220.2	195.3	207.7	200	600
9	Calcium as Ca, mg/l	85.18	92.61	68.12	64.9	66.56	62.4	53.84	75	200
10	Magnesium as Mg, mg/l	8.89	28.95	19.25	15.15	13.12	9.60	17.80	30	100
11	Sodium as Na, mg/l	62.4	75.44	57.2	81.2	66.4	64.2	72.46	--	--
12	Potassium as K, mg/l	0.98	3.46	2.04	1.12	0.99	1.82	2.89	--	--
13	Total Suspended Solids	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	--	--
14	Chloride as Cl, mg/l	26.97	59.73	26.97	28.90	53.95	40.46	30.33	250	1000
15	Sulphate as SO_4, mg/l	32.58	34.556	34.26	22.896	20.246	27.136	22.472	200	400
16	Nitrate as NO_3	15.24	18.22	13.24	13.26	14.24	16.24	22.64	45	No Relaxation
17	Fluoride as F, mg/l	0.66	0.60	0.77	0.62	0.52	0.56	0.52	1.0	1.5

S.No	Parameters	GW-1 Kundwa	GW-2 Indrapuri	GW-3 Near Ash Dyke	GW-4 Narari Kalan	GW-5 Rahra	GW-6 Ankhora	GW-7 Narai Khurd	IS 10500:2012 Acceptable limit	IS 10500:2012 Permissible limit
18	Phenolic compound as C_6H_5OH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.001	0.002
19	Phosphate, mg/l	0.31	0.44	0.42	0.34	0.28	0.26	0.31	--	--
20	Silica as Si, mg/l	5.28	11.44	8.14	4.74	6.11	5.46	5.78	--	--
21	Arsenic as As, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.01	0.05
22	Cadmium As Cd, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.003	No Relaxation
23	Chromium as Cr^{+6}	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	--
24	Iron as Fe, mg/l	0.24	0.18	0.22	0.25	0.22	0.19	0.18	0.3	No Relaxation
25	Copper as Cu, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.05	1.5
26	Lead as Pb, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.01	No Relaxation
27	Selenium as Se, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.01	No Relaxation
28	Mercury as Hg, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.001	No Relaxation
29	Zinc as Zn, mg/l	0.24	0.18	0.28	0.26	0.21	0.32	0.22	5	15
30	Dissolved Oxygen, mg/l	6.5	6.7	6.8	6.7	6.7	6.6	6.9	--	--
31	COD, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	--
32	BOD, 27°C 3 days, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	--	--
33	Oil & Grease, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.5	No

S.No	Parameters	GW-1 Kundwa	GW-2 Indrapuri	GW-3 Near Ash Dyke	GW-4 Narari Kalan	GW-5 Rahra	GW-6 Ankhora	GW-7 Narai Khurd	IS 10500:2012 Acceptable limit	IS 10500:2012 Permissible limit
										Relaxation
34	Total Chromium, mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.05	No Relaxation
35	Total Coliforms, MPN/100ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Shall not be detectable in any 100 ml sample	

3.10.4.3 Discussion:

In order to assess the chemical quality of groundwater of phreatic aquifers of Nabinagar STPP, Aurangabad, Bihar groundwater samples of within 2km buffer zone have been collected and analyzed. The Salient features of chemical parameters of groundwater of phreatic aquifer are given in Table 3.30A. A perusal of the analysis indicates that the groundwater is slightly alkaline in nature with pH ranged between 6.95 and 7.29. Electrical conductivity (EC) is an important criterion for assessing suitability of water for various uses. The EC values indicate that the groundwater is having non saline with observed value ranges between 681 µS/cm to 1456 µS/cm at 25°C which is non saline in nature. Analysis indicates that Ca, Mg and Na are three dominating cations while bicarbonate and chloride are dominating anions. The water is mainly calcium-magnesium bicarbonate type. A perusal of the chemical analysis of groundwater tapping phreatic aquifer indicates that the groundwater is by and large potable in nature and also suitable for irrigation purposes.

Pond and groundwater quality samples were collected within a 2 km radius of hotspots such as schools and hospitals from the TPP boundary. The location and analysis details are provided in tables 3.30 and 3.30A. It was concluded that all water samples collected within 2 km radius are well within the acceptable limits of IS 10500:2012.

Figure 3.48: Ground water sample collection for first three months

3.10.5 GROUND WATER LEVEL

3.10.5.1 PRE-MONSOON 2024 DEPTH TO WATER LEVEL

To study the current ground water situation, an optimal monitoring network has been designed and observation wells have been established around the Ash Pond and in the buffer zone to understand the spatial variation of the water level. Accordingly, 23 open wells and bore wells ranging from 20 to 60 m have been established as observation wells. The depth to water level in these wells was measured using the sounder, manually during June 2024. The details of the wells established for monitoring are given in **Table 3.32.**

Table 3.32: Depth to Water (June 2024)

Sl. No	Location	Latitude (Deg)	Longitude (Deg)	DTW (m.bgl)
1	Jasoiya	24.7535	84.3307	17.01
2	Kashipur	24.7768	84.3771	20
3	Basalpur	24.8215	84.4105	13
4	Kunrwa	24.8104	84.2295	16.9
5	Harchanpur	24.7824	84.2388	20.2
6	Indrapuri	24.8246	84.1658	6.7
7	Saraiya	24.813	84.0891	12.4
8	Rahara	24.7743	84.1378	20
9	Majhiaon	24.7687	84.1333	10.2
10	Mahuaon	24.764	84.1291	12.3
11	Obipur	24.7475	84.1169	13.5
12	Khaira	24.6911	84.0965	9.8
13	Sundar	24.6924	84.0965	11
14	Khaira NTPC	24.711	84.0993	16
15	Kankar	24.7389	84.113	15
16	Sekhpura	24.8261	84.1707	23
17	Barun (Kesu More)	24.8808	84.2223	30
18	Sone- Nagar	24.8831	84.2307	10.2
19	Sasna	24.7824	84.1442	11.1
20	Majhiaon	24.7672	84.1318	12
21	Ankorha	24.7584	84.1692	38
22	Ghuja	24.7495	84.1799	45.5
23	Barun	24.8673	84.224	42.4

From the above table, it may be observed that the depth to ground water level in the study area during the period ranged from 6.7 mbgl (Indrapuri) to 45.5 mbgl (Ghuja Borewell). Depth to water level map of the study area during June 2024 is given in **Fig. 3.49**. The depth to water level in the western part of the study area ranges from 10 to 15 m. bgl. while depths of water level show variation from 20 to 25 m. bgl in the eastern part of the study area. Deeper water levels in the range of 25 to 50 m.bgl are present in the northeastern and southeastern parts of the study area indicating the presence of significant ground water extraction from localized pockets.

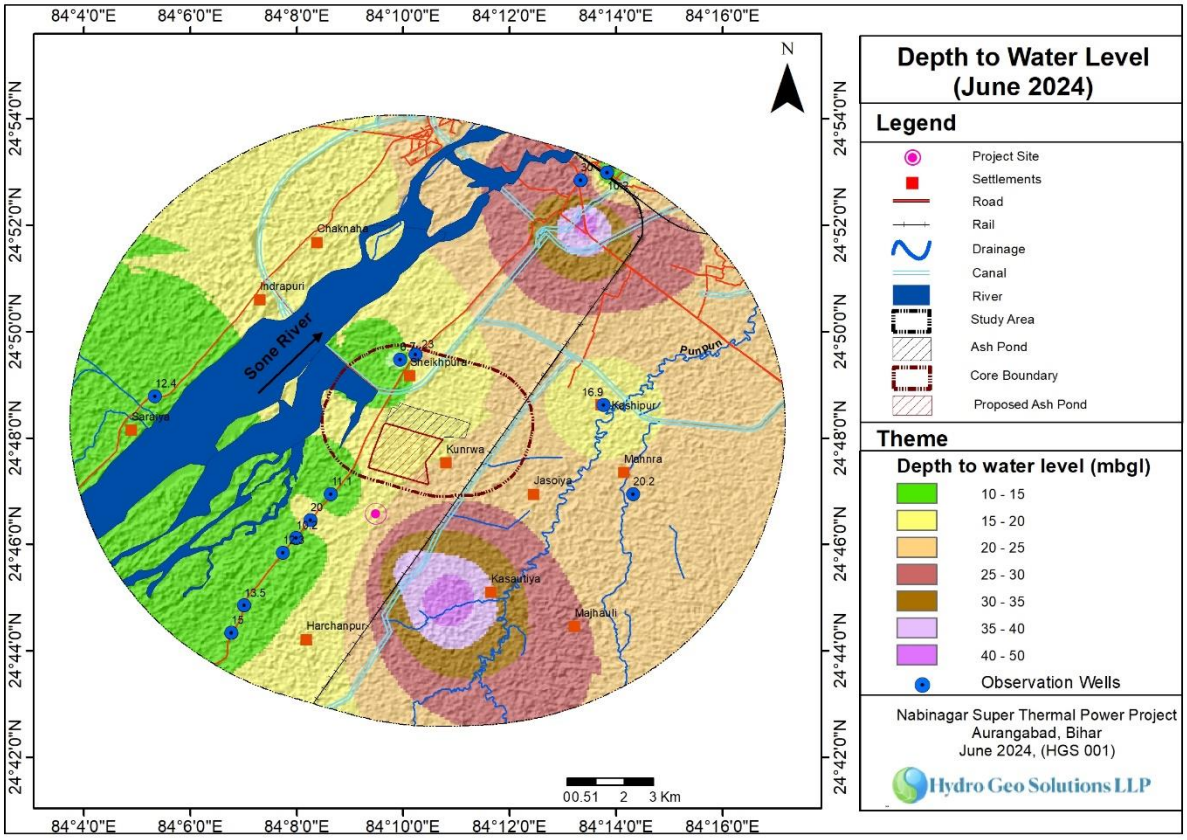


Figure 3.49: Depth to water Level map of Study Area (Pre monsoon 2024)

3.10.5.2 Post-Monsoon 2024 Depth to Water Level

During post monsoon i.e. November 2024, the depth to water level in and around the study area varied from 4.1 mbgl (Basalpur) to 11.8 mbgl (Kashipur). Post-monsoon depth to water level map of the study area is presented in **Fig. 3.50**. From the perusal of post-monsoon map, it is observed that depth to water levels in a major part of the study area ranged from 7 to 10 mbgl. Shallower water levels in the range of 5 to 7 m.bgl. were observed in the central part of the study area.

The details of the wells established for monitoring are given in **Table 3.33.**

Table 3.33: Depth to Water (Nov 2024)

Sl. No	Location	Latitude (Deg)	Longitude (Deg)	DTW (m.bgl)
1	Jasoiya	24.7535	84.3307	8.5
2	Kashipur	24.7768	84.3771	11.8
3	Basalpur	24.8215	84.4105	4.1
4	Kunrwa	24.8104	84.2295	8.9
5	Harchanpur	24.7824	84.2388	7.2
6	Chauraha	24.8604	84.1344	8.3
7	Indrapuri	24.8246	84.1658	5.2
8	Saraiya	24.813	84.0891	7.4
9	Meh	24.8152	84.199	9.5

Sl. No	Location	Latitude (Deg)	Longitude (Deg)	DTW (m.bgl)
10	Rehra NTPC	24.7772	84.1401	9

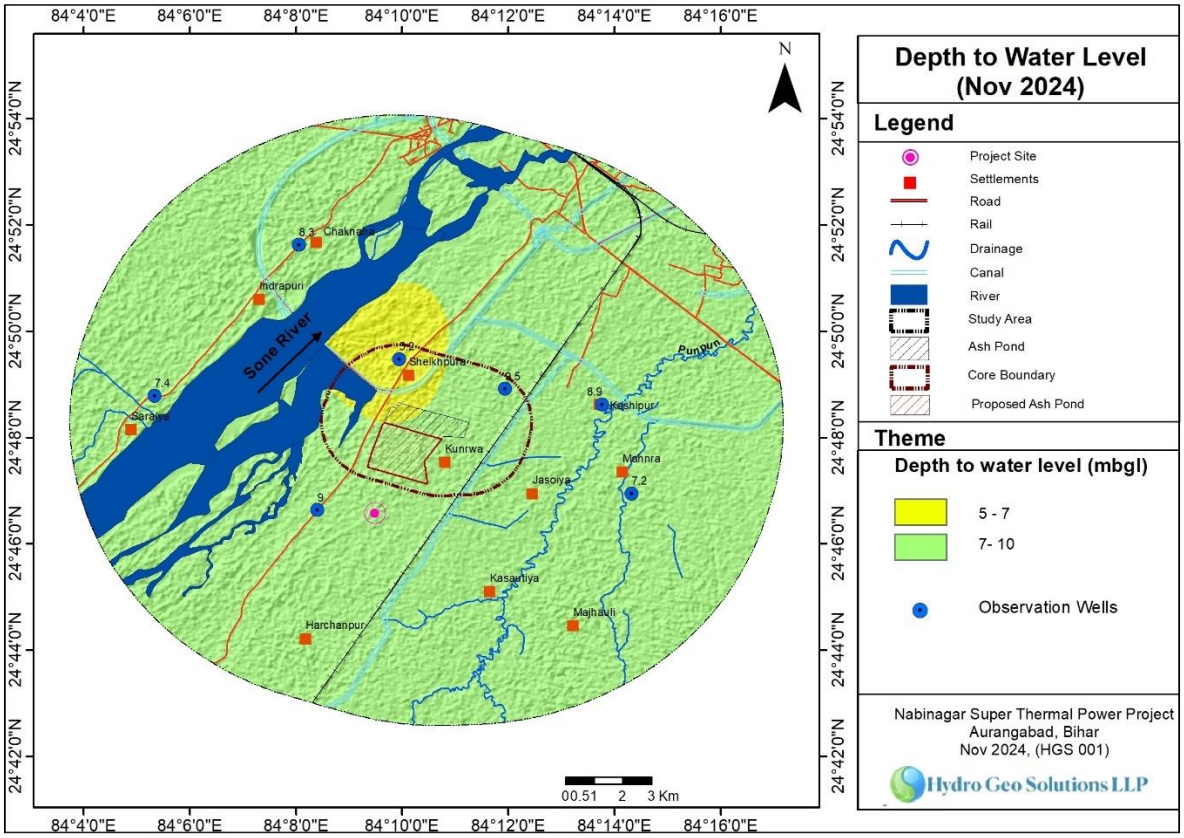


Figure 3.50: Depth to water Level map of Study Area (Post monsoon 2024)

3.10.5.3 Seasonal Water Level Fluctuation (2024)

All the observation wells in the area registered rise in ground water levels in November 2024 when compared to June. A seasonal water level fluctuation map of the study area is presented in **Fig. 3.51**. A major part of the area registered a rise more than 6 m in ground water levels during post monsoon period.

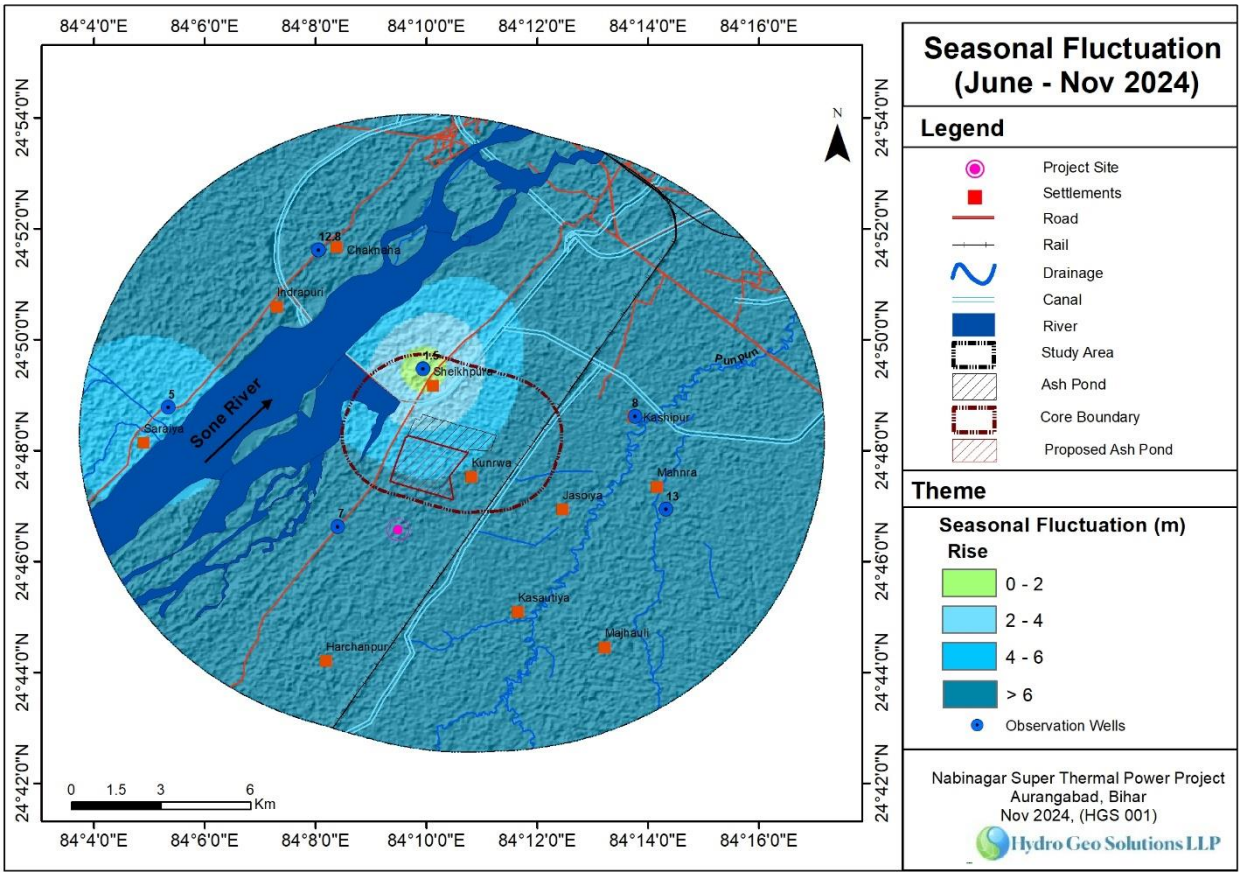


Figure 3.51: Seasonal Fluctuation Map of Study Area (June – Nov 2024)

3.11 Comparative Study

A comparison has been conducted to assess the water quality from the start of the project up to year 2024. This study focuses on a 5 km radius, analysing data from common stations that were monitored both in 2008 and 2024 within the study area.

Table 3.34: Comparison Table of Air parameters

S.No	Parameters	98% Range during 2008 study (in µg/m3)	98% Range during 2024 study (in µg/m3)
1	PM_{10}	71.5-77.0	69.8-91.6
2	SPM	163.5-175.0	--
3	$PM_{2.5}$	--	39.08-53.73
4	SO_2	9.4-9.8	12.40-26.47
5	NO_2	14.3-14.5	13.52-35.89

1. **Air:** During 2008 study PM_{10} of 98% varies 77.0 µg/m^3 (Ankorha) to 71.5 µg/m^3 (Baghi & Chainpura). SPM of 98% varies 175.0 µg/m^3 (Ankorha) to 163.5 µg/m^3 (Baghi). The 98% of SO_2 varies between 9.8 µg/m^3 (Ankorha) to 9.4 µg/m^3 (Chainpura). NO_2 of 98% varies between 14.5 µg/m^3 (Baghi) to 14.3 µg/m^3 (Chainpura).

   During 2024 study the 98th percentile value of PM_{10} varies between 91.6 µg/m^3 to 69.8 µg/m^3 and the 98th percentile value of $PM_{2.5}$ varies between 53.73 µg/m^3 to 39.08 µg/m^3. The 98th percentile value of SO_2 in the study area ranges from 26.47µg/m^3 to 12.40 µg/m^3.NO_2 varies between 35.89 µg/m^3 to 13.52 µg/m^3.

Whereas in common monitoring station PM10 observe 83.04 µg/m^3, PM2.5 observed 51.61 µg/m^3, SO_2 indicated 18.40 µg/m^3 and NO_2 observe 33.86 µg/m^3.

So, it is concluded that in Ankorha village pollution level slightly increases due to increase in coal consumption or may be due to its proximity to industrial area and vehicular pollution and the dominant wind direction. Anthropogenic sources including fuel combustion and fuel combustion for vehicles in the study area. SO_2 is mainly from burning fuels containing sulphur or emissions from coal combustion depending on the sulphur content in the coal. NO_2 increase due to motor vehicles, electric utilities and residential sources that burn fuels.

But overall concluded that during 2008 and 2024 study ambient air quality indicated PM10, PM2.5, SO_2 and NO_2 are within standard limit of NAAQ, 2009.

Table 3.35: Comparison Table of Soil parameters

S.No	Parameters	Range during 2008 study	Range during 2024 study
1	pH	neutral to slightly alkaline	neutral to slightly alkaline
2	EC	average to harmful to germination of seed	average to harmful to germination of seed
3	Soil texture	sandy loam	sandy loam
4	Nitrogen	good to sufficient	"sufficient"
5	Phosphorous	less to medium	"very less" to "less"
6	Potassium	very less to better	"more than sufficient"

2. **Soil:** In 2008 study, pH in soil observed neutral to slightly alkaline in nature. EC observed average to harmful to germination of seed, texture of soil is sandy loam whereas nutrient level in soil showed nitrogen good to sufficient, phosphorous less to medium and potassium very less to better. So, it was concluded that nutrient level is sufficient for the irrigation within study area.
Whereas during 2024 study, pH in soil neutral to slightly alkaline in nature indicated that other nutrient like K, S and Mg available in soil. Texture of soil is sandy loam whereas nutrient level in soil showed nitrogen good to sufficient, phosphorus medium to average sufficient and potassium very less to medium. So, it was concluded that nutrient level (NPK) is sufficient for the irrigation within study area. The organic matter found in the study area is "on an average sufficient". As the pH is slightly alkaline in nature macronutrient such as Fe, Mn, Cu & Zn availability is less in soil.

Whereas in common soil location i.e Ankorha village and Madhe village NPK observed less to better N, P found less and K observed very less to less. Whereas in current study period N found better to sufficient, P medium" to "average sufficient and potassium observed very less" to "medium.

Therefore, it is concluded that the NPK content is satisfactory for the growth of seasonal crops. During both years of study, it was concluded that study area showed that NPK content is improve in 2024.

Table 3.36: Comparison Table of Noise parameters

S.No	Parameters	Range during 2008 study (in dB(A))	Range during 2024 study (in dB(A))
1	during day time	40.3-55.1	51.8-68.3
2	during night time	32.8-39.5	40.2-46.8

3. **Ambient Noise:** During 2008 noise study observed during day time varies between 55.1dB(A) (Ankorha village) to 40.3dB(A) (Near Kaimur Sanctuary, Chainpura), whereas during night time it varied between 39.5dB(A) in Ankorha village to 32.8dB(A) in Baghi.

   However, in 2024 study during day time in study area noise varies between 68.3dB(A) in Ankorha village to minimum 51.8dB(A) in Mahdeva village, whereas during night time maximum noise recorded in 46.8dB(A) at Ankorha to minimum 40.2dB(A) in Mahdeva village. High noise level during day and night time at Ankorha village is due to village is present nearest to railway line and due to movement of vehicles.

   Whereas in common monitoring station i.e Ankorha village and Madhe village noise level is high during day and night time, except Madhe village as per CPCB norms for residential area.

   So, it was concluded that noise study conducted during 2008 and 2024 the noise level increase in 10km study area.

Table 3.37: Comparison Table of Surface Water parameters

S.No	Parameters	Range during 2008 study	Range during 2024 study
1	pH	neutral	slightly alkaline
2	TDS	under tolerance limit	169.51 - 410 mg/l
3	Nitrate	under tolerance limit	under limit
4	Fluoride	under tolerance limit	under limit
5	BOD	more than 3.0 mg/l	6-16.92 mg/l
6	COD	7.4 to 8.4 mg/l	16-62 mg/l

4. **Surface water:** In 2008 study, annual surface analysis data shows pH neutral in SW1 and SW2 samples. TDS of SW indicated under tolerance limit and conductivity indicated non saline nature of water. Nitrate and F of samples observed under tolerance limit. BOD and COD of surface water samples indicated more than 3.0 mg/l and COD observed 7.4 to 8.4 mg/l. Total coliform observed under limit as per CPCB norms Class B and C.

   However, during pre-monsoon, 2024 study, pH in SW indicated slightly alkaline. Nitrate and fluoride were under limit in pre-monsoon season i.e March to May.2024. High BOD in surface water is due to decaying plants, animal waste, and other organic compounds added to water. Whereas COD also found high is surface water sample and it was observed min. 16 mg/l in SW4 during march month to max. recorded 62 mg/l in SW3 during April month. Reason behind high COD may be due to accumulation of solid waste, soluble organic compounds, residual food waste, emulsified oils and the dying bacterial cells. During summer, the value of dissolved Oxygen was found to be low because DO is Directly or indirectly dependent on water temperature. Comparing the values of pH, DO, BOD and total coliform with 'Use based classification of surface waters' published by Central Pollution Control Board given in Table 3-28 and majority of the surface water samples meet the criteria C, D and E.

   Therefore, it is concluded that the BOD in Indrapuri barrage and Sone River showed that high BOD is due to decaying plants, human or animal waste and other organic compounds added to water and high COD is may be due to accumulation of solid waste, soluble organic compounds, residual food waste, emulsified oils and the dying bacterial cells.

Table 3.38: Comparison Table of Ground Water parameters

S.No	Parameters	Range during 2008 study	Range during 2024 study
1	pH	slightly alkaline	slightly alkaline
2	TDS	under permissible limit	within the permissible limits of the IS10500:2012
	EC	non saline nature of water	554 to 878 µS/cm
3	Nitrate	under tolerance limit	under limit
4	Fluoride	under tolerance limit	0.22-0.62 mg/l
5	BOD	more than 3.0 mg/l	below detection limit
6	COD	4.5 to 16.0 mg/l	below detection limit

5. **Ground water:** In 2008 study, annual surface analysis data shows pH slightly alkaline. TDS of GW indicated under permissible limit and conductivity indicated non saline nature of water. Nitrate and F of samples observed under permissible limit as per IS10500:2012. BOD a of ground water samples indicated more than 3.0 mg/l and COD observed 4.5 to 16.0 mg/l. Total coliform not present in groundwater.

   Whereas, during pre-monsoon, 2024 study, pH in SW indicated slightly alkaline. EC and TDS show strong positive correlation. All samples were within permissible limits of 1.5 mg/l. Nitrate were under limit acceptable limit as per IS1050:2012. BOD & COD in groundwater observed below detection limit. Total coliform not present in groundwater.

   Therefore, it is concluded that the ground water quality is improved in respect of BOD and COD from 2008 to 2024 as compare with IS 10500:2012.

3.12 TRAFFIC SCENARIO

The traffic survey monitoring was carried out to forecast future traffic growth and the burden on the road and environs as a result of the plant's expansion. Measurements of traffic density were taken continuously for 24 hours at T1: Barun-Nabinagar road (connecting road to NH-19) and. This is the route used for product transportation, by visual observation and counting of vehicles in 4 categories, namely, cycle/ motorcycles/ scooters (two-wheelers), passenger cars/vans/ auto-rickshaws (three- wheelers), heavy motor vehicle & Light motor vehicle. Two people were stationed on either side to tally the number of automobiles. The total number of vehicles per hour in each of the four categories was calculated. Traffic Volume count was done at the survey location is given in (**Figure 3-49**) is presented in **Table 3-37**.

Table 3.39: Existing Traffic Scenario

T1:Barun-Nabinagar road (connecting road to NH-19)			
Carrier Type	**No. of Vehicle/day (A)**	**Equivalency factor (B)**	**No. of PCU/day (A*B)**
2 Wheelers	2064	0.5	1032
3-4 Wheeler	816	1	816
LMV	144	1.5	216
HMV	480	3.0	1440
Total	**3504**	**-**	**3504**

Source: (i) Traffic Survey by GCPL (ii) IRC: 106-1990 (iii) IRC: 64-1990

The results of the survey, the existing PCU of each location were compared with the capacity of each type of road as suggested by Indian Road Congress thus determining the existing Level of Service (LoS) for each location. The existing conditions shows **B Level of service** at T1 which implies a zone of stable flow (**Table 3-38**).

Table 3.40: Existing Level of Service

Location	Distance (km)	Direction	V: Volume in 24 hours (PCU)	C: Design capacity in PCU/day	V/C	LoS as per IRC
T1: Barun-Nabinagar road (connecting road to NH-19)	0.80	W	3504	15000	0.23	B

Relation between V/C ratio &LoS		
V/C Ratio	**LoS**	**Performance**
0.0-0.2	A	Represents a condition of free flow
0.2-0.4	B	Represents a zone of stable flow
0.4-0.6	C	The general level of comfort and convenience declines noticeably at this level
0.6-0.8	D	Represents the limit of stable flow
0.8-1.0	E	Represents operating condition when traffic volumes are at or close to the capacity level

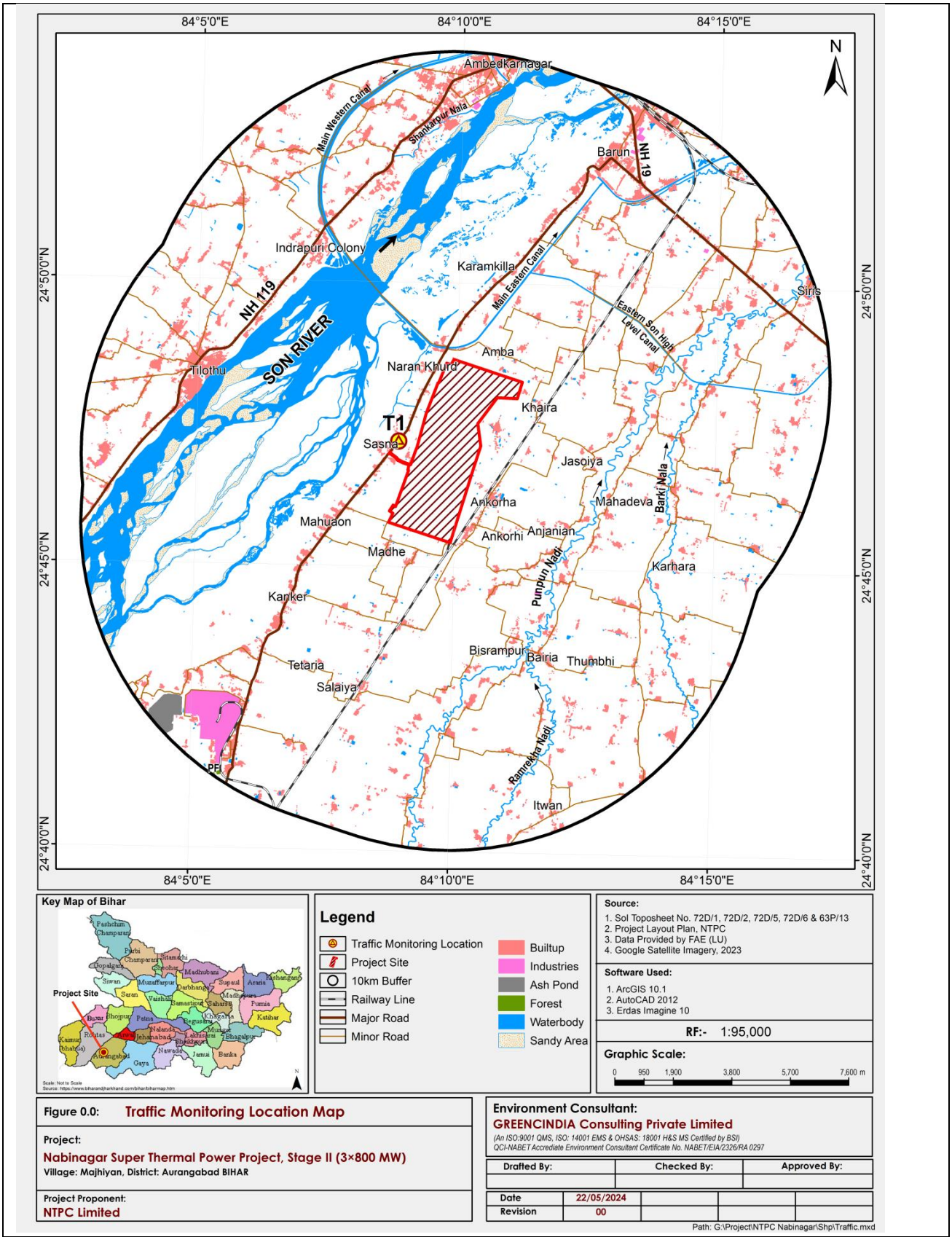


Figure 3.52: Traffic Study Locations

3.13 TERRESTRIAL ECOLOGICAL SURVEY AND BIODIVERSITY STUDY

Plants and animals are particularly vulnerable to environmental stress. Changes in the composition of biological communities are evident through shifts in the distribution pattern, frequency, density, and abundance of natural flora and fauna species within the ecosystem. These changes can be measured over time and linked to current environmental conditions. Baseline ecological information is gathered through literature reviews and quadrat surveys in forest areas of the study region. The baseline terrestrial ecology study area included all ecological zones likely to be affected.

The ecological survey depends on primary survey and secondary literature review and assesses habitat types, vegetation patterns, and created an inventory of flora and fauna within a 10km radius from the project site's boundary. The biological assessment aimed to identify any rare, endangered, or threatened species of flora or fauna in both the core and buffer zones, as well as any ecologically sensitive areas within the buffer zone that might be impacted.

To achieve these objectives, a detailed study was conducted using the following methods:

- Field surveys to collect primary data
- Interviewing local residents to gather information about local plants, animals, and their uses
- Collecting ethno-biological data

This report reviews published secondary data and presents the findings from the general ecological survey conducted in the area. The terrestrial ecological status of the area is detailed below.

3.13.1 FOREST TYPE

The state of Bihar is generally forest deficient, and it has very few regions that have natural forests. Sal woods can be found in the Kaimur, Rohtas, Aurangabad, Gaya, Jamui, Munger, and Banka districts in southern Bihar, as well as the West Champaran district in the Terai region of the north. While South Bihar contains dry deciduous sal forests, the West Champaran district has moist deciduous sal forests. The majority of natural woods have been designated as Protected woods.

One National Park and twelve wildlife sanctuaries make up the state's network of protected areas, which covers 3.44% of the total land area. The state's 6,877 sq km of recorded forest area (RFA) is divided into 693 sq km of reserved forest, 6,183 sq km of protected forest, and 1 sq km of unclassified forest. According to the state, the total documented forest area (RFA) is 6,877 square kilometers, or 7.30% of the total land area. In the state, the percentages of reserved, protected, and unclassified forests are 10.08%, 89.91%, and 0.01%, respectively.

Bihar has 7.76% forest cover, which comprises land with trees covering an area larger than one hectare and having a tree canopy density of 10%, according to the India State of Forest Report. It rose nominally by 0.10 percent in 2019 compared to 2017. With a geographical area of 94,163 sq km, Bihar is projected to have 2.13% (2,003 sq km) of tree cover, which comprises scattered trees and tree patches that are less than 1 hectare in size and occur outside of the forest.

The thermal power plant falls in the Aurangabad district of the state of Bihar and the 10 km radius around it is called the study area for this report. A major river Sone flows at 0.80 km in the WNW direction from the project site. The area on the east bank of the river comes under Aunagabad forest division and the area on the west bank of the river come under the Rohtas forest division.

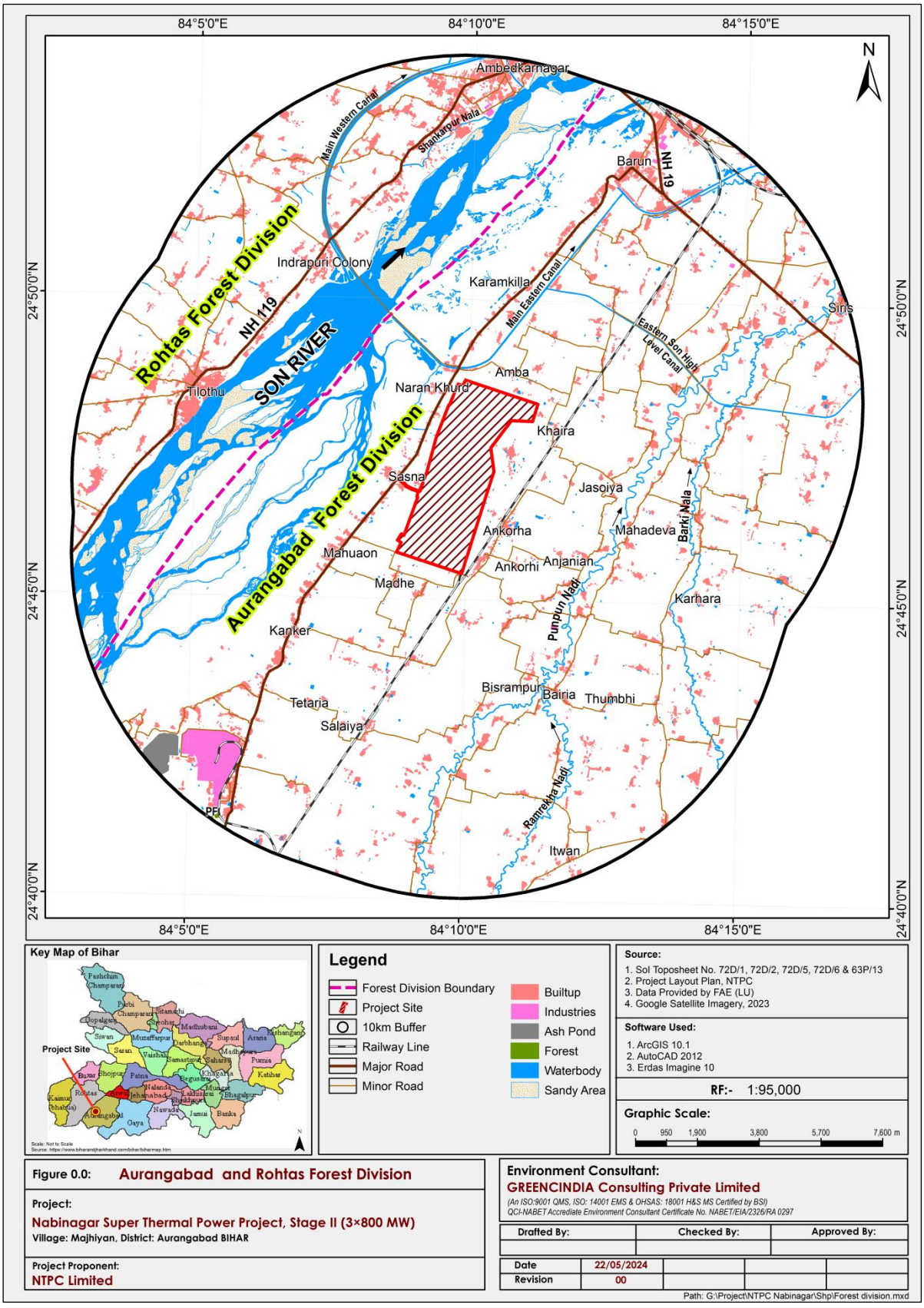


Figure 3.53: Map showing site and marking Aurangabad and rohtas forest division

As per the Working Plan of Aurangabad Forest Division (Gaya Circle) for 2013-14 to 2022-23, available during the stakeholder consultation with the forest officials at Aurangabad DFO office, suggest that the forest of this division come under 'Tropical Dry Deciduous Forests' of Champion and Seth's Classification. The following types under "Sub Group 5B Northern tropical dry deciduous forests" are identifiable:

Forest Type	Symbol
Dry Peninsular Sal	5Bcic
Northern dry mixed deciduous forests	5BC2
Dry deciduous scrub	5BC2/DS
Boswellia forest	5BC2/E1
Butea forest	5BC2/E1

The area on the left bank of Sone river coming within the 10 km radius of the project site falls under the Rohtas forest division. Following figure shows the Aurangabad and Rohtas forest divisions in Bihar.

Figure 3.54: Forest cover map of Bihar

3.13.2 FLORAL STUDY

Study of biological environment is one of the important aspects in Environmental Impact Assessment in view of the need for conservation of Environmental quality. Ecological study was carried out by ecology team of GCPL. Reconnaissance study of the area was done to obtain flora & Fauna structure of the area. Forest officials were consulted and data based on their records were also collected. The project site predominantly comprises of barren land with a few patches of agricultural field. The region is predominantly characterised by two types of landscapes: agricultural and riverine, except for the hilly Kaimur Sanctuary, which is located beyond the

studyarea. The study area's Sone River Belt features a vegetative environment dominated by agriculture as a result of extensive human impact. It is a boring landscape with little biological diversity.

In the study region, dry tropical vegetation is seen. Within the study area are trees such as *Terminaliabellerica, Acacia nilotica, Azadirachtaindica, Tamarindusindica, Mangiferaindica, Madhucaindica, and Dalbergiasissoo*etc. In the research region, *Partheniumhysterophorus* is associated with the dominance of grasses such as *Cynodondactylon*. In the research region, shrubs such as *Solanumxanthocarpum* and *Calotropisgigantea* are observed. **Table 3.39** provides the inventory of trees, climbers, herbs, shrubs, grasses, etc. recorded during the survey from the entire study area and from information obtained from all these sources.

Table 3.41: Inventory of Trees, Shrubs, Herbs and Climbers recorded from the study area

Sl. No.	Common Name	Scientific Name	Family	Source		
				Survey	Villagers	Forest Officials
Tree Species						
1	Karma	*Adina cordifolia*	Rubiaceae	✓		
2	Kahua	*Terminaliaarjuna*	Combretaceae	✓		
3	Piaar	*Buchnanialanzan*	Anarcardiaceae	✓		
4	Batai	*Albiziafalcata*	Fabaceae	✓		
5	Babool	*Acacia nilotica*	Fabaceae	✓		
6	Amaltas	*Cassia fistula*	Leguminosae	✓		
7	Kathmohlee	*Bauhinia racemosa*	Leguminosae	✓		
8	Kachnar	*Bauhinia vahlii*	Leguminosae	✓		
9	Aam	*Mangiferaindica*	Anarcardiaceae	✓		
10	Aonla	*Emblicaofficinalis*	Euphorbiaceae	✓		
11	Bakain	*Meliaazedarach*	Meliaceae		✓	
12	Datranga	*Ehretialaevis*	Boraginaceae		✓	
13	Katai	*Flacourtiaindica*	Bixaceae		✓	
14	Kevati	*Ventilagomaderaspatana*	Rhamnaceae		✓	
15	Koirala	*Bauhinia variegata*	Leguminosae	✓		
16	Karanj	*Pongamiapinnata*	Leguminosae	✓		
17	Kala siris	*Albizialebbeck*	Leguminosae	✓		
18	Kainsa	*Sterculiaurens*	Sterculiaceae			✓
19	Khair	*Acacia catechu*	Leguminosae	✓		
20	Gamhar	*Gmelinaarborea*	Verbenaceae	✓		
21	Galgala	*Cochlosperiumreligiosum*	Bixaceae			✓
22	Gilchi	*Casearia graveolens*	Samydaceae			✓
23	Kakor	*Zizyphusxylopyra*	Rhamnaceae	✓		
24	Chilbil	*Holopteleaintegrifolia*	Ulmaceae	✓		
25	Lamrasi	*Elaeodendrongalucum*	Celastraceae			✓
26	Jamun	*Syzygiumcumini*	Myrtaceae	✓		
27	Dhoka	*Lanneacoromandelica*	Anacardiaceae		✓	
28	Kaind/Tendu	*Diospyrosmelanoxylon*	Ebenaceae		✓	
29	Dudhi	*Wrightiatinctoria*	Apocynaceae	✓		
30	Shisham	*Dalbergiasissoo*	Leguminosae	✓		
31	Dhawda	*Anogeissulatifolia*	Combretaceae	✓		

Sl. No.	Common Name	Scientific Name	Family	Source		
				Survey	Villagers	Forest Officials
32	Neem	*Azadirachtaindica*	Meliaceae	✓		
33	Jungle Jalebi	*Pithecellobiumdulce*	Fabaceae	✓		
34	Paras	*Buteamonosperma*	Leguminosae	✓		
35	Kharhar	*Gardenia turgida*	Rubiaceae			✓
36	Baheda	*Terminaliabellerica*	Combretaceae			✓
37	Bael	*Aeglemarmelos*	Rutaceae	✓		
38	Baer	*Zizyphusmauritiana*	Rhamnaceae	✓		
39	Mahua	*Madhucaindica*	Sapotaceae	✓		
40	Sagwan	*Tectonagrandis*	Verbenaceae	✓		
41	Saja	*Terminaliatomentosa*	Combretaceae	✓		
42	Saal	*Shorearobusta*	Depterocarpaceae		✓	
43	Salai	*Boswelliaserrata*	Burseraceae		✓	
44	Sitaphal	*Anonasquamosa*	Anonaceae		✓	
45	Siddha	*Lagerstroemia parviflora*	Lythraceae		✓	
46	Semal	*Bombaxceiba*	Malvaceae	✓		
47	Bar	*Ficustomentosa*	Moraceae	✓		
48	Taad	*Borassusflabelliefer*	Convolvulaceae	✓		
49	Jingra	*Garugapinnata*	Burseraceae	✓		
50	Kath Bel	*Feronialimonia*	Rutaceae			✓
51	Neelgiri	*Eucalyptus*	Myrtaceae	✓		
Climbers						
1	Anantmool	*Hemidesmusindicus*	Asclepiadaceae	✓		
2	Kiwaj	*Mucunaprurita*	Leguminosae		✓	
3	Dasriya	*Ventilagodenticulata*	Rhamnaceae	✓		
4	Arhar	*Acacia pennata*	Mimoseae	✓		
5	Dudhlar	*Ichnocarpusfrutescens*	Apocynaceae	✓		
6	Dhorni	*Buteaparviflora*	Leguminosae		✓	
7	Satavar	*Asparagus racemosus*	Liliaceae		✓	
Shrubs						
1	Ratair	*Combretumroxburghii*	Combretaceae	✓		
2	Harsingar	*Nyctanthusarbortristis*	Oleaceae		✓	
3	Kaner	*Nerium oleander*	Apocynaceae	✓		
4	Bachita	*Urenalobata*	Malvaceae	✓		
5	Kasunda	*Cassia occidentalis*	Caesalpiniaceae	✓		
6	Dhataki	*Woodfordiafruticosa*	Lythraceae		✓	
7	Kandola	*Carissa opaca*	Apocynaceae		✓	
8	Putoosh	*Lantana camara*	Verbenaceae	✓		
9	Katihari	*Olaxscandens*	Olacaceae		✓	
10	Khareti	*Sidacordifolia*	Malvaceae	✓		
11	Chilla	*Casearіatomentosa*	Salicaceae	✓		
12	Baer	*Zizyphusjujuba*	Rhamnaceae	✓		
13	Indrajav	*Holarrhenaantidysenterica*	Apocynaceae		✓	
14	Karhar	*Randiadumetorum*	Rubiaceae		✓	
15	Datura	*Daturastramonium*	Solanaceae	✓		

Sl. No.	Common Name	Scientific Name	Family	Source		
				Survey	Villagers	Forest Officials
16	Nirgundi	*Vitexnegundo*	*Lamiaceae*	✓		
HERBS						
1	Dudhi	*Euphorbia hirta*	Euphorbiaceae	✓		
2	Bankulthi	*Atylosiascarabaeoides*	Fabaceae			
3	Janglimethi	*Sidaacuta*	Malvaceae	✓		
4	Salparni	*Desmodiumgangeticum*	Leguminosae	✓		
5	Ratnamala	*Indigoferalinifolia*	Fabaceae	✓		
6	Chakora	*Cassia tora*	Fabaceae	✓		
7	Gokhru	*Echinopsechinatus*	Asteraceae	✓		
8	Amarbel	*Cuscutareflexa*	Convolvulaceae	✓		
9	Bantulsi	*Hyptissuaveolens*	Lamiaceae	✓		
10	Chirchir	*Achyranthesaspera*	Amaranthaceae	✓		
11	Chia	*Lindenbergiaphilippensis*	Orobanchaceae	✓		
12	Sadabahar	*Catharanthusroseus*	Apocynaceae	✓		
13	Satyanashi	*Argemonemexicana*	*Papaveraceae*	✓		
Grasses						
1	Needle grass	*Aristidaadscensionis*	Gramineae	✓		
2	Bamboo	*Dendrocalamusstrictus*	Gramineae	✓		
3	Kel	*Dicanthiumannulatum*	Gramineae	✓		
4	Bhurbhusi	*Eragrostistenella*	Gramineae	✓		
5	Ghaas	*Heteropogoncontortus*	Gramineae	✓		

3.13.3 PHYTO-SOCIOLOGICAL STUDY

To understand the floristic composition, a Phyto-sociological study of vegetation in reference to trees, shrub & herb layer was conducted in three forest patches in the study area of the proposed project. The direction and distance of these locations from the project site is provided in **Table 3.40.** At each selected site, random vegetation sampling was done with the help of quadrat (Size 10m X 10 m for tree & shrub layer and $1m^2$ quadrat for herb layer). In each quadrat number and name of all the tree, shrub and herb species was counted. Quantitative analysis of vegetation for frequency, density and abundance was calculated following Curtis and Mc. Intosh (1950) method. Their relative values were calculated and summed to get important value index (IVI). The IVI is a composite index based on measures of relative frequency (RF), relative density (RD) and relative abundance (RAB) (Muller – Dombois and Ellenberg, 1974). Species diversity index was calculated using Shannon-Weiner index (1963) Shanon Weiner diversity index was calculated by following formula:

$H = - \Sigma Pi \text{ Log } Pi$

Where: H = Shanon Weiner diversity index

Pi = ni/N where ni is number or biomass or IVI of individual species and N is the total number or biomass or IVI of all individuals. In the present study IVI (Importance Value Index) has been taken into consideration for evaluation of diversity index. Since IVI includes many of the attributes at a time, therefore consideration of IVI was preferred on number over for Shanon-Weiner diversity index. The diversity index gives an indication about the status of community, higher the value of index indicates more stability of the community. The location of the Monitoring stations in mentioned in **Figure 3.52**

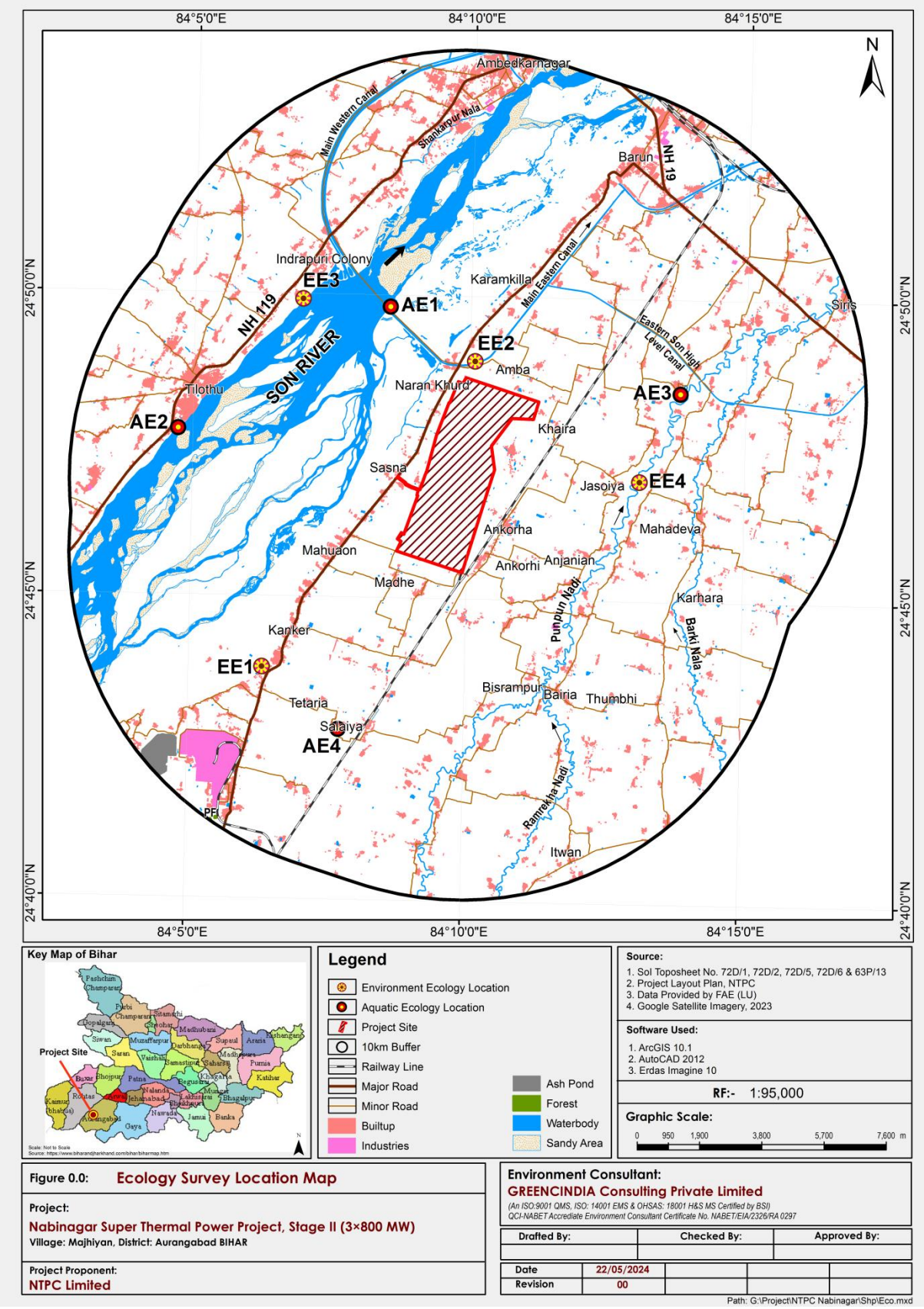


Figure 3.55: Terrestrial and Aquatic Ecology Study Locations

Table-3.42: Co-ordinates of Terrestrial and Aquatic Ecology Study

Terrestrial Ecology Study Locations					
Sr. No.	**Description**	**Latitude**	**Longitude**	**Distance (in km)**	**Direction**
EE1	(PSS 1) Phyto-sociology sample 1	24°43'49.52"N	84° 6'20.31"E	5.34	SW
EE2	(PSS 2) Phyto-sociology sample 2	24°48'55.99"N	84°10'5.42"E	0.54	N
EE3	(PSS 3) Phyto-sociology sample 3	24°49'54.99"N	84° 6'57.47"E	5.43	NW
EE4	(PSS 4) Phyto-sociology sample 4	24°46'59.20"N	84°13'6.38"E	3.84	E
Aquatic Ecology Study Locations					
AE1	Aquatic sample 1	24°49'48.64"N	84° 8'32.47"E	3.13	NW
AE2	Aquatic sample 2	24°47'44.72"N	84° 4'44.45"E	6.91	W
AE3	Aquatic sample 3	24°48'27.19"N	84°13'49.35"E	4.39	ENE
AE4	Aquatic sample 4	24°42'48.99"N	84° 7'44.29"E	5.67	SWS

The phyto-sociological parameters for different types of vegetation- trees, shrubs and herbs for the three different locations in core zone and three locations in buffer zone is provided in the following tables.

Table 3.43: Phyto-sociological analysis of trees in PSS 1 location

S. No.	Botanical Name	Frequency	Abundance	Density	IVI
1	*Bauhinia vahlii*	20.0	150.0	30.00	52.09
2	*Mangiferaindica*	20.0	100.0	20.00	31.73
3	*Emblicaofficinalis*	20.0	200.0	40.00	46.64
4	*Meliaazedarach*	20.0	150.0	30.00	42.54
5	*Delonixregia*	20.0	150.0	30.00	49.32
6	*Azadirachtaindica*	20.0	100.0	20.00	32.55
7	*Zizyphusxylopyra*	10.0	200.0	20.00	27.49
8	*Holopteleaintegrifolia*	10.0	100.0	10.00	17.63

Table 3.44: Phyto-sociological analysis of shrubs in PSS 1 location

S. No.	Botanical Name	Frequency	Abundance	Density	IVI
1	*Nerium oleander*	20	250.00	50.00	88.25
2	*Urenalobata*	10	200.00	20.00	45.30
3	*Cassia occidentalis*	20	150.00	30.00	75.80
4	*Woodfordiafruticosa*	20	150.00	30.00	61.75
5	*Carissa opaca*	10	100.00	10.00	28.90

Table 3.45: Phyto-sociological analysis of herbs in PSS 1 location

S. No.	Botanical Name	Frequency	Abundance	Density
1	*Hyptissuaveolens*	30	3.33	100
2	*Achyranthesaspera*	20	5.00	100
3	*Lindenbergiaphilippensis*	30	4.33	130

Table 3.46: Phyto-sociological analysis of trees in PSS 2 location

S. No.	Botanical Name	Frequency	Abundance	Density	IVI
1	*Anogeissulatifolia*	20.0	100.0	20.00	35.20
2	*Azadirachtaindica*	20.0	100.0	20.00	28.48
3	*Pithecellobiumdulce*	20.0	100.0	20.00	27.38
4	*Buteamonosperma*	20.0	150.0	30.00	37.86
5	*Gardenia turgida*	20.0	150.0	30.00	43.74
6	*Acacia catechu*	20.0	250.0	50.00	52.98
7	*Gmelinaarborea*	10.0	100.0	10.00	15.50
8	*Cochlosperiumreligiosum*	20.0	250.0	50.00	58.86

Table 3.47: Phyto-sociological analysis of shrubs in PSS 2 location

S. No.	Botanical Name	Frequency	Abundance	Density	IVI
1	*Carissa opaca*	20	250.00	50.00	63.87
2	*Lantana camara*	20	250.00	50.00	77.06
3	*Olaxscandens*	20	150.00	30.00	54.64
4	*Sidacordifolia*	30	133.33	40.00	62.70
5	*Casearіatomentosa*	20	100.00	20.00	41.73

Table 3.48: Phyto-sociological analysis of herbs in PSS 2 location

S. No.	Botanical Name	Frequency	Abundance	Density
1	*Indigoferalinifolia*	30	1.00	30
2	*Cassia tora*	20	1.50	30

Table 3.49: Phyto-sociological analysis of trees in PSS 3 location

S. No.	Botanical Name	Frequency	Abundance	Density	IVI
1	*Adina cordifolia*	30.0	200.0	60.00	64.67
2	*Terminaliaarjuna*	20.0	100.0	20.00	22.24
3	*Buchnanialanzan*	20.0	150.0	30.00	26.61
4	*Albiziafalcata*	20.0	150.0	30.00	29.12
5	*Acacia nilotica*	20.0	100.0	20.00	25.96
6	*Cassia fistula*	30.0	266.7	80.00	63.25
7	*Bauhinia racemosa*	20.0	200.0	40.00	37.01
8	*Pongamiapinnata*	20.0	150.0	30.00	31.14

Table 3.50: Phyto-sociological analysis of shrubs in PSS 3 location

S. No.	Botanical Name	Frequency	Abundance	Density	IVI
1	*Nerium oleander*	30	166.67	50.00	82.36
2	*Urenalobata*	20	150.00	30.00	60.78
3	*Cassia occidentalis*	20	200.00	40.00	76.17
4	*Woodfordiafruticosa*	30	166.67	50.00	80.69

Table 3.51: Phyto-sociological analysis of herbs in PSS 3 location

S. No.	Botanical Name	Frequency	Abundance	Density
1	*Echinopsechinatus*	80	1.25	100
2	*Cuscutareflexa*	70	1.43	100
3	*Hyptissuaveolens*	60	2.17	130

Table 3.52: Phyto-sociological analysis of trees in PSS 4 location

S. No.	Botanical Name	Frequency	Abundance	Density	IVI
1	*Delonixregia*	20.0	150.0	30.00	49.32
2	*Terminaliaarjuna*	20.0	100.0	20.00	22.24
3	*Azadirachtaindica*	20.0	100.0	20.00	28.48
4	*Albiziafalcata*	20.0	150.0	30.00	29.12
5	*Emblicaofficinalis*	20.0	200.0	40.00	46.64
6	*Gmelinaarborea*	10.0	100.0	10.00	15.50

7	*Cochlosperiumreligiosum*	20.0	250.0	50.00	58.86
8	*Pongamiapinnata*	20.0	150.0	30.00	31.14

Table 3.53: Phyto-sociological analysis of shrubs in PSS 4 location

S. No.	Botanical Name	Frequency	Abundance	Density	IVI
1	*Nerium oleander*	30	166.67	50.00	82.36
2	*Sidacordifolia*	30	133.33	40.00	62.70
3	*Woodfordiafruticosa*	20	150.00	30.00	61.75
4	*Carissa opaca*	10	100.00	10.00	28.90

Table 3.54: Phyto-sociological analysis of herbs in PSS 4 location

S. No.	Botanical Name	Frequency	Abundance	Density
1	*Achyranthesaspera*	20	5.00	100
2	*Cuscutareflexa*	70	1.43	100
3	*Cassia tora*	20	1.50	30

Figure 3.56: Terrestrial Ecology Study

3.13.4 FAUNAL STUDY

- Collection of information on wildlife present or occasionally present or rarely present in the core zone and buffer Zone was carried out by inquiry with forest persons and local people and visual observation.
- Random survey for the fauna was also carried out and recorded both in the core zone and buffer zone. These covers scats, dung, sign etc., interview with the forest officials and knowledgeable persons of the areas. Secondary data (from Forest Department and published literature) are also collected.
- Effort was made to identify the migratory paths of wild animals considering the water sources, forest patches and fodder plants and grasslands in the study area and the direct and indirect signs of their presence.
- Only the major faunal taxonomical groups were addressed at field survey & investigations. Different standard methods as convenient for different category of individual were applied as is described below. Many methods were adopted for achieving the objectives, but having a common criterion of strategy was adopted.

3.13.4.1 MAMMALS

Mammals are the most challenging groups to do research on due to their relatively low abundance at which they are found, and the vast range of environmental niches they may inhabit. Different trapping methods used for different mammal groups were as follows:

(i) Pitfall traps: Here, delicate mice and other small creatures were the target demographic. A small to medium-sized hole was made in the earth, and a plastic container of similar size was put within. To direct animals into the plastic container, a drift-fence was constructed on the ground, with varying heights and lengths.

(ii)Cage traps: This was done to target medium-sized ground- and arboreal-dwelling animals. It was created a collapsible rectangular trap with one or more trap doors. It was set up on the ground. It may also be hung from trees with the use of suitable food preferred by the intended species.
(iii) Mist nets: Bats get trapped in a fine, light-weight nylon mesh that is pinched between two poles during flight, during the night. A very close continuous watch is necessary since it is crucial to get rid of captured people as soon as possible to lessen tension and increase the danger of harm to the person.
(iv) Tracks and scats: It is possible to use this technique with practically all mammals. It might not be able to identify an animal if one cannot catch it or see it. Animal presence clues like footprints or scats can be interpreted in a useful way. In addition to this, the species can be positively identified using bones, teeth, and skulls. Such mammal remains can be recognised using the field guide of Triggs, B. (1996).
(v) Spotlighting: All mammals, especially nocturnal arboreal species, are the target populations for this approach. This is a typical technique that involves doing a timed search in a certain area or a more thorough search across a larger area. Because there are more sites that an animal can use, it takes more work. Eye shine is occasionally, but not always, seen.

3.13.4.2 BIRDS

The methods used to sample birds are often among the simplest, although the enormous diversity in any given area and the range of cries and colour changes within species themselves can make sampling birds more difficult. For this, the following trapping techniques were used. In populated areas, the periods in between were employed, although early morning and late evening were more frequently used in desolate areas. Additionally, efforts were made to locate any nearby avian roosting, breeding, or nesting locations.
(i) Visual and call census: It involved identifying species visually (either by naked eye or by binocular). Bird calls are extremely useful in surveying birds.
(ii) Additional signs: The identification of old eggs, nests and feathers or other signs (like owl pellets) give a valuable information on the presence of a species in the surveyed area.
(iii) Point count method: Point count method with limited distance (100m, Hutto et al. 1986, Bibby et al. 1992) was employed with slight modification of 25 m. Point counts were performed in the morning, beginning with increased bird activity, and finishing around 3 hours later, the time for sampling at each point was 15 minutes, and another 15 minutes was the time necessary for the displacement from one point to another.
(iv) Flock count method: For terrestrial and aquatic bird assessments, this method was also adopted, wherever possible.

3.13.4.3 REPTILES & AMPHIBIANS

For the purpose of cataloguing and counting the amphibians and reptiles, a thorough search strategy was used along the water hedges of all aquatic environments. The objectives are achieved using the following strategies.
(i) Pitfall traps: Lizards and frogs were the intended target species. A small to medium-sized hole was made in the earth, and a plastic container of similar size was put within. To direct animals into the plastic container, a drift-fence was constructed on the ground, with varying heights and lengths.
(ii) Active searches: These searches are conducted actively and purposefully at a set time and place when the habitat is physically disturbed to find animals that may be hiding. Conversely, a passive search may involve simply observing animals for a fixed time.

(iii) Spotlighting: It is similar to active searches but done at night, aiming the target groups like geckoes, frogs and snakes.

3.13.5 FAUNAL STATUS

Inside the project site some common bird species, squirrel, chameleon etc were recorded. From the buffer zone, 13 Species of mammals, 14 species of birds, 8 species of reptiles and amphibians were recorded. 12 number of Schedule 1 species were recorded from the study area and the Wildlife Conservation Plan has been prepared and submitted to the Aurangabad and Rohtas forest division.

Table 3.55: List of Animals in the study area

Mammals						
S. No.	**Scientific Name**	**Core Zone**	**Buffer Zone (Aurangabad or Rohtas)**	**Common Name**	**Status**	
					WPA Amendment 2022	**IUCN**
1	*Maniscrassicaudata*	-	R	Pangolin	Schedule I	EN
2	*Pantherapardus*	-	R	Leopard	Schedule I	VU
3	*Melursusursinus*	-	R	Sloth Bear	Schedule I	VU
4	*Antelope cervicarpa*	-	R	Blackbuck	Schedule I	NT
5	*Canisaureus*	-	R	Jackal	Schedule I	LC
6	*Cuonalpinus*	-	A, R	Wild Dog/ Dhole	Schedule I	EN
7	*Rusa unicolor*	-	R	Sambar	Schedule I	VU
8	*Hyaenahyaena*	-	A, R	Hyna	Schedule I	NT
9	*Susscrofa*	-	A, R	Wild pig	Schedule II	VU
10	*Axis axis*	-	A, R	Chital	Schedule II	LC
11	*Boselaphustragocamelus*	-	A, R	Neel Gai	Schedule II	LC
12	*Semnopithecus entellus*	-	A, R	Gray Langoor	Schedule II	LC
13	*Lepusnigricollis*	-	A, R	India hare	Schedule II	LC
Reptiles & Amphibians						
1	*Chameleon zeylanicus*	-	A, R	Indian Chameleon	Schedule I	LC
2	*Python molurus*	-	R	Indian Rock Python	Schedule I	NT
3	*Python bivittatus*	-	R	Burmese Python	Schedule I	VU
4	*Hemidactylusbrookii*	-	A, R	Lizard	-	LC
5	*Ptyas mucosa*	-	A, R	Rat Snake	Schedule II	LC
6	*Calotesversicolor*	-	A, R	Garden Lizard	-	LC
7	*Hoplobatrachustigerinus*	-	A, R	Bullfrog	Schedule II	LC
8	*Duttaphrynusmela*	-	A, R	Common Indian Toad	Schedule IV	
Birds						
1	*Pavocristatus*		A, R	Peafowl	Schedule I	LC
2	*Columba livia*		Blue Rock Pigeon			LC
3	*Corvussplendens*		House crow			LC
4	*Egrettaqurzetta*		Little egret			LC

5	*Eudynamysscolopaceus*	Asian koel	LC
6	*Meropsorientalis*	Green Bee Eater	LC
7	*Melophuslathami*	Bulbul	LC
8	*Passer domesticus*	House Sparrow	LC
9	*Psittaculakrameri*	Rose ringed parakeet	LC
10	*Streptopelia*	Indian Ring Dove	LC
11	*Streptopeliasenegalensis*	Little Brown Dove	LC
12	*Alcedoatthis*	Common kingfisher	LC
13	*Upupaepops*	Common Hoopeo	LC
14	*Coturnixcoromendelica*	Rain Quail	LC

Wildlife management is a multidisciplinary field that combines science and art to maintain or modify habitats, wildlife populations, and human activities in order to achieve specific conservation goals. In India, wildlife science is an emerging discipline with a developing scientific knowledge base. Although wildlife management has traditionally been part of mainstream forest management, it demands a distinct scientific approach to address its unique challenges. Effective wildlife conservation aims to prevent biodiversity loss by applying ecological principles—such as carrying capacity, disturbance, and succession—and considering environmental factors like soil science, hydrology, and geography. The ultimate goal is to strike a balance between the needs of wildlife and those of human populations.

The total estimated cost for implementing the Wildlife Management Pla over 5 years is approximately 126 Lakhs INR. The funds will be distributed between the Aurangabad and Rohtas Forest Divisions in a 40:60 ratio, as the Rohtas Forest Division reported a higher number of Schedule I species. Accordingly, Rs. 50.4 Lakhs will be allocated to the Aurangabad Forest Division, while Rs. 75.6 Lakhs will go to the Rohtas Forest Division for conservation activities. The schedule for fund disbursement will be finalized in consultation with the respective forest departments. The Wildlife Conservation Plan is attached as **Annexure 7.5.**

Table 3.56: Estimated Budget for Implementation of Flora & Fauna Conservation and

Component	Items Proposed	Financial Outlay (in Lakhs)					Financial Outlay (in Lakhs)
		1st Year	2nd Year	3rd Year	4th Year	5th Year	
Component 01: Habitat Management							
1	Greenbelt Development/Plantation and Management	2	2	2	2	2	10
2	Water Management (maintenance of ponds/water bodies used by animals), Bird Baths	1	1	1	1	1	5
3	Grassland Management	2	2	2	2	2	10
4	Seed Balls Preparation	2	1	1	1	1	6
5	Sapling Procurement & Distribution	2	2	2	2	2	10
Componenet-02: Fire management							
1	Fire Management Squad	2	2	2	2	2	10
Componenet-03: Wildlife Management							
1	Setting up of animal rescue center, Prevention of Diseases in animals	4	4	4	4	4	20

2	Wildlife Monitoring	2	2	2	2	2	10
Component 04: Awareness Generation & Capacity Building							
1	Awareness Campaign, Garbage Bins, Distribution of Storage Containers to Villages,	2	2	2	2	2	10
2	Mitigation measures for Man Animal Conflict	2	2	2	2	2	10
3	Capacity Building through training	2	2	2	2	2	10
4	Infrastructure Building for the forest department	3	3	3	3	3	15
Total (One hundred Twenty six lakhs)							126

3.13.6 Aquatic Ecology

The aquatic ecology of Nabinagar, Bihar, is characterized by its river systems, especially the Punpun River. Studies indicate that the water quality is affected by both natural and anthropogenic factors, including contamination from industrial and agricultural activities. Common pollutants include heavy metals such as arsenic, fluoride, and iron, which have significant health implications for local populations. The region's groundwater, heavily relied upon for irrigation and drinking, faces quality issues due to these contaminants. Additionally, the area is rich in aquatic biodiversity, supporting various fish species and aquatic plants.

3.13.6.1 Study of Phytoplanktons

Methodology

1. **Sample Collection**

- **Location Selection**: Different sampling sites representing different aquatic environments have been provided in **Figure 3.34**
- **Collection Tools**: A plankton net with a mesh size 55µ was used for capturing phytoplankton.
- **Sample Volume**: 1-2 litres of water were collected from locations.

2. **Preservation**

- **Fixatives**: UsedLugol's iodine solution or formaldehyde for immediate preservation.
- **Storage**: Stored samples in dark, cool conditions to prevent degradation.

3. **Laboratory Analysis & Identification**

- **Sedimentation**: Allow samples to settle for 24-48 hours to concentrate phytoplankton at the bottom.
- **Taxonomic Keys**: Standard taxonomic keys and guides were employed.
- **Morphological Features**: Focus on cell shape, size, color, and colony formation was given to identify the phytoplanktons and also reference from text books and online available material was done.

Inventory of phytoplanktons recorded from the study area is provided in **Table 3.55**. These groups represent common genera that are often found in freshwater systems, reflecting a variety of ecological niches and environmental conditions.

Table 3.57: Inventory of Phytoplanktons from study area

Sl No.	Phyto-plankton

Cyanophyceae (Blue-green Algae)	
1	Microcystis
2	Anabaena
3	Oscillatoria
4	Nostoc
5	Spirulina
Chlorophyceae (Green Algae)	
1	Chlorella
2	Scenedesmus
3	Pediastrum
4	Spirogyra
5	Volvox
6	Closterium
Bacillariophyceae (Diatoms)	
1	Navicula
2	Nitzschia
3	Fragilaria
4	Cyclotella
5	Asterionella
Euglenophyceae (Euglenoids)	
1	Euglena
2	Phacus
3	Trachelomonas
Dinophyceae (Dinoflagellates)	
1	Ceratium
2	Peridinium

3.13.6.2 Study of Zooplanktons

1. **Sample Collection**

- **Location Selection**: Sampling sites representing different aquatic habitats were used to study zooplankton diversity.
- **Collection Tools**: A plankton net with a mesh size of 50-200 µm, depending on the target zooplankton size was used.
- **Collection Technique**:
  - **Vertical Haul**: Lower the net to a known depth and then haul vertically.
  - **Horizontal Tow**: Drag the net horizontally for a set distance or duration.
  - **Integrated Sample**: Combine multiple vertical and horizontal samples.

2. **Preservation**

- **Fixatives**: Immediately preserved samples in 4% formalin or Lugol's iodine solution.
- **Storage**: Samples were kept in dark, cool conditions to avoid degradation.

3. **Laboratory Analysis & Identification**

- **Sedimentation**: Allow samples to settle for 24-48 hours to concentrate phytoplankton at the bottom.

- **Taxonomic Keys**: Standard taxonomic keys and guides were employed.
- **Morphological Features**: Focus on cell shape, size, color, and colony formation was given to identify the phytoplanktons and also reference from text books and online available material was done.

Inventory of zooplanktons recorded from the study area is provided in **Table 3.56**. These groups represent common genera that are often found in freshwater systems, reflecting a variety of ecological niches and environmental conditions.

Table 3.58: Inventory of zooplanktons recorded from the study area

Sl. No.	Zooplanktons
Rotifera	
1	*Brachionus*
2	*Keratella*
3	*Asplanchna*
4	*Polyarthra*
Cladocera	
1	*Daphnia*
2	*Bosmina*
3	*Moina*
Copepoda	
1	*Cyclops*
2	*Diaptomus*
3	*Mesocyclops*
Protozoa	
1	*Parameciu*m
2	*Vorticella*

3.13.6.3 Benthic Macro-invertebrates

Methodology

1. **Sample Collection**

- **Kick Sampling**: A D-frame net to disturb the substrate and collect dislodged macroinvertebrates is used.
- **Surber Sampler**: Employed a Surber sampler for quantitative sampling in specific areas.
- **Core Sampling**: Extracted sediment cores for benthic macroinvertebrate sampling.

2. **Preservation**

- **Immediate Preservation**: Preserved collected samples in 70% ethanol or formalin on-site.
- **Labeling**: Properly labelled each sample with site, date, and other relevant information.

3. **Laboratory Analysis**

- **Sorting**: Rinsed samples and sorted macroinvertebrates from debris by hand.
- **Identification**: Identifiedmacroinvertebrates to the lowest practical taxonomic level using keys and guides.

The commonly found benthic biota is given below:

Table 3.59: Inventory of macro invertebrates recorded from study area

Sl. No.	Macro invertebrates
1	*Tiara scabra*
2	*Parregsiajavideus*
3	*Plentala spp.*
4	*Lymnaeaacuminata*
5	*Polichaeteyvorm*
6	*Pilaglobosa*
7	*Hirudinariagranulosa*
8	*T. tuberculata*
9	*Argalaspp*
10	*Ostracodes spp.*

3.13.6.4 Study of Fishes

Secondary sources and stakeholder consultations and visit to the fish markets were made to create an inventory of the fishes found in and around the study area. The following species were reported to be present.

- **Cypriniformes**:

- *Labeorohita* (Rohu)
- *Catlacatla* (Catla)
- *Cirrhinusmrigala* (Mrigal)
- *Puntiussophore*
- *Amblypharyngodonmola*

- **Siluriformes**:

- *Clariasbatrachus* (Magur)
- *Heteropneustesfossilis* (Singhi)
- *Mystusvittatus*

- **Perciformes**:

- *Channapunctata* (Spotted snakehead)
- *Anabas testudineus* (Koi)

3.14 SOCIAL ENVIRONMENT

The project is located on the right bank of Sone River near village Majhiyan in Aurangabad district of Bihar. In this section the profile of the socio-economic conditions of the people in the 10 km radius of project site has been described. The demographic and socio-economic parameters i.e. population growth, density, gender ratio, health, work force participation, occupational structure, literacy etc. plays an important role in determining the impact of the proposed mining activity directly or indirectly on the human population of the study area.

3.14.1 DEMOGRAPHIC CHARACTERISTICS OF THE STUDY AREA

There are 257 villages in the study area. These villages have total population of 240307 (in 2001) & 300858 (in 2011). The average household size in the study area was found to have reduced from 7.23 in 2001 to 6.56 in 2011. According to the survey, gender ratio of study area was 925 in 2001 and 923 in 2011. The details are given in **Table 3.58 & Table 3.59**.

Table 3.60: Demographic Profile of the Study Area

Parameters	Number of Villages	Total Population		Male		Female		Gender Ratio	
		2001	2011	2001	2011	2001	2011	2001	2011
within 2 km	26	17213	20523	8915	10618	8298	9905	931	933
2km to 5km	59	45797	58390	23556	30247	22241	28143	944	930
5km to 7km	52	69909	86666	36386	45089	33523	41577	921	922
7km to 10 km	120	107388	135279	55975	70486	51413	64793	918	919
Total	**257**	**240307**	**300858**	**124832**	**156440**	**115475**	**144418**	**925**	**923**

(Source: Primary Census Abstract of India 2001 & 2011 and District and Census Handbook 2001 & 2011)

Table 3.61: Demographic Features of the Study Area

Parameters	Number of Villages	Total Population		Number of House Hold		House Hold Size	
		2001	2011	2001	2011	2001	2011
within 2 km	26	17213	20523	2283	3151	7.54	6.51
2km to 5km	59	45797	58390	6292	8710	7.28	6.70
5km to 7km	52	69909	86666	9907	13337	7.06	6.50
7km to 10 km	120	107388	135279	14779	20664	7.27	6.55
Total	**257**	**240307**	**300858**	**33261**	**45862**	**4.8**	**3.8**

(Source: Primary Census Abstract of India 2001 & 2011 and District and Census Handbook 2001 & 2011)

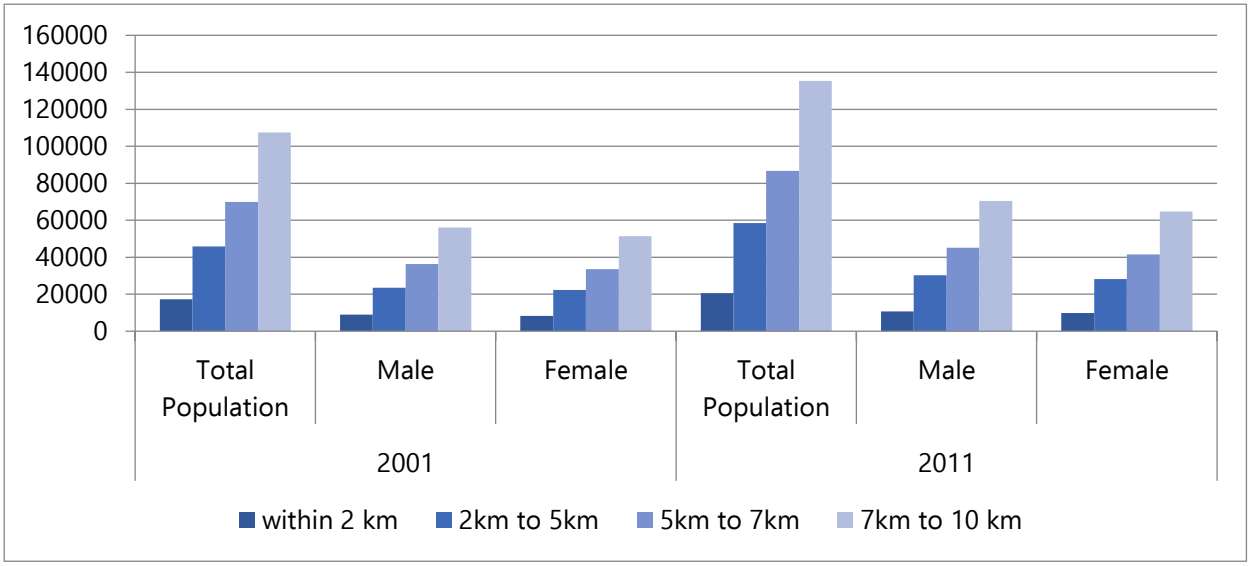


Figure 3.57: Demographic Profile of Study Area

3.14.2 VULNERABLE GROUP

As of the 2011 census, the study area encompasses a scheduled caste population of approximately 20.59% and a scheduled tribe population of 0.17%. The data is further broken down based on different distance ranges, providing insights into the distribution of scheduled caste and scheduled tribe populations within specific areas. The percentages represent the proportion of these populations in relation to the total population of each distance range within the study area. (Refer Table **3.60**).

Table 3.62: Vulnerable Group

Parameters	Number of Villages	Total Population		SC				ST			
		2001	2011	2001	2011	2001 (%)	2011 (%)	2001	2011	2001 (%)	2011 (%)
within 2 km	26	17213	20523	2971	3637	17.26	17.72	0	2	0.00	0.01
2km to 5km	59	45797	58390	9376	12447	20.47	21.32	41	15	0.09	0.03
5km to 7km	52	69909	86666	12903	16881	18.46	19.48	328	261	0.47	0.30
7km to 10km	120	107388	135279	22134	28985	20.61	21.43	145	243	0.14	0.18
Total	257	240307	300858	47384	61950	19.72	20.59	514	521	0.21	0.17

(Source: Primary Census Abstract of India 2001 & 2011 and District and Census Handbook 2001 & 2011)

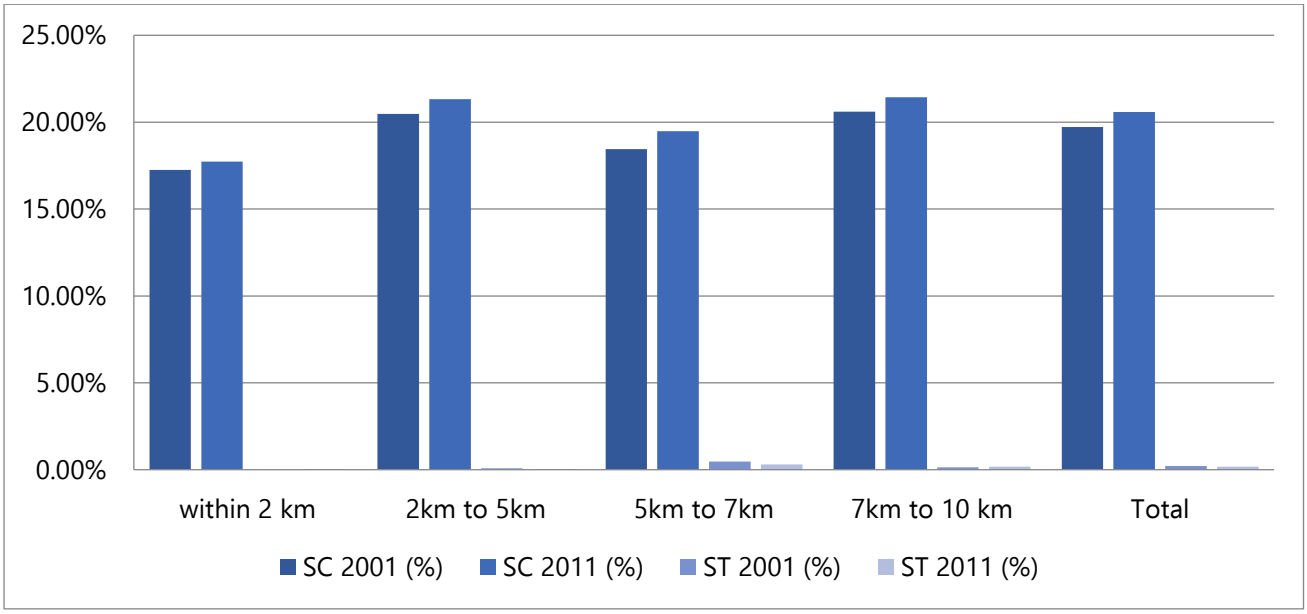


Figure 3.58: Vulnerable Population in the Study Area

3.14.3 LITERACY RATE

Literacy is one of the most significant indicators of human and social development. This not only reflects on the educational attainment of the population but also reflects on the status of women, caste equation and economic condition of a particular area. It also shows the skill level of the people and their capability to get trained and work. **Table 3.61** indicates the gender-wise literacy rate of the people in the study area.

The female literacy rate of the study area has increased with time (34.07% in 2001 & 49.24% in 2011) along with the male literacy rate which was 58.20% in 2001 and 66.98% in 2011. The data shows that the average literacy rate of the area has increased with time.

Table 3.63: Literacy Rate

Parameters	Number of Villages	Male Literate				Female Literate			
		2001	2011	2001 (%)	2011 (%)	2001	2011	2001 (%)	2011 (%)
within 2 km	26	5002	7181	56.11%	67.63%	2507	4912	30.21%	49.59%
2km to 5km	59	13100	19623	55.61%	64.88%	7042	12879	31.66%	45.76%
5km to 7km	52	21355	29946	58.69%	66.42%	12089	20408	36.06%	49.08%
7km to 10 km	120	33197	48033	59.31%	68.15%	17707	32918	34.44%	50.80%
Total	257	72654	104783	58.20%	66.98%	39345	71117	34.07%	49.24%

(Source: Primary Census Abstract of India 2001 & 2011 and District and Census Handbook 2001 & 2011)

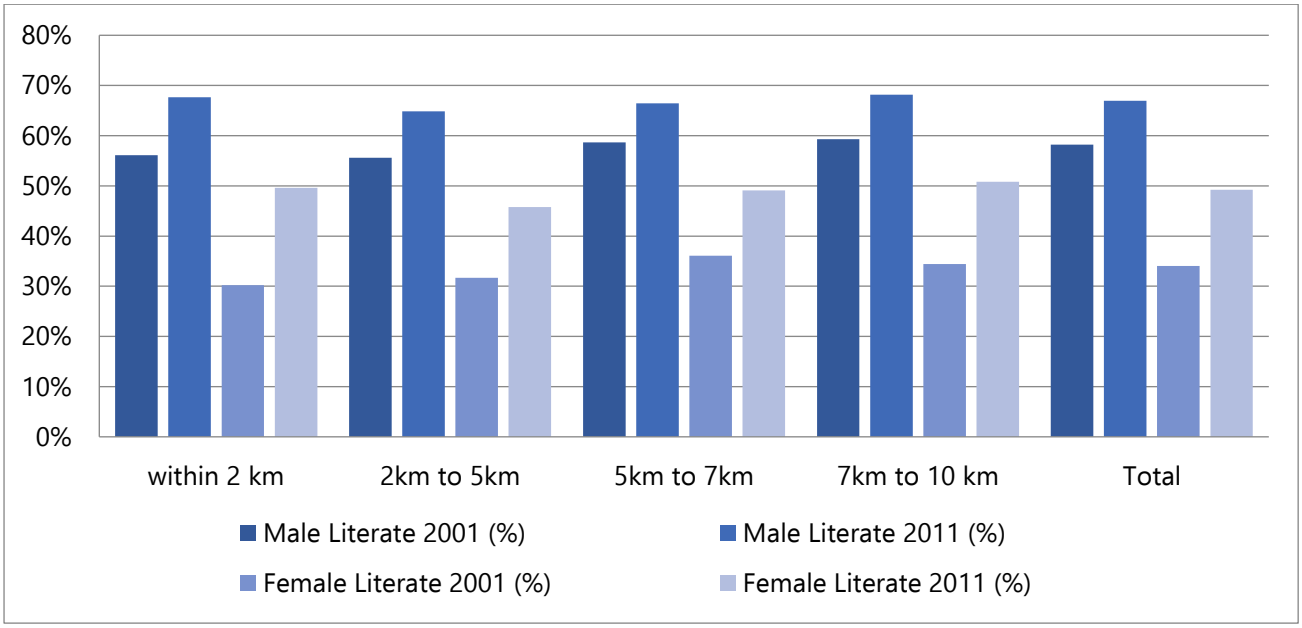


Figure 3.59: Literacy Rate in the Study Area

3.14.4 WORK PARTICIPATION

3.14.4.1 OCCUPATIONAL STRUCTURE

In the villages around the study area, people mainly earn from agriculture and animal rearing. From **Table 3-62**, it can be said that the percentage of non-workers is high (>50%) in the study area as compared to the total workers. It can also be seen that the percentage of workers have increased marginally from 2001 to 2011.

Table 3.64: Occupational Structure of the Study Area

Parameters	Number of Villages	Total Population		Total Workers		Main Workers		Marginal Workers		Non - Workers	
		2001	2011	2001 (%)	2011 (%)	2001 (%)	2011 (%)	2001 (%)	2011 (%)	2001 (%)	2011 (%)
within 2 km	26	17213	20523	38.20	33.71	28.55	21.71	9.64	12.00	61.80	66.29
2km to 5km	59	45797	58390	33.04	34.31	23.54	21.78	9.50	12.53	66.96	65.69
5km to 7km	52	69909	86666	29.14	31.85	20.89	17.17	8.25	14.68	70.86	68.15
7km to 10 km	120	107388	135279	30.49	31.49	20.96	17.58	9.53	13.91	69.51	68.51
Total	257	240307	300858	31.13	32.29	21.97	18.56	9.16	13.73	68.87	67.71

(Source: Primary Census Abstract of India 2001 & 2011 and District and Census Handbook 2001 & 2011)

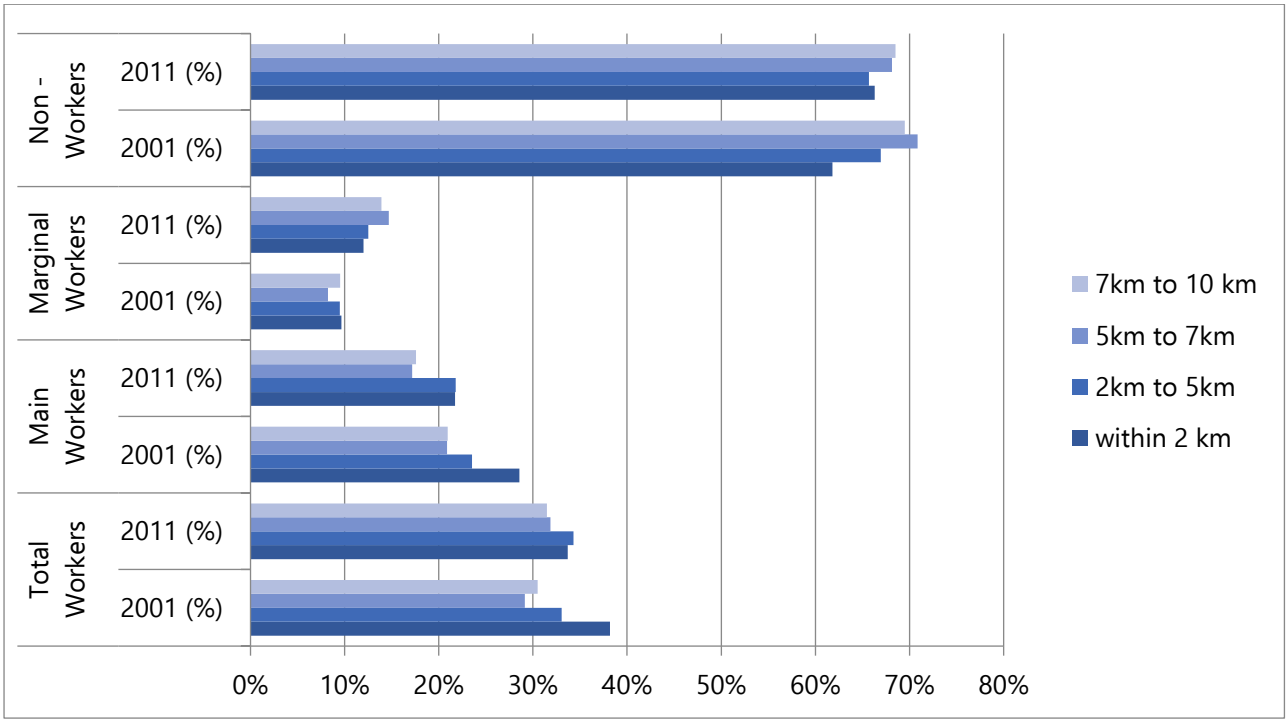


Figure 3.60: Category of Workers in the Study Area

3.14.5 INFRASTRUCTURE

3.14.5.1 EDUCATIONAL FACILITIES:

There is a total of 1089 Primary Schools, 1087 Middle Schools, 1074 Secondary School and 1076 Senior Secondary Schools in the study area as per Census 2011. It can be seen that there has been a substantial increase in the number of schools over the 10 years in the study area. This is a very healthy sign which is reflected in the increase of literacy rate of the area.

Table 3.65: Educational Facilities in the Study Area

Parameters	Number of Villages	Primary School		Middle School		Senior School		Senior Secondary School	
		2001	2011	2001	2011	2001	2011	2001	2011
within 2 km	26	16	11	2	7	1	1	0	1
2km to 5km	59	28	278	6	279	2	274	0	274
5km to 7km	52	34	252	9	251	3	250	0	249
7km to 10 km	120	68	548	14	550	4	549	0	552
Total	**257**	**146**	**1089**	**31**	**1087**	**10**	**1074**	**0**	**1076**

(Source: Primary Census Abstract of India 2001 & 2011 and District and Census Handbook 2001 & 2011)

3.14.5.2 HEALTH FACILITIES:

Health facilities in the study area are not up to the mark. The number of primary health centres has decreased from 451 to 25 from 2001 to 2011. Though a balanced distribution of different types of health facilities can be seen in the study area. (Refer **Table 3.64)**.

Table 3.66: Health Facilities in the Study Area

Parameters	Number of Villages	Mother & Child Welfare Centre		Primary Health Centre		Primary Health Sub-Centres		Family Welfare Centre		TB Clinic	
		2001	2011	2001	2011	2001	2011	2001	2011	2001	2011
within 2 km	26	0	2	61	1	1	2	0	2	0	2
2km to 5km	59	2	15	79	3	1	13	0	13	1	12
5km to 7km	52	1	13	110	13	2	13	0	14	3	12
7km to 10 km	120	2	39	201	8	8	36	1	53	0	38
Total	**257**	**5**	**69**	**451**	**25**	**12**	**64**	**1**	**82**	**4**	**64**

(Source: Primary Census Abstract of India 2001 & 2011 and District and Census Handbook 2001 & 2011)

3.14.5.3 BANKING AND POST OFFICE FACILITIES:

Number of post offices, commercial banks, co-operative bank and agricultural society in the study area has increased from 2001 to 2011 as can be observed from **Table 3.65**.

Table 3.67: Banking & Post Office Facilities in the Study Area

Parameters	Number of Villages	Post Office		Commercial Bank		Coop Bank		Agricultural Society	
		2001	2011	2001	2011	2001	2011	2001	2011
within 2 km	26	2	7	1	4	2	0	9	0
2km to 5km	59	5	15	2	6	2	7	7	15
5km to 7km	52	7	14	4	11	3	11	6	15
7km to 10 km	120	13	32	2	14	1	15	20	13
Total	**257**	**27**	**68**	**9**	**35**	**8**	**33**	**42**	**43**

(Source: Primary Census Abstract of India 2001 & 2011 and District and Census Handbook 2001 & 2011)

3.14.5.4 DRINKING WATER FACILITIES:

One of the most important factors responsible for the emergence of a settlement is availability of water. Many water sources such as wells, hand pumps, tanks, etc. are available in rural areas. In the villages under study, the main source of water is tap water, well, followed by hand pump and service reservoirs. The list of water sources is given in **Table 3.66.**

Table 3.68: Drinking Water Facilities in the Study Area

Parameters	Number of Villages	Tap		Well		Tank		Tube well		Handpump	
		2001	2011	2001	2011	2001	2011	2001	2011	2001	2011
within 2 km	26	0	0	23	0	14	0	0	1	23	7
2km to 5km	59	0	0	45	6	10	2	4	34	47	55
5km to 7km	52	3	0	47	4	13	4	13	28	50	50
7km to 10 km	120	11	0	104	6	23	4	32	56	106	109
Total	**257**	**14**	**0**	**219**	**16**	**60**	**10**	**49**	**119**	**226**	**221**

(Source: Primary Census Abstract of India 2001 & 2011 and District and Census Handbook 2001 & 2011)

Figure 3.61: Public consultation at different locations

3.14.6 FINDINGS:

The social survey conducted within a 10 km radius of the site revealed significant gaps in essential services and infrastructure in the area. One of the primary concerns highlighted was the poor state of healthcare facilities. Residents are often compelled to travel considerable distances to Aurangabad or Rohtas to access even basic medical treatment, which poses challenges during emergencies and for routine healthcare needs. Additionally, the survey identified a lack of adequate opportunities for higher education, leaving young individuals with limited options for pursuing advanced studies locally. Furthermore, the electricity supply in the region was found to be irregular, disrupting daily life and affecting the overall quality of living. These issues underscore the urgent need for improvements in healthcare, education, and infrastructure to enhance the well-being of the community.

4. Impacts Assessment & Mitigation Measures

4.1 INTRODUCTION

Correlating the relationship between project activities and environmental parameters are used to first identify an environmental impact. Impact Identification is a method of "mapping" the environmental effects of the project's major components and alternatives. After that, impact predictions are made. A variety of quantitative and qualitative tools and procedures are used to predict the impacts of project operations on physical, ecological and social components of the environment. This chapter identifies and estimates the likely impacts on various environmental parameters as a result of the proposed activities' construction and operation. An environment mitigation measure details pollution mitigation and control measures based on prediction results in order to minimize negative environmental impacts.

Coal-based Super Thermal Power Plant may cause adverse impacts on the surrounding environment unless proper environmental mitigation measures are adopted. For plants undergoing expansion within the existing plant area can minimize the major possible impacts.

In this chapter, an attempt is made to quantify the possible environmental impacts on various features such as air quality, noise level, water use and quality, land-use, ecological status, soil quality and socio-economic factors. The above-mentioned aspects have been studied to identify the impacts of the proposed expansion. The magnitude and significance of the environmental pollution caused by the project depends on extent of project activity. On the basis of the impact analysis, the mitigating action and future monitoring requirement are focused in the Environmental Management Plan (EMP) (Chapter 10) for minimizing adverse impacts. The impact identification has been done using a Matrix given in **Table 4.1 & 4.2.**

Table 4.1: Environment Identification Matrix for Construction Phase

Environmental Parameters	Activities during Construction Phase					
	Site Preparation	Transportation and Storage of Construction Material/ Equipment	Civil Construction Activities	Mech. & Elec. Erection Activities	Influx of Labour& Construction of Temporary Houses	Transportation and Disposal of Construction Debris
Ambient Air	●	●	●	●		●
Water Resource	●		●		●	●
Water Quality		●	●	●	●	●
Ambient Noise	●	●	●	●		●
Flora and Fauna	●					●
Soil Quality		●				●
Public Utilities		●				

Environmental Parameters	Activities during Construction Phase					
	Site Preparation	Transportation and Storage of Construction Material/ Equipment	Civil Construction Activities	Mech. & Elec. Erection Activities	Influx of Labour& Construction of Temporary Houses	Transportation and Disposal of Construction Debris
Socio-economic			❍	❍	●	

● Adverse Impacts ❍ Beneficial Impacts

4.2 IDENTIFICATION OF ACTIVITIES AND ITS IMPACT

The wastes and pollutants generated due to various activities of the project cause impacts on different environmental attributes. The major project activities and the anticipated environmental impacts of the proposed project are discussed below in **Table 4.4 and 4.19.**

Table 4.2 :Description of identifiable impacts during Construction Phase

Sl. No.	Activities	Parameters	Description of Impacts
1	Site Preparation	Ambient Air	Fugitive Dust Emissions Air Emissions from construction equipment & machinery
		Water Resource	Extraction of water and disposal of sewage
		Ambient Noise	Noise Emissions from use of construction equipment & machinery
		Flora and Fauna	Deposition of air pollutants on flora and disturbance to fauna from noise generation.
2	Transportation and Storage of Construction Material/ Equipment	Ambient Air	Noise and air emissions from vehicles Fugitive dust emissions due to traffic movement Spillage and fugitive emissions of construction materials
		Water Quality	Spillage of construction material and flow into streams Run-off from storage areas of construction material
		Ambient Noise	Noise Emissions from movement of construction equipment & machinery
		Soil Quality	Deposition of spilled construction material on soil
		Public Utilities	Increased flow of traffic Congestion on roads
3	Civil Construction Activities	Ambient Air	Air Emissions from Construction Machinery Fugitive Dust Emissions due to Movement of Traffic
		Water Quality	Run-off from Construction Areas containing construction material
		Ambient Noise	Noise Emissions from Construction Machinery
		Socio Economic	Employment and secondary activities
4	Mechanical & Electrical Erection Activities	Ambient Air	Noise & air emissions from machines/ activities
		Water Quality	Run-off from erection areas containing oils, paints
		Ambient Noise	Noise Emissions from erection activities.

Sl. No.	Activities	Parameters	Description of Impacts
		Socio Economic	Employment and secondary activities
5	Influx of Labour & Construction of Temporary Houses	Water Resource	Extraction of water and disposal of sewage
		Water Quality	Domestic wastewater from labour colonies
		Socio Economic	Stress on infrastructure Stress on social relations
6	Transportation & Disposal of Construction Debris	Ambient Air	Gaseous emissions from construction and transport vehicles. Fugitive dust emissions due to movement of heavy construction vehicles Fugitive emissions of debris materials
		Water Quality	Spillage/ spread of debris material and flow into streams Run-off from disposal areas
		Ambient Noise	Noise generation from construction and transport vehicles
		Soil Quality	Spillage/ spread/ deposition of debris

4.3 IMPACTS & MITIGATIONS DURING CONSTRUCTION PHASE

4.3.1 IMPACT & MITIGATION OF AIR QUALITY

Site development activities, excavation, and vehicular movement during the construction phase may lead to the release of fugitive dust into the air, as well as a marginal increase in the concentration of pollutants like SO_2, NO_x, and CO due to vehicular traffic. Un-metaled roads within the plant site and heavy truck mobility further contribute to localized dust emissions. These impacts, however, are temporary and largely confined within the project premises, with negligible effects expected outside the site.

To mitigate these impacts, regular sprinkling of water is carried out during construction to suppress dust, and this practice will continue even after construction due to anticipated truck movements. Approach roads and vehicles are kept in good condition to minimize emissions, and provision is made for water sprinklers in the vicinity of construction activities. Additionally, the project includes extensive tree plantation around the site to further control fugitive dust and improve air quality. These measures, combined with proper vehicle maintenance, material handling protocols, and sufficient vegetation, ensure effective mitigation of potential environmental impacts during the construction phase.

4.3.2 IMPACT & MITIGATION OF WATER QUALITY

During the construction phase, water requirements will be met from the Sone River, ensuring no impact on groundwater sources in the region. Water-intensive activities will primarily include foundation and superstructure development, along with curing of the structure. The construction workforce will mostly consist of local labourers, and in the event that labourers stay on-site, their number is not expected to exceed 4,000. At peak demand, the water requirement for the labour camp will be approximately 100 m^3/day, based on 100 liters per capita per day (lpcd).

Temporary accommodations for workers will be provided within the project premises, along with adequate sanitation facilities, including septic tanks followed by soak pits. This arrangement will maintain hygiene standards and ensure proper waste management. The water requirements during construction are temporary and expected to cause only a minor impact on the water source. Overall, suitable measures, such as the provision of sanitation facilities and controlled water usage, will mitigate any potential environmental impacts during the construction phase. An area earmarked for vehicle equipment maintenance is located in such a manner to prevent contamination of surface and groundwater sources. Unauthorized dumping of waste oil is prohibited for the same.

4.3.3 IMPACT & MITIGATION OF NOISE QUALITY

During the construction phase, noise is generated primarily from vehicular traffic and construction equipment such as dozers, scrapers, concrete mixers, cranes, hoists, pumps, compressors, pneumatic tools, saws, and vibrators. Noise levels from these sources typically range between 70–85 dB(A), significantly impacting the existing ambient noise levels. To mitigate this, major construction activities are carried out during the daytime, and operations are staggered to minimize their cumulative effect on noise levels, as detailed in Table 4.3.

Table 4.3: NOISE LIMITS FOR APPLIANCES AND EQUIPMENT'S

Equipment	Noise Limit dB (A)
Window Air Conditioner	68
Air Cooler	60
Diesel Generators	85-90
Compactors (rollers), Front Loaders, Concrete Mixers, Cranes, Vibrators, and Saws	75

Source: *CPCB, Domestic Appliances and Construction Equipment's at the Manufacturing Stage*

The impact of noise on nearby inhabitants is negligible, as there are no habitations within a 1.5 km radius of the project site. On-site workers are provided with personal protective equipment (PPE) to safeguard their hearing. Additionally, noise-prone activities are limited to daytime hours to further reduce disruption. These measures ensure that the noise impact during construction is effectively controlled and kept within acceptable limits.

4.3.4 IMPACT & MITIGATION OF TOPOGRAPHY AND LAND USE

The proposed project site, housing an unfinished 3x800 MW thermal power plant (TPP), is situated on undulating land with limited development in its surroundings. Prior to construction, land development activities such as leveling and grading will be undertaken to prepare the site for erecting the proposed plant units. The absence of streams within the project site ensures minimal

hydrological impact, though certain amounts of cutting and filling will be required to address land undulations.

During the construction phase, muck generated from excavation activities will be reused for grading, backfilling foundations, filling low-lying areas, and developing the green belt, minimizing waste and resource use. The influx of construction workers may temporarily affect the land use pattern around the project site due to the establishment of temporary labour colonies. However, this impact is expected to be insignificant because most of the labour force will be locally sourced, reducing pressure on resources, and the colonies will be situated within the project boundary. Additionally, this change will be temporary, as the areas occupied by labour colonies will be restored post-construction for plant needs, green belt development, or afforestation.

The conversion of the site to industrial land use is an irreversible impact. To mitigate this, green belt development and afforestation activities will be implemented to enhance the site's ecological value and offset the industrial footprint. Overall, the temporary impacts on land use during the construction phase will be managed effectively, with long-term benefits from sustainable land development practices.

4.3.5 IMPACT & MITIGATION OF SOIL QUALITY

Blasting is not required for levelling or foundation work at the project site. The area is predominantly plain and requires minimal grading, filling, and levelling. The soil primarily consists of clay-sand, and the sub-strata are uniformly plain and non-rocky. Consequently, no significant impacts are anticipated during site preparation activities.

4.3.6 IMPACT & MITIGATION OF ECOSYSTEM

- **Terrestrial Ecology:**

The project site lacks forest cover and does not support any significant fauna. Therefore, no adverse impacts on the terrestrial ecosystem are expected during the construction phase.

- **Aquatic Ecology:**

Sanitation facilities will be provided for construction labourers, ensuring no discharge of wastewater outside the project premises or into nearby water bodies. As a result, the aquatic ecosystem within the study area will remain unaffected.

4.3.7 IMPACT & MITIGATION OF WASTE GENERATION

During the construction phase, hazardous waste such as lubricants, oil filters, and batteries may be generated. Pollution risks could arise from leakage or spillage of oil or fuel due to inadequate protection, vehicle damage, or accidental valve openings. Additional pollution concerns may stem from the storage, treatment, and transportation of contaminated soils, as well as from residual paints and solvents. To mitigate these risks, hazardous waste is securely stored and periodically disposed of through authorized vendors, ensuring compliance with environmental standards.

Upon completion of construction activities, all rubble and waste will be cleared, and unbuilt surfaces will be reinstated and landscaped with vegetation. This not only enhances the plant's aesthetic appeal but also creates a positive working environment during the operational phase.

Table 4.4: Summarization of Impacts & Mitigation Measures-Construction Phase

Sl. No.	Aspects	Impact identified	Mitigation Measures
A	**Land Environment**		
A.1	Soil Quality	Soil compaction may occur due to movement of trucks bringing construction material and transporting construction debris which may affect the soil characteristics like soil fertility, infiltration rate, porosity etc. This ultimately restricts the growth of deep-rooted plants which finally leads to stagnation of succession. Contamination of the soils of surrounding area due to spillage of construction materials such as cement, sand etc.	• Truck movement shall be carried out through existing roads. Any unpaved roads shall be avoided to prevent accidents. • Trucks shall be covered with tarpaulin and overloading shall be avoided.
	Soil Quality	Excavation, leveling, and the removal of existing vegetation are examples of construction operations that inevitably disrupt the top soil. The primary causes of soil effects during the building phase will be topsoil loss in the construction areas and soil pollution in the surrounding regions from construction products such cement, sand, oils, etc. Strong rains throughout the summer and monsoon seasons would cause the disruptions to be more noticeable.	• Appropriate soil conservation measures associated with improved construction techniques would minimize such local impacts.
A.2	Public utilities	Transportation of construction materials shall be by road which will increase the traffic load and may lead to congestion.	• Transportation of construction materials shall be through connecting road to NH -19 and 119 which will be able to accommodate the vehicles that will be required for transportation of necessary materials to and from the site.
A.3	Hazardous Waste	The hazardous materials used during the construction may include diesel and paints. Construction sites handle small quantities of lube oils and diesel for running the construction equipment's. In	• In order to avoid soil contamination due to accidental spills, it has been recommended to provide spill absorbing material at the construction site and the contaminated soil should be

Sl. No.	Aspects	Impact identified	Mitigation Measures
		case of spill of these materials, the soil quality can get deteriorated.	excavated and these materials shall be stored and disposed of to hazardous waste disposal sites according to the guidelines. • Hazardous waste such as used oil generated during construction activities shall be stored at designated paved area in leak proof containers at site and shall be sent for disposal to an authorized recycler. • Other solid waste generated during construction phase such as packaging waste i.e. paper, plastic and etc., shall be collected in dedicated area and shall be disposed off to an approved scrap dealer. • Care will be taken to avoid direct contact and spillage of painting waste containing heavy metals during painting job. It is recommended to cover ground with protecting sheets to avoid damage to soil.
B	**Air Environment**		
B.1	Air Quality	Dust will be the main pollutant affecting the ambient air quality of the area during the construction phase. Activities such as site preparation, operation of heavy machineries and vehicle movement shall generate fugitive dust. Vehicle movement shall also emit gaseous pollutants.	• Necessary dust suppression measures like water sprinkling using road tankers etc. will be deployed to mitigate the dust emissions. • Suitable surface treatment to the roads and regular sprinkling of water shall be provided which will reduce the dust generation. • Proper tuning of vehicles will be done and pollution certificate to keep the gas emissions under check will be made compulsory. • Necessary pollution control measures as per the requirement under local laws and regulations, and otherwise also, will be provided.
	Air Quality	The movement of equipment at site, dust emitted during the leveling, grading, earthworks, foundation works,	• Transport vehicles and construction equipment/machineries will be properly maintained to reduce air

Sl. No.	Aspects	Impact identified	Mitigation Measures
		vehicle movement on unpaved roads and other construction related activities, exhaust emissions from diesel generators, vehicles and other heavy construction equipment deployed at site will be the main sources of air pollution during the construction period. Due to the short duration of the planned action, any impacts on ambient air quality during construction activities are expected to be short term.	emissions • Equipment will be periodically checked and maintained time to time. • Exhaust vent of DG set will be kept at proper height to ensure quick dispersion of gaseous emissions • Sprinkling of water on roads and construction site, growing sufficient vegetation are some of the measures that would greatly reduce the impacts during the construction phase. • Implementing proper upkeep and maintenance of vehicles and using Pollution under Control (PUC) certified vehicles for transport machinery.
B.2	Noise Level Noise Level	The operation of construction equipment will generate noise. The noise produced during the construction will have significant impact on the existing ambient noise levels. There will be noise generation from construction equipment and material handling equipment. Vehicles carrying construction materials will also generate noise.	• Any machinery or equipment generating excessive noise levels will be taken out for maintenance. • Use of proper personal protective equipment will be encouraged which will mitigate any significant impact of the noise generated by such equipment. • Well-tuned vehicles will be used and loud noise will be checked every day which help in reducing noise during operations.
		The activities such as foundation & infrastructure construction, plant erection will produce periodic noise during construction phase. However, possible noise control measures will be adopted and hence the impact of generated noise on the equipment is likely to be temporary and insignificant.	• D.G set to be used during construction phase shall be provided with acoustic enclosures. • Hearing protection shall be provided to the workers and their use by workers shall be enforced by contractors as well as site management.
C	**Water Environment**		
C.1	Water quality	During the construction phase, site preparation (leveling, excavations etc.) and erection of structures may have temporary effect on the water quality of receiving water body. Flow of loose materials (soil and	Construction management will ensure the following: • The wash off will be directed to a sedimentation basin before discharge. As the site and drainage network is already developed, the

Sl. No.	Aspects	Impact identified	Mitigation Measures
		construction material) into the drains, especially during monsoons may result in higher turbidity and suspended solids content. Stagnation of water may create unhygienic condition.	impacts shall be controlled effectively. • Fuel oil, lubricants and grease etc. shall be stored in closed containers in dykes in storage areas with impermeable floors. • Adequate arrangements would be made to ensure proper drainage and disposal of the wastewater; so that water does not stagnate promoting the breeding of mosquitoes and creating unhygienic conditions.
D	Ecology	As the land is already under possession of NSTPP and is under industrial use, the direct impact on terrestrial ecology (loss of flora and fauna) during construction phase is likely to be insignificant. Construction activities may result in fugitive dust emission. The dust deposition on pubescent leaves of the surrounding vegetation may lead to temporary reduction of photosynthesis. The runoff from construction area may lead to a short-term increase in suspended solids and decrease in dissolved oxygen near the discharge point in receiving water body. This may lead to a temporary decrease in the photosynthetic activity of phyto-planktons, rise in anaerobic conditions and food chain modification.	• As the site infrastructure facilities are already developed, construction activities will be confined to the proposed project site and the impact will be marginal for a short time period. • Fugitive dust emission shall be minimized through regular water sprinkling in dust-generating areas and green belt development. • All the stormwater runoff shall be channelized through sedimentation basins to control suspended solids.
E	Demography & Socio-economics	The social impact during the construction stage will be beneficial in nature. During construction phase, people from neighborhood will be engaged by contractors on daily average basis as most of the construction work is labour intensive. Local people would be preferred for secondary employment with contracting agencies, depending upon their skill and experience. During construction, due to influx of	Positive impacts • Generation of employment both direct and indirect to the local people. • Improvements in local infrastructure, such as roads, transportation, and utilities. • Increased employment and small business opportunities near construction site that can increase economic growth, leading to improved living standards.

Sl. No.	Aspects	Impact identified	Mitigation Measures
		labour, economic activities in surrounding areas will be increased. The construction material like stone chips and sand may be procured locally. Thus, there is possibility of generation of local trading opportunities for a limited period of time.	
F	Local Infrastructure	The influx of labor will result in increased load on drinking water facilities, health facilities and sewerage system. The labours may get engaged in fights with the locals resulting in social unrest.	• Basic facilities for labors hired from outside such as shelters, and adequate drinking and sanitation facilities shall be provided.
G	Site Development & Construction of Main Plant & Ash Pond	The site development and construction activity will generate dust, which generally settles down on the adjacent areas within a short period due to its larger particulate size. This temporary dust generation and deposition on vegetation from the construction activity have adverse impact on visual and aesthetic quality in and around the proposed activity. The proposed main plant site is located within the existing power plant site, have experienced in such activities. The potential impact on Visual and aesthetics due to fugitive emission without mitigation major is considered to be Moderate significance.	• Dust nuisance from the construction site will be suppressed through periodical water spraying at disturbance area; • Construction material will be transported through covered truck/trailors.
	Local Resources	Stress on Local Resources and Overcrowding Unemployment or underemployment, leading to increased crime rates.	• Creating job opportunities and promoting economic development will reduce unemployment and associated crime rates. • Raising awareness about the importance of education can help control population growth and improve overall quality of life. • Increase vocational training programs to improve employability and reduce unemployment.

4.4 IMPACTS QUANTIFICATION & MITIGATIONS DURING OPERATIONAL PHASE

Identification of probable activities during operational phase and its impact on certain environmental factors is given below:

Table 4.5: Environment Identification Matrix for Operation Phase

Environmental Factors	Activities during Operation Phase					
	Plant Operation	Unloading and Storage of Coal	Coal Combustion	Water withdrawal & Treatment	Ash Handling	Disposal and Storage of Gypsum
Ambient Air	●	●	●	●	●	●
Water Resource				●	●	●
Water Quality	●	●		●	●	●
Ambient Noise		●				
Flora and Fauna	●		●	●	●	●
Soil Quality			●		●	●
Public Utilities	●					
Socio-economic	❍					

● Adverse Impacts ❍ Beneficial Impacts

Description of identifiable impacts during operational phase is given below:

Table 4.6: Description of identifiable impacts during Operation Phase

Sl. No.	Activities	Parameters	Description of Impacts
1	Plant Operation	Ambient Air	Air emission due to operation and transportation of coal. Fugitive dust emission due to material handling, movement of trucks and oil tankers
		Water Quality	Spillage of coal/ oil and flow into streams
		Flora and Fauna	Dust emission due to operation and transportation of coal. Fugitive dust emission due to material handling, movement of trucks and oil tankers
		Public Utilities	Increased flow of traffic Congestion of roads
		Socio-Economic	Primary and secondary employment
2	Unloading and Storage of Coal	Ambient Air	Fugitive dust emissions and noise from coal handling areas
		Water Quality	Effluents for CHP/ oil storage areas Effluents from dust extraction/suppression systems Run-off from coal stock yard
		Ambient Noise	Noise emission due to operation and transportation of coal. Noise emission due to material handling, movement of trucks and oil tankers
3	Coal combustion	Ambient Air	Stack emissions
		Soil Quality	Deposition of dust on soil
		Flora and Fauna	Deposition of dust and gaseous pollutants on leaves
4	Water withdrawal	Water Resource	Reduced availability to downstream users

Sl. No.	Activities	Parameters	Description of Impacts
	& Treatment		Reduced flow in downstream direction/change in regime
		Water Quality	Generation of Effluents and Sludge from Treatment Plant Clarifier Sludge Filter Backwash DM Plant Regeneration Waste Tube Settler Sludge
		Flora and Fauna	Entrapment/ impingement of organisms
5	Ash Handling	Ambient Air	Air pollution due to fugitive nature of coal ash
		Water Resource	Water needs for ash disposal
		Water Quality	Leachate from ash dyke may affect ground water quality
		Soil Quality	Spill out of ash may accumulate in soil leading to change in soil structure.
6	Disposal and Storage of Gypsum	Water Resource	Water needs for FGD and gypsum disposal
		Water Quality	Generation of effluents and sludge
		Soil Quality	Generation of effluents and sludge

4.4.1 IMPACT, QUANTIFICATION & MITIGATION OF AIR QUALITY

4.4.1.1 AIR POLLUTION MODELLING

4.4.1.1.1 FUGITIVE EMISSION

The air borne fugitive dust from the plant is likely to be generated from coal handling plants, stock piles and traffic movement which will be deposited on the topsoil in the immediate vicinity of the plant boundary. However, the fugitive emission is likely to be controlled to a great extent through control measure like dust suppression system at coal transfer point, dedusting system at Crusher House by bag filter, water sprinkling on road, extensive greenbelt development thereby limiting emission of PM to less extent etc. The impact of fugitive emissions from all sources is likely to be restricted over a limited area (up to a maximum distance of 500 m from the source).

4.4.1.1.2 PROCESS STACK EMISSION

Other than the fugitive emission, the flue gas emission from the chimney of the existing and proposed units of the power plant as a result of coal burning is anticipated to be the major contributor to increase in pollution level in the ambient air quality of the project vicinity. For the proposed units, PM will be limited below 30 mg/Nm^3 and 100 mg/Nm3 for SO_2& NO_2 as per standards vide S.O.3305E dated 7th December.2015. Hg emissions will be insignificant and below TPP emission standards of 0.03 mg/Nm^3 for Indian coals. The emissions from the existing Unit will be 30, 100 and 100 mg/Nm^{3}for PM_{10}, SO_2 and NO_2 respectively.

In order to quantify the maximum likely impact within a 15km buffer area around the project site, the contribution of the existing as well as proposed units of the power plant on the ambient concentration level is assessed using suitable approved dispersion model.

4.4.1.1.3 AIR MODELLING AIR POLLUTION IMPACT PREDICTION THROUGH MODELLING FOR OPERATING PHASE

The impact on air quality is assessed based on combined emissions of the proposed power plant along with the present baseline data. Suspended Particulate Matter (SPM), Sulphur dioxide (SO2) and Oxides of Nitrogen (NOX) will be the important pollutants emitted from the power plant. Prediction of impacts on air environment has been carried out employing mathematical model based on a steady state Gaussian plume dispersion model designed for multiple point sources for short term. In the present case, AERMOD dispersion model based on steady state Gaussian plume dispersion, designed for multiple point sources for short term and developed by United States Environmental Protection Agency [USEPA] has been used for simulations from point sources.

Air Dispersion Modelling Studies

Prediction of impacts on air environment has been carried out by air dispersion modelling employing mathematical model based on a steady state Gaussian plume dispersion model designed for multiple point sources.

The assessment methodology for the air dispersion modelling is done based on document "Assessment of Impact to Air Environment: Guidelines for Conducting Air Modelling" by Central Pollution Control Board.

The detailed model recommended is AMS/EPA Regulatory Model (AERMOD). The model of selection was the commercially available AERMOD Ver 8.0 View dispersion model, developed by Lakes Environmental. This model is used extensively to assess pollution concentration and deposition from a wide variety of sources. AERMOD View is a true, native Microsoft Windows application and runs in Windows applications. The AMS/EPA Regulatory Model (AERMOD) was specially designed to support the EPA's regulatory modelling programs.

AERMOD is a regulatory steady-state plume modelling system with three separate components:

- AERMOD (AERMIC Dispersion Model)
- AERMAP (AERMOD Terrain Preprocessor), and
- AERMET (AERMOD Meteorological Preprocessor).

The AERMOD model includes a wide range of options for modelling air quality impacts of pollution sources, making it a popular choice among the modelling community for a variety of applications.

Modelling capabilities of AERMOD include the following:

- The model can be used to analyze primary pollutants and continuous releases of toxic and hazardous waste pollutants.
- Source emission rates can be treated as constant or may be varied by month, season, hour-of-day, or other optional periods of variation. These variable emission rate factors may be specified for a single source or for a group of sources. For this project all emission rates were treated as constant.
- The model can account for the effects of aerodynamic downwash due to buildings that are nearby point source emissions.
- Receptor locations can be specified as gridded and/or discrete receptors in a Cartesian or polar coordinate system.

- For applications involving elevated terrain, the U.S. EPA AERMAP terrain preprocessing program can be incorporated into the model to generate hill height scales as well as terrain elevations for all receptor locations.
- The model contains algorithms for modelling the effects of settling and removal (through dry and wet deposition) of large particulates and for modelling the effects of precipitation scavenging for gases or particulates.

AERMOD requires two types of meteorological data files, a file containing surface scalar parameters and a file containing vertical profiles. These two files are provided by the U.S. EPA AERMET meteorological preprocessor program.

- **For Proposed Units:**
  - Electrostatic Precipitators to limit the particulate emission (PM) within 30 mg/Nm^3
  - Wet FGD system will be provided to bring down SO_2emission within 100 mg/Nm^3.
  - Low NOX burners (LNB)/Low NOx System, which reduces the air available to the fuel stream during the devolatilization process, and thus reduces NOX production to bring down NO_2 emission within stipulated norms.
  - Chimney height of 275 m for wider dispersal of cleaned flue gas.

- **For Existing Units:**
  - Electrostatic Precipitators to limit the particulate emission (PM) within 30 mg/Nm^3
  - Wet FGD system will be provided to bring down SO_2emission within 100 mg/Nm^3.
  - Low NOX burners (LNB)/Low NOx System, which reduces the air available to the fuel stream during the devolatilization process, and thus reduces NOX production to bring down NO_2 emission within stipulated norms.
  - Chimney height of 275 m for wider dispersal of cleaned flue gas.

Model Input Data

4.4.1.1.4 STACK DETAILS

The emission data in the model has been calculated using the Sulphur content and emission factors of various components. Emission Rates (Maximum) has been calculated considering the MoEF&CC emission standards of pollutants dated 07.12.2015. Modelling has been done for two different scenarios for proposed units as given as below.

Scenario 1: Emissions from existing units of NTPC Nabinagar is covered in baseline monitoring. For proposed units stack height is considered 275m with FGD within 15 km radius. PM emission rate is 30 mg/Nm^3, SO_2 & NOx emission rate is considered at 100mg /Nm^3

Scenario 2: Emissions from existing units of NTPC Nabinagar is covered in baseline monitoring. For proposed units stack height is considered 275m with FGD within 15 km radius. PM emission rate is 30 mg/Nm^3, SO_2 emission rate is considered as 100 mg/Nm^3 while NOx emission rate is considered at 350mg /Nm^3. The stack details are given in table below:

Table 4.7: Details of Stack Emissions of Proposed Plant

Description	**Proposed Stage-II (3x800 MW)**	
Scenario	**With FGD**	
Units	**Unit-1**	**Unit-2&3**
No. of Stack(s)	**1 (Single Flue)**	**2 (Bi Flue)**
Stack height (m)	275	275
Internal diameter at Stack Top(m)	8.3	8.3
Exit velocity of flue gas (m/s)	18.3 (Max.)	18.3 (Max.)
Temp. of flue gas degree ^{o}C	60	60
Flue gas flow rate (Nm^3/Sec)	815	815
Rate of coal consumption, TPH	488	488
GCV of Coal(kcal/kg)	3400	3400
PM emission rate (g/s)	24.45 @30 mg/Nm^3	24.45 @30 mg/Nm^3
SO_2 emission rate (g/s)	81.50 @ 100mg /Nm^3	81.50 @ 100mg /Nm^3
NOx emission rate (g/s) (Scenario-1)	81.50 @ 100mg /Nm^3	81.50 @ 100mg /Nm^3
NOx emission rate (g/s) (Scenario-2)	285.25 @ 350 mg/ Nm3	285.25 @ 350 mg /Nm3

4.4.1.1.5 PREDICTED GROUND LEVEL CONCENTRATIONS

Short-term simulations, for maximum 24-hourly average ground level concentrations (GLCs) as applicable is carried to predict the concentrations at the various receptors to quantify the likely impact on the ambient concentration level over an area covering 15-km radius from the point of emission source. The maximum incremental ground level concentrations (GLCs) are predicted taking the worst-case scenario of emission from the project. The maximum incremental GLCs due to the proposed expansion project for PM_{10}, SO_2 and NO_x are superimposed on the ambient baseline concentration of PM_{10}, SO_2 and NO_X recorded at all the monitoring locations during the field monitoring period of pre monsoon season i.e., March to May, 2024.

The resultant maximum ambient air quality (baseline+incremental) after implementation of worst-case scenario is tabulated in **Table 4.8.**

Table 4.8: Resultant GLC for Nabinagar - Proposed Units for Scenario-1

Sl. No.	Sampling Location Code	Station Name	Direction	Distance (km)	Baseline AAQ, µg/m3			Incremental GLCs, µg/m3			Resultant GLCs, µg/m3		
					SO_2	NO_2	PM	SO_2	NO_2	PM	SO_2	NO_2	PM
1	AAQ1	Project Site	0	Inside Project Boundary	25.51	35.60	91.60	2.80	2.80	0.84	28.31	38.40	92.44
2	AAQ2	Sasna	WNW	0.50	20.51	26.60	87.10	9.87	9.87	2.96	30.38	36.47	90.06
3	AAQ3	Akorhi	ESE	0.85	18.40	23.90	83.04	4.30	4.30	1.29	22.70	28.20	84.33
4	AAQ4	Madhe	SW	0.90	17.22	22.40	76.63	2.70	2.70	0.81	19.92	25.10	77.44
5	AAQ5	Jasoiya	E	3.32	12.40	16.10	69.80	1.34	1.34	0.40	13.74	17.44	70.2
6	AAQ9	Karamkila Village	N	3.30	16.30	21.20	83.35	3.25	3.25	1.22	19.55	24.45	84.57
7	AAQ8	Bisrampur	SE	4.01	17.37	22.60	77.00	2.40	2.40	1.64	19.77	25.00	78.64
8	AAQ10	Salaiya Village	SSW	5.60	14.50	18.80	83.35	1.23	1.23	0.72	15.73	20.03	84.07
9	AAQ7	Charan Kalan	ESE	6.31	17.12	22.30	80.59	5.46	5.46	0.97	22.58	27.76	81.56
10	AAQ6	Tilouthu Village	WNW	6.55	19.50	25.40	84.99	4.07	4.07	0.37	23.57	29.47	85.36
24 hours NAAQS for Industrial, Residential, Rural and Other Areas											**80**	**80**	**100**

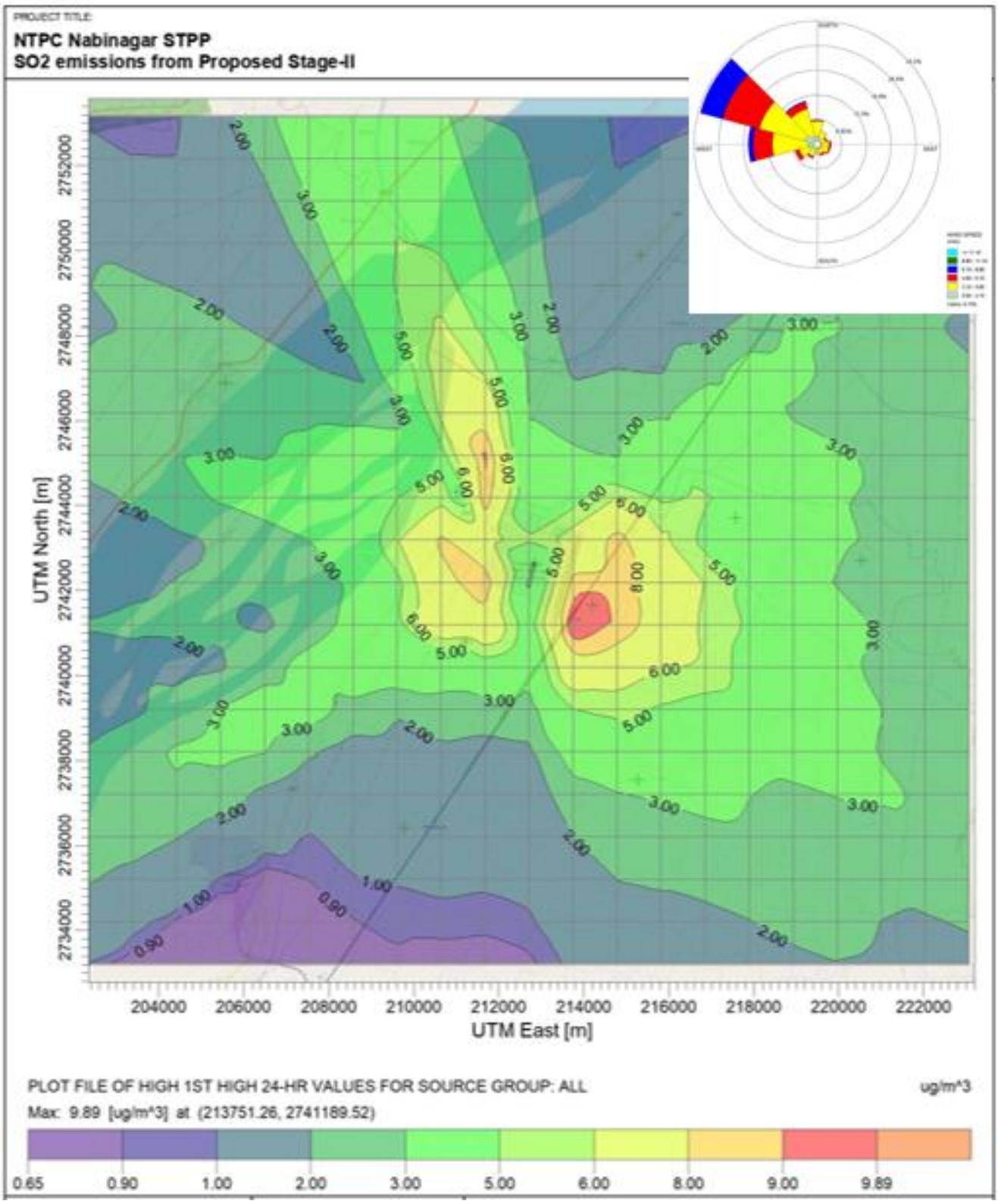


Figure 4.1: SO_2 Incremental Ground Level Concentration with FGD (Max = 9.89 µg/m^{3}at 1.1 km in SE)

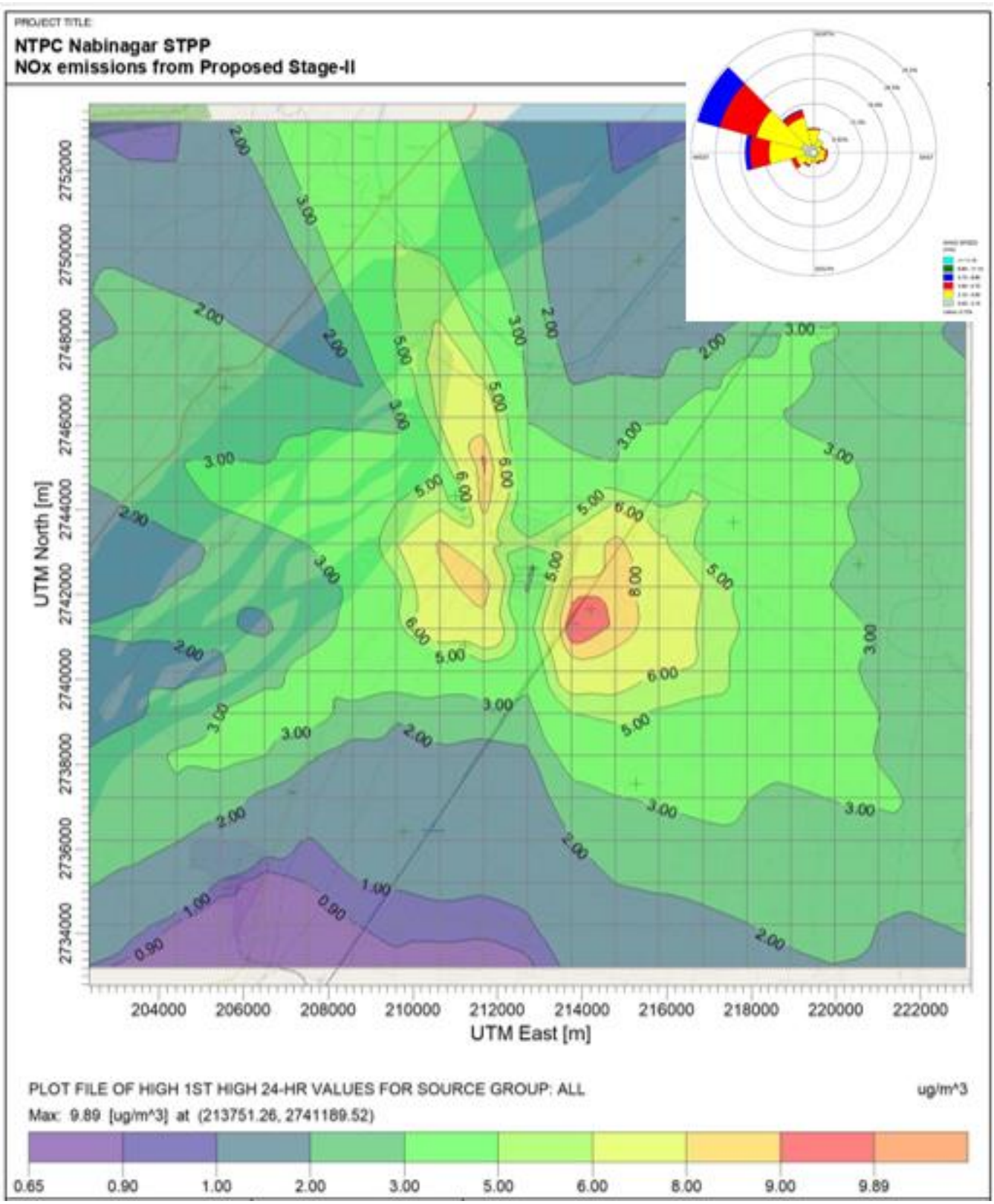


Figure 4.2: NO_x Incremental Ground Level Concentration with FGD
(Max = 9.89 µg/m^3 at 1.1 km in SE)

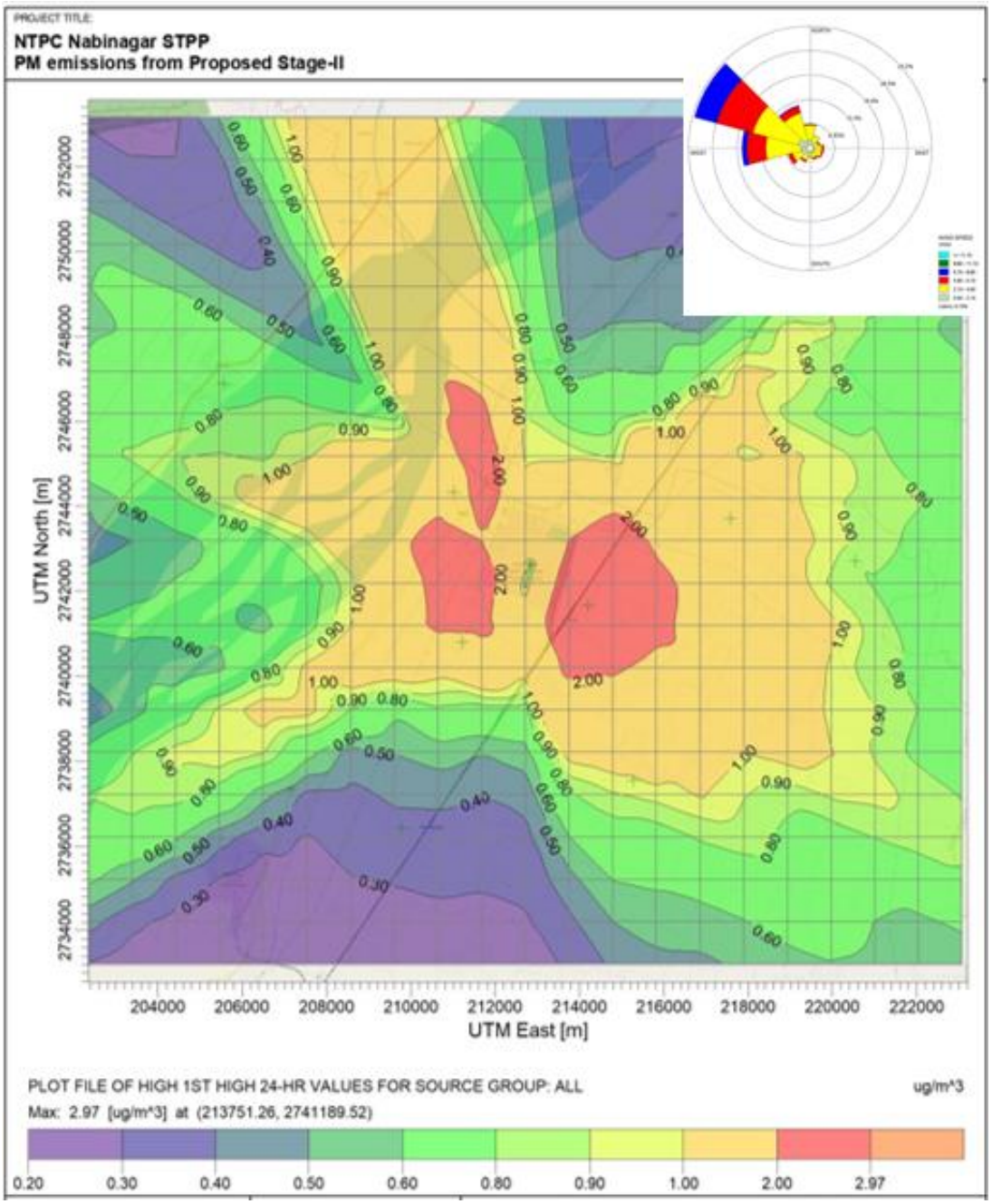


Figure 4-3: PM Incremental Ground Level Concentration with FGD (Max = 2.97 µg/m^3 at 1.1 km in SE)

Observation:

Thus, from the prediction of the proposed project, it is clear that even the highest contribution on the ground level concentrations of NOx and SO_2 are very low. The resultant concentrations at all locations are found to be within the permissible limits of NAAQS. Therefore, after implementation of the units of project, the maximum GLCs for SO2 and NOx are predicted to be within the prescribed 24 hours NAAQS for Industrial, Residential, Rural and Other Areas Hence impact on air quality is considered to be insignificant due to the proposed project.

Table 4.9: Resultant GLC for Nabinagar - Proposed Units with for Scenario-2

Sl. No.	Station Name	Direction	Distance (km)	Baseline AAQ, µg/m3			Incremental GLCs, µg/m3			Resultant GLCs, µg/m3		
				SO_2	NO_2	PM	SO_2	NO_2	PM	SO_2	NO_2	PM
1	Project Site	0	Inside Project Boundary	25.51	35.60	91.60	2.80	9.82	0.84	28.31	45.42	92.44
2	Sasna	WNW	0.50	20.51	26.60	87.10	9.87	34.53	2.96	30.38	61.13	90.06
3	Akorhi	ESE	0.85	18.40	23.90	83.04	4.30	15.06	1.29	22.7	38.96	84.33
4	Madhe	SW	0.90	17.22	22.40	76.63	2.70	9.45	0.81	19.92	31.85	77.44
5	Jasoiya	E	3.32	12.40	16.10	69.80	1.34	4.71	0.40	13.74	20.81	70.20
9	Karamkila Village	N	3.30	16.30	21.20	83.35	4.07	11.38	1.22	20.37	32.58	84.57
8	Bisrampur	SE	4.01	17.37	22.60	77.00	5.46	8.40	1.64	22.83	31.00	78.64
10	Salaiya Village	SSW	5.60	14.50	18.80	83.35	2.40	4.30	0.72	16.90	23.10	84.07
7	Charan Kalan	ESE	6.31	17.12	22.30	80.59	3.25	19.13	0.97	20.37	41.43	81.56
6	Tilouthu Village	WNW	6.55	19.50	25.40	84.99	1.23	14.27	0.37	20.73	39.67	85.36
24 hours NAAQS for Industrial, Residential, Rural and Other Areas										**80**	**80**	**100**

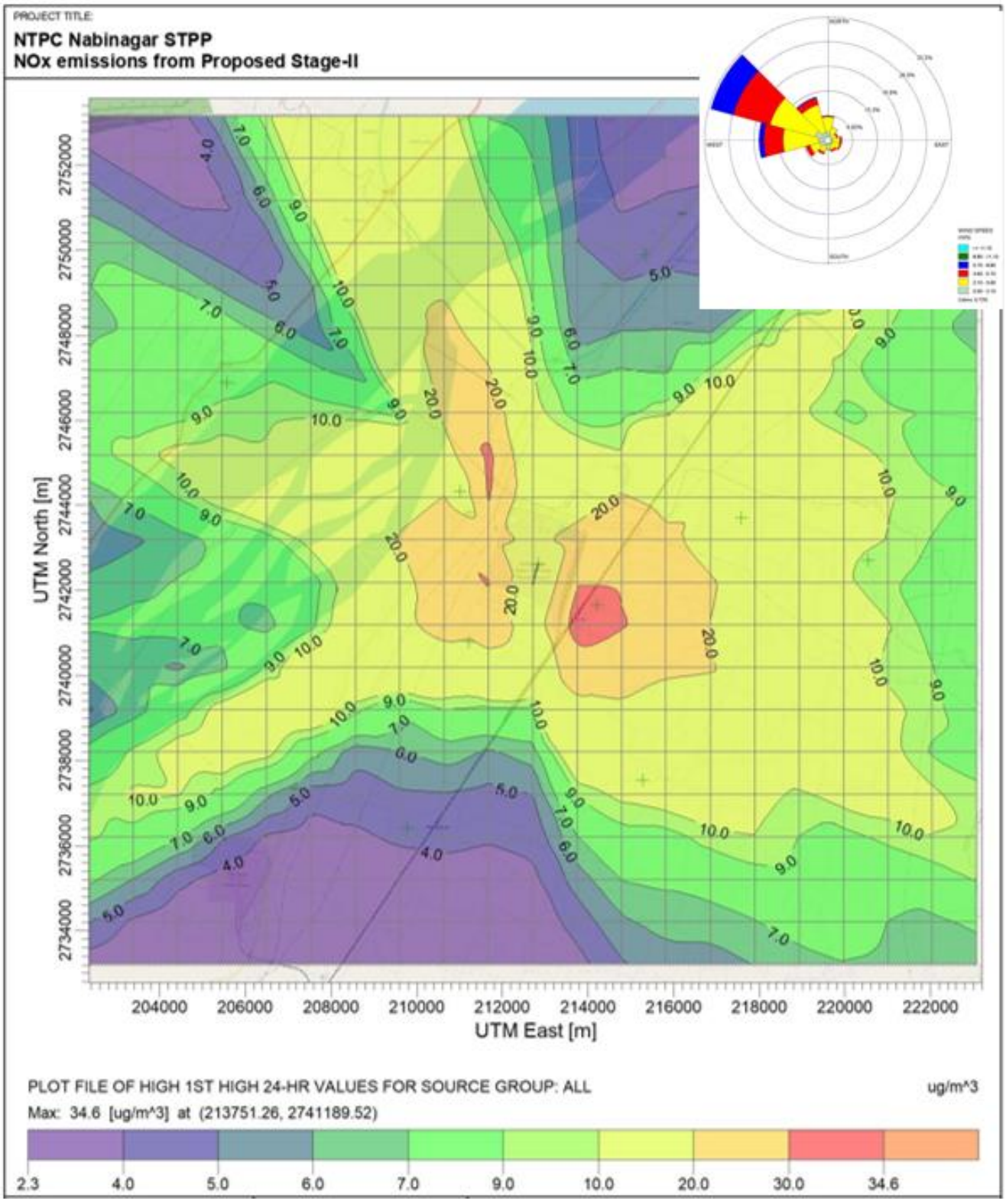


Figure 4.3: NO_x Incremental Ground Level Concentration with FGD (Max = 34.6 µg/m^3 at 1.5 km SE)

Observation:
Thus, from the prediction of the proposed project, it is clear that the highest contribution on the ground level concentrations of NOx is close to the limit. The resultant concentrations at all locations are found to be within the permissible limits of NAAQS. Therefore, after implementation of the units of project, the maximum GLCs for SO_2 and NOx are predicted to be within the prescribed 24 hours NAAQS for Industrial, Residential, Rural and Other Areas.

4.4.1.2 MITIGATION OF AIR QUALITY

Electrostatic Precipitator (ESP) for Particulate Matter (PM) Control

- Installation of ESP: To control particulate matter emissions from the stacks, an Electrostatic Precipitator (ESP) will be installed. The ESP will effectively capture and remove fine particulate matter before it is released into the atmosphere.
- Regular Maintenance and Monitoring: Routine inspection and maintenance of the ESP will ensure optimal performance and minimal emissions, with continuous monitoring of particulate emissions to adhere to regulatory standards.
- Efficient Dust Collection: The ESP will be designed to handle high-efficiency dust collection, ensuring that particulate emissions are kept well within the legal limits set by regulatory bodies.

Flue Gas Desulphurization (FGD) for SO2 Control

- Lime Scrubbing System: A Flue Gas Desulphurization (FGD) system with lime scrubbing will be implemented to control sulphur dioxide (SO_2) emissions. The FGD process will absorb SO_2 from the flue gases before they are released into the atmosphere.
- Compliance with SO_2 Limits: The FGD system will be designed to meet the stringent SO_2 emission limits and will be regularly monitored to ensure consistent and effective operation.
- Lime Handling and Disposal: Proper handling and disposal mechanisms for lime used in the scrubbing process will be established to prevent environmental contamination.

Low NOx Burners for Nitrogen Oxides (NOx) Control

- Installation of Low NOx Burners: To reduce the formation of nitrogen oxides (NOx) during combustion, low NOx burners will be installed in the boilers. These burners will ensure that NOx emissions are minimized by optimizing combustion conditions.
- Operational Adjustments for Efficiency: The low NOx burners will be calibrated for maximum efficiency, and periodic checks will be conducted to ensure that NOx emissions remain well below the permissible limits.

Mercury (Hg) Emission Monitoring

- Monitoring and Compliance: Regular monitoring of mercury levels will be implemented to ensure adherence to national and international emission standards.

Dust Suppression at Railway Siding and Coal Handling Plant

- Dust Suppression Measures: Dust suppression systems, including water sprinkling and dust suppressants, will be employed in the railway siding and coal handling plant. This will minimize fugitive dust emissions during coal unloading and transportation.
- Regular Dust Control: Regular monitoring and maintenance of dust suppression equipment will ensure their effectiveness in reducing particulate matter release into the environment.
- Sprinkling on Coal Wagons: To control fugitive emissions during coal transportation, the top surface of coal wagons will be adequately sprinkled with water to minimize dust during transit.

Minimizing Fugitive Dust from Conveyor Belts

- Covered Belt Conveyors: To reduce fugitive dust emissions from the coal handling system, the belt conveyors will be fully covered. This will help contain the dust and prevent its spread into the surrounding environment.
- Efficient Dust Capture: The design will include provisions for the effective capture of dust generated during coal transfer, with systems in place to control any emissions from the conveyor system.

Temporary Auxiliary Fuel Transportation

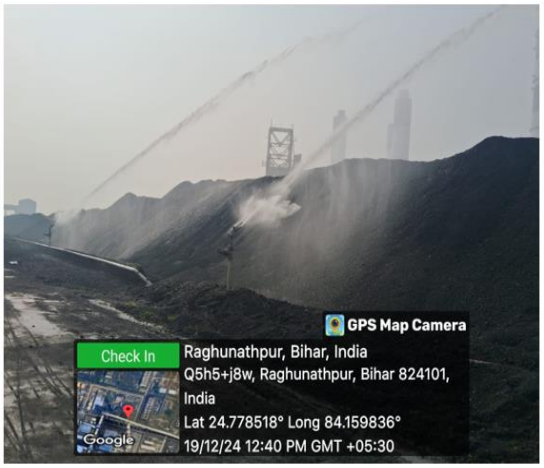
- Limited Impact: The transportation of auxiliary fuel will be occasional, with minimal impact on air quality. Measures will be in place to ensure that any emissions from fuel transport are controlled and temporary.
- Dust and Emission Control: During fuel transportation, vehicles will be covered to prevent dust emissions and minimize environmental impact.

Fly Ash Silo Bag Filters

- Bag Filters for Fly Ash Silos: To prevent particulate emissions from the fly ash silos, bag filters will be installed. These filters will effectively capture and contain fine particles of fly ash that may otherwise be released into the atmosphere.
- Routine Maintenance and Monitoring: Regular maintenance and performance checks of the bag filters will be conducted to ensure their proper functioning and minimize fly ash emissions.

Regular Housekeeping and Maintenance

- Housekeeping Practices: Regular housekeeping activities will be carried out at plant roads, platforms, and storage areas to prevent the accumulation of dust and debris. These efforts will contribute to a cleaner working environment and reduce fugitive emissions.
- Scheduled Cleaning: The plant will implement a scheduled cleaning program, focusing on high-traffic areas and critical equipment, to minimize dust generation.
- By integrating these mitigation measures, the thermal power plant will significantly reduce its environmental impact, ensuring that emissions remain within permissible limits and contribute to a cleaner, safer environment.



SPRINKLING SYSTEM AT COAL HANDLING PLANT

SPRINKLING SYSTEM AT WAGON TRIPPLER

4.4.2 IMPACT, QUANTIFICATION & MITIGATION OF WATER RESOURCES-SURFACE & GROUND WATER

Most of the wastewater generated will be recycled and reused. The effluent recycling/ reuse system will be designed for maximum reuse of all the plant effluents. This system will not include storm water/ rainwater reuse in the plant during monsoon seasons. The sources of plant effluent are mainly: (i) CW blow down; (ii) Effluent from WT plant; (iii) Coal pile area run off water and (iv)Plant drains

Part of the CW blow down will be utilized for meeting the requirement of ash/ coal handling systems and horticulture. Excess blow down will be led to guard pond.

Water treatment plant effluent comprises mainly of WT plant regeneration waste and filter backwash. These effluents will be pumped to the guard pond through a neutralizing pit.

The drains from the coal handling area run off (during rainy season) will be led to a pond. Coal particles will settle down in the pond and clear water from the pond will overflow to the storm water drain.

Plant drains from SG/ TG area will be led to a sump which will also collect wastes from transformer area and fuel oil farm area. These oily effluents will be further treated in an oil water separator for

removal of oil traces. The clear water will be led to the guard pond and the dirty oil will be disposed off in drums, separately.

The cooling tower blow down will be passed ultimately to the guard pond to keep the temperature within the acceptable limit before re-use within the plant premises.

The domestic sewage will be treated in the STP and treated sewage will be used for horticulture proposes. Provision is to be made for rainwater harvesting to collect stormwater from roof top, road/ paved areas, greenbelt and open areas.

The impact on water resources shall be insignificant as wastewater generating within the project site is getting treated in the ETP & STP and is being recycled & reused following the zero liquid discharge concept.

Figure 4.4: Water Reservoir at site

4.4.2.1 IMPACT ON WATER SOURCE

The Water Resources Department (WRD) of the Government of Bihar, through a communication dated 06.06.2007, has approved a commitment of 125 cubic feet per second from the River Sone to the Nabinagar project. The project site is conveniently situated within 3 kilometers of the existing intake point at Indrapuri Barrage on the Sone river. The water requirement for Stage-I of the project is about 1,42,560 KLD (5940 m^3/hour). For the Nabinagar-II (3x800 MW) project, it is approximately 72,000 KLD (3000 m^3/hour) using an ash water recirculation and air-cooled condenser system.

The proposed project will operate under Zero Liquid Discharge (ZLD) compliance, ensuring that no effluents are discharged, thereby preventing any adverse impact on the surrounding water bodies. Raw water will be sourced from the left bank of the Sone River, which minimizes the risk of aquatic life entrapment. To further safeguard aquatic organisms, finer bar screens (4 to 6 mm diameter) or steel meshes with closer spacing (5 to 10 mm) will be utilized, effectively preventing fish and other aquatic species from being entrapped.

Figure 4.5: NPGC Pump House

4.4.2.2 IMPACT ON GROUND WATER

No significant impact on groundwater quality is expected, as all wastewater generated from the proposed project will be treated and reused. Additionally, there will be no groundwater extraction since the water requirement will be met through sourcing from the Sone River.

4.4.2.3 MITIGATION MEASURES –RUN OFF & WASTEWATER

There is no generation of process wastewater in the proposed project. Zero Liquid Discharge norms will be followed.

4.4.2.3.1 RAIN WATER HARVESTING

Based on the site specific drainage map and contour map interpretation hydrological calculations have been made for the proposed project. The total annual rainwater available for harvesting is calculated 2886823.6 m^3 or 2.8 MCM per annum. The rainwater available for harvesting based on heaviest rainfall in 15 mins is calculated 107563.32 m^3 or 0.1 MCM per annum (Table 10.4). There is no extraction of groundwater for project. To harvest this rainwater around 38.24 i.e. 39 Nos of Pits with a size of 12.5m x 15m x 15m (Length x Breath x Height) have been proposed.

The storage tanks will be designed considering heaviest rainfall in 15 mins. The rainwater from amenities, parking area & roads will be diverted to storm water drains. The storm water drains would be provided all along the roads & surface streams. They would be adequately sized to prevent flooding of the site. Details of rainwater harvesting is given in chapter 10 section 10.6.3.

Table 4.10: Rainwater available for harvesting in a year

Sr. No.	Description	Total Area (m^2)	Effective area considered for rainwater harvesting (m^2)	Average Annual Rainfall (m)	Coefficient as per annexure IV of revised guidelines for NOC, CGWA, 2017	Water available for Rainwater Harvesting (m^3)
1	Roof top/shed area – BTG etc.	1050000	945000	1.070	0.70	707805
2	Road/paved area (Switchyard, weigh bridge, road, tank etc)	1785900	1607310	1.070	0.6	1031893
3	Green belt	5956000	5360400	1.070	0.20	1147125.6
Total						**2886823.6**

Table 4.11: Rainwater available for harvesting in 15 mins

Sr. No.	Description	Total Area (m^2)	Effective area considered for rainwater harvesting (m^2)	Average Annual Rainfall (m)	Coefficient as per annexure IV of revised guidelines for NOC, CGWA, 2017	Water available for Rainwater Harvesting (m^3)
1	Roof top/shed area – BTG etc.	1050000	945000	0.020	0.70	13230
2	Road/paved area (Switchyard, weigh bridge, road, tank etc)	1785900	1607310	0.020	0.6	19287.72
3	Green belt	5956000	5360400	0.020	0.20	75045.6
Total						**107563.32**

Figure 4.6: Rainwater Harvesting unit at site

4.4.3 IMPACT, QUANTIFICATION & MITIGATION OF ECOLOGICAL RESOURCES

The direct impacts of the project are limited to the project site itself. It will not adversely affect the existing flora and fauna, and therefore, there will be no impact on biodiversity.

4.4.3.1 IMPACTS ON TERRESTRIAL ECOLOGY

Impacts on terrestrial ecology may arise from gaseous emissions such as SO_2 and NO_x. At low concentrations, these pollutants can act as atmospheric fertilizers for vegetation, but at higher levels, they may harm both plants and animals. The primary sources of air pollution from the proposed plant include flue gas emissions from stacks and fugitive dust. Key pollutants include sulfur dioxide, suspended particulate matter, and NO_x. However, modeling simulations indicate that incremental pollutant concentrations remain well within permissible NAAQ limits. Therefore, no significant impact is anticipated on the surrounding terrestrial ecology.

4.4.3.2 IMPACT ON AQUATIC ECOLOGY

The unit will operate on a zero-discharge process, ensuring no adverse impact on aquatic ecology. The plant's drainage system will be designed to prevent stormwater from carrying any pollutants. Regarding migratory paths for wildlife, forest working plans indicate no identified routes for major or minor wildlife within the project site or study area. The avifauna observed in these regions are local migrants only. Hence, the proposed plant operations are unlikely to adversely affect avian migratory paths.

4.4.3.3 MITIGATION MEASURES –GREENBELT DEVELOPMENT

4.4.3.3.1 OBJECTIVE

The primary objective of the green belt is to create an effective barrier between the plant and its surrounding areas. This green belt serves to capture fugitive emissions, reduce noise levels generated within the plant, and enhance the overall aesthetic appeal of the site. To effectively control industrial pollutants, dense tree plantations are essential.

The design of the green belt will consider the sedimentation patterns of pollutants, along with their ambient and ground-level concentrations, which are influenced by factors such as wind direction, wind speed, and thermal gradients in the area. Accordingly, the plantation will be planned to maximize its efficacy. The width of the green belt will depend on factors like gaseous emissions, land availability, and site-specific characteristics. Proper geometry of tree planting is crucial to ensure an effective windbreak.

A diverse mix of tree species will be planted, supplemented with shrubs and grasses intercropped to enhance coverage. Efforts will be made to avoid gaps in the green belt; where gaps are unavoidable, alignments to roads will be designed to minimize the funnelling effect of wind.

The tree species selected for the green belt will include native varieties identified in Chapter-3. These will be planted in multiple rows with a density of 2000–2500 trees per hectare. The plantation will maintain adequate width around the plant boundary as per CPCB guidelines. Interspaces will be planted with grasses, bushes, and hedges to create a comprehensive green cover.

In summary, the green belt will consist of rows of trees strategically planted to form an effective barrier between the plant and its surroundings. Its design and implementation will adhere strictly to the latest CPCB guidelines, with the following broad aspects to be addressed:

- Shrubs and trees will be planted in encircling rows around the proposed project site;
- The short trees (10 m height) will be planted in the outer rows (away from plant side).
- Planting of trees in each row will be in staggered orientation (Triangular form);

Existing area of the greenbelt is 597.16 Ha. A total of 1,73,049 trees (since commissioning) have been planted on the existing land. Further, 595.60 Ha of greenbelt & plantation is proposed to be developed to achieve plantation on 33% of the site area. Greenbelt development plan from 2024-25 to 2032-33 is given below.

Table 4.12: Green Belt Development Plan from 2024-25 up to 2032-2033

Action Plan for Green Belt development in NTPC Nabinagar					
S no	**Financial Year**	**Area in Acres**	**Green Belt proposed In Ha (2500 no/Ha)**	**Tentative budget In Crores**	**Remarks**
1	2024-25	4.94	2	1.77	Miyawaki Plantation including 3 yrs maintenance in Township area work under Execution
2	2025-26	111.15	45	10.0	Above rates includes 3 Yr Maintenance of Green Belt for 5000 No's(Considered 2 Ha) Amount Rs 4444250
3	2026-27	111.15	45	10.0	
4	2027-28	123.5	50	11.1	
5	2028-29	123.5	50	11.1	
6	2029-30	74.1	30	6.7	
7	2030-31	74.1	30	6.7	
8	2031-32	74.1	30	6.7	
9	2032-33	40.9279	16.57	3.7	
	Total	**737.468**	**298.57**	**67.67**	

To enhance the greenbelt's effectiveness, shrubs will be planted in front of the trees to cover the lower portion of the trunks, which are typically devoid of foliage. Additionally, the spacing between trees will be slightly reduced compared to standard practices, encouraging vertical growth and thereby increasing the effective height of the greenbelt.

Plant Species for Greenbelt

The selection of plant species for the proposed greenbelt will be based on the following criteria:

- Fast-growing species will be prioritized.
- Species with a dense canopy cover will be selected.
- Perennially green plants will be preferred.
- Native species will be given precedence.
- Plants with a high leaf area index will be chosen.

Details of the greenbelt development plan are provided in Section 10.6.2 of Chapter 10.

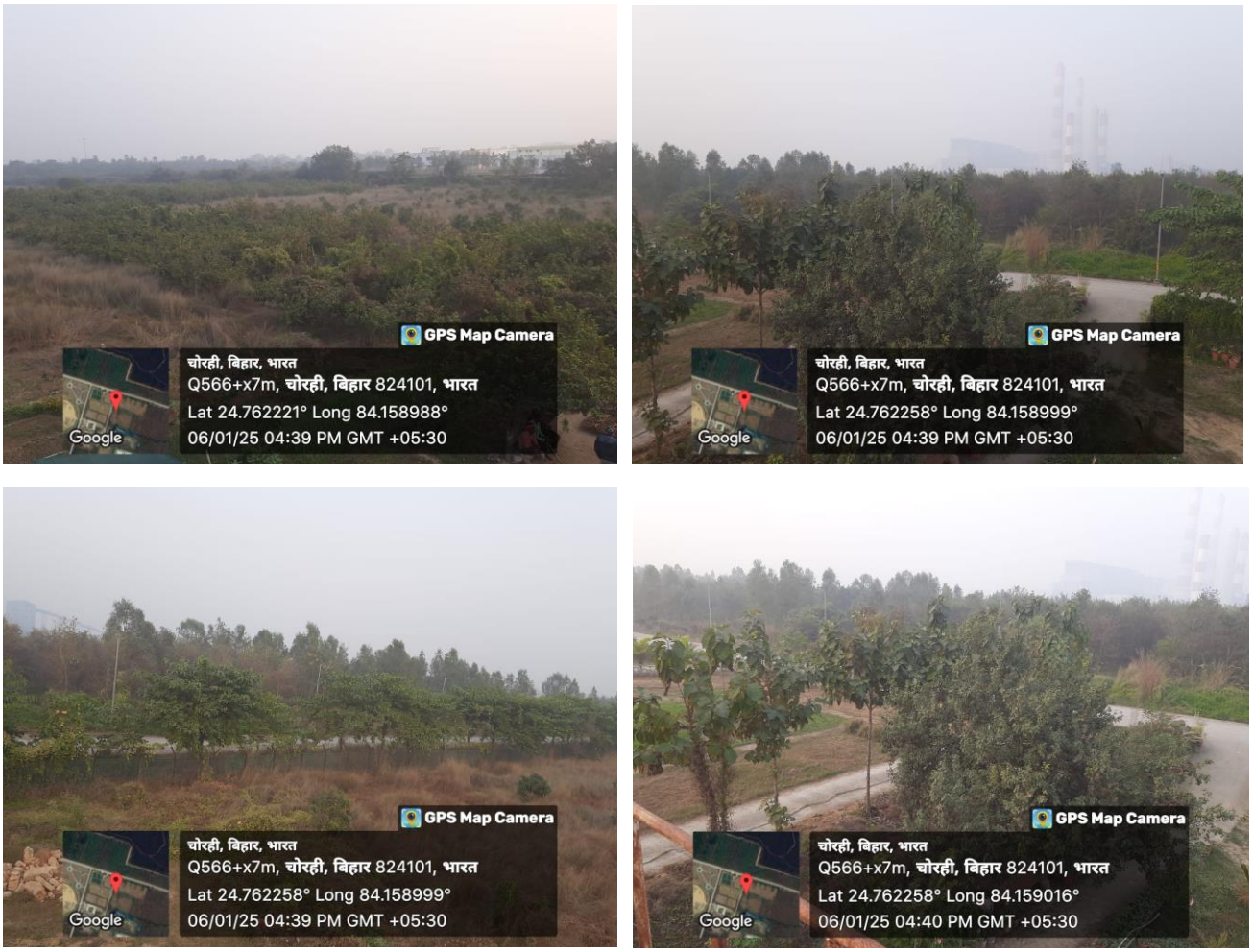


Figure 4.7: Plantation of saplings

4.4.4 IMPACT, QUANTIFICATION & MITIGATION OF SOCIO-ECONOMIC ENVIRONMENT

Most people around the site rely on agriculture and service-related work for their income. The proposed brownfield project will positively impact the socio-economic conditions of the region by employing local personnel during both the construction and operation phases, while also generating secondary employment, thereby enhancing income levels and improving living standards. However, the plant's expansion activity may have both positive and negative effects on the surrounding population. To assess these socio-economic impacts, studies were conducted

through focus group discussions and consultations with Gram Panchayat officials, with the findings summarized in **Table-4.13.**

Table 4.13: ASPECTS DURING CONSTRUCTION & OPERATION PHASE

Positive Impacts	Negative Impacts
No land acquisition is planned, ensuring there is no loss of land or associated livelihoods. The project will generate employment opportunities for local workers during both the construction and operational phases. The project is expected to create a multiplier effect through induced growth during the construction and operational phases, benefiting around local individuals, with the majority being local youth, through downstream and upstream activities. 50% of the employees working in Stage-I are from Aurangabad. Over the next five years, vocational and soft skills training programs will be developed or upgraded for local youth, enhancing their employability. The project is expected to foster the growth of local entrepreneurs in complementary activities such as small businesses, transportation, and equipment repair and maintenance.	Air and noise pollution may occur if appropriate mitigation measures are not implemented. The increased influx of people and vehicle transportation may place additional pressure on the existing road network in the area.

4.4.4.1 MEASURES TO IMPROVE ON SOCIO ECONOMIC CONDITIONS

The surrounding areas require significant infrastructure development, particularly in medical facilities, sanitation, and skill-based education in nearby villages. The proposed project is expected to act as a catalyst for such development by attracting substantial capital investment to the district. Efforts will also focus on providing essential amenities like drinking water, promoting educational institutions, and improving medical services, especially for senior citizens, infants, and pregnant women. Community centers, recreational facilities, and other social initiatives will be developed as part of the project's social responsibility. The primary aim is to enhance the overall development and economic status of local villages in the project's vicinity.

4.4.4.2 SOCIO- ECONOMIC IMPACT MATRIX

The impact of general activities on socio-economic indices can be assessed by creating a matrix to predict likely impacts. The predicted impacts on the socio-economic environment are detailed in Table 4.14.

Table 4.14: Predication of Likely Impacts on Socio- Economic Environment

Parameter	Local	Regional	Direct	Indirect
Employment	+	+	+	+
Income	+	·	+	+
Transport	-	+	-	-
Education	+	+	+	+
Medical facilities	+	·	+	·
Communication	+	·	+	·
Availability of power	+	+	+	+
Sanitation	+	·	+	·
Housing	+	·	+	·
Health	-	·	-	·
Recreation	·	·	·	·

Agriculture	-	.	.	.
Cost of living	.	.	.	.
Business	+	+	+	+
Pollution	-	.	-	.

+=Positive Impact, -=Negative Impact, ·=Insignificant

From the proposed expansion activity direct impact will be on employment, health, business growth and environmental pollution.

Figure 4.8: Public consultation at different locations

4.4.4.3 MITIGATION MEASURES

- Minimize disturbances to the local community during construction by:
    - Implementing safe practices during the loading and unloading of construction materials.
    - Reducing transportation activities during the daytime and ensuring roads remain undamaged by heavy transportation.
- Prioritize hiring local workers during both construction and operational phases, providing them with appropriate safety and technical training.
- Offer vocational and IT-related courses to SC/ST youth.
- Implement dust control measures, including:
    - Water sprinkling on unpaved roads and work sites.
    - Installing wheel and truck washing facilities at the site.
- Construct and maintain approach roads; ensure materials are covered during transportation.

- Conduct health initiatives such as:
    - Organizing health camps in nearby villages.
    - Providing mobile dispensary services and free medicines to BPL and vulnerable populations.
- Arrange regular awareness programs on sanitation, health, and education, addressing prevalent regional health issues to improve the socio-economic status of the area.
- Pave unpaved roads to improve accessibility and reduce dust.
- Foster coordination with local communities through discussions and development planning by NSTPP in collaboration with village representatives.

4.4.5 IMPACT, QUANTIFICATION & MITIGATION ON TRAFFFIC

The study has been done as per Indian Road Congress (IRC) Standards and based on the existing traffic scenario. This includes the traffic due to the existing plant for bringing raw materials and taking out solid waste. To &from movement of vehicles are considered for carrying men & materials to plant. The PCU due to existing expansion of plant traffic has then been deducted from existing PCU as surveyed to project PCU. This will be considered as a theoretical baseline PCU without expansion of Nabinagar TPP. On this baseline, PCU due to expanded plant will be added to obtain PCU due to expanded plant when the number of trucks increases further.

(i) **Change in Road Scenario:** The traffic volume as surveyed during field survey has been projected till 2026-27 considering 7% growth each year.

(ii) **Post-expansion change in road scenario:** After expansion, there will be an increase in the number of vehicles. The contribution of additional 666 PCU/day from the plant will be over and above the projected baseline PCU of 2026-27. It is being considered that 100% of this additional PCU shall travel thru the selected locations. The Level of Service in this scenario is outlined in **Table 4-15**.

Relation between V/C ratio &LoS		
V/C Ratio	**LoS**	**Performance**
0.0-0.2	A	Represents a condition of free flow
0.2-0.4	B	Represents a zone of stable flow
0.4-0.6	C	The general level of comfort and convenience declines noticeably at this level
0.6-0.8	D	Represents the limit of stable flow
0.8-1.0	E	Represents operating condition when traffic volumes are at or close to the capacity level

Table 4.15: Existing and Proposed Level of Service

Parameters	T1: Barun-Nabinagar road (connecting road to NH-19)	Parameters	T1: Barun-Nabinagar road (connecting road to NH-19)
Existing PCU/day during 2023	3504	Projected PCU/day during 2026-27 with 7% growth	4292
--	--	Additional PCU/day due to project expansion	666
--	--	Total PCU/day in 2026-27	4958
Design capacity (C) PCU/day	15000	Design capacity (C) PCU/day	15000
V/C	0.23	V/C	0.33
Existing LoS during 2023	B	LOS in 2026-27 due to project expansion	B

From the survey, it is clear that the LoS of the road will not change i.e. remains B only, during 2026-27 even if the project comes into operation.

(iii) Prediction of Incremental Air Pollution due to increase in Traffic

The emission factors reported in this study are based on BS-IV certified diesel trucks for which the predicted Ground level concentrations of Sulphur dioxide, CO, and HC+NOx have been estimated on 24 hours basis. The model has been run on the basis of the number of trucks on which a survey has been done during the monitoring period from March to May 2024. For the expansion project, wind speed of 1.6 km/hr and stability class C has been considered. The predicted ground level concentration of gases is given in **Table 4.16**.

Table 4.16: Comparison between Pollution Load before and after Project Scenario

Pollutant	Distance (m)	GLC 24hr (µg/m^3) BS IV	
		T1: Barun-Nabinagar road (connecting road to NH-19)	
		Existing	After expansion
NOx+HC	100	5	9
	200	2	4
	300	2	3
	400	1	3
	500	1	2
	600	1	2
	700	1	2
	800	1	1
	900	1	1
SO_2	100	0.1	0.3
	200	0.1	0.1
	300	0.0	0.1
	400	0.0	0.1
	500	0.0	0.1
	600	0.0	0.1

Pollutant	Distance (m)	GLC 24hr (µg/m^3) BS IV	
		T1: Barun-Nabinagar road (connecting road to NH-19)	
		Existing	After expansion
	700	0.0	0.0
	800	0.0	0.0
	900	0.0	0.0
CO	100	27	49
	200	14	25
	300	9	16
	400	8	14
	500	7	12
	600	6	11
	700	5	9
	800	5	8
	900	4	8

Due to the use of ultra-low sulfur diesel oil, the incremental GLC due to SO_2 emission (GLC – 24 Hrs) will be insignificant. The contribution of CO (GLC – 1 Hrs) is well within prescribed NAAQS and HC+NOx(GLC – 24 Hrs) is almost insignificant.

4.4.5.1 MITIGATION ON TRAFFFIC

- **Introduction of Electric Vehicles (EVs)**

  - **Deployment of Electric Vehicles**: To mitigate air pollution from traffic associated with the Nabinagar Thermal Power Plant, a fleet of electric vehicles (EVs) will be introduced for plant-related transportation needs, including employee commuting, material handling, and internal plant logistics.
  - **Charging Infrastructure**: Sufficient EV charging stations will be installed at strategic locations within the plant premises and nearby areas to ensure the availability and efficient use of electric vehicles.
  - **Incentives for EV Adoption**: To promote the use of electric vehicles among employees, the plant can offer incentives such as subsidies or preferential parking for electric vehicles.
  - **Regular Maintenance and Upkeep**: Regular maintenance of the EV fleet will be ensured to maximize their operational efficiency, extend vehicle lifespan, and minimize emissions associated with any potential failures.

- **Adoption of BS-VI Compliant Vehicles**

  - **Transition to BS-VI Vehicles**: All diesel and petrol-powered vehicles used within the plant and in its transportation system will be upgraded to meet the stringent BS-VI (Bharat Stage VI) emission standards. These vehicles emit significantly lower levels of harmful pollutants

like nitrogen oxides (NOx) and particulate matter (PM) compared to their older BS-IV counterparts.

- **Fleet Replacement Program**: The plant will gradually phase out older vehicles that do not comply with BS-VI standards, replacing them with new, cleaner vehicles that meet the latest emission norms.
- **Monitoring Emission Levels**: Regular monitoring of vehicle emissions will be conducted to ensure compliance with BS-VI standards and to identify any vehicles that may need repairs or replacements.

➢ **Traffic Management and Optimization**

- **Reduced Traffic Congestion**: The plant will implement effective traffic management strategies to reduce congestion and ensure smooth vehicle flow in and around the plant area. This will help reduce vehicle idling time, thereby minimizing the release of exhaust pollutants.
- **Dedicated EV and Low Emission Zones**: Specific lanes or zones within the plant and its vicinity will be designated for electric vehicles and BS-VI compliant vehicles, reducing the presence of older, more polluting vehicles in high-traffic areas.
- **Encouraging Carpooling and Public Transport**: The plant will promote carpooling and encourage the use of public transportation systems to reduce the number of private vehicles on the road, thereby cutting down on overall emissions.

➢ **Vehicle Maintenance and Eco-Driving Training**

- **Routine Vehicle Maintenance**: Regular servicing and maintenance of all plant-related vehicles will be mandatory to ensure they operate efficiently and in line with emission standards. This will include checking and replacing parts like air filters, fuel injectors, and exhaust systems to minimize pollutants.
- **Eco-Driving Training for Drivers**: Drivers will undergo eco-driving training to optimize fuel efficiency and reduce emissions. Techniques such as smooth acceleration, braking, and speed regulation will be taught to minimize the environmental impact of driving.

➢ **Use of Alternate Fuels**

- **Biofuels and Compressed Natural Gas (CNG)**: In addition to BS-VI compliant vehicles, the use of alternative fuels like CNG and biofuels will be explored for vehicles in the transportation fleet. These fuels emit significantly fewer pollutants than conventional diesel or petrol, further contributing to air quality improvement.

➢ **Enhanced Greenery and Planting**

- **Green Buffer Zones**: To further mitigate the effects of traffic pollution, green buffer zones will be developed along major traffic routes within and around the plant. This will help absorb airborne pollutants, reduce dust, and improve the overall air quality.
- **Tree Planting Initiatives**: Tree planting campaigns will be initiated along roads and in open areas within the plant to act as natural air purifiers, sequestering carbon dioxide and filtering other airborne contaminants.

➢ **Monitoring and Reporting**

- **Continuous Air Quality Monitoring**: Air quality monitoring systems will be established to track pollution levels related to ambient air emissions, especially around plant and nearby areas. The data will be used to assess the effectiveness of implemented measures and guide future actions.
- **Public Disclosure of Emissions**: Transparent reporting of air quality and emissions from various sources will be made available to the public through display board at main gate, fostering accountability and ongoing improvement.

4.4.6 IMPACT, QUANTIFICATION & MITIGATION ON NOISE QUALITY

An industrial complex typically comprises multiple noise sources, either in clusters or as individual units. These sources may be located within buildings of varying dimensions and materials, or placed in open areas or under sheds. To estimate noise levels at different distances from the plant site, a user-friendly model is used to predict the noise levels accurately.

4.4.6.1 MATHEMATICAL MODEL FOR SOUND WAVE PROPAGATION DURING OPERATION

To estimate the dispersion of noise in the ambient environment from a source point, a standard mathematical model for sound wave propagation is applied. The sound pressure level produced by noise sources decreases as the distance from the source increases, primarily due to wave divergence. Further reduction in sound pressure levels occurs due to atmospheric effects or interactions with objects along the transmission path. For hemispherical sound wave propagation through a homogeneous, loss-free medium, noise levels at various distances can be calculated using a first-principles-based model with the following equation:

$$Lp2 = Lp1 + 20 \log (r1/r2) \quad \text{.....(1)}$$

Here, Lp1 and Lp2 are the sound pressure levels (SPLs) at distances r1 and r2 from the source. The combined noise levels from multiple sources at a specific location can be determined using:

$$Lp\ (Total) = 10 \log (10^{(Lp1/10)} + 10^{(Lp2/10)} + 10^{(Lp3/10)} \dots) \quad \text{.....(2)}$$

Where Lp1, Lp2, Lp3 represent the sound pressure levels at the given point due to different noise sources.

Using these equations, a user-friendly model has been developed with the following features:

- Supports up to 200 noise sources;
- Predicts noise levels at any specified distance from the source;
- Designed for flat terrain conditions;
- Inputs include source coordinates in meters;
- Calculates maximum and minimum noise levels;
- Provides output in the form of isopleths;
- Environmental attenuation factors and machine corrections are excluded from the model, but adjustments are made for the measured Leq levels.

This model serves as a practical tool for estimating and analyzing noise levels in an industrial or environmental context.

4.4.6.1.1 INPUT FOR THE MODEL

The incremental noise levels during the operational phase of the plant expansion have been predicted using a mathematical model. Key noise sources have been identified and considered as cumulative noise inputs to the model. Major contributors to the noise include the turbine generator, along with other sources such as cooling towers, boilers, mills, transformers, compressors, and similar equipment.

4.4.6.1.2 RESULTS & DISCUSSION

The ambient noise levels measured at the plant boundary are 66.5 dB(A) during the day and 44.1 dB(A) at night. Predicted noise levels show that the 30 dB(A) noise contour occurs at the plant boundary in all directions, except toward the west, where incremental noise levels are expected to reach up to 60 dB(A). However, the predicted maximum noise levels remain below the monitored ambient baseline noise levels at the plant site. Therefore, no significant increase in ambient noise levels is anticipated.

4.4.6.1.3 WORK ZONE NOISE LEVELS

The Occupational Safety and Health Administration (OSHA) damage risk criteria stipulate that noise levels up to 90 dB(A) are acceptable for an 8-hour work shift. Modeling results indicate that high noise levels, ranging between 60-80 dB(A), are confined to the work zones. At the plant boundary, noise levels are expected to range between 30.0 dB(A) and 60.0 dB(A).

Adequate protective measures, such as ear muffs and ear plugs, have been provided for workers in high-noise areas. Necessary noise protection equipment will be supplied to personnel working near high-noise-generating sources. Additionally, noise reduction in high-noise machinery zones can be achieved through preventive measures, such as optimizing building layouts for equipment placement.

4.4.6.1.4 COMMUNITY NOISE LEVELS

The day-night sound pressure level (Ldn) is commonly used to assess community noise exposure, incorporating a 10 dB(A) penalty for nighttime. The predicted incremental noise levels at a distance of 0.5 km from the plant boundary are expected to be below 30.0 dB(A). Since most human settlements are located beyond 0.5 km from the plant site, the impact on the general population is expected to be negligible.

4.4.6.1.5 CONCLUSION

The noise assessment for the Nabinagar STPP indicates that the ambient noise levels at the plant boundary are within acceptable limits, with no significant increase anticipated due to plant operations. Work zone noise levels, while higher, are confined to specific areas and comply with OSHA standards, ensuring worker safety through the provision of protective equipment. Community noise exposure is predicted to remain minimal, as incremental noise levels beyond 0.5 km from the plant boundary are well below thresholds of concern. Overall, the project demonstrates effective noise management strategies to safeguard both workers and the surrounding community.

4.4.6.2 Noise Mitigation Measures

The following design features have been incorporated to ensure low noise levels:

- Noise pressure levels will be minimized through proper design and installation of enclosures around equipment, wherever possible.
- A dense green belt will be developed around the plant boundary to attenuate noise to acceptable levels at the boundary and beyond.
- Workers operating near high-noise-generating machinery will be provided with protective equipment like ear muffs and ear plugs.
- The plant will comply with OSHA standards, ensuring that noise levels do not exceed 90 dB(A) for an 8-hour work shift.
- Employee rotation will be implemented in areas with higher noise levels to limit individual exposure as per OSHA guidelines.
- Regular noise level monitoring will be conducted to ensure compliance with safety standards.
- Preventive maintenance of noise-generating machinery will be carried out to control noise emissions effectively.

4.4.7 IMPACT, QUANTIFICATION & MITIGATION OF SOIL QUALITY

Soil compaction can result from truck movements transporting construction materials and debris, affecting soil properties such as fertility, infiltration rate, and porosity. This compaction can hinder the growth of deep-rooted plants, ultimately stalling ecological succession. Additionally, construction material spills, such as cement and sand, may contaminate surrounding soils. To mitigate these impacts, truck movement will be confined to existing roads to avoid damage to unpaved surfaces, with trucks covered by tarpaulin and overloading prevented. Construction activities, including excavation and leveling, may disrupt topsoil, with the loss of topsoil and pollution from construction materials being primary concerns, especially during heavy rainfall in the monsoon season. Appropriate soil conservation practices and improved construction techniques will be employed to minimize such impacts. During the operation phase, fugitive dust and gas emissions, including ash and coal spillage, may cause localized soil contamination. These pollutants, along with particulate matter (PM), SO2, and NOx, can alter the soil's physical and chemical properties, impacting plant growth. Measures to control these effects include using tarpaulin-

covered transportation vehicles to minimize dust, and the installation of emission control technologies such as ESP, dust suppression, and bag filters for particulate matter. FGD and De-NOx systems will control SO2 and NOx emissions, while ash silos and HCSD systems will ensure proper handling of fly and bottom ash. Overall, the incremental levels of particulate matter and gaseous emissions are expected to remain within the National Ambient Air Quality Standards (NAAQS), reducing their impact on surrounding soils.

4.4.8 IMPACT, QUANTIFICATION & MITIGATION OF SOLID WASTE GENERATION

4.4.8.1 IMPACTS OF SOLID WASTE GENERATION:

During the operation phase, the project is expected to generate significant solid waste, primarily comprising ash and gypsum. Ash will result from coal combustion, with 80% as fly ash and 20% as bottom ash. Improper management of these wastes could lead to environmental issues such as air pollution from dust emissions and potential soil and water contamination. Gypsum from the Flue Gas Desulfurization (FGD) system also requires careful handling to prevent adverse environmental effects.

4.4.8.2 MITIGATION MEASURES OF SOLID WASTE GENERATION:

To mitigate these impacts, the project will strictly comply with the *Construction and Demolition Waste Management Rules, 2016*. A robust ash management strategy will be implemented, including dry collection of fly ash and dewatering bin-based collection of bottom ash. The ash will be supplied to entrepreneurs for industrial and construction applications, promoting reuse. Surplus ash will be disposed of in an ash dyke equipped with a water blanket to control dust emissions. Upon the closure of the ash dyke, reclamation will be carried out through green vegetation.

Gypsum from the FGD system will be handled responsibly, with a focus on achieving 100% utilization in industrial or agricultural applications. These comprehensive measures will ensure that solid waste is managed sustainably, minimizing environmental impacts and enhancing resource recovery.

4.4.9 IMPACTS, QUANTIFICATION & MITIGATION OF FLY ASH

4.4.10 IMPACTS OF FLY ASH

Fly ash, when not managed properly, can have several environmental and health impacts. If allowed to accumulate in large quantities, it can lead to soil contamination, groundwater pollution, and adverse effects on local ecosystems. Additionally, airborne fly ash particles, if not collected effectively, can contribute to respiratory issues in humans and animals. However, in this case, the fly ash will be collected in dry form and transported for 100% utilization in cement manufacturing, road construction, brick production, and other productive uses, as per the Fly Ash Notification of December 31, 2021. Ash Generation and Utilization Data of Stage-I from 2019-20, 2020-21, 2021-22, 2022-23 and 2003-24 is given in **Table 4.17.**

Table 4.17: Ash Utilization Report from 2019-20 up to2023-2024

Fin Year	Ash Production (LMT)	Total AU (LMT)	Total AU (%)
FY 2019-20	6.44	3.31	51.41
FY 2020-21	10.43	5.39	51.70
FY 2021-22	16.84	8.57	50.89
FY 2022-23	26.07	19.97	76.61
FY 2023-24	29.92	20.98	70.13
FY 2024-25 till Dec'24	26.32	21.55	81.88

A detailed Ash Utilization Plan has been prepared for the period from FY 2023-24 to FY 2032-33 in compliance with the MoEF&CC Fly Ash Notification dated December 31, 2021. As per the notification, starting from April 2022, all Thermal Power Plants (TPPs) are required to utilize 100% of the ash (fly ash and bottom ash) generated annually, with a minimum utilization of 80% each year in a rolling three-year cycle, while achieving an average of 100% ash utilization over the cycle. Plants with an ash utilization rate below 60% in FY 2021-22, however, are granted a two-year relaxation. Since the ash utilization for NPGCL Nabinagar during FY 2021-22 was 50.89%, the three-year compliance cycle will commence from April 2024. Accordingly, the Ash Utilization Plan for the MoEF&CC compliance cycle (FY 2023-24 to FY 2032-33) has been outlined in Table 4.18. Failure to comply with these requirements will result in an environmental compensation of ₹1,000 per metric ton of unutilized ash.

Table 4.18: Ash Utilization Report Plan up to 2022-2033

MoEF& CC Compliance Cycle	Year	Ash Generation (LMT)	Area Development (LMT)	Outside Bricks (in MT)	Own Brick plant (LMT)	Cement & Other Industries (LMT)	Roads Construction (LMT)	Ash based Product / Others (LMT)	Mines Filling (LMT)	Total Ash Utilized (LMT)	Ash Utilization (%)
First	**Operation from existing 3x 660 MW(St-1)**										
	FY 2022-23	26.07	0.15	0.07	0.00	14.43	5.33	0.00	0.00	19.97	76.61
	FY 2023-24	29.92	0.24	0.24	0.00	10.80	9.70	0.00	0.00	20.98	70.13
	FY 2024-25	34.00	0.35	1.36	0.00	23.12	14.96	0.00	0.00	39.79	117.04
	FY 2025-26	34.00	0.37	1.36	0.00	23.12	15.64	0.00	0.00	40.49	119.08
	FY 2026-27	34.00	0.38	1.36	0.00	23.12	16.32	0.00	0.00	41.18	121.12
Second	FY 2027-28	34.00	0.41	1.36	0.48	20.40	10.88	0.48	0.00	34.00	100.00
	FY 2028-29	34.00	0.41	1.36	0.48	20.40	10.88	0.48	0.00	34.00	100.00
	FY 2029-30	34.00	0.41	1.36	0.48	20.40	10.88	0.48	0.00	34.00	100.00
Third	**With Commissioning of St-2 Unit-1& Operation from 3x 660 MW(St-1) + 1x800 MW(St-2)**										
	FY 2030-31	48.00	0.58	1.92	0.67	28.80	15.36	0.67	0.00	48.00	100.00
	With Commissioning of St-2 Unit-2& Operation from 3x 660 MW(St-1) +2x800 MW(St-2)										
	FY 2031-32	61.00	0.73	2.44	0.85	36.60	19.52	0.85	0.00	61.00	100.00
	With Commissioning of St-2 Unit-3& Operation from 3x 660 MW(St-1) +3x800 MW(St-2)										
	FY 2032-33	75.00	0.90	3.00	1.05	45.00	24.00	1.05	0.00	75.00	100.00

Figure 4.9: Ash Dyke area

Air Pollution:

Fly ash particles can become airborne during handling, transport, and storage, leading to dust emissions that degrade air quality.

Water Contamination:

Improper disposal or leakage from ash ponds can contaminate nearby surface and groundwater resources, posing risks to the environment and human health.

Land Degradation:

The accumulation of ash in disposal areas can result in soil contamination and loss of land productivity, affecting the surrounding ecosystem.

Resource Wastage:

Limited utilization of fly ash increases waste generation, placing additional strain on disposal systems and the environment.

Operational Challenges:

Inefficient handling and transport systems can lead to spillage, increased dust emissions, and challenges in maintaining environmental compliance.

4.4.11 MITIGATION OF FLY ASH IMPACTS

Air Pollution Control:

- Use pneumatic conveying systems for transferring ash to silos, reducing dust emissions.
- Install dust suppression systems such as bag filters, pulse jet mechanisms, and aeration blowers in silos and hoppers.
- Provide fugitive dust suppression facilities in ash dyke areas.

Water Contamination Prevention:

- Implement a High-Concentration Slurry Disposal (HCSD) system for secure ash slurry transportation to dykes.
- Reuse decanted water from ash ponds through an ash water recirculation system, minimizing fresh water usage.

Land Restoration:

- Maintain water blankets on ash dykes to prevent dust dispersion.
- Reclaim ash disposal sites with green vegetation once the dykes are no longer in use, restoring ecological balance.

Resource Utilization:

- Segregate fine and coarse ash using classified silos for efficient reuse.
- Supply fly ash to industries for applications such as cement production and brick making.
- Use mechanized bagging systems for safe packaging and transport of fine ash.

Operational Efficiency:

- Optimize fly ash handling with advanced systems, including screw-type air compressors, refrigerant air dryers, and buffer hoppers.
- Use rotary feeders and telescopic chutes in silos for efficient ash loading into tankers.

Compliance and Monitoring:

- Design ash handling and disposal systems to comply with environmental regulations.

- Conduct regular monitoring of air quality, water management, and ash utilization to ensure compliance.
- Provide training to workers on best practices for sustainable fly ash handling and disposal.

4.5 OVERALL IMPACTS & MITIGATION MEASURES

Some of the impacts identified in various construction & operation phases are insignificant and do not warrant much attention whereas some others are important especially with respect to the existing site context. Therefore, such impacts which are significant and require a detailed analysis for decision-making or formulating adequate management measures have been identified. This section deals with an assessment of impact of various activities during construction & operation phase on environmental conditions. The methodology of assessment is based upon identification and description of the project activities as well as environmental components followed by predicting the impact of the proposed project and associated activities on the environment. The environmental components that are likely to be influenced or modified during construction phase are: (i) Air environment, (ii) Noise level, (iii) Water resources, (iv) Soil quality; (v) Water quality; (vi) Biological environment and (vii) Socio-economic status of the area.

A. Impacts due to Operation of the project:

Table 4.19: Summarization of Impacts & Mitigation Measures-Operation Phase

Sl. No.	Aspects	Impact identified	Mitigation Measures
A	**Land Environment**		
A.1	Soil Quality	During the operation stage, the project will generate fugitive dust and gas emissions. The transportation of ash and coal will also have some spillage which will have limited impact on localized soils. The soils within the deposition zone of pollutants may undergo physico-chemical changes due to deposition of PM (ash particles) and washout of gases (SO_2 and NOx) during the rains. The soil microbial environment undergoes changes as a result of accumulation of pollutants. Fugitive dust (including ash particles) induced alterations in soil properties ultimately affects plant growth. Spillage of fly ash while transportation may lead to change in soil characteristics.	Transportation vehicles will have tarpaulin to avoid dust emission. The impacts on soil due to operation of the power plant and gaseous emission are likely to be under control as the incremental concentration of particulate matter PM_{10}, $PM_{2.5}$, SO_2& NO_2 levels are observed within NAAQS in the surrounding areas. Particulate matter from boilers will be controlled by the installation of ESP Dust suppression and bag filters for the coal handling systems will control PM emissions. FGD and De-NOx systems shall be provided to effectively control SO_2 and NOx emission levels. Ash silos will be provided for collection of fly ash in dry form for further transportation to utilities. Bottom ash will be collected by HCSD Systems.
A.2	Solid and	**Solid Waste:**	**Solid Waste:**

Sl. No.	Aspects	Impact identified	Mitigation Measures
	Hazardous Wastes	During the operation stage, the project will generate fly ash and bottom ash. 3.87 MTPA of ash will be generated from the proposed 3x800 MW unit. Approximately 80% (8482.19 tonne/day) of it will be fly ash and balance 20% (2120.55tonne/day) will be in the form of bottom ash. **Hazardous Waste:** During the operation stage, the project will not generate Hazardous Wastes from processes but only some spent oil and waste oil from DG sets and Vehicles. The quantity will be insignificant.	100% Ash utilization shall be achieved as per MoEF&CC notification from the day-1 of the operations. Dry ash will be handled by pneumatic conveying systems and will be supplied to ash brick/ash product manufacturers. Wet ash will be handled using HCSD systems and used for low land filing. **Hazardous Waste:** The spent oil and waste oil will be collected in drums and sent to authorized re-user.
B	**Air Environment**		
B.1	Air Quality	The proposed expansion of coal based thermal power station along with the existing unit will have pollutant emission in form of SO_2, NO_x and PM from flue gas of the stacks. The air borne fugitive dust from the plant is likely to be generated from coal handling plants, which will be deposited on the topsoil and leaves of flora in the immediate vicinity of the plant boundary. Fugitive dust nuisances are the aspects of concern for people residing nearby, trees in vicinity whose leaves will accumulate these depositions and local fauna which will inhale the Respirable component of those dust particles. Predictions have been carried out for stack emissions & emissions from crusher houses considering worst coal characteristics.	To control PM from TPP Stacks, Electrostatic Precipitator (ESP) is proposed. For control of SO_2, Flue Gas Desulphurization (FGD) with lime scrubbing is proposed. To control NOx emission low NOx burner is proposed. With these controls, Hg emission is expected to be brought below the emission limits as measured in various other TPPs in India. Necessary dust suppression arrangement and bag filters will be used in railway siding and coal handling plant. The top surface of coal wagons will be adequately sprinkled to reduce fugitive emissions during transportation. Belt conveyors will be covered to minimize the fugitive dust emissions. Auxiliary fuel transportation will be occasional; hence its impact will be for limited time period. The fly ash silos will be provided with bag filter to control emission. Regular housekeeping will be done at plant roads, platforms and storage area.
B.2	Noise Level	During operation, the maximum expected noise level will be from turbine generator and other sources	Noise pressure level from equipment will be kept low by proper design and enclosures, wherever possible.

Sl. No.	Aspects	Impact identified	Mitigation Measures
		like cooling tower, boiler, mills, transformer, compressors, etc. Exposure to prolonged or excessive noise has been shown to cause a range of health problems ranging from stress, poor concentration, productivity losses in the workplace, and communication difficulties and fatigue from lack of sleep to other more serious issues.	Dense green belt all around will attenuate noise to acceptable limits at boundary and beyond. In addition, protective measures (ear muff & ear plug etc.) will be provided to the operators and workers working near high noise generating machineries. 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 which will be taken care. In case of higher noise level at work places, rotation of employees will be done as per OSHA Limits.
C	**Water Environment**		
C.1	Water resource	A thermal power plant requires huge quantity of water for its continuous operation. Water requirement for the existing unit is 61320 KLD while additional water requirement for the proposed unit is 72000 KLD. The entire water shall be sourced from Sone river allocated by Water Resources Department, Nabinagar, Bihar.	Waste water will be treated, recycled & re-used to reduce fresh water consumption and make it more sustainable & efficient.
C.2	Surface water quality	Sources of waste water include: • Regeneration waste from DM plant • Boiler blow down • Boiler & ESP area wash water • CHP-DS system effluent & CHP run off • Effluent from floor washing run-off and oil handling areas. • Domestic sewage These effluents, if discharged outside, may degrade the quality of the water body. The effluent system may also pose a risk to surface water bodies if allowed to mix up with the storm water drainage system.	Regeneration waste from DM (De-mineralized Water) Plant and CPU (Condensate Polishing Unit) will be collected in Neutralizing pit. After Neutralizing; the water will be pumped to CMB (Central Monitoring Basin). Boiler blow down collected in separate sump will be pumped to CMB. Boiler & ESP area wash water will be collected in pre settling pit. Water collected in CMB will be monitored and after pH correction water will be treated in PSF, UF & RO to make it suitable for reuse in DM Plant makeup / CW (Cooling Water) make-up. The sewage from plant shall be treated in a sewage treatment plant. The treated sewage conforming to prescribed standards shall be utilized for plantation

Sl. No.	Aspects	Impact identified	Mitigation Measures
			& horticulture to the extent possible. The proposed plant will be designed for zero discharge.
C.3	Groundwater resource and quality	Groundwater issues typically arise from leachate from ash disposal area.	No groundwater extraction is proposed. The ash dyke is already existing and properly lined so as to prevent any spillage of ash water to the ground. Stormwater will be collected in RWH Reservoirs and reused without allowing to be discharged outside causing ground water pollution.
		Ground water pollution can take place due to leachate from ash pond. Ground water pollution can take place due to leachate from storage of toxic waste.	• Ash pond bottom will be lined by compacting clay making an impervious layer. Though possibility of leaching of metals from ash water is very low, the impervious lining will eliminate possibility of ground water pollution. • There is also no storage of toxic waste and thus there is also no scope of polluting groundwater sources by seepage or leaching.
D	Ecology	Quantitative and qualitative changes in solar radiation impinging on the leaf surface and alterations in the energy exchange process of leaf due to dust deposition. Particulate emission and Sulphur dioxide emissions from the proposed TPP are the major pollutant that may affect the ecology of the area. Dust particles deposited on stigmatic surfaces of flowers reduce effective pollinations and hence fruit yields. Noise generated from various activities of the plant may disrupt breeding behaviors, resulting in shifts in population dynamics. As the water required shall be drawn from Sone river, fish may tend to get entrapped and impinged in the intake system; and smaller organism as phytoplanktons & zooplanktons may get entrained in the intake system. The entrained organism may be subjected	Emission of particulate matter, SO2 and NOx from the proposed plant. CPCB adopted the injury symptoms and pollution dose thresholds of tolerance by sensitive species of plants developed by W.H. Smith (1981) which stipulates that SO2 at 0.70 ppm (1820 µg/m3) after 1 hour exposure or 0.18 ppm (468 µg/m3) after 8 hours' exposure gives rise to visible injury symptoms in vegetation. Similarly, NOx at 20 ppm (38x103 µg/m3) after 1 hour exposure or 1.6-2.6 ppm (3000-5000 µg/m3) after 48 hours' exposure or 1 ppm (1900 µg/m3) after 100 hours' exposure is likely to bring about injury symptoms in vegetation. However, such high ambient air concentration of SO2 and NOX is not likely to occur in the area. As per modeling studies done, the maximum resultant concentration of SO_2 and NO_xin the ambient air even after the power plant comes into operation will be

Sl. No.	Aspects	Impact identified	Mitigation Measures
		to a combination of physico-chemical and mechanical stresses, leading to their destruction.	28.71µg/m^3& 49.96 µg/m^3 respectively. The details of the incremental concentration of the pollutants at existing forest blocks, along with distance and direction from project site as given in **Table 4.8** shows that the values are too less to induce any significant impact on vegetation. Suitable screens are provided at the intake point of water to prevent entrapment of organisms.
E	Demography & Socio-economics	The proposed project will improve the basic infrastructure & the people of nearby villages will be able to use these amenities. During operational phase, manpower of 396(direct) & 500 (indirect) are anticipated for operation, maintenance and general requirements of the power station. The skilled manpower will be in general sourced from the present pool, while the semi-skilled and unskilled workers will be sourced locally as per qualification and skill.	Positive impact
F	Physical Presence of Plant, Ash Pond and Associate Facility	The physical presence of main plant, especially the elevated structures like Boiler& turbine house, stack, coal silos, elevated coal conveyor, etc. will lead to adverse visual impact for residents of the area.	Greenbelt development proposed in the plan need to be implemented along with the construction phase depending upon the availability of the area for sapling plantation. It is proposed to develop a greenbelt around the main plant, and ash pond, which would provide visual screening. Periodic monitoring of greenbelt survival as well as plantation of new plants shall be carried out. Plantation shall be carried out in 2 to 3 tier.
G	Coal Handling Plant	Unloading of coal from coal rakes, transport of coal-to-coal crushing plant, crushing of coal and stacking of coal will generate coal dust, which lead to dust nuisance in the immediate vicinity of coal handling plant.	Dust suppression measures through sprinklers; Greenbelt plantation around the CHP

Sl. No.	Aspects	Impact identified	Mitigation Measures
		The deposition of coal dust on vegetation and property would have some adverse impact. However, dust suppression measures in coal unloading site, crushing plant, storage of coal in silos, greenbelt along the main plant will minimize dust emission. This limited dust generation in coal handling plant will settle down on the adjacent areas within a short period due to its larger particulate size.	
H	Coal Combustion and Stack Emission	The major visual impact from the power plant will be deposition of fly ash from the stack emission on the adjacent land and property. The Project will be having advanced air pollution control systems in place in order to comply with the air quality standards, which include ESP, taller stacks for better dispersion of pollutants. Stack emissions will also be monitored by Continuous Emission Monitoring System	• The selection of coal to be based on calorific value and ash content. • Installation and operation of high efficiency pollution control equipment to ensure maximum removal of flue gas air pollutants. • Continuous emissions monitoring of flue gas

5. ANALYSIS OF ALTERNATIVE SITES & TECHNOLOGIES

5.1 INTRODUCTION

The consideration of alternatives is a proactive approach of an environmental assessment by enhancing the project design by examining alternates instead of only having a defensive approach to reduce adverse impacts from the project. This calls for the systematic comparison of feasible alternatives for the proposed expansion site and technology.

5.2 SITE ALTERNATIVES

The Ministry of Power, through an Office Memorandum dated April 12, 2023, reported a meeting chaired by the Honourable Minister of Power and NRE on March 10, 2023, to assess the construction of an additional 25 GW thermal capacity. In this context, the Nabinagar STPP Stage-II (3x800) MW has been identified as a potential coal plant for future development under the non-pithead category of the central sector. The proposed project is an expansion of Nabinagar Super Thermal Power Plant by adding (3x800) MW Ultra Super Critical TPP to the existing (3x660 MW) within the existing plant boundary at Village Majhiyan, Nabinagar taluka, Aurangabad District, Bihar by NTPC. The total land area is 1202.88 hectares out of which the expansion is proposed in 595.60 hectares of the existing land available. Site was identified at the time of Stage-I implementation on the basis of availability of suitable & adequate land, distance from coal source, distance from reliable source of water, road & rail access, availabilities of infrastructure facilities and environmental aspects with the Bihar Government & Bihar State Electricity Board. The project will benefit from the available infrastructure, logistics, water source & proximity to the coal mine sources. It also provides all other necessary infrastructure to cater to the requirement of the enhanced capacity which will be developed while also using the facilities of the existing plant. Hence, no alternative site is explored for this expansion.

5.3 TECHNOLOGY ALTERNATIVE

5.3.1 DESCRIPTION OF EACH ALTERNATIVE

5.3.1.1 SUB-CRITICAL BOILER

Subcritical boilers are boilers that work below the critical point at water i.e. temperatures up to 374°C and pressure of 225 kg/cm2. These boilers compose a system with constant evaporation endpoint. A typical example for a subcritical boiler is the drum-type steam generator.

Inside the boiler, the natural circulation of the fluid is generated by heating the risers. The water and steam mixture that is leaving this riser is then separated into water and steam in the drum. Water is circulated, water returns to the evaporator inlet through down corners while steam flows into the super-heater chamber.

If the fluid is allowed to undergo natural circulation, the application range is limited to about 190 bar as the maximum drum pressure. But if the circulation is done using a circulating pump, (known as forced circulation), this range can be extended. This extension happens because of the fixing of the endpoint of evaporation in the drum and also, it sets the size of the heating surface in the evaporator and in the super-heater. A major drawback of the subcritical parameters having low efficiency hence require more coal to produce power.

5.3.1.2 SUPER CRITICAL BOILER

A supercritical boiler burns pulverized coal and is a once-through boiler, meaning that it doesn't require a drum to separate steam from water. Rather than boiling water to produce steam and then using that steam to turn a plant's turbine, a supercritical boiler operates at such high pressure i.e. above critical point of water.

This supercritical fluid turns the turbine that generates electricity. As it does so, it drops below the critical pressure point and becomes a mix of steam and water, passing into a condenser. In the process, less fuel is consumed than in a traditional drum boiler, making supercritical boilers more efficient than their subcritical counterparts.

Supercritical boilers offer benefits in the three interrelated areas that mean the most to plant owners and operators today: efficiency, emissions, and cost. While supercritical boilers cost more than comparably sized subcritical boilers, the larger initial capital investment can be offset by the lifecycle savings yielded by the technology's improved efficiency, reduced emissions, and lower operating costs —all due to its higher steam temperature and pressure parameter.

Improved Efficiency	Reduced Emissions	Lower Operating Costs
• Supercritical and ultra-supercritical boilers' ability to operate at much higher pressures and temperatures than subcritical boilers translate into noticeably better efficiency ratings. • Subcritical boilers typically run at 170 kg/cm2, 540°C/568°C. By way of contrast, modern supercritical units can go as high as250 kg/cm2, 565°C/593°C. The even more advance ultra-supercritical units reach pressures and temperatures as high as 280°C, 600°C/600°C.	• Improved plant efficiency also translates into reduced emissions, particularlyCO_2 and mercury, which are difficult to manage otherwise. The general rule of thumb is that each percentage point of efficiency improvement yields 2–3% less CO_2.	• For all fossil fuel–fired plants, fuel represents the largest operating cost. By reducing the amount of fuel needed to yield the requisite energy, supercritical plants make a noticeable dent in bottom lines when compared to subcritical plants

5.3.1.3 ULTRA-SUPER CRITICAL BOILER

Ultra-supercritical boiler is essentially "once-through type". The volume of the evaporator system of once-through boiler is much smaller compared to a natural circulation boiler. This leads to smaller amount of water in the evaporator. Due to smaller inventory of stored water and steam, theoretical rate of response of supercritical and ultra-supercritical units are much faster than drum type unit.

With ultra-supercritical parameters, there is an improvement of cycle efficiency attributable to elevated pressure and temperatures. However, for smaller units the improvement in heat rate is marginal.

5.3.2 SELECTED TECHNOLOGY

The ultra-super critical technology has been proposed for expansion. The ultra-supercritical units have low thermal inertia resulting in a shorter start-up time, faster rates of load change and shorter time of forced cooling operation during emergency shutdown. Pressure changes could be achieved more easily and a true sliding pressure operation mode with reasonable load change capabilities becomes possible. In ultra-supercritical units,

main steam temperature is controlled by water-fuel ratio control with back up spray at attemperation. As a result, rated steam outlet temperature could be achieved at all loads with all types of fuel.

Using ultra-supercritical parameters is more advantageous for larger units where thermal efficiency improvement is more pronounced. An approximate efficiency gains of 3 – 5% points compared to conventional supercritical technology can be obtained by selecting ultra-supercritical steam parameters.

In addition to faster response times, ultra-supercritical technology, increase in overall plant thermal efficiency results in reduction of fuel consumption per unit of electricity generated, which in turn also reduces CO_2 emissions in coal fired power plant. Ultra-supercritical units also emit less SOx and NOx. Improvement in thermal efficiency also causes substantial reduction in emission of suspended particulate matter to the environment. Lastly, better efficiency is associated with lower fuel costs.

5.3.2.1 SUMMARY OF ADVANTAGES OF ULTRA SUPER CRITICAL THERMAL POWER PLANT

The benefits of ultra-supercritical technology, may be summarized as:

- Improved thermal efficiency attainable.
- Reduced fuel cost.
- Reduction of CO_2 emission by as much as 15% per unit of electricity generated compared to typical sub-critical units. This may help in meeting country's GHG Reduction target.
- Very good part load efficiency.
- Very low emissions of NOx, SO_2 and PM achievable using modern flue gas clean-up equipment.
- Initial investment requirement marginally higher than super critical technology and less than other clean coal technology. This, however, depends on the unit size considered.

5.3.3 AIR COOLED CONDENSER SYSTEM

In a thermal power plant, condenser is used to dissipate the heat from the steam coming out from LP turbine exhaust in order to condense it and make a close cycle. This heat can either be removed using water or air as cooling medium. When, water is used as cooling medium, the condenser is termed as water cooled condenser and in case cooling medium is air, it is called Air Cooled Condenser (ACC). The design, construction and size of both type of condensers is entirely different.

5.3.3.1 A COMPARATIVE OVERVIEW OF TWO CONDENSERS

1) Water Conservation:

I. **Primary Benefit:** ACCs eliminate the need for water in the condenser cooling process, which is critical in water-scarce regions.

II. **Environmental Impact:** Reduced water withdrawal and consumption to avoid the impact on local water resources and ecosystems.

2) Technical Considerations:

I. **Efficiency:** ACCs are generally less efficient than water-cooled systems due to high condenser back pressure. It is further less efficient in high ambient temperature regions like in Indian condition where the ACC design temperature has to be considered higher. This leads to higher operational costs and reduced plant efficiency.

II. **Heat Rejection:** ACC rely on ambient air to dissipate the waste heat of condenser, which can be challenging in hot climates where air temperatures are high, potentially leading to reduced plant performance during peak summer months.

3) Economic Factors:

I. **Capital Costs:** Initial installation of ACC is generally more expensive compared to traditional water-cooled systems due to the need for larger heat exchange surfaces, fans and structural civil cost.

II. **Operational Costs:** Although water costs are minimized, the poor unit heat rate increases the operating cost for the lifetime.

4) Location Suitability:

I. **Climate:** Dry cooling is more suitable for regions with moderate ambient temperatures. In extremely hot climates, the efficiency losses may be higher. The Unit output may be derated for those extreme hot climate operating hours.

II. **Water Availability:** ACC adoption may be ideal for those areas where water resources are limited or where regulatory constraints on water use are stringent.

5) Capital cost is more in case of ACC compared to WCC although it depends on other factors also e.g. proximity of water source, requirement of water reservoir (in case it is mandatory in water allocation). Land requirement is less in case of ACC.

6) The breakeven cost of water at which the ACC becomes economical over WCC (even if water is available) is generally of the order of 20 to 30 Rs/kL for a typical case for 800 MW Unit. Although the above breakeven cost may vary project to project depending upon the project cost, ACC design conditions and prevailing water charges etc.

7) Layout feasibility is also an important factor while deciding about ACC.

6. ENVIRONMENT MONITORING PROGRAMME

6.1 NEED FOR ENVIRONMENT MONITORING

The monitoring program is designed to verify the implementation of environmental measures and confirm their effectiveness in delivering the intended benefits to the target population. To ensure proper implementation of the Environment Monitoring Programme, it is essential that an effective monitoring program is designed and carried out.

The primary aims of the environmental monitoring initiative include:

- To monitor impacts on the surrounding environment and the effectiveness of mitigation measures during the construction and operation phases.
- To ensure that the environmental control systems are installed and operating satisfactorily.
- To suggest ongoing improvements in mitigation measures, if required, for subsequent effective monitoring.

In the sections below the proposed environment cell, its functions and financial implications are described. The monitoring program will be implemented in consultation with Bihar State Pollution Control Board (Bihar SPCB) during start of operation of plant.

The construction and operation of the thermal power station will be overseen by a dedicated Environmental Management Group (EMG), which will handle key functions related to environmental, safety, and occupational health management for the plant and its surroundings.

Regularly periodic environmental monitoring is being done for existing power plant as per the Environmental Clearance & its amendments and reports are being submitted to MoEF&CC & Bihar SPCB/CPCB along with EC compliance reports. The Latest EC compliance report was submitted for the period of April'2024 to Sept'2024 vide Letter no. 1086/NSTPS/Envt,Mgt./12/2024/01 dated,30.12.2024 for existing 3x660 MW Nabinagar Super Thermal Power Plant. Latest IRO Certified Compliance Report vide file no 105-36/ROR/-2024 dated 14.01.2025 is enclosed as **Annexure-6.1**

6.2 ENVIRONMENT MONITORING PROGRAMME

The monitoring program has been formulated to take care of impact of proposed expansion project. The monitoring program for different parameters of environment, outlined in the following sections, is based on the findings of the impact assessment. Environment Monitoring Plan during Construction Phase is given in **Table 6.1**. The final post-study environmental monitoring program including number and location of monitoring stations, frequency of sampling and parameters to be covered have been summarized and presented in **Table 6.2**. Locations shall be finalized in consultation with Bihar State Pollution Control Board.

Table 6.1: Environment Monitoring Program during Construction Phase

Sl. No.	Aspect	Parameters	Frequency	Location
1	Meteorological aspects	Wind speed & direction, temperature, rainfall, and humidity	Continuous hourly monitoring	At plant site

Sl. No.	Aspect	Parameters	Frequency	Location
2	Ambient Air quality	PM_{10}, $PM_{2.5}$, SO_2, NOx and other parameters as per CPCB notification 2009	As per CPCB/BSPCB requirement or regular twice in a week manner	At site & nearby four locations
3	Noise	Equivalent noise pressure level	Once in a month	At site & nearby four locations
4	Ground water quality	Physical, chemical and biological parameters including heavy metals as per IS 10500	Quarterly	Five locations
5	Surface water quality	Physical, chemical and biological parameters including heavy metals as per IS 10500	Quarterly	Two locations in study area likely to receive surface run-off from the site

Table 6.2: Environment Monitoring Program during Operation Phase

Sl. No.	Aspect	Parameter	Location	Monitoring & Frequency	Responsible Person/ Organization
1	Meteorology	Wind speed & direction, temperature, rainfall and humidity	At project site	Continuous automatic monitoring	Environmental Management Group (EMG)
2	Work zone air quality	PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO or as per CTO.	5 work zones inside	Monthly	MoEF&CC / NABL Accredited laboratory coordinated by EMG.
3	Ambient Air Quality	PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO & other parameters as per AAQ Standard within and outside the plant area at least at four locations (one within and three outside the plant area)	4 Continuous Ambient Air Quality Monitoring Station within plant site (at already installed location)	Continuous on-line monitoring connected to Bihar SPCB	Environmental Management Group (EMG)
			4 nearby locations (offline)	Twice in a week as per NAAQS Norms	MoEF&CC / NABL Accredited laboratory co-ordinated by EMG
4	Process Stack	PM_{10}, SO_2, NO_X The project proponent shall install a 24x7 continuous emission monitoring system at main process stacks to monitor stack emission concerning standards	All Process Stacks	Continuous on-line monitoring Monthly Offline Hg monitoring	MoEF&CC / NABL Accredited laboratory coordinated by EMG

Sl. No.	Aspect	Parameter	Location	Monitoring & Frequency	Responsible Person/ Organization
		prescribed in Environment (Protection) Rules 1986 and connected to Bihar SPCB and CPCB online servers and calibrate these systems from time to time according to equipment supplier specification. Hg emission Monitoring			
5	Ambient Noise levels	Noise	05 locations around project boundary and 05 locations outside in a nearby residential area/Villages, township etc.	Monthly	MoEF&CC / NABL Accredited laboratory coordinated by EMG.
6	Surface Water Quality	Physical, chemical, and biological parameters including heavy metals.	5 locations near to project site	Monthly	MoEF&CC / NABL Accredited laboratory coordinated by EMG.
7	Ground Water Quality& Level	Physical, chemical, and biological parameters including heavy metals	5 locations near to project site	Monthly	MoEF&CC / NABL Accredited laboratory coordinated by EMG.
		Piezometer(Ask Dyke & Plant/townshop) to be included for long-term monitoring of groundwater table.	4 locations	Monthly	NABL Accredited laboratory coordinated by EMG
8	Soil	Physical and chemical parameters with organic content	4 locations near to waste storage area	4 times a year	MoEF&CC / NABL Accredited laboratory coordinated by EMG.
9	Ecology	Biodiversity Study of local flora & fauna	Project Site & its Buffer zone within 10 km radius of the project site	Once in every two years	Reputed institute coordinated by EMG.
10	Coal	Heavy Metals & Radio activity Parameters	Plant-2 samples	Half Yearly	Reputed Institute coordinated by EMG.
11	Fly Ash & Bottom ash	Heavy Metals & Radio activity Parameters	Plant- 2 samples	Half Yearly	Reputed Institute coordinated by EMG.

6.3 WASTEWATER QUALITY MONITORING

The wastewater quality monitoring programme consists of treated wastewater parameters monitoring prior to reuse, recycle & recirculation, Surface water and groundwater quality monitoring will also be covered. The monitoring schedule for treated water generated from various sources and the parameters to be analysed are shown in **Table 6.3.**

Table 6.3: Wastewater monitoring schedule

Waste water source	Frequency of analysis	Parameter of examination	Responsible Person
Boiler blow down	Monthly	Temperature, suspended solids, oil & grease, dissolved solids, copper, iron etc.	MoEF&CC / NABL Accredited laboratory coordinated by EMG.
Wastewater Treatment plant effluent	Monthly	pH, suspended solids, COD, BOD, dissolved solids	MoEF&CC / NABL Accredited laboratory coordinated by EMG.
Domestic Wastewater Treatment	Monthly	pH, TSS, BOD, COD, Oil & Grease, Phosphate, Nitrate etc	MoEF&CC / NABL Accredited laboratory coordinated by EMG.
Ash pond effluent	Monthly	pH, suspended solids, oil & grease, dissolved solids, heavy metals like chromium, zinc, iron, manganese, aluminium, nickel, Hg, phosphate etc.	MoEF&CC / NABL Accredited laboratory coordinated by EMD.

The assessment of surface and groundwater quality (e.g.) drinking and irrigation wells, ponds, tube wells etc.) of surrounding areas will be carried out at 10 different locations, within a 10 km radius of the proposed power plant once in a month. The parameters to be monitored encompass dissolved solids, oxygen levels, bacterial contamination, and heavy metals etc as per IS 10500 Standards.

6.4 DATA ANALYSIS

Data generated from monitoring and analysis of the samples will be compared with the prescribed/stipulated limits. If any parameter is not found within the prescribed/stipulated limit appropriate control measures will be taken to satisfy the limit.

6.5 REPORTING SCHEDULE

Regular monitoring and data analysis shall be followed through proper documentation and reporting system. Provision will be made for continuous online monitoring of emission (CEMS) and effluent (EQMS)data is already available for the existing unit and same arrangements shall be made for the upcoming expansion units and the data shall be uploaded to BPCB/CPCB server to make them available on real-time basis as public disclosure. Environmental monitoring report shall be submitted to the regional offices of MOEF&CC/BSPCB/CPCB for their further assessment.

To ensure timely and effective implementation of the Monitoring Plan, various stages of reporting and monitoring systems have been proposed.

6.6 EMERGENCY PROCEDURES

Well planned emergency procedures, drills shall be employed viz, Emergency Evacuation Plan, Disaster Management Plan and Industrial Safety plan to meet the requirement in case of failure of any pollution control equipment. In case it is not possible to take appropriate corrective measures immediately, the unit will be shut down.

6.7 INFRASTRUCTURE

The list of equipment's required for environment monitoring is given in **Table 6.4**.

Table 6.4: Laboratory Equipment's Required for Environment Monitoring

Sl. No.	Equipment	Quantity
I	**Meteorology**	
1	Automatic Weather Station with data logger	1 set
II	**Stack & Ambient Air**	
1	Respirable Dust Sampler/Fine Particulate Sampler	5 sets
2	Vacuum Pump with Electric Motor	2 sets
3	Ammeter and Voltmeter	1 set
4	DG set	1 set
5	Stack monitoring Kit with necessary Accessories	2 sets
III	**Noise**	
1	Integrated Noise Level Meter with Frequency Analyzer and data logger	1 set
IV	**Water**	
1	BOD Incubator	1 set
2	Bacteriological Incubator	1 set
3	Oven	1 set
4	Muffle Furnace	1 set
5	Analytical Balance (Single Pan Digital)	1 set
6	Spectrophotometer (Spectronic 20)	1 set
7	pH Meter	1 set
8	Turbidity Meter	1 set
9	Conductivity Meter	1 set
10	Thermometer	1 set
11	Flame Photometer	1 set
12	Atomic Absorption Spectrophotometer	1 set
13	Distillation Apparatus	2 sets
14	Hot Plate	4 sets
15	Regents and Chemicals	As required
16	COD Assembly	1 set

6.8 ENVIRONMENT MONITORING COST

The estimated capital costs to be incurred by the Project Proponent on CEMS & EQMS is Rs. 640 Lakhs. Environment monitoring for undertaking pollution prevention measures at the plant during construction and operation are provided in **Table 6.5**.

Table 6.5: Environment Monitoring Cost

Component	Stage	Locations	Frequency	Total no. of samples annually	Cost per Sample (Rs)	Recurring cost (Rs)	Capital Cost (Rs)
Construction Phase							
Air	Construction	2	Once in two weeks	52	5000	2,60,000	-
Water	Construction	2 surface water samples	Twice in 6 months	8	6000	48,000	-
		2 ground water samples	Twice in 6 months	8	5500	44,000	-
Noise	Construction	2	Once in three months	8	2000	16,000	-
Total Environment Monitoring Cost during Construction Phase (recurring):					**Rs. 3,68,000/-**		
Operation Phase							
Air	Operation	Continuous online monitoring station	Continuous	0	-	-	-
		4	12 times a year	48	5000	2,40,000	-
Water	Operation	5 surface water samples	Monthly	60	6000	3,60,000	-
		5 groundwater	Monthly	60	5500	3,30,000	-
		4 Wastewater/ ETP/STP	Once a month	48	4000	1,92,000	-
		Piezometer	Long term assessment	4	-	-	1,20,000

Component	Stage	Locations	Frequency	Total no. of samples annually	Cost per Sample (Rs)	Recurring cost (Rs)	Capital Cost (Rs)
Noise	Operation	10	Monthly	120	2000	2,40,000	-
Soil	Operation	2	Quarterly	8	6000	48,000	-
Ecology	Operation	Study Area	Once a two year	1		3,50,000	-
Coal (Heavy metals)	Operation	CHP	Half yearly	4	4,500	18,000	--
Coal Radioactivity	Operation	CHP	Half yearly	4	32,000	32,000	--
Fly Ash (Heavy Metals & Radio activity Parameters)	Operation	Silo	Half yearly	4	2,000	8,000	--
Bottom Ash (Heavy Metals & Radio activity Parameters)	Operation	Ash Pond	Half yearly	4	2,500	10,000	--
Total Environment Monitoring Cost during Operation Phase (Capital):					**Rs. 1,20,000/-**		
Total Environment Monitoring Cost during Operation Phase (recurring):					**Rs. 18,28,000/-**		

During the construction phase of the project, the recurring cost for environment monitoring amounts to Rs. 3,68,000. This expense covers the ongoing monitoring activities that are necessary to assess and ensure environmental compliance and impact during the construction period.

Once the project enters the operational phase, the recurring environment monitoring cost increases to Rs. 18,28,000 and the capital environment monitoring cost comes to Rs. 1,20,000. This higher amount reflects the continued need for environmental monitoring and maintenance during the operational lifespan of the project.

In addition to the recurring monitoring costs, the project incurs a capital cost of Rs. 640 lakhs on CEMS & EQMS installation. This capital expenditure represents the initial investment or one-time expense related to establishing the necessary environmental monitoring infrastructure or systems required for the project.

Overall, the environmental monitoring costs during both the construction and operation phases are significant, with the operational phase bearing a higher recurring expense due to ongoing monitoring and compliance requirements. The capital cost represents the upfront investment necessary to initiate the environmental monitoring activities essential for the project's environmental sustainability and compliance throughout its lifecycle.

6.9 MAINTENANCE PLAN FOR APC EQUIPMENTS

Electrostatic Precipitators:

1. Daily Routine Inspection:
   a. Visual inspection of ESP components for signs of wear, damage, or corrosion.
   b. Check for abnormal noise or vibration during operation.
2. Weekly Data Logging:
   a. Record voltage, current, and power consumption.
   b. Inspect the condition of electrodes and collector plates.
   c. Check and clean the discharge electrodes as needed.
3. Monthly Calibration and Certification:
   a. Calibrate voltage and current sensors.
   b. Verify the accuracy of pressure drop measurements.
4. Quarterly Emission Testing:
   a. Perform stack emission tests to ensure compliance with regulatory limits.
   b. Check the effectiveness of particulate/gas removal.
5. Semi-Annual Inspection:
   a. Inspect and clean insulators.
   b. Check and replace any damaged or malfunctioning components.
6. Comprehensive Performance Test:
   a. Conduct a comprehensive performance test to evaluate ESP equipment efficiency and pressure drop as a when required.
7. Documentation and Reporting:
   a. Maintain detailed records of all inspections, tests, and maintenance activities.
   b. Report emissions data to regulatory authorities as required.

Flue Gas Desulphurization System (FGD):

Operations personnel will inspect the affected air pollution control system (i.e. scrubber) routinely and monitor its performance using the continuous emissions monitoring system (CEMS)as well as the plant process control system. There are four (4) categories of inspections to be performed on a routine basis. These are:

- Operation inspections/walk-throughs
- Mechanical maintenance inspections and/or repairs
- Electrical maintenance inspections and/or repairs

- Instrumentation inspections and/or repairs

A summary of each group's inspections will be maintained at department level. The complete set of checklists and inspection sheets is available on the plant's data repository. Each summary includes:

- Equipment number and name
- Type of inspection (i.e. running or stopped)
- Description of inspection
- Frequency of inspection (daily, weekly,)

Departmental Head responsible for implementation of the FGD maintenance program are:

- Head- Operation
- Head- Maintenance
- Head- Electrical
- Head- C&I

FGD Operating Variables

Emissions and Operating variables are monitored using the following methods:

- SO_2 emissions are monitored using the continuous emissions monitoring system (CEMS). The values are displayed on the process control system and environment display screens at prominent locations.
- Operating variables are displayed continuously on the process control system in control room.
- If a fault should occur then the process control system will activate a visual and/or audible alarm to notify the operator so that he may take corrective action.
- In the case of critical failures likely to result in an exceedance of applicable emission limitations or risk to equipment (e.g. loss of power, the control system's program logic), corrective actions up to and including plant shutdown will be initiated. The most important indicator of satisfactory operation of the FGD system is emissions as monitored by the SO_2 CEMS and compliance with applicable emission limitations. In addition, operating variables, which are monitored and recorded continuously, afford the ability to identify any operational deficiencies which may be impairing satisfactory performance of the FGD system. The monitored operating variables and their expected operating ranges (under normal operating conditions) are maintained as per process manual:

Corrective Procedures

The following procedures are to be followed in the event of a malfunction is identified causing or with the potential to cause an SO_2 emissions exceed accelerated to the FGD system:

The shift in charge must investigate the problem and record the start time and problem scope in the plant's operations log. This investigation should occur as soon as possible when the potential to exceed the SO_2 emission limit has been identified.

The shift in charge must make a determination after the investigation period if the problem can be rectified while maintaining Stack SO_2 emission performance. In the event that noncompliance will result with continued operation, the in charge will consult with plant O&M head on the next course of action. Corrective actions taken and considered should be logged.

When the equipment is released for operation and/or repairs have been completed, it will ensure that the system can operate in compliance with the emission limit.

The reason for system problems must be logged. The corrective measures taken to alleviate the problem must be identified, including documenting total time of the system issue and the time the equipment resumed normal operation.

Several redundant pieces of equipment are installed to enhance the scrubber system's reliability. Examples of redundant equipment are:

- Spare (back-up) spray pump
- Spare (back-up) quench pump

All spray and quench pumps will be rotated in and out of service to prevent slurry settling as well as to ensure they are operational when needed.

Critical equipment (e.g. quench pumps) are tied into an emergency back-up generator to protect the scrubber equipment in the event of a power outage.

In the event monitored emissions indicate impairment in the performance of the FGD system and an operating variable falls outside its normal range, corrective actions may include the following, depending on the applicable operating variable:

- Check monitoring instrument to ensure accuracy; calibrate or repair as necessary
- Perform manual/physical testing of sample to confirm results
- Trouble shoot system (pumps, valves, etc.) to determine root cause

In the event of a CEMS malfunction, the following are possible course so faction:

- Trouble shoot and repair the affected CEMS components
- Operate back-up data acquisition system (DAS)
- Apply actions for any missing data

In the event that SO_2 emissions exceed the applicable emissions limitations, corrective actions may:

- Adjustment of the scrubber slurry pH level
- Adjustment to the scrubber slurry pumps

Reporting

Malfunctions shall be reported as may be required by applicable consent condition to Bihar SPCB

7. ADDITIONAL STUDIES

7.1 INTRODUCTION

The additional studies as suggested in Para 7 & Appendix-III of EIA Notification 2006 amended to date are (i) Public Consultation; (ii) Risk Assessment; (iii) Social Impact Assessment and (iv) Rehabilitation & Resettlement (R&R) Action Plan. As the expansion will take place within the area of existing plant, there will be no applicability of R&R.

Based on the TOR specified by the Ministry of Environment, Forest, and Climate Change (MoEF&CC) issued vide letter no. J-13012/127/2007-IA.II(T) dated 15.04.2024for preparation of EIA&EMP report for the proposed expansion project, NTPC, Nabinagar is carrying out several additional studies regarding hydrogeology study, Wildlife conservation plan, Occupational Health Management, Watershed Management Plan etc. which will help in the understanding the environmental impact of the expansion project in better ways. Summary of all the additional studies are presented in this chapter with the detailed report is in Annexures of draft EIA & EMP report. The separate cumulative environmental impact assessment study which is considered as another Additional Study as prescribed in the TOR additional condition no. 1.21 is presented in chapter 13.

7.2 PUBLIC HEARING & CONSULTATION

As per the condition of the TOR issued by MoEF&CC dated; 15.04.2024 and the EIA Notification 2006, Public Hearing for the expansion project was conducted on Wednesday, November 13th, 2024, from 12:00 AM at Nabinagar Super Thermal Power Station, Nabinagar, Aurangabad Campus (Bihar), under the chairmanship of the District Magistrate, Aurangabad organized by Bihar State Pollution Control Board (Bihar SPCB), Aurangabad.

The publicity for the hearing was made through public announcement and paper published in leading newspapers – (1) Navbihar times, dated 24th Sept 2024, (2) Hindustan, Gaya edition, dated 24th Sept 2024 giving a notice period of 30 days by Bihar SPCB informing the details of public hearing to be held on 13.11.2024.

Table 7.1: Details of Public hearing Advertisement

Sr. No.	Particulars	Dates
1	Navbihar times	24th Sept 2024
2	Hindustan, Gaya edition	24th Sept 2024
3	Venue: Nabinagar Super Thermal Power Station, Nabinagar, Aurangabad Campus (Bihar)	November 13th, 2024, from 12:00 AM

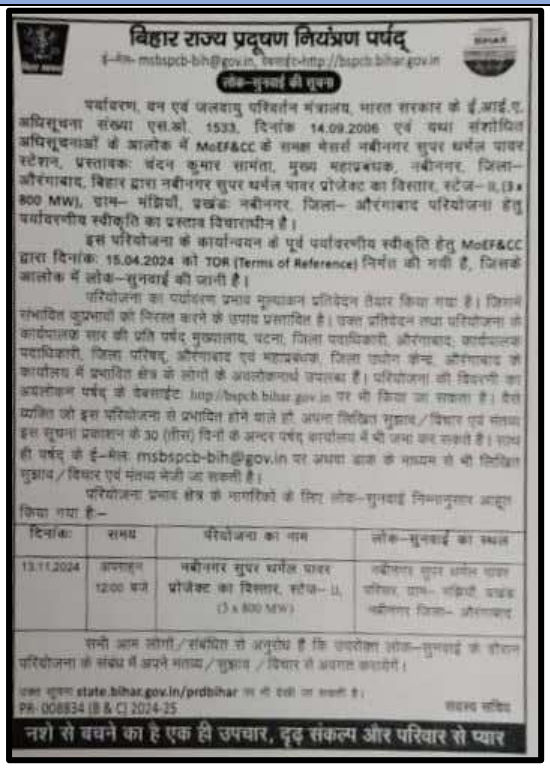
Navbihar times	Hindustan times, Gaya edition
	

Figure 7.1: Public Hearing Announcements in 02 different Newspaper

The hearing was held in presence of:

- Sri Shrikant Shastree, District Magistrate, Aurangabad
- Mr. Manoranjan Kumar Singh, Regional Officer, Bihar State Pollution Control Board (Bihar SPCB), Gaya
- Mr. S. K. Singh, Sub-Divisional Magistrate Aurangabad,
- Mr. Chandan Kumar Samanta, Project Head, Nabinagar Super Thermal Power Station, Nabinagar, Aurangabad
- Mr. Shyamsundar and Sreya Paul, Representative of Greencindia Consulting Private Limited

The Regional Officer Gaya (Bihar SPCB) addressed the district Magistrate, Aurangabad, Project Head of the proposed project, its employees, project affected citizens and the environmental advisor present in the public hearing meeting. He began his address by welcoming all the attendees. Giving details about the proposed thermal power project, he informed that in the light of the EIA notification no. S.O. 1533 dated 14.09.2006 as amended by the Ministry of Environment Forest and Climate Change (MOEF&CC) Government of India, the ministry has prepared Terms of Reference (ToR) for the proposal of 3x 800 MW Thermal Power Project. In the notification issued before obtaining environmental clearance of the expansion of project located at Nabinagar, there is a provision to obtain views, comments and suggestions from local citizens regarding the responsibilities of environmental adverse effects during the implementation process of the proposed project. In case the suggestion received are found to be mandatory, there is a provision to include them as conditions in the environmental clearance.

A Brief information about the Expansion project & its salient features like project cost, CER amount, Management Plan, Mitigative measures to be implemented, etc. were informed to public by project proponent – Mr, Brijendra Agrawal. During the public hearing, 19 representations (suggestions, comments & objections were received) were submitted. The attendance sheet has 968 signatures. The entire public hearing was videotaped. The public hearing was attended by villagers from nearby villages and the issues raised during the hearing are listed in **Table 7.2**. The minute of Public Hearing is attached as **Annexure – 7.7.**

Figure 7.2: Public Hearing conducting on 13.11.2024

Table 7.2: Issues raised during Public Hearing with Project Proponent's Response & Action Plan

S.L.	Name/Smt./ Shri/Address.	Comments, Questions/ Objections and Suggestions from citizens/ members/ villagers	Response and comments from NTPC Nabinagar Project Proponent	Action Plan	Budget Rs in lakhs	Timeline
1.	Shri Bhola Yadav, Village: Lakhepur, Aurangabad:	In the interest of local farmers, their basic facilities like irrigation facilities should be restored, during construction of national highways dust particles spread on the roads due to fly ash and its cleaning water sprinkling facility should be provided on the roads. The employment of local citizens and the solution of family dispute should be found soon and the concerned should be given annuity benefits. This area should be connected to Employees State Insurance Corporation (ESIC) and arrangements for opening a hospital should be ensured.	1.1 – Irrigation facility - NTPC Nabinagar will approach to Minor Irrigation Department, Govt. of Bihar to resolve the issue of irrigation of farmers land. 1.2 NTPC Nabinagar has taken care to cover the ash while transporting through Hywa for construction of National Haighay and arrangements have been made for continuous sprinkling of water through tankers and clearing of the route of transportation. 1.3 Annuity to PAPs - As per decision taken with farmers (Project affected persons), annuity is being provided through LIC of India. So far, annuity is being paid to 1610 PAPs and the payment of annuity to 110 PAPs will started by Feb-March-2025.	Irrigation issue to be taken up with irrigation department, Govt. of Bihar. Action taken for water sprinkling as per site requirement every year. Under Implementation	- 25.00 --	6-12 months. On regular basis 2 months to12 Months

S.L.	Name/Smt./ Shri/Address.	Comments, Questions/ Objections and Suggestions from citizens/ members/ villagers	Response and comments from NTPC Nabinagar Project Proponent	Action Plan	Budget Rs in lakhs	Timeline
			1.4 **The project of NTPC Nabinagar is based on State-of-Art technology, hence the possibility of direct employment will be limited**. However, during the construction of the project, maximum priority is being given to the locals residing in nearby villages through indirect employment. **1.5** Presently, Aurangabad district is not notified under ESIC area. NTPC Nabinagar has requested the Regional Office of ESIC to notify Aurangabad district through letter No.0370/NSTPS/ER/01 – dtd.03.12.2024, so that the workers may get health benefits.	Under Implementation Under Implementation		0-5 years 0-1 Year
2.	Shri Mudrika Singh Yadav, Sheikhpura, Aurangabad	Employment should be provided to local unemployed children as per their qualification and the annuity benefit amount of the farmers should be paid as soon	2.1-Please refer reply given at **Key Issue 1.4 Employment.** 2.2 – NTPC will approaches the balance	--		--

S.L.	Name/Smt./ Shri/Address.	Comments, Questions/ Objections and Suggestions from citizens/ members/ villagers	Response and comments from NTPC Nabinagar Project Proponent	Action Plan	Budget Rs in lakhs	Timeline
		as possible.	PAPs to submit the details and relevant documents to start the annuity benefits.	Under Implementation.	-	1-2 years
3.	Shri Arun Kumar, Village: Madhe, Aurangabad	The labourers dependent on the land acquired under the proposed project should be identified and their 750 days minimum agricultural wage (MAW) should be paid as soon as possible. Village Health Centre in Ankorha, free electricity to villagers, increase in employment opportunities for youth, arrangement of sprinkling of water to prevent dust emission from fly ash, plantation of more and more trees, halting of trains at Ankorha station, arrangement of payment for 3.5 acres of land of Radhe Krishna temple of Madhe village should be ensured.	3.1 – The process of land acquisition for setting up the project was done in the year 2011-12, which is already completed. The list of dependent labourers has not been provided by the district administration. 3.2 – **Health Centre at village Ankorha** - Additional primary Health Centre building has been completed in village Ankorha under CD scheme of NTPC. Action will be taken up with State health department to start in this year. 3.3 **– Free electricity to local citizens**. NTPC is not authorised to distribute electricity under the Electricity Act-2003.	-- Under Implementation --	-- 94.00 --	-- 2-6 months --

S.L.	Name/Smt./ Shri/Address.	Comments, Questions/ Objections and Suggestions from citizens/ members/ villagers	Response and comments from NTPC Nabinagar Project Proponent	Action Plan	Budget Rs in lakhs	Timeline
		.	3.4 - Please refer reply given at **Key Issue 1.4 Employment.**	--	--	--
			3.5 -Please refer reply given at Key Issue – 1.2 - **Fugitive dust emission** Till now, NTPC, Nabinagar has planted around 1,52,000 tree in a planned manner in the area around the plant and work of planting trees will be done regularly in future also so that the environment remains clean.	Additional Approx 7,00,000 Lakh Trees will be planted in around of plant.	6767.00	1-8 years
			3.6 – **Stoppage of Train at Ankorha**- NTPC management will request the higher level of railway administration for stoppage of trains at Ankroha railway station.	--	--	2-3 months

S.L.	Name/Smt./ Shri/Address.	Comments, Questions/ Objections and Suggestions from citizens/ members/ villagers	Response and comments from NTPC Nabinagar Project Proponent	Action Plan	Budget Rs in lakhs	Timeline
			3.7 – The land compensation payment of Radhe Krishna temple will be taken up with district land acquisition department after receipt of required documents from claimants.	Under Implementation	--	0-12 months
4.	Shri Rameshwar Singh, Village: Shivanpur, Aurangabad	Urged to stop trains at Ankorha station and provide employment to the children of farmers.	4.1 - Please refer reply given at **Key Issue 3.6 Stoppage of train at Ankorha railway station.** 4.2 - Please refer reply given at **Key Issue 1.1 Employment.**	-- --		-- --
5	Shri Satish Singh, Village: Simara Dusadh, Aurangabad:	Drew attention towards setting up of ROB in village Simara Dusadh. Construction of Surya Mandir Pond in village Kanker and Badem and maintenance of water reservoirs to make environment free from possible pollution.	**5.1 - Key Issue ROB– ROB at Ankorha, Simar & Badki Salaiya** - A request will be made at high level to the Railway Management for ROB in village Ankorha, Simra & Badki Salaiya.	Under Implementation (is being taken up with Indian Railways on deposit basis as per railway Norms)	--	--

S.L.	Name/Smt./ Shri/Address.	Comments, Questions/ Objections and Suggestions from citizens/ members/ villagers	Response and comments from NTPC Nabinagar Project Proponent	Action Plan	Budget Rs in lakhs	Timeline
			5.2 – The work of renovation of pond in village Kanker and Badem will be done through NTPC Community Development Program / CSR. 5.3 Scientific study is being conducted for the maintenance of water bodies available in the area around NTPC project. Based on the recommendations of the study, proper arrangements will be made for the maintenance of water bodies.	Renovation of pond in village Kanker and Badem is planned. Scientific Study	80.00 16.00	1-3 years 1-3 years
6.	Shri Wakil Singh, Village: Meh, Aurangabad	Added construction of high technology library in the affected village, solution of basic problems of villagers, arrangement for sprinkling of water on the roads, arrangement of free electricity to local citizens, annuity benefits to all farmers, renovation of ponds under CSR scheme, arrangement of	6.1 – If land is made available by the Gram Panchayat, NTPC will construct library in the village under Community Development / CSR scheme. 6.2 - Please refer reply given at **Key Issue 1.2 – Fugitive dust.**	6.1 Library to be Set up after land made available by Gram panchayat. --	40.00	3-4 years --

S.L.	Name/Smt./ Shri/Address.	Comments, Questions/ Objections and Suggestions from citizens/ members/ villagers	Response and comments from NTPC Nabinagar Project Proponent	Action Plan	Budget Rs in lakhs	Timeline
		streetlights, reduction of fee of Bal Bharti Vidyalaya and increasing the seating capacity in Kendriya Vidyalaya.	**6.3 –** Please refer reply given at Kay Issue 3.3 – Free electricity to local citizens.	--		--
			6.4 - Please refer reply given at Kay Issue 1.3 – Annuity to farmers.	Pond Renovation works(Shivanpur Ankhora) already undertaken through CD/CSR work.	70.00	1-3 years
			6.5 – **Renovation of Pond** – Scheme related to pond and street light will be done under community development work / CSR. At present, ponds in village Kurwa, Salaiya, Narari Khurd and Madhe have been renovated at a cost of Rs.1.10 crore and tender process is being done for renovation of ponds in village Ankorha and Shivanpur and process has been started to install solar high mast light at 21 places in the villages.	Installation of solar high mast light at 21 places in the villages	37.00	1-2 years

S.L.	Name/Smt./ Shri/Address.	Comments, Questions/ Objections and Suggestions from citizens/ members/ villagers	Response and comments from NTPC Nabinagar Project Proponent	Action Plan	Budget Rs in lakhs	Timeline
			6.6 – The Balbharti School fee has been decided by the school management committee considering the salary and other relevant factors as per statutory provision and sanction of school capacity in Kendriya Vidalaya being decided by the Education department, GOI.	--		--
7.	Shri Annu Yadav, Mukhiya, Village: Meh, Aurangabad	The proposed project is between Nabinagar and Barun Blocks. He requested to name this project as "Nabinagar Barun Thermal Power Plant". He suggested to establish medical and engineering college in the said area in the interest of the children of farmers.	7.1 – The process of NTPC Nabinagar is registered as Nabinagar Super Thermal Power Project. 7.2 – The sanction of a medical college and an engineering college in this area is under the ambit of State Government.	-- --		-- --
8.	Shri Brijmohan Singh, Mukhiya, Village: Mahuon, Aurangabad	At least one person from every PAP family should be given employment.	8.1 - Please refer reply given at **Key Issue 1.4 Employment.**	--		--

S.L.	Name/Smt./ Shri/Address.	Comments, Questions/ Objections and Suggestions from citizens/ members/ villagers	Response and comments from NTPC Nabinagar Project Proponent	Action Plan	Budget Rs in lakhs	Timeline
09.	Shri Birendra Singh, Sarpanch, Village: Mahuon, Aurangabad	Cases have been filled against several villagers which should be withdrawn.	9.1 – The removal of court cases under the jurisdiction of the competent court.	--		--
10.	Shri Raj Kumar, Village: Ankorha, Aurangabad:	Employment to the children of displaced families under the proposed project, reduction of education fees by 40-50% in Kendriya Vidyalaya and Bal Bharti Vidyalaya. He presented this proposal regarding stoppage of trains at Ankorha Station, land acquisition related to farmers, CSR and early completion of the health centre under construction at Ankorha.	10.1 - Please refer reply given at **Key Issue 1.4 Employment.** 10.2 - Please refer reply given at **Key Issue 6.6 – School Fee related.** 10.3 - Please refer reply given at Sl.No **3.6 Stoppage of train at Ankorha railway station.** 10.4 – The refer cases towards the land acquisition being decided by the competent court.	-- -- -- --		-- -- -- --

S.L.	Name/Smt./ Shri/Address.	Comments, Questions/ Objections and Suggestions from citizens/ members/ villagers	Response and comments from NTPC Nabinagar Project Proponent	Action Plan	Budget Rs in lakhs	Timeline
			10.5 **CSR** – The CSR scheme is being implemented in the surrounding villages under the CSR policy of NTPC and the directives of the Govt. of India, Till date, NTPC Nabinagar has implemented developmental activities under CSR and community development. for Rs.70.88 crores	Implemented.		--
			10.6 – Please refer reply given at **Key Issue 3.2 – Health Centre at Ankorha village.**	--		--
11.	Shri Lav Kumar, Up Pramukh, Nabinagar, Aurangabad:	Proposed to provide maximum employment to the local people, community development and further development of local area through CSR, construction of ROB at Ankorha and Salaiya and linking of ROB with Bharat	11.1 - Please refer reply given at **Key Issue 1.4 Employment.**	--	--	--
			11.2 – **CSR & CD works** – The scheme is being implemented under the CSR policy of NTPC, in which most of the	--	--	--

S.L.	Name/Smt./ Shri/Address.	Comments, Questions/ Objections and Suggestions from citizens/ members/ villagers	Response and comments from NTPC Nabinagar Project Proponent	Action Plan	Budget Rs in lakhs	Timeline
		Mala Project at Simra village.	development works are being done in the surrounding villages. 11.3 –Details of implementation of ROB Please **refer sl. No.5.1**	 Correspondence with railways regarding ROB	 --	 2-3 months
12.	Shri Baleshwar Singh, Village: Khaira, Aurangabad:	Proposed irrigation facilities to farmers, employment opportunities to the unemployed, proposal of bulb corridor by railway and renovation of the big pond in Khaira by NTPC.	12.1 - Please refer reply given at **Key Issue 1.1 Irrigation facility to farmers.** 12.2 – The process related to land acquisition for construction of Bulb Corridor has been done by Indian Railways. 12.3 – The work of renovation of ponds and arrangement of Solar lights will be done through NTPC's Community Development / CSR.	-- -- Pond renovation in Khaira Village. Solar lights installation in	-- -- 45.00 5.00	-- -- 1-2 years 1-2 Years

S.L.	Name/Smt./ Shri/Address.	Comments, Questions/ Objections and Suggestions from citizens/ members/ villagers	Response and comments from NTPC Nabinagar Project Proponent	Action Plan	Budget Rs in lakhs	Timeline
				Khaira village.		
13.	Shri Radhe Prasad Yadav, Village: Meh, Aurangabad:	A proposal was made to provide irrigation facilities to farmers, free electricity, benefits of CSR scheme to villagers on a general basis, beautification work in Amba and Meh and proper solution to the problem of ash in the surrounding area by NTPC Management.	13.1 - Please refer reply given at **Key** Issue 1.1 Irrigation facility to farmers. 13.2 – Please refer reply given at Sl.No.3.3 - Free electricity to local citizens. 13.3 – The benefit of CSR scheme is being provided to all the concerned villages. The CD work in Amba being taken under Community Development program. In village Meh, various CD works has already completed up like Construction of APHC, Village road and hand pumps. 13.4 - Please refer reply given at Key	-- -- Community development activities already taken up in Amba for village road.	-- -- 38.00	-- -- 1-2 Years

S.L.	Name/Smt./ Shri/Address.	Comments, Questions/ Objections and Suggestions from citizens/ members/ villagers	Response and comments from NTPC Nabinagar Project Proponent	Action Plan	Budget Rs in lakhs	Timeline
			Issue 1.2 – Fugitive dust.	--		---
14	Shri Sunil Gupta, Village: Meh, Aurangabad	Suggested for proper sprinkling of water on Barun-Nabinagar road, free electricity, identification of labourers and providing them minimum wages, focus on CSR project and withdrawal of case filed against local citizens.	14.1 – Sprinkling of water on road – Ash transportation is carried out either through tarpaulin covered vehicles or through Closed container vehicles in line with environmental norms. The concerned transport agency regularly sprinkle water on Haulage Road by Tankers due to which the possibility of dust generation is minimized and the project affected people are also getting employment. 14.2 - Please refer reply given at Sl. No. 3.3 – Free electricity to local citizens. 14.3 – Please refer reply given at Sl. No.3.1-Regarding Identification of	-- -- --		-- -- --

S.L.	Name/Smt./ Shri/Address.	Comments, Questions/ Objections and Suggestions from citizens/ members/ villagers	Response and comments from NTPC Nabinagar Project Proponent	Action Plan	Budget Rs in lakhs	Timeline
			labourers 14.4 – Please refer reply given at Sl.No.11.2 – CSR project. 14.5 – Please refer reply given at 9.1 – Case filed against local citizens.	-- --		-- --
15.	Shri Mantu Yadav, Village: Shivanpur, Aurangabad	Suggested to provide employment to the unemployed, to construct a hospital in Ankorha soon, to construct Chaurahi Baba temple and to prepare a sports team by NTPC.	15.1 - Please refer reply given at Sl.No.1.4 – Employment. 15.2 – Please refer reply given at Sl. No.3.2 – Health Centre at Ankorha. 15.3 – Proposal for re-location of old Chaurahi Baba (statue) will be taken up with district administration.	-- -- New worship place has developed by	-- -- 10.00	-- -- 1-3 years

S.L.	Name/Smt./ Shri/Address.	Comments, Questions/ Objections and Suggestions from citizens/ members/ villagers	Response and comments from NTPC Nabinagar Project Proponent	Action Plan	Budget Rs in lakhs	Timeline
			15.4 – NTPC will prepare a plan for promotion of sports sector and provide facility through community development/CSR.	NTPC. Playground in village- Tetaharh being done through CSR scheme.	85.00	6-12 Months
16.	Shri Subodh Singh, Village: Madhe, Aurangabad	The cases filed against the villagers should be withdrawn, the land related cases in Gaya Could should be brought to Aurangabad Court and the amount should be paid on the basis of verification of records.	16.1 – Pl refer reply sl 9.1 related to court cases. Further issue related to transfer of cases from Gaya court to Aurangabad is jurisdiction of the competent court.	--	--	--
17.	Shri Vijay Kumar Singh, Village: Madar, Aurangabad	Arrangements should be made for drainage of water logging in Madar village during rainy season and suggested construction of culvert.	17.1 - The construction of culvert in village Marar will be done under CSR scheme.	Construction of culvert in Madar Village. Under progress.	13.00	6 months

S.L.	Name/Smt./ Shri/Address.	Comments, Questions/ Objections and Suggestions from citizens/ members/ villagers	Response and comments from NTPC Nabinagar Project Proponent	Action Plan	Budget Rs in lakhs	Timeline
18.	Shri Birendra Kumar Singh, Village: Madhe, Aurangabad	Suggested that the benefits related to displaced persons should be given to the landowners and their sons also.	18.1 - Benefits are being provided to the family of farmers under the Rehabilitation & Resettlement policy of NTPC.	--	--	On regular basis.
19.	Shri Sanjay Giri, Village: Ankorha Panchyat, Aurangabad	Suggested to provide employment to local poor families, children of displaced and affected families and to stop the trains at Ankorha Station.	19.1 - Please refer reply given at Sl.No.1.4 – Employment. 19.2 – Please refer reply given at Sl. No.3.6 – Stoppage of Train.	-- --	-- --	-- --
Total Amount in lakhs					**7325.00**	

7.3 CORPORATE ENVIRONMENT RESPONSIBILITY

NTPC has been pioneers in implementing Environmental & Social Responsibility / Corporate Environmental Responsibility and made significant contribution to improve quality of people's life and Environment in all the regions they are operating in, around the nearby villages, NSTPP have started key initiative in support of sustainable development.

All CSR initiatives were aligned with Sustainable Development Goals (SDGs). In recent times many new initiatives are taken like;

- Sath Padhe Sath Badhe education scheme in 24 Govt. Schools and other educational facilities,
- Sankalp Aarogyam – Health services in the surrounding villages,
- Jal Dhara – Drinking water facilities in the surrounding villages,
- Sanitation (Nirmal) programme for the project affected villages,
- Promoting welfare and cultural activities in the surrounding villages,
- Community Development Programme at Aurangabad district,
- Buniyadi Sanrachna – Construction of infrastructure facilities in the surrounding villages.

NTPC is committed to inclusive development and will further strengthen its activities for improvement in education, sanitation and health, livelihood, rural infrastructure, plantation drives and rural sports.

The CER Activity aims at bettering the Environment around the operated area as well as socio economic and cultural status of local people. The key Highlight of some initiatives & activities that NSTPP is going to undertake in nearby villages are as follow:

Sustainable Livelihood Options & Woman Empowerment

- Skill development Centre (SDC) to make the youth for achieving their Goals in life by becoming skilled Professionals.
- Provide training on sustainable farming and organic practices.
- Offer animal husbandry and dairy development programs.
- Organize workshops for traditional crafts and artisan skills.
- Strengthening the community-based organization like self-help groups, farmer federation etc.
- Capacity building of underprivileged communities on various market driven skills:
- Establishment of forward and backward market linkages through networking.
- Facilitating the easy reach to the technical institution for knowledge up gradation; and
- Promotion of livestock health management
- Facilitate the formation and support of women's self-help groups.
- Conduct vocational training in tailoring, beauty services, and food processing.
- Support women entrepreneurs with mentorship and financial resources.

Educational Initiatives

- Modernization & expansion of identified Primary / Higher Secondary School within 10km radius of the project site.
- Distribution of drinking water filter/Drinking water coolers, Basic teaching and learning infrastructure support to Govt. Schools, Conducting Quiz competition for Students
- Supporting in creation of assembly halls, prayer halls, classrooms, computer labs, space for mid-day meals, playground, school walls etc. for government school.

- Educational Vocational Guidance fair (EVGF) for career talk.
- Community to provide awareness about education, health, hygiene, and discipline.
- Program for skill improvements of teaching staffs in govt. school.
- Skill up gradation through establishment of technical training institution.
- Establish and support local libraries and reading rooms.
- Provide scholarships and financial assistance to underprivileged students.
- Implement digital education programs and e-learning facilities.
- Facilitate after-school tutoring and mentoring programs.

Community Health Initiatives

- Providing fund for the operation of identified Primary Health Centre within 10km radius of project site.
- Rural Medical Camps through Medical Team of Primary Health Centre from NTPC, Safe Menstrual Hygiene Management Awareness, Mega Health Camp, Cataract Screening & Operation.
- Promotion of awareness of malnutrition and anaemia.
- Control on blindness, malaria, TB, HIV & AIDS, diarrhoea etc.
- Support the district health administration in the community health activities.
- Provide free or subsidized medicines to the local community.
- Implement vaccination drives for common diseases.
- Offer dental care and eye care camps with free check-ups and treatments.
- Distribute sanitary napkins and promote menstrual hygiene management.
- Facilitate mental health awareness programs and provide counselling services.
- Implement health education programs focusing on nutrition and healthy lifestyles.
- Establish partnerships with local hospitals for advanced medical care and referrals.
- Establish and support maternal and child health clinics.
- Conduct regular health check-up camps for mothers and children.
- Offer prenatal and postnatal care services.
- Distribute nutritional supplements and vitamins to pregnant women and children.
- Regular cleaning of stagnant water to reduce diseases like malaria and dengue.

Community Rural Infrastructure development:

- Repairing, Strengthening & Maintenance of Existing roads
- To provide facility for potable drinking water by providing RO Plants, drinking water supply system, overhead tank, and underground pump in villages.
- Creation of clean and hygienic environment by proper drainage systems, community sanitation campaign etc.
- Upgradation of primary health centres, renovation of existing roads, construction of toilet facilities etc.
- Provision of solar street lighting, green nurturing programs, implementation of swachchh bharat initiatives
- Enhancement of green coverage.
- Protection of wildlife through awareness generation.
- Promotion of renewal energy; and
- Waste management through installation of recycling measures.
- Tree plantation in nearby villages or vacant land may be carried out under joint effort of NTPC, local government agency and the local community.
- Install solar street lights to enhance safety and security in villages.
- Construct public toilets to improve sanitation and hygiene.
- Develop rainwater harvesting systems for sustainable water management.

Sports & Culture Development

- Renovation existing community Parks & Maintenance of the same
- Provide play area – Swing sets & other equipment for physical activities such as Gym.
- Establishing sports facilities and providing equipment for local schools and communities.
- Organizing annual sports tournaments and cultural festivals to promote local talent.
- Providing scholarships and training programs for young athletes.

General Management & Administration

- Programme Manager/Programme Coordinator (Team Leader),
- Project Officer (Female & Male),
- Village Coordinator(s), Vehicles & expanses,
- Capacity Building activities.

The details of work executed by NSTPP under R&R and CD activities are given in mentioned below in **Table 7.1** & enclosed in **Annexure 7.1.** Total amount of Rs. 45.57 Crore on R&R, CD activities and amount of Rs. 21.19 Crore has been incurred on CSR activities since inception till 2023-24. Year-wise CSR expenditures are given below in **Table 7.2.**

Furthermore, proposed NSTPP activities for Stage-II has been envisaged and mentioned in **Table 7.3**

Table 7.3: Existing Nabinagar STPP- R&R-Community Development Activities for Stage-I

Sl. No	Activities	Budget in Rs. Cr.	Awarded Amount in Rs. Cr.	Expenditure Incurred in Rs. Cr.
A	**Education (Sath Padhe Sath Badhe)** Distribution of School Bags, Stationary items, Sweaters, Quiz & Painting Competition, Distribution of Computers, Play Equipment etc.	5.0	3.10	3.01
B	**Health (Sankalp Aarogayam)** Mobile Van Health Service, Tri- Cycle Distribution, Addl. PHC Construction at Ankorha, Furniture and medical equipment's, etc.	6.7	4.03	3.05
C	**Drinking Water (Jal Dhara)** Installation of Hand Pumps	1.5	0.67	0.53
D	**Sanitation (Nirmal) and other activities** Distribution of Dustbin, Broom, Duster Cloth, Hand Wash Soap, Toilets in Govt. School	0.65	0.02	0.02
E	**Welfare & Cultural Activities** Distribution of Blankets and Cloth, Balti, Tarpoline, Sponsoring and Supporting Sports event, Providing Wheel chair, Skill development awareness camp, e Food distribution to villagers, Face mask distribution, Sanitaztion activities (During COVID-19), etc.	1.3	0.98	0.98

Sl. No	Activities	Budget in Rs. Cr.	Awarded Amount in Rs. Cr.	Expenditure Incurred in Rs. Cr.
F	**Community Development Programme at Aurang abad District** Furnishing of public meeting hall, Construction of Football Stadium, Shifting of High Mast light, Wooden Badminton court, Construction of toilet complex for public uses, Community hall, etc.	10.4	7.21	6.65
G	**INFRASTRUCTURE (Buniyadi Sanrachna)** Construction of PCC Roads and drainage system, Reparing & maintenance of Road, Supply Installation of Solar Street Light System, Shifting of Chourahi Baba Religious place, Construction of Community Shed, Levelling of Playground, etc.	34,98	35.72	31.33
Total Amount in Cr.			**51.73**	**45.57**

Table 7.4: Yearly CSR Expenditure

Nabinagar STPP Yearly CSR Expenditure		
Sr. No.	**Financial Year**	**Amount in Cr.**
1	FY 2019-20	3.46
2	FY 2020-21	1.70
3	FY 2021-22	5.60
4	FY 2022-23	6.50
5	FY 2023-24	3.93
6	FY 2024-25(till Dec 24)	1.68
	Total (Cr.)	**22.87**

Table 7.5: Proposed CSR Activities for Nabinagar STPP Stage-II

NABINAGAR SUPER THERMAL POWER PROJECT STATION AURANGABAD BIHAR COMMNUNITY DEVELOPMENT PROGRAMME FOR PAVs & VICINITY OF THE PROJECT			
Activities planned under Capital expenditure for Corporate Environment responsibility/Community Development for NSTPS St-II (3X800 MW)			
Sl.No	**Strategically important Activities**	**Capital Amount (in Crs)**	**Timeline**
1.0	**Education/Training**		
1.1	Schools : Construction of school building, Additional class room, Toilets, Playground development works, Distribution of Computers & peripherals, Furniture, Sweaters, School bags with stationeries, smart classes equipments, Tat-Patti, LED Bulb for school going childrens/electrification/ Ceiling/pedestal fan, Sewing/ knitting/Embroidery machines, Game kits, play equipment, installation of jhoola etc.	10.00	4-5 years

1.2	Sponsoring/Organizing various relevant skill development/vocational trainings/ Reimbursement of tution fee to PAPs wards etc. for youths/students of vicinity villages/Scholarship to meritorious students/Award to meritorious student of PAVs/Support to meritorious & BPL students for higher study/support to sport development etc.		
2.0	**Health**		
2.1	Support to development of health facilities at Govt. Hospitals at village level, Block level & District level.	10.00	4-5 years
3.0	**Drinking Water**		
3.1	Installation of Hand Pumps/overhead tanks/boring/water ATMs/RO System in Project Affected Villages/schools and other strategic locations/disbursement of water filter among the students of project affected schools etc (Revised)	2.00	3-4 years
4.0	**INFRASTRUCTURE DEVELOPMENT**		
4.1	Internal Village PCC Road with drainage system, Solar light, Development/cleaning/ Rejuvenation of village Pond/Panchayat Bhawan, High Mast/street lights, Construction of Kala Manch/ Construction of stadium, Construction of Ghat, Irrigation system etc	35.00	4-5 years
5.0	**SPORTS, WELFARE, ART & CULTURAL ACTIVITIES**		
5.1	Supporting/organizing sports/Cultural events on festivals and other occasions/support to BPL families of Project affected villages/Support to NGO/Govt. bodies for SociaL-welfare, Sports activities at project affected villages.	5.00	3-4 years
6.0	**Others /Sanitation**		
6.1	Tree plantation, Activities under Swachh Bharat/Govt. activities Vidyalaya Abhiyan and other Environment related activities.	2.00	3-4 years
7.0	**Community Development Programme for Surrounding area of District in consultation with District authorities/ Stakeholders.**	20.00	3-4 years
	Total Amount (In Cr.)	**84.00**	

Note: The above activities will be taken up in consultation of stakeholders/ NAS recommendation/ District authority requirement.

Regular expenditure under CSR

1. NTPC, NSTPS already incurring annual CSR expenditure of RS. 3-5 / annum every year. This will continue during construction phase of Stage-II.

2. After commissioning of Stage-II (after 2030-31), the above expenditure shall be enhanced to Rs. 8.5 Cr. per annum.

3. The activities are tentative and shall be decided in consultation with district administration, local stakeholders based on need-based requirement under the ambit of schedule -VII of Companies Act-2013 and GOI guidelines.

Sl	Proposed works under CSR	Estimated recurring amount (in lakh)
1	Educational Infrastructure, furnitures, Bench-Desk, Playground Toilet etc. (regular)	200.0
2	Health and sanitation- Medical support, Mobile health facilities in villages,	100.0
3	Rural Infrastructure- Village approach, road & drain, Community Hall, Panchayat Bhawan, Community Platform (strategic)	300.0
4	Solar light/ High mast	30.0
5	Sports, Social - Cultural activities, Arts, Cultural heritage conservation	20.0
6	Skill development/ livelihood training	10.0
7	Pond development/ Rejuvenation/clearing	100.0
8	Drinking water facilities	30.0
9	Need assessment/Social impact/ SIE study	10.0
10	Misc. activities	50.0
	Total	**850**

7.4 RISK ASSESSMENT

A hazard is something that can potentially cause harm, and a risk is the chance, high or low, that any hazard will actually cause somebody harm. Industrial disaster may arise when a major accident occurs and becomes uncontrollable resulting in the consequences spreading out of the project boundary. Hazards are inherent to all industrial operations since they involve handling of hazardous materials (flammable, explosive, corrosive and toxic materials), heavy machineries & technical units. Thus, risk assessment becomes an important part of the EIA-EMP study. Risk Assessment is a methodology to determine the nature and extent of risk by analyzing 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 thermal power plant operations since they involve working with many Hazards such as (i) High pressure super-heaters, re-heaters, economizer units exchanging heat with the hot flue gases; (ii) Turbines that utilize the HP steam to generate power; (iii) Fuel oil storage and handling units; (iv) Coal handling units; (v) Hydrogen as a coolant in turbo generators drawn from hydrogen cylinders; (vi) Chlorine as water treatment chemical drawn from cylinders and (vii) Switchyard including transformers, isolators etc.

Nevertheless, a properly designed and operated potentially hazardous unit of a thermal power plant will have a very low probability (to a level of acceptable risk) of a threat. Subsequently, a properly designed and executed management plan can further reduce the probability of a threat 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
- Risk characterization

Hazard identification is a process that determines the probable risk on human health or properties that could result from exposure to a potential hazard. This process requires a review of the scientific literature. The literature could include information published by the national and international organizations like US Environmental Protection Agency (EPA), state agencies, and health organizations. Identification of causes and types of potential hazards is the primary task for planning for consequential risk assessment.

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 non-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: **Component-1:** Identification of contaminants being released which are hazardous; **Component-2:** Estimation of the amounts of contaminants released from all sources or the source of concern and **Component-3:** Estimation of the concentration of contaminants.

7.4.1 COMPONENT-1 IDENTIFICATION OF CONTAMINANTS/HAZARDS

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 from a coal fired thermal power plant, various hazards are identified which are given in **Table 7.6**.

Table 7.6 Potential Hazards

Sl. No.	Blocks/Areas	Hazards Identified
1	Coal storage in open yard	Fire, Spontaneous Combustion
2	Coal handling plant	Fire and/or Dust Explosions
3	Boilers	Fire (mainly near oil burners), steam; Explosions, Fuel Explosions
4	Turbo-generator buildings	1. Fires in a) Lube Oil systems; b) Cable galleries c) Short circuits in (i) Control rooms(ii) Switchgears 2. Explosion due to leakage of hydrogen and fire following it. 3. Fire in oil drum storage

Sl. No.	Blocks/Areas	Hazards Identified
5	Power transformer	Explosion and fire
6	Switch yard control room	Fire in cable galleries and Switchgear/ Control Room
7	Hydrogen Plant	Explosion and/or fire, Physical dangers
8	Tank farms: HFO/HSD/LDO	Fire
9	Chlorine-dioxide plant	Release of chlorine dioxide
10	FGD	FGD effluent –Corrosive

7.4.2 COMPONENT-2 ESTIMATION OF AMOUNT OF CONTAMINANTS

In a coal based TPP, fuel oils are needed for start-up operations. Hazardous substances in fuel oil storage may be classified into three main classes namely flammable substances, unstable substances and toxic substances. The fuel storage details of the project and properties are LDO/ HSD /HFO which falls under Class B Flammable Liquids **(Table 7.7).**

Table 7.7: Flammability Classification Criteria

Sl. No.	Flammability Class	Flash point (°C)
1	Class A Flammable Liquid	FP < 23
2	Class B Flammable Liquid	23 > FP <65

Fuel oils (LDO/HFO/HSD) will be used in small quantity for initial start-up. Chlorine and other chemicals are used in the makeup water treatment & DM Plant. The hazards associated with the use of these materials would be taken careful consideration and due precaution would be taken for its safe handling at various stages of usage.

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: (i) Particles dispersed in the air with minimum size (typical figure is 400 microns); (ii) Dust concentrations must be reasonably uniform; and (iii) Minimum explosive concentration for coal dust (33% volatiles) is 50g/Nm^3. Failure of dust extraction and suppression systems may lead to abnormal conditions and may increase the concentration of coal dust to the explosive limits. However, uncontrolled emission of coal dust from coal handling plant do no exceed 5 g/Nm^3.

Sources of ignition present are electric equipment and cables, friction, spontaneous combustion in accumulated dust. Dust explosions may occur without any warnings with Maximum Explosion Pressure up to 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 life line of the power plant.

Thus, storage of coal would be designed in such a way that the air content in the coal pile is minimized. Dimension of the coal stack, particularly the height, is a very important parameter for making storage of coal safe and adequate care would be taken while designing the same. Regular watering of stock pile will be done to keep temperature within limits.

7.4.3 COMPONENT-3: ESTIMATION OF THE CONCENTRATION OF CONTAMINANTS

Preliminary Hazard Analysis: Two scenarios are considered for the **Preliminary Hazard Assessment (PHA)**: (i) Spillage of chemicals while handling and (ii) Leakage of chlorine.

Table 7.8: Preliminary Hazard Assessment for Power Plant: Environmental Factors

PHA Category	Description of Plausible Hazard	Recommendation
Environmental factors	Spillage of chemicals from tanks and while handling	• Any unintentional spills must be handled in accordance with the MSDS for each chemical. • All chemical storage tanks must be housed inside a ditch with dike wall according to volume of tank to prevent spills from occurring from ruptures or leaks in joints outside. • A copy of the MSDS must be maintained in the warehouses and chemical laboratory.
	Spillage of chemicals or baths into trench	• All tanks storing chemicals shall be kept within Dyke with wall so that spillage due to rupture or leakages in joints does not take place. • The source of the spillage shall be immediately identified and plugged. • The spilled chemical shall be washed with water and the washed water shall be collected and treated.
	Chlorine dioxide leakage	• Chlorine dioxide plant shall be provided with required chlorine dioxide containers, instrumentation panels, leak detectors etc. • The best protection is to enclose operations and/or provide local exhaust ventilation at the site of chemical release. • Automatically pump Chlorine Dioxide from cylinders or other storage containers to process containers. • The area shall be isolated until the gas has dispersed

7.4.4 HAZARDS FROM LDO HANDLING & STORAGE

7.4.4.1 POOL FIRE OF LDO STORAGE

One number of existing storage tank of capacity 3000 M3 (earlier provided for HFO) will be used. Additional two number of storage tanks each of capacity 2000 KL are envisaged for LDO for the Stage-II. The tanks will be kept within Dyke. In the event of spilling its contents through a small leakage or due to rupture of the pipeline connecting the tank and on ignition, fire will eventuate. As a worst, case it is assumed that the entire contents are leaked out from the storage tank into the tank bund.

7.4.5 MITIGATION MEASURES OF FIRE & EXPLOSION HAZARDS

7.4.5.1 GENERAL MITIGATION MEASURES

- Fire is one of the major hazards, which can result from auxiliary fuel (LDO) storage Tanks. Fire prevention and relevant code enforcement is one of the major responsibilities of project proponent. The fire service facility shall be equipped with:
    - Smoke and fire detection alarm system
    - Water supply
    - Fire hydrant and nozzle installation
    - Foam system
    - Water fog and sprinkler system
    - Mobile Firefighting equipment
    - First aid appliances
- Smoke and fire detection, fire hydrant & nozzle installation etc. as indicated above shall be included as part of all major units.
- Periodic maintenance of all protective and safety equipment shall be done.
- Windsocks/wind cock should be operational at suitable height and with proper visibility to check the prevailing wind direction at the time of accident.
- Periodical training/awareness shall be given to work force at the project to as refresh courses in order to handle any emergency situation.
- Periodic mock drills shall be conducted so as to check the alertness and efficiency of the DMP and EMP and corresponding records should be maintained.
- Signboards including emergency phone numbers and no smoking signs shall be installed at all appropriate locations.
- Plant shall have adequate communication system.
- All major units/equipment shall be provided with smoke/fire detection and alarm system.
- All electrical equipment shall be provided with proper earthing. Earthed electrode shall periodically tested and maintained
- Emergency lighting shall be available at all critical locations including the operator's room to carry out safe shut down of the plant and for ready identification of firefighting facilities such as fire water pumps, fire alarm stations, etc.
- In addition to normal lighting, each installation shall be equipped with emergency (AC) and critical (DC) lighting.
- All electrical equipment shall be free from carbon dust, oil deposits, grease etc.
- Cable routing shall be planned away from heat sources, gas, water, oil, drain piping, air conditioning ducts etc.

7.4.6 PROJECT SPECIFIC MITIGATION MEASURES

- The LDO storage shall be located at least 100m away from coal storage area in view the predicted heat radiation contour distance.
- Protective systems with high reliability and availability should be designed to ensure that these physical conditions are maintained.
- Dyke shall be provided for LDO Storage Tanks
- Co-ordination with local authorities such as fire, police, ambulance, district administration and nearby industries would be ensured to manage / control meet any eventuality.
- To prevent the hazard of static electricity, the fill and recirculation lines to the Storage Tanks shall be located below the liquid level.
- The following arrangements are suggested for LDO Storage Tanks:
    - One independent high-level alarm and trip off liquid inlet-line.
    - One low level alarm with trip off device.
    - Provision of auto deluge Water Sprinkler system for each bulk Storage Tank. The auto deluge Water Sprinkler would be set to start working at a temperature of 66°C.
- In case of any Tank on fire or fire in the vicinity, the cooling of adjoining tank shall be resorted promptly in addition to Tank on fire so that the affected tanks well as the neighbouring Tanks does not give away.
- The night vision wind stocking be mounted on top of administrative building, main plant building and storage tanks is preferred so that people can move in upwind directions in the event of massive spillage from tank on fire.
- No machinery of vital importance like firefighting pump house, Hydrant and Fuel oil pump house shall be placed at radiation contours of 37.5 kW/m2 heat intensity having a distance of concentration of 13.5 m.

It is recommended that strict adherence to standards and accepted maintenance and operation of the plant plays a vital role in proper up-keep of the plant. Regular checking and monitoring of the health of equipment, pipeline and machines, thickness survey etc. will improve plant performance and safety.

7.4.6.1 HAZARDS FROM RELEASE OF CHLORINE DIOXIDE

ALOHA® is the hazard modelling program for the CAMEO® software suite, which is used widely to plan for and respond to chemical emergencies and approved by USEPA. The same is used here.

SITE DATA:

Location: Nabinagar, INDIA

Building Air Exchanges Per Hour: 0.38 (unsheltered single storied)

ASSUMED ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

Wind: 1.11 meters/second from NW at 3 meters

Ground Roughness: open country Cloud Cover: 5 tenths

Air Temperature: 28.85^{0}C Stability Class: E

No Inversion Height Relative Humidity: 50%

CHEMICAL NAME: CHLORINE DIOXIDE

- CAS Number: 10049-4-4 Molecular Weight: 67.45g/mol
- Acute Exposure Guideline Level (AEGL):
  AEGL-1 (60 min): 0.15 ppm;
  AEGL-2 (60 min): 1.1 ppm;
  AEGL-3 (60 min): 2.4 ppm

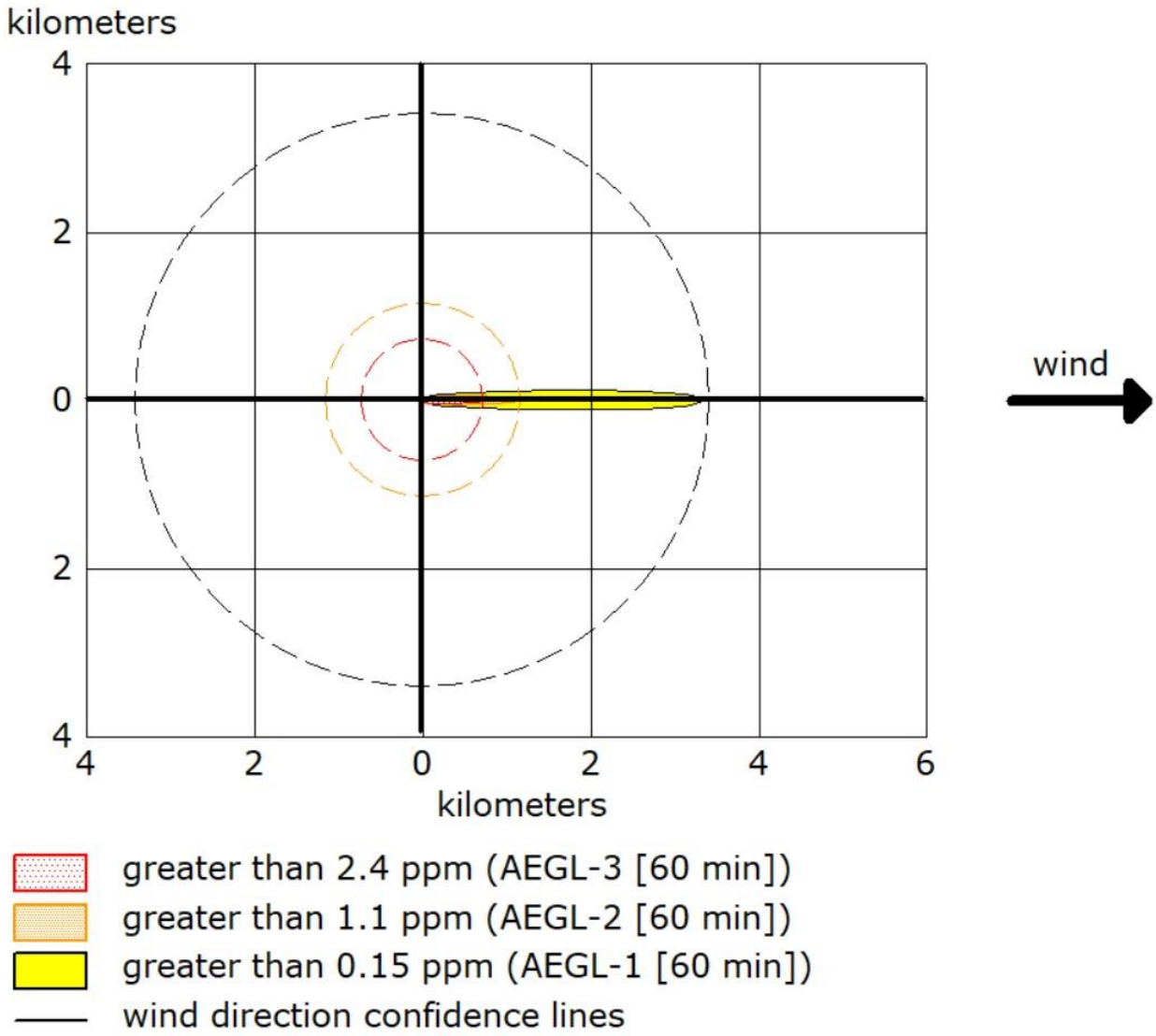
SOURCE STRENGTH:

- Leak from hole in horizontal cylindrical tank
- Non-flammable chemical is escaping from tank
- Tank Diameter: 29.9 meters Tank Length: 9.95 meters
- Tank Volume: 6,986 cubic meters
- Tank contains liquid Internal Temperature: 28.85° C
- Chemical Mass in Tank: 7,303,184 kilograms
- Tank is 70% full
- Circular Opening Diameter: 0.04 inches
- Opening is 0.63 meters from tank bottom
- Release Duration: ALOHA limited the duration to 1 hour
- Max Average Sustained Release Rate: 986 grams/min(averaged over a minute or more)
- Total Amount Released: 59.1 kilograms

Note: The chemical escaped as a mixture of gas and aerosol (two phase flow).

THREAT ZONE:

- Model Run: Heavy Gas
- Red : 728 meters --- (2.4 ppm = AEGL-3 [60 min])
- Orange: 1.2 kilometers --- (1.1 ppm = AEGL-2 [60 min])
- Yellow: 3.4 kilometers --- (0.15 ppm = AEGL-1 [60 min])



7.5 DISASTER MANAGEMENT PLAN

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.

Nabinagar STPP has already implemented a Disaster Management Plan for existing unit. New units shall also be included in the same plan.

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. Emergency preparedness planning can be divided in two subsections: **(i) Onsite Disaster Management Plan and (ii) Off-site Disaster Management Plan**

Onsite Disaster Management Plan: The Onsite 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. Considering the process and the material used at Nabinagar STPP, the following hazards are identified along with the probable areas of occurrence as summarized in **Table 7.4.**

Table 7.9: Identification of Hazards and Potential/Probable Locations of Occurrence

Nature of Hazard	Potential Areas / Locations of Occurrence
Fire Hazards	(i) Coal Handling Plant, Coal Conveyor; (ii) Fuel Oil Handling and Storage Areas; (iii) Transformer and switch yard Areas; (iv) Oil and Lubricants Stores and (v) Boiler area
Explosion Hazard	(i) Hydrogen Plant; (ii) Turbo generators; (iii) Transformers; (iv) Boiler and (v) Coal dust in mills and boilers
Bursting of Pipe Lines& Vessels	(i) Steam pipes due to high pressure & temperature; (ii) Water pipes due to high pressure and (iii) Hydrogen Lines and Chlorine Lines
Release of Gases / Dust	(i) Chlorine in Water Treatment Plant; (ii) Hydrogen in Turbo Generator area of main plant and H_2plant; (iii) Flue gases from ducts and (iv) Coal dust in transfer points, CHP Crusher & Mill area
Release of Liquid	(i) Chemicals tanks in Water Treatment Plant; (ii) Fuel oil tanks in Fuel oil handling section; (iii) FGD effluent and (iv) Chlorine dioxide from ClO2 cylinder

As has been discussed before, the main hazards are due to heat radiation due to LDO and toxic release due to Choline. Other hazards are not anticipated.

The Emergency Management Plan (EMP) envisages the need for providing appropriate action so as to minimize loss of life/property and for restoration of normalcy within the minimum time. Adequate manpower, training and infrastructure shall achieve this. An appropriate fire protection system is also developed to meet any emergency.

The emergencies are classified as construction hazard, natural hazard and operational hazard. During the construction time good construction practice and safety requirement should be enforced by the contractor at site. The construction manager can be the co-ordinator for the emergency management. Depending on the severity of the injury/ disaster outside medical help can be obtained. Before commencement of the work the hospital facilities should be identified and the address and phone numbers to be available to the contractor as well as the construction manager. During natural hazard the emergency plan to be implemented with the help and guidance from the district collector, who is the co-ordinator for such activity. During operation, the plant manager become the co-ordinator for the emergency activity and the emergency cell will be acting in accordance with the disaster management plan (DMP).

During construction phase proper measures should be taken to ensure safety at heights. Fencing/railing should be provided at construction openings to prevent physical injuries and fall of construction workers.

The following important elements in the disaster management plan (DMP) are suggested to effectively achieve the objectives of emergency planning:

- Reliable and early detection of an emergency and careful planning.
- The command, co-ordination, and response organisation structure along with efficient trained personnel.
- The availability of resources for handling emergencies.
- Appropriate emergency response actions.
- Effective notification and communication facilities.
- Regular review and updating of the EMP.
- Proper training of the concerned personnel.

SEQUENCE OF ACTION

In order to handle disaster/emergency situations, an organizational chart entrusting responsibility to various plant personnel has been prepared along with their specific roles during an emergency. The possible composition of the management team is given in **Figure 7.1**

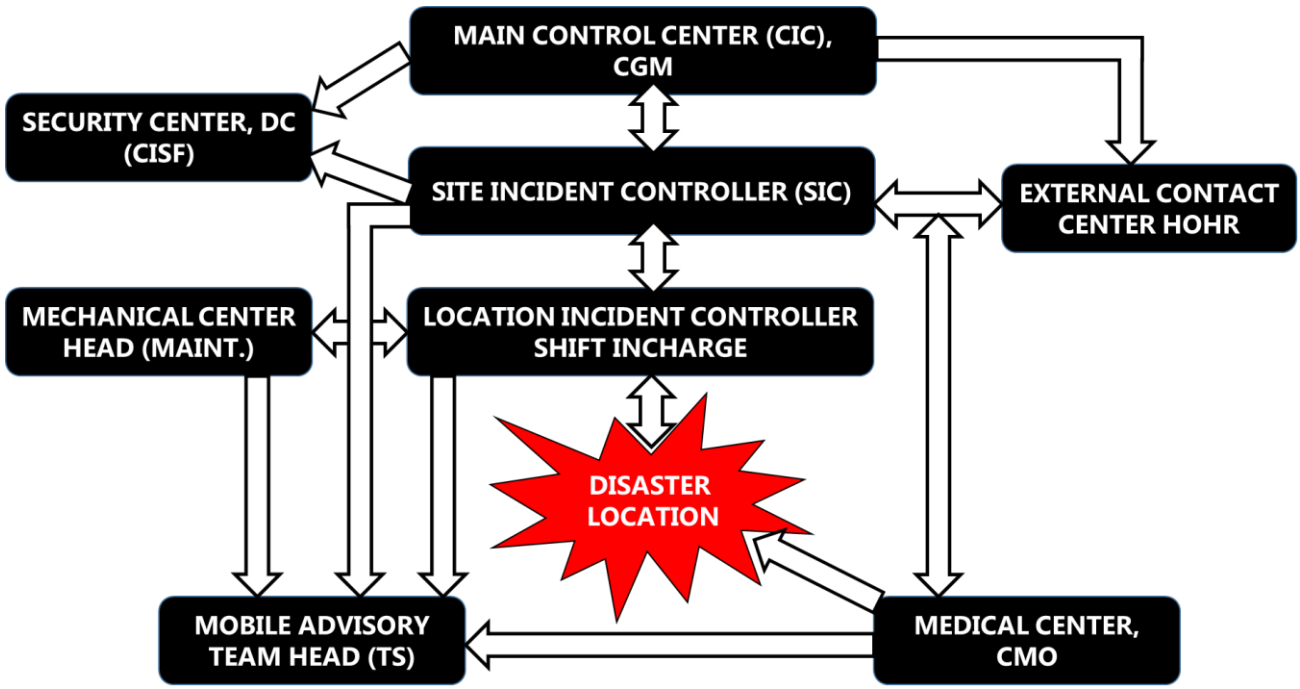


Figure 7.3: Structure of Disaster Management Team

INFRASTRUCTURE

Following infrastructure & operational systems should be provided to meet emergencies:

- First aid boxes
- Gas masks
- Telephone line with STD facility
- Loud hailers
- Emergency lighting system
- Stretchers
- Transport facility
- Appropriate Fire-fighting equipment
- Fire-tenders
- Ambulance

ASSEMBLY POINTS

Assembly points are to be set up farthest from the location of likely hazardous events, where pre-designated persons would assemble in case of emergency. The location near to the entrance gate is one of the safest places. This can be the assembly point.

EVACUATION PATH

The road straight to the entrance gate is quite wide and no hazardous installation besides the road. This road can be taken as the evacuation path.

COMMUNICATION SYSTEM

Different types of alarms to differentiate types of emergencies should be provided. In case of failure of siren, placards of various colours should be used to indicate the situations. If everything fails, a messenger should be used for sending the information and the various placards mentioned would also be used.
Alarms should be followed by announcement over Public Address System. In case of failure of alarm system, communication should be by telephone operator who will make announcement in plant through Public Address System, which should be installed. Walkie-talkie and paging systems using predetermined codes of communication are very useful during emergency.

WARNING SYSTEM AND CONTROL

The control centres shall be located at an area of minimum risk or vulnerability in premises concerned, taking into account the wind direction, areas which might be affected by fire/explosion, toxic releases etc.

EMERGENCY SERVICES

This includes fire-fighting system, first aid centre, hospital etc. Alternate sources of power supply for operating fire-pumps, communication with local bodies, fire-brigade etc. should also be clearly identified. Adequate number of external and internal telephone connections should be installed.

FIRE PROTECTION SYSTEM

The fire protection system for the proposed plant is to consists of:

- Hydrant system for all the vulnerable areas of the plant.
- Portable carbon-dioxide extinguishers for the control room.
- Portable hand appliances of suitable types/ capacities for extinguishing small fires in selected areas of the plant.

The emergency plan will have the key personnel of the organisation and responsibilities assigned to them in case of an emergency and their telephone numbers. These telephone numbers and persons will be finalised after commissioning of the plant.
Depend on the severity of the emergency outside agency will be called for the assistance. The following information will be included in case outside organizations are involved in assisting on-site emergency:

- Type of accidents
- Responsibility assigned to each of the organisation.
- Liaison arrangement between the organisations.

The safety equipment installed and fire-fighting equipment available will be mentioned in the detailed DMP.
Small size maps should be available in control tower, fire station, rescue and firefighting and all other supporting vehicles responding to an emergency.
The map should contain the site related details such as:

- Location of dangerous substances.
- Seat of key personnel.
- Location of emergency control room.
- Quantity of the chemicals stored.

The parking points of Ambulances and Fire-fighting vehicles must be located such that no hindrance will be posed at any time of the day.

Off-site Disaster Management Plan: 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 its application to emergencies. The following conditions will ordinarily constitute an off-site emergency:

- Release of chlorine-dioxide, due to rupture of valve or rupture of the shell, explosion in chlorine dioxide cylinder due to fire, terrorist activities or otherwise; resulting in its spread to neighbouring areas.
- Major fire involving combustible materials like oil, and other facilities. Under the Environmental Protection Act 1986, the responsibility of preparation of Off-Site Emergency Plan lies with the State Government. The Collector / 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 offsite emergencies are Collector / 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.)

7.5.2 NATURAL DISASTERS

A natural disaster is the result of a natural phenomenon (e.g. flood, tornado, earthquake, Tsunami, Cyclone and land slide, epidemics, pandemics 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. Bihar State Disaster Management Authority is a nodal agency for preparation of disaster management plan of natural disaster for Bihar.

Earthquake: As per the recent categorization, the country has been divided into four zones (II, III, IV and V) and the project site is coming under Moderate Earthquake Zone (i.e. Zone-III). The plant and surrounding area fall in a moderate damage risk zone as per the recent earthquake categorization zone.

Objectives

- Minimize the risk to human life and property.
- Ensure the continuous operation of critical plant functions.
- Facilitate a coordinated and efficient response to earthquake events.
- Promote rapid recovery and return to normal operations.

Before an Earthquake (Preparedness and Mitigation)

A. Risk Assessment and Planning

1. **Seismic Hazard Analysis:**
   - Conduct regular seismic hazard assessments to understand the potential impact of earthquakes.
   - Identify and map out high-risk areas within the plant.
2. **Structural Safety:**
   - Ensure all buildings and structures meet seismic design standards.
   - Retrofit vulnerable structures to enhance earthquake resistance.
3. **Emergency Planning:**
   - Develop and regularly update an Earthquake Emergency Response Plan.
   - Establish clear evacuation routes and assembly points.
   - Prepare an inventory of emergency supplies, including first aid kits, water, food, and communication devices.

B. Training and Drills

1. **Employee Training:**
   - Conduct regular training sessions for employees on earthquake preparedness, response, and evacuation procedures.
   - Train personnel in first aid and basic search and rescue techniques.

2. **Drills and Simulations:**

- Organize periodic earthquake drills to test the effectiveness of the emergency response plan.
- Evaluate and improve response strategies based on drill outcomes.

C. Infrastructure and Equipment

1. **Equipment Safety:**
   - Secure heavy machinery and equipment to prevent movement during an earthquake.
   - Install automatic shut-off systems for gas, electricity, and other critical utilities.
2. **Communication Systems:**
   - Ensure reliable communication systems are in place for internal and external coordination.
   - Maintain backup communication systems in case of primary system failure.

During an Earthquake (Immediate Response)

A. Initial Actions

1. **Drop, Cover, and Hold On:**
   - Instruct all personnel to drop to the ground, take cover under sturdy furniture, and hold on until the shaking stops.
2. **Emergency Shutdown:**
   - Implement automatic or manual shutdown procedures for critical operations to prevent accidents.

B. Evacuation and Safety

1. **Evacuation:**
   - Evacuate non-essential personnel to predetermined safe areas following established routes.
   - Ensure the safe evacuation of visitors and contractors on-site.
2. **Emergency Response Team:**
   - Activate the Emergency Response Team to assess damage and initiate immediate response actions.
   - Coordinate with local emergency services for additional support if necessary.

After an Earthquake (Recovery and Rehabilitation)

A. Damage Assessment and Repair

1. **Inspection:**
   - Conduct a thorough inspection of all plant facilities and infrastructure to identify damage.
   - Prioritize the assessment of critical systems and structures.
2. **Repairs and Restoration:**
   - Initiate repair work to restore essential services and operations.
   - Engage qualified engineers to ensure repairs meet safety standards.

B. Communication and Coordination

1. **Internal Communication:**
   - Keep all employees informed about the status of recovery efforts and any safety advisories.
   - Use multiple communication channels to ensure messages reach everyone.

2. **External Coordination:**
   - Liaise with local authorities, emergency services, and stakeholders to coordinate recovery efforts.
   - Provide regular updates to the community and regulatory bodies.

C. Support and Counselling

1. **Employee Support:**

   - Offer counselling and support services to employees affected by the earthquake.
   - Provide assistance for temporary housing and other essential needs if required.

2. **Community Support:**

   - Participate in community recovery initiatives and offer support to affected residents.

Review and Improvement

1. **Post-Event Analysis:**

   - Conduct a detailed analysis of the earthquake response to identify strengths and areas for improvement.
   - Document lessons learned and update the Disaster Management Plan accordingly.

2. **Continuous Improvement:**

   - Regularly review and revise the DMP based on new information, technological advancements, and feedback from drills and actual events.
   - Ensure ongoing training and awareness programs for all employees.

General precautions by people before the earthquake: Following safety measures has been suggested.

- Keep the following in a designated place: bottled drinking water, non-perishable food, first aid kit, torchlight, and battery-operated radio with extra batteries.
- Awareness to people about everybody how to turn off electricity, gas, etc.
- Identify places in the plant as well as house that can provide cover during an earthquake.
- It may be easier to make long distance calls during an earthquake. Identify an out of- town relative or friend as your family's emergency contact. If the family members/colleague get separated after the earthquake and are not able to contact each other, they should contact the designated relative/friend.
- The address and phone number of the contact person/relative should be with all the family members.

General precaution by people after the earthquake: Here are a few things to keep in mind after an earthquake. The caution by people should display in the aftermath can be essential for their personal safety.

- Wear shoes to protect their feet from debris.
- After the first tremor, be prepared for aftershocks.
- Though less intense, aftershocks cause additional damages and may bring down weakened structures.
- Aftershocks can occur in the first hours, days, weeks, or even months after the quake.

- Check for fire hazards and use torchlight instead of candles or lanterns.
- If the building is in a good shape after the earthquake, stay inside and listen for radio announcements.
- If one is not certain about the damage to his/her building, evacuate carefully. Do not touch downed power lines, if any.
- Help injured or trapped persons.
- Give first aid where appropriate. Do not move seriously injured persons unless they are in immediate danger of further injury. In such cases, call for help.
- Remember to help neighbours who may require special assistance-infants, the elderly, and people with disabilities.

7.6 OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT PLAN

Large industries, in general, and power plants in particular where multi-functional activities are involved during construction, erection, testing, commissioning, operation and maintenance, occupational health needs attention during all phases. However, the problem varies both in magnitude and variety in the above phases.

7.6.1 CONSTRUCTION & ERECTION PHASE

The problems envisaged at construction and erection stage can mainly be due to accident, fugitive dust emissions 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. Mobile water sprinkler and wet drilling will be used to control dust emissions.

7.6.2 OPERATION & MAINTENANCE PHASE

The problems envisaged during the operation and maintenance phase are accident, exposure to heat, noise, chemicals etc. Suitable personnel protective equipment should be provided to all employees, likely to be exposed to these situations. The working personnel should be given the personnel protective equipment as listed in **Table 7.8**. In addition, medical facilities should be made available round the clock for attending any medical emergency.

Table 7.10: Personnel protective Equipment

Protection For	Equipment	Protection Against
Head	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
	Leather mask goggles	Foreign bodies entering the dyes and smoke.
	Spectacles type goggles with plain shatter proof lens	Foreign bodies entering the eyes and reflected arc rays
	Spectacle type goggles, with blue lens	High temperature flame during furnace work
	Panorama goggles with green plastic	Reflected arc rays during arc welding job.

Protection For	Equipment	Protection Against
	visor	
Ear	Ear plugs or muffs	High noise level
Nose	Dust respirators	Fine dust particles
	Light fume mask	Acid fumes, vapours and gases (2.0%)
	Heavy fume mask	Toxic gases (0.1%)
	Canister gas mask	Acid fumes, vapours and gases (2.0%)
Face	Plastic face shield	Liquid chemicals, dust particles
	Welding helmet and shield	Welding fumes, sparks and UV rays
	Asbestos hood	Heat radiation during furnace work
Body	Leather apron	Falling of hot chips, slag's etc.
	Asbestos apron	Heat radiation
	PVC apron	Splashing of chemicals
	Safety Belt	Falling of persons from height
Hand	Leather gloves	Cuts due to handling
	Asbestos gloves	Heat radiation
	Acid and Alkali proof rubber gloves	Burns due to chemical handling
	Electrical resistance gloves	Electric shock
	Canvas gloves	Contact with oil, grease etc.
Leg	Leg guards	Welding sparks
	Leather safety boots	Striking by objects, fall of objects and stepping on sharp or hot objects.
	Asbestos safety boots	Eat radiation, stepping on hot or sharp objects, striking by stationary or moving objects
	Gum boots	Liquid splashing, in submerged and chemically hazardous area

Other Occupational Health Risks Envisaged

Common[1]

- **Electrical hazards:** Thermal power plants are used to generate electricity therefore they utilize various types of machines and electrical equipment that are used to process a large amount of electricity which poses a significant threat to the workers.
- **Heat stress and Fire hazards:** Workers are exposed to high temperatures, especially those working in boiler rooms and turbine sections. Fire safety in thermal power plants is another important focus. Various

[1]Safety, S., & Safety, S. (2022, May 3). *Safety 101: Power Plant Safety Measures*. Salvation Safety. https://salvationsafety.com/safety-101-power-plant-safety-measures/

pieces of equipment use flames and sparks to do their jobs and that opens up the risk of a fire occurring in the plant.

- **Fall:** Many thermal power plants have large pieces of equipment spread across multiple stories. When employees work on these, they often do so on a ladder or some other type of elevation tool, which opens them up to the potential of falling and sustaining injury.
- **Exposure to chemicals:** Power plant workers are also routinely exposed to materials and chemicals that can be dangerous to come into contact with handling of chemicals used in water treatment and maintenance processes can lead to skin and respiratory issues.
- **Dust and particulate matters:** Coal dust and fly ash can cause respiratory problems like pneumoconiosis and chronic obstructive pulmonary disease (COPD). During maintenance and handling of ash, workers can be exposed to silica dust, increasing the risk of silicosis.
- **Noise exposure:** High noise levels from turbines, generators, and other machinery can lead to hearing loss.

Specific[2]

- Apart from the above-mentioned occupational hazards, the following hazards also exist specifically for the power plant under discussion:
  - **Ergonomic Hazards:** For saving costs and due to availability of cheap labour the power plant employs manual laborers**.** Manual handling of heavy equipment can lead to musculoskeletal disorders.
  - **Lack of expertise:** The power plant being located in an educationally backward region, the laborers tend to pay little heed to the safety standards and precautions thus exposing themselves to dangers.

7.6.3 OCCUPATIONAL HEALTH MONITORING, AWARENESS AND TRAINING

The work environment will be monitored for occupational accidents, diseases and dangerous occurrences. A proper record of the same will be maintained. The aspects will be adopted to ensure good health condition of employees are (i) Pre- employment check-up; (ii) Awareness programme; (iii) Routine check-up and (iv) Periodic vaccination programme etc.

Occupational Health Monitoring for Workers: Engagement of contractual workers will be done only after proper health check-up and fitness certificate by approved medical practitioner through contractor. Periodic medical examination (PME), as required under the Factories Act shall be undertaken. However, the investigations performed under the PME should be relevant to the job exposures. Since coal/ash handling workers are prone to dust exposure-related diseases, due attention is required to those workers. In case of need, the frequency of PME may be scheduled, based on observation of the health check-up information. Providing PPE and relocating of job for those workers may also be considered.

Awareness programmes and training: Periodic awareness programmes regarding the health and safety with active involvement of the workers will be organized, covering each individual with the minimum annual average duration of 8 hours per worker. Regular community level awareness programmes may be organized in the vicinity of the plant for the family members of the workers. First-aid training will be imparted to workers on regular basis to provide immediate relief to accident victim**.**

[2]*Economy | Welcome to Aurangabad Bihar | India*. (n.d.). https://aurangabad.bih.nic.in/economy/

7.6.4 ASSESSMENT OF ENDEMIC DISEASES OF ENVIRONMENTAL ORIGIN

Endemic Diseases in the area: From data available, it is understood that malaria and dengue are endemic in the region which may be due to lack of hygiene and health facilities.

Diseases

- **Common**[3]
  - **Respiratory:** High levels of air pollution contribute to respiratory conditions like asthma and chronic bronchitis.
  - **Noise:** High noise generation can result in hearing problems for the nearby residents as well.

- **Specific**[4]
  - **Water borne diseases:** The region being part of the floodplains is prone to waterborne diseases like cholera and typhoid. The seepage of untreated wastes into the river waters as well as the groundwater (during mining) can lead to contamination of water.
  - **Vector borne diseases:** The region's economic and educational backwardness has led to non-adoption of cleanliness and disease-preventive environmental measures like proper waste disposal or non-open defecation leading to vector-borne diseases like Malaria and Dengue.
  - **Other issues:**
    - **Maternal Mortality:** Lack of proper healthcare infrastructure has led to the facing of serious problems by the women during pregnancy and childbirth.
    - **Sanitation:** This lack of healthcare facilities coupled with educational backwardness has also led to lack of proper sanitation facilities like toilets, waste disposal systems, etc.
    - **Environmental Hazards:** Deforestation and untreated disposal of wastes has also lead to silting of the riverbeds thus resulting in flash floods. Also the region lies between the Seismic Zones 3 & 4 thus having a potential earthquake threat.

Factors

- **Environmental**
  - **Pollution:** The major factor in this regard and the spread of different types of diseases is the pollution of air, water and land due to the mining activities thus weakening an already unstable environment.
  - **Global Warming and Climate Change:** An increase in the global warming due to ozone depletion has led to the melting of glaciers as well as excessive heatwaves and the unchecked and unregulated mining and power-generation activities is adding more to this heatwave. Also the melting of glaciers has led to an increase in the river-basins and the silting of riverbeds has led to an increase in the intensity of the flash floods.

- **Human (including social and political)**
  - The major human factors in this regard are the ones already discussed above such as –
    - **Lack of education**
    - **Lack of healthcare infrastructure**
    - **Lack of public infrastructure**
    - **Improper waste management**
    - **Improper Sanitation**
    - **Lack of Government vigilance**
    - **Social issues:** The issues of caste division have also lead to lack of access towards already limited public utilities for the oppressed classes and castes.

[3] *New Page 1*. (n.d.). https://bspcb.bihar.gov.in/technicalreport.html
[4] *Welcome to Aurangabad Bihar | Surya Mandir | India*. (n.d.). https://aurangabad.bih.nic.in/

- **Impact:** The local community, particularly those living near the plant, experience higher rates of respiratory and waterborne diseases. Surveys indicate a higher incidence of chronic respiratory conditions among residents compared to regions farther from the plant. Also they are in the crosshairs of impending natural hazards like floods and earthquakes and are also the victims of bad governance.

The District Health Department serves as the nodal agency responsible for preventing the occurrence of diseases originating from environmental factors. Recognizing the critical importance of maintaining public health, especially during construction projects, several proactive measures are being implemented to mitigate the risk of endemic diseases. These initiatives are part of a comprehensive strategy aimed at improving sanitation, hygiene, and overall health conditions in the affected areas. Below are the detailed actions being undertaken by NTPC to maintain and enhance sanitation and hygiene, with a commitment to strengthen these efforts during the proposed expansion.

1. **Maintaining Hygiene and Sanitation in Plant and Township**
   - Regular cleaning and disinfection of all plant and township areas.
   - Implementation of waste management systems to ensure proper disposal of waste materials.
   - Routine inspections and monitoring to ensure compliance with hygiene standards.
2. **Provision of Community Toilets and Sanitation Facilities**
   - Construction of community toilets in labour colonies to prevent wastewater stagnation.
   - Ensuring the availability of clean and functional sanitation facilities to all workers.
   - Regular maintenance and cleaning of these facilities to ensure a hygienic environment.
3. **Providing Mosquito Nets for Villagers**
   - Distribution of mosquito nets to households in nearby villages to prevent mosquito-borne diseases such as malaria and dengue.
   - Conducting awareness campaigns to educate villagers on the proper use and maintenance of mosquito nets.
4. **Supply of Bleaching Powder for Sanitation**
   - Regular supply of bleaching powder to neighbouring villages to assist in maintaining sanitation and hygiene.
   - Training and support for villagers on the effective use of bleaching powder for disinfection and cleaning purposes.
5. **Construction of Community and School Toilets**
   - Building new community toilets and repairing existing ones in nearby villages.
   - Constructing toilets in schools to ensure children have access to clean and safe sanitation facilities.
   - Promoting the importance of sanitation and hygiene practices among school children through educational programs.
6. **Medical Health Camps and Mobile Clinics**
   - Organizing regular medical health camps in villages to provide healthcare services to the community.
   - Deployment of mobile clinics to reach remote areas and offer medical consultations, treatment, and health check-ups.
   - Distribution of essential medicines and health supplies during these camps.
7. **Construction and Repair of Village Roads and Drains**
   - Building and repairing village roads to ensure proper access and mobility.
   - Constructing and maintaining drainage systems to prevent water stagnation and reduce the risk of water-borne diseases.

- Regular monitoring and cleaning of drains to ensure they are free from blockages and function effectively.

8. **Enhanced Waste Management Practices**
   - Implementation of comprehensive waste management systems to handle solid and liquid waste generated during construction and operation.
   - Training workers and community members on proper waste segregation, recycling, and disposal practices.
   - Installation of waste collection points and bins to ensure proper waste handling and reduce environmental contamination.
9. **Awareness and Education Programs**
   - Conducting awareness campaigns and educational programs to inform the community about the importance of hygiene and sanitation.
   - Collaboration with local health departments and organizations to promote health education and disease prevention strategies.
   - Distribution of informational materials such as pamphlets, posters, and flyers to raise awareness about endemic diseases and preventive measures.

By implementing these comprehensive measures, NTPC aims to create a healthier and safer environment for both workers and the surrounding communities. These efforts not only address immediate health concerns but also contribute to the long-term well-being and development of the region. The commitment to maintaining and enhancing sanitation and hygiene practices during the proposed expansion underscores NTPC's dedication to sustainable and responsible development.

7.7 NTPC SAFETY POLICY & PRACTICES

Overview:

Safety is part of NTPC's core values. NTPC is committed to provide a safe, healthy and hygienic work environment to all its employees and contract workers. NTPC is committed towards striving for zero incidents at work which is explicitly mentioned in ita safety policy. NTPC recognizes all accidents are preventable; therefore, safety shall be at the forefront of all our activities.

Principles of Safety Policy of NTPC

The safety policy of NTPC is built around following six principles:

1. Our activities carry various hazards; however, all hazards can be identified.
2. Every job shall be done safely, no matter how important or urgent it is.
3. Putting people to work carries a specific responsibility and accountability for safety which shall be visibly demonstrated.
4. Right procedures and actions can bring the risks under control.
5. Trained and committed team can ensure incident free operations.
6. Compliance to all applicable safety regulations and other legal requirements is a must. To the extent possible, we should improve and make it better than minimum standard(s).

Our safety policy is the apex document that includes commitment of organisation towards safety along with organisation responsibilities. Safety framework, different safety rules, procedures, manuals, TC documents are

developed by safety department to achieve the policy intent. The safety policy supported by these rules and procedures are applicable for all business activities carried out by NTPC.

7.8 NTPC Safety Framework:

NTPC safety framework is a guidance document to the various functions and roles. It contains a set of expectations that ensure that all efforts are aligned with the overall policy and objectives of NTPC. The expectations are expressed broadly in the form of components –

- Safety Policy & Objective,
- Safety Risk Management,
- Safety Assurance and
- Safety Promotion.

This Framework also covers functional implementation expectations: what the different functions & roles must do to implement a robust system and provides essential guidance and how it will be accomplished. To facilitate such guidance, where required, components are divided into smaller Elements and Processes, as mentioned in Exhibit-1.

These components are described in the following sections.

Exhibit-1: Over View of Safety Framework

7.9 Component 1. Safety Policy and Objectives

The Policy serves as the foundation for the NTPC Safety Framework, its Components and Elements. The Business unit, functional and individual employee goals and objectives are typically aligned to those of the overall organization.

Component 2. Safety Risk Management

The objective of safety risk management is to ensure that a formal system of hazard identification is in place so that the activity or, situation posing the risk may be avoided, accepted, reduced, shared, or transferred, depending on the facts and circumstances.

Component 3. Safety Assurance

Safety assurance ensures that all projects comply with safety policy, rules, procedures, legal requirements in achieving safety targets and objectives, ensure continual improvement and effectiveness of implementation of the safety framework; through regular inspections, audits and reviews, in order to provide assurance that procedures are followed, and appropriate controls are in place. Safety Assurance also includes Contractors and Contract Control to ensure Safety Policy objectives are achieved effectively.

Component 4. Safety Promotion

The objective of safety promotion is to promote Safety as a core value with practices that facilitate & support a sound safety culture. Elements of such promotion include communication, training & promotional activities.

SAP Integrated Safety Framework

NTPC has successfully completed full-fledged SAP INTEGRATION OF SAFETY FRAMEWORK in all NTPC stations. This ensures implementation of a uniform and evidence based safety management system across all stations. It triggers auto generated orders for uploading evidence of compliance (in central repository) for mandatory safety activities as per defined set of expectations for different roles and functions. It enables the executives with ease of tracking, monitoring and auditing the safety system of the plants in a seamless manner.

7.10 Safety Training for Agency Workers: -

1. Induction training modules and 23 Job Specific Standard Training Module are developed in English and in Hindi. The standard modules of safety trainings include Induction Training, Caught In/ Caught By, Heavy Vehicle Safety, Working at Height, Electrical Safety, Working in Confined Spaces, Struck By, Safety in Using Hand Tools, Safety in Using Power Tools, Fire Prevention, Safety in Hot Works, Safety in Work On or Near Water, Work Permit System, Use of PPE, Manual Handling, Excavation Safety, Safety in Handling Hazardous Substances, Ergonomics, General Safety and Hygiene for Office, Safety in Demolition, Slips and Trips, Safety in Material Handling, Safety in Coal Handling Plant.
2. Language of Training modules are kept simple, personal and direct.
3. Guidance slides for trainers and prerequisite for training are available in training modules itself.
4. The identification of training needs (as per nature of work, potential exposure to hazards, working condition, personal capacity etc.) is to be done by EIC for each worker at the time of processing of gate pass. Thus, worker role competency matrix is to be prepared for all workers.
5. Safety Department of the station are required to conduct training on Induction, Fire and PPE Modules mandatorily for all workers.
6. Line managers (preferably trained trainers) are required to conduct training on other job specific safety training modules as identified during training need assessment.
7. The progress of training in form of identified Vis-a-vis Trained is to be captured on monthly basis by EIC to keep a track and completion of all identified trainings.

Safety in Overhauling Activity:

Overhauling of power plants is a specialised activity and many agencies involving high number of agency workers perform different works simultaneously. Safety provisions mentioned in 'Maintenance Management- Unit Overhauls' and 'Electrical & Mechanical- Safety Rules Handbook' are followed during unit overhauls.

From all the agencies involved in overhauling activities, nominations of Safety Officers/ Supervisors and qualified & trained electricians are obtained from each Agency. Safety Review Meeting with Contractors & Agencies' Safety Supervisors in presence of EICs and head of O&M before start of overhaul works shall be organized. In the meeting safety measures, which are to be followed during overhauling works are discussed. Detailed guideline for maintaining safety in over hauling has been prepared and followed.

Safe Practices at Work:

For safety Practices at work NTPC has developed various guidance notes and directives on several topics like Hazard Identification and Risk Assessment, Implementation of Safety Rules (Electrical and Mechanical), Job Safety Analysis and Method Statements, First Aid Control and Monitoring, Safety Objectives and Plans, Safety Monitoring, Measurement & Improvement, Safety Awareness, Communication & Promotion, System for Reporting arrangements and Investigation of Accidents, Dangerous Occurrences and Major Incidents in a Power Station, Appointment of Key Safety Roles, Emergency Response Planning, Mitigating Occupational Health Risks - Stressors, Hygiene & Facilities, Periodic Safety Assessments (Internal to Station), Written Safe Work Procedures, General Safety Competencies and Training, Compliance with legal and other requirements, System for action on investigation reports etc.

Apart from above, various communications and circulars are issued from time to time by Corporate Safety regarding safe practices. Accident enquiry recommendations are also source of information regarding safe practice of work which circulated and made readily accessible.

Safety Audits:

Audits are conducted to assess whether any deviation is existing from laid out procedure. Every year, internal safety audits are conducted by inter station team of Safety Officers and External safety audits are carried out by reputed organizations as per statutory requirement for each Project/ Station. Every TC document as mentioned above has a section on procedures to conduct audit for that particular document. This also clearly specifies documents to be verified and site samples to be taken. This process is followed for all internal audit purpose.

Apart from that, special audits are conducted from time to time to assess adherence to laid out procedures and rules. NTPC has developed a pool of NOSA certified auditors, certified lead / internal auditors as per ISO 45001 for ensuring quality audit.

All audit observations are notified in SAP ERP system and compliance recorded along with evidence of compliance. Station safety department is required to monitor the progress of the closure of such notifications and present the status of the notifications to station management during review and other forums.

Incident Investigation:

There is a formal process for investigation of all accidents to examine each case in detail and in depth to find out the causes of accidents, the extent of losses caused, the circumstances / individuals responsible and to obtain considered recommendations for prevention of recurrences in similar or related nature of accidents.

There are specific guidelines and systems for handling the investigation report so that all recommendations of such investigations are taken up to a logical end and implemented. For all accident enquiry recommendations, action plan is prepared for compliance.

7.11 CORPORATE SOCIAL RESPONSIBILITY

NTPC is committed to develop the surrounding area in a well-coordinated and balanced manner while safeguarding the environmental and social aspects under its CSR programme. Wherever possible, NSTPP shall provide infrastructure to help set up local schools, centres for primary learning and education, and repair/construction of primary schools in neighbouring villages. NSTPP is committed to inclusive development and will further strengthen its activities for improvement in education, sanitation and health, livelihood, rural infrastructure and rural sports.

The details of work executed by NSTPP under R&R and CD activities are given in **Annexure 7.1** and presented in **Table 7.6.** Total amount of Rs. 45.56 Crore on R&R, CD activities and amount of Rs. 22.87 Crore has been incurred on CSR activities since inception 2024-25(till Dec 24). Year-wise CSR expenditures are given bellow in **Table 7.7.**

NTPC shall ensure that the following activities are taken up in the proposed CSR plan:

Education: Education must be given priority in CSR Schemes. Special attention is required for girls' education. Educational facilities provide to the handicapped should be free of cost. Activities related to athletics and games should be promoted to keep students healthy and fit. In order to create awareness regarding education, educational society must be constituted which will look after related activities such as libraries providing magazine and newspaper to the villages/ hamlets. These societies should play important role in creating awareness among the community regarding importance of education.

Community health: Health awareness camp must be organized to aware the people regarding health, hygiene and rural sanitation. To improve health status more emphasis should be taken regarding safe drinking water & personal hygiene. People should be informed well in advance regarding health development activities being implemented by NTPC so that more & more people may get benefitted.

Rural infrastructure: Ensuring that the communities are not left behind due to poor infrastructure and focusing on strengthening community structures such as schools and institutions of higher learning, community halls, playground, Anganwadi centres, panchayat offices and villages information Centre, amongst other.

Plantation: Afforestation is an important method for ensuring environmental sustainability including mitigating the negative effects of climate change. Tree plantation in nearby villages or vacant land may be carried out under joint effort of NSTPP, forest department & other government agency and the local community.

Skill development training: This major problem of unemployment can be eliminated up to certain level by conducting skill development programmes. The programme can be organized to familiarize the existing participant with the latest technology available in their area of operation, sensitize them for the adoption of new technology by educating them about the support available from the different organizations. An effort will be made to improve the managerial skill of these entrepreneurs by arranging lecture discussions and cases on different aspects of enterprise management.

Additional manpower will be required during the construction phase and operation phase for proposed expansion project. The skilled manpower will be in general sourced from the present pool of NTPC, while the semi-skilled and unskilled workers will be sourced locally as per qualification and skill. For this purpose, local youth from neighbouring villages will be identified through the Gram Panchayat and provided training in trades such as fitters, welders, electricians, and plumbing from the nearest ITI. As part of the CSR activity, the ITI will be upgraded.

Furthermore, proposed CSR activities for NSTPP has been envisaged and mentioned in **Table 7.11**

Table 7.11: Proposed CSR Activities for Nabinagar STPP Stage-II

NABINAGAR SUPER THERMAL POWER PROJECT STATION AURANGABAD BIHAR COMMNUNITY DEVELOPMENT PROGRAMME FOR PAVs & VICINITY OF THE PROJECT			
Activities planned under Capital expenditure for Corporate Environment responsibility/Community Development for NSTPS St-II (3X800 MW)			
Sl.No	**Strategically important Activities**	**Capital Amount (in Crs)**	**Time line**
1.0	**Education/Training**		

1.1	Schools : Construction of school building, Additional class room, Toilets, Playground development works, Distribution of Computers & peripherals, Furniture, Sweaters, School bags with stationeries, smart classes equipments, Tat-Patti, LED Bulb for school going childrens/electrification/ Ceiling/pedestal fan, Sewing/ knitting/Embroidery machines, Game kits, play equipment, installation of jhoola etc.	10.00	4-5 years
1.2	Sponsoring/Organizing various relevant skill development/vocational trainings/ Reimbursement of tution fee to PAPs wards etc. for youths/students of vicinity villages/Scholarship to meritorious students/Award to meritorious student of PAVs/Support to meritorious & BPL students for higher study/support to sport development etc.		
2.0	**Health**		
2.1	Support to development of health facilities at Govt. Hospitals at village level, Block level & District level.	10.00	4-5 years
3.0	**Drinking Water**		
3.1	Installation of Hand Pumps/overhead tanks/boring/water ATMs/RO System in Project Affected Villages/schools and other strategic locations/disbursement of water filter among the students of project affected schools etc (Revised)	2.00	3-4 years
4.0	**INFRASTRUCTURE DEVELOPMENT**		
4.1	Internal Village PCC Road with drainage system, Solar light, Development/cleaning/ Rejuvenation of village Pond/Panchayat Bhawan, High Mast/street lights, Construction of Kala Manch/ Construction of stadium, Construction of Ghat, Irrigation system etc	35.00	4-5 years
5.0	**SPORTS, WELFARE, ART & CULTURAL ACTIVITIES**		
5.1	Supporting/organizing sports/Cultural events on festivals and other occasions/support to BPL families of Project affected villages/Support to NGO/Govt. bodies for SociaL-welfare, Sports activities at project affected villages.	5.00	3-4 years
6.0	**Others /Sanitation**		
6.1	Tree plantation, Activities under Swachh Bharat/Govt. activities Vidyalaya Abhiyan and other Environment related activities.	2.00	3-4 years
7.0	**Community Development Programme for Surrounding area of District in consultation with District authorities/ Stakeholders.**	20.00	3-4 years
	Total Amount (In Cr.)	**84.00**	

7.12 Hydrogeology Studies

- The study focuses on complying with environmental clearance conditions by MoEF&CC for the Nabinagar Super Thermal Power Project.
- Aims to understand groundwater flow dynamics, assess groundwater resources, and design a monitoring network.
- Detailed hydrogeological investigations within a 2 km radius of the Plant site to monitor the impact of ash disposal on groundwater.
- Study area in Aurangabad District, Bihar, features a subtropical climate with significant monsoon rainfall.
- Landuse/land cover: 72% agricultural land, 11.53% built-up areas, 8.25% rangeland, 6.21% water bodies, 1.70% barren land, 0.26% plantation.
- Reconnaissance survey conducted to gather preliminary data and understand general geological and hydrogeological conditions.
- Geological and hydrogeological setup established, with alluvial plains having significant sand and clay deposits forming principal aquifers.
- Field investigations in pre-monsoon 2024 included groundwater level measurements, infiltration tests, and aquifer parameter analysis.
- Groundwater depth ranged from 6.7 to 45.5 meters below ground level.
- Soil infiltration tests showed infiltration capacity of soils around the proposed ash disposal area ranging from 0.6 to 6 cm/hr.
- Sone River contributes to groundwater; Pun Pun River gains through groundwater base flow.
- Long-term water level data (2013-2023) analysis showed falling trends in 2 out of 3 wells.
- Technical issues prevented long duration pumping tests; transmissivity of the alluvial aquifer ranges from 1100 to 1160 m^2/day.
- Study area assessed as SAFE by CGWB in 2023.
- Available groundwater quality data indicated major ions and heavy metals within permissible limits.
- Spatial distribution of electrical conductivity, nitrate, fluoride, and chloride concentrations mapped.
- Assessed potential impacts of coal ash deposits on water quality, identifying heavy metals as primary contaminants.
- Comprehensive groundwater monitoring and surveillance system designed, proposing installation of piezometers and observation wells.
- Monthly monitoring of water quality, particularly around the ash pond, to detect potential contamination.
- Recommendation to construct 4 dedicated piezometers, 36-40 m deep, with provision for water sample collection.

7.13 Wildlife Conservation Plan

The project site does not fall in the Critically Polluted Area (CPA), where MoEF & CC has imposed moratorium on grant of environmental clearance vide its OM dated 13th January 2010. There are no eco sensitive areas like National Park, Wildlife Sanctuary, Elephant/ Tiger Reserves or Wildlife Corridors and/or breeding or nesting grounds and Eco-sensitive Zones or Biosphere Reserves or Ramsar Wetlands either within the Core Zone (project site) or within the zone of influence (ZoI) say Buffer Zone i.e. within 10 km radius of the project boundaries. Kaimur Wildlife Sanctuary is 11.2 km away from the project ste on NW direction. The aim of wildlife conservation is to prevent the loss of biodiversity by considering ecological principles such as carrying capacity, disturbance, succession, and environmental conditions including physiological geography, soil science, and hydrology, to balance the needs of wildlife with those of human populations.

The thermal power plant falls in the Aurangabad district of the state of Bihar and the 10 km radius around it is called the study area for this report. A major river Sone flows at a distance of 0.80 km in the WNW direction from the project site and acts as a natural barrier between Aurangabad and Rohtas forest divisions. The area on the east bank of the river comes under Aunagabad forest division and the area on the west bank of the river come under the Rohtas forest division.

Primary surveys were undertaken to understand the actual baseline and analyse the impacts of the proposed project on ecological baseline. Available secondary data through published research papers, books and periodicals and PhD thesis from the area was reviewed and enlisted to confirm the presence of species. Secondary data was also collected on the historical surveys in the area. Management plan of the protected area was also reviewed. Consultation with the locals and forest officials were also made.

In the study region, dry tropical vegetation is seen. Within the study area are trees such as *Terminalia bellerica, Acacia nilotica, Azadirachta indica, Tamarindus indica, Mangifera indica, Madhuca indica, and Dalbergia sissoo* etc. In the research region, *Parthenium hysterophorus* is associated with the dominance of grasses such as *Cynodon dactylon*. In the research region, shrubs such as *Solanum xanthocarpum* and *Calotropis gigantea* are observed.

Inside the project site some common bird species, squirrel, chameleon etc were recorded. From the buffer zone, 11 Species of mammals, 14 species of birds, 8 species of reptiles and amphibians were recorded. Twelve Schedule 1 species were recorded from the study area, especially Rohats forest division and through stakeholder consultation and the Wildlife Conservation Plan has been prepared and submitted to the Aurangabad and Rohtas forest division.

Comprehensive conservation measures for *Manis crassicaudata, Panthera pardus, Melursus ursinus, Antelope cervicarpa, Canis aureus, Cuon alpinus, Rusa unicolor, Hyaena hyaena, Chameleon zeylanicus, Python molurus, Python bivittatus* and *Pavo cristatus* have been provided in the Wildlife Conservation Plan. A thermal power plant can affect vegetation communities by eliminating them or altering one or more of these factors, potentially weakening the communities (e.g., through shading or redirecting runoff, leading to reduced water availability).

The induced impact on the wildlife from construction workers is the likelihood of involvement in hunting/ trafficking of wild animals and other unlawful activity during the execution of the project. The impact will be limited to the activity areas, approach roads and raw water & coal corridors and will not cause a significant change in the population of these species and therefore the impact magnitude has been deemed as Medium. The impact during construction period is deemed as "Short term" and likely to be reduced in subsequent years due to high re- generation rate.

But in this proposed expansion of the thermal power plant, Air Cooled Condensers (ACCs) will be incorporated, with a makeup water demand of approximately 2910 m^3/hour, including an ash water recirculation system that operates at about 4110 m^3/hour in once-through ash water operation. Air-cooled condenser technology offers advantages in reducing raw water consumption compared to traditional water-cooling systems. ACCs significantly reduce water consumption as they use air instead of water to condense steam. This is particularly advantageous in arid regions or areas facing water scarcity. By reducing the dependency on water resources, ACCs help in preserving local water bodies and minimizing the ecological impact on aquatic ecosystems. Additionally, they eliminate thermal pollution associated with discharging warm water back into rivers or lakes.

The cost of implementation for Forest & Wildlife Conservation & Management Plan for the proposed expansion of Nabinagar Super Thermal Power Plant is estimated considering different project specific activities as well as management actions through agencies. The overall cost estimated for implementation of wildlife management plan (WLMP) to be implemented over a period of 5 years is approximately **126 Lakhs INR.** The funds allocated are to be divided between the Aurangabad and Rohtas Forest divisions in the ratio of 40:60 as more number of Schedule 1 species were reported from the Rohtas forest division. The Aurangabad Forest division will be provided Rs. 50,40,000 and the Aurangabad Forest division will be provided Rs. 75,60,000 to carry out the conservation activities. The chronology of the amount submission will be finalised in consultation with the respective forest departments.

7.14 Water Shed Development Plan

- **Watershed Map Analysis:**
  - The study area is divided into three different watersheds.
  - The project site falls under two different watersheds, channelling precipitation into two different outlets.
  - The ash disposal site is located on the hydrological divide, separating the project site and ash pond into different catchments, minimizing environmental impact.
  - Contamination of surface water bodies due to the ash pond is limited during the monsoon, as drainage is directed away from major river bodies.
  - Macro watershed management requires community involvement and financial resources; hence, it is divided into sub-watersheds for better planning.
  - Sub-watersheds around the ash dyke will be studied for development activities.
  - Erosion control and groundwater quality maintenance around the ash dyke are crucial to prevent pollution and soil contamination.

7.14.1 Action Plan

- **Challenges in Watershed Development:**
  - Water source conservation and supply management.
  - Lack of vegetation causing soil erosion and poor soil health.
  - Agricultural practices and cropping patterns.
  - Lack of institutional mechanisms.

- **Assessment and Measures for Watershed Development:**
  - **Water Resources:**
    - Develop storage capacities of natural and constructed water bodies.
    - Construct check dams with local materials and coordinate with district authorities for resources.
    - Build runoff management structures to control water harvesting and gully reclamation.
    - Rejuvenate existing water bodies, especially the river Punpun, for agricultural use.
    - Construct farm ponds in suitable areas for water storage.
  - **Soil Moisture Conservation:**
    - Field bunding with vetiver grass to control soil erosion.
    - Implement gully control measures to protect cropland.

- River bank protection using Dry Rubble Stone Masonry (DRSM) or crate wire, and tree plantation in riparian zones.

- **Agro-climate Conditions & Land Productivity:**
  - Characterized by hot summer, cool winter, and annual rainfall of 1000-1200 mm.
  - Moderate quality and productivity of agricultural land, threatened by soil erosion and low moisture.
  - Majority of the area is used for paddy, wheat, and pulses production, with groundwater as the main irrigation source.
  - Rejuvenate surrounding water bodies to reduce dependency on groundwater.
  - Develop cropping patterns to maximize productivity and water utilization.

- **Improvement in Social Status:**
  - Agriculture and animal husbandry are the main livelihoods.
  - Better water availability from watershed development will improve agricultural output and income.
  - Evaluate water demand and supply and assess rainwater harvesting potential at the household level.
  - Provide training and demonstrations on rainwater harvesting to raise awareness and coordinate efforts to eliminate water scarcity.

8. PROJECT BENEFITS

8.1 INTRODUCTION

The proposed expansion of Nabinagar Super Thermal Power Project, Nabinagar, by adding 2400 (3x800) MW will benefits local and regional economy. It will bring improvement in the standard of living of the local population by providing employment opportunities and improved infrastructure. The project will also attract the high-income groups to invest in the region and thus bring about economic growth of the region.

- Infrastructure development.
- Direct & Indirect employment opportunity
- Revenue generation to central & state government.
- Enhancement in CSR/CD activities.
- Trickledown effect of enhance profitability to the local populace
- Skill development and capacity building like vocational training, income generation programmes and entrepreneurship development program
- Awareness programme and community activities, like health camps, medical aides, family welfare camps, sanitization/ cleanliness awareness programme, immunization camp, sports & cultural activities, plantation, etc.
- Awareness about water borne diseases and pandemic diseases etc. will be done to local villagers.

8.2 IMPROVEMENT IN PHYSICAL INFRASTRUCTURE & COMMUNITY DEVELOPMENT

Establishment of large developmental projects improve the availability of the physical infrastructure (like approach roads, drainage, communication and transportation facilities etc.) and social infrastructures (like education and health care system). These will also benefit the local population.
In addition to the plants & equipment for generation of power the following facilities shall be provided in this station:

- Construction offices and stores
- Time and security offices
- First Aid and fire-fighting station with appropriate equipment
- Canteen and welfare center
- Toilets and change/rest rooms
- Parking facility – 2 & 4 wheelers
- Safety Training center
- Development of additional residential facilities in existing township to provide accommodation for staff.

Office space shall be provided as per good practice and canteens, toilets and restrooms according to norms laid down in relevant factories act. The above facilities shall also be adequately furnished and equipped.

The proposed expansion of Nabinagar STPP will improve the power supply position in the state as well as in India, which is vital for economic growth as well as improving the quality of life. The power generated from this

plant will benefit to a large extent leading to industrial/ commercial development in the state of Bihar and also in the country.

The enhanced power supply will decrease the reliance of the general public and commercial establishments on DG Sets, thus lowering both noise and air pollution at the local level.

The construction and operation of the power plant is likely to attract influx of persons 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 or at nearby villages up to the plant area is expected to improve significantly. These will also benefit the local population.

The proposed project will induce the development of ancillary and small-scale industries in the area to meet the requirement of the project. The people residing in the nearby areas will be benefited indirectly. The construction and operation of the proposed power plant are expected to bring benefits to the local community in two distinct phases.

8.3 IMPROVEMENT IN SOCIAL INFRASTRUCTURE

Social infrastructure is a component of the broader infrastructure sector, encompassing assets designed to support social services. Implementing the proposed project is expected to have a favourable impact on existing infrastructure, creating conditions conducive to urban development in the region. Company will employ additional workers, supervisors and engineers available locally to the extent possible.

Necessary medical facility will upgrade under CSR activities/ programs which will be beneficial to locals residing in the study area as per Companies Act.

People coming from outside are expected to be educated and skilled. In addition, some secondary developments like opening of new shops may take place in view of the increased family population due to the proposed employment. These factors will be beneficial to locals residing in the study area.

8.4 EMPLOYMENT POTENTIAL

Direct Employment: Power projects have mechanized and automated plants. Hence, the employment prospects during the operational phase are constrained. The number of NTPC employees during construction and operation phases are 96 and 216 respectively. The direct employment opportunities with NTPC are extremely limited and the opportunities would exist mainly with the contractors and sub-contractors. The number of work force employed during construction phase by the EPC contractors would be much higher (about 4000-5000 during peak deployment). Providing jobs to local persons on a preferential basis wherever feasible would be facilitated through these agencies. The skilled manpower requirements for the operational phase of the power project shall come from outside the study area. Need of unskilled people would be satisfied from local population, depending on availability & feasibility.

In addition to the direct employment opportunities mentioned above, there will be indirect employment opportunities of local people by utilizing their expertise in different areas like horticulture, travel services, housekeeping and painting etc. Additionally, the advancement of the study area is expected to create new job opportunities.

Indirect employment: During operation phase, there will be employment opportunities, mainly in service sector, although its magnitude will be limited. Unskilled people and limited skilled people (depending on availability) may be hired by contractors from local population.

In addition, some secondary developments like opening of new shops may take place in view of the increased family population due to the proposed employment. These factors will be beneficial to locals residing in the study area. The local people may have opportunity to be engaged, under different agencies, as per their qualification & skill set, during the project expansion activities of NTPC - Nabinagar STPP.

8.5 CORPORATE ENVIRONMENT RESPONSIBILITY

The Ministry of Environment, Forests & Climate Change issued the National Environment Policy (NEP) in the year 2006, as a "response to our national commitment to a clean environment as mandated in the Constitution in Articles 48A and 51A (g) and strengthened by judicial interpretation of Article 21." The NEP is intended to mainstream environmental concerns in all development activities. The dominant theme of the policy is that "while conservation of environmental resources is necessary to secure livelihoods and well-being of all, the most secure basis for conservation is to ensure that people dependent on particular resources obtain better livelihoods from the fact of conservation than from degradation of the resource." Whereas Corporate Social Responsibility (CSR) is mandatory as per Companies Act 2013, Corporate Environmental Responsibility (CER) gives specific stress on environment as per NEP. To meet the needs of NEP, MoEF&CC, w.e.f 01.05.2018, has issued an OM on CER. Another OM was issued in supersession of this OM by MoEF&CC dated 30th September, 2020 as revision of CER, Corporate Environment Responsibility.

Hence, additional fund shall be allocated towards CER activities (as per Ministry's OM dated 01.05.2018) after addressing issues raised during Public Consultation.

The details of work executed by Nabinagar STPP under R&R and CD activities are given in mentioned below in **Table 8.1** & enclosed in **Annexure 7.1.** Total amount of Rs. 45.57 Crore on R&R, CD activities and amount of Rs. 22.87 Crore has been incurred on CSR activities since inception 2024-25(till Dec 24). Year-wise CSR expenditures are given below in **Table 8.2.**

Furthermore, proposed Nabinagar STPP activities for Stage-II has been envisaged and mentioned in **Table 8.3**.

Table 8.1: Existing Nabinagar STPP- R&R-Community Development Activities for Stage-I

Sl. No	Activities	Budget in Rs. Cr.	Awarded Amount in Rs. Cr.	Expenditure Incurred in Rs. Cr.
A	**Education (Sath Padhe Sath Badhe)** Distribution of School Bags, Stationary items, Sweaters, Quiz & Painting Competition, Distribution of Computers, Play Equipment etc.	5.0	3.10	3.01
B	**Health (Sankalp Aarogayam)** Mobile Van Health Service, Tri- Cycle Distribution, Addl. PHC Construction at Ankorha, Furniture and medical equipment's, etc.	6.7	4.03	3.05

Sl. No	Activities	Budget in Rs. Cr.	Awarded Amount in Rs. Cr.	Expenditure Incurred in Rs. Cr.
C	**Drinking Water (Jal Dhara)** Installation of Hand Pumps	1.5	0.67	0.53
D	**Sanitation (Nirmal) and other activities** Distribution of Dustbin, Broom, Duster Cloth, Hand Wash Soap, Toilets in Govt. School	0.65	0.02	0.02
E	**Welfare & Cultural Activities** Distribution of Blankets and Cloth, Balti, Tarpoline, Sponsoring and Supporting Sports event, Providing Wheel chair, Skill development awareness camp, e Food distribution to villagers, Face mask distribution, Sanitation activities (During COVID-19), etc.	1.3	0.98	0.98
F	**Community Development Programme at Auran gabad District** Furnishing of public meeting hall, Construction of Football Stadium, Shifting of High Mast light, Wooden Badminton court, Construction of toilet complex for public uses, Community hall, etc.	10.4	7.21	6.65
G	**INFRASTRUCTURE (Buniyadi Sanrachna)** Construction of PCC Roads and drainage system, Repairing & maintenance of Road, Supply Installation of Solar Street Light System, Shifting of Chourahi Baba Religious place, Construction of Community Shed, Levelling of Playground, etc.	34,98	35.72	31.33
Total Amount in Cr.			**51.73**	**45.57**

Table 8.2: Yearly CSR Expenditure

Nabinagar STPP Yearly CSR Expenditure		
Sr. No.	**Financial Year**	**Amount in Cr.**
1	FY 2019-20	3.46
2	FY 2020-21	1.70
3	FY 2021-22	5.60
4	FY 2022-23	6.50
5	FY 2023-24	3.93
6	FY 2024-25(Till Dec24)	1.68
	Total (Cr.)	**22.87**

Table 8.3: Proposed CSR Activities for Nabinagar STPP Stage-II

NABINAGAR SUPER THERMAL POWER PROJECT STATION AURANGABAD BIHAR COMMNUNITY DEVELOPMENT PROGRAMME FOR PAVs & VICINITY OF THE PROJECT *Activities planned under Capital expenditure for Corporate Environment responsibility/Community Development for NSTPS St-II (3X800 MW)*			
Sl. No	**Strategically important Activities**	**Capital Amount (in Crores)**	**Timeline**
1.0	**Education/Training**		
1.1	Schools : Construction of school building, Additional class room, Toilets, Playground development works, Distribution of Computers & peripherals, Furniture, Sweaters, School bags with stationeries, smart classes equipment, Tat-Patti, LED Bulb for school going children/electrification/ Ceiling/pedestal fan, Sewing/ knitting/Embroidery machines, Game kits, play equipment, installation of jhoola etc.	10.00	4-5 years
1.2	Sponsoring/Organizing various relevant skill development/vocational trainings/ Reimbursement of tuition fee to PAPs wards etc. for youths/students of vicinity villages/Scholarship to meritorious students/Award to meritorious student of PAVs/Support to meritorious & BPL students for higher study/support to sport development etc.		
2.0	**Health**		
2.1	Support to development of health facilities at Govt. Hospitals at village level, Block level & District level.	10.00	4-5 years
3.0	**Drinking Water**		
3.1	Installation of Hand Pumps/overhead tanks/boring/water ATMs/RO System in Project Affected Villages/schools and other strategic locations/disbursement of water filter among the students of project affected schools etc (Revised)	2.00	3-4 years
4.0	**INFRASTRUCTURE DEVELOPMENT**		
4.1	Internal Village PCC Road with drainage system, Solar light, Development/cleaning/ Rejuvenation of village Pond/Panchayat Bhawan, High Mast/street lights, Construction of Kala Manch/ Construction of stadium, Construction of Ghat, Irrigation system etc	35.00	4-5 years
5.0	**SPORTS, WELFARE, ART & CULTURAL ACTIVITIES**		
5.1	Supporting/organizing sports/Cultural events on festivals and other occasions/support to BPL families of Project	5.00	3-4 years

	affected villages/Support to NGO/Govt. bodies for Social-welfare, Sports activities at project affected villages.		
6.0	**Others /Sanitation**		
6.1	Tree plantation, Activities under Swachh Bharat/Govt. activities Vidyalaya Abhiyan and other Environment related activities.	2.00	3-4 years
7.0	**Community Development Programme for Surrounding area of District in consultation with District authorities/ Stakeholders.**	20.00	3-4 years
	Total Amount (In Cr.)	**84.00**	

Note: The above activities will be taken up in consultation of stakeholders/ NAS recommendation/ District authority requirement.

Regular expenditure under CSR

1. NTPC, NSTPS already incurring annual CSR expenditure of Rs. 3-5 Crores every year. This will continue during construction phase of Stage-II.

2. After commissioning of Stage-II (after 2030-31), the above expenditure shall be enhanced to Rs. 8.5 Cr. per annum.

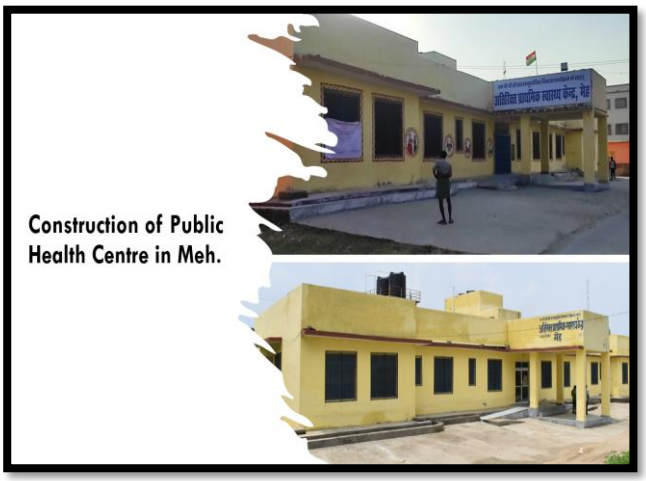
3. The activities are tentative and shall be decided in consultation with district administration, local stakeholders based on need-based requirement under the ambit of schedule -VII of Companies Act-2013 and GOI guidelines.

S.N.	Proposed works under CSR	Estimated Recurring Amount (in lakh)
1	Educational Infrastructure, furniture, Bench-Desk, Playground Toilet etc. (regular)	200.0
2	Health and sanitation- Medical support, Mobile health facilities in villages,	100.0
3	Rural Infrastructure- Village approach, road & drain, Community Hall, Panchayat Bhawan, Community Platform (strategic)	300.0
4	Solar light/ High mast	30.0
5	Sports, Social - Cultural activities, Arts, Cultural heritage conservation	20.0
6	Skill development/ livelihood training	10.0
7	Pond development/ Rejuvenation/clearing	100.0
8	Drinking water facilities	30.0
9	Need assessment/Social impact/ SIE study	10.0
10	Misc. activities	50.0
	Total	**850.00**

SKILL TRAINING for subsistent livelihood assistance
• BEE KEEPING & VERMI-COMPOST TRAINING FOR THE FARMERS
• TOTAL OF 50 FARMERS WERE TRAINED.

Stitching & Tailoring training for women.

Training on Amrit Krishi Farming (Organic Farming) to over 100 plus farmers.


Construction of Public Health Centre in Meh.

Deployment of Mobile Medical Van in 26 project affected villages of NTPC Nabinagar.

Construction of roads in the villages
Installation of 110 handpumps.
Installation of Deep Tube Wells.

• Construction of PCC roads in the project affected villages.

Small steps in providing better education in Govt schools

Construction of Tube Well for Irrigation in 22 PAVs
Construction of Power Sub Station

• GIRL EMPOWERMENT MISSION 2024
• NTPC Nabinagar is taking care of 08 meritorious girls education till 12th class
• 80 girls from 26 PAVS studying in govt schools were trained during summer camp for 30 days.
• This program was a huge success.

Distribution of meritorious scholarships to the students.

9. ENVIRONMENT COST BENEFIT ANALYSIS

9.1 INTRODUCTION

Environmental Cost-Benefit Analysis (CBA) involves evaluating the economic impacts of policies and projects designed to enhance environmental services or those that may influence the environment, sometimes negatively. Originating from welfare economics, CBA addresses how different outcomes compare in terms of societal benefits. Welfare economics, grounded in eighteenth-century Utilitarian philosophy, aims to maximize benefits for the largest number of people. This approach focuses on assessing outcomes based on their overall utility to the population. The environmental costs and benefits of a development project are best understood when expressed both qualitatively and quantitatively (in monetary terms), and then compared to determine their relative value.

9.2 STAGES OF COST-BENEFIT ANALYSIS

- Defining the Project
- Identifying Impacts of the Project
- Valuing Impacts
- Valuing Benefits
- Cost Benefit analysis ratio
- Inference

The existing Nabinagar STPP has an installed capacity of 3x660 MW. All the units of Stage-I are under commercial operation.

In recent years, coal-based power generation has risen by 16.1% compared to previous years. According to the Central Electricity Authority (CEA), the installed capacity for coal and lignite power generation is projected to reach 251 GW by the end of 2029-30 to satisfy growing power demands, requiring an additional 34 GW from new coal and lignite projects. Given the current trend of retiring older, less efficient sub-critical units in line with emission standards set on 07.12.2015 and government policies on upgrading older units, there is a proposal to establish a 1600 MW ultra-supercritical unit. This new unit is expected to decrease greenhouse gas emissions by utilizing more advanced, efficient technologies.

9.3 IDENTIFYING IMPACTS OF THE PROJECT

The impacts of construction and operational phases of the proposed expansion project comprise various activities each of which may have an impact on some or other environmental parameters. Various impacts during the construction and operation phase on the environment have been studied to estimate the impacts on the environmental attributes and are discussed in the subsequent sections. Impacts of the project activates are given in Table no 9.1.

Table 9.1: Impacts of the Proposed Stage – II project during construction & operation phase

S. No.	Sector	Probable Impact
1.	Air Environment	➢ Stack emissions (PM, SO_2 and NO_2).
2.	Water Environment	➢ Effluent generation from project site and township.
3.	Noise Environment	➢ Generation of noise due to various equipment's.

S. No.	Sector	Probable Impact
4.	Solid Waste Environment	➢ Generation of Solid waste from plant and township.
5.	Ecology & Biodiversity Environment	➢ Diversion of forest land for the additional land requirement.
6.	Socio-economic Environment	➢ Resettlement of people due to proposed expansion project. ➢ Impact on people due noise and air pollution. ➢ Damage to public facility like road due to proposed expansion project.
7.	Land Environment	➢ Change in land use pattern and land degradation

9.4 Evaluation of Impacts

There is no approved methodology for Cost Benefit Analysis of thermal power projects. However, the same has been undertaken based on the parameters identified under the following two documents:

(a) The Methodology for Cost Benefit Analysis for Projects involving Forest Diversion as per Consolidated Guideline & Clarification issued under Van (Sanrakshan evam Samvardhan) Adhiniyam, 1980 and Van (Sanrakshan evam Samvardhan) Rule 2023. Although the Stage-II project does not involve any forest land, the parameters specified in the analysis, as applicable have been considered.

(b) MOEF&CC OM dated 05.03.2020 on Draft Guidelines for Environmental Damage assessment Cost- Although the project does not involve any violation or damage, the parameters for emission & discharge have been considered as per Draft Guidelines.

The study focuses on analysing and evaluating the environmental and socioeconomic impacts including environmental pollution, plantation, job creation, displacement, health risks, and changes in local community in terms of qualitative and quantitative. Evaluation of the impact during construction and operation is showing in **Table 9.2.**

Table 9.2: Estimation of Environment cost

SI	Parameters	Remarks	Monetary Equivalent
1	Ecosystem services losses due to proposed forest diversion.	Economic value of loss of ecosystem service due to forest diversion of forest shall be the net-present value (NVP) of the forest land being diverted as prescribed by the Central Government (MoEF&CC). Note: In case of National parks the NVP shall be ten (10) times the normal NVP and in case of wildlife Sanctuary the NPV shall be five (5) times of normal NPV or otherwise prescribed by the ministry or any other competent authority.	Nil No Forest land is proposed for diversion in Stage-II and the land is already in Industrial use.
2	Loss of animal husbandry	To be quantified and expressed in monetary terms or 10% of NVP	Nil

SI	Parameters	Remarks	Monetary Equivalent
	productivity. including loss of fodder	applicable whichever is maximum	
3	Cost of human resettlement/ rehabilitation	To be quantified and expressed in monetary terms as per approved R&R Plan.	Resettlement & Rehabilitation already done earlier. Hence no R&R is required is not required, only R&R is envisaged.
4	Loss of public facilities and administrative infrastructure (Roads, building, schools, dispensaries, electric lines, railway etc.) on forest land. Which would require forest land if these facilities were diverted due to the project.	To be quantified and expressed in monetary terms on actual cost basis at the time of diversion.	Nil Human resettlement is not required, since land is in possession of PP and the land is already in Industrial use. No Forest land is proposed for diversion in Stage-II
5	Possession value of forest land diverted	10% of environment costs (NPV) due to loss of forests or circle rate of adjoining area in the district should be added as a cost component as possession value of forest land whichever is maximum.	Nil
6	Cost of suffering to outees	The social cost of rehabilitation of outees (in addition to the cost likely to be incurred in providing residence, occupation and social services as per R&R Plan) be worked out as 1.5 times of what oustees should have earned in two years had he not been shifted.	Nil
7	Habitat Fragmentation Cost	While the relationship fragmentation and forest goods and services is complex for the sake of simplicity the cost due to fragmentation has been pegged at 50% NVP applicable as a thumb rule.	Nil
8	Compensatory afforestation and soil & moisture conservation cost.	The actual cost of compensatory afforestation and soil moisture conservation and its maintenances in future at present discounted value.	Nil

<table>
<tr><th>SI</th><th>Parameters</th><th>Remarks</th><th>Monetary Equivalent</th></tr>
<tr><td>9</td><td>Cost of air emissions</td><td>Impact Cost; per kg of emission.
PM10 – Rs. 340/Kg Emission
SOx – Rs. 165/Kg Emission
NOx – Rs. 96/Kg Emission
(Source: As per MoEF&CC OM. No. 19-125/2019-IA.III dated 05.03.2020).
Although above parameters are mentioned for emission beyond the limits, the same rate has been considered for emission above the present levels.
Total Emission/ Year based on Air Quality Modelling considering 24 hrs. operation for 330 days for all units of stage: -II with FGD for 25 years of design life of plant
<table><tr><th>Pollutant</th><th>Emission rate (g/s)</th><th>Total emission/ year (Kg)</th><th>Impact cost in Rs (Lakh)/yr</th></tr><tr><td>PM_{10}</td><td>73.35</td><td>2091355.2</td><td>7110.61</td></tr><tr><td>SOx</td><td>244.5</td><td>6971184.0</td><td>11502.45</td></tr><tr><td>NOx</td><td>244.5</td><td>6971184.0</td><td>6692.34</td></tr></table></td><td>Rs.6326.35 Cr</td></tr>
<tr><td>10</td><td>Water Environment</td><td>(ZLD based ETP & STP shall be installed at project site, hence no impact on water environment envisaged).</td><td>Nil
(Cost included at Environment Management Plan)</td></tr>
<tr><td>11</td><td>Noise Environment</td><td>(Proper Equipment's design, and PPE kit will be provided, no major impact envisages).</td><td>Nil</td></tr>
<tr><td>12</td><td>Solid Waste Environment</td><td>(Nabinagar has a facility for management and disposal of solid waste, no adverse impact due to solid waste is envisaged).</td><td>Nil</td></tr>
<tr><td rowspan="2">13</td><td rowspan="2">Cost of EMP</td><td>Environment Management Plan (EMP) includes all the Pollution control equipment's, CEMS, EQMS, Rainwater Harvesting, Solar Power Harnessing and Green Belt development cost</td><td>(Capital Cost of EMP included in Project Cost)</td></tr>
<tr><td>Recurring cost of EMP (53.31 Cr per year for 25 years)</td><td>1332.75 Cr.</td></tr>
<tr><td>14</td><td>Capita Investment</td><td>Total Project Cost</td><td>29,947.91 Cr.</td></tr>
<tr><td></td><td colspan="2">Total cost or Investment Amount (Rs. Crores)</td><td>37607.01 Cr</td></tr>
</table>

9.5 EVALUATION OF BENEFITS

The commissioning of the proposed Nabinagar STPP Stage-II (3x800 MW) project is expected to significantly enhance the power supply in various Indian states, which is crucial for both economic development and improving living standards. This upgraded power infrastructure will lessen the reliance of the public and businesses on diesel generators, thereby decreasing local noise and air pollution.

As part of its corporate social responsibility, the project will initiate several activities, including support for disadvantaged and physically challenged individuals, capacity-building programs, sports events, assistance to government schools, and scholarships. A key advantage of this expansion will be the creation of numerous temporary jobs during both the construction and operational phases.

Additionally, community development initiatives under CSR/CER such as education, healthcare, water, and sanitation improvements will be implemented in nearby villages affected by the project. NTPC Ltd will also invest in essential infrastructure, including water supply, sewage systems, and medical facilities. Evaluation of benefits from the proposed Stage– II project is given in **Table 9.3.**

Table 9.3: Estimating Environment of Benefits from the project

SI. No.	Parameters	Remarks	Monetary Equivalent
1	Increase in Productivity attribute to the specific project	To be quantified & expressed in monetary terms avoiding double counting	**Rs. 30,750 Cr** (Profit after Tax over the design life of 25 yrs.)
2	Benefits to economy due to the specific project	The incremental economic benefit in monetary terms due the activities attributed to the specific project	**Rs.46,562 Cr** (Tota cash flow during construction and operation of the project)
3	No. of Population benefited due to specific project	As per the Detailed project report	Based on average electrical consumption of 1331 units/capita/year, Total 5.37 Lakh population shall be benefitted. It will help to improve socio- economic development of the area.
4	Economic benefits due to of direct and indirect employment due to the project	As per the Detail project report	**a) During construction (5 yrs)** No of temp. employment: 4000 nos. Man-days in 05 years=7300000 Considering Rs.600/man-day =7300000*600= **Rs 43800.00 Lakh** No of permanent employment=96 Mandys in 05 years=125925 Considering Rs.5000/per employee/day = **Rs.6296.25 Lakh** b) **During operation phase**: No of temporary employment=5040 Man-days in 25 years=13687500 Considering Rs.800/man day

SI. No.	Parameters	Remarks	Monetary Equivalent
			=13687500*800= **Rs 109500 Lakhs** No of permanent employee 216 Considering average value @Rs.6000 per employee/day = 216*25*365*6000 = **Rs.118260 Lakh** Considering 05 years for construction period and 25 years of plant life, the direct employment potential of the project proposal = Rs.438 Cr+62.96 Cr+1095 Cr+Rs.1182.60 Cr =Rs.2778.56= **Rs.2779.0 Cr**
5	Economic Benefits due to Compensatory afforestation/ Afforestation	Benefits from such compensatory forestation accruing over next 50 years monetized and discounted to the present value should be included as benefits of compensatory Afforestation * For benefits of CA the guideline of the ministry for NVP estimation may be consulted.	Environment Improvement due to Afforestation, Greenbelt Development, Rainwater Harvesting and water conservation through ACC based cooling system, watershed development works in the study area and wildlife conservation Plan implantation.
		Total	**Rs. 80091.00 Cr**

9.6 COST BENEFIT ANALYSIS RATIO

The cost benefit analysis ratio based on above calculations is as under:

Cost/Impact Evaluation: Rs 37,607.01 Cr.

Benefits Evaluation: Rs 80,091.00 Cr.

Environmental Cost Benefit Analysis ratio = Value of Impact: Value of Benefits

Environmental Cost Benefit Analysis ratio = 1:2.13

Hence, the project benefits are 2.13 times is higher than the impacts evaluated.

9.7 INFERENCE

The cost benefit analysis for the proposed Nabinagar STPP, Stage– II (3x800 MW) indicates in favour of the project. The financial expenditure incurred in preventing, containing, mitigation or removing environmental contaminations occurring as a result of the proposed project activity will further add to the environmental benefit.

10. ENVIRONMENT MANAGEMENT PLAN

10.1 EMP IMPLEMENTATION, INSPECTION AND MONITORING

Environmental Management Plan (EMP) is proposed for its implementation during development of the project so objective of environmental protection can be achieved as per MoEF &CC norms &guidelines. If any adverse impact on the environment shall be identify during the operation of project, suitable mitigation measures, along with the monitoring mechanism shall be prepared to control the adverse impact of the operation. This covers description of the administrative aspects of ensuring that mitigative measures are implemented and their effectiveness monitored, after approval of the EIA/EMP report and grant of Environment Clearance (EC).

In order to manage environmental issues, appropriate institutional arrangements with suitable organizational structure need to be in place, with clear definition of a range of required activities, powers and responsibilities. The assessment of environmental impacts and mitigation measures have been identified for effective operation of environmental management activities in the pre-construction, construction, commissioning and operation & maintenance (O&M) activities. These have to be operated with necessary resources i.e manpower, hardware and software to establish and monitor appropriate indicators for suitable remedial measures. NTPC having well define organization structure at corporate and site level to ensure proper implementation of NTPC Environment Policy as given in **Annexure 10.1.**

10.1.1 COMPONENTS OF EMP

Environment Management Plan (EMP) comprises of the components: (i) Institutional Arrangements; (ii) Monitoring Programme/plan;(iii) Environmental Enhancement Measures; and (iv) Social Enhancement Measures.

10.1.2 INSITUTIONAL ARRANGEMENTS

The construction and operation of a thermal power station entail significant environmental considerations, since it is an operative project, NTPC Nabinagar's Environmental Management Group (EMG) is already functional and led by Additional General Manager (TS/EMG) and supported by manager (EMG). The same group would be strengthened for the proposed Stage-II project. However, this group draws technical support from environmental engineering group, environmental management group and Rehabilitation & Resettlement groups at Corporate Centre. The head of site EMG is directly reporting to the Head of the Project/Plant who would be accountable for implementation of environmental regulations and social impact improvement/mitigation measures.

Training programs will be conducted to educate staff on environmental monitoring, stack emission monitoring, AAQMS, CEMS, EQMS, ambient air & water quality assessments, municipal & hazardous waste management, noise reduction measures etc.

To ensure operational efficiency, pollution control equipment will be equipped with spare parts and maintenance facilities. Staff will receive specialized training to operate Electrostatic Precipitators (ESP), Flue Gas Desulphurisation System, ETP, STP and other pollution control systems optimally.

10.1.2.1 Operation & Maintenance Group

O&M team head would have primary responsibility for the operation & maintenance of the power station. NTPC Nabinagar has Operation & Maintenance Group Management Organization headed by a GM(O&M) and is assisted by a team of managers & engineer. This O&M Group Organization will take up additional responsibility of operations and monitoring of pollution control equipment/system related to proposed Ultra Super Critical Thermal Power Plant. O&M team is expected to comprise four broad functional areas viz. operations, maintenance, engineering, and administration. The fundamental responsibilities associated with each of these functional domains are outlined below:

10.1.2.2 Operations

Operation of Power Plant, coal and ash handling systems, water systems including water treatment system, switchyard and other auxiliary plant, will be carried out by the personnel of operation section. Except for the Operations Manager who would be overall in charge of operations, all other operation personnel would be on three - shift basis. Shift personnel manpower planning for key areas will be generally done on (3+1) concept to take into account leave taken by shift personnel.

The shift operation of the power station shall be overseen by a Shift In charge, one in each main control room, one for coal, fuel oil, ash handling systems and water systems. Shift In charges will be assisted by Control Engineers and other operation staffs.

10.1.2.3 Maintenance

Maintenance of all mechanical and electrical plant, control systems, buildings, roads, drainage and sewage systems, etc., operation of the plant workshop, planning for scheduled maintenance works and deciding requirement of spare parts, will be done in general shift by the personnel of the maintenance section.

10.1.2.4 Engineering

Personnel of this section will be responsible for Monitoring of plant performance, maintenance of documentation, improvements in plant systems, plant safety aspects including, information services and training. All personnel in this functional area would be in the general shift.

10.1.2.5 Administration

Purchase of spares and other equipment/ materials, stores management, fuel supply coordination, plant security, finance & accounts, medical services, personnel services, secretarial and clerical services, will be taken care by this functional area.

10.1.2.6 Set up of the Project's O&M Groups

Operation & Maintenance Head would represent the Project's Company's interest in the operation & maintenance of the power station and would oversee the functioning of O&M Groups of the project. He would be assisted by a team covering the following functional areas:

Technical: For monitoring overall plant performance, purchase of spare parts, consumables, etc., metering energy sent to the grid and for resolving any other technical aspects required to be resolved.

Finance & Accounts: To oversee the operational and maintenance (O&M) expenses related to the plant, manage billing for energy supplied to the grid, ensure timely repayment of loans and interest, handle staff salaries and expenses, and coordinate the renewal of necessary insurance coverage at regular intervals.

Administration & Personnel: For providing administration support such as secretarial, clerical and transport services & providing personnel services and managing the staff colony. An organization chart of Nabainagar STPP is given in **Annexure-10.2**

10.2 Environmental Monitoring Programme

A robust environmental monitoring program is essential to gather scientifically valid data for assessing the environmental quality around the power station and ensuring critical pollutants remain within acceptable limits. This initiative provides an early alert system for detecting unacceptable environmental conditions, enabling prompt implementation of control measures. Furthermore, it facilitates timely detection of changes in local environmental conditions.

The program specifies the monitoring locations, duration, and frequency of parameters to be observed. Monitoring during both construction and operation phases is integral to environmental mitigation efforts. Regular monitoring is vital for evaluating the effectiveness and performance of pollution control equipment. Regular monitoring is being carried out for existing Nabinagar STPP which covers monitoring activity for air quality, water quality, soil quality and noise levels and the data is submitted to Bihar State Pollution Control Board (BSPCB) at regular intervals. The same would be augmented/ strengthened encompassing proposed 3x 800MW Nabinagar STPP.

Environment Monitoring Plan is described in **Chapter 6**. Monitoring during construction phase is given in **Table 6.1**. The final post-study environmental monitoring program including number and location of monitoring stations, frequency of sampling and parameters to be covered have been summarized and presented in **Table 6.2**.

10.3 Laboratory

The monitoring will be done by an internal & external NABL/ MoEF&CC approved laboratory and in-house laboratory is also proposed.

10.4 Occupational Safety

In a power plant, primary safety hazards include burns, slips, falls, fire, and explosions, especially from flame outs. Electrical hazards and the risk of electrocution are significant due to high voltage in electrical lines. Excessive noise from generators poses another serious concern. Additionally, heat and humidity can lead to heat stress among boiler workers. To prevent and reduce accidents, the following safety measures are proposed:

- All elevated platforms, walkways, stairways, and ramps will be equipped with handrails, toe-boards, and non-slip surfaces.
- Steam pipes will be insulated to prevent burns.
- Guard rails and shield guards will be installed around belts, pulleys, shafting, gears, and other moving parts.
- Electrical equipment will be properly grounded and regularly inspected for defective insulation.
- Workers cleaning boilers will be provided with special footwear, masks, and dust-proof clothing due to exposure to corrosive acids and caustic chemicals. They will also wear protective goggles, and emergency eyewash and showers will be available.

- Regular safety awareness programs and training will be conducted for all workers.
- Mock drills will be regularly conducted.
- Maintenance workers entering enclosed areas to clean fuel, oil residues, or coal ash dust will wear self-contained air respirators.
- Regular fire safety programs will be implemented to address potential fires from flame outs.
- Good housekeeping practices will be enforced, including clearing walkways of debris, promptly cleaning oil spots and excess water, and regularly inspecting and maintaining machinery.
- Rigorous procedures for de-energizing and inspecting electrical equipment before maintenance work begins will be followed. Supervisors will oversee all work on energized equipment to ensure safety measures are in place. Revival techniques after electrocution will be included in employee first aid training.
- The temperatures can go as high as 130ºF in boiler rooms, and this can result in heat stress. General ventilation and frequent work breaks to the employees will be provided to reduce these problems.
- The noise level around the generators or other equipment would be kept lower than 90 decibels (dBA). If impossible, those working near the equipment will have an insulated room where the noise level is below 75 dBA. Personnel will be supplied with ear protection to be worn when working around the equipment. Good maintenance of equipment will also help to reduce noise.

10.5 Ash Utilisation Plan

The Fly Ash will be collected in dry form in silos for further utilization/transportation through rail wagons / bulkers trucks to adjacent Cement Plants. 100% Ash will be utilised in Cement Industries, reclamation of abandoned mines, manufacturing of bricks, road construction, aggregate replacement in concrete, etc. as per Fly Ash Notification, 31st December'2021. Provision will be made for disposal of un-utilized ash in high concentration slurry form to ash dyke. Ash Generation and Utilization Data of Stage-I from 2019-20, 2020-21, 2021-22, 2022-23 and 2003-24 in **Table 10.1**

Table 10.1: Ash Utilization Report from 2019-20 up to Dec'2024

Fin Year	Ash Production (LMT)	Total AU (LMT)	Total AU (%)
FY 2019-20	6.44	3.31	51.41
FY 2020-21	10.43	5.39	51.70
FY 2021-22	16.84	8.57	50.89
FY 2022-23	26.07	19.97	76.61
FY 2023-24	29.92	20.98	70.13
Till Dec' 24	26.32	21.55	81.88

A Detail Ash Utilization Plan has been prepared from FY 2023-24 to FY 2032-33:

- As per MoEF&CC Fly Ash Notification on dated 31.12.2021, starting w.e.f. April 2022, all TPPs to utilise 100% current ash (fly ash and bottom ash) generated during that year with minimum utilization of 80% every year in 03-year cycle while achieving average 100% AU in each 03-year cycle. However, there is relaxation of two years for Plants with Ash utilization below 60 % in FY 2021-22.

- Since Ash utilization for NPGCL Nabinagar in Financial Year 2021 22 was 50.89 %, 03-year cycle shall start from April 2024. So accordingly, Ash Utilization Plan For MOEF&CC 3-Compliance Cycle (from FY 2023-24 to FY 2032-33) is given in **Table 10.2.**

- Non-compliance of same shall attract Environmental Compensation @ Rs. 1000 per metric ton on unutilized ash.

Table 10.2: Ash Utilization Report Plan up to 2022-2033

MoEF& CC Compliance Cycle	Year	Ash Generation (LMT)	Area Development (LMT)	Outside Bricks (in MT)	Own Brick plant (LMT)	Cement & Other Industries (LMT)	Roads Construction (LMT)	Ash based Product / Others (LMT)	Mines Filling (LMT)	Total Ash Utilized (LMT)	Ash Utilization (%)
First	**Operation from existing 3x 660 MW(St-1)**										
	FY 2022-23	26.07	0.15	0.07	0.00	14.43	5.33	0.00	0.00	19.97	76.61
	FY 2023-24	29.92	0.24	0.24	0.00	10.80	9.70	0.00	0.00	20.98	70.13
	FY 2024-25	34.00	0.35	1.36	0.00	23.12	14.96	0.00	0.00	39.79	117.04
	FY 2025-26	34.00	0.37	1.36	0.00	23.12	15.64	0.00	0.00	40.49	119.08
	FY 2026-27	34.00	0.38	1.36	0.00	23.12	16.32	0.00	0.00	41.18	121.12
Second	FY 2027-28	34.00	0.41	1.36	0.48	20.40	10.88	0.48	0.00	34.00	100.00
	FY 2028-29	34.00	0.41	1.36	0.48	20.40	10.88	0.48	0.00	34.00	100.00
	FY 2029-30	34.00	0.41	1.36	0.48	20.40	10.88	0.48	0.00	34.00	100.00
Third	**With Commissioning of St-2 Unit-1& Operation from 3x 660 MW(St-1) + 1x800 MW(St-2)**										
	FY 2030-31	48.00	0.58	1.92	0.67	28.80	15.36	0.67	0.00	48.00	100.00
	With Commissioning of St-2 Unit-2& Operation from 3x 660 MW(St-1) +2x800 MW(St-2)										
	FY 2031-32	61.00	0.73	2.44	0.85	36.60	19.52	0.85	0.00	61.00	100.00
	With Commissioning of St-2 Unit-3& Operation from 3x 660 MW(St-1) +3x800 MW(St-2)										
	FY 2032-33	75.00	0.90	3.00	1.05	45.00	24.00	1.05	0.00	75.00	100.00

- The above data is tentative and the actual ash generation as well as utilization, shall depend upon a number of factors such as PLF, ash content of coal, demand of ash, etc.

Bottom Ash System:

- The bottom ash and coarse ash slurry from all the units will be transported from the bottom ash slurry disposal pump house using slurry duty pumps.
- In the case of a dry bottom ash extraction system, the ash will be transported to the Ash Pond.
- In the case of a wet bottom ash extraction system, the ash will be transported to either the Ash Pond or dewatering bins.
- The system will include two (2) operational streams and two (2) standby streams.
- Each pumping stream will have its own dedicated disposal pipes.
- No crossover is planned for the disposal piping between the different streams.

Fly Ash System:

- Fly ash from the Main Fly Ash cum HCSD silos will be mixed with water in an agitator tank to achieve the required high concentration slurry.
- This slurry will be pumped to the designated ash disposal area.
- There will be four (4) operational HCSD (High Concentration Slurry Disposal) streams and four (4) standby streams for all units.
- Each HCSD stream will have its own HCSD pump.
- Each pumping stream will be equipped with its own dedicated disposal pipes.
- All HCSD pumps and HCSD silo aeration blowers will be housed in the HCSD pump house.

Ash Water System:

- An ash water re-circulation system is proposed to comply with environmental regulations.
- Decanted water from the ash pond will be pumped back to the plant using 2x100% capacity ash water recirculation pumps.
- This recycled water will be conveyed through pipes from the ash dyke to the plant area for use in the ash handling system.
- A blowdown process will be implemented to maintain a scale-free system.
- The normal makeup water for the ash system will be sourced from the cooling water (CW) blowdown water.
- Provision will be made to operate the ash water system in a "Once Through" mode when recycled ash water is unavailable.
- During "Once Through" mode, additional makeup water will be supplied from the plant's raw water reserves.
- An ash pond fugitive dust suppression system will be installed in the ash dyke area to control dust emissions.

Ash Pond:

- Efforts to promote ash utilization, with unutilized ash disposed in Ash Dyke if necessary.
- Ash Dyke are provided with adequate liners, with green belt, raised in stages, and with an Ash water recovery system.

Mill Reject System:

- A Mill Reject system will be implemented to handle mill rejects continuously.
- The system's capacity must be at least 1% of the mill's design capacity for the worst quality coal, or whichever is higher, accounting for the maximum number of operational mills.
- Each mill will be equipped with a pyrite hopper to collect mill rejects.
- Mechanical conveyors will transport the mill rejects from the mill area to a storage silo.
- The storage silo will have the capacity to hold 16 hours' worth of mill rejects for all units.
- From the storage silo, the mill rejects will be loaded onto trucks for disposal.

10.6 Environment Enhancement Measures

10.6.1 Solar Power Harnessing

For harnessing solar power, Solar Street Lights will be provided. In addition, the building structures will be so designed that daylight enters the shops through roofs. Daylighting can be especially helpful in industrial environments where natural light is often non-existent, presenting a prime opportunity for implementation.

10.6.1.1 Windows and Skylights

Incorporating windows and skylights is the most popular option for introducing natural light into a building. To ensure the effectiveness of windows and skylights, correct placement is essential. The selection and placement of windows and skylights should be determined by the amount of light needed, regional climate, security requirements and the design of the building. This will be done during detailed engineering stage.

10.6.2 Greenbelt

The green belt will be composed of indigenous and rapidly growing tree species. Additional trees will be strategically planted around the coal stockpile and ash disposal areas to reduce fugitive dust pollution.

It is preferable to cultivate a diverse mix of tree species rather than relying on monocultures. Line and rows of green belt will be break with the resistant tree species. This practise will help in improving the life of green belt by improving the disease resistance. The treated sewage water will be used for developing the green belt area. The survival rate of trees & plantation should be more than 90%, and it can be achieved by proper administration and good technical skill.

Existing area of the greenbelt is 121.20 Ha. A total of 1,73,049 trees (since commissioning) have been planted on the existing land. Further, 275.96 Ha of greenbelt development is proposed to be developed to achieve 33% (397.16 Ha) green belt area of the total site area (1202.88 Ha). The greenbelt shall have 3-tier plantation as per the CPCB guidelines with re-densification & strengthening of existing greenbelt. Details of treen plantation in Stage-I is given in **Table 10.3** and a green belt development plan for During Stage-II is given **Table-10.4**

Table 10.3: Tree Plantation from 2019-20 up to 2023-2024

Sl. No	P.O No. & Date	Name of Agency	Period	No. of Plantation
1	5500033511 dtd.01.07.2019	Forest Deptt.	01.07.2019 to 30.06.2021	33650.00

2	5500040756 dtd.16.06.2020	Forest Deptt.	21.06.2022 to 31.03.2025	20000.00
3	5500036612 dtd.25.08.2020	M/s Jai Mata Dee	01.08.2020 to 31.10.2020	6000.00
4	5500036550 dtd.28.07.2020	Forest Deptt.	28.07.2020 to 31.03.2024	50000.00
5	5500036611 dtd.31.07.2020	M/s Prabhat Constn.	01.08.2020 to 31.10.2021	8000.00
6	5500036614 dtd.25.08.2020	M/s Ranjay Kr Singh	01.08.2020 to 31.10.2021	6000.00
7	Misc Plantation	By departmental	2022-23	23301.00
8	Misc Plantation	By departmental	2023-24	1322.00
9	Misc Plantation	By departmental	2024-25	4227.00
10	Misc Plantation	By departmental (plant for Mother Earth)	2024-25	549.00
11	4000317136 date 28.11.2024	Forest Deptt.	2024-25(under Execution)	20000.00
Total :				**173049.00**

In addition to the above app 25,000 tree plantation is also carried out on the different occasion i.e. on birthday of employees, on supernation & on World environment day etc. Miyawaki Tree plantation of 20,000 saplings shall be carried out during 2024-25 through forest department.

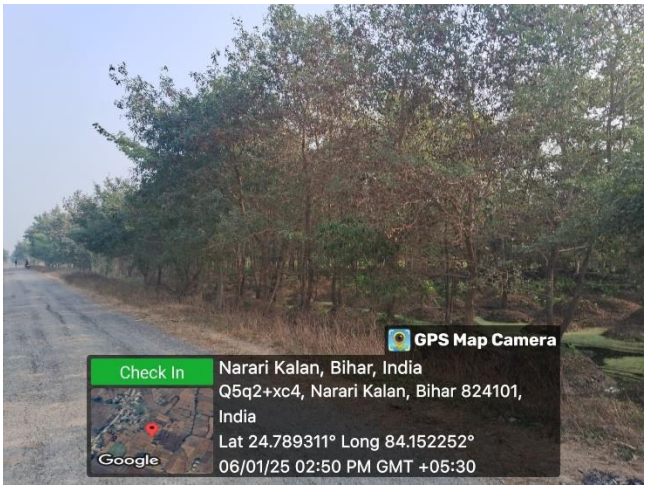


Figure 10.1: Plantation of saplings

Table 10.4: Green Belt Development Plan from 2024-25 up to 2032-2033

Action Plan for Green Belt development in NTPC Nabinagar					
S no	**Financial Year**	**Area in Acres**	**Green Belt proposed In Ha (2500 no/Ha)**	**Tentative budget In Crores**	**Remarks**
1	2024-25	4.94	2	1.77	Miyawaki Plantation including 3 yrs maintenance in Township area work under Execution
2	2025-26	111.15	45	10.0	Above rates includes 3 Yr Maintenance of Green Belt for 5000 No's(Considered 2 Ha) Amount Rs 4444250
3	2026-27	111.15	45	10.0	
4	2027-28	123.5	50	11.1	
5	2028-29	123.5	50	11.1	
6	2029-30	74.1	30	6.7	
7	2030-31	74.1	30	6.7	
8	2031-32	74.1	30	6.7	
9	2032-33	40.9279	16.57	3.7	
	Total	**737.468**	**298.57**	**67.67**	

Green Belt by afforestation is a key element in environment conservation and protection. The establishment of a vegetation covering land in and around the proposed thermal power plant will result in many direct and indirect benefits as:

- Plants can absorb a wide variety of atmospheric pollutants emitted from thermal power plant and attenuates the noise levels.
- Plants will be able to control the build-up of atmospheric greenhouse gases (e.g., CO2) that are emitted during power generation and thereby will postpone global warming.

- Afforestation will help restore the eco dynamics around the plant. It checks soil erosion and increases soil fertility.
- A green belt acts as a buffer zone and increases the aesthetic value of the surrounding area by adding to the greenery and providing a visual filter.
- A green belt will also compensate the vegetation loss during the construction phase and will help in reclamation of land used for ash disposal.
- Provision of one third land of the project area will help in complying with the statutory requirements.

An appropriate greenbelt plantation programme is envisaged for expansion as per CPCB guidelines which will help in establishing the harmony with the environment of the proposed power plant and surrounding environment. The above tree plantation program would consider the following:

- Native plant species would be preferred for green belt development. Introduction of monocultures and alien plant species would be avoided.
- Heterogeneous native tree species will be selected and planted considering soil and climate adaptability, flowering, growth characteristics, canopy structure and resistance to pollution load.

A nursery will be maintained at site or sapling may be taken from local forest nursery to develop good planting stock to meet the plantation requirements.

Extensive green plantation within 10 km radius of the plant focusing on water reservoir, school, hospital, other institutional area and over & above the green belt, as carbon sink, additional plantation shall be carried out on the identifying blocks of degraded forests, in close consultation with the District Forests Department. A request submitted for additional plantation plan along with their budgetary provisions to the district Forest department vide NSTPP latter NSTPS/EMG/2024 dated 17.07.2024 enclosed as **Annexure-10.3.** Letter from DFO Aurangabad vide dated 07.08.2024 for tree plantation in public building within 10 km of project area and vide dated 16.08.2024 for tree plantation in degraded forest land are enclosed as **Annexure-10.4 & 10.5**

10.6.3 Rainwater Harvesting

Summary of rainwater of last 30 years as per IMD climatological normal is given in Table 3.12 of Chapter 3. The effective area available for the rainwater harvesting is tabulated in the **Table 10.3**. The effective area is considered on the basis of rainwater harvesting comes in contact with other possible contaminants.

The average annual rainfall in the area is 1070.1mm[1].

[1] Climatological Tables of Observatories in India 1991-2020

Table 10.5: Rainwater available for harvesting in a year

Sr. No.	Description	Total Area (m^2)	Effective area considered for rainwater harvesting (m^2)	Average Annual Rainfall (m)	Coefficient as per annexure IV of revised guidelines for NOC, CGWA, 2017	Water available for Rainwater Harvesting (m^3)
1	Roof top/shed area – BTG etc.	1050000	945000	1.070	0.70	707805
2	Road/paved area (Switchyard, weigh bridge, road, tank etc)	1785900	1607310	1.070	0.6	1031893
3	Green belt	5956000	5360400	1.070	0.20	1147125.6
Total						**2886823.6**

The total annual rainwater available for harvesting is calculated **2886823.6** m^3 or **2.8** MCM per annum (Table 10.3).

For the design of rainwater harvesting pits, a rainfall intensity of 15–30 mm over a 15-minute duration is considered. This range accounts for the period within which water percolation typically initiates within the harvesting pit, ensuring the system is effectively sized to manage runoff efficiently.

Table 10.6: Rainwater available for harvesting in 15 mins

Sr. No.	Description	Total Area (m^2)	Effective area considered for rainwater harvesting (m^2)	Average Annual Rainfall (m)	Coefficient as per annexure IV of revised guidelines for NOC, CGWA, 2017	Water available for Rainwater Harvesting (m^3)
1	Roof top/shed area – BTG etc.	1050000	945000	0.020	0.70	13230
2	Road/paved area (Switchyard, weigh bridge, road, tank etc)	1785900	1607310	0.020	0.6	19287.72
3	Green belt	5956000	5360400	0.020	0.20	75045.6
Total						**33957.72**

The rainwater available for harvesting based on heaviest rainfall in 15 mins is calculated **107563.32 m^3** or **0.1 MCM** per day (Table 10.4). There is no extraction of groundwater for project. To harvest this rainwater around 38.24 i.e. 39 Nos of Pits with a size of 12.5m x 15m x 15m (Length x Breath x Height) have been proposed.

Water Saving:

i. To the possible extent water is saved at each point of use by taking proper care in maintenance of drain pipe, tap etc. from leakage. There should be display board for optimum use of water in washroom, toilet or at other appropriate locations.
ii. Use of recycled water, if possible, in cleaning of toilets or gardening after proper treatment and testing for its intended use.
iii. Use of sprinkler or drip irrigation method in garden irrigation.
iv. Adoption of machinery– equipment, methods, if possible and economic viable, for manufacturing.
v. Appropriate plantation to reduce evaporation.

Maintenance of the recharging system: Periodic maintenance required for reliable and higher quality water supply. During raining season, the entire system to be checked before and after rains and cleaned after every dry period. Before first shower storage tanks should be cleaned and flushed of all sediments and debris. Also, the roof top will be cleaned before monsoon and coarse mesh is used to prevent the debris on the entrance of the water at roof. The first shower should be flushed so the any sediment can be washed away.

10.6.3.1 Existing Facilities

At present, six recharge pits have been installed at the site. In the plant area, four rainwater recharge pits have been constructed, each connected to six borewells with an approximate depth of 20 meters. In the township area, two rainwater recharge pits have been constructed, each connected to three borewells with a similar depth of 20 meters. Each recharge pit has a water holding capacity of 31.5 m^3, resulting in a total capacity of 189 m^3.

Figure 10.2: Existing Rainwater Harvesting facilities at site

10.7 Social Enhancement Measures

10.7.1 Training

The education and training of employees in good safety practices will be the responsibility of management. Employees will be instructed in the proper use of all equipment operated, safe lifting practices, location and handling of fire extinguishers, and the use of personal protective equipment.

An experienced O&M crew will be placed at an early stage to introduce the best system and operational management and practices. O&M crew will be assisted by a group of experienced technical personnel, to carry out the operation of the plant.

The O&M crew will be associated with the plant commissioning stage itself to get them fully familiar with the plant. A suitable training schedule will be developed for this purpose.

10.7.2 Welfare Activities & Facilities for Employees

Employees required for 3x800MW Units O&M are estimated to be around 216 nos. excluding contract labour. In addition to the plants & equipment for the generation of power the following facilities shall be provided in this station:

- Construction offices and stores
- Time and security offices
- First Aid and fire-fighting station
- Canteen and welfare centre Toilets and change rooms.
- Car parks and cycle/ scooter stands
- Training centre

Office space shall be provided as per good practice and canteens, toilets and restrooms according to norms laid down in the relevant factories act. The above facilities shall also be adequately furnished and equipped.

The main health hazards due to working in coal handling areas, ash handling areas, acid and alkali using areas, oil storage areas etc. are skin diseases and chemical burns. The workers will be encouraged to wash frequently and good sanitary and washing facilities shall be provided. A separate lunch room will be provided outside the work area. This will help to reduce dermatitis among the employees due to contact with acids, caustic chemicals, solvents, oils, as well as coal ash and fuel oil residues. The work atmosphere will be monitored for SPM, SO_2, and NO_x etc. to avoid excessive exposure.

10.8 Cost of Environment Management Measures

A capital cost provision of **Rs. 274522.35 lakhs** towards environmental protection measures/EMP and the recurring cost of Rs.**6122.95 lakhs per annum** (as an operations & management cost) have been earmarked. The break of EMP cost is mentioned below in **Table 10.5.**

Table 10.7: Environment Management Cost Provisions

S. No.	Item Description	Capital Cost (Rs. in Lakhs)	Recurring Cost (Rs. in Lakhs)
1	Electrostatic Precipitator	52481.92	1049.64

S. No.	Item Description	Capital Cost (Rs. in Lakhs)	Recurring Cost (Rs. in Lakhs)
2	Chimney	16488.50	329.77
3	Aux. Cooling Towers incl. Civil Works	2856.50	57.13
4	Ash Handling incl AWRS	90397.04	1807.94
5	Ash Dyke	15000.00	300.00
6	Dust extraction & suppression System	750.00	15.00
7	DM plant waste treatment systems	600.00	12.00
8	Sewerage collection, treatment & disposal	150.00	3.00
9	Rainwater Harvesting	35.00	0.70
10	Green Belt, Afforestation & Landscaping	6590.00	131.8
11	FGD and GHP	79394.76	1587.90
12	Solar power harnessing	688.63	13.77
13	Environmental Lab equipment	50.00	1.00
14	CEMS & EQMS	640.00	12.80
15	CER/CD/CSR Cost	8400.00	800.50
Total in Rs in Lakhs		**274522.35**	**6122.95**

11. SUMMARY AND CONCLUSION

11.1 INTRODUCTION

NTPC Limited, India's largest power generating company, was established in November 1975 to advance thermal power development nationwide. Recognized as a "Navratna" in 1997 and a "Maharatna" in 2010, NTPC has diversified into hydro, solar, coal mining, power trading, equipment manufacturing, power distribution, and renewable energy, and is exploring nuclear power. Currently, NTPC operates various power projects with a capacity of 76,733.18 MW and has 30,026 MW under various construction stages.

The 3x660 MW Nabinagar Thermal Power Plant was initially developed by Nabinagar Power Generation Company Private Limited (NPGCL), a joint venture between NTPC and Bihar State Power Generation Company Limited (BSEB). NPGCL merged with NTPC in 2022. The project received environmental clearance in 2010, with extensions in 2018 and 2020. All three units of Stage-I are operational.

Stage-II (3x800 MW) aims to meet India's power demand by 2030, serving Bihar and the Eastern Region. The project site spans 1202.88 hectares, with land allocated for both stages. Stage-II involves no forest land.

Nabinagar STPP received ToR from Expert Appraisal Committee, MoEF&CC vide letter J-13012/127/2007-IA.II(T) dated 15/04/2024 for expansion of 1980 (3x660) MW to 2400 (3x800) MW ultra super critical technology within existing boundary at village Majhiyan, Tehsil Nabinagar, Dist. Aurangabad in Bihar.

EC transfer application was submitted on 29.07.2024 vide proposal no IA/BR/THE/490112/2025 for Transfer of Environmental Clearances from NPGCL to NTPC Limited. The proposal is in under examination with MOEF&CC as on 21.01.2025.

11.2 THE PROJECT

The Ministry of Power identified the Nabinagar STPP Stage-II for future development, aiming to establish it as a regional power project for the Eastern Region. The site is near Majhiyan village in Aurangabad district, Bihar.

Location: Near Majhiyan village, Aurangabad district, Bihar

Elevation & Topography: HFL in Sone River, Indrapuri, Sone Barrage is (+)110.90m. Approx distance from HFL point to Plant is 5685.00 m.

Plant Capacity: Existing 1980 MW (Stage-I), Proposed 2400 MW (Stage-II), Total 4380 MW

Technology: Super Critical (existing), Ultra Super Critical (proposed)

Land Area: 1202.88 Ha

Main Fuel/Coal Consumption: 21.49 MTPA

Water Requirement: 133,320 KLD from Indrapuri Barrage on River Sone

11.3 Project Description

The Ministry of Power identifies Super Thermal Power Plant (STPP) Stage II as a potential future coal plant development project under the non-pithead category of the central sector. NTPC Nabinagar is planning to expand the Nabinagar Super Thermal Power Plant by adding 2400 MW (3x800 MW) of Ultra Super Critical

Technology to the existing 1980 MW (3x660 MW) capacity within the current plant boundary in Majhiyan village, Nabinagar taluka, Aurangabad district, Bihar. The Proposed expansion is for State II- 2400 MW (3 X 800 MW) Ultra Super Critical Technology. For STPP Stage-I estimated coal requirement is 11.25 MTPA and that for State-II is 10.18 MTPA.

The company has an operating 1980 MW plant with BTG (including FGD, Switchyard, Transformer yard etc. along with coal & ash handling facility, water system (including raw water reservoir, cooling tower, DM water system, Clarified, IWT facility) and Ash dyke.

The proposal is to deploy the state-of-the-art technology and accordingly three units of 800MW are being considered with ultra-supercritical steam parameters to attain high cycle efficiency. Water would be sourced from Indrapuri Barrage on River Sone, located 3.09 km from the project boundary. The land is already under possession of NTPC and expansion will take place in the existing plant site.

A total of 1202.88 hectares of land has been acquired to accommodate the Nabinagar Super Thermal Power Plant. Approximately 607.28 hectares of this land has been utilized for Stage-I. The remaining 595.60 hectares of land will be allocated for Stage-II Units, Ancillary Facilities, and Ash Disposal Area.

The proposed project falls under Category A (1d) of EIA Notification, 2006 amended to date. NTPC has appointed QCI-NABET accredited Greencindia Consulting Private Limited, Ghaziabad to conduct the Environment Impact Assessment Study for the proposed project.

11.4 Description of Environment

Vulnerability of Study Area:
The district Aurangabad has fall under Zone III: Moderate Damage Risk Zone. The project site falls in moderate damage risk zone. The project site falls in very low (<50) Flood Hazard Index area.

Study Area and Period: The project site is located at villages Majhiyan, Nabingar Tehsil in Aurangabad District. An area of 10km radius (aerial distance) from the boundary of the project area is the study area for the EIA study. The study area is divided into two zones viz core zone and buffer zone where core zone is the project site and buffer zone is of 10km radius around the project boundary. The study period for baseline data collection was March to May, 2024.

Land use/ Land Cover Details: The land used of the study area shows that majority of the land in the study area i.e., buffer zone is agricultural area is 35089.63 Ha. (71.6%) total study area. The forest land 1.42 Ha. (0.0%), open land is 5641.59 (11.5%), industrial area (0.54%), sandy area is 1186.38 Ha i.e 2.42%, Ash Pond area 89.21 ha (0.18%), waste land cover 0.14% and brick kiln area 51.51ha. (0.11%) are also crucial land use characters of the study area. About 6.50% of the study area is covered by the water body which covers primarily rivers, channels, ponds and reservoirs. Built up area (2273.39 Ha) of the study area is which is 4.64% of the total study area.

Physical Environment

- **Topography:** The southern hilly ranges and the northern Gangetic Plains form two physiographic units of the Aurangabad district. The maximum elevation is attained to heights to 411.48 m above mean sea level

by the hills located south of Deo. The minimum elevation of ~80 m amsl runs at the northeastern parts around Goh[1]. The district is covered in the elevation range of 80-140 m amsl.

- **Drainage:** The Aurangabad district falls in the Punpun River Sub-basin. The craton-origin Pun pun River is a 3rd order stream, forming a southern tributary of the Ganga River. There are no natural drain passing through the project boundary.
- **Geology:** The Nabinagar Super Thermal Power Project shall be located on Sone River valley porcellanitic which are exposed in the bed of the Sone River. The study area comes under the Southern Gangetic plain. The Kaimur range passes through the study area from Rohtas district south of the alluvial plain of Gangetic plain.
- **Hydrogeology:** The hydrogeological transects indicate the existence of prolific aquifers in the northern and northwestern parts of the district thick deposits of sand of size varying between fine to coarse in the areas. The lithology becomes more clayey towards south. The central and southwestern parts of the district are clayey in character with infrequent minor sand zones.

Soil Quality:

The composite soil samples were collected from the study area and analyzed for different parameters. The NPK content was found to be satisfactory for growth of plants. Therefore, it can be concluded that the soil quality in terms of fertility is good for growth of vegetation in study area.

Climatology and Meteorology

The study area experiences a distinct climatic pattern. Temperatures are generally high from April to June, reaching a peak of 44.8°C in May. Conversely, the coldest month is January with a minimum temperature of 4.3°C. The region receives an annual rainfall of 1400 mm, distributed evenly throughout the year with a range of 21.6mm to 254.5 mm per month. The monsoon season, from June to September, is the wettest period. Humidity levels are highest between July and December, averaging 75.1%. Prevailing wind direction is West North West during the pre-monsoon months of March to May.

Air Environment

An assessment of air quality parameters in the study area reveals varying levels of pollutants. PM_{10} and PM 2.5, indicators of particulate matter, exhibited concentrations ranging from 69.8 to 91.6 µg/m^3 and 39.08 to 53.73 µg/m^3 respectively, at the 98th percentile. Sulfur dioxide (SO_2) levels fluctuated between 12.40 and 22.50 µg/m^3, while nitrogen dioxide (NO_2) concentrations varied from 16.15 to 35.89 µg/m^3. Carbon monoxide (CO) was present at relatively lower levels, with 98th percentile values between 0.93 and 0.96 mg/m^3. Notably, mercury levels remained below detectable limits at all monitoring locations.

Noise Environment:

Noise levels were measured at multiple locations within the study area during both day and night. Daytime noise levels ranged from a low of 52.8 dB(A) at at Narari Khurd and Mahdeva Village to a high of 66.5 dB(A) at Nabinagar STPP. Notably, two locations, Ankorha Village and Sasna, exceeded the prescribed noise limits for residential areas during the day.

[1] GWIB, Aurangabad

Night time noise levels were generally lower, with a minimum of 40.8 dB(A) at Mahdeva Village and a maximum of 46.2 dB(A) Ankorha village. Even at night, Ankorha Village displayed noise levels surpassing the permitted limits for residential zones.

Water Environment:

Water samples were collected once in every month during the study period and analysed for following selected physico chemical and biological parameters.

- **Surface Water Quality**

There is no natural drain passing through the project boundary. pH of the study area varied from 7.11 (SW3) in month of March and 7.15 in April to 7.58 (SW6) in the month of May which is slightly alkaline in nature. TDS was observed in the range of 169.51 mg/l at SW6 in the month of March to max. 410 mg/l at SW3 in the month of April. Value of Total suspended solids ranges from 2.1 to 3.1 Conductivity of water samples indicated non saline in nature.

Dissolve oxygen is one of the key factors of natural or wastewater; it is influenced by the physico-chemical parameter and biological activity in the water body such as rivers, lake. Dissolved oxygen was recorded sufficient in the study area i.e min 5.20 mg/l (SW1 & SW4) in April month to max. 6.20 mg/l (SW6) in April month. During summer, the value of dissolved Oxygen was found to be low.

BOD and COD of the samples showed above limit as per class C of CPCB norms. High BOD is due to decaying plants, human or animal waste and other organic compounds added to water and high COD is may be due to accumulation of solid waste, soluble organic compounds, residual food waste, emulsified oils and the dying bacterial cells.

- **Ground Water Quality**

Several types of wells can be available for groundwater monitoring including monitoring wells and water supply wells (tube wells or dug wells). Groundwater is an important source of drinking water throughout the world (Chilton and Seiler, 2006) and it is often consumed with little or no treatment (Pedley *et al.,* 2006). Total coliform presence in groundwater sources can be used to indicate that the groundwater source may be vulnerable to contamination. But as on our study indicated absent of total coliforms was found in all groundwater samples in study area.

Traffic Scenario: The existing PCU of each location were compared with the capacity of each type of road as suggested by IRC thus determining the existing level of service of the Barun-Nabinahar road as B Level of Service which implies a zone of stable flow.

Ecological Survey:

Forest type: The area on the left bank of Sone River coming within the 10km radius of the project site falls under the Rohtas forest division which falls under 'Tropical Dry Deciduous Forests' of Champio and Seth's Classification.

Floral Study: In the study region, dry tropical vegetation is seen. Within the study area are trees such as *Terminaliabellerica, Acacia nilotica, Azadirachtaindica, Tamarindusindica, Mangiferaindica, Madhucaindica, and Dalbergiasissoo*etc. In the research region, *Partheniumhysterophorus* is associated with the dominance of

grasses such as *Cynodondactylon*. In the research region, shrubs such as *Solanumxanthocarpum* and *Calotropisgigantea* are observed.

Faunal Study: Inside the project site some common bird species, squirrel, chameleon etc were recorded. From the buffer zone, 13 Species of mammals, 14 species of birds, 8 species of reptiles and amphibians were recorded. Several Schedule 1 species were recorded from the study area and the Wildlfie Conservation Plan has been prepared and submitted to the Aurangabad and Rohtas forest division.

Aquatic Ecology: The aquatic ecology of Nabinagar, Bihar, is characterized by its river systems, especially the Punpun River. Studies indicate that the water quality is affected by both natural and anthropogenic factors, including contamination from industrial and agricultural activities. Common pollutants include heavy metals such as arsenic, fluoride, and iron, which have significant health implications for local populations.

Social Environment

There are 257 villages in the study area. These villages have total population of 240307 (in 2001) & 300858 (in 2011). The average household size in the study area was found to have reduced from 7.23 in 2001 to 6.56 in 2011. According to the survey, gender ratio of study area was 925 in 2001 and 923 in 2011.

The study area is predominantly rural, with a notable population of scheduled castes (20.59%) and a smaller scheduled tribe community (0.17%). Literacy rates have improved over time, particularly among females, rising from 34.07% in 2001 to 49.24% in 2011. Male literacy also increased from 58.20% to 66.98% during the same period. The local economy primarily relies on agriculture and animal husbandry, although a significant portion of the population (over 50%) is not engaged in the workforce.

Infrastructure

- **Educational Facilities:** There is a total of 1089 Primary Schools, 1087 Middle Schools, 1074 Secondary School and 1076 Senior Secondary Schools in the study area as per Census 2011. It can be seen that there has been a substantial increase in the number of schools over the 10 years in the study area.
- **Banking and Post Office Facilities:** Number of post offices, commercial banks, co-operative bank and agricultural society in the study area has increased from 2001 to 2011.
- **Drinking water facilities:** Many water sources such as wells, hand pumps, tanks, etc. are available in rural areas. In the villages under study, the main source of water is tap water, well, followed by hand pump and service reservoirs.

11.5 Impacts Assessment & Mitigation Measures

The environmental impacts of a coal-based super thermal power plant are assessed by predicting emissions and their effects on air, water, soil, flora, fauna, and socio-economic conditions. If predicted ground-level concentrations are high, emissions must be reduced and re-evaluated. During construction, activities such as site preparation, material transport, and erection generate dust, noise, and potential water and soil contamination. Mitigation measures include dust suppression, proper waste management, and minimizing noise through equipment maintenance and protective measures.

During operation, impacts include air emissions (SO_2, NOx, PM), water usage and pollution, noise from machinery, and solid and hazardous waste generation. Mitigation strategies include installing emission control systems, using water efficiently, maintaining equipment to minimize noise, and managing waste responsibly.

The Environmental Management Plan (EMP) outlines these measures to minimize negative impacts and ensure sustainable operations.

11.6 Impact on Air Quality

Air pollution modelling has been done for the project. Fugitive dust from coal handling, stockpiles, and traffic will mainly affect the topsoil near the plant. Dust control measures like dust suppression systems, bag filters, and greenbelt development will limit particulate matter (PM) emissions, with the impact restricted to 500 meters from the source.

Flue gas emissions from chimneys due to coal burning will be major contributors to air pollution. The proposed units will limit PM to below 30 mg/Nm^3, SO_2 and NO_2 to 100 mg/Nm^3. Hg emissions will be minimal. Existing units will maintain similar limits. The impact is modelled using Lake Environment dispersion model, considering a 15 km buffer area.

Combined emissions from the proposed and existing units have been assessed using AERMOD, focusing on PM, SO_2, and NO_X. The model incorporates multiple point sources, aerodynamic downwash, varied emission rates, and terrain effects.

Short-term simulations predict maximum 24-hour average Ground Level Concentrations (GLCs) is predicted PM from 92.44 mg/Nm^3, SO_2 is 30.8 mg/Nm^3 and NO_X is 61.13 mg/Nm^3. The worst-case scenario shows that resultant concentrations for SO_2 and NOx will remain within NAAQS limits, indicating an insignificant impact on air quality.

11.7 Impact on Water Resources

Wastewater will be recycled and reused, minimizing impact. Sources include CW blowdown, WT plant effluent, coal pile runoff, and plant drains. Treatment measures ensure compliance with regulatory standards, maintaining a zero liquid discharge concept. Stormwater will be managed through rainwater harvesting.

11.8 Impact on Ecological Resources

Air pollutants are expected to have minimal impact on flora. Stack emissions will be controlled with FGD and NOx systems. Wastewater treatment ensures no adverse effect on ecology. Greenbelt development will further mitigate any potential impact.

11.9 Impact on Socio-Economic Environment

The project will provide employment to locals, enhancing income and living standards. Secondary employment will also be generated, positively affecting the socio-economic environment.

11.10 Impact on Traffic

Traffic studies indicate that road service levels will remain stable (LoS B) even with increased traffic from the expanded plant. The incremental pollution from traffic emissions will be within NAAQS limits, showing minimal impact.

11.11 Analysis of Alternative Technologies

Site Alternative: A total of 1202.88 hectares of land has been acquired to accommodate the Nabinagar Super Thermal Power Plant. Approximately 607.28 hectares of this land has been utilized for Stage-I. The remaining 595.60 hectares of land is allocated for Stage-II Units, Ancillary Facilities, and Ash Disposal Area. Hence, no alternate site was explored.

The ultra-supercritical technology has been selected for the proposed expansion unit. The ultra-supercritical units have low thermal inertia resulting in a shorter start-up time, faster rates of load change and shorter time of forced cooling operation during an emergency shutdown. Pressure changes could be achieved more easily and a true sliding pressure operation mode with reasonable load change capabilities becomes possible.

11.12 Environmental Monitoring Programme

The environmental monitoring program encompasses the location, duration, frequency of the parameters that have to be monitored. Monitoring of environmental components during the construction and operation phase is a part and parcel of the environmental mitigation measures. Only frequent monitoring can assess the functioning and efficiency of all pollution control equipment. Data generated from monitoring and analysis of the samples will be compared with the prescribed/stipulated limits. If any parameter is not found within the prescribed/stipulated limit appropriate control measures will be taken to satisfy the limit. A report with recommendations will be prepared and submitted to the regional offices of SPCB/CPCB and other concern authority of MoEF&CC for their further assessment. A full record will be kept as part of normal contract monitoring. Reporting and Monitoring Systems for various stages have been proposed to ensure timely and effective implementation of the Monitoring Plan.

Total environmental monitoring cost during construction phase (recurring) is 3,68,000 lac. and the same during operation phase, the recurring environment monitoring cost increases to Rs. 17,90,500 and the capital environment monitoring cost comes to Rs. 1,20,000. and total environmental monitoring capital cost is 3,80,000 lac.

11.13 Additional Studies

NTPC, Nabinagar is carrying out additional studies of Public Consultation, Risk Assessment, Watershed management in EIA Notification 2006.

Public Hearing & Consultation: Consultation process comprises of two parts, viz Public Hearing and written response from stakeholders. The Public Hearing will be arranged in a systematic, time bound and transparent manner ensuring widest possible public participation at the project site or in its close proximity by Bihar Environment Conservation Board (BPCB). The Draft EIA-EMP report will be submitted to BPCB, Bihar along with other relevant documents. The Authority is expected to process the application for Public Hearing and conduct the same within 45 days of receiving the application as per EIA notification 2006 and its subsequent amendments.

Corporate Environment Responsibility: The CER Activity aims at bettering the environment around the operated area as well as socio economic and cultural status of local people. The key initiative and activities that NSTPP is going to undertake in nearby villages are-

- Sustainable Livelihood options & Women Empowerment
- Educational Initiatives
- Community Health Initiatives
- Community Rural Infrastructure Development
- Sports & Culture Development
- General Management & Administration

11.14 Risk Assessment

Risks present in a thermal power plant operation mostly arises due to involvement of hazards like High pressure super-heater, re-heaters, economizer units exchanging heat with the hot flue gases, Turbines utilizing HP steam, Fuel oil storage and handling units, Coal handling units, Hydrogen as coolant in turbo generators drawn from hydrogen cylinders, Chlorine as water treatment chemical drawn from cylinders and Switchyard including transformers, isolators etc.

Hazard Identification: Hazard identification includes **Component-1:** Identification of contaminants being released which are hazardous. Estimation of probability of an expected event and its consequences form the basis of quantification of risk in terms of damage to property, environment, or personal. 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.; **Component-2:** Estimation of the amounts of contaminants released from all sources or the source of concern. Fuel oils (LDO/HFO/HSD) will be used in small quantity for initial start-up. Chlorine and other chemicals are used in the makeup water treatment & DM Plant. The hazards associated with the use of these materials would be taken careful consideration and due precaution would be taken for its safe handling at various stages of usage.; **Component-3:** Estimation of the concentration of contaminants through Preliminary Hazard Analysis considering i) Spillage of chemicals while handling and ii) Leakage of chlorine.

Mitigation Measures of Fire & Explosion Hazards: Fire prevention and relevant code enforcement is one of the major responsibilities of project proponent. The fire service facility shall be equipped with- Smoke and fire detection alarm system, Water supply, Fire hydrant and nozzle installation, Foam system, Water fog and sprinkler system and First aid appliances. Apart from the general mitigation measures site specific mitigation measures are also suggested for LDO Storage.

Disaster Management Plan: Nabinagar STPP has already implemented a Disaster Management Plan for existing unit. New units shall also be included in the same plan. Emergency preparedness planning is divided in two subsections:

- **Onsite Disaster Management Plan:** The management plan will include a sequence of action in order to handle disaster/emergency situations, with organizational chart entrusting responsibility to various plant personnel with their specific roles. Infrastructures & operational systems should be provided to meet emergencies. Assembly points, evacuation path should be marked. Different types of alarms to differentiate types of emergencies should be provided along with warning system and control, emergency services and fire protection systems.
- **Off-site Disaster Management Plan:** Under the Environmental Protection Act 1986, the responsibility of preparation of Off-site Emergency Plan lies with the State Government. The Collector/ Deputy Collector are ordinarily nominated by State Government to prepare Off-site Emergency Plan.

Occupational Health and Safety Management Plan: Large industries, and power plants in particular where multi-functional activities are involved during construction, erection, testing, commissioning, operation and maintenance, occupational health needs attention during all phases. However, the problem varies both in magnitude and variety in the above phases.

Assessment of Endemic Diseases of Environmental origin: Dengue and malaria are the endemic diseases in the region which occurs due to lack of hygiene and health facilities. District Health Department is a nodal agency to prevent the occurrence of diseases of environment origin. During construction of project,

community toilets and sanitation facilities will be provided in labour colony so that stagnation of wastewater can be prevented. The following activities are being undertaken by NTPC to maintain sanitation & hygiene.

Corporate Social Responsibility: NTPC is committed to develop the surrounding area in a well-coordinated and balanced manner while safeguarding the environmental and social aspects under its CSR programme. Wherever possible, NSTPP shall provide infrastructure to help set up local schools, centers for primary learning and education, and repair/construction of primary schools in neighbouring villages. NSTPP is committed to inclusive development and will further strengthen its activities for improvement in education, sanitation and health, livelihood, rural infrastructure and rural sports.

11.15 Project Benefits

The proposed expansion of Nabinagar Super Critical Thermal Power Project will benefit local and regional economy along improving the standard of living of the local by providing employment opportunities and improved physical and social infrastructure.

The establishment of the proposed project will contribute to infrastructure development in the region. It is anticipated to generate both direct and indirect employment opportunities, leading to increased revenue for both central and state governments. The project will allocate 2 % of its profits towards corporate environmental responsibility (CER) activities. This investment will have a trickle-down effect, benefiting the local populace through enhanced profitability. Additionally, the project will focus on skill development and capacity building, including vocational training, income generation programs, and entrepreneurship development. To promote community well-being, awareness programs and activities such as health camps, medical aids, family welfare initiatives, sanitation awareness, immunization drives, and sports and cultural events will be organized. Furthermore, the project will educate local villagers about waterborne and pandemic diseases.

Employment potential: Employees required for the proposed project are estimated to be around 216 nos through direct employment which would exist mainly with the contractors and sub-contractors along will unskilled people would be satisfied from the local population, depending on availability and feasibility. In addition to the direct employment opportunities, there will be indirect employment opportunities of local people in different sectors like horticulture, travel services, housekeeping and painting etc. During operation phase, there will be employment opportunities, mainly in service sector.

11.16 Environment Monitoring Plan

An environmental monitoring programme is required to provide scientifically defensible information for determining the status of the environmental quality of the surrounding area of the power station and to check whether the levels of critical pollutants are within the environmentally acceptable limits.

The environmental monitoring program encompasses the location, duration, frequency of the parameters that have to be monitored. Monitoring of environmental components during the construction and operation phase is a part and parcel of the environmental mitigation measures. Only frequent monitoring can assess the functioning and efficiency of all pollution control equipment. Regular monitoring is being carried out for the existing Nabinagar TPP which covers monitoring activity for air quality, water quality, soil quality and noise levels and the data is submitted to Bihar State Pollution Control Board (BSPCB) at regular intervals. The same would be augmented/ strengthened encompassing the proposed 3x800 MW NSTPP.

Laboratory: The monitoring will be done by an internal & external NABL/MoEF&CC approved laboratory and in-house laboratory is also proposed.

Occupational Safety: In power plant, primary safety hazards include burns, slips, falls, fire and explosions. Electrical hazards and the risk of electrocution are significant due to high voltage in electrical lines. To prevent and reduce accidents safety measures including spatial measures, insulation, guard rails, shield guards, grounding of electrical equipment, protective measures, mock drills and regular safety awareness programs and training will be conducted for all workers.

Ash Utilisation Plan: 100% Ash will be utilised in Cement Industries, reclamation of abandoned mines, manufacturing of bricks, road construction, aggregate replacement in concrete, etc.

11.17 Environment Enhancement Measures:

- **Maintenance of the recharging system:** Periodic maintenance required for reliable and higher quality water supply.
- **Solar Power Harnessing:** For harnessing solar power, Solar Street Lights will be provided, in addition the building structures will be so designed that daylight enters through the roofs.
- **Windows and Skylight:** Incorporating windows and skylights is the most popular option for introducing natural light into a building.
- **Tubular Daylight Devices (TDDs):** Tubular daylighting devices utilize a rooftop dome to harness sunlight, which is then directed through a reflective tube.
- **Greenbelt:** The green belt will be composed of indigenous and rapidly growing tree species. Additional trees will be strategically planted around the coal stockpile and ash disposal areas to reduce fugitive dust pollution.

11.18 Social Enhancement Measures:

- **Training:** Management will be responsible to instruct employees in proper use of all equipment operated, safe lifting practices, location and handling of fire extinguishers, and use of personal protective equipment and overall education and training in good safety practices.
- **Welfare Activities & Facilities for Employees:** In addition to the plants & equipment for the generation of power facilities like construction offices and stores, time and security offices, first aid and fire-fighting station, canteen, parking, training stations, toilets and restrooms shall also be adequately furnished and equipped. The work atmosphere will be monitored for SPM, SO_2, and NO_x etc. to avoid excessive exposure.
- **Cost of Environment Management Measure:** A cost provision of Rs. 2662.06 crores towards providing environmental measures have been earmarked and the recurring cost (Operations & Management will be about 53.31 Cr per annum).

11.19 Cumulative Assessment Study

The Cumulative Impact Assessment (CIA) study evaluates the environmental impact of adding new industries within a 15 km radius of the Nabinagar Super Thermal Power Plant (NSTPP). The study identifies existing and proposed industries, assesses their combined effects on air, water, ecology, and socio-economics, and determines whether the area can accommodate additional industrial activities without exceeding permissible limits.

11.20 Cost of Environment Management Measures

A capital cost provision of Rs. 2662.06 crores towards providing environmental measures have been earmarked.

12. DISCLOSURE OF CONSULTANT

12.1 INTRODUCTION TO THE TEAM

Greencindia Consulting Private Limited (GCPL) is an environmental consultancy organization, manned by a highly qualified, experienced and multidisciplinary team of scientists and engineers. The company has received accreditation from Quality Council of India (NABET-QCI) as an EIA Consultancy organization. The validity of NABET accreditation is up to 22.02.2026, Certificate of accreditation is given in **Annexure-12.1.** The company has MOU with Eco Care NABL Laboratory.

The primary aim of GCPL is to sensitize policy planner and local people about their development needs through capacity building process. The company facilitates managerial and technical expertise to people and associations for development of areas and regions.

GCPL has undertaken more than 150 EIA and other associated studies and clearances for township & area development projects, mining projects, thermal power projects; airports, road and highways; special economic zones (SEZs); urban infrastructure projects, etc.

GCPL has been appointed by the Project proponent to carry out Environment Impact Assessment Studies for the proposed project.

The main objects of the Company are as follows:

- To carry on the business of providing all types of consultancy services related to Social And Environmental Impact Assessment, Environment Action Plan, Tribal Development Plan, Resettlement and Rehabilitation Action Plan, Project Information Report, Detailed Project Report, Need Assessment Report, Corporate Social Responsibility Plan, Forest Diversion Plan, Wildlife Conservation Plan, Drainage Plan and Hydrogeology Environment, Social & Land related legal services and any other consultancy services and studies related to urban development, rural development, environment, forest and legal aspects.
- To provide consultancy services in environment monitoring, sample collection of air, water, soil, meteorological data and publish testing results for the collected samples
- To undertake research study in the field of environment, social, legal, agriculture, urban planning, rural planning, alternate sources of energy etc. and provide consultancy/advisory/training services in these field to government, quasi-government, non-government and private institutions.
- EPFI (Equator Principle & Financial Institution) reporting, environmental and social impact assessment according to IFC (International Finance Corporation) guidelines and equator principles.

12.2 PROJECT AREAS OF EXPERTISE

- Environmental Impact Assessment
- Environmental Management Plan

- Disaster Management Plan
- Risk Assessment
- Rehabilitation & Resettlement Plan
- Pre-Feasibility Report
- Detailed Project Report
- Geo-Technical Investigation
- National, Regional and Urban Plans
- Management Information System and Geographic Information system
- Urban Infrastructure Development including Water Supply and Solid Waste Management
- Environmental Monitoring and Assessments
- Impact Assessment Formulate Policies & Mitigation Measures R&R
- Natural Resource Management
- Terminal Planning and Design
- Institutional Strengthening
- Development, Functional and Strategic Planning and Design
- Preparation of Manuals
- Training Programmes.

12.3 ACHIEVEMENT OF THE COMPANY

Greencindia Consulting Private Limited (GCPL) (formerly GIS Enabled Environment & Neo-graphic Center) is an ISO 9001:2008-QMS, 14001:2004-EM and 18001:2004-OHSAS certified company. The company is accredited with QCI-NABET since 2010. We are accredited for following sectors: -

- Townships & Area development projects.
- Thermal Power Plants.
- Mining Project-Open Cast & Underground Mining.
- Coal Washery.
- River Valley Projects.
- Metallurgical Industries (Ferrous and Non-Ferrous).
- Industrial Estate/Parks/Complexes/areas, export processing zones, special economic zones, biotech parks, leather complexes.
- Highways.
- Cement Plants.
- Oil & gas transportation pipelines.

- Common Municipal Solid Waste Management Facility.
- Airports.
- Buildings and construction projects.

12.4 TEAM INVOLVED

GCPL comprises of group of professionals drawn from development related fields. The core members of GCPL team hold experiences in Developmental Planning, Pollution Control, Economic Analysis, Social Work and Information Technologies. In addition, there is a panel of senior associates and young voluntaries facilitating the various programmes. The brief resume of the Environment Coordinator and Functional Area experts (Core Functional Areas & Significant Functional Area) involved in this project are discussed below:

GCPL is accredited under QCI-NABET scheme for accreditation of EIA consultants organizations vide certificate number: NABET/EIA/2326/RA 0297 for and Mining Projects (open cast and underground), River Valley projects, Thermal Power Plants projects, Coal washeries, Metallurgical Industries (Ferrous only)-both primary & secondary, Petroleum refining industries, Petro chemical complexes, Airports, Industrial Estate Planning, TSDFs, Highways, CETPs, Building and construction projects and Townships & Area Development Projects. Validity of the accreditation is extended till 22nd February, 2026 vide certificate no. NABET/EIA/2326/RA 0297. (enclosed as **Annexure-12.1**).

12.5 ACCREDITED LABORATORY

The analytical tests for GCPL are conducted by M/s Eco Care in Asansol, Kolkata which was accredited by NABL **Annexure-12.2**). GCPL has signed MoU with M/s Eco Care in Asansol for specialized testing and analysis of samples from their laboratory.

Sl. No.	Name of Expert	Years of Experience	Area of Specialization	Involvement (Period & Task)
1	Nandini Choudhury	22	EC- Thermal Power Plant	**MARCH 2024 TO TILL DATE 2025** ▪ Selecting the team to be involved in the EIA report. ▪ Visiting the site for appropriate duration for the selection of sampling locations and deciding the type of samples in consultation with the FAEs. ▪ Reviewing the process write-up ▪ Developing the EIA report and circulating the same amongst EIA team members for final feedback and ensuring coverage of the respective functional areas FA in the EIA.

Sl. No.	Name of Expert	Years of Experience	Area of Specialization	Involvement (Period & Task)
CORE FUNCTIONAL AREAS				
2	Dr. Subinoy Mondal	10	Water Pollution-WP	**MARCH 2024 TO TILL DATE 2025** ▪ Selection of Monitoring location for ground water and surface water ▪ Assessment of Impact associated with the project operation activities ▪ Preparing cost estimate for treatment of waste water. ▪ Development of Water Management Plan.
3	Shyam Sundar Earanti	30	Water Pollution-WP	**JULY 2024 TO TILL DATE 2025** ▪ Assessment of Impact associated with the project operation activities ▪ Preparing cost estimate for treatment of waste water. ▪ Development of Water Management Plan.
4	Nandini Choudhury	22	Socio-economy-SE	**MARCH 2024 TO TILL DATE 2025** ▪ Assessment of impact associated with the project. ▪ Interpretation of primary and secondary data to derive socio-economic status of PAFs/PAPs and related stakeholders. ▪ Assessment of social changes arising out of the project. ▪ Suggesting measures to enhance the socio-economic status of the people living in and around the project.
5	Dr. Sangeeta Verma	6	Ecology & Biodiversity-EB	**MARCH 2024 TO TILL DATE 2025** ▪ Survey of existing flora & fauna in the study area ▪ Assessment of impact associated with project ▪ Selection of species for greenery development. ▪ Preparation of conservation plan for scheduled species ▪ Assistance during development of project management plan.
SIGNIFICANT FUNCTIONAL AREAS				
6	Nandini Choudhury	22	Land-use	**MARCH 2024 TO TILL DATE 2025** ▪ Development of Land-use Map ▪ Impact of project on surrounding land use ▪ Assistance during development of project management plan.

Sl. No.	Name of Expert	Years of Experience	Area of Specialization	Involvement (Period & Task)
				▪ Suggestion of mitigation measures due to change in land uses by the project.
	& Rahul Singh		Soil Conservation-SC	**MARCH 2024 TO TILL DATE 2025** ▪ Baseline data generation for soil sampling analysis and characterization of soil. ▪ Assessment of fertility/productivity of soil. ▪ Suggesting soil conservation measures.
7	G.C. Patnaik	40	Risk & hazard-RH	**MARCH 2024 TO TILL DATE 2025** ▪ Assessment of risk likely to be generated from the project activities. ▪ Preparation of emergency preparedness plan. ▪ Development of disaster management plan for the project.
8	Shyam Sundar Earanti	30	Air Pollution-AP	**JULY 2024 TO TILL DATE 2025** ▪ Identification of sources of air pollution and most suitable control device and mechanism. ▪ Assessment of impact associated with the project operation activities ▪ Assessment of impact associated with vehicle movement operation Development of management plan to control the air pollution & its mitigation.
9	Shyam Sundar Earanti	30	Air quality modeling-AQ	**JULY 2024 TO TILL DATE 2025** ▪ Study of wind pattern & wind conditions. ▪ Developing micro-meteorological data for use in modeling. ▪ Quantitative assessment of project impact associated with project activities using AERMOD.
10	Shyam Sundar Earanti	30	Solid & Hazardous Waste-SHW	**JULY 2024 TO TILL DATE 2025** ▪ Identifying source of waste generation. ▪ Quantitative assessment of hazardous and industrial solid waste likely to be generated. ▪ Development of management, handling and disposal techniques. ▪ Suggesting measures for minimization of waste generation.
11		18	Geology-Geo	**MARCH 2024 TO TILL DATE 2025**

Sl. No.	Name of Expert	Years of Experience	Area of Specialization	Involvement (Period & Task)
	Nirzar Ajay Lakhia			▪ Study of geological and rock structure of the study area based on secondary data and literature survey.
			Hydrogeology-HG	**MARCH 2024 TO TILL DATE 2025** ▪ Study of hydrogeological study of the study area. ▪ Study rainwater harvesting and groundwater fluctuation in the study area.
12	Rahul Singh	21	Noise & Vibration-NV	**MARCH 2024 TO TILL DATE 2025** ▪ Assessment of noise and vibration likely to be generated from the project activities. ▪ Assessment of impact associated with project. ▪ Assistance during development of project management plan.

13 CUMULATIVE ASSESSMENT STUDY

13.1 INTRODUCTION

The study observed that from an environmental perspective, the area can accommodate a few more industries without exceeding permissible limits. In this chapter, the proposed industries within a 15 km radius are identified, and a cumulative study is conducted to evaluate whether the proposed industries can coexist with the existing ones.

Cumulative impacts occur when a project activity interacts with other projects or third-party activities, affecting the same environmental or social resource or receptor. Cumulative impact is defined as 'impacts resulting from the incremental impact on areas or resources used or directly impacted by the project, from other existing, planned, or reasonably defined developments at the time the risks and impacts identification process is conducted.' Significant cumulative impacts can result from individually minor but collectively major actions occurring over time.

Cumulative Impact Assessment (CIA) is an approach to environmental impact assessment (EIA) that considers the effects of multiple actions or impacts on the environment of proposed and ongoing activities within a given area. CIAs assess the actual and potential impacts of several activities or projects that may combine over time and/or space with appropriate limitations based on the action being assessed and its foreseeable impacts.

Unlike an Environmental and Social Impact Assessment (ESIA), a CIA focuses on Valued Environmental and Social Components (VECs) as receptors of impacts from different projects and activities, rather than on a project as a generator of impacts on various environmental and social receptors. While VECs may be directly or indirectly affected by a specific development, they are often also affected by the cumulative effects of several developments. VECs are the ultimate recipients of impacts because they tend to be at the ends of ecological pathways.

For an environmental and social component to be included in this CIA, it must be valued by some identifiable stakeholder group, whether the scientific community or any group of national, regional, and local stakeholders. Additionally, the VEC must be reasonably expected to be affected by both the projects under evaluation (here, the Power Plant) and some combination of other projects and external drivers.

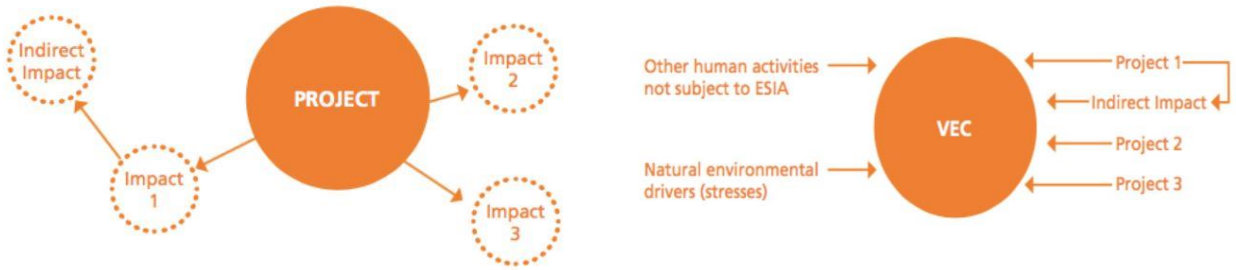


Figure 13.1: Difference in ESIA & CIA

Source: ifc.org

Other projects: There is an operating thermal power plant within the 15 km study area which is at approximately 7.49 km distance in North. The plant has presently a capacity of 1000 MW (4 x 250 MW).

External Drivers: The project is located in the Aurangabad district of Bihar, which falls under Seismic Zone III, indicating a moderate damage risk zone (MSK VII) according to the Seismic Zoning Map of India (IS: 1893:2002). Climate change further exacerbates these risks. Sand mining is prevalent throughout the district, especially along the stretch of the Sone River. Industry development in Bihar is relatively limited compared to other Indian states. However, the state and its Districts have been important suppliers of raw materials to other industrially developed regions in the country. Particularly in the South Bihar region, there is an abundance of agriculture and agro-based products, which serve as raw materials for agro-based industries. The district has a thriving MSME sector and also hosts a few large and medium-scale industries.[1]

13.2 BACKGROUND

Nabinagar Super Thermal Power Plant proposes the expansion of the existing 1980 MW thermal power plant by the addition of 3 units of 800 MW each translating to a capacity addition of 2400 MW. As per the additional condition no. (i) Stipulated in the TOR granted on 15.04.2024 to conduct a cumulative assessment study considering a 15 km study area. As such, the area will be a 15 km radius of the proposed Expansion Project site and all proposed activities needing Environmental Clearance (EC) and ongoing activities within the study area are to be identified. The Cumulative Impact Assessment (CIA) has been done considering all industries in the study area.

The Cumulative Impact Assessment Study of the area has been developed mainly considering the air, water, ecology and socio-economic status of the area. For air, in addition to the baseline study, a quantitative study

[1] *DISTRICT INDUSTRIAL POTENTIAL SURVEY With DISTRICT DEVELOPMENT PLAN AURANGABAD 2021-22*

has been done by studying the total contribution by all existing and proposed industries on the baseline which includes:

Table 13-1: List of Industries

Sl. No.	Project	Distance & Direction	Existing capacity/ area	Proposed capacity/ area
1	Nabinagar Super Thermal Power Plant	Project Site	3x660 MW Units	3x800 MW Units
2	Nabinagar Thermal Power Project (4x250 MW) of M/s BRBCL	7.49 km, SW	4x250 MW Units	-

13.2.1 Objectives

Cumulative Impact Assessment is done to limit more regionally based impacts/system thresholds and provide certainty for future planning. Accordingly, NTPC has assigned consultancy services to GCPL for EIA-EMP including Cumulative Impact Assessment (CIA) with the following objectives:

- Identification of industrial units existing & proposed falling within a 15 km radius of the project site.
- Assessment of baseline environmental conditions for the terrestrial and aquatic environment within the study area of 15 km based on results of primary surveys carried out by GCPL for a 15 km radius and Primary data generated by other Industrial units located within a 15 km radius for their EIA studies as available and from US EPA AP42 when no reliable EIAs are available. Other relevant secondary data published by Government is used.
- Identification and prediction of significant impacts on the environment within a 15 km radius by using appropriate qualitative and quantitative models.

13.2.2 CIA Study Area:

13.2.2.1 Spatial & Temporal Boundaries:

From the information available, there are one existing thermal power plant within 15 km radius. Apart from this, timeline for any other upcoming project could not be established. The timeframe being considered for this CIA begins with the initiation of activities of Nabinagar Super Thermal Power Plant project in 2030.

13.2.2.2 Selection & Description of Valued Environmental and Social Components (VECs):

VECs are environmental and social components that reflect public concerns about social, cultural, economic, or aesthetic values, considered as the end receptors of cumulative impacts. A preliminary list of VECs was prepared based on the environmental and social receptors identified during the site visit and interviews.

Based on the definition of VECs and the available information, components with the greatest importance or value were identified. The list of VECs identified covers environmental, social, and cultural components:

Table 13-2: List of VECs

Sl. No.	Feature Name	Distance (in km)	Direction
	Forests		
1	Protected forest n/v Surar	9.40	SSW
2	Protected forest n/v Koiridih	10.00	NW
3	Protected forest n/v Guraila	11.20	NNW
4	Kaimur Wildlife Sanctuary	11.20	NW
	Water bodies		
1	Main Eastern Canal	0.30	NNW
2	Son River	0.80	WNW
3	Punpun Nadi	3.30	E
4	Eastern Son High level canal	3.60	NNE
5	Ramrekha Nadi	4.50	SE
6	Barki Nala	5.20	E
7	Main western canal	5.80	NW
8	Western Son high level canal	9.80	NNW
9	Patna Canal	11.20	NE
10	Batane Nadi	13.10	ENE
	Socio Cultural component		
1	Kendriya Vidyalaya NPGC Nabinagar	0	Project site
2	Bal Bharti Public School NPGCL	0	Project site
3	Khaira Public School	0.5	E
4	Madhe Sivanpur Janta High School Ankorha	0.1	SE
5	Swatantra Public School	0.6	SSW
6	Government middle school Tiwaridih	2.93	SW
7	Middle school baratetriya	6.16	SW
8	Gurukul English School, Indrapuri	5.73	NW
9	Mount Carmel Pablic School Sonoura	7.20	WNW
10	Primery school Babuganj	7.94	W
11	Amaltas Niketan School	7.48	W
12	Shiv mandir Rahra	1.58	W
13	Surya Narayan Temple, Kanker	4.65	SW
14	Radhe Krishna Mandir Madhe	1	S
15	Kali temple, Tilouthu	7.13	W
16	Jama Masjid, Masjid More	13.83	SW
17	Jama Mosque, Churesar	11.16	W

18	Tilauthu JAMA MASJID	7.25	W
19	Radha Shantha Mahavidyalaya	6.34	W
20	Amaltas B.Ed college	5.51	WNW
21	SUSHIL I.T.I & INTERMEDIATE COLLEGE	6.06	NW
26	R.S. College	10.33	WNW

13.2.2.3 Components not selected for assessment

Some of the social receptors or components were not selected for cumulative impact assessment. Below are some of the components that were not selected for the CIA.

Table 13-3: Components not selected for assessment

Sl. No.	Component	Reason for not selecting for assessment
1	Shiv Mandir, Surya Narayan Temple, Kanker, Radhe Krishna Mandir Madhe, Kali temple, Tilouthu, Jama Masjid, Masjid More, Jama Mosque, Churesar; Tilauthu Jama Masjid	Religious temples in the study area cater to a limited population of the villages or township. They have local significance rather than any historical cultural importance. The project activity is not causing any adverse impact on them as such.

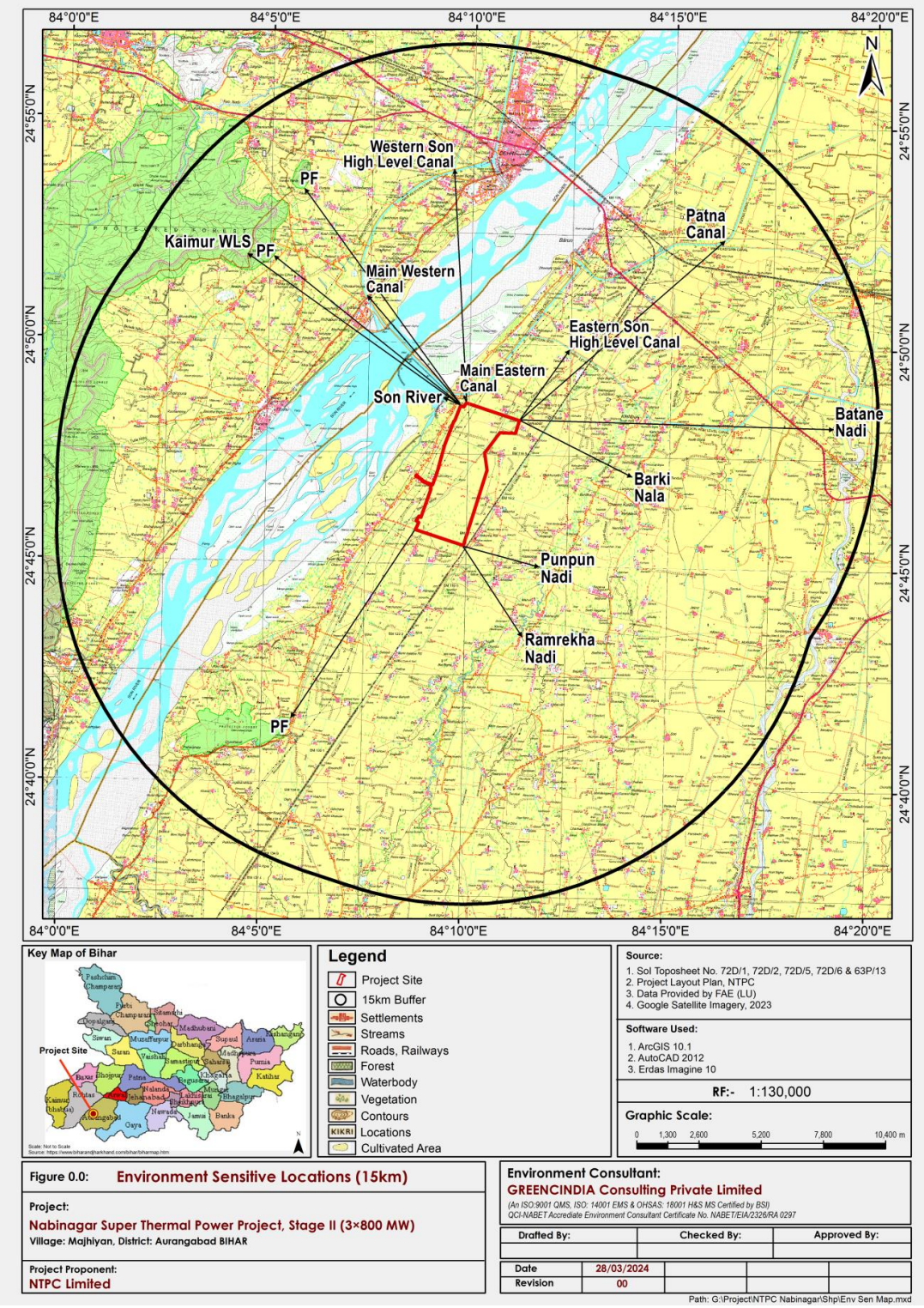


Figure 13.2: Environmental-sensitivity Map of 15 km radius of project site

13.3 GENERAL DESCRIPTION OF THE BUFFER AREA

Baseline environmental data have been collected within the 15 km radius of the project site to determine the existing status of various environmental attributes viz., Air, Water, Soil, Land use pattern, Ecological and Socio-Economical environment. This study would help to undertake corrective mitigation measures for protection of the environment on account of any change deviation of attributes due to activities of the proposed project. The detailed baseline data is presented in the**Chapter-3** of this EIA/EMP report and the summary is given here.

13.3.1 Air Pollution:

From the baseline data on AAQ, it is observed that the ground level concentration of all criterial pollutants is within the permissible limits as shown in **Fig. 13.3 to 13.7**.

The air quality monitoring in the study area reveals a range of pollutant concentrations. The 98th percentile values of PM10 vary from 69.8 µg/m^3 at AAQ5 to 91.6 µg/m^3 at AAQ1, with higher levels attributed to industrial activity, vehicular emissions, and prevailing wind directions. For PM2.5, the values range from 39.08 µg/m^3 at AAQ5 to 53.73 µg/m^3 at AAQ1, and concentrations remain within permissible limits across all locations. Sulphur dioxide (SO_2) concentrations range from 12.40 µg/m^3 at AAQ5 to 22.5 µg/m^3 at AAQ1, well below the National Ambient Air Quality (NAAQ) standards. Similarly, the nitrogen dioxide (NO_2) levels range from 16.15 µg/m^3 at AAQ5 to 35.89 µg/m^3 at AAQ1, also within permissible limits. Carbon monoxide (CO) concentrations range from 0.93 mg/m^3 at AAQ2 to 0.96 mg/m^3 at AAQ3, 4, 5, and 8, remaining below the prescribed NAAQ standards. Furthermore, pollutants such as mercury, lead, ammonia, and nickel were below detection limits at all monitoring locations. While particulate matter levels, particularly PM10, are influenced by local anthropogenic activities, other pollutants, including SO_2, NO_2, and CO, indicate compliance with regulatory standards, ensuring overall ambient air quality within acceptable limits.

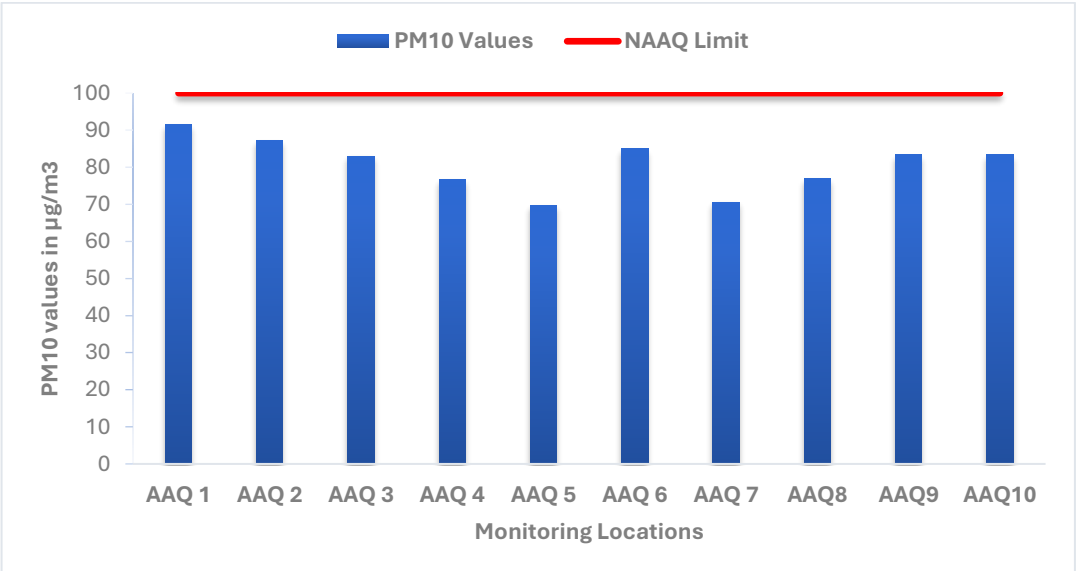


Figure 13.3: 98 Percentile of PM10 in µg/m3

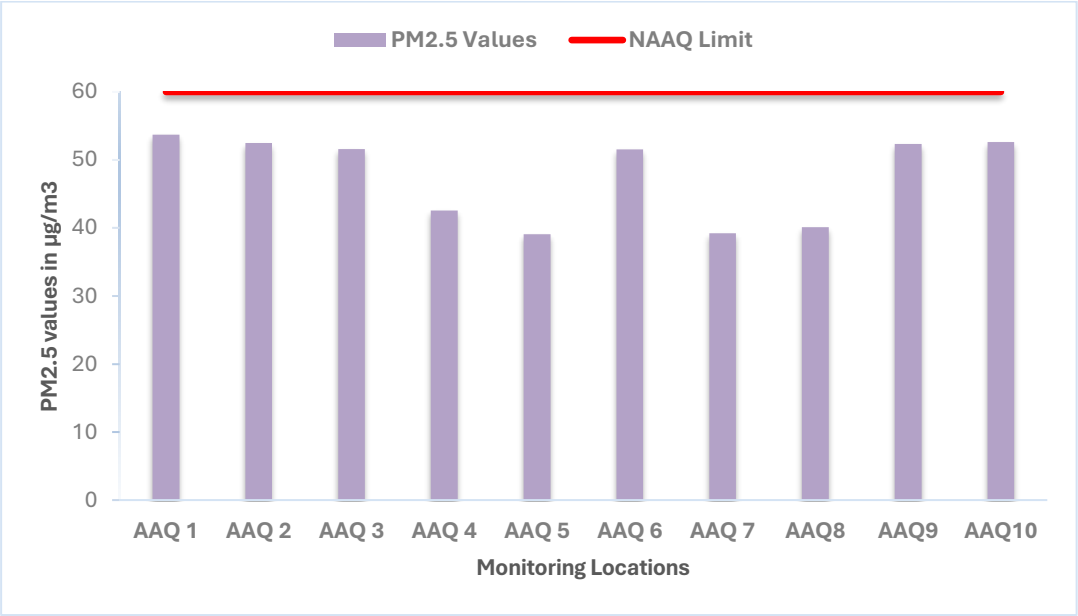


Figure 13.4: 98 Percentile of PM2.5 in µg/m^3

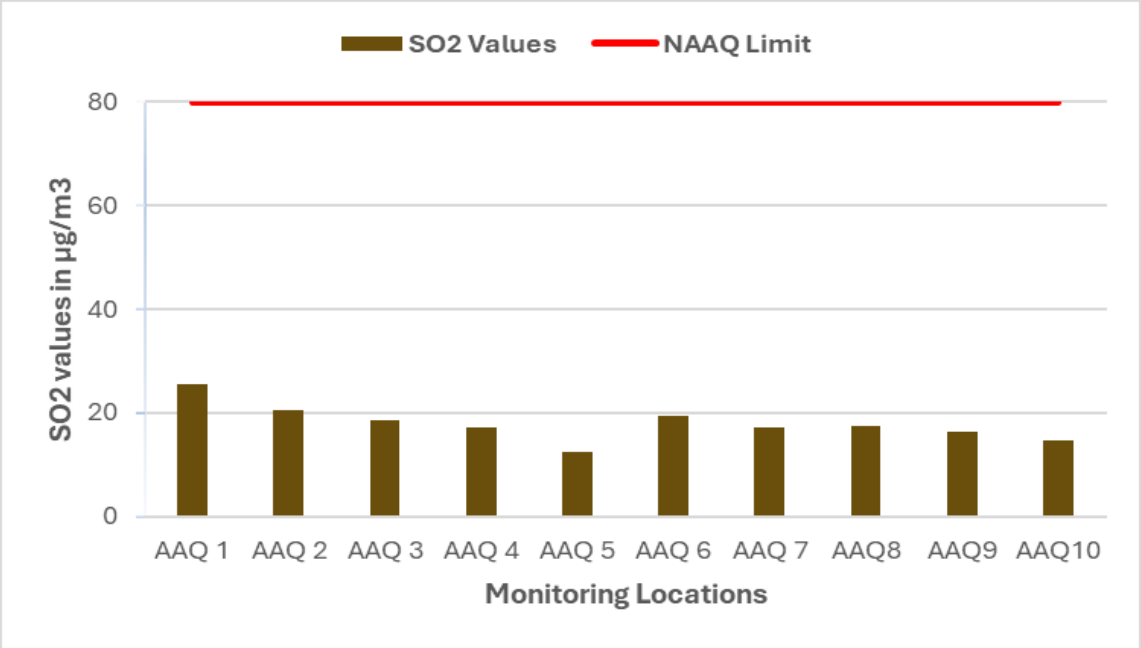


Figure 13.5: 98 Percentile of Sulphur Dioxide (SO2) in µg/m^3

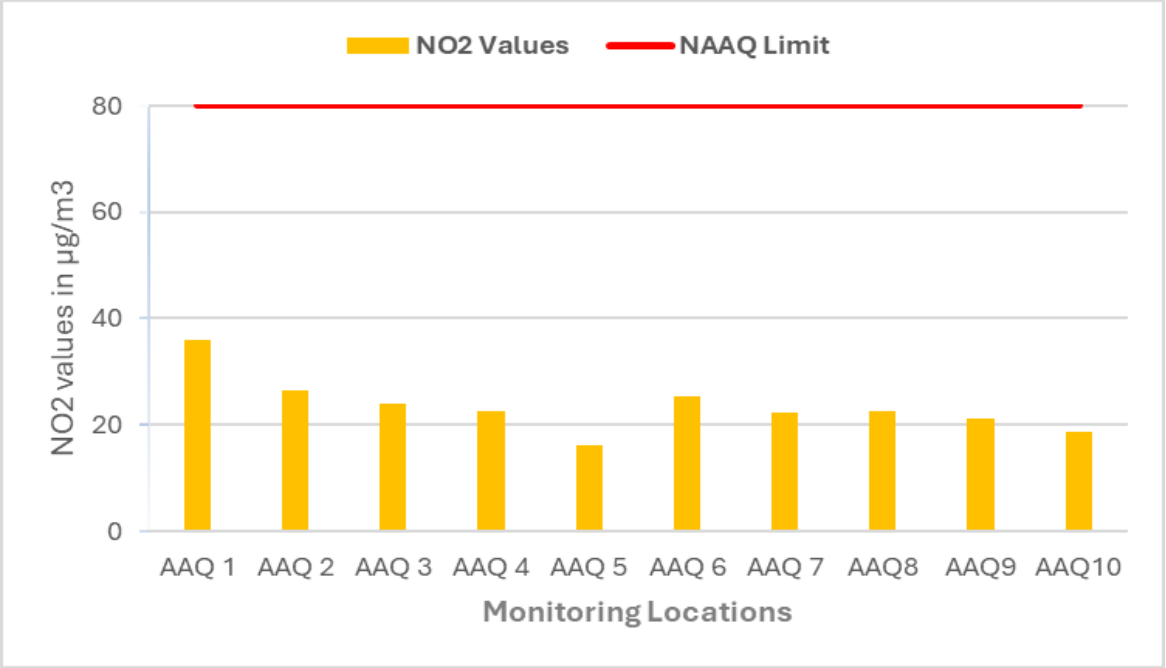


Figure 13.6: 98 percentiles of Nitrogen Dioxide (NO2) in µg/m^3

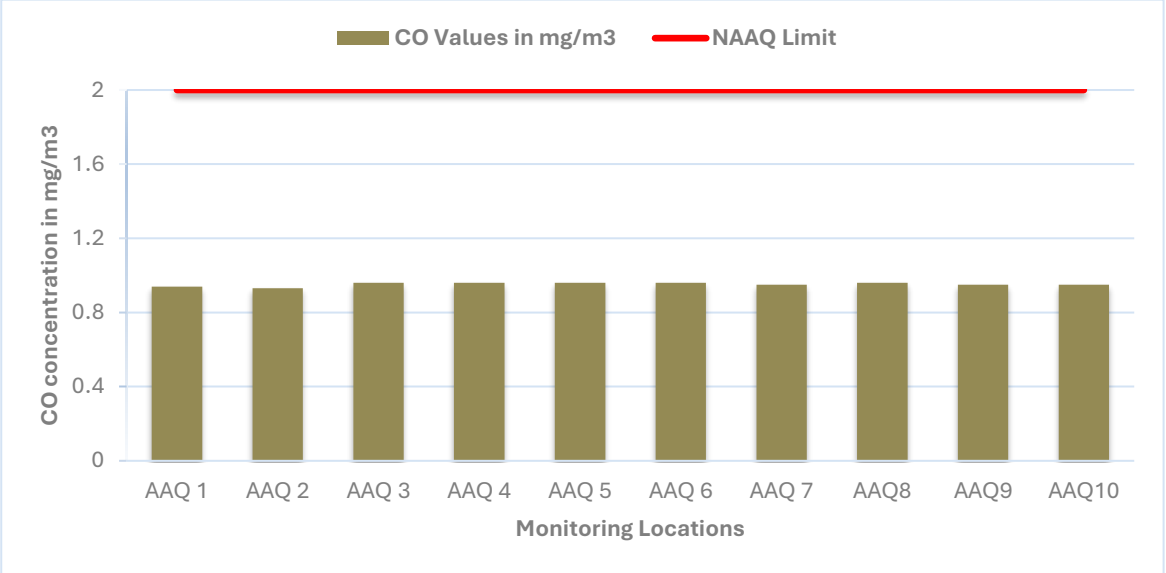


Figure 13.7: 98 Percentile of Carbon Monoxide (CO) in mg/m^3

13.3.2 Water Pollution

The groundwater samples comply with the permissible limits set by IS 10500:2012, showing no signs of industrial contamination.

Based on the former IS:2296 standards (now discontinued) and the MoEF&CC classification for Inland Surface Water, the surface water is deemed suitable for drinking after conventional treatment, as well as for the propagation of wildlife and fisheries.

Additionally, the current plants operate on a 'Zero Liquid Discharge' (ZLD) concept, ensuring no potential for water pollution in the study area.

Therefore, the region possesses significant carrying capacity for further industrialization concerning water pollution.

13.3.3 Ecology

The adjacent forest area forms the habitat of some species which are listed in the Schedule I of the Indian Wildlife (Protection) Act, 1972 and its subsequent amendments. There are 13 Species of mammals, 14 species of birds, 8 species of reptiles and amphibians recorded in the buffer area.

However, the existing power plant and mine are not emitting air &water pollutants of significant amount to have any impact on ecology. As such, the area has considerable carrying capacity left for further industrialization as regards Ecology.

13.3.4 Socio Economic Condition

Based on the distribution of SC & ST population in the study area, it is observed that the Scheduled Tribe population has decreased from 2001 to 2011, while the Scheduled Caste population has seen only a marginal increase. The tribal population is lower than the national average of 8.6%. Literacy rates indicate significant improvement in women's education in the area, reflecting overall progress in the education sector.

The Work Participation Rate in the area remains low, with a concerning trend of negative growth among main workers, indicating a reduction in job opportunities. Establishing large projects in the area could help improve employment prospects. The socio-economic analysis of the Project Impact Area reveals poor development in terms of education and other sectors, with the overall socio-economic status of the target population being low in terms of literacy, work participation rate, and access to facilities. Greater attention and care are needed to provide the affected population with better access to modern education and development facilities.

Over the past decade, there has been a significant increase in the number of schools in the study area. Common diseases reported include fevers, dengue, and malaria, with medical facilities being inadequate. Inputs from the local population, gathered during public hearings for existing NTPC Units, indicate a positive public perception, which will be further refined after conducting public hearings for the expansion project. The area still has considerable carrying capacity for further industrialization, considering public opinion.

13.4 EXISTING CONDITION OF VECS

The VECs (Valued Environmental and Social Components) within the 15 km radius of the NTPC project site are thoroughly discussed in Chapter 3 of this draft EIA-EMP report. Currently, part of the Kaimur Wildlife Sanctuary falls within the 15 km radius of the project site. The quality of flora and fauna in the study area indicates a well-functioning ecosystem. This study will assist in implementing corrective mitigation measures to protect the environment from any changes or deviations in attributes due to the proposed project's activities, enabling further industrialization in the area responsibly.

13.5 ASSESSMENT OF CUMULATIVE IMPACT OF VECS

The scope of the CIA study includes physical parameters like Source Emission Dispersion Modelling, AAQM, Water & Waste Water Elemental Analysis and Soil Analysis. In addition to the documentation of physical parameters, biodiversity and ecosystems, analysis in the study area has been done.

For the existing and proposed Nabinagar STPP activity, the analysis is presented in **Chapter- 4** of this Final EIA report.

In this chapter, the cumulative impact due to major industries including the existing and proposed Nabinagar STPP, the existing BRBCL Power Plant, which is likely to have an insignificant impact on the air quality of the area located within a 15 km radius study area has been carried out through cumulative air modeling. The input data for air modeling for the plants based on information available from secondary sources.

As discussed, apart from the existing and proposed project of the NTPC Plant, other industries like BRBCL Power Plant has been taken into consideration for cumulative air impact assessment. BRBCL Power Plant is at a distance of 7.49 km from Nabinagar STPP in the SW direction. The cumulative modelling has been undertaken assuming these two (2) industries which have emission loads as per prescribed emission norms.

13.5.1 Air Environment:

PM_{10}, SO_2 and NO_2 are the major emissions from industries in the study area. The impact has been predicted for air quality taking PM_{10}, SO_2 and NO_2 into consideration in and around the Nabinagar STPP project area. The impact assessment has been carried out considering the following point:

Activity-wise emission rates have been estimated. Controlled emission from Nabinagar STPP has been taken to generate the air pollution dispersion models. Proposed stacks of Nabinagar STPP has been considered with FGD.

Contribution of SO_2, NO_X & PM_{10}:

Simulation modeling exercise is showing the max. GLCs for NTPC Nabinagar plant at 1.2 Km from the main stack of Unit -1 of Stage I in SE direction whereas at 0.85-km from the Stack-1 of BRBCL in SE. It was observed that GLCs of both the plants are not intersecting each other as both the plants are separated by about 7.49-km from each other.

It can be concluded that the cumulative impact will not have any significant impact due to each of Nabinagar and BRBCL as both units are separated by 7.49 km which far enough to dilute the impacts due to each of the unit before reaching close to the other unit.

Additionally, the highest emission rate for NOx has been calculated at 350 mg/Nm^3 (as detailed in Chapter 4). This represents the peak emission level. In the future, with the installation of FGD (Flue Gas Desulfurization) systems, there will be no possibility of an increase in pollution levels. On the contrary, pollution levels are expected to decrease after commissioning of FGD, resulting in reduced emissions from both Nabinagar STPP and BRBCL.

13.5.2 Water Environment

The groundwater samples comply with the permissible limits set by IS 10500:2012, showing no signs of industrial contamination.

Based on the former IS:2296 standards (now discontinued) and the MoEF&CC classification for Inland Surface Water, the surface water is deemed suitable for drinking after conventional treatment, as well as for the propagation of wildlife and fisheries.

The cumulative effect on the water environment within a 15 km radius of Nabinagar STPP, operating under a Zero Liquid Discharge (ZLD) system, is minimal due to the strict water management practices in place. The presence of another thermal power plant, BRBCL, which also follows the ZLD principle, ensures that no effluents are discharged into the surrounding water bodies. Consequently, the risk of water contamination from industrial activities is effectively mitigated.

Given that the area is predominantly agricultural, the primary source of water usage is irrigation, with minimal industrial water demand. The ZLD systems in both power plants recycle and reuse water, significantly reducing the dependency on external water sources and minimizing the potential impact on local water availability. Additionally, the lack of other prominent industries within the 15 km radius further reduces the likelihood of cumulative industrial water pollution.

Overall, the implementation of ZLD systems by both Nabinagar STPP and BRBCL ensures the protection of the water environment, with no adverse impacts on surface or groundwater quality. This sustainable approach, combined with the agricultural nature of the area, helps maintain the ecological balance and ensures that water resources remain unpolluted and sufficient for local agricultural and domestic needs.

13.5.3 Ecology

The adjacent forest area forms the habitat of some species which are listed in the Schedule-I of the Indian Wildlife (Protection) Act, 1972 and its subsequent amendments. There are 12 Schedule-I species, 13 Species of mammals, 14 species of birds, 8 species of reptiles and amphibians recorded in the buffer area.

The cumulative effect on the ecology within a 15 km radius of the Nabinagar STPP is minimal and localized due to the effective environmental management practices adopted. The presence of another thermal power plant, BRBCL, further contributes to the overall impact in the region. Since there are no other prominent industries within this radius, the ecological disturbances from industrial activities remain limited.

The area is predominantly agricultural, which helps maintain ecological stability. The greenbelt development initiatives undertaken by both Nabinagar STPP and BRBCL contribute positively to the local ecology by enhancing vegetation cover, providing habitats for small fauna, and mitigating dust and noise pollution. These greenbelts act as ecological buffers, promoting biodiversity and supporting ecological balance in the region.

Aquatic ecosystems in the vicinity, such as ponds or the Sone River, are not significantly impacted as there is no evidence of harmful industrial discharges affecting water quality. Additionally, strict compliance with emission norms ensures that air pollution levels, which could indirectly affect flora and fauna, are controlled effectively.

Overall, the cumulative ecological impact of Nabinagar STPP and BRBCL remains limited. The predominantly agricultural landscape, combined with greenbelt development and adherence to environmental management practices, supports a balanced ecological environment with no significant disruptions to local biodiversity.

13.5.4 Socio Economic Environment:

The cumulative effect of the Nabinagar STPP and BRBCL thermal power plant on the socio-economic environment within a 15 km radius has been largely positive, with some areas requiring further attention. The presence of these power plants has significantly contributed to economic growth by creating direct and indirect employment opportunities for local residents, particularly during the construction and operational phases. This has improved income levels and provided economic stability to many families in the region. Additionally, the development of infrastructure such as roads, communication networks, and utility services has enhanced the quality of life for nearby communities. Local businesses, including shops, transport services, and food vendors, have also benefited from increased demand, leading to further economic activity. Moreover, the plants have facilitated skill development among the workforce, boosting employability and enhancing the skill set of the local population.

Despite these positive impacts, certain challenges remain. The availability of healthcare and education facilities in the area is still inadequate, with residents having to travel to Aurangabad or Rohtas for basic medical treatment and higher education. This highlights the need for further investment in social infrastructure to support the well-being and development of the local population. While the predominantly agricultural practices in the region have not been significantly affected by the plants, there is still a need to ensure that these activities continue unhindered. Overall, the power plants have contributed to economic growth and improved infrastructure, but addressing gaps in healthcare and education will be crucial for long-term socio-economic sustainability in the region.

As such, if a proper EMP is recommended by apprising authorities, the existing and proposed plants are expected to improve the socio-economic conditions of the area after the start of proposed units of the NTPC Plant.

13.6 MANAGEMENT OF CUMULATIVE IMPACTS

Cumulative impact management can be done at project level & regional level. At project level, each industry prepares or furnishes Environment Management Plan in their EIA-EMP report based on the activity of that particular industry. The EMP for the proposed units of Nabinagar STPP of 3X800 MW is described in Chapter 10 of the draft EIA- EMP report.

Project Site Level

At the project level, impact management includes detailed information about the institutional arrangements, such as a multi-disciplinary Environmental Management Group (EMG) and the roles of the staff involved:

- The major environmental considerations during the construction and operation of the thermal power station will be managed by a comprehensive Environmental Management Group (EMG). This division will focus on environmental management for the entire plant and surrounding environment. The EMG at Nabinagar STPP is led by an AGM(TS/EMG) and supported by a team of Senior Manager (EMG), Dy. Manager (EMG), Engineers, Chemists, and operating staff.
- The Operation& Maintenance (O&M) team head will be primarily responsible for the power station's operation and maintenance. NTPC's Nabinagar STPP Operation & Maintenance Group Management Organization, led by a GM(Operation), includes a team of operations engineers. The GM (O&M) will represent the project's company in the power station's operation and maintenance and oversee the O&M activities of the station. This team covers the following functional areas: Technical, Finance & Accounts, and Administration & Personnel.
- An environmental monitoring program is essential to provide scientifically defensible information for determining the environmental quality status around the power station and to ensure critical pollutants are within acceptable limits.
- In a power plant, safety hazards include burns, slips, falls, fire and explosions, electrical hazards, excessive noise, and heat stress. Safety measures are proposed to prevent and reduce accidents among employees.
- Management is responsible for educating and training employees in good safety practices. This includes proper equipment use, safe lifting practices, fire extinguisher handling, and personal protective equipment use.
- Office space, canteens, toilets, and restrooms will be provided per good practice and relevant factories act norms. These facilities will be adequately furnished and equipped.
- To address health hazards in coal handling areas, ash handling areas, acid and alkali using areas, and oil storage areas, measures such as frequent washing, good sanitary and washing facilities, and separate lunchrooms will be implemented. This will help reduce dermatitis and other skin issues due to contact with harmful substances. The work atmosphere will be monitored for SPM, SO_2, NOx, etc., to avoid excessive exposure.

Regional Level

- The environmental monitoring program is detailed in Chapter 6 of the EIA-EMP report, outlining the locations, duration, and frequency of the parameters to be monitored. Monitoring environmental components during both the construction and operation phases is integral to the environmental mitigation measures. Regular monitoring is essential to assess the functioning and efficiency of all pollution control equipment. Ongoing monitoring for the existing Nabinagar STPP includes activities for air quality, water quality, soil quality, and noise levels, with data submitted to the Bihar State Pollution Control Board (Bihar SPCB) regularly. This monitoring will be expanded and strengthened to include the proposed Nabinagar STPP (3x 800MW).
- Green belt development through afforestation is crucial for environmental conservation and protection. Establishing vegetation in and around the proposed thermal power plant will bring numerous direct and indirect benefits. The green belt will consist of native, evergreen, and fast-growing trees. A mix of tree species will be preferred over monocultures, with rows of resistant tree species. This approach will enhance the green belt's lifespan by improving disease resistance.

13.7 CONCLUSIONS:

Following are the major conclusions from the Cumulative Study:

i. The baseline values of air pollutants are within the limit.
ii. Surface and Ground Water qualities are acceptable as per standards.
iii. Socio-economic quality indicates that the area needs more economic development.
iv. The forest areas nearby have high ecological importance.
v. There is no migratory corridor or wildlife sanctuary in the buffer area.
vi. The prediction of the existing Nabinagar STPP Plant and existing BRBCL Nabinagar Thermal Power Plant indicate that insignificant contribution to the GLC is associated with the study area as can be seen from the maximum GLC contributed by industries in the study area as follows:
vii. Groundwater sampling was carried out at 6 locations and analyzed as per the drinking water standards (IS 10500:2012). The groundwater samples were found well within the permissible limit of IS 10500:2012 and do not indicate any industrial contamination. No leakage is expected from the existing and proposed projects in groundwater due to control measures applied. Also, there will be no extraction of groundwater for project activities.
viii. Surface water sampling was carried out at 6 locations and analyzed as per erstwhile IS:2296 criteria & use-based classification by CPCB. The water samples indicated suitability for drinking with conventional treatment & for the propagation of Wildlife and Fisheries. The existing and proposed projects will run on the 'Zero Liquid Discharge' (ZLD)concept.
ix. Soil samples were collected from 10 locations. The soil quality was analyzed as per the Indian Council of Agriculture Research. The samples tested were neutral to slightly alkaline, highly saline in nature which can hinder the plant's ability to absorb water. Macronutrients such as N, P, K were also analyzed

Nitrogen ranged from good to sufficient condition, whereas Phosphorus ranged from medium to average sufficient& Potassium ranged from very less to medium. No impact on soil due to the project is anticipated due to insignificant GLC of air pollutants from existing and proposed projects and 'Zero Discharge' of wastewater from existing and proposed projects.

x. Land use & landcover assessment of the study area reveals that the majority of the study area is under Agriculture Land(71.61%), thus, indicating its reliance on agriculture for economic activities, food production, and livelihoods. There are rivers &nallas flowing through the buffer area and water bodies comprising 6.5% of the total buffer area. Another major land use after Agricultural lands is Open Scrub which covers 11.51% of the buffer area. Comparatively the area under industries is marginal (0.54%) at present due to which there is no significant impact on the agricultural lands at large.

xi. The ecology assessment of the area dealt with the extensive documentation of floral & faunal diversity in the buffer area. There are no migratory corridors or wildlife sanctuaries in the buffer area.

xii. The study of biodiversity revealed that the adjacent forest area forms the habitat of some species which are listed in Schedule-I & Schedule-II of the Indian Wildlife (Protection) Act, 1972 and its subsequent amendments. There are 13 Species of mammals, 14 species of birds, 8 species of reptiles and amphibians recorded among faunal group. Many species are indicators of a polluted or degraded ecosystem. Many of them change their habitat depending upon the season, temperature and other environmental conditions. The presence of the floral & faunal diversity in the large number indicates the ecosystem of the region is functioning to its capacity and is not degraded.

xiii. The socio-economic study reveals the area has scope for development. With the industrialization of the region social & physical infrastructure has the potential to improve along with opportunities for employment of the local populace resulting in better living standards. Apart from that any concerns from the local farmers/ villagers surrounding the project area regarding adverse impacts from the existing and proposed projects on their health, farmlands, water sources etc. Fine-tuning will be done after the public hearing.