BEFORE THE NATIONAL GREEN TRIBUNAL

EASTERN ZONE BENCH KOLKATA

APPEAL NO. 02 OF 2021/EZ

IN THE MATTER OF:-

PRAFULLA SAMANTRAY … APPELLANT

VERSUS

UNION OF INDIA & ORS. … RESPONDENTS

INDEX

LIST OF DOCUMENTS ON BEHALF OF APPELLANT

S. NO.	PARTICULARS	PAGE NO
1	Final EIA Report, January 2020 as downloaded from Parivesh Portal	**1417-1669**

Through

Ritwick Dutta **Rahul Choudhary** **Saurabh Sharma**

Counsel for the Appellants

N-73, Lower Ground Floor, Greater kailash-1

New Delhi – 110048

Mobile No. 9312407881

Email:- Litigation.life@gmail.com

Place:- Kolkata/Delhi

Dated;- 18.03.2023

File No. - J-13012/14/2017– IA, I (T)
Study Period : January –March 2018

FINAL EIA REPORT

NLC INDIA
CREATINGWEALTH FORWELLBEING

For

3x800 MW Talabira Thermal Power Project
By
M/S NLC India Ltd
At
Kumbhari & Tareikela villages in Jharsuguda District
&
Thelkoloi Village in Sambalpur District, Odisha

January 2020

Prepared By

ABC Techno Labs India Private Limited
An ISO : 9001:2008, ISO:14001:2004 & OHSAS:18001:2007 Certified Company
(Accrediated by NABL, NABET, MoEF)
Corporate Ofice & MultiLab:
ABC TOWER, No:400, 13th Street,
SIDCO Industrial Estate - North Phase,
Ambattur, Chennai - 600 098.
P.No: +91- 44 - 2625 7788 / 7799.
Helpline: +91 - 94442 60000 / Website: www.abctechnolab.com
Branches: Delhi, Mumbai, Kolkata, Jaipur, Hyderabad, Banglore, Cochin, Coimbatore

ABC Techno Labs®
India Private Limited
(Recognised by NABL, NABET & MoEFCC)

Declaration by ABC Techno Labs India Pvt. Ltd.

M/S NLC India limited has **Proposed *3x800 MW NLC Talabira Thermal Power Project (NTTPP) Kumbhari & Tharaikela Tehsil in Jharsuguda District & Ash dyke in Thelkoloi Villages Sambalpur District***. In this Regard ***NLC India limited*** appointed ABC Techno Labs India Pvt. Ltd. to conduct the Environmental Impact Assessment (EIA) study as per the Terms of Reference (ToR) for carrying out the EIA/EMP study vide vide letter dated Jan 02nd, 2018, File No. - J-13012/14/2017– IA, I (T) by Expert Appraisal Committee (EAC)- Thermal Power Plant, Ministry of Environment, Forest & Climatic Change (MoEF&CC).

ABC Techno Labs has taken all reasonable predictions in the preparation of this EIA report. ABC Techno Labs also believes that the facts presented in this report are accurate as on date it was written.

ABC Techno Labs confirm that the mentioned experts has prepared the EIA report for **Proposed *3x800 MW NLC Talabira Thermal Power Project (NTTPP) Kumbhari & Tharaikela in Jharsuguda Tehsil and District & Ash dyke in Thelkoloi Villages Sambalpur District***. ABC Techno Labs also confirm that the consultant organization shall be fully accountable for any misleading information mentioned in this statement.

Name: Mr. G. Murugesh

Designation: Chairman & Managing Director

Name of the EIA Consultant Organisation: ABC Techno Labs India Pvt. Ltd

NLC India Limited
('Navratna' - Government of India Enterprise)
CIN No.: L93090TN1956GOI0031007, Website: www.nlcindia.com

OFFICE OF THE CHIEF GENERAL MANAGER,
Projects & Business Development

/Tele: 04142-252286 /Common Fax:04142-252645 -/Email: cgmpbd@nlcindia.in

Declaration

I, **Devendra Pratap Singh, Deputy General Manager/Project&Busness Development Division (P&BD)** of M/s NLC India Limited, give this declaration/undertaking to the effect that EIA report preparation has been undertaken in compliance with the Standard Terms of Reference (ToR) Prescribed by MoEF & CC, vide proposal No: **IA/OR/THE/67938/2017**, dated 27.12.2017, for our proposed NLC Talabira Thermal Power Project (NTTPP) (3 X800 MW - Ultra Mega Power Project – coal based) at village Khumberi,Tareikela in the district of Jharsuguda and Thelkoloi village in the District of Sambalpur, Odisha and the information and content provided in the report are factually correct.

Date : 13th February 2020

Place : Neyveli

For & On behalf of NLC India Limited

(DEVENDRA PRATAP SINGH)
DEPUTY GENERAL MANAGER

ABC Techno Labs®
India Private Limited

Declaration by Experts contributing to the EIA Study for the Proposed *3x800 MW NLC Talabira Thermal Power Project (NTTPP)* by M/S NLC India

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

EIA Coordinator

Name : **Mrs. Vijayalakshmi**

Signature :

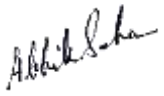
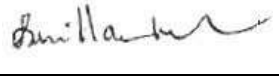
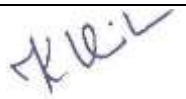
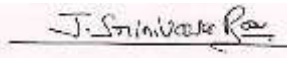
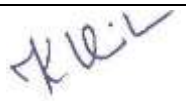
Period of involvement : October 2017 – till date

Contact information : vijayalakshmi@abctechnolab.com

Functional Area Experts

S. No.	Functional Areas	Name of the Expert/s	Involvement (Period and task)	Signature
1)	NV	Mrs. Vijayalakshmi	Oct 2017 – till date	
2)	Geo	Mr. Thillai Govidarajan	Oct 2017 – till date	
3)	WP	Mr. Abhik Saha	Oct 2017 – till date	
4)	AP	Dr. Muthiah Mariappan	Oct 2017 – till date	
5)	ISW	Dr. Muthiah Mariappan	Oct 2017 – till date	
6)	SE	Mr. Sushil Meshram	Oct 2017 – till date	

ABC Techno Labs®
India Private Limited
(Formerly ABC Environ Solutions Pvt. Ltd.,)

7)	EB	Mr. Abhiksaha	Oct 2017 – till date	
8)	HG	Mr. Thillai Govidarajan	Oct 2017 – till date	
9)	SC	Mr. Sameer Deshpande	Oct 2017 – till date	
10)	AQ	Mr. K. Vijayalakshmi	Oct 2017 – till date	
11)	LU	Dr. J.S.Rao	Oct 2017 – till date	
12)	RH	Mrs. Vijayalakshmi	Oct 2017 – till date	

Declaration by the head of the Accredited Consultant Organization

I, Mr. G. Murugesh, hereby confirm that the above mentioned experts prepared the EIA for the **Proposed *3x800 MW NLC Talabira Thermal Power Project (NTTPP) by M/S NLC India***). I also confirm that I shall be fully accountable for any misleading information mentioned in this statement.

Signature : 

Name : Mr. G. Murugesh

Designation : Chairman & Managing Director

Name of the EIA Consultant Organization: ABC Techno Labs India Private Limited NABET Certificate No. & Issue Date: **NABET/EIA/1619/RA0048 date 29th May 2017**

Compliance to Terms of Reference Issued by Ministry of Environment, Forest and Climate Change, F.No.J-13012/14/2017-IA.I (T) dated 27.12.2017

A. STANDARD TERMS OF REFERENCE		
S. No.	**Terms of reference (TOR)**	**Action Plan/responsibility**
1	All the recommendations made in the site visit of the sub–committee dated 4.11.2017 shall be followed.	Most of the recommendations made in the site visit of the sub–committee dated 4.11.2017 have been complied and the balance pertaining to execution phase of the project will be complied.
2	The proposed power plant area shall be reduced and the raw water reservoir area be shifted near to the existing water bodies. Re-alignment of proposed power plant is to be done and the revised layout map is to be submitted.	Complied. The plant area reduced to 602 Acres and reservoir area shifted near to the existing water bodies upward. Revised layout map is attached as Annexure II.
3	Ficus species to be raised in and around the temples.	This will be taken up during the execution of the project.
4	Even though the proposed area is far from any wildlife sanctuary recommendations of chief wildlife warden on the impacts of proposed wildlife is to be obtained.	NOC from Sambalpur DFO obtained and NOC from DFO Jharsuguda s under process.
5	The social impact assessment due to proposed project is to be conducted and a report shall be submitted.	Social Impact Assessment Study report is attached as Annexure –XII.
6	The proposed project shall be given a unique name in consonance with the name submitted to other Government Departments etc. for its better identification and reference.	**The project name is "NLC Talabira thermal power project" (NTTPP).**
7	Vision document specifying prospective long term plan of the project shall be formulated and submitted.	Vision document specifying prospective long term plan of the project are given in Section 2.7 of Chapter 2 (Page No. 17) of the EIA Report.
8	Latest compliance report duly certified by the Regional Office of MoEFCC for the conditions stipulated in the environmental and CRZ clearances of the previous phase(s) for the expansion Projects shall be submitted.	Not applicable as it is a green field project

S. No.	Terms of reference (TOR)	Action Plan/responsibility
9	The project proponent needs to identify minimum three potential sites based on environmental, ecological and economic considerations, and choose one appropriate site having minimum impacts on ecology and environment. A detailed comparison of the sites in this regard shall be submitted.	Alternate Site Selection of the project are given in Section 1.6 of Chapter 1 (Page No.8) and in Chapter 5 (pg. no 156)of the EIA Report and site alternative layout is attached as annexure III
10	Executive summary of the project indicating relevant details along with recent photographs of the proposed site (s) Shall be provided. Response to the issues raised during Public Hearing and the written representations (if any), along with a time bound Action Plan and budgetary allocations to address the same, shall be provided in a tabular form, against each action proposed.	Executive summary of the project is attached along with the EIA report. public hearing Minutes of Meeting, Response to the issues raised during Public Hearing is attached as annexure XIII
11	Harnessing solar power within the premises of the plant particularly at available roof tops and other available areas shall be formulated and for expansion projects, status of implementation shall also be submitted.	Details in respect of harnessing of Solar power within the project area is given in section 9.5 of chapter 9 (pg.no:195) of the EIA report.
12	The geographical coordinates (WGS 84) of the proposed site (plant boundary), including location of ash pond along with topo sheet (1:50,000 scale) and IRS satellite map of the area, shall be submitted. Elevation of plant site and ash pond with respect to HFL of water body/nallah/River and high tide level from the sea shall be specified, if the site is located in proximity to them.	The geographical coordinates of the site are given in section 1.5 of chapter 1 of the EIA report Page no 4 and 5. Elevation of plant site and ash pond with respect to HFL of water body/nallah/River is given in Section 2.5(pg. no. 17) of Chapter-II.
13	Layout plan indicating break-up of plant area, ash pond, green belt, infrastructure, roads etc. shall be provided.	Layout plan indicating break-up of plant area, ash pond, green belt, infrastructure, roads are given in Annexure -II
14	Land requirement for the project shall be optimized and in any case not more than	Land requirement has been optimized (meeting the CEA norms) and given in section 2.3 of chapter

S. No.	Terms of reference (TOR)	Action Plan/responsibility
	what has been specified by CEA from time to time. Item wise break up of land requirement shall be provided.	2 in the EIA report.
15	Present land use (including land class/kind) as per the revenue records and State Govt. records of the proposed site shall be furnished. Information on land to be acquired including coal transportation system, laying of pipeline, ROW, transmission lines etc. shall be specifically submitted. Status of Land acquisition and litigation, if any, should be provided.	Present land use (including land class/kind) as per the revenue records and State Govt. records of the proposed site is given in section 3.1
16	If the project involves forest land, details of application, including date of application, area applied for, and application registration number, for diversion under FCA and its status should be provided along with copies of relevant documents.	Not applicable since no forest land is involved in project area.
17	The land acquisition and R&R scheme with a time bound Action Plan should be formulated and addressed in the EIA report.	An appropriate Rehabilitation and Resettlement plan as formulated in RPDAC (comprising of all the stakeholders) and duly approved by Government of Orissa will be implemented for the project affected persons.
18	Satellite imagery and authenticated topo sheet indicating drainage, cropping pattern, water bodies (wetland, river system, stream, nallahs, ponds etc.), location of nearest habitations (villages), creeks, mangroves, rivers, reservoirs etc. in the study area shall be provided.	Satellite imagery and authenticated topo sheet image are given in Fig 1.1 & 1.2 of chapter 1 in the EIA report.
19	Location of any National Park, Sanctuary, Elephant/Tiger Reserve (existing as well as proposed), migratory routes / wildlife corridor, if any, within 10 km of the project site shall be specified and marked	NIL

S. No.	Terms of reference (TOR)	Action Plan/responsibility
	on the map duly authenticated by the Chief Wildlife Warden of the State or an officer authorized by him.	
20	Topography of the study area supported by Toposheet on 1:50,000 scale of Survey of India, along with a large scale map preferably of 1:25,000 scale and the specific information whether the site Requires any filling shall be provided. In that case, details of filling, quantity of required fill material; its source, transportation etc. shall be submitted.	Topography details of the study area (10 km) is given in section 2.5 of chapter 2 and shown on Toposheet on 1:50,000 scale of survey of India in figure 1.2 of chapter 1 in the EIA report. The plant formation level has been decided based on Area Drainage Study carried out by National Institute of Hydrology (NIH), Roorkee. Levelling of plant area to the identified formation level shall be carried out by cutting and filling with additional earth through OB of mine area.
21	A detailed study on land use pattern in the study area shall be carried out including identification of common property resources (such as grazing and community land, water resources etc.) available and Action Plan for its protection and management shall be formulated. If acquisition of grazing land is involved, it shall be ensured that an equal area of grazing land be acquired and developed and detailed plan submitted.	A detailed study on land use pattern in the study area is given in section 3.3.1.1 of chapter 3 (pg.no: 39) In the EIA report.
22	A mineralogical map of the proposed site (including soil type) and information (if available) that the site is not located on potentially mineable mineral deposit shall be submitted.	A copy of CMPDIL clearance for Non coal bearing area and no mineral Zone certificate issued by Director/Geolgy, Govt. of Orissa is given as **Annexure-VI**
23	Details of fly ash utilization plan as per the latest fly ash Utilization Notification of GOI along with firm agreements / MoU with contracting parties including other usages etc. shall be submitted. The Plan shall also include disposal method / mechanism of bottom ash.	Fly ash will be used by cement industries & brick manufacturers and mine void filling in NLCIL's mines meeting the latest fly ash Utilization Notification of GOI. Draft report on Market survey of Ash utilization & marketing done by National Productivity council, Bhubaneswar is attached as annexure XIV
24	The water requirement shall be optimized (by adopting measures such as	The water requirement is optimized by adopting the concept of zero discharge as per latest MOEF

S. No.	Terms of reference (TOR)	Action Plan/responsibility
	dry fly ash and dry bottom ash disposal system, air cooled condenser, concept of zero discharge) and in any case not more than that stipulated by CEA from time to time, to be submitted along with details of source of water and water balance diagram. Details of water balance calculated shall take into account reuse and recirculation of effluents.	Norms. Details of source of water are given in section 2.8 of chapter 2 (pg.no:19) and water balance diagram As annexure IX in the EIA report.
25	Water body/Nallah (if any) passing across the site should not be disturbed as far as possible. In case any Nallah / drain is proposed to be diverted, it shall be ensured that the diversion does not disturb the natural drainage pattern of the area. Details of proposed diversion shall be furnished duly approved by the concerned Department of the State.	Existing nallah passing through Ash dyke area will be diverted as per recommendations of NIH, Roorkee in Area Drainage Study report.
26	It shall also be ensured that a minimum of 500 m distance of plant boundary is kept from the HFL of river system / streams etc. and the boundary of site should also be located 500 m away from railway track and National Highways.	The requirement has been complied in the layout.
27	Hydro-geological study of the area shall be carried out through an institute/ organization of repute to assess the impact on ground and surface water regimes. Specific mitigation measures shall be spelt out and time bound Action Plan for its implementation shall be submitted.	Hydro-geological study of the area carried out through National Institute of hydrogeology , Roorkee to assess the impact on ground and surface water regimes and mitigation measures and attached as annexure IV
28	Detailed Studies on the impacts of the ecology including fisheries of the River/Estuary/Sea due to the proposed withdrawal of water / discharge of treated wastewater into the River/Sea etc. shall be carried out and submitted along with the EIA Report. In case	No discharge of treated wastewater into River/Sea as the project will have a well- developed ETP to treat the effluent generated and it will be adopted in such a way to achieve Zero discharge of plants treated effluents and hence there will not be any impact on Bedhan river.

S. No.	Terms of reference (TOR)	Action Plan/responsibility
	Requirement of marine impact assessment study, the location of intake and outfall shall be clearly specified along with depth of water drawl and discharge into open sea.	
29	Source of water and its sustainability even in lean season shall be provided along with details of ecological impacts arising out of withdrawal of water and taking into account inter-state shares (if Any). Information on other competing sources downstream of the proposed project and commitment regarding availability of requisite quantity of water from the Competent Authority shall be provided along with letter / document stating firm allocation of water.	The consumptive water requirement of the project shall be met from Hirakud reservoir. Necessary water commitment from state government available. The Water source and requirement are given in section 2.8 of chapter 2 (pg.no: 19) in the EIA report. After taking into consideration the competitive users demand, the water resources Dept. Govt of Orissa has given allocation of 90 Cusecs from Hirakud Reservoir from the industrial quota without curtailing irrigation demand.
30	Detailed plan for rainwater harvesting and its proposed utilization in the plant shall be furnished.	Rainwater harvesting details are given in section 9.4.2.1 of chapter 9 in the EIA report.
31	Feasibility of near zero discharge concept shall be critically examined and its details submitted.	Water Balance diagram enclosed in the report covers Zero Liquid Discharge (ZLD) from the project.
32	Optimization of Cycles of Concentration (COC) along with other water conservation measures in the project shall be specified.	The consumptive water requirement meets the latest MoEF norms. The details are given in section 2.8.1 Of chapter 2 (pg.no:18) in the EIA report.
33	Plan for recirculation of ash pond water and its implementation shall be submitted.	Ash water recirculation system (AWRS) shall be implemented to recycle decanted ash water.
34	Detailed plan for conducting monitoring of water quality regularly with proper maintenance of records shall be formulated. Detail of methodology and identification of monitoring points (between the plant and drainage in the direction of flow of surface / ground water) shall be submitted. It shall be ensured that parameter to be monitored	Regular monitoring of water quality shall be carried out by EMG department of the project. Detailed plan for conducting monitoring of water quality is given in table 6.1 & 6.2 of chapter 6 in the EIA report.

S. No.	Terms of reference (TOR)	Action Plan/responsibility
	Also include heavy metals. A provision for long-term monitoring of ground water table using Piezometer shall be incorporated in EIA, particularly from the study area.	
35	Socio-economic study of the study area comprising of 10 km from the plant site shall be carried out through a reputed institute / agency which shall consist of detail assessment of the impact on livelihood of the local communities.	Socio-economic details of the study area comprising of 10 km from the plant site is given in section 3.16 of chapter 3 (pg.no: 105) in the EIA report. Social Impact Assessment Report by NCDS , Bhubaneswar has been attached as annexure XII.
36	Action Plan for identification of local employable youth for training in skills, relevant to the project, for eventual employment in the project itself shall be formulated and numbers specified during construction & operation phases of the Project.	The local youth shall be sponsored for skill development trainings. Various infrastructure development Contracts like fencing, boundary wall, vehicle contract, horticulture, cleaning, will be awarded to locals for their upliftment. There will be contract labours of about 250 – 500 persons will be engaged during plant construction stage. During operation phase the requirement would be about 400 persons.
37	If the area has tribal population it shall be ensured that the rights of tribal are well protected. The project proponent shall accordingly identify tribal issues under various provisions of the law of the land.	No tribal population is involved in project area.
38	A detailed CSR plan along with activities wise break up of financial commitment shall be prepared. CSR component shall be identified considering need based assessment study and Public Hearing issues. Sustainable income generating measures which can help in upliftment of affected section of society, which is consistent with the traditional skills of the people shall be identified. Separate budget for community development activities and income generating programmes shall be specified.	Details in respect of Corporate Environmental Responsibility (CER) & Corporate Social Responsibility (CSR) is given in section 9.7 & 9.10 of chapter 9 in the EIA report.
39	While formulating CSR schemes it shall	Yes, it will be provided

S. No.	Terms of reference (TOR)	Action Plan/responsibility
	be ensured that an in-built monitoring mechanism for the schemes identified are in place and mechanism for conducting annual social audit from the nearest government institute of repute in the region shall be prepared. The project proponent shall also provide Action Plan for the status of implementation of the scheme from time to time and dovetail the same with any Govt. scheme(s). CSR details done in the past should be clearly spelt out in case of expansion projects.	
40	R&R plan, as applicable, shall be formulated wherein mechanism for protecting the rights and livelihood of the people in the region who are likely to be impacted, is taken into consideration. R&R plan shall be formulated after a detailed census of population based on socio economic surveys who were dependent on land falling in the project, as well as, population who were dependent on land not owned by them.	R&R plan as formulated in RPDAC duly approved by Govt, of Odisha shall be implemented. Socio Economic survey with Cultural resources Mapping and Infrastructure survey is under process in line with Odisha R&R policy. That Industrial Development corporation of Odisha (IDCO) through Nabakrishna Choudhary, Verification of PAP is under progress. Considering the social Responsibility of the company and Development of the project Affected Measures, the project strict to follow R&R package to be approved by Honorable Collector and District Magistrate of Odisha R&R policy and subsequent amendment from time to time. R&R policy for Talabira Mines II &III OCP of NLCIL
41	Assessment of occupational health and endemic diseases of environmental origin in the study area shall be carried out and Action Plan to mitigate the same shall be prepared.	Details in respect of occupational health and endemic diseases in the study area is given chapter 7.4.5 (pg.no: 173) in the EIA report.
42	Occupational health and safety measures for the workers including identification of work related health hazards shall be formulated. The company shall engage full time qualified doctors who are trained in occupational health.	The designed equipment with noise levels not exceeding beyond the requirements of occupational Health and Safety Administration Standard will be employed. Health monitoring for workers will be done at regular basis.

S. No.	Terms of reference (TOR)	Action Plan/responsibility
	Monitoring of the workers shall be conducted at periodic intervals and health records maintained. Awareness programme for workers due to likely adverse impact on their health due to working in non-conducive environment shall be carried out and precautionary measures like use of personal equipments etc. shall be provided. Review of impact of various health measures undertaken at intervals of two to three years shall be conducted with an excellent follow up plan of action wherever required.	
43	One complete season site specific meteorological and AAQ data (except monsoon season) as per latest MoEF&CC Notification shall be collected and the dates of monitoring shall be recorded. The parameters to be covered for AAQ shall include PM10, PM2.5, SO2, NOx, CO and Hg. The location of the monitoring stations should be so decided so as to take into consideration the upwind direction, pre-dominant downwind direction, other dominant directions, habitation and sensitive receptors. There should be at least one monitoring station each in the upwind and in the pre – dominant downwind direction at a location where maximum ground level concentration is likely to occur.	Ambient Air Quality monitoring details are given in section 3.11 of chapter 3 (pg.no: 54) in the EIA report.
44	In case of expansion project, air quality monitoring data of 104 observations a year for relevant parameters at air quality monitoring stations as identified/stipulated shall be submitted to assess for compliance of AAQ Standards (annual average as well as 24	NA

S. No.	Terms of reference (TOR)	Action Plan/responsibility
	hrs).	
45	A list of industries existing and proposed in the study area shall be furnished.	Details of existing industries and infra structures are given in section 3.16.4 of chapter 3 (pg.no:111) in the EIA report.
46	Cumulative impacts of all sources of emissions including handling and transportation of existing and proposed projects on the environment of the area shall be assessed in detail. Details of the Model used and the input data used for modeling shall also be provided. The air quality contours should be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any. The wind rose and isopleths should also be shown on the location map. The cumulative study should also include impacts on water, soil and socio-economics.	Details of AERMOD are given in section 4.4.1.1 of chapter 4 (pg.no:132) in the EIA report.
47	Radio activity and heavy metal contents of coal to be sourced shall be examined and submitted along with laboratory reports.	Will be furnished during Environmental clearance stage.
48	Fuel analysis shall be provided. Details of auxiliary fuel, if any, including its quantity, quality, storage etc. should also be furnished.	Fuel analysis details are given in section 2.6 of chapter 2 (pg.no:18) in the EIA report.
49	Quantity of fuel required, its source and characteristics and documentary evidence to substantiate confirmed fuel linkage shall be furnished. The Ministry's Notification dated 02.01.2014 regarding ash content in coal shall be complied. For the expansion projects, the compliance of the existing units to the said Notification shall also be submitted	Fuel analysis details are given in section 2.6 of chapter 2 (pg.no:18) in the EIA report.
50	Details of transportation of fuel from the source (including port handling) to the proposed plant and its impact on ambient	The details are given in section 2.9 of chapter 2 (pg.no:19) in the EIA report.

S. No.	Terms of reference (TOR)	Action Plan/responsibility
	AAQ shall be suitably assessed and submitted. If transportation entails a long distance it shall be ensured that rail transportation to the site shall be first assessed. Wagon loading at source shall preferably be through silo/conveyor belt.	
51	For proposals based on imported coal, inland transportation and port handling and rail movement shall be examined and details furnished. The approval of the Port and Rail Authorities shall be Submitted.	NA
52	Details regarding infrastructure facilities such as sanitation, fuel, restrooms, medical facilities, safety during construction phase etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase should be adequately catered for and details furnished.	All necessary infrastructure facilities will be provided to the labour force during construction as well as operation phase of the project.
53	EMP to mitigate the adverse impacts due to the project along with item - wise cost of its implementation in a time bound manner shall be specified.	EMP Details are given in chapter 9 (pg.no:196) in the EIA report.
54	A Disaster Management Plan (DMP) along with risk assessment study including fire and explosion issues due to storage and use of fuel should be carried out. It should take into account the maximum inventory of storage at site at any point of time. The risk contours should be plotted on the plant Layout map clearly showing which of the proposed activities would be affected in case of an accident taking place. Based on the same, proposed safeguard measures should be provided. Measures to guard against fire hazards should also be	Disaster Management Plan (DMP) along with risk assessment study is covered in chapter 9.

S. No.	Terms of reference (TOR)	Action Plan/responsibility
	Invariably provided. Mock drills shall be suitably carried out from time to time to check the efficiency of the plans drawn.	
55	The DMP so formulated shall include measures against likely Fires/Tsunami/Cyclones/Storm Surges/ Earthquakes etc., as applicable. It shall be ensured that DMP consists of both On-site and Off-site plans, complete with details of containing likely disaster and shall specifically mention personnel Identified for the task. Smaller version of the plan for different possible disasters shall be prepared both in English and local languages and circulated	Will be compiled.
56	Detailed scheme for raising green belt of native species of appropriate width (50 to 100 m) and consisting of at least 3 tiers around plant boundary with tree density of 2000 to 2500 trees per ha With a good survival rate of around 80% shall be submitted. Photographic evidence must be created and submitted periodically including NRSA reports in case of expansion projects. A shrub layer beneath tree layer would serve as an effective sieve for dust and sink for CO_2 and other gaseous pollutants and hence a stratified green belt should be developed.	Greenbelt details are given in section 9.4.5 of chapter 9 (pg.no:192) in the EIA report.
57	Over and above the green belt, as carbon sink, plan for additional plantation shall be drawn by identifying blocks of degraded forests, in close consultation with the District Forests Department. In pursuance to this the project proponent shall formulate time bound Action Plans along with financial allocation and shall submit status of implementation to the Ministry every six	Additional plantation in vacant space in the project area will be done. In addition plantation in degraded forest area will be undertaken.

S. No.	Terms of reference (TOR)	Action Plan/responsibility
	Months.	
58	**Corporate Environment Policy**	
a	Does the company has a well laid down Environment Policy approved by its Board of Directors? If so, it may be detailed in the EIA report.	Details are given in section 9.7 of chapter 9 (pg.no:201) in the EIA report.
b	Does the Environment Policy prescribe for standard operating process / procedures to bring into focus any infringement / deviation / violation of the environmental or forest norms / Conditions? If so, it may be detailed in the EIA.	Yes
c	What is the hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance with the environmental clearance conditions? Details of this system may be given.	Organization structure of the EMG department is given in chapter 9 (pg.no:200) in the EIA report.
d	Does the company has compliance management system in place wherein compliance status along with compliances / violations of environmental norms are reported to the CMD and the Board of Directors of the company and / or shareholders or stakeholders at large? This reporting Mechanism should be detailed in the EIA report.	Yes
59	Details of litigation pending or otherwise with respect to project in any Court, Tribunal etc. shall invariably be furnished.	NIL
	ADDITIONAL TOR	
1	Is the project intended to have CDM-intent? (i) If not, then why?	NO. It is not feasible.
	(ii) IF yes, then a. has PIN (Project Idea Note) or PCN	NA

S. No.	Terms of reference (TOR)	Action Plan/responsibility
	(Project Concept Note) submitted to the NCA (National CDM authority) in the MoEF. b. IF not, then by when is that expected? c. Has PDD (Project Design Document) been prepared? d. What is the carbon intensity? From your electricity generation projected (i.e. CO_2 in tons/MWH or Kg/KWH) e. Amount of CO2 in Tons/year expected to be reduced from the baseline data available on the CEA's website (www.cea.nic.in)	
2.	Not with standing 1 (i) above, data on (d) & (e) above shall be worked out and reported.	NA

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ANNEXURES

X	Corporate Environment Policy & CSR Policy
XI	Water allocation letter
XII	Social Impact Assessment Report
XIII	Public Hearings Proceedings with time bound Action Plan
XIV	Fly ash utilization Market Survey Report
XV	R&R policy
XVI	Land Use Pattern

Executive Summary

I. Introduction

'NLC India Limited (NLCIL) formerly Neyveli Lignite Corporation is a 'Navratna' profit making, Government of India Enterprise engaged in mining of lignite and generation of power through lignite based thermal power plants. NLCIL was established by Government of India in 1956, following the discovery of lignite deposits in Neyveli, Tamil Nadu. The company has contributed to the social and economic development of the country for over 5 decades. NLCIL has the advantage of rich experience and expertise in both mining and power generation, giving it a unique position for setting up of cost effective power projects. The company has also diversified into generation of renewable energy through Solar Power Generation and Wind Power Generation.

NLCIL comes under administrative control of Ministry of Coal, Government of India and serves as an important source of power generation to the states of Tamil Nadu, Andhra Pradesh, Karnataka, Kerala, Telangana, Rajasthan and Union Territory of Puducherry.

NLCIL currently operates four open cast lignite mines in Neyveli (Tamil Nadu) and Barsingsar (Rajasthan) of total capacity of 30.6 Million Tonnes per Annum (MTPA). The company operates five pithead thermal power stations at the above locations with a total installed capacity of 3240 MW. NLCIL, through its subsidiary NTPL, also operating a 1000 MW Coal based power plant at Tuticorin (Tamil Nadu).In addition, NLCIL has recently commissioned 440 MW solar plant at Neyveli (Tamil Nadu)& other locations and 51 MW wind power plant at Kazhuneerkulam (Tamil Nadu), thus bringing the total installed capacity of the company to **4731 MW.**

II. Need for the Project

NLCIL Talabira TPP (3x800 MW) project is proposed to be implemented by NLCIL to supply power to Southern States of Tamil Nadu, Kerala and Pondicherry and the Home state of Odisha. Comfort letters are available from DISCOMs of Tamil Nadu (1500 MW), Kerala (400 MW) and Pondicherry (100 MW). Odisha has expressed interest in availing 400 MW power from this project and the comfort letter is expected shortly. The allocation of power as indicated above requires approval by Ministry of Power. 1st unit of 800 MW is envisaged to be commissioned during 2023-24 and subsequent units at an interval of 6 months thereafter.

Power Plant is included as Item 1(d) in the Schedule of the EIA Notification issued on September 14th 2006. Based on the capacity (3 x 800 MW), the power plant is classified as Category "A". Any project falling under Category "A" requires prior Environmental Clearance from Ministry of Environment, Forest & Climate Change, which is to be sanctioned by Thermal Power Projects Environmental Appraisal Committee (EAC).

Form-I and Pre-Feasibility Report (PFR) was submitted to MOEF&CC by NLCIL in October 2017. Terms of Reference (ToR) has been issued with vide letter dated 27.12.2017, File No. - J-13012/14/2017– IA, I (T).

III. Project Location

The project site is located near Kumbhari and Tareikela villages on south west of Brijraj Nagar town on Sambalpur Rourkela highway in Jharsuguda district. The ash disposal area is located near Thelkolai village in Sambalpur district. The nearest airport is at Jharsuguda at a distance of about 25 km on North Direction and International/ commercial Airports are at Bhubaneswar (Biju Patnaik International Airport at a distance of 250 km on South Eastern direction of the Project Site and Raipur (Swami Vivekananda International Airport) at a distance of 240 km on South Western Direction of the Project site. Nearest railway station at Jharsuguda Junction section is at a distance of about 12 kms on North Eastern side of the project site. The site coordinates are as follows

Description	Latitude	Longitude
North Extreme	21° 46' 56.11'' N	83° 59' 30.59'' E
East Extreme	21° 46' 52.95'' N	84° 00' 20.72'' E
South Extreme	21° 45' 16.80'' N	83° 59' 9.36'' E
West Extreme	21° 46' 34.18'' N	83° 58' 50.54'' E

The Ash Dyke area coordinates are as follows

Description	Latitude	Longitude
North Extreme	21°45'58.02"N	84° 0'15.30"E
East Extreme	21°45'23.03"N	84° 0'22.34"E
South Extreme	21°45'26.08"N	83°59'55.58"E
West Extreme	21°44'55.49"N	83°59'56.88"E

There are no forest land involved at the project site. There are three Reserved forest (Katikela RF – 6.5 km, Patrapali FR – 0.7 km, Malda RF – 3.18 km) within 10 km radius. There are no notified ecologically sensitive areas in the study area. Environmental Settings of the Study area is given in **Table-1** .Google map, Topomap and the site photographs of the project site is shown in Fig 1, Fig 2 and Fig 3 respectively.

Table-1Environmental Settings of the Project Site

S.No	Particulars	Details
1.	Location of the Project Site	Kumbhari & Tharaikela in Jharsuguda Tehsil and District & Ash dyke in Thelkoloi Villages Sambalpur District
2.	Latitude and longitude	North corner 21°46'56.11''N and 83°59'30.59''E South corner 21°45'16.80''N and 83°59'9.36''E East corner 21°46'52.95''N and 84°00'20.72''E West corner 21°46'34.18''N and 83°58'50.54''E
3.	Elevation above mean sea level (MSL)	197m to 211m
4.	Nearest highway	NH-10 (2.5Km E)
5.	Nearest railway station	Brundamal (3Km NNE)
6.	Nearest airport	Jharsuguda(16Km NNE) Bhubaneswar (290 kms SE)
7.	Nearest port	Paradeep port trust (325Km E)
8.	Nearest village /town	Sarbahal (6Km N)
9.	Hill/valleys	NIL within 10Km zone
10.	Topography	Plain surface with gentle slope towards Bedhan River
11.	Archeologically important places	NIL within 10Km zone
12.	National parks or wildlife sanctuaries	Ushakothi (80 Km)
13.	Reserved or protected forest	Katikela RF (6.5 Km ENE) Patrapali RF (0.7Km W) Malda RF (3.18 km W)
14.	Seismicity	The study area falls in Seismic Zone II (low risk zone)
15.	Defence installations	NIL within 10Km zone
16.	Nearest river	IB river (3.8Km W) Bhedan river (0.5 Km W)

17.	Reservoir	Hirakud (4.3Km S)
18.	Industries	SMC power generation Ltd (1.4 Km N) Bhusan power and steel Ltd (2.2Km E) Adithya aluminium (5.9Km SE) Vedanta aluminium capative power plant(5.4Km ENE)
19.	Hospital	Sripura govt hospital (3.8Km E) JDS MSS hospital (7.2Km NNE) District headquarters hospital (7.5Km NNE) BPSL hospital (1.5Km E)

Fig 1: Google Earth Image of the Project Site

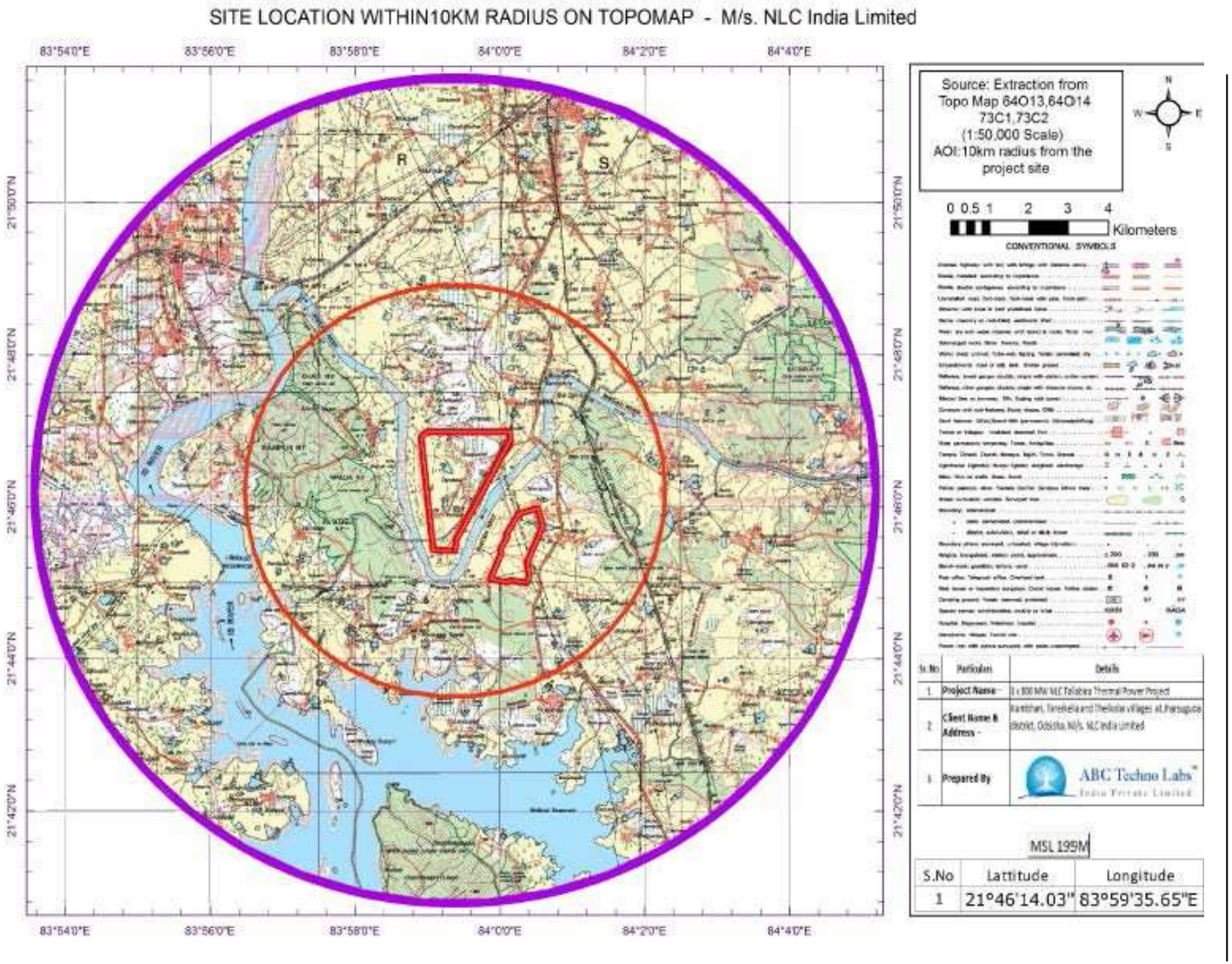


Fig 2: Topomap of the Project Site

Figure 3: Site Photographs

IV. Overview of the proposed project

Land Requirement

The project site was finalized after site visit of three alternative sites by a team of NLCIL comprising members from Power Station Engineering., Talabira project site at Sambalpur, Regional office,

Bhubaneswar and Advisor (Power) from New Delhi supported by local revenue officials in August, 2016 and Nov.2016

Site Selection – Alternative Sites

The salient details of alternative sites are briefly elaborated below:

Site-I near Babuchakli, Baunsen and Jharmunda villages in Rengali Tehsil

The site is located near Babuchakli, Baunsen and Jharmunda villages in Rengali Tehsil at a distance of about 6 km. South of Rengali town on Sambalpur – Jharsuguda State highway (now declared as NH). About 2500 acres of land comprising of about 800 acres barren/ single crop agriculture land, about 1200 acres Government barren land and about 500 acres forest land was earlier identified in 2004-06 by NLC for development of 2000 MW capacity power project linked to Talabira -II & III mine blocks. The site is located close to water spread of Hirakud reservoir. The likely water drawl point in Hirakud reservoir is at a distance of about 1.5 km. The Talabira – II & II mine blocks are at a distance of about 15 km. (a bridge is needed to cross the water spread of Hirakud reservoir). There is no land in possession of NLCIL.

Site-II near Hadumunda, Tolibahal and Bamloi villages in Rengali Tehsil

The site is located near Hadumunda, Tolibahal and Bamloi villages in Rengali Tehsil at a distance of about 4 km. North of Rengali town on the Sambalpur – Jharsuguda State highway (now declared as NH). The project site area of about 1500 acres was selected on the Survey of India Topo-sheet clearing the reserve forest area and habitation for further examination. The water source (Hirakud reservoir is at a distance of about 15 km from the identified site. Talabira – II & II Mine Blocks are at a distance of about 15 km. (a bridge is needed to cross the Bedhan river and ROB is needed for crossing the highway. There is no land in possession of NLCIL.

Site-III near village Kumbhari and Tareikela villages in Jharsuguda

About 1200 acres of land identified near Kumbhari & Tareikela villages for power plant, water reservoir & integrated township at a distance of approx. 12 km. South West of Brijraj Nagar in Jharsuguda District and about 500 acres of land near Thelkolai village has been identified for Ash Disposal area in Sambalpur. The plant area is located below the Southern boundary of SMC Power Plant and surrounded on three sides by Bedhan River. The entire land is barren/ single crop (rain fed) agricultural land and is not likely to pose problem in acquisition. The Talabira -II & III mine

Blocks are across the river Bedhan at a distance of about 2 km and hence the pipe conveyor could be provided for coal transportation to the power plant. Water reservoir could be developed in low lying area on the southern side (surrounded by river on three sides) in about 160 acres and ash could be transported to disposal area located across river (about 2 km.) through HCSD system.

There is no land in possession of NLCIL. Further, it will require 2 nos. bridges on Bedhan River for coal transportation from Talabira mines and ash disposal & make up water pipelines.

Analysis of Alternative Sites

Amongst the above cited alternatives, Site-III near Kumbhari and Tareikela villages has been considered as optimal project site.

Site-I near Babuchakli, Baunsen and Jharmunda villages in Rengali Tehsil is not considered suitable since sufficient land for development of large capacity project is not available and coal source is also at a longer distance.

Site-II near Hadumunda, Tolibahal and Bamloi villages in Rengali Tehsil is not considered suitable since sufficient land for development of large capacity project is not available and coal source is also at a longer distance.

Site-III near village Kumbhari and Tareikela villages in Jharsuguda & Sambalpur districts is considered suitable and selected for development of 3200 MW capacity coal based thermal power project.

This selected site is generally in conformity to the Siting Criteria of MOEF. No wildlifesanctuaries/national park or any ecological sensitive area of national importance exists within 10 km radius of proposed site. No archaeological monument and defence installations exist within 10 km of proposed site.

Water Requirement

Make up water requirement for this project would be about 7200 M^3/hr with ash water recirculation system and about 9150 M^3/hr with once through ash water system. This project is planned on zero discharge of water concept. The water is proposed to be drawn from Hirakud reservoir at a point near the intake location of M/s Bhushan Steel and Power Ltd, at a distance of about 20 Km. Makeup water from the source will be pumped to an in-plant raw water reservoir

having storage capacity of about 10 days to take care of emergencies. Presently, Induced Draft Cooling Towers (IDCT) has been proposed for the project.

Fuel requirement

Coal Quality

The GCV is assumed as 3400 kcal/kg (of G12 grade coal on total moisture basis). Central Institute of Mining & Fuel Research (CIMFR) is being approached to carry out a detailed analysis of the coal samples of Talabira II & III coal blocks. Based on the reports, coal specifications will be finalized.

Coal Availability & Transportation

Coal requirement of the project will be met from NLCIL's Talabira -II & III captive mines of 20 MTPA capacity located nearby. Coal requirement is estimated to be 11.37 MTPA considering a GCV of 3400 Kcal/kg, Station Heat Rate of 2163 kcal/kwh and PLF of 85%. The coal will be transported from the linked mines through Belt Conveyor system from coal stock at mine end up to transfer point and thereafter by Pipe conveyor for crossing Bedhan River up to crusher house in plant area.

Construction Power requirement

The construction power requirement would be met through a 33 kV D/C line drawn from nearby 220kV/33kV substation of OPTCL/ CESU. Necessary 11kV ring main/LT sub-station will be provided inside the plant.

Man power

Temporary employment of 1500 people and 250 people direct during construction phase. Long-term employment of up to 700 direct people and 400 contract people in the operation and maintenance of the power station.

Project cost

The estimated project cost for the proposed project is 16073.86 Crores. Commercial Operation Date (COD) of the first 800 MW units is envisaged in 52 months from the zero date and second and third units at an interval of 6 months each thereafter.

V. Process description

In thermal Power generation, chemical energy of fuel is first converted into thermal energy (during combustion), which is then converted into mechanical energy (through a turbine) and finally into electrical energy (through a generator).

NLCIL has planned to install Supercritical pulverized fuel combustion technology for this proposed 3x800 MW power plant, targeting higher efficiency (and hence minimum coal consumption) as well as conforming to best possible friendliness to environment at reduced emission.

Supercritical Technology is categorized with higher steam pressure (over and above critical pressure of 221 bar) exceeding 240 bar and steam temperatures (both super heat & Reheat) ≥ 595°C. Such technology is well-proven in Europe and Japan and many 800 MW supercritical units are under execution in India as well.

Additionally, following pollution control equipment are attached to the once-through steam generator, for compliance to latest MoEF&CC guidelines.

- Selective Catalytic Reactor (SCR)
- Flue Gas Desulphurization (FGD)
- Electrostatic Precipitator (ESP)

VI. Description of the environment

The identified plant area is surrounded by Bedhan River on three sides and the natural ground levels varying between 199.0 to 208 m above MSL. The main drainage of the area is controlled by Bedhan river flowing in the East – South – West direction of the identified plant and thereafter meeting with Ib river. The Ib River then meets the Mahanadi River near the upstream of Hirakud reservoir. High Flood Level (HFL) of the Bedhan River near the National Highway Bridge (collected from WRD, Hirakud Reservoir) is RL 200.9m. The HFL of Bedhan River joining at Ib River is 200.55 m and HFL of Hirakud reservoir is 199.90 m and Full Reservoir Level (FRL) of Hirakud reservoir is 192.02 m.

Meteorological Data

The district is characterized by extreme climate with very hot summer (41.8°C) and very cold winter (11.8°C). The relative humidity is recorded to be 91 % in August and 36 % in May. The average annual rainfall is 1232.1 mm.

Ambient Air Quality

The highest 98th percentile concentration of PM_{10} (79.73µg/m³) was recorded at Thelkoloi (AAQ2). At the other sampling locations, the PM_{10} concentrations were within the standard of 100 µg/m³ set by the CPCB, with the lowest (68.51µg/m³) being recorded at the Patrapali (AAQ5). The highest 98th percentile concentration of $PM_{2.5}$ (41.212µg/m³) was recorded at Project site (AAQ1). At the other sampling locations, the $PM_{2.5}$ concentrations were within the standard of 60 µg/m³ set by the CPCB, with the lowest (34.41 µg/m³) being recorded at Patrapali (AAQ5). The highest 98th percentile concentration of SO_2 (11.70 µg/m³) was recorded at the Project site- Tareikela (AAQ1). At all the sampling locations, the SO_2 concentrations were within the standard of 80 µg/m³ set by the CPCB, with the lowest (6.30 µg/m³) being recorded at Khinda, Brajrajnagar and Rampur (AAQ 3, 6, 8).

The highest 98th percentile concentration of NO_2 (24.90 µg/m³) was recorded at the project site-Tareikela (AAQ1). At all the sampling locations, the NO_2 concentrations were within the standard of 80 µg/m³ set by the CPCB, with the lowest (8.40 µg/m³) being recorded at the New Ash Pond (AAQ9). The highest 98th percentile concentration of CO (0.193mg/m³) was recorded at the project site-Tareikela (AAQ1). At all the sampling locations, the CO concentrations were within the standard of 2 mg/m³ set by the CPCB, with the lowest (0.170 mg/m³) being recorded at Khinda and Patrapali (AAQ3,5).At all sampling locations, the recorded concentrations of Ammonia were below 5 µg/m³, which is considered BDL (Below Detection Limit). The standard set by the CPCB is 400 µg/m³ of NH_3.

The highest 98th percentile concentration of Ozone (14.77µg/m³) was recorded at the Kantatikra (AAQ10). At all the sampling locations, the Ozone concentrations were within the standard of 100 µg/m³ set by the CPCB, with the lowest (0 µg/m³) being recorded at the New Ash Pond (AAQ9). At all sampling locations, the recorded concentrations of Mercury were below 1 ng/m3, which is considered BDL (Below Detection Limit).At all sampling locations Lead, Benzene, Benzo(a)pyrene, Arsenic and Nickel are found to be Below Detection Limit.

Noise Levels in the study area

The maximum Daytime Noise Level was recorded at Jharsuguda (57.3 dB (A)) while the minimum Daytime Noise Level was recorded at Khinda (46.9 dB (A)). The Daytime Noise Level at all locations was found to fall within the limit of 75 dB (A) for Industrial Area, within the limit of respected Category prescribed by the CPCB.

The maximum Nighttime Noise Level was recorded at Jharsuguda (44.3 dB (A)) while the minimum Nighttime Noise Level was recorded at Tareikela (38.1 dB (A)). The Nighttime Noise Level at all locations was found to fall within the limit of 70 dB (A) for Industrial Area, within the limit of respected category prescribed by the CPCB.

Water Environment

Ground Water

The analysis of groundwater results indicate that the average pH ranges in between 6.06–6.91, TDS ranges from 52 mg/l – 354 mg/l, Total Hardness ranges from 22 mg/l - 172 mg/l,

Surface Water

The analysis of Surface water results indicate that the average pH ranges in between 7.42 – 8.58, TDS ranges from 97 mg/l - 260 mg/l, Total Hardness ranges from 56 mg/l - 110mg/l, iron content ranges from 0.05 mg/l – 0.35 mg/l, nitrate content ranges from BDL (<1) – 4 mg/l was observed DO ranges from 6.3 mg/l – 7.8 mg/l was observed.

Soil Environment

The soil results were compared with soil standards. It has been observed that the pH of the soil was ranging from6.33 to 7.22 indicating the soils are Ideal for plant growth. The Electrical conductivity of the soil ranges from 0.047 to 0.118 mS/cm. Since the EC value is less than 2000 µS/cm, the soil is said to be Non-saline in nature. The texture of the soil sample is predominantly clayey. Soil organic content varied from 0.13 to 0.23 % which indicates the very low level of organic matter.

The available nitrogen content ranges between 302 to 620 mg/kg in the locality and the value of phosphorus content varies between 19.8 to 66.5 mg/kg. This indicates that the soil has high quantities of Nitrogen and Phosphorus. The potassium content varies from 173 to 307 mg/kg which indicates that the soils have moderate quantities of potassium.

Ecological Environment

An ecological survey of the study area was conducted, particularly with reference to listing of species and assessment of the existing baseline ecological conditions in the study area. The main objective of biological study is to collect the baseline data regarding flora and fauna in the study

area. There is no **National Parks, Wildlife Sanctuaries, Biosphere Reserves and Migratory Corridors of Wild Animals found in the study area.**

Socio-economic Condition

S.No	Demographic Parameters	Villages Details
1.	Name of States	Odisha
2.	Name of District	Jharsuguda, Sambhalpur
3.	No. of Tehsil	Ten
4.	No. of Total Villages	32
5.	Total No. of Households	50983
6.	Total Population	250953
7.	Sex ratio (N0. of female\ 1000 males)	927
8.	Scheduled castes	38938 (17.43%)
9.	Scheduled Tribe	41161(18.43%)
10.	Literate	162373(72.70%)
11.	Main Worker	67003 (22.27%)
12.	Marginal Worker	13457 (4.47%)
13.	Non Worker	143466 (47.68%)

VII. Anticipated Environmental Impacts

Air Environment

Construction Phase

The sources of air emission during construction phase will include site clearing, demolition activities, vehicle movement, material storages and handling and operation of construction equipment. Emissions from them are expected to result in temporary degradation of air quality, primarily in the working environment affecting construction employees.

Operation Phase

The ambient air quality in respect of air pollutants will change during the operation phase due to the operation of the proposed 3 x 800 MW project. Air borne pollution envisaged to be caused by wind and traffic movement from access roads. Also fugitive dust will be generated from handling and feeding of raw materials. There shall be fugitive dust during raw material handling, junction houses and transfer points.

Mitigation Measures

- Storage areas should be located downwind of the habitation area.
- Water shall be sprayed on earthworks periodically.
- Latest Pollution control equipment will be adapted to the once-through steam generator – Selective Catalytic Reactor (SCR), Flue Gas De sulphurisation (FGD), Electrostatic Precipitator (ESP).

Noise Environment

Construction Phase

The general noise levels during construction phase such as due to working of heavy earth moving equipment and machinery installation may sometimes go up to 90 dB(A) at the work sites in day time.

Operation Phase

During normal operation phase, Stationary sources due to operation of heavy duty machinery at the project site like Compressors, Pumps, Turbines, Boilers, etc. Mobile sources corresponding to mainly vehicular traffic for staff mobilization, material transport, and fuel transport to project site etc.

Mitigation Measures

- All equipment shall be fitted with silencers and will be properly maintained to minimize its operational noise.
- Stationary noise making equipment shall be placed along uninhabited stretches.
- The project does not envisage any continuous stationary source of noise. The proposed green belt development will further attenuate the noise emanating from the individual industries.

Water Environment

During the construction phase of proposed project, Water will be used for construction of civil structures, dust suppression and drinking purpose. The construction water requirement of the project would be met from Bedhan River through Barge mounted temporary pumping system. This may induce impact on local hydrology in specific cases if not taken care of specifically debris, mud etc. will be generated during construction.

Mitigation Measures

- The drainage system of construction site will be connected to the existing drainage system at an early stage.
- Settling tanks shall be provided to prevent to discharge of excessive suspended solids.
- The Pre Treatment plant would be designed to remove suspended/colloidal matter in the raw water. Separate pre-treatment plant will be provided for meeting the CW system and Demineralization (DM) plant.
- There will be one standby gravity/pressure sand filter each for water PT- Potable water plant & PT-DM plant system.

Land Use

Construction Phase

The land environment would be impacted due to the demolition, construction related activities such as excavation of earth and earthwork, civil construction work etc. Land may also get contaminated around construction site, machine maintenance area, construction material storage and preparation site, and haulage road. However, all these impacts will be of temporary in nature.

Mitigation Measures

- Excavated soil from foundation work will be back filled.
- Surplus quantity of rubbish will be cleared and utilized to fill up low laying areas immediately after completion of construction activities.

VIII. Environmental Management Plan

Air pollution Control Measures

- High efficiency electrostatic precipitators (ESPs) of 99.9% will be installed to control the emission of fly ash particles. The precipitators will be designed to limit the particulate emission to 30 mg/Nm^3 under all design conditions.
- To facilitate wider dispersion of particulate and gaseous pollutants, three numbers single flue concrete chimney of appropriate height per unit above plant grade level will be envisaged for this project.

- Flue Gas Desulphurization (FGD) system will be installed for controlling and limiting SO_2 emission to 100 mg/Nm^3 under all operating conditions.
- The appropriate low NOx burners will be installed for controlled NOx emission. In addition, De-NOx system such as Selective Catalytic Reduction (SCR) system will be installed in boiler for controlling and limiting NOx emission within 100 mg/Nm^3 under all operating conditions.
- For control of fugitive dust emissions within the coal handling plant and coal / stockyard and around all other dust vulnerable area, adequate no. of dust extraction / suppression systems will be provided. Necessary Greenbelt development will be done in and around all the available spaces of the plant to arrest the fugitive emissions.

Water and Waste water Management

The water treatment system of the project comprises of Water Pre-treatment Plant, Water Demineralizing Plant, Chlorination Plant, Condensate Polishing Plant, and CW Treatment Plant. An effluent management scheme consisting of collection, treatment, recirculation and disposal of effluents will be implemented in order to optimize the make-up water requirement as well as liquid effluent generation.

- The waste effluents from neutralization pits of DM Plant and Condensate Polishing Plant will be collected in the respective neutralization pits and neutralized before pumping to the Ash slurry sump.
- Re-Circulating type Cooling Water (C.W) system with Induced Draft Cooling Towers (IDCT) will be provided with C.W blow down from cold water side to ensure no thermal pollution. Major Part of CW system blow down would be used for fly ash handling, bottom ash handling and coal dust suppression and FGD system. The unused blow down if available will be led to RO system. The permeate of RO system is used as a CW make up. The reject of RO system will be used for CHP Dust suppression.

Solid Waste Management

Ash will be the major solid waste generated from the power project. An ash management scheme will be implemented consisting of dry collection of fly ash. The plant will have two different systems for ash disposal – conventional wet slurry disposal with ash water re-circulation for bottom ash and

High Concentration Slurry Disposal (HCSD) for fly ash. HCSD system will require less quantity of water.

Noise Environment

The major noise generating sources are the turbines, turbo-generators, compressors, pumps, fans, coal handling plant etc. from where noise is continuously generated. Acoustic Treatment/equipment design will be done to control the noise level below 90dB (A). Wherever required, the workers will be provided with protective equipment such as ear plugs/ ear muffs.

Environment Management System

The major environmental considerations involved in the construction and operation of the thermal power station, will be taken up by a full-fledged multi-disciplinary Environmental Management Division (EMD) with key functions of environmental, safety and occupational health for management of the entire plant and surrounding environment. The EMD will comprise a team of environmental engineers, chemists, horticulturists, safety specialists and well-trained staff for operation and maintenance of pollution control equipment.

IX. Benefits of the Proposed Project

The following direct /indirect benefits will be available to the locality as well as the region due to the project.

- People will get employment and business opportunity in the project and project activities.
- Small to big business opportunity will emerge in the areas which will provide further employment and revenue to the local people.
- With good infrastructure in the area, small to medium projects will be set uplinked with proposed project to provide raw materials and use of waste. Area will be converted into industrial hub with small to medium industries.
- In view of the paucity of skilled labourers, company will train local people though vocational training programs based on their educational qualification and adaptability.
- Company will provide Health care, vocational education and clean drinking water and other infrastructures facilities with the advice of local Panchayats and district administration. Company though various programs will work closely with local administration of the state Govt. run various programs to monitor health of women and young children.

X. Conclusion

The proposed power plant will be adopting the new power plant regulations by installing efficient pollution control systems and FGD and hence the emissions of SO2 from the power plant will be several folds lower than that of the current power plant emission scenario in India. This will further help to achieve very low ground level concentration of SO2, NOx and PM during the operational phase without any appreciable change from the background levels.

The proposed facility will utilize the lowest possible water consumption of 3.0 m3/MWHR as per the new power plant regulations and also it has been proposed to completely recycle and reuse the waste water generated from the plant to achieve zero discharge. Hence the possible impacts on the ecological and biological environment in the surface water bodies in the region will be insignificant.

NLCIL intends to spend 2% of net profit towards various CSR programs in coming years, which will benefit the local people in several folds and the social and cultural environmental will be enhanced. The project will give an impetus to induced industrial growth in region.

The project positively leads to commercial business opportunities, Employment opportunities, increased revenue and infrastructural development. Thus, it can be concluded that with the judicious and proper implementation of the pollution control and mitigation measures, the proposed project can proceed without any significant negative impact on the environment.

Chapter 1. INTRODUCTION

1.1 Prelude:

'NLC India Limited (NLCIL) formerly Neyveli Lignite Corporation is a 'Navratna' profit making, Government of India Enterprise engaged in mining of lignite and generation of power through lignite based thermal power plants. NLCIL was established by Government of India in 1956, following the discovery of lignite deposits in Neyveli, Tamil Nadu. The company has contributed to the social and economic development of the country for over 5 decades. NLCIL has the advantage of rich experience and expertise in both mining and power generation, giving it a unique position for setting up of cost effective power projects. The company has also diversified into generation of renewable energy through Solar Power Generation and Wind Power Generation.

NLCIL comes under administrative control of Ministry of Coal, Government of India and serves as an important source of power generation to the states of Tamil Nadu, Andhra Pradesh, Karnataka, Kerala, Telangana, Rajasthan and Union Territory of Puducherry.

NLCIL currently operates four open cast lignite mines in Neyveli (Tamil Nadu) and Barsingsar (Rajasthan) of total capacity of 30.6 Million Tonnes per Annum (MTPA). The company operates five pithead thermal power stations at the above locations with a total installed capacity of 3240 MW. NLCIL, through its subsidiary NTPL, also operating a 1000 MW Coal based power plant at Tuticorin (Tamil Nadu).In addition, NLCIL has recently commissioned 140 MW solar plant at Neyveli (Tamil Nadu)& other locations and 51 MW wind power plant at Kazhuneerkulam (Tamil Nadu), thus bringing the total installed capacity of the company to **4731 MW.**

Company has donned many feathers due to excellence in the operations as well as environment friendly practices and social activities. Latest of few are listed below:

Date	Recent Awards Bagged by Neyveli Lignite Corporation
15.12.2017	• **National Awards** - Best Corporate Film (First place), Best PSU Implementing RTI (First Place) and Best CSR Project for Women's Development (Third Place) by Public Relations Society of India (PRSI)
14.11.2015	• "VishwamuktiRashtriyaRajbhashaSamman Award – 2015"

29.12.2015	• Central Board of Irrigation & Power (CBIP) Award for Excellence' in recognition of its Integrated water Resources Management for Sustainable management of the ground water resources available in the Neyveli hydro- geological basin.
27.11.2015	• Greentech CSR Award (Platinum category for the Metals and Mines Sector) by Greentech Foundation.
15.02.2016	• 'Golden Peacock Award for CSR - 2015', instituted by the Institute of Directors
18.02.2016	• Corporate Vigilance Excellence Award 2015-16 instituted by Institute of Public Enterprise (IPE)
11.04.2016	• SCOPE Excellence Award - Gold Trophy presented to NLC by Shri Pranab Mukherjee, Hon'ble President of India
09.05.2016	• 'National Award for Outstanding Industrial Relations' (First Runner up) for the year 2014-15 ,Instituted by the All India Organization of Employers (AIOE)
08.07.2016	• 'Golden Peacock Environment Award 2016' instituted by the Institute of Directors
16.12.2016	• "Best PSU Implementing CSR Award (2nd Place)", Best Corporate Film in Hindi (2nd Place) and Best PSU Implementing RTI (Special Award)
11.02.2017	• Best Enterprise Award -2016 presented by Central Apex Forum
28.02.2017	• Fly Ash Utilization Award -2017 from Mission Energy Foundation
18.07.2017	• 'National Award for Excellence in Cost Management - 2016' by the Institute of Cost Accountants of India
15.09.2017	• "National Award for Best HR Practices -2017" by National Institute of Personnel Management (NIPM)
07.12.2017	• Bagged "Brand building through Inclusive Growth Initiatives -2017 Award instituted by Standing Conference of Public Enterprises (SCOPE), New Delhi.

1.2 Project Background:

Ministry of Coal, Government of India vide Order No. 103/I/2016-NA dated 02.05.2016 have allocated Talabira-II & III captive coal mining blocks in Sambalpur District of Odisha to NLCIL. The rated capacity of Talabira-II & III mines is20 MTPA.

Talabira mines were initially envisaged to supply coal to proposed 4000 MW Sirkali project in Tamil Nadu. Now, this involves a long distance rail/road and sea transportation of coal, requires the construction of coal jetty and shore un-loaders, and also will burden the railway infrastructure. This will lead to increase in the cost of generation.

Hence it was proposed to shift the Sirkali thermal power project closer to the mine blocks allocated to NLCIL, to make the project cost competitive in the long run, in the scenario of decreasing costs of solar power generation.

NLCIL Board on 12.09.16 accorded in-principle approval for setting up a 2000 MW Thermal Power Project in close proximity to Talabira-II & III coal blocks.

A project site near Kumbhari &Tareikela villages in Jharsuguda District adjacent to captive Talabira-II&III coal mining blocks was identified. Subsequently two sets of online applications were submitted to Investment Promotion and Infrastructure Corporation of Odisha Limited (IPICOL) on 18.11.16 & 30.01.17, each for 2x800 MW Thermal Power Projects, for approval of Government of Odisha (GOO), towards availability of land and water.

IPICOL vide letter dated 10.07.2017 forwarded the approval of High Level Clearing Authority (HLCA), communicating GOO's in-principle approval for availability of land and water for the 3200 MW capacity project.

NLCIL is now planning to implement a pithead 'NLC Talabira Thermal Power Project' (NTTPP-3X800 MW) whose coal requirement will be met from the adjacent Talabira-II & III captive coal blocks.

Form-I and Pre-Feasibility Report (PFR) was submitted to MOEF&CC by NLCIL in October 2017. Terms of Reference (ToR) has been issued with vide letter dated Jan 02nd, 2018, File No. - J-13012/14/2017– IA, I (T). Therefore, Environmental Impact Assessment (EIA) study is being

Carried out by **ABC Techno Labs India Private limited, Chennai**. Now, on completion of EIA report based on one season (non-monsoon) ambient data monitoring, the Odisha State Pollution Control Board shall be approached for conducting Public Hearing for the proposed project.

1.3 Need for the Proposed Project:

NLC Talabira TPP (3x800 MW) project is proposed to be implemented by NLCIL to supply power to Southern States of Tamil Nadu, Kerala and Pondicherry and the Home state of Odisha. Comfort letters are available from DISCOMs of Tamil Nadu (1500 MW), Kerala (400 MW) and Pondicherry (100 MW). Odisha has expressed interest in availing 400 MW power from this project and the comfort letter is expected shortly. The allocation of power as indicated above requires approval by Ministry of Power. 1st unit of 800 MW is envisaged to be commissioned during 2023-24and subsequent units at an interval of 6 months thereafter.

1.4 Need of Study:

Power Plant is included as Item 1(d) in the Schedule of the EIA Notification issued on September 14th2006. Based on the capacity (3 x 800 MW), the power plant is classified as Category "A". Any project falling under Category "A" requires prior Environmental Clearance from Ministry of Environment, Forest & Climate Change, which is to be sanctioned by Thermal Power Projects Environmental Appraisal Committee (EAC).

In order to obtain prior environmental clearance from statutory authorities, EIA study has tube carried out as per approved Terms of Reference (ToR) by Ministry of Environment, Forests & Climate Change (MoEF&CC), New Delhi. In order to assess the likely impacts arising out of the proposed3 x 800 MW Supercritical (PF Fired) Thermal Power Project on the surrounding environment M/s. ABC Techno Labs India Private limited, Chennai. Has entrusted to carry out an Environmental Impact Assessment (EIA) study for the proposed power project.

1.5 Project Location:

The project site is located near Kumbhari and Tareikela villages on south west of Brijraj Nagar town on Sambalpur Rourkela highway in Jharsuguda district. The ash disposal area is located near Thelkolai village in Sambalpur district. The nearest airport is at Jharsuguda at a distance of about 16 km on North Direction and International/ commercial Airports are at Bhubaneswar (Biju

Patnaik International Airport at a distance of 250 km on South Eastern direction of the Project Site and Raipur (Swami Vivekananda International Airport) at a distance of 240 km on South Western Direction of the Project site. Nearest railway station at Jharsuguda Junction section is at a distance of about 12 kms on North Eastern side of the project site. The site coordinates are as follows

Description	Latitude	Longitude
North Extreme	21° 46’ 56.11’’ N	83° 59’ 30.59’’ E
East Extreme	21° 46’ 52.95’’ N	84° 00’ 20.72’’ E
South Extreme	21° 45’ 16.80’’ N	83° 59’ 9.36’’ E
West Extreme	21° 46’ 34.18’’ N	83° 58’ 50.54’’ E

The Ash Dyke area coordinates are as follows

Description	Latitude	Longitude
North Extreme	21°45'58.02"N	84° 0'15.30"E
East Extreme	21°45'23.03"N	84° 0'22.34"E
South Extreme	21°45'26.08"N	83°59'55.58"E
West Extreme	21°44'55.49"N	83°59'56.88"E

Figure 1.1: Google Earth Image of the Project Site

Figure 1.2: Topomap of the Project Site

1.6 Site Selection Criteria:

The project site was finalised after site visit of three alternative sites by a team of NLCIL comprising members from Power Station Engineering., Talabira project site at Sambalpur, Regional office, Bhubaneswar and Advisor (Power) from New Delhi supported by local revenue officials in August, 2016 and Nov.2016

The location of alternative sites on a map is placed at Annexure-III. The sites were examined based on the following considerations:

- Availability of suitable & adequate land
- Availability of reliable source of water
- Availability of road and railway access
- Environmental aspects
- Availability of infrastructural facilities
- Conformity to Siting Criteria of MOEF

This selected site is generally in conformity to the Siting Criteria of MOEF. No wildlife sanctuaries/national park or any ecological sensitive area of national importance exists within 10 km radius of proposed site. No archaeological monument and defense installations exist within 10 km of proposed site.

1.7 Scope and Methodology of the Study:

For the purpose of environmental assessment study, area within 10 km radial zone of the project have been studied and classified as Study Area. Following methodology has been adopted for the EIA study:

- ♣ Identification of sources of pollution during construction and operation phases of the project at the proposed site
- ♣ Identification of utilization of resources obtained during construction and operation phases of the project
- ♣ Assessment of extent of pollution and resource utilization in the proposed area
- ♣ Recommend measures to optimize resource utilization
- ♣ Develop an environmental monitoring plan to ensure effective implementation of the environmental management plan.

The schematic diagram for approach and methodology adopted for the EIA Study is shown in **Figure 1.3.**

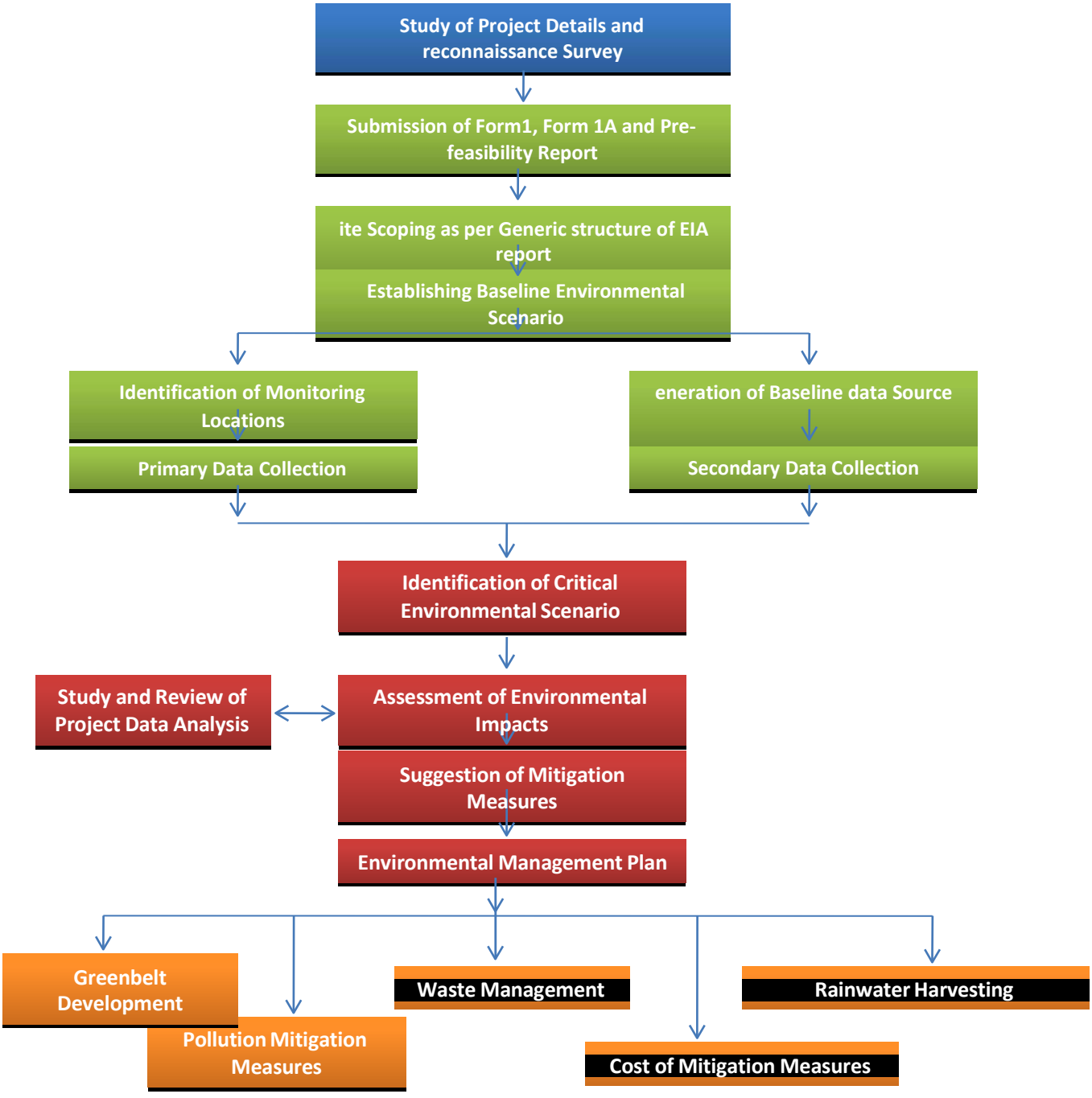


Figure1.3: Methodology Adopted for EIA study

1.8 Structure of the Report

This EIA report has been prepared on the basis of available on-site primary data (survey/monitoring) and secondary data/literature data. The EIA report contains project features, baseline environmental conditions, assessment of environmental impacts, and formulation of mitigation measures along with environmental management and monitoring plan.

The report includes the following chapters:

- **Chapter 1: Introduction**

This chapter provides background information of the project proponent, need for the EIA study as per prevailing legislation, location and brief description of the project, methodology adopted for EIA study and structure of the report.

- **Chapter 2: Project Description**

This chapter deals with the details of the proposed project such as location, connectivity, size and magnitude of the operation, project requirements, Infrastructure development, environmental consideration, project cost, implementation schedule, etc.

- **Chapter 3: Description of the Environment**

This Chapter describes the baseline environmental conditions around the project site for various environmental attributes, viz., and physical, biological and socio-economic, within the meteorology, air, noise, and land constitute the physical environment, whereas flora and fauna constitute the biological environment. Demographic details and occupational pattern in the study area constitute socio-economic environment. Baseline environmental conditions are based on the field studies carried out during January, February and March 2018 at and around the proposed site and through secondary data collected from published sources.

- **Chapter 4: Anticipated Environmental Impacts and Mitigation Measures**

This chapter details the inferences drawn from the environmental impact assessment of the proposed project. It describes the overall impacts of the project activities and underscores the areas of concern, which need mitigation measures.

- **Chapter 5: Alternative Analysis (Site and Technology)**

This Chapter provides an alternative analysis considered for the site and technology for the proposed project.

- **Chapter 6: Additional Studies**

This Chapter provides details about the Disaster Management Plan (DMP) and on-site emergency plan proposed for the proposed project.

- **Chapter 7: Project Benefits**

This chapter lists the brief details of the benefits associated with the project.

- **Chapter 8: Environmental Management Plan**

This Chapter provides mitigation and control measures to attenuate and/or eliminate environmental impacts, which are likely to be caused by the proposed project. An Environmental Management Plan (EMP) has been developed to mitigate the potential adverse impacts and to strengthen the beneficial impacts during the construction and operation phase.

- **Chapter 9: Environmental Monitoring program**

This chapter provides the environmental monitoring plan proposed for the proposed project for both the construction and operation stage.

- **Chapter 10: Summary and Conclusions**

This chapter concludes on the findings that emerged from the environmental assessment study and summarizes the key points to be addressed to ensure the environmental sustainability of the project during the construction and operation phases.

- **Chapter 11: Disclosure of Consultants Engaged**

This chapter lists the Functional Area Experts (FAEs) who have worked on the EIA report along with their signatures.

Chapter 2 PROJECT DESCRIPTION

2.1 Project Introduction:

NLCL is proposing to setup 2400 MW of coal based project with super critical units. This project is linked to Talabira – II & III captive coal blocks allocated to NLCIL, which are situated in very close proximity to the project site at Kumbhari and Taraikela Villages, Jharsuguda District, Odisha state.

2.2 Project Location:

The project site located near Kumbhari and Taraikela villages on south west of Brijraj Nagar town on Sambalpur Rourkela highway in Jharsuguda district. The ash disposal area is located near Thelkoloi village in Sambalpur district.

The latitude and longitude of the proposed project are 21°46'14.03"N and 83°59'35.65"E. The site is at an elevation of 208 m and Ash pond is 203 m above mean sea level (MSL). The nearest airport is at Jharsuguda at a distance of about 16 km on North Direction and International/ commercial Airports are at Bhubaneswar (Biju Patnaik International Airport at a distance of 250 km on South Eastern direction of the Project Site and Raipur (Swami Vivekananda International Airport) at a distance of 240 km on South Western Direction of the Project site. Nearest railway station at Jharsuguda Junction section is at a distance of about 12 kms on North Eastern side of the project site.

Co-ordinates of Plant Boundary

Description	Latitude	Longitude
North Extreme	21° 46’ 56.11’’ N	83° 59’ 30.59’’ E
East Extreme	21° 46’ 52.95’’ N	84° 00’ 20.72’’ E
South Extreme	21° 45’ 16.80’’ N	83° 59’ 9.36’’ E
West Extreme	21° 46’ 34.18’’ N	83° 58’ 50.54’’ E

The project site photographs are shown in Figure 2.1. The road connectivity map of the proposed project is shown in Figure 2.2. The master plan Layout of the proposed project is attached as Annexure II.

2.3 Land Requirement

The project will be accommodated in the identified land of 1447 acres, as shown below

S.No	Description	Area
1	Plant Area	602 Acres
2	Reservoir	88 Acres
3	Green Belt	252 Acres
4	Ash disposal area	340 Acres
5	Township	50 Acres
Sub Total		**1332 Acres**
6	Corridors	100 Acres
7	Peripheral road for local commuting	15 Acres
Total Area		**1447 Acres**

Additional land (approximately 220 acres) for makeup water pipelines from Intake Pump House at Hirakud Reservoir up to plant and for transmission line corridors up to Jharsuguda Pooling Station of PGCIL etc. will be taken on Right of Way basis after finalization of its alignments. IDCO vide letter dated 30.12.2017 confirmed alienation of 1447.14 acres of land in favor of NLCIL.

The Central Electricity Authority (CEA) has prescribed the land requirement for different configurations of 660 MW/ 800 MW Supercritical Units. As per CEA guidelines, the land requirement for 3x 800 MW Supercritical coal based power project is 1605 acres and NLCIL has optimized the land requirement to 1447 Acres which is less than the stipulated land.

The entire land of 1447 acres required for the project has been identified and presently under acquisition process through IPICOL (a single window agency of Govt. of Odisha for development of large industries) and IDCO.

Village wise Land Use Details

S.no	Name of Village	Ownership			Total (In Acre.)
		Government (In Acre.)	Private (In Acre.)	Forest Land (In Acre.)	
1.	Thelkuli	62.890	307.59	nil	370.48
2.	Tereikela	26.11	296.24	nil	322.35
3.	Khumbari	87.36	348.06	nil	435.42

4.	Tumbekela	5.26	56.29	nil	61.55
5.	Hirima	51.19	115.74	nil	166.93
6.	Luherankachar	5.02	21.39	nil	26.41
Total		237.83	1145.31	nil	1383.14

Current Site Photographs

Figure 2.1: Site Photographs

2.4 CONNECTIVITY OF THE PROJECT SITE:

The proposed site is well connected through road network. The plant and Township of the project are located near Kumbhari and Tareikelavillages on south west of Brijraj Nagar town on Sambalpur Rourkela highway inJharsuguda district and ash disposal area is located near Thelkolai village in Sambalpur district. The total land identified for the project is 1447acres. Theproject site is approachable from Jharsuguda Sambalpur State highway (SH10). Two separate 4 lane roads from Sambalpur - Jharsuguda highway has been envisaged for main approach to the project site.

The nearest airportis at Jharsuguda is on North Direction and International/ commercial Airports are at Bhubaneswar (Biju Patnaik International Airport at a distance of 250 km on South Eastern direction of the Project Site and Raipur (Swami Vivekananda International Airport) at a distance of 240 km on South Western Direction of the Project site. Nearest railway station at Jharsuguda Junction section is at a distance of about 12 kms on North Eastern side of the project site.

There are no monuments of archaeological importance, Defense Installation, National Park, Wild Life Sanctuaries, Elephant/Tiger Reserve, elephant corridor, etc. within 10 km radius.

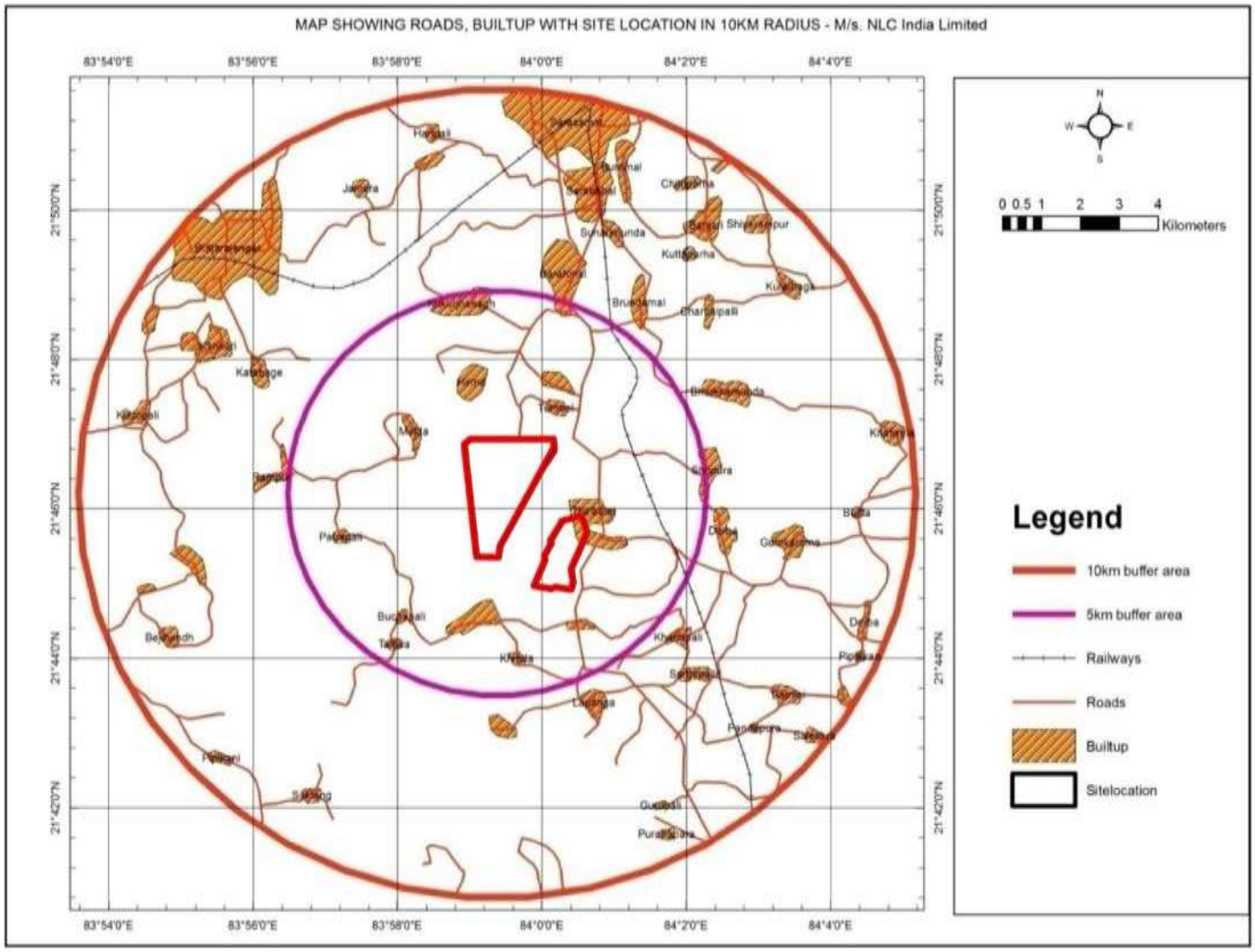


Figure 2.2: Major Roads in and Around the Project Site

2.5 TOPOGRAPHY OF THE PROJECT SITE:

As per the Topographical Survey carried out by M/s Nirman, Kolkata for the proposed project, the topography of the identified project area is undulating. The identified plant area is surrounded by Bedhan River on three sides and the natural ground levels varying between 197m to 211 ma bove MSL. The main drainage of the are a is controlled by Bedhan river flowing in the East – South – West direction of the identified plant and thereafter meeting with Ib river. The Ib River then meets the Mahanadi River near the upstream of Hirakud reservoir. High Flood Level (HFL) of the Bedhan River near the National Highway Bridge (collected from WRD, Hirakud Reservoir) is RL 200.9m. The HFL of Bedhan River joining at Ib River is 200.55 m and HFL of Hirakud reservoir is 199.90 m and Full Reservoir Level (FRL) of Hirakud reservoir is 192.02 m.

The Area Drainage Study for the plant site has been conducted by National Institute of Hydrology (NIH), Roorkee for establishing the natural drainage pattern and HFL of the area. The NIH study report includes the MOEF's suggestion in respect of repair/ remodeling of river bank, which has been broken at certain locations due to local excavation. The 197 m level generally exist at the areas where locals have removed the earth Considering sufficient free board over the HFL and to optimize cutting and filling quantities, the finished formation level of Plant area has been kept at RL (+) 203m. The formation level of western side green belt area is kept at 202.5 m and eastern side green belt area at 202.0 m.

The discharge of plant drainage will be in to the Bedhan River by gravity.

2.6 Vision of the Project

NLC India Limited, a Navratna CPSU under Ministry of Coal, GOI, is engaged in mining cum power generation since its inception in the year 1956 and has contributed to the social and economic development of the country for over 5 decades. NLCIL has the advantage of rich experience and expertise in both mining and power generation, giving it a unique position for setting up of cost effective power projects.

NLC Talabira TPP (3x800 MW) project is proposed to be implemented by NLCIL to supply power to Southern States of Tamil Nadu, Kerala and Puducherry and the Home state of Odisha. Comfort letters are available from DISCOMs of Tamil Nadu (1500 MW), Kerala (400 MW) and Puducherry (100 MW). Odisha has expressed interest in availing 400 MW power from this project and the comfort letter is expected shortly. The allocation of power as indicated above and exemption for

Signing the PPA without competitive bidding as a special case requires approval by Ministry of Power. 1st unit of 800 MW is envisaged to be commissioned during 2022-23 and subsequent units at an interval of 6 months thereafter.

NLCIL is in the process of further expansion in Neyveli, to set up a pithead '2X660 MW lignite based supercritical thermal power project', with a linked third lignite mine cut of capacity 11.5 MTPA.

A 3X660 MW coal based thermal power project (Neyveli Uttar Pradesh Power Limited Ghatampur, UP), as a joint venture with Government of U.P. is under execution. MOC, GOI has allocated South Pachwara Coal block, to meet coal requirements for this project.

2.7 Fuel requirement and availability

Coal Quality

The GCV is assumed as 3400 kcal/kg (of G12 grade coal on total moisture basis). Central Institute of Mining & Fuel Research (CIMFR) is being approached to carry out a detailed analysis of the coal samples of Talabira II & III coal blocks. Based on the reports, coal specifications will be finalized.

Coal Availability &Transportation

Coal requirement of the project will be met from NLCIL's Talabira -II & III captive mines of20 MTPA capacity located nearby. Coal requirement is estimated to be 11.37 MTPA considering a GCV of 3400 Kcal/kg, Station Heat Rate of 2163 kcal/kwh and PLF of 85%.The coal will be transported from the linked mines through Belt Conveyor system from coal stock at mine end up to transfer point and thereafter by Pipe conveyor for crossing Bedhan River up to crusher house in plant area.

Railway Siding

No separate railway siding is envisaged for the project. It is proposed to take a spur lineup to the power plant from the railway siding being constructed for the evacuation of surplus coal from Mines. M/s RITES have already been requested to include this siding as an additional scope. This railway siding will be used for receipt of oil rakes, as well as for disposal of ash from the silos.

2.8 Water Consumption

Make up water requirement for this project would be about 7200 M^3/hr with Ash water recirculation system(AWRS) about 9150 M^3/hr with once through ash water system. This project is planned on zero discharge of water concept. Water balance diagram is enclosed as Annexure VIII

2.8.1 Cooling water source, requirement and commitment

Consumptive water requirement for 2400 MW capacity project is estimated as 72 Cusecs. The water is proposed to be drawn from Hirakud reservoir at a point near the intake location of M/s Bhushan Steel and Power Ltd, at a distance of about 20 Km. In-principle Water approval commitment letter has been obtained from State Government is available and is attached as annexure XI. However, water drawl point location, pipe routing and other details need to be finalized in consultation with WRD, GOO.

Makeup water from the source will be pumped to an in-plant raw water reservoir having storage capacity of about 10 days to take care of emergencies. Presently, Induced Draft Cooling Towers (IDCT) has been proposed for the project. Cycle of Concentration will be adopted in such a way to achieve zero discharge of plant's treated effluents to any water body outside the project area so as to avoid the damage to life of fishes and other aquatic plants.

2.9 Coal handling system

It is proposed to have one coal handling plant of 3000 TPH rated capacity to cater the coal requirement of the project. From the proposed coal mine in the vicinity of the power project, pipe conveyor (in mine's scope) of capacity 3000 TPH will be provided up to the Crusher House inside the plant area. From the Crusher House, conventional belt conveyor system will be provided for receiving and conveying the crushed coal to boiler bunkers or stacking/ reclaiming the coal to/ from crushed coal stockyards. Two (2) nos of rail-mounted, bucket wheel type travelling Stacker cum Reclaimers are proposed for crushed coal stockyard management. The overall operating hours of the coal handling plant will be 16 hours spread over two shifts per day leaving third shift exclusively for routine inspection and maintenance. The proposed CHP will cater to the peak daily requirement of coal for all units in two bunker filling cycles in 12 hrs effective operation.

The (-) 20mm crushed coal can either be conveyed directly to the coal bunkers through a series of conveyors or stacked on to the crushed coal stockpiles by means of stacker/ Re-claimers. Motorized travelling trippers will be provided to feed crushed coal into the raw coal bunkers of the boilers.

Crusher House

Crusher house will be of structural steel with permanently colour coated steel sheet cladding. Floor slabs will be of RCC. Crushers will be supported on RCC deck slab which in turn will rest on vibration

Isolation system consisting of springs & dampers. Ironite flooring has been on soldered for floors, open foundations have been considered for column foundations.

Transfer Points

Transfer points will be of structural steel with RCC floors and will have permanently colour coated steel sheet cladding. Floors will be provided with Ironite finish. Open foundations are envisaged for column foundations.

Conveyor Galleries

Conveyor galleries will be of structural steel with trestles at regular intervals. These will have permanent colour coated steel sheets as side & roof cladding. Open foundations have been envisaged for trestle foundations.

Stacker/Reclaimer Foundations

The Stacker/Reclaimer rails will be supported on RCC raft, which in turn will be supported on open foundation.

2.10 Construction Power requirement

The construction power requirement would be met through a 33 kV D/C line drawn from nearby 220kV/33kV substation of OPTCL/ CESU. Necessary 11kV ring main/LT sub-station will be provided inside the plant.

2.11 Water treatment system

2.11.1 Water pre-treatment plant

i. The Pre Treatment plant would be designed to remove suspended/colloidal matter in the raw water. Separate pre-treatment plant will be provided for meeting the CW system and Demineralization (DM) plant. A common chemical house will be provided to store chemicals such as chlorine, lime, alum & coagulant aid and respective lime, alum and coagulant dosing equipment such as tanks, pumps etc for all the PT systems. Independent chemical preparation tanks and chemical dosing pumps will be provided for each PT system.

ii. The Water PT plant for CW system will consist of three (3) clarifiers of reactor type/tube settler/ lamella type, of 2300 m^3/hr capacity, one number of aerator and one number of stilling chambers (common for all three clarifiers). The water PT plant for Potable water Plant will have two (2 x

100% capacity) gravity filters/pressure sand filter each of 100 m^3/hr for potable water purpose. The water PT plant for DM Plant will consist of One (1) Tube settler/ Lamella clarifier or reactor type clarifier of 230 m^3/hr capacity, one number of aerator and one number of stilling chambers and two (2 x 100% capacity) numbers of gravity filters/pressures and filters each of 150 m^3/hr.

iii. There will be one standby gravity/pressure sand filter each for water PT- Potable water plant & PT-DM plant system. Water from the clarifiers will be led to clarified water storage tank or to the filters as the case may be. Water from the clarified water storage tank will be pumped to the HVAC make up system, Potable water system, Service water system, Make up to miscellaneous cooling system. For CW system, make up water will be supplied through pumps.

iv. From the gravity/pressure sand filters, filtered water would flow by gravity to respective filtered water reservoirs and filtered water would be pumped to DM plant and Potable water system.

v. Required hoists, cranes and weighing scales will be provided for handling pumps, chemicals, chlorine ton containers etc.

vi. The Water pre-treatment plants will be provided with required instrumentation, interlocks, controls, control panels to facilitate safe & reliable operation.

2.11.2 Water Demineralization Plant

The DM plant will be sized to meet the makeup water requirement of the steam cycle, make up to closed circuit auxiliary system, hydrogen generation plant, and stator water cooling system. Considering the quality of water, it is proposed to adopt a service cycle of 20 hrs for DM Plant. The D.M. plant will consist of three (3) streams of 100 m^3/hr capacity (2W+1S) and each stream will comprise of Activated carbon filter, Cation exchangers, degasser system (comprising of degasser tower, degassed water tank, degassed water pumps and degasser blowers etc.), anion exchangers and mixed bed exchanger. The cation resins will be regenerated with hydrochloric acid and the anion resins with sodium hydroxide. The regeneration facilities will consist of the bulk acid & alkali storage tanks, alkali solution preparation system, acid & alkali measuring tanks and dosing ejectors etc. The plant will be designed for semi-automatic operation with PLC/DDCMIS based control. Two (2) D.M. water storage tanks each of 2000 m^3capacity will be provided to store DM water. One neutralization pit will be provided for neutralizing the pH and discharging the effluent water from the DM plant. A reverse osmosis with mixed bed combination plant for DM water will also be kept. However, the type of plant i.e. conventional Dematerializing plant or reverse osmosis with mixed

bed combination plant for DM water can be finalized based on technical suitability later during specification stage.

2.11.2.1 Zero Liquid Discharge concept

The Reverse Osmosis plant is proposed to produce 200-250 m^3/hr permeate. Cooling tower blow down (CTBD) water will be used as feed water to Reverse Osmosis plant. The purpose of Reverse Osmosis system is to remove the dissolved solids from the water to produce specified quantity of CW make up. Reject water from Reverse Osmosis trains will be led to CHP dust suppression tank.

2.11.3 Chlorination plant

Chlorination plant will be provided for chlorine dosing in the CW system to avoid the growth of algae and bacteria. Separate chlorination plants will be provided for water PT plant and CW system (at two locations). CW chlorination system would consist of Three (3) numbers of chlorinator-evaporator sets of 100 Kg/hr capacity. For PT system there will be Three (3) (3x50% capacity) numbers of chlorinator sets each of 20 Kg/hr capacity. Each chlorination system will be provided with required chlorine ton containers, instrumentation, panels, chlorine leak detectors etc. Complete chlorination plant will be located indoor. Chlorine leak absorption system as plant emergency measure will be provided for each of the CW chlorination plants and PT chlorination plants to neutralize chlorine leakage from the plant. Provision of Chlorine dioxide system will also be acceptable.

2.11.4 Condensate polishing plant (CPU)

For maintaining the feed water purity condensate polishing plant will be provided in the feed water cycle at the downstream of condensate extraction pumps as per the existing practice. The condensate polishing plant will be of full flow, deep mixed resin bed type consisting of 3x50% capacity service vessels for each unit. The resins to be used would be strongly acidic cation and strongly basic anion type, appropriate for condensate polishing system. A common external regeneration facility will be provided along with one additional Mixed Resin Storage vessel. The exhausted charge of resins from the service vessel will be hydraulically transferred to the resin separation/ cation regeneration vessel for regeneration and reuse. One additional charge of resin will be procured for use during start-up of both the units. Acid, Alkali & DM Water Storage for regeneration, and Wastewater Neutralization facilities with one additional mixed resin storage vessel will be provided separately for the external regeneration facility.

2.11.5 CW treatment system

It is proposed to provide suitable chemical treatment Programme of acid dosing and scale cum corrosion inhibitor for the CW system for control of CW system water chemistry at two locations. It is proposed to provide acid & chemical storage tanks and respective dosing pumps will as a part of CW treatment system. The plant will be provided with neutralization pits, disposal pumps with required corrosion measurement track, instrumentation for interlocks and controls, control panels etc. to facilitate safe &reliable operation.

2.12 Wastewater treatment system

Temporary sanitation facilities (soak pits/septic tanks/ Bio Toilets) will be set up to prevent contamination.

2.12.1 Effluent treatment system

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

i) The filter backwash water of PT Plant will be collected and recycled back to the CW system clarifier.

ii) The sludge from clarifiers of Water PT plants will be collected and sent to ash slurry sump for disposal to ash dyke.

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

iv) The Power cycle effluents sent to CW make up with the help of pumps.

v) CW system blow down would be used for coal dust suppression system, Ash handling Plant and FGD system. Excess CW blow down will pass through RO system for reuse. Water after RO system will be sent to CW makeup.

vi) A coal settling pond will be provided to remove coal particles from coal handling plant waste. Decanted water will be pumped back to the coal dust suppression system

vii) Service water effluent drains from various areas will be separately routed to a sump. From the sump the service water will be pumped up to lamella clarifier for treatment of suspended solids. Treated service water will be sent back to service water tank for re-use.

viii) Balance effluents will be mixed in CMB and finally reused in horticulture point using of 2 x 100% capacity pumps.

2.13 Project Cost

The estimated project cost for the proposed project is 16073.86 Crores. Commercial Operation Date (COD) of the first 800 MW units is envisaged in 52 months from the zero date and second and third units at an interval of 6 months each thereafter.

2.14 Manpower Requirement

- Temporary employment of 1500 people and 250 Direct during construction phase.
- Long-term employment of up to 700 direct people and 400 contract people in the operation and maintenance of the power station.

2.15 Hazardous and Solid Waste Generation

Ash will be the major solid waste generated from the power project. An ash management scheme will be implemented consisting of dry collection of ash, supply of ash to entrepreneurs for utilization and promoting ash utilization to maximum extent and safe disposal of unused ash.

Unlike other process industries, power project does not handle and generate any major flammable materials (Class A and Class B Flammable material) except small quantities of furnace oil for boiler start up conditions. Other hazardous materials that will be handled at the power plant will be small quantities of Chlorine used as biocide in the cooling tower. In general about 2 to 5ppm of Chlorine is doped in the cooling water circulation line for this purpose. Both Hydrochloric acid and Sodium Hydroxide will be used for regeneration of the De-Mineralization Plant resin beds. The solid waste (effluent) generated in DM & PT plant shall be disposed off in ash disposal area.

2.16 PROJECT COMMISSIONING SCHEDULE:

The commercial operation (COD) of the 1st unit is envisaged in 52 months from the zero date and subsequent units will have a phase gap of 6 months each, thereafter. The zero date of the project has

been reckoned as date of award of Main Plant package(s). Based on the same, the Master Network (MNW) of NLC Talabira Thermal Power project (3x800 MW) has been prepared.

The Master Network (MNW) covers overall programme of project implementation and shows optimum schedule for different activities in bar chart. It identifies the key milestone dates for each package in the areas of engineering, procurement, manufacturing, dispatch, construction, erection, testing and commissioning. The zero date of the Master Network is date of award of Main Plant (SG & TG EPC packages).

PROJECT IMPLEMENTATION

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

- Planning phase
- Tendering and Engineering phase
- Manufacturing phase
- Construction/erection phase, and
- Commissioning phase

2.17 PROCESS FLOW DIAGRAM OF PROPOSED PROJECT:

In line with the observations of MoEF&CC and CEA guidelines, it is proposed to adopt Supercritical technology. It is worthwhile mentioning that the proposed plant would be the first 800 MW Supercritical Unit in NLCIL having higher cycle parameters (Main Steam pressure -281 ata, MS/RH temperature 603 deg C/ 603 deg C). The advantages of supercritical technology are listed below:

- Higher plant efficiency
- Less Fuel Consumption
- Less Infrastructure Investment for Fuel Transport / Storage and Ash Disposal
- Less Emission (CO2, SOx, NOx, Dust/Ash)
- Less Auxiliary Power Consumption of plant auxiliaries.
- Less Water Consumption (No needs of continuous blow down in case of once through boiler.)
- Lower operating costs
- Greater operating flexibility

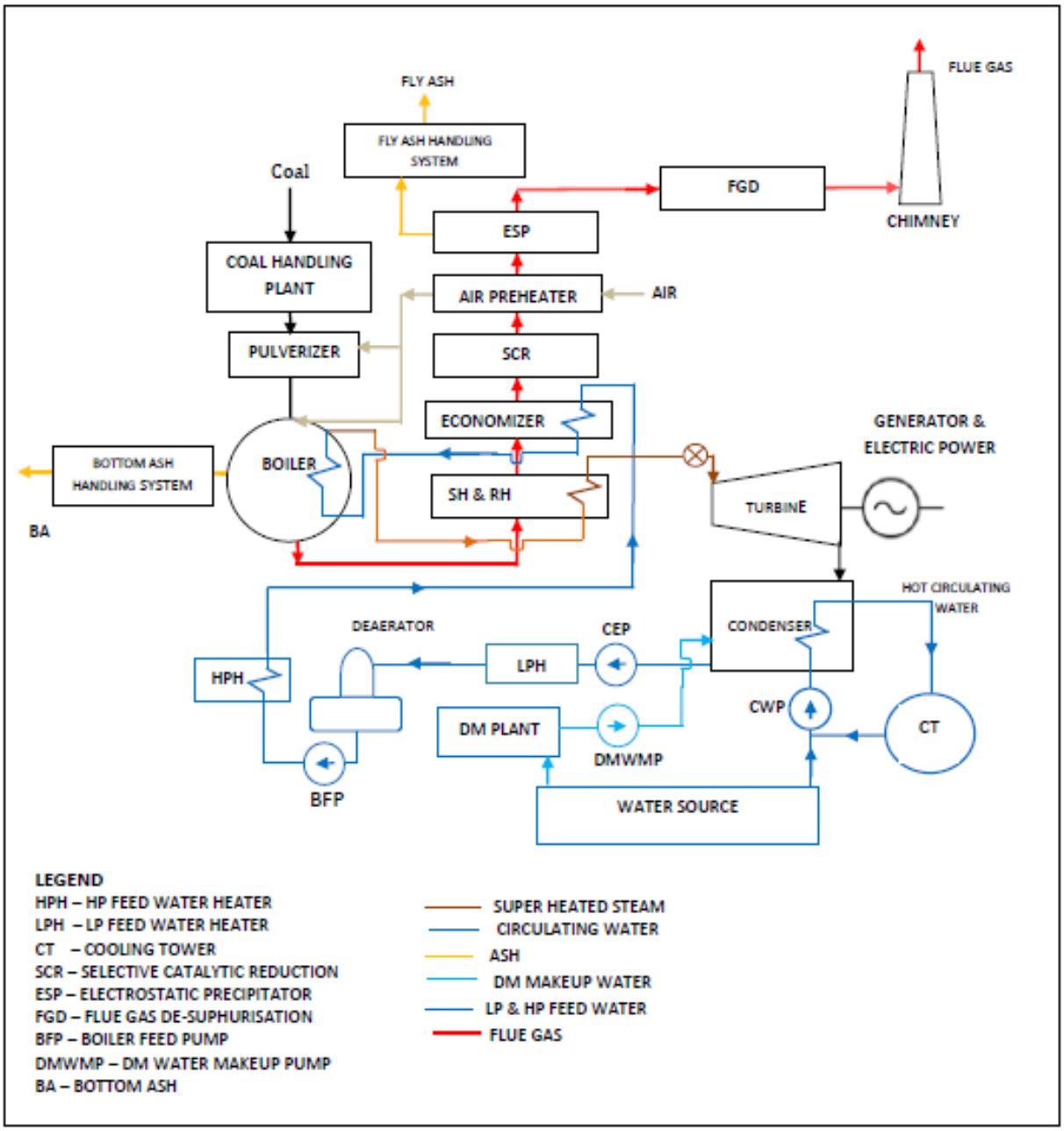


Figure 2.3: Process Flow Diagram for Coal Based Thermal Power Plant

2.17.1 PROCESS DESCRIPTION AND TECHNOLOGY

In thermal Power generation, chemical energy of fuel is first converted into thermal energy (during combustion), which is then converted into mechanical energy (through a turbine) and finally into electrical energy (through a generator).

NLCIL has planned to install Supercritical pulverized fuel combustion technology for this proposed 3x800 MW power plant, targeting higher efficiency (and hence minimum coal consumption) as well as conforming to best possible friendliness to environment at reduced emission.

Supercritical Technology is categorized with higher steam pressure (over and above critical pressure of 221 bar) exceeding 240 bar and steam temperatures (both super heat & Reheat) ≥ 595°C. Such technology is well-proven in Europe and Japan and many 800 MW supercritical units are under execution in India as well.

Additionally, following pollution control equipment are attached to the once-through steam generator, for compliance to latest MoEF&CC guidelines.

- Selective Catalytic Reactor (SCR)
- Flue Gas Desulphurization (FGD)
- Electrostatic Precipitator (ESP)

2.17.2 Power Evacuation System

Considering the project capacity as 2400 MW, the step up and evacuation voltage for NLC Talabira Thermal Power Project (3X800 MW) has been envisaged at 765 kV. The power generated in each 800 MW units will be stepped up to 765 kV level through suitably rated Generator Transformers and will be evacuated through one D/C 765 kV transmission lines up to Jharsuguda Pooling Substation of Power Grid Corporation India Limited (PGCIL). Unit start-up power requirement will be met by back charging of one of the 765 kV transmission line.

2.17.3 Air Pollution Control Device

High efficiency electrostatic precipitators (ESPs) will be installed to limit the particulate emission to 30 mg/Nm^3 to facilitate wider dispersion of particulate and gaseous pollutants. One single flue and one twin flue chimneys of 180 m& 150 m height will be provided for wider dispersion of pollutants. On-line equipment will be provided for monitoring of stack emissions.

As per draft notification of MOEF dated 16.10.2017, the height of chimney to be kept as per formula or 100 m whichever is higher. Once the notification comes in to force, single flue chimneys for each unit of 800 MW with revised height will be explored. To control NOx emission, supercritical boilers having advanced low NOx generation system will be installed to limit the NOx emission as per latest environmental guidelines. FGD system will be installed in flue gas duct to the chimney as per latest environmental stipulation. The design and layout of steam generator and its auxiliaries will take into account wet Flue Gas Desulphurization (FGD) system to be installed taking suction from duct after ID fan and feeding the Desulphurized flue gases back to the chimney. For control of fugitive dust emissions within and around coal handling plant, dust extraction/suppression systems would be provided. Dust suppression system will also be provided in the coal stock yard.

2.17.3.1 Electrostatic Precipitator

It is proposed to install high efficiency electrostatic precipitator having an efficiency that limits the outlet emission to 30 mg/Nm^3 while the boiler is operating at its MCR, firing worst coal having maximum ash content.

The electrostatic precipitators will have six (6) parallel gas streams, isolated from each other on the electrical as well as gas side and will be provided with gas tight guillotine dampers at inlets and outlets of each stream, so as to allow maintenance to be carried out safely on the faulty stream, while the unit is working. ESP specific collection area will not be less than 285m^2/m^3/sec at 100% TMCR. Electrostatic precipitator will be provided with microprocessor based programmable type rapper control system and ESP management system to ensure safe and optimum operation of ESP.

ESP transformer rectifier sets will use high flash point oil as the cooling medium. The dust collection hoppers at all strategic locations will have a minimum storage capacity of eight (8) hours. The hoppers will have heating arrangements to prevent ash sticking to the sloping sides and down pipes. Level indicators to indicate ash levels in the hoppers and trip the ESP in case of high ash levels in the ash hoppers are also envisaged to ensure safety of ESP.

2.17.3.2 Flue Gas De-sulphurisation (FGD)

Flue Gas Desulphurization system and its auxiliaries will be installed for three (3)number steam generators of 800MW nominal rating to reduce the emissions of Sulphur Dioxide in flue gas produced by coal being fired in boiler to less than 100 mg/NM^3. The FGD system will be either based on Wet Lime Stone Forced Oxidation process technology or Ammonia based FGD technology. FGD

System will have an independent absorber for each unit and ID fans of each unit will be sized to include pressure drop across the FGD system.

Wet Lime Stone Forced Oxidation process technology FGD system

Limestone to the absorbers will be supplied by common wet limestone grinding system. Each wet limestone mill will be fed from an independent bunker through a gravimetric feeder. The classified limestone slurry from the mills will be stored in three (3 no) limestone slurry storage tanks, from where the slurry will be pumped to the individual absorbers by dedicated limestone slurry pumps. The gypsum from the three (3 no)absorbers will be pumped by dedicated gypsum bleed pumps to a common Gypsum Dewatering system consisting of multiple streams of primary and secondary dewatering equipment. The water removed from the absorber will be recycled to the absorbers. The waste water from the system will be collected & neutralized using lime and thereafter neutralized effluent will be pumped to Ash slurry sump. Washed and dewatered gypsum from the dewatering system will be fed to a belt conveyor. Common gypsum dewatering system will be installed. The common dewatering system will receive the gypsum slurry from each absorber through slurry feed pipes and will comprise of dewatering equipment. The filtrate water from belt filter dewatering and washing system and the over flow from the secondary hydro-cyclone will be taken to a common filtrate water tank and further to absorber tank.

Ammonia based FGD System

In case Ammonia based FGD technology is provided, common Ammonia handling &storage system, common Ammonia transfer pumps, Ammonium Sulphate storage &disposal system will be provided for all the three units, including Unit wise Ammonia day tanks.

In Ammonia-based FGD system, (aqueous or anhydrous) Ammonia with high reactivity is used as absorbent to capture SO_2 in the Flue gas, and the by-product of the process is Ammonium Sulphate fertilizer. Ammonium sulphate solution is refined through concentration, crystallization, solid-liquid separation, drying to obtain ammonium sulphate fertilizer.

Process:

The flue gas from the ID fan is introduced into the absorber, where the flue gas is cooled and SO_2 in the flue gas is absorbed. The clean gas is discharged from the stack after the droplets and mist are removed in the demisting section of the absorber.

Initial reaction between SO_2 in the flue gas and the ammonia-based absorption solution forms ammonium sulfite solution. Through forced oxidation, concentration and crystallization, ammonium sulfite is converted into ammonium sulfate slurry with precisely controlled solid content. The ammonium sulfate slurry is further processed in the hydro cyclone, the centrifuge, and the dryer to yield ammonium sulfate with water content less than 1%. The ammonium sulfate is then packaged in the packaging machine and palletized as fertilizer-grade Ammonium Sulfate product.

In Ammonia based technology SO_2 recovery is essentially without generating any wastewater, solid waste, or CO_2. The by-product (Ammonium Sulfate) of the ammonia-based process is saleable fertilizer. However, Lime-stone based FGD technology is considered as a base case for FR estimates.

2.17.3.3 Selective Catalytic Reduction (SCR)

Selective Catalytic Reduction (SCR) based De-NO**x** system and its auxiliaries for three (3) number steam generators of 800MW nominal rating will be installed. The SCR System will be installed in each unit, to limit NO_X emission below 100 mg/Nm^3 so as to meet the MOEF requirements. The SCR reactor will be arranged for gas flow from top to the bottom and arranged in the flue gas pass of the steam generator between economizer and air heater. The reagent will be ammonia/air mixture. The overall design of the SCR will be done considering all operating conditions, minimization of ammonia consumption and slip, prevention of formation of ammonium hydrogen sulphate and other ammonia components, which deactivate or plug up the catalysts, minimization of SO3-conversion, prevention of disturbances in downstream equipment, prevention of plugging by ash particles, especially "popcorn ash", maximizing the life of the catalyst.

The catalyst layers will be installed in two or three layers on horizontally arranged support frames. Furthermore, provision for one additional (reserve) layer without catalysts but equipped with soot blowing system will be designed and provided for. The SCR reactor considerably consisting of Reactor housing, Inlet and outlet hood with guiding vanes, connecting nozzles for media (e.g. flue gas, steam, pressurized air, etc.), grid measurement with adapters, fixture for soot blower connection per catalyst layer and bearing beams for catalyst. Soot blowers will be installed for all the catalyst layers including the reserve layer for removal of ash deposits on the catalyst.

The entire SCR plant e.g. reactor, ammonia injection will be equipped with a sufficient number and size of platforms for inspection, maintenance and sampling. Storage and supply of ammonia will be delivered by truck tanks as liquid-pressurized form to the Power Plant. The storage capacity of

Ammonia will be sufficient to accommodate 14 days demand for Power Plant at maximum consumption corresponding to BMCR worst case. Ammonia injection system considerably consisting of Nozzle lances, one control fitting with lockable flow rate gauge, complete piping for the distribution of the ammonia/air mixture, connection to ammonia piping from ammonia supply system, protection for the control fittings mixer in the flue gas duct. Soot blowing will be carried out with steam.

2.17.4 Mercury abatement as co-benefit of reduction of NOX, SO2 and dust

Mercury content in Indian coal ranges between '0.01 to 1' ppm. Average mercury content in coal found in India to be 0.272ppm as per CPCB. A typical power plant emits 90% of its mercury into air and 10% to land. The main reason for such high rate of emissions is that mercury boils at operating temperatures of power plant.

Mercury exists in three forms in coal fired thermal power plants flue gas:

i. Elemental Hg (O)

ii. Oxidized Hg (2+)

iii. Particle bound Hg (P)

Hg (2+) and Hg (P) are relatively easy to remove from flue gas using typical air pollution control devices such as ESP and wet FGD.

Mercury emissions from coal-fired boilers can be controlled through proposed measures for removing particulate matter (PM), sulphur dioxide (SO2) and Nitrogen oxides (NOx). The Hg(P) fraction is typically removed by ESP, particulate control device. The Hg (2+) portion is water soluble and therefore a relatively high percentage can be captured by wet flue gas desulphurization (FGD) system. The Hg (O) fraction is generally not captured by proposed air pollution control device. However, the proposed SCR for controlling NOx emissions will promote oxidation of Hg (O) to Hg(2+) and enhance Hg capture in downstream FGD. Mercury emission control is thus expected to be within the emission limits of MOEF, with the above measures. Thus, no other special measures are needed/envisaged.

2.17.5 Turbine generator unit and its auxiliaries

The scope of each TG unit of 800MW will broadly cover the Steam Turbine along with its integral systems and auxiliaries like lube oil system, control-fluid system, condensers, condenser air evacuation system, COLTCS, HP&LP Bypass system, complete regenerative feed heating system, Condensate Extraction Pumps (CEP) along with their drives, boiler feed water pumps along with their drives, automatic turbine run-up system, instrumentation and control devices, turbine supervisory instruments, turbine protection and interlock system, automatic turbine testing system and turbine hall EOT cranes.

Steam turbine type

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

2.17.6 Condensing equipment

Single pass or double pass with single or dual pressure condenser with stainless steel tubes of welded type as per ASTM-A-249-TP304, will be adopted. The condenser will be with divided water box construction. It will be horizontal, surface type with integral air cooling section. Condenser hot-well will be sized for three (3) minutes storage capacity (between normal and low-low level) of total design flow with the turbine operating at V.W.O condition, 3% make-up, and design back pressure. The condenser will be adequately sized to cater to all the conditions of turbine operation including the abnormal operating conditions such that condenser would not be a bottleneck at any stage of operation.

The exact condenser parameters will be optimized on the basis of site data and most economical combination of cooling surface and circulating water quantity. The condenser will be designed, manufactured and tested in accordance with the latest applicable requirements of the Heat Exchange Institute (HEI), USA. Provision of separate sponge rubber ball type condenser on-load

Tube cleaning system for each half of the condenser including ball circulation pumps, strainer, ball monitoring system etc. will be made.

2.17.7 Balance of Plant System

Descriptions in respect of balance of plant system such as coal handling plant, ash handling plant, etc., are covered in chapter 9.

Chapter 3- Description of Environment

3.1 Introduction

Baseline Environmental Studies have been conducted to determine the existing status of various Environmental attributes viz., Climate and Atmospheric conditions, Air, Water, Noise, Soil, Hydrogeological, Land use pattern, Ecological and Socio-Economical environment, prior to setting up of the proposed project. This study would help to undertake corrective mitigation measures for the protection of the environment on account of any change deviation of attributes due to activities of the proposed project. The major purposes of describing the environmental settings of the study area are:

- To understand the environmental characteristics of the area.
- To assess the existing environmental quality.
- To identify environmentally significant factors.

3.2 Scope of Baseline Study

An area, covering a 10 km radial distance from the project site is considered as the study area for the purpose of the baseline studies. Primary data on Water, Air, Land, Flora, Fauna & Socio-Economic data were collected by a team of Engineers and Scientists. Secondary data was collected from various Departments of State/Central Government Organizations, Semi-Government and public Sector Organizations. Important features observed in 10 Km buffer zone is given at **Table 3.1.Table 3.2** gives various environmental attributes considered for formulating environmental baseline and **Table 3.3** gives the frequency and monitoring methodology for various environmental attributes.

Table 3.1 Significant Features in the Study area

S.No	Particulars	Details
1.	Location of the Project Site	Kumbhari & Tharaikela in Jharsuguda Tehsil and District & Ash dyke in Thelkoloi Villages Sambalpur District
2.	Latitude and longitude	North corner 21°46'56.11''N and 83°59'30.59''E South corner 21°45'16.80''N and 83°59'9.36''E East corner 21°46'52.95''N and 84°00'20.72''E West corner 21°46'34.18''N and 83°58'50.54''E

3.	Elevation above mean sea level (MSL)	197m to 211m
4.	Nearest highway	NH-10 (2.5Km E)
5.	Nearest railway station	Brundamal (3Km NNE)
6.	Nearest airport	Jharsuguda(16Km NNE) Bhubaneswar (350 kms SE) Raipur(
7.	Nearest port	Paradeep port trust (325Km E)
8.	Nearest village /town	Sarbahal (6Km N)
9.	Hill/valleys	NIL within 10Km zone
10.	Topography	Plain surface with gentle slope towards Bedhan River
11.	Archeologically important places	NIL within 10Km zone
12.	National parks or wildlife sanctuaries	Ushakothi (80 Km)
13.	Reserved or protected forest	Katikela RF (6.5 Km ENE) Patrapali RF (0.7Km W) Malda RF (3.18 km W)
14.	Seismicity	The study area falls in Seismic Zone II (low risk zone)
15.	Defence installations	NIL within 10Km zone
16.	Nearest river	IB river (3.8Km W) Bhedan river (0.5 Km W)
17.	Reservoir	Hirakud (15 Km)
18.	Industries	SMC power generation Ltd (1.4 Km N) Bhusan power and steel Ltd (2.2Km E) Adithya aluminium (5.9Km SE) Vedanta aluminium capative power plant(5.4Km ENE)
19.	Hospital	Sripura govt hospital (3.8Km E) JDS MSS hospital (7.2Km NNE) District headquarters hospital (7.5Km NNE) BPSL hospital (1.5Km E)

Table 3.2 Environmental Attributes

S.No	Attribute	Parameter	Source of Data
1	Climatology & Meteorology	Wind Speed, Wind direction, Relative humidity, Rainfall and Temperature	Indian Meteorological Department and Site-specific information

2	Water Quality	Physical and Chemical parameters	Monitored Data (Surface water – 4 locations and groundwater - 5 locations)
3	Ambient Air Quality	PM_{10}, $PM_{2.5}$, SO_2, NO_x, CO & TVOC and Mercury (13 parameters)	Monitored Data (10 locations)
4	Noise levels	Noise levels in dB (A)	Monitored Data (8 locations)
5	Ecology	Existing terrestrial flora and fauna within the study area	Field survey and Secondary sources
6	Geology	Geological history	Secondary sources
7	Soil	Soil types and samples analyzed for physical and chemical parameters.	Analysis of soil samples at 8 locations
8	Socio-economic Aspects	Socio-Economic characteristics of the affected area	Based on field survey and data collected from secondary sources
9	Land Use	Trend of land use change for different categories	Secondary data

Table 3.3 Frequency and Monitoring Methodology

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
A. Meteorology				
Wind Speed, Wind direction, Relative humidity, Rainfall and Temperature	Project site	Continuous for 3 months	Weather monitor with database	
B. Air Environment				
Particulate Matter (PM_{10})	Requisite locations in the project influence area	24 hourly-Twice a week for 3 months in Non-Monsoon season	Gravimetric (High-Volume with Cyclone)	As per CPCB standards/ Notification for National Ambient Air Quality Standards (NAAQS)&latest MOEF&CC Notifications
Particulate Matter ($PM_{2.5}$)			Gravimetric (High-Volume with Cyclone)	
Oxides of Sulphur (SO_2)			EPA Modified West & Gaeke method	
Oxides of Nitrogen (NO_x)			Arsenite Modified Jacob & Hochheiser	
Total Volatile Organic Compounds		--	EPA Method TO 17	

(TVOC)				
Carbon Monoxide		--	Gas Analyzer (NDIR)	
Mercury		--	EPA IO-5	
C. Noise				
Hourly equivalent noise levels	Requisite locations in the project influence area	Once	Instrument: Sound level meter	IS: 4954 1968
D. Water				
Parameters for water quality: pH, temp, turbidity, Total hardness, total alkalinity, chloride, sulphate, nitrate, fluoride, sodium, potassium, Electrical Conductivity, Ammoniacal nitrogen, Nitrate-Nitrogen total phosphorus, BOD, COD, Calcium, Magnesium, Total Dissolved Solids, Total Suspended Solids	Set of grab samples At requisite locations for ground and surface water	Once	Samples for water quality collected and analyzed as per IS: 2488 (Part 1-5) methods for sampling and testing of Industrial effluents Standard methods for the examination of water and wastewater analysis published by American Public Health Association.	
E. Land Environment				
Parameter for soil quality: pH, texture, electrical conductivity, organic matter, nitrogen, phosphate, sodium, calcium, potassium and Magnesium.	Requisite soil samples be collected as per BIS specification within project influence area	Once in season	Collected and analyzed as per soil analysis reference book, M.L.Jackson	
F. Biological Environment				
Terrestrial & Aquatic Flora and Fauna	Requisite locations in the project	Once in season	Collected and analyzed as per IUCN Red Data	

	influence area		Book.	

3.3 Collection of Baseline Data

Appropriate methodologies have been followed in developing the EIA/ EMP report. The methodology adopted for the study is outlined below:

- Conducting reconnaissance surveys for knowledge of the study area.
- Selecting sampling locations for conducting various environmental baseline studies.

The sampling locations have been selected on the basis of the following:

- Predominant wind directions recorded by IMD.
- Existing topography.
- Drainage pattern and location of existing surface water bodies like lakes/ponds, rivers and streams;
- Location of villages/towns/ sensitive areas.
- Areas, which represent baseline conditions.

The field observations have been used to:

- Assess the positive and negative impacts due to the proposed increase in production project.
- Suggest appropriate mitigation measures for negating the adverse environmental impacts, if any.
- Suggest post-project monitoring.

3.3.1 Land Environment

3.3.1.1 Land use Pattern

The total geographical area of Jharsuguda district is 208186 Ha out of which net sown area is 86000 Ha, area under forest is 20317 Ha and 101869 Ha comes under wasteland including area under other uses. Gross cropped area of the district is 75770 Ha with 88.1% cropping intensity.

The total geographical area of the project site is 2000 Ha. The site specific land use pattern is attached as Annexure XVI. The land use map of the project site is shown in Fig 3.1.

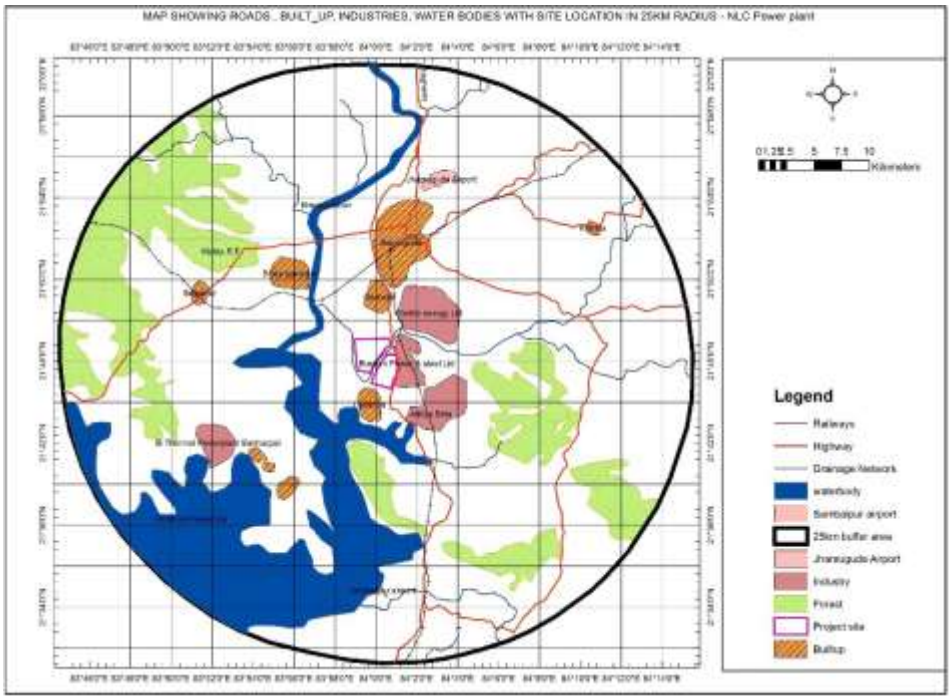


Fig 3.1: Land use map of the Project site

Breakup of the land use for the identified land for the project site (excluding corridors) is given in Table below

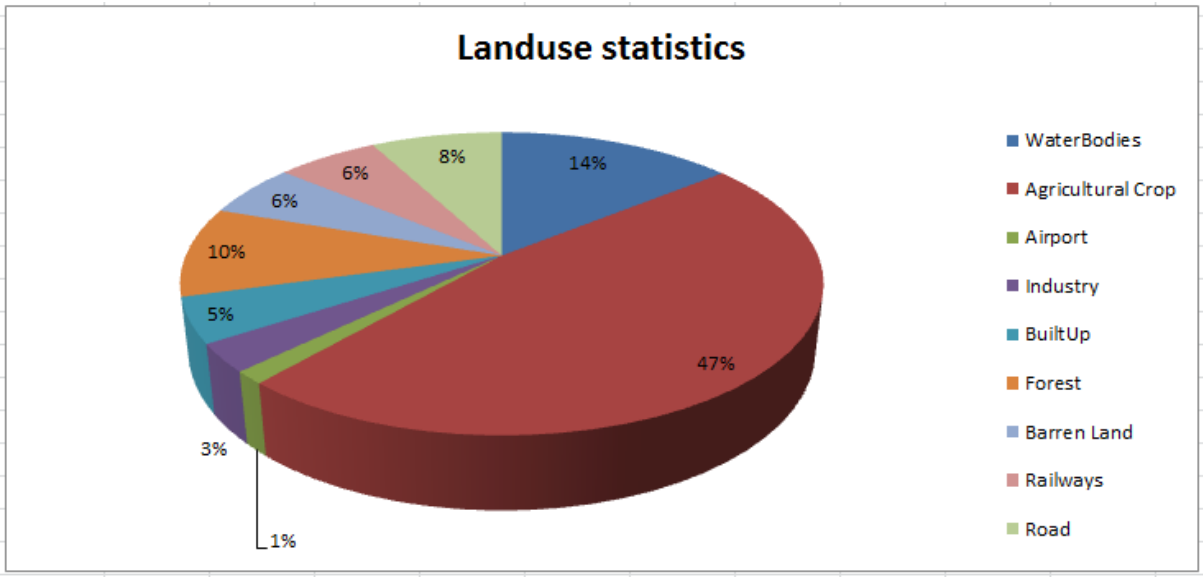


Fig. 3.1.2: Graphical Presentation of Land Use Statistics

Table 3.4 Land Use Land Covers Statistics of Buffer Zone

SL No	LULC Class	Area (Ha)	Area (%)
1	Water Bodies	32400.00	14%
2	Agricultural Crop	108065.00	47%
3	Airport	3100.00	1%
4	Industry	6900.00	3%
5	Built Up	11000.00	5%
7	Forest	22000.00	10%
8	Barren Land	13000.00	6%
	Railways	14000.00	6%
13	Road	18000.00	8%
Total		228465.00	100%

3.3.2 Micro Meteorological Data

Micrometeorological studies are simultaneously conducted with the Ambient Air Quality monitoring. Meteorology plays an important role in the dispersion of pollutants. The meteorological data is very useful for interpretation of the baseline information and for study of air quality impacts also.

A temporary meteorological station was installed at project site. The station was installed at a height of 4 meters above the ground level in such a way that there are no obstructions facilitating flow of wind, wind speed, wind direction, humidity and temperature are recorded on hourly basis.

3.3.2.1 Rainfall & Climate

The district is characterized by extreme climate with very hot summer (41.8°C) and very cold winter (11.8°C). The relative humidity is recorded to be 91 % in August and 36 % in May. The average annual rainfall is 1232.1 mm. The annual rainfall data of Jharsuguda district from year 2013 to 2017 is given in **Table 3.5**

Table 3.5 Rainfall data in mm for Jharsuguda district

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
2013	1.4	9.6	6.8	35.4	17.1	175.8	411.1	267.9	165.2	193.5	0	0	1283.8
2014	0	12.1	6.8	3.2	16.2	87.3	411.4	420.7	284.5	39.7	0	0.9	1282.8

2015	13.2	3.5	3	34	7.5	182	487	444	260.5	3.3	0	25.5	1463.5
2016	0.3	19.5	18.7	0.1	16	77.4	257.2	422	263.8	35.1	0	0	1110.1
2017	10.7	0	6	2	63.5	209.4	413.6	300	236.1	90.7	0.1	0	1332.1

3.3.3 Micro-Meteorology At Site

Meteorological station was set-up at site and surface meteorological data were recorded during the study period from January to March 2018.

Wind speed and wind direction data recorded during the study period has enabled identifying the influence of meteorology on the air quality of the area. Based on the collected meteorological data, relative percentage frequencies of different wind directions were calculated and plotted as wind roses for 8hr duration. Maximum and minimum temperatures including percentage relative humidity were also recorded simultaneously. Combined Wind Rose for the months January, February and March 2018 is given in **Fig.3.6** and the weather report for the months January, February and March 2018 is given in **Table 3.6, 3.7** and **3.8** respectively.

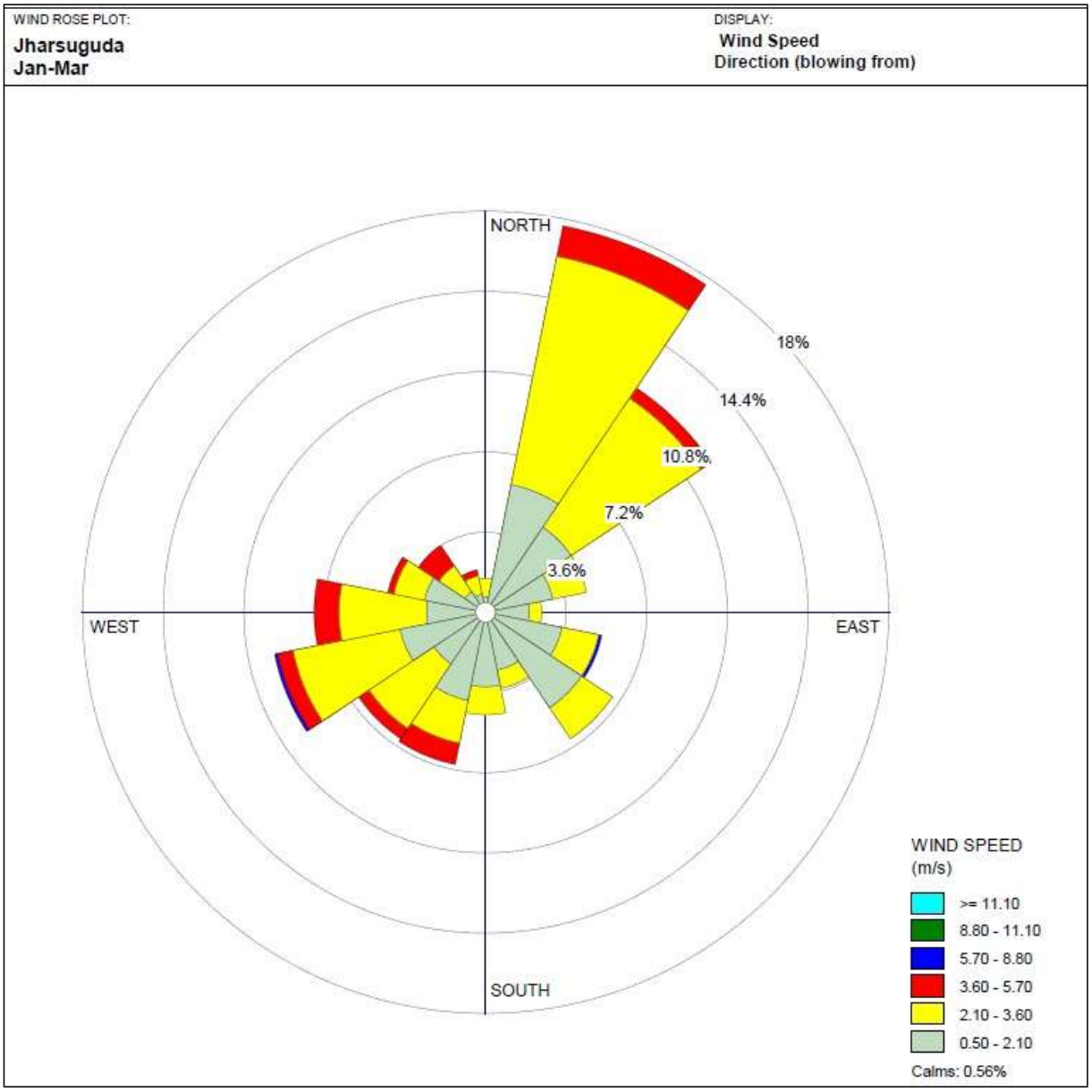


Figure 3.6– Combined Wind rose for the months of January, February and March 2018

Table 3.6 – Jharsuguda District Weather Report for the month of January 2018

Summary	Air Temp. (^{0}C)		Relative Humidity (%)	Wind Speed (m/s)
	Max	Min		
1/01/2018	29	15	38.63	1.79

2/01/2018	28	14	41.75	2.01
3/01/2018	27	13	44.50	2.12
4/01/2018	29	13	38.5	1.68
5/01/2018	27	13	33.38	1.57
6/01/2018	27	13	29.75	1.73
7/01/2018	28	12	30.20	1.9
8/01/2018	28	12	30.63	1.62
9/01/2018	29	13	30.15	1.13
10/01/2018	28	13	29.25	1.90
11/01/2018	27	14	26.30	1.85
12/01/2018	29	15	24.88	1.62
13/01/2018	29	15	25.9	2.57
14/01/2018	30	15	28.54	2.13
15/01/2018	30	15	29.50	2.27
16/01/2018	30	14	29.58	1.68
17/01/2018	30	13	29.63	1.68
18/01/2018	31	13	27.85	1.85
19/01/2018	31	13	26.13	1.62
20/01/2018	32	15	31.0	1.62
21/01/2018	31	15	33.45	1.51
22/01/2018	31	15	36.25	1.62
23/01/2018	31	16	36.92	1.9
24/01/2018	30	16	37.13	2.07
25/01/2018	29	14	39.88	2.24
26/01/2018	30	14	32.89	2.07
27/01/2018	31	13	27.25	2.18
28/01/201.7	31	14	27.25	1.85

29/01/2018	30	14	27.25	1.73
30/01/2018	31	16	25.75	1.9
31/01/2018	33	18	27	2.4

Table 3.7 – Jharsuguda District Weather Report for the month of February 2018

Summary	Air Temp. (^{0}C)		Relative Humidity (%)	Wind Speed (m/s)
	Max	Min		
1/2/2018	33	17	29.25	3.02
2/2/2018	33	17	28.54	1.85
3/2/2018	33	18	27.5	1.9
4/2/2018	34	18	28.46	1.57
5/2/2018	34	18	30.75	1.57
6/2/2018	32	19	34.63	1.90
7/2/2018	29	20	38.63	2.07
8/2/2018	31	19	34.76	1.96
9/2/2018	33	18	32	1.56
10/2/2018	33	19	34.25	3.13
11/2/2018	33	19	35.47	3.02
12/2/2018	34	19	36.25	1.79
13/02/2018	33	20	37.78	2.63
14/2/2018	32	20	42	2.91
15/02/2018	32	21	28.25	2.41
16/02/2018	33	20	29.12	2.18
17/02/2018	33	19	31.88	2.01
18/02/2018	34	19	27.93	1.79
19/02/2018	35	19	26	1.45
20/02/2018	35	19	25.63	1.68
21/02/2018	35	20	23.46	2.29

22/02/2018	35	20	23.63	2.01
23/02/2018	36	20	20.37	1.68
24/02/2018	38	21	20	1.57
25/02/2018	37	21	22.88	1.62
26/02/2018	34	22	30.5	1.34
27/02/2018	35	21	24.73	2.35
28/02/2018	36	20	23	2.57

Table 3.8 – Jharsuguda District Weather Report for the month of March 2018

Summary	Air Temp. (^{0}C)		Relative Humidity (%)	Wind Speed (m/s)
	Max	Min		
01/03/2018	37	21	21.53	2.53
02/03/2018	38	21	21.32	2.19
03/03/2018	39	22	20.25	2.01
04/03/2018	38	23	20.13	1.8
05/03/2018	38	24	19.5	2.46
06/03/2018	37	23	21.71	1.62
07/03/2018	37	21	22.38	2.35
08/03/2018	37	21	23.56	2.52
09/03/2018	37	21	24.75	2.19
10/03/2018	38	22	16.38	2.24
11/03/2018	38	22	18.57	1.96
12/03/2018	37	23	20.13	1.79
13/03/2018	38	23	18.37	2.13
14/03/2018	40	23	14.25	2.25
15/03/2018	40	24	18.63	3.52
16/03/2018	24	22	64	4.53
17/03/2018	34	20	54.25	2.97

18/03/2018	36	23	30	2.35
19/03/2018	39	22	15.5	2.58
20/03/2018	39	24	14.75	2.58
21/03/2018	38	24	20.75	3.13
22/03/2018	38	25	20.94	2.51
23/03/2018	40	27	21.5	1.85
24/03/2018	40	26	25.9	2.52
25/03/2018	40	24	28	2.47
26/03/2018	39	24	15.5	2.74
27/03/2018	40	24	13.46	2.07
28/03/201.7	41	24	10.38	2.36
29/03/2018	40	25	14	2.02
30/03/2018	42	24	20.88	1.96
31/03/2018	42	26	31	2.57

3.4 Drainage

The Mahanadi traverses from the northwest of Sambalpur subdivision to the southeast for a distance of about 122kms. It flows into the Hirakud Reservoir, situated in Jharsuguda district. Hirakud reservoir covers an area of 774.41sq km when the depth of the storage water level stands at 192 meters AMSL. The principal tributary of Mahanadi, Ib River forms a border line between the police station of Brajarajnagar and Jharsuguda and falls into the Hirakud reservoir. There are some other Nalas like Hitianala, Betcharanala etc, which are utilized for irrigation purpose. The Drainage Map (10 km) of the project site is given as **Figure 3.3.**

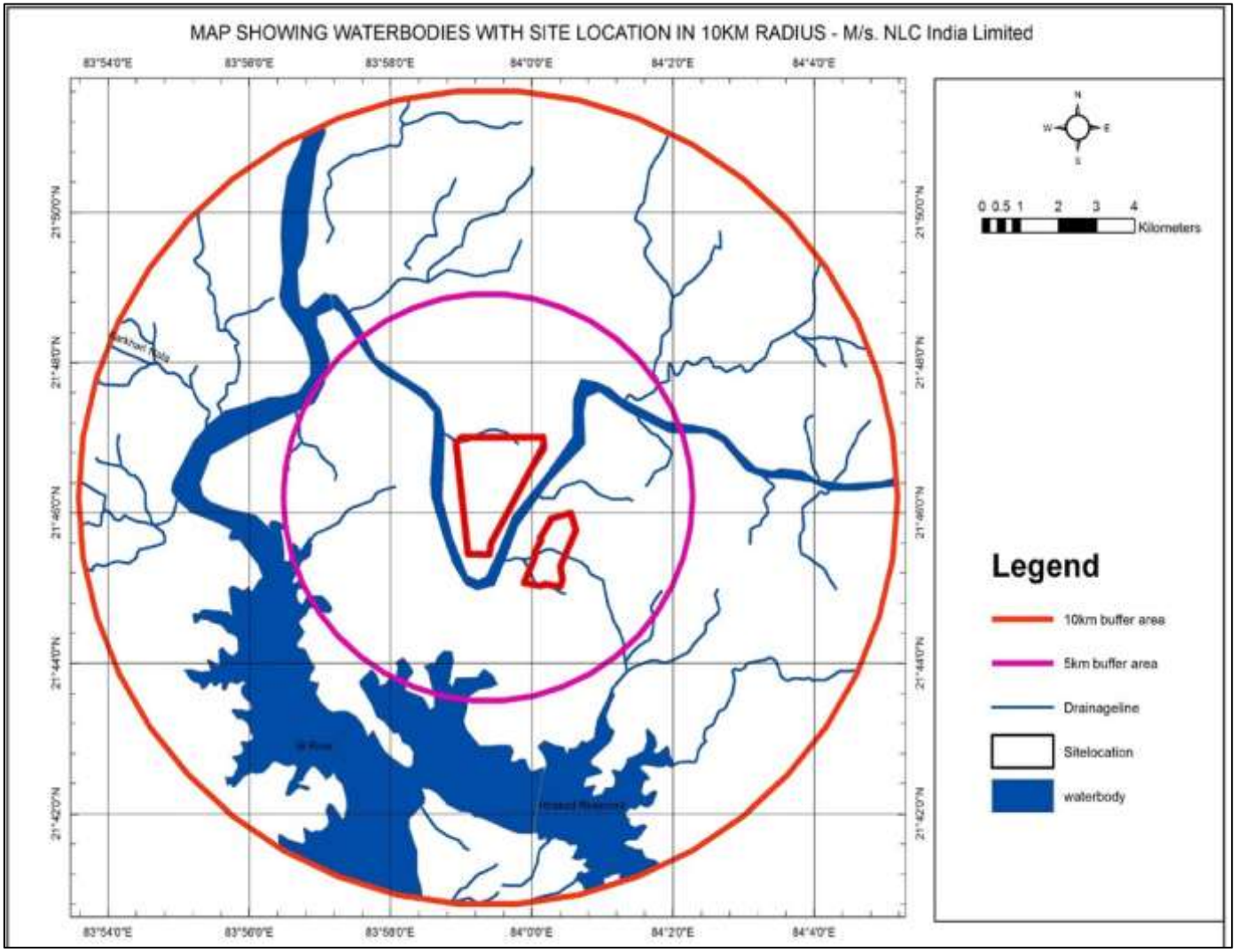


Figure 3.3 – Drainage Map (10 Km)of the Project Site

3.5 Geomorphology

The North –Western part of the district is mainly hilly. About 80 % of the area is characterized by isolated hillocks and rounds and undulating plains. A part of Hirakud reservoir occupying 185 sq. km is present in southern part of the district. The highest and lowest topographic elevation of the district is 474 meter and 193 meter respectively. The drainage of the district is controlled by the Mahanadi in the western part and Ib River, a tributary of the Mahanadi in the central and eastern part. The Bhedan, Lilari and Basundhararriverwhich join the Ibriver, comprise other drainage channels in the area. The drainage pattern is mainly dendritic and high drainage density is found in the western part of the district..

3.6 Soil

The most usual classification of the soil of the district is based on its composition or level. The soil, which covers greater portion of the district, is apparently derived from the underlying metamorphic rocks and the differences in it are mainly due to the elimination and transportation affected by surface erosion. The finer particles are carried into the low lying areas along drainage lines giving the soil a clayey texture and leaving the uplands light and sandy.

The sub-order associations of soil are Aqualfs-Aquepts, Ustalfs-Ochrepts and Ustalfs Rockouts. The soil resource map of Jharsuguda district is shown **Fig 3.4.**

These soil associations are generally classified as follows in this district.

(i) Red Forest Soil - It is rich in organic matter, is porous and is suitable for forest growth as well as for citrus and mango orchards.

(ii) Brown Forest soil – Pulses, millets and scrub jungle grow well in it.

(iii)Sandy Soil – This soil is coarse and contains low organic matter. The soil is best for ground nuts and pulses. On the bank of the river, the silt deposited on mal lands is suitable for growing paddy and the lower mal land i.e. pitamal gets excellent drainage growing good varieties of rice.

(iv) Black Cotton Soil - It contains liberal amount of organic matter.

(v) Kharipani –It is the most valuable type of land in the district. The water flowing through the village carries all manure which is deposited in the village by the people and cattle. Due to undulating plain of the areas, people built their houses on the highlands, cultivated land slopes away from the house site allowing drainage directly to their paddy fields.

(vi)) Clay loam and Clay Soil -This soil contains various percentages of organic matters from different types of parent rock. This soil is a mixture of sand, gravel and clay. Being less fertile, the soil helps to grow light rice and few weeds.

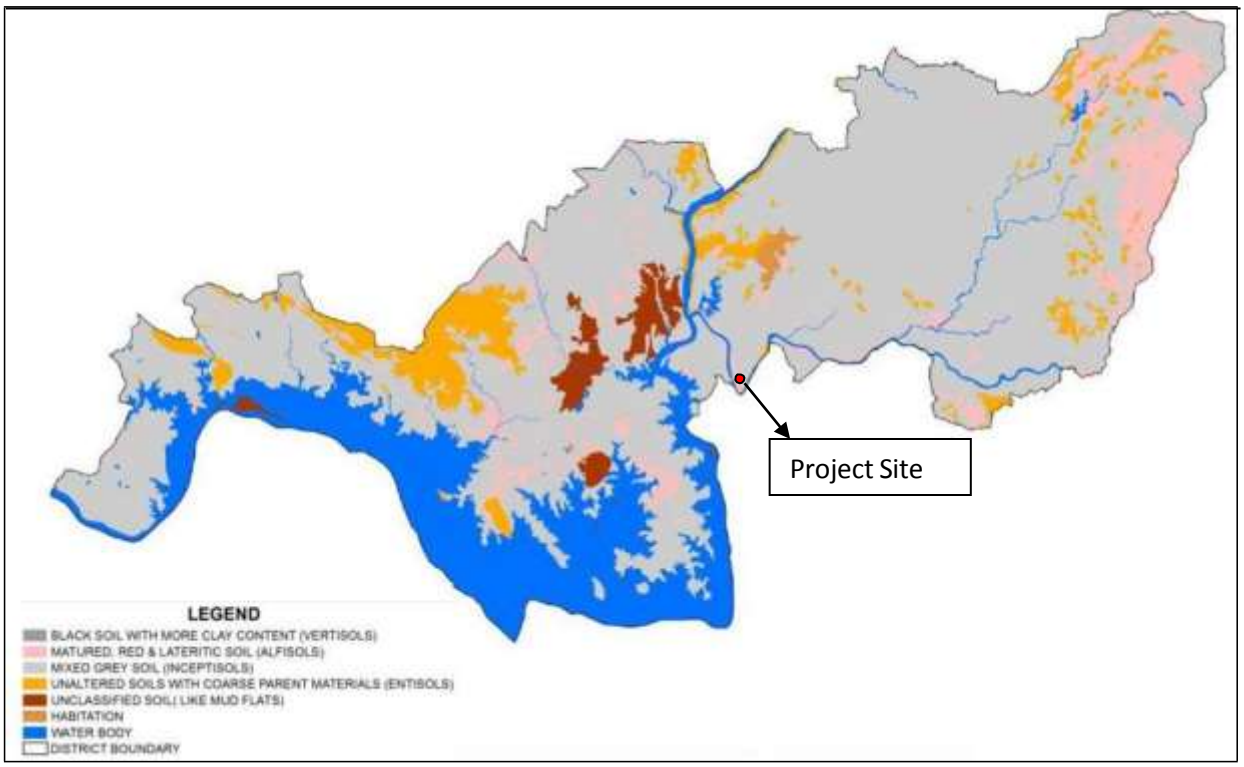


Figure 3.4 – Soil Resource Map of Jharsuguda District

3.7 Hydrogeology

Consolidated formations

About 60% of the area is under lain by consolidated formations comprising Precambrian Meta sediment of Sambalpur series, Iron ore and Gangpur series. These rocks are very hard and compact and the ground water occurs mainly in secondary porosity. Ground water occurs under semi confined to confined conditions in fractured rocks.

Granite Gneisses are the most predominant rock types usually occupying the underlating plains and topographic lows. These rocks are highly weathered and the thickness of the weathered zone usually ranges from 4.57 to 12.03 m bgl and depth to water level from 3.91 to 9.92 and 1.36 to 6.69 m bgl in pre and post monsoon respectively. The specific capacity of open wells varies from 5.765 to 53.001 1 pm/m.

Quartzite of the iron ore group are bedded, joined but having little ground water development prospects. The depth of open wells varies from 6.94 to 9.37 m below ground level (bgl) and depth to water level from 5.99 to 8.70 and 3.26 to 4.45 m bgl in pre monsoon and post monsoon respectively. The open wells are tested and its capacity was found to be 7.266 lpm/m. Mica schists have low permeability. The depth of the open wells ranges from 6.11 to 7.84 m and depth

to water level varies from 4.12. to 7.1 and 2.53 to 3.18m bye in pre and post monsoon respectively. The specific capacity of the open well tested was found to be of the order of 5.765 lpm/m.

Semi consolidated formation

Sandstones, shales, conglomerates grits etc. belonging to Talcher, Barakar and Kamthis of lower Gondwanas constitute the semi consolidated formations. The needle shales with high frequency of intersecting joints form good aquifers. The depth of the open well varies from 6.6 to 12.5m bgl. The pre monsoon and post monsoon water level vary from 5.4 to 10.25 and 1.6 to 7.5 m respectively. The specific capacity is found to be 7.148 lpm/m.

Unconsolidated formation

Laterites and alluvium of sub recent to recent age constitute the unconsolidated formations. Laterites which occur in patches as capping the older formations and form a very good shallow aquifer. The coarse grained sand with gravels and pebbles form repository of ground water which occurs under water table conditions. Alluvium forms potential shallow aquifer to be developed through dug wells.

3.7.1 Water Level Fluctuation

The rise at water table between pre-monsoon and post monsoon periods indicates accretion to the ground water storage mainly due to rainfall recharge. The seasonal fluctuation which depends on rainfall and hydrogeological characteristic of the formation is of the order of 0.94 to 5.09m in crystalline and 0.49 to 5.78 m in Gondwana sedimentaries. The fluctuation is observed to be very high in the high land areas compared to the low land areas.

Source: District Groundwater Brochure - Jharsuguda by CGWB

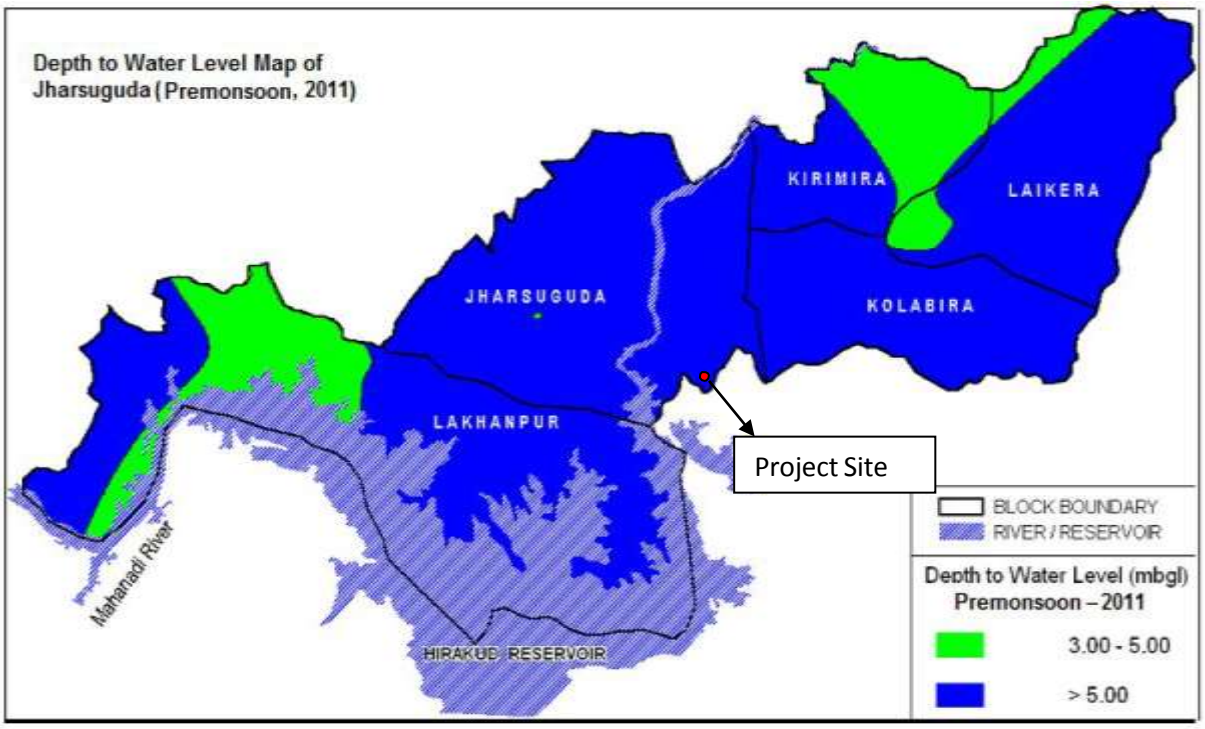


Figure 3.5 – Depth to Water Level Map (Pre Monsoon)

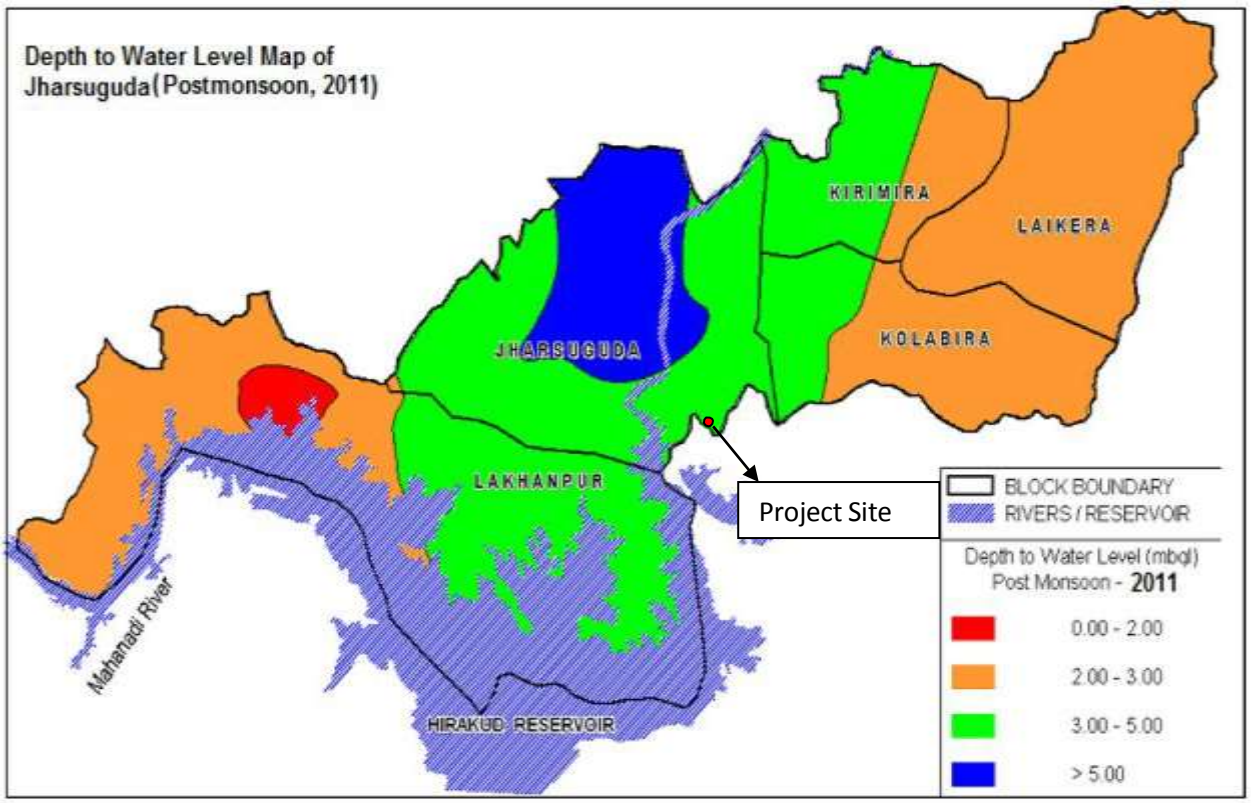


Figure 3.6 – Depth to Water Level Map (Post Monsoon)

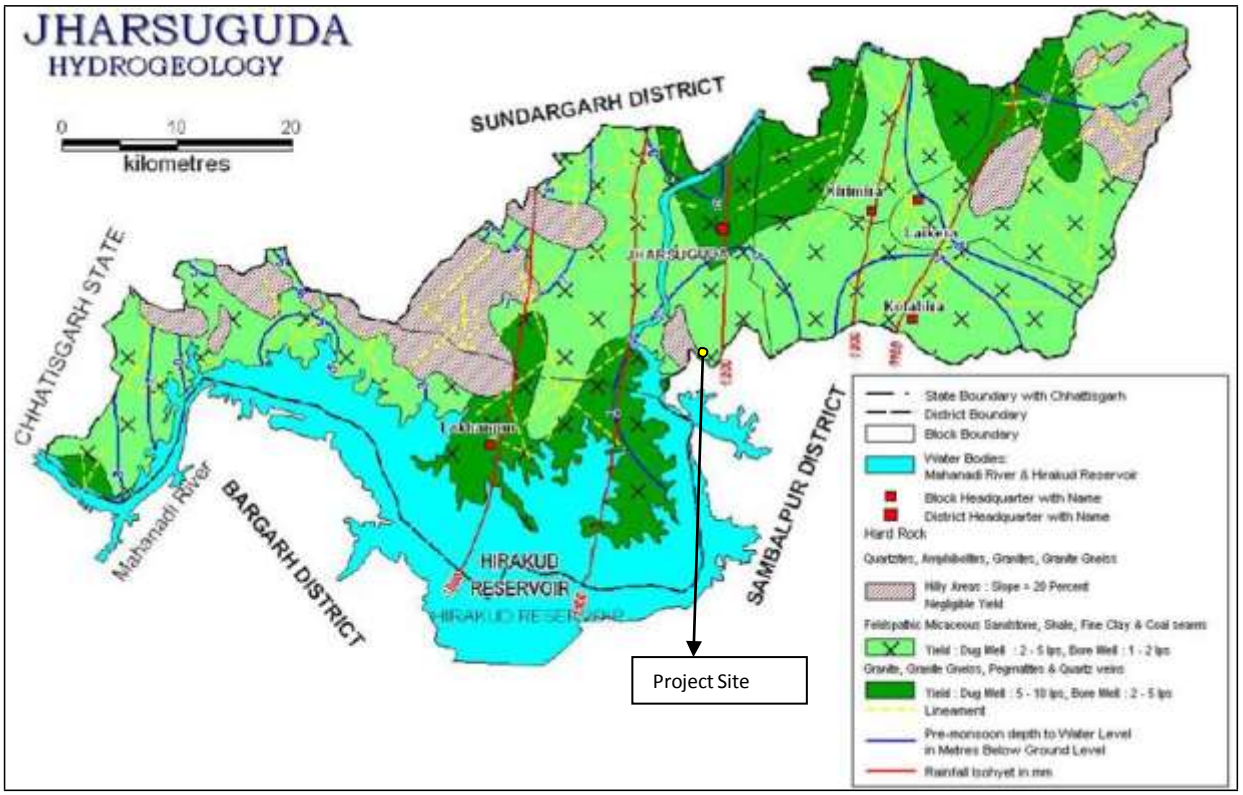


Figure 3.7 – Hydrogeology Map of Jharsuguda District

3.8 Ground Water Resources

Jharsuguda has an annually replenish able ground water resource of 17266 Ha.m (Hectare meter). The existing gross Ground water Draft for irrigation is 2733 Ha and the existing gross ground water draft for domestic and industrial water supply is 1143 Ham. Hence the total ground water draft for all uses is 3876 Ham. The net ground water availability for future irrigation and development is 12684 Ham. The stage of ground water development is 22.45%. The ground water resource of Jharsuguda district is given in **Table 3.9** and **Figure 3.8**.

Table 3.9 – Ground water Resources of Jharsuguda District

Sl No	Block	Utilizable Ground Water Resources	Gross Ground Water Draft for all uses	Balance Ground Water Resources	Allocation for Domestic and Industrial Requirement for next 25 years	Net Ground Water Availability for Future Irrigation Development	Stage of Ground Water Development	Category
		Ha. M	Ha. M	Ha. M	Ha. M	Ha. M	%	
1	Jharsuguda	4284	1050	3686	809	2877	24.51	Safe
2	Kirimira	1571	625	1037	139	898	39.78	Safe
3	Kolabira	2756	440	2410	163	2247	15.97	Safe

4	Laikera	4239	592	3753	172	3581	13.97	Safe
5	Lakhanpur	4416	1169	3647	566	3081	26.47	Safe
District Total		17266	3876	14533	1849	12684	22.45	Safe

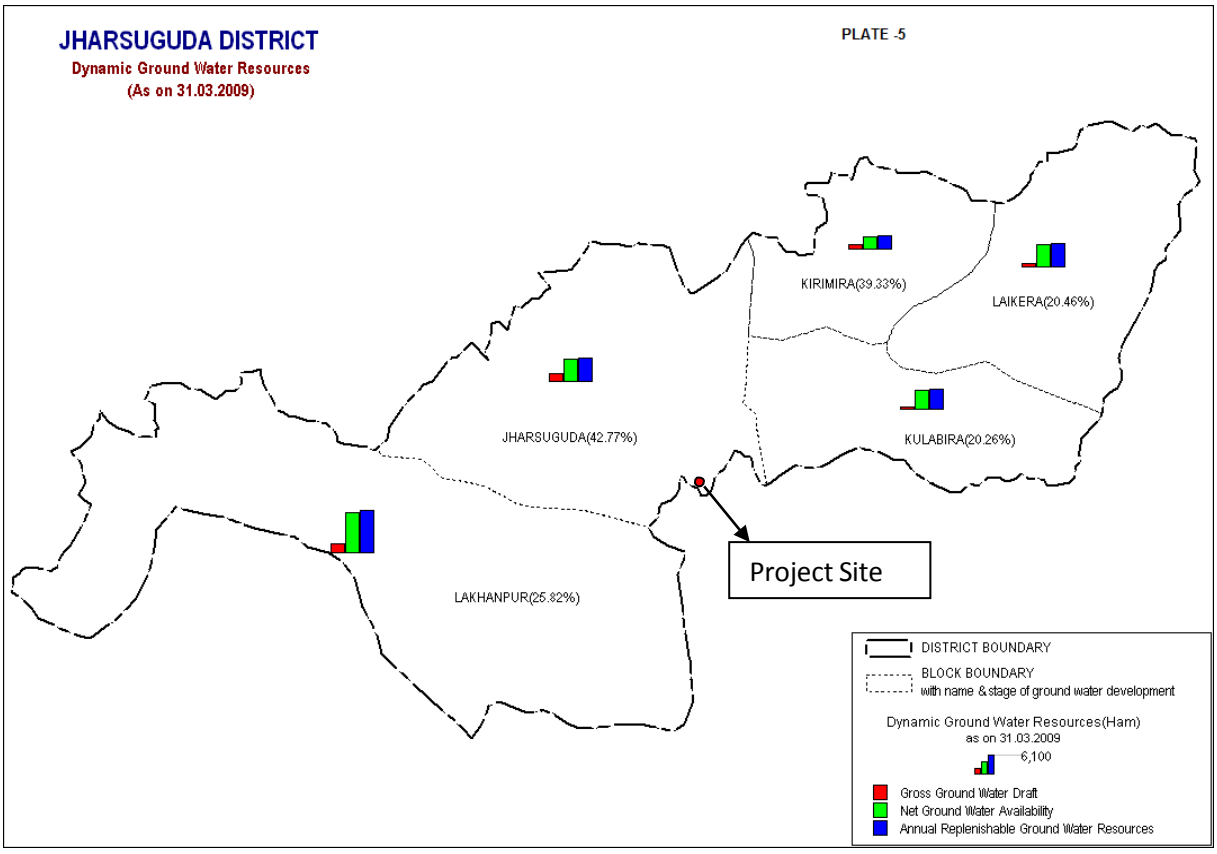


Figure 3.8 – Ground Water Resources Map Of Jharsuguda District

3.9 9 Seismicity of The Area

There are 4 major seismic zones (zones II, III, IV and V) in India (**Figure 3.9**), based on the seismo-tectonic parameters, history of seismicity and certain geophysical parameters. The project site at Tareikela village, Jharsuguda district comes under **Seismic zone II**

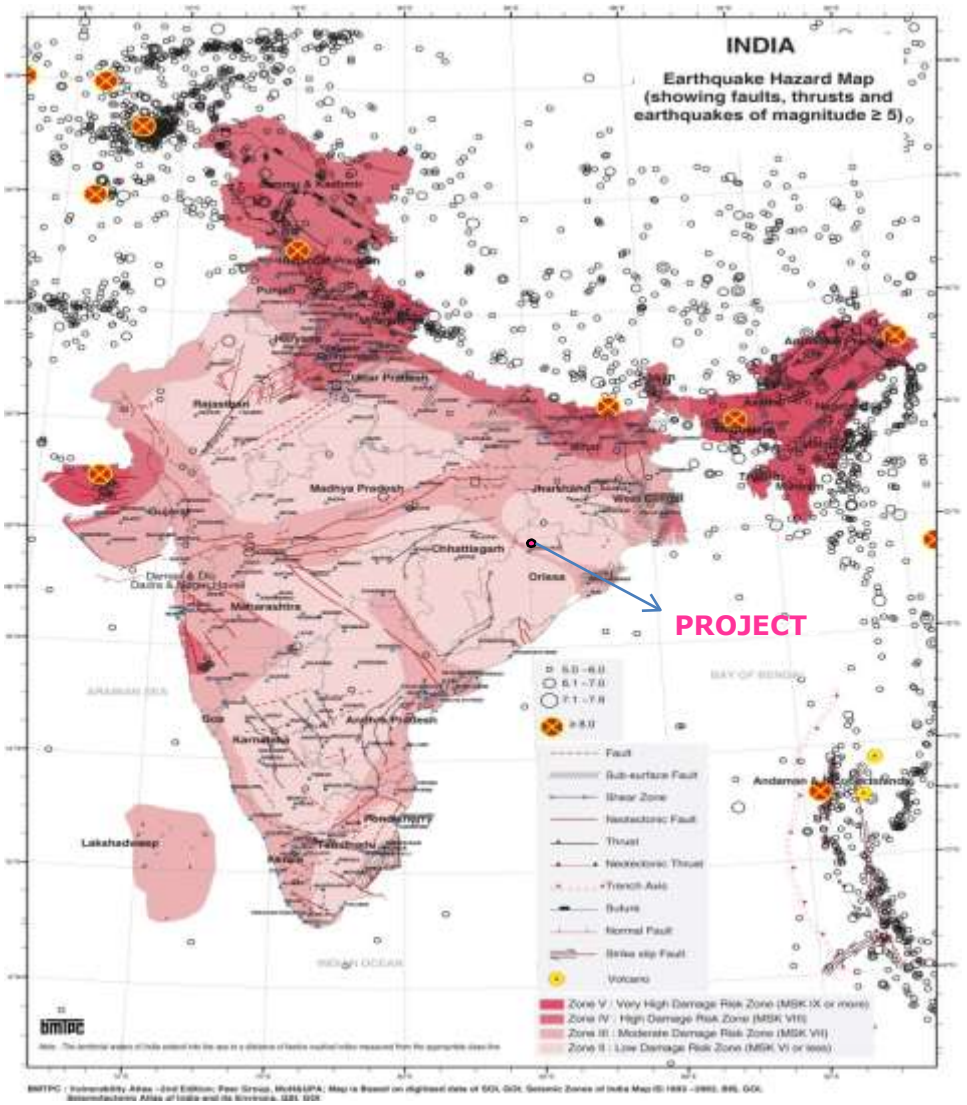


Figure 3.9 - Map Showing Seismic Tectonic Zone

3.10 Flood Hazard Zone of the Area

As per the "Vulnerability Atlas – 2nd Edition; Peer Group, MoH & UPA; based on digitized data of SOI, GOI; Flood Atlas, Task Force Report, C.W.C., GOI" the project site does not fall under "area liable to flood" (Figure 3.10).

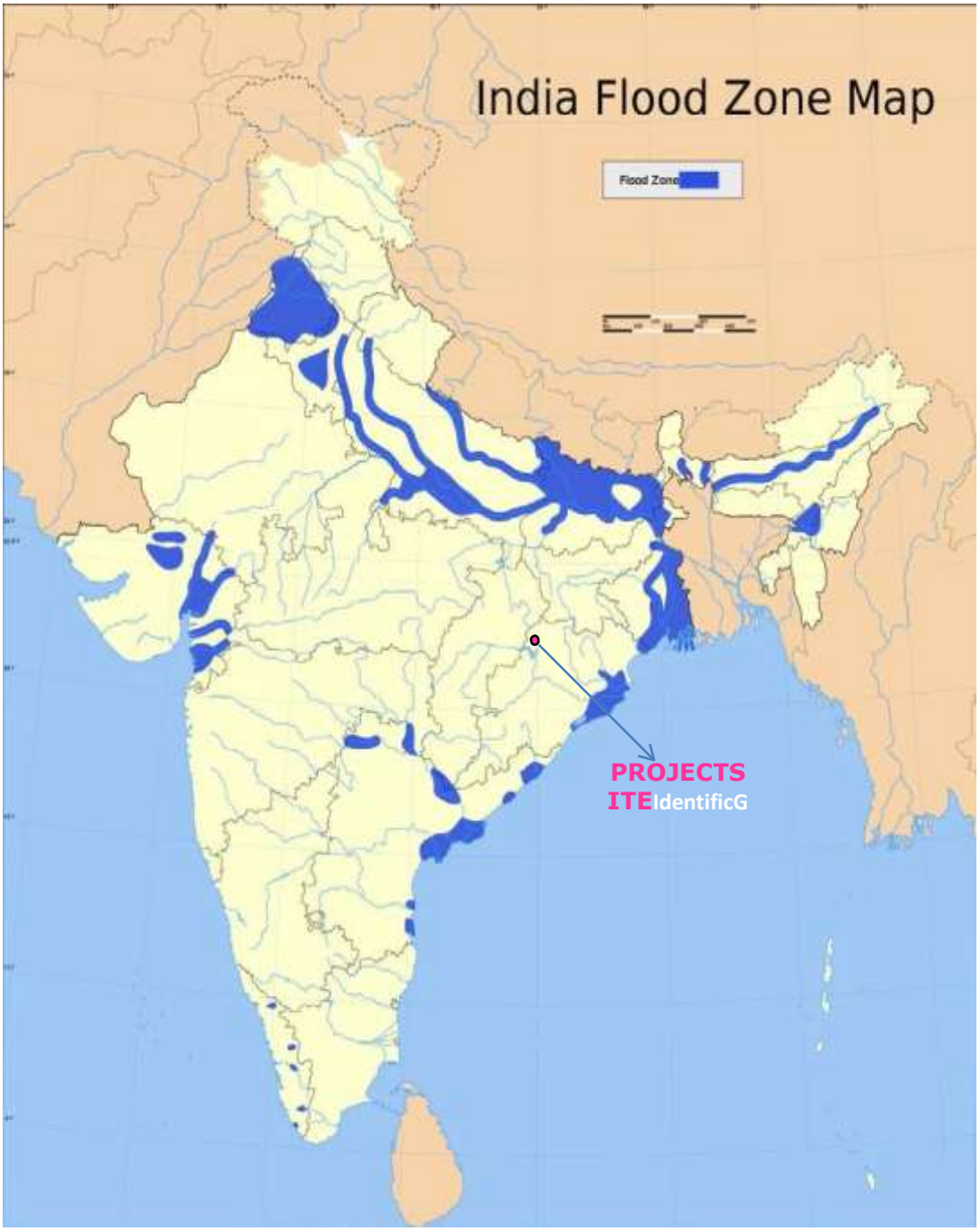


Figure 3.10 Flood Hazard Zone of the Area

3.11 Air Environment

To study the baseline air quality scenario in the study area, 10 ambient air quality monitoring (AAQM) stations were selected in the study area in different directions and at different distances from the project site keeping in view of the guidelines of the Ministry of Environment, Forest and Climate Change (MOEF&CC).Envirotech APM 460 BL Respirable Dust Sampler (RDS) and Sampler

(Envirotech APM 550)/ Ecotech (AAS 127) fine particulate matter were deployed for ambient air quality monitoring.

3.11.1 Selection of Sampling Locations

The locations for air quality monitoring were scientifically selected based on the following considerations using climatologically data.

- Topography / Terrain of the study area
- Human Settlements
- Health status
- Accessibility of monitoring site
- Resource Availability
- Representativeness of the region for establishing baseline status
- Representativeness with respect to likely impact areas.

The Ambient Air Quality monitoring locations are given in **Table 3.11** and shown in **Figure 3.11.**

Table 3.10 – Ambient Air Quality Monitoring Locations

Air sampling location code	Location	Geographical location	Direction with the respect to project site	Distance with respect to project site (km)	Environmental Setting
AAQ1	Project site	21°46'20.0"N; 83°59'31.02"E	-	-	Rural
AAQ2	Thelkoloi	21°45'36.8"N; 84°00'42.1"E	ESE	2.47	Rural
AAQ3	Khinda	21°44'21.2"N; 83°58'56.0"E	SSW	3.90	Rural
AAQ4	Talabira	21°44'15.4"N; 83°57'86.2"E	SSE	4.09	Rural
AAQ5	Patrapali	21°45'37.5"N; 83°57'14.8"E	WSW	4.21	Rural
AAQ6	Brajrajnagar	21°49'09.6"N; 83°55'54.7"E	NW	8.08	Industrial
AAQ7	Jharsuguda	21°51'34.5"N; 84°01'02.1"E	NNE	9.90	Commercial
AAQ8	Rampur	21°46'40.2"N; 83°56'21.5"E	WNW	5.51	Rural
AAQ9	New Ash Pond	21°45'07.5"N; 84°00'32.0"E	SE	2.90	Rural
AAQ10	Kantatikra	21°46'35.7"N; 83°53'56.7"E	W	9.66	Rural

3.11.2 Parameters for Sampling

The parameters chosen for assessment of ambient air quality were Particulate Matter<10 (PM_{10}), Particulate Matter<2.5 ($PM_{2.5}$), Sulphur dioxide (SO_2), Oxides of Nitrogen (NO_x), Carbon Monoxide (CO), TVOC.

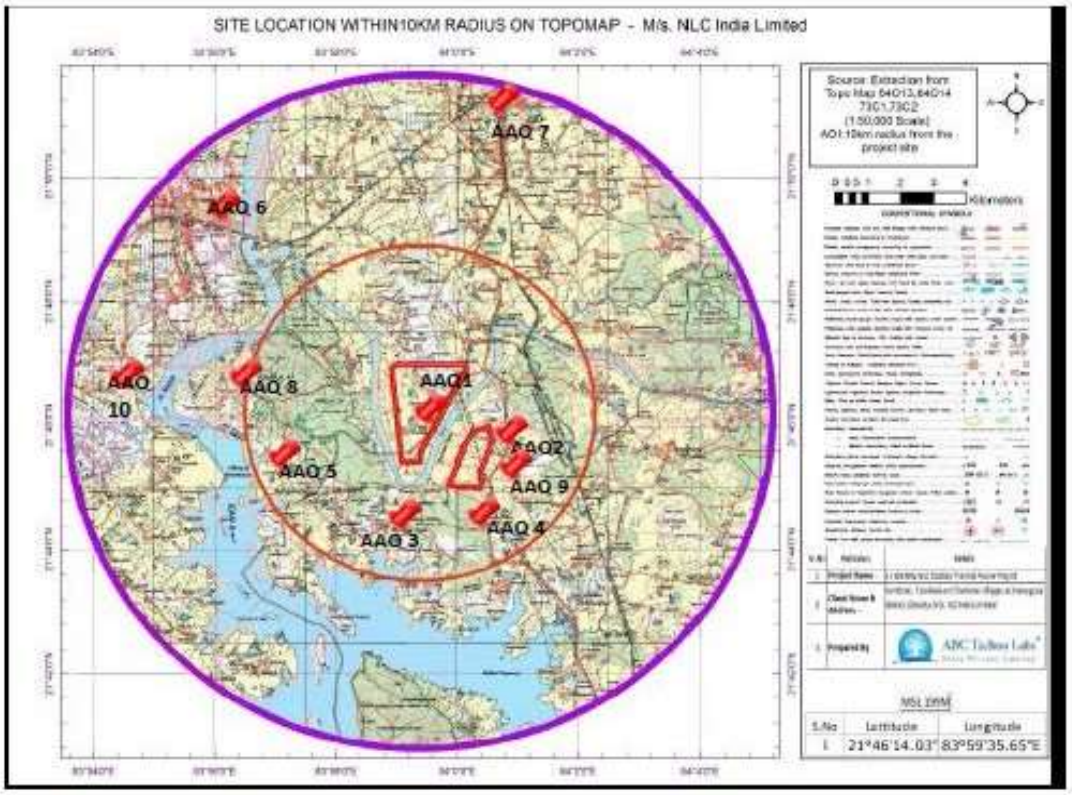


Figure 3.11– Map Showing Air Quality Monitoring Stations Locations

3.11.3 Instruments Used For Sampling

Respirable Dust Samplers APM- 460 BL of Envirotech was used for monitoring Particulate matter (PM-10), gaseous pollutants like SO_2 and NO_x ,MVS sampler for Hg, Fine Particulate Samplers APM 550 of Envirotech was used for monitoring $PM_{2.5}$.

3.11.4 Sampling and Analytical Techniques

PM_{10} and $PM_{2.5}$ have been estimated by gravimetric method. In RDS, ambient air is sucked through a cyclone. Coarse and non-respirable dust is separated from the air stream by centrifugal forces acting on the solid particles, these particles fall through the cyclone's conical hopper and get collected in the sampling cap placed at the bottom. The fine dust (<10 microns) forming the respirable particulate matter (PM_{10}) passes the cyclone and is retained on the filter paper. A tapping is provided on the suction side of the blower to provide suction for sampling air througha

set of impingers which contains absorbing solutions for SO_2 and NO_x. Samples of gases are drawn at a flow rate of 0.2 lpm.

$PM_{2.5}$ was determined by Fine Particulate Sampler. The air inlet has a circular symmetry so that air entry is unaffected by wind direction and is designed to keep out rain, insects and very large particles. The inlet section immediately leads to an impactor stage designed to trap particles with an aerodynamic diameter larger than 10 microns. Thus the air stream in the down tube consists of only medium and fine particulates. The streamlined air flow of the down tube is accelerated through the nozzle of the well-shaped impactor designed to trap medium size particulates with an aerodynamic diameter between 2.5 and 10 microns. To avoid sampling errors due to the tendency of small particles to bounce off the impaction surface a 37mm diameter GF/A paper immersed in silicone oil is used as an impaction surface. The air stream leaving the WINS impactor consists of microns. These fine particles are collected on a special Teflon membrane filter of 47 mm diameter.

Modified West and Gaeke method (IS-5182 part-II, 1969) has been adopted for estimation of SO_2, EPA IO-5 for Hg and Jacobs-Hochheiser method (IS-5182 part-IV, 1975) has been adopted for the estimation of NO_x. The test method for sampling and analysis of parameters are presented in **Table 3.11.**

Table 3.11- Test method used for Ambient Air Quality Monitoring

S. No	Parameters	Test method
1	Particulate Matter (PM_{10}), µg/m³	IS 5182 Pt.23 : 2006 (Reaff. 2017)
2	Particulate Matter ($PM_{2.5}$), µg/m³	40 CFR Appendix L to Part 50
3	Oxides of Sulphur (SO_2), µg/m³	IS 5182: Part 2:2001 (Reaff. 2017)
4	Oxides of Nitrogen (NO_x), µg/m³	IS 5182: Part 6:2006 (Reaff. 2017)
5	Total Volatile Organic Compounds (TVOC), µg/m³	EPA METHOD TO – 17
6	Carbon Monoxide, mg/m³	IS 5182 (Part 10): 1999 (RA 2014)
7	Mercury	EPA IO-5

3.11.5 Results

Various parameters like maximum, minimum and average have been computed from the monitored data for all the locations and summary of Ambient Air Quality test results are presented in **Tables 3.12.**

Table 3.12 Ambient Air Quality Test Results

Co-de	Loca-tion	PM_{10} (µg/m³)				$PM_{2.5}$ (µg/m³)				SO_2 (µg/m³)				NO_2 (µg/m³)			
		Min	Max	Avg	98 Perc.	Min	Max	Avg	98 Perc.	Min	Max	Avg	98 Perc.	Min	Max	Avg	98 Perc.
AAQ1	Project Site	61.80	79.60	72.88	79.384	27.10	41.50	24.25	41.212	8.50	11.70	10.45	11.700	15.20	24.90	21.24	24.900
AAQ2	Thel-koloi	63.60	79.80	73.43	79.73	29.40	41.40	34.38	39.10	5.20	6.77	5.82	6.69	9.90	14.10	11.61	13.96
AAQ3	Khinda	52.80	75.40	66.78	74.212	25.10	35.40	30.44	35.202	5.20	6.30	5.60	6.300	10.10	13.80	11.60	13.734
AAQ4	Talabira	54.80	73.60	65.32	72.874	23.90	36.60	30.46	36.072	5.20	6.77	5.90	6.767	9.90	14.10	11.65	13.836
AAQ5	Patra-pali	48.90	69.10	59.07	68.51	24.70	35.40	28.41	34.41	5.90	7.00	6.29	7.00	11.90	17.10	14.49	16.97
AAQ6	Brajraj-nagar	49.80	76.30	63.68	75.838	24.90	36.90	30.38	35.58	5.20	6.30	5.59	6.3	10.10	13.80	11.52	13.734
AAQ7	Jharsu-guda	52.90	75.90	65.23	74.712	25.80	36.60	31.28	35.61	7.90	11.20	9.77	11.134	9.90	14.10	11.75	13.968
AAQ8	Rampur	49.60	76.40	62.04	74.744	24.50	36.90	29.96	36.828	5.20	6.30	5.61	6.3	10.10	13.80	11.52	13.728
AAQ9	New Ash Pond	57.10	79.60	69.07	79.072	24.70	28.10	32.57	37.308	7.30	11.20	9.61	11.134	5.69	8.40	6.51	8.4
AAQ10	Kanta-tikra	48.80	72.50	61.32	71.906	23.60	36.70	29.84	36.634	9.50	11.70	10.68	11.568	19.10	24.90	21.74	24.702
CPCB / MoEF Standards																	
Industrial /Residential / Rural and Other Area		**100**				**60**				**80**				**80**			

Code	Location	CO (mg/m³)				NH_3 (µg/m³)				O_3 (µg/m³)				Lead (µg/m³)				Mercury(ng/m3)			
		Min	Max	Avg	98 Perc.	Min	Max	Avg	98 Perc.	Min	Max	Avg	98 Perc.	Min	Max	Avg	98 Perc.	Min	Max	Avg	98
AAQ1	Project Site	0.11	0.20	0.14	0.193	BDL <5				9.87	15.20	12.48	14.696	BDL <5				BDL <0.1			
AAQ2	Thelkoloi	0.11	0.18	0.14	0.18					5.66	12.20	8.04	11.48								
AAQ3	Khinda	0.10	0.17	0.14	0.170					5.47	9.32	7.04	8.937								
AAQ4	Talabira	0.11	0.18	0.14	0.1734					5.78	8.96	6.90	8.4254								
AAQ5	Patrapali	0.11	0.17	0.14	0.17					5.69	14.10	11.71	13.77								
AAQ6	Brajrajnagar	0.11	0.18	0.14	0.1734					5.36	10.10	7.24	9.4664								
AAQ7	Jharsuguda	0.11	0.18	0.14	0.1734					5.17	8.74	6.66	8.5948								
AAQ8	Rampur	0.11	0.18	0.14	0.18					5.66	8.11	6.66	8.11								
AAQ9	New Ash Pond	0.11	0.18	0.14	0.1734					0	0	0	0								
AAQ10	Kantatikra	0.11	0.18	0.14	0.1734					10.30	15.10	13.05	14.77								
CPCB / MoEF Standards																					
Industrial/Residential / Rural and Other Area		**2**				**400**				**100**				**1**				**Not specified**			

Co-de	Loca-tion	Benzene (µg/m³)				BaP (ng/m³)				As (ng/m³)				Ni (ng/m³)			
		Min	Max	Avg	98 Perc.	Min	Max	Avg	98 Perc.	Min	Max	Avg	98 Perc.	Min	Max	Avg	98 Perc.
AAQ1	Project Site	BDL				BDL				BDL				BDL			
AAQ2	Thelkoloi																
AAQ3	Khinda																
AAQ4	Talabira																
AAQ5	Patra-pali																
AAQ6	Brajraj-nagar																
AAQ7	Jharsu-guda																
AAQ8	Rampur																
AAQ9	New Ash Pond																
AAQ10	Kanta-tikra																
CPCB / MoEF Standards																	
Industrial /Residential / Rural and Other Area		**5**				**1**				**6**				**20**			

3.11.6 Observations

PM_{10}: The highest 98th percentile concentration of PM_{10} (79.73 µg/m³) was recorded at Thelkoloi (AAQ2). PM_{10} concentrations at all sampling locations were within the standard of 100 µg/m³ set by the CPCB, with the lowest (68.51 µg/m³) being recorded at the Patrapali (AAQ5).

$PM_{2.5}$: The highest 98th percentile concentration of $PM_{2.5}$ (41.212 µg/m³) was recorded at Project site (AAQ1). At the other sampling locations, the $PM_{2.5}$ concentrations were within the standard of 60 µg/m³ set by the CPCB, with the lowest (34.41 µg/m³) being recorded at Patrapali (AAQ5).

SO_2: The highest 98th percentile concentration of SO_2 (11.70 µg/m³) was recorded at the Project site-Tareikela (AAQ1). At all the sampling locations, the SO_2 concentrations were within the standard of 80 µg/m³ set by the CPCB, with the lowest (6.3 µg/m³) being recorded at Khinda, Brajrajnagar and Rampur (AAQ 3, 6, 8).

NO_2: The highest 98th percentile concentration of NO_2 (24.90 µg/m³) was recorded at the project site- Tareikela (AAQ1). At all the sampling locations, the NO_2 concentrations were within the standard of 80 µg/m³ set by the CPCB, with the lowest (8.40 µg/m³) being recorded at the New Ash Pond (AAQ9).

CO: The highest 98th percentile concentration of CO (0.193 mg/m³) was recorded at the project site-Tareikela (AAQ1). At all the sampling locations, the CO concentrations were within the standard of 2 mg/m³ set by the CPCB, with the lowest (0.170 mg/m³) being recorded at Khinda and Patrapali (AAQ3,5).

Ammonia (NH_3): At all sampling locations, the recorded concentrations of Ammonia were below 5 µg/m³, which is considered BDL (Below Detection Limit). The standard set by the CPCB is 400 µg/m³ of NH_3.

Ozone (O_3): The highest 98th percentile concentration of Ozone (14.77 µg/m³) was recorded at the Kantatikra (AAQ10). At all the sampling locations, the Ozone concentrations were within the standard of 100 µg/m³ set by the CPCB, with the lowest (0 µg/m³) being recorded at the New Ash Pond (AAQ9).

Lead: At all sampling locations, the recorded concentrations of Lead were below 5 µg/m³, which is considered BDL (Below Detection Limit). The standard set by the CPCB is 1 µg/m³ of Lead.

Benzene: At all sampling locations, the recorded concentrations of Benzene were below 5 µg/m³, which is considered BDL (Below Detection Limit). The standard set by the CPCB is 5 µg/m³ of Benzene.

Benzo(a)pyrene (BaP): At all sampling locations, the recorded concentrations of Benzo(a)pyrene were below 5 ng/m^3, which is considered BDL (Below Detection Limit). The standard set by the CPCB is 1 ng/m^3 of Benzo(a)pyrene.

Arsenic (As): At all sampling locations, the recorded concentrations of Arsenic were below 6 ng/m^3, which is considered BDL (Below Detection Limit).

Nickel (Ni): At all sampling locations, the recorded concentrations of Nickel were below 5 ng/m^3, which is considered BDL (Below Detection Limit). The standard set by the CPCB is 20 ng/m^3 of Nickel.

Mercury (Hg): At all sampling locations, the recorded concentrations of Mercury were below 1ng/m3, which is considered BDL (Below Detection Limit).

3.12 Noise Environment

The main objective of monitoring of ambient noise levels was to establish the baseline noise levels in the surrounding areas and to assess the total noise level in the environment of the study area.

3.12.1 Identification Of Sampling Locations

A preliminary reconnaissance survey was undertaken to identify the major noise sources in the area. The sampling location in the area was identified considering the location of industry, residential area, Highways and Institutional areas. The noise monitoring locations are presented in **Table 3.13** and shown in **Figure 3.12.**

Table 3.13 – Noise Quality Monitoring stations

Location Code	Sample location	Geographical location	Direction with respect to project site	Distance with respect to project site (km)	Environmental Setting
N1	Project site	21°46'20.0"N; 83°59'31.02"E	-	-	Rural
N2	Thelkoloi	21°45'36.8"N; 84°00'42.1"E	ESE	2.47	Rural
N3	Gumakarama	21°45'31.6"N; 84°03'28.5"E	E	6.97	Rural
N4	Talabira	21°44'15.4"N; 83°57'86.2"E	S	3.95	Rural
N5	Khinda	21°44'21.2"N; 83°58'56.0"E	SSW	3.92	Rural
N6	Brajrajnagar	21°49'09.6"N; 83°55'54.7"E	NW	8.07	Industrial
N7	Kukurjangha	21°45'31.6"N; 84°03'28.5"E	E	6.97	Rural
N8	Jharsuguda	21°51'34.5"N; 84°01'02.1"E	NNE	9.90	Commercial

3.12.2 Instrument Used For Sampling

Noise levels were measured using a sound level meter. The sound level meter measures the equivalent continuous noise level (Leq) by switching on the corresponding function mode.

3.12.3 Method of Monitoring

Noise, in general, is sound which is composed of many frequency components of various types of loudness distributed over the audible frequency range. Various noise scales have been introduced to describe, in a single number, the response of an average human to a complex sound made up of various frequencies at different loudness levels. The most common and universally accepted scale is the 'A' weighted Scale which is measured as dB (A). This is more suitable for an audible range of 20 to 20,000 Hz. The scale has been designed to weigh various components of noise according to the response of a human ear.

Sound Pressure Level (SPL) measurements were measured at all locations. The readings were taken for every hour for 24 hours. The day noise levels have been monitored during 6 am to 10 pm and night levels during 10 pm to 6 am at all the locations covered in a 10-km radius of the study area. The noise levels were measured once during the study period. These readings were later tabulated and the frequency distribution table was prepared. Finally, hourly and 24 hourly values for various noise parameters viz. L day and L night were calculated.

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

L_{10} is the noise level exceeded 10 percent of the time
L_{50} is the noise level exceeded 50 percent of the time and
L_{90} is the noise level exceeded 90 percent of the time

Equivalent Sound Pressure Level (Leq)

The Leq is the equivalent continuous sound level, which is equivalent to the same sound energy as the actual fluctuating sound measured in the same period. This is necessary because the sound from noise source often fluctuates widely during a given period of time.
This is calculated from the following equation:

$$\mathbf{Leq = L50 + (L_{10} - L_{90})^2/60}$$

Parameters Measured During Monitoring

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

Hourly Leq day: Equivalent noise levels between 6.00 hours to 22.00 hours.

Leq night: Equivalent noise levels between 22.00 hours to 6.00 hours.

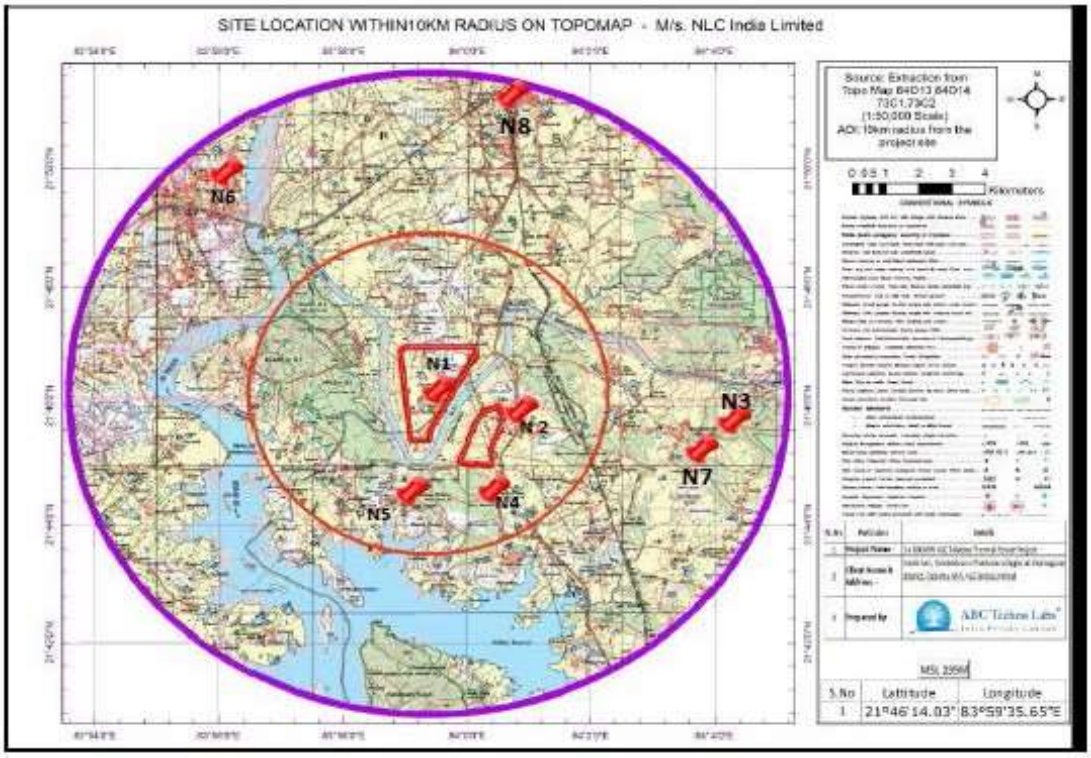


Figure 3.12 - Map Showing The Location Of Noise Level

Monitoring Stations

3.12.4 Results

The summary of computed ambient noise level parameters like L_{day} and L_{night} are presented in **Table 3.14** and compared to the standards specified by CPCB mentioned below in **Table 3.15.**

Table 3.14 – Ambient Noise Level

Location Code	Sample Location	Lday dB(A)	Lnight dB(A)	Leq dB(A)
N1	Tareikela	48.9	38.1	47.3
N2	Thelkoloi	52.6	42.1	51
N3	Gumakarama	47.5	39.3	46.1

N4	Talabira	48.1	40.7	46.7
N5	Khinda	46.9	38.9	45.4
N6	Brajrajnagar	51.7	43.5	50.2
N7	Kukurjangha	47.6	39.9	46.1
N8	Jharsuguda	57.3	44.3	55.6

Table 3.15 – Ambient Noise Quality Standards

Category of Area / Zone	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

Source: CPCB

Note: *Daytime shall mean from 6.00 a.m. to 10.00 p.m.*

Night time shall mean from 10.00 p.m. to 6.00 a.m.

3.12.5 Observations

Daytime Noise Levels

The maximum Daytime Noise Level was recorded at Jharsuguda (57.3 dB (A)) while the minimum Daytime Noise Level was recorded at Khinda (46.9 dB (A)). The Daytime Noise Level at all locations was found to fall within the limit of 75 dB (A) for Industrial Area, within the limit of respected category prescribed by the CPCB.

Night time Noise Levels

The maximum Nighttime Noise Level was recorded at Jharsuguda (44.3 dB (A)) while the minimum Nighttime Noise Level was recorded at Tareikela (38.1 dB (A)). The Nighttime Noise Level at all locations was found to fall within the limit of 70 dB (A) for Industrial Area, within the limit of respected category prescribed by the CPCB.

3.13 Water Environment

Water sampling has been conducted to establish baseline water quality in the area. Water analysis was carried out for physical and chemical parameters as per the methods prescribed in

IS and "Standard Methods for the Examination of Water and Wastewater (American Public Health Association)".

3.13.1 Sampling Locations

The details of the water sampling stations are presented in the **Table 3.16** and shown in **Figure 3.13.**

Table – 3.16 Water Quality Monitoring Locations

Location Code	Location	Geographical location	Direction with respect to project site	Distance wit respect to project site (km)	Type of water
GW1	Project site	21°46'21.4"N; 83°59'32.0"E	-	-	Ground water
GW2	Thelkoloi	21°45'36.8"N; 84°00'42.1"E	ESE	2.47	Ground water
GW3	Patrapali	21°45'37.5"N; 83°57'14.8"E	WSW	4.2	Ground water
GW4	Gumakarama	21°45'31.7"N; 84°03'28.6"E	ESE	6.97	Ground water
GW5	Kukurjangha	21°48'52.6"N; 83°59'02.7"E	NNW	4.68	Ground water
SW1	Bedhan River US	21°47'23.2"N; 83°58'42.4"E	NNW	2.35	Surface water
SW2	Bedhan River DS	21°46'19.6"N; 84°04'33.4"E	E	8.65	Surface water
SW3	IB River US	21°51'48.1"N; 83°56'51.1"E	NNW	11	Surface water
SW4	IB River DS	21°43'22.8"N; 83°58'37.9"E	SSW	5.77	Surface water
SW5*	Hirakud Reservoir	21.565456° N; 83.971220° E	S	23	Surface water

*** Water Source for the Project**

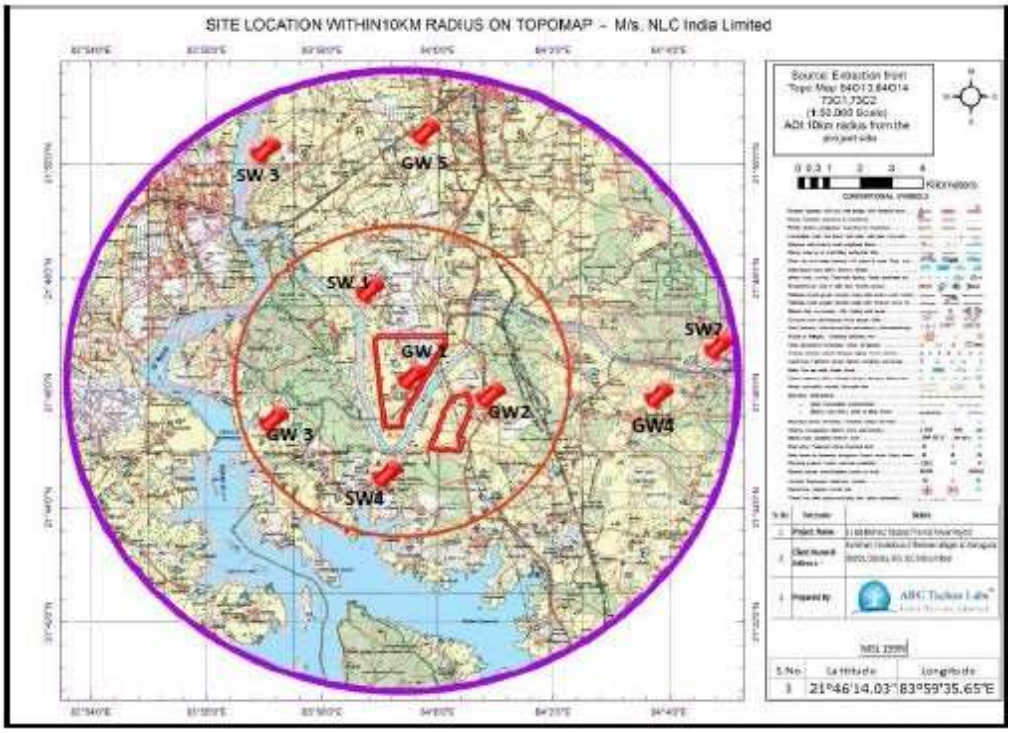


FIGURE 3.13 - MAP SHOWING WATER QUALITY MONITORING LOCATIONS

3.13.2 Results

The physicochemical characteristics of water in the study area are presented in the **Tables 3.17** and is compared with the standards (IS 10500: Indian Standards/Specifications for Drinking Water) reference values.

Table 3.17 – Results for Water Analysis

S. No	Parameters	Unit	Test method	Limit as per IS 10500 : 2012	GW1	GW2	GW3	GW4	GW5
1	Colour	-	APHA 22nd EDITION	5	3	2	Nil	1	3
2	Odour	-	APHA 22nd EDITION	Unobjection-able	No Odour observ-ed	No Odour observed	No Odour observed	No Odour observ-ed	No odour observ-ed
3	pH at 25°C	-	IS : 3025 Part 11- 1983 (Reaff: 2002)	6.5-8.5	6.58	6.91	6.62	6.65	6.06
4	Electrical Conductivity	µS/cm	IS : 3025 Part 14- 1984 (Reaff: 2002)	Not Specified	140	130	97	652	198
5	Turbidity	NTU	IS : 3025 Part 10-1984 (Reaff: 2002)	1	1.6	1.4	0.6	1.3	1.9
6	Total Dissolved Solids	mg/l	IS : 3025 Part 16-1984 (Reaff: 2003)	500	76	69	52	354	106
7	Total Hardness as $CaCO_3$	mg/l	IS : 3025 Part 21-2009	200	52	34	22	172	60
8	Total Alkalinity as $CaCO_3$	mg/l	IS : 3025 Part 23-1986(Reaff:2003)	200	46	48	18	88	68
9	Chloride as Cl	mg/l	IS : 3025 Part 32-1988 (Reaff: 2003)	250	12.7	11	17	112	22
10	Sulphate as SO_4	mg/l	APHA 22nd EDN-4500-	200	3	2	2	47	3

			SO_4^{2-} E						
11	Fluoride as F	mg/l	APHA 22nd EDN -4500-F B&D	1	0.18	0.36	0.13	0.36	0.17
12	Nitrate as NO_3	mg/l	APHA 22nd EDN -4500-NO_3^- B	45	1.6	1	2.9	20	1.1
13	Ammonia as N	mg/l	APHA 22nd EDN -4500-NH_3 B&C	0.5	BDL <0.05	BDL <0.05	BDL <0.05	BDL <0.05	BDL <0.05
14	Sodium as Na	mg/l	IS : 3025 Part 45-1993 (Reaff:2003)	Not Specified	8	9	11	54	18
15	Potassium as K	mg/l	IS : 3025 Part 45-1993 (Reaff:2003)	Not Specified	1	1	1.3	12	2.6
16	Calcium as Ca	mg/l	IS : 3025 Part 40-1991 (Reaff:2003)	75	14	12	5	48	14
17	Magnesium as Mg	mg/l	APHA 22nd EDN-3500, Mg - B	30	4	3.9	2	13	6
18	Iron as Fe	mg/l	IS : 3025 Part 53-2003	1	0.24	0.41	0.26	0.33	0.54
19	Manganese as Mn	mg/l	APHA 22nd EDN-3500, Mn D	0.1	BDL <0.05	BDL <0.05	BDL <0.05	BDL <0.05	BDL <0.05
20	Phenolic compounds as Phenol	mg/l	APHA 22nd EDN-5530, Mn - B, C, D	0.001	BDL <0.001	BDL <0.001	BDL <0.001	BDL <0.001	BDL <0.001

21	Copper as Cu	mg/l	IS: 3025 Part 42 (Reaff: 2003)	0.05	BDL <0.03	BDL <0.03	BDL <0.03	BDL <0.03	BDL <0.03
22	Mercury as Hg	mg/l	APHA 22nd EDN-3112 B	0.001	BDL <0.001	BDL <0.001	BDL <0.001	BDL <0.001	BDL <0.001
23	Cadmium as Cd	mg/l	APHA 22nd EDN-3113 B	0.003	BDL <0.001	BDL <0.001	BDL <0.001	BDL <0.001	BDL <0.001
24	Selenium as Se	mg/l	APHA 22nd EDN-3113 B	0.01	BDL <0.01	BDL <0.01	BDL <0.01	BDL <0.01	BDL <0.01
25	Total Arsenic as As	mg/l	APHA 22nd EDN-3113 B	0.01	BDL <0.01	BDL <0.01	BDL <0.01	BDL <0.01	BDL <0.01
26	Cyanide as CN	mg/l	APHA 22nd EDN-4500 – CN E	0.05	BDL <0.05	BDL <0.05	BDL <0.05	BDL <0.05	BDL <0.05
27	Lead as Pb	mg/l	APHA 22nd EDN-3113 B	0.01	BDL <0.01	BDL <0.01	BDL <0.01	BDL <0.01	BDL <0.01
28	Zinc as Zn	mg/l	APHA 22nd EDN-3111 B	5	0.27	0.096	0.173	0.361	0.114
29	Total Chromium as Cr	mg/l	APHA 22nd EDN-3113 B	0.05	BDL <0.03	BDL <0.03	BDL <0.03	BDL <0.03	BDL <0.03
30	Nickel	mg/l	APHA 22nd EDN-3113 B	0.02	BDL <0.02	BDL <0.02	BDL <0.02	BDL <0.02	BDL <0.02
32	Total coliforms	MPN/ 100ml	IS 10500 - 1622 (1981) (Reaff 2014)	Absent	<2	<2	<2	<2	<2
33	E coli	MPN/ 100ml	IS 10500 - 1622 (1981) (Reaff 2014)	Absent	<2	<2	<2	<2	<2

BDL – Below Detection Limit

S. No	Parameters	Unit	Test method	SW1	SW2	SW3	SW4	SW5
1	Colour	Hazen	APHA 22ND EDITION	5	8	3	3	1
2	Odour	-	APHA 22ND EDITION	No Odour Observed	No Odour Observed	No Odour Observed	No Odour Observed	No Odour Observed
3	Turbidity	NTU	IS : 3025 Part 10-1984 (Reaff: 2002)	3.3	3.2	2	1.9	0.8
4	pH at 25°C	-	IS : 3025 Part 11- 1983 (Reaff: 2002)	7.64	8.58	7.51	7.42	8.05
5	Electrical Conductivity	µS/cm	IS : 3025 Part 14- 1984 (Reaff: 2002)	238	452	183	206	198
6	Total Dissolved Solids	mg/l	IS : 3025 Part 16-1984 (Reaff: 2003)	132	260	97	110	106
7	Total Hardness as $CaCO_3$	mg/l	IS : 3025 Part 21-1983 (Reaff: 1998)	76	110	60	56	64
8	Total Alkalinity as $CaCO_3$	mg/l	IS : 3025 Part 23-1986(Reaff:2003)	77	130	60	64	68
9	Chloride as Cl	mg/l	IS : 3025 Part 32-1988 (Reaff: 2003)	27	63	21	22	18
10	Sulphate as SO_4	mg/l	APHA 22ND EDITION - 4500- SO_4^{2-} E	6	20	1	3	3
11	Fluoride as F	mg/l	APHA 22ND EDITION - 4500-F B&D	0.59	0.91	0.49	0.48	0.38
12	Nitrate as NO_3	mg/l	APHA 22ND EDITION - 4500- NO_3^- B	3	4	BDL(<1)	1	1
13	Ammonia as NH_3	mg/l	APHA 22ND EDITION - 4500- NH_3 B&C	0.06	0.58	BDL (<0.05)	0.08	BDL (<0.05)
14	Phosphate as PO_4	mg/l	IS : 3025 Part 31-1988 (Reaff:2002)	0.18	0.42	0.15	0.13	0.10

15	Sodium as Na	mg/l	IS : 3025 Part 45-1993 (Reaff:2003)	21	54	12	17	13
16	Potassium as K	mg/l	IS : 3025 Part 45-1993 (Reaff:2003)	3.5	4.5	2	2.3	3
17	Calcium as Ca	mg/l	IS : 3025 Part 40-1991 (Reaff:2003)	20	30	14	16	19
18	Magnesium as Mg	mg/l	APHA 22ND EDITION	6	8.5	6	4	4
19	Iron as Fe	mg/l	IS : 3025 Part 53-2003	0.33	0.35	0.11	0.13	0.05
20	Manganese as Mn	mg/l	APHA 22nd EDN -3500-Mn D	BDL (<0.05)	0.14	BDL (<0.05)	BDL (<0.05)	BDL (<0.05)
21	Phenolic compounds as Phenol	mg/l	APHA 22nd EDN 5530 B,C,D	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)
22	Copper as Cu	mg/l	IS:3025 Part 42 (Reaff:2003)	BDL (<0.05)	BDL (<0.05)	BDL (<0.05)	BDL (<0.05)	BDL (<0.05)
23	Mercury as Hg	mg/l	APHA 22nd EDN -3112B	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)
24	Cadmium as Cd	mg/l	APHA 22nd EDN -3113 B	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)
25	Selenium as Se	mg/l	APHA 22nd EDN -3113B	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)
26	Total Arsenic as As	mg/l	APHA 22nd EDN -3113 B	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)
27	Cyanide as CN	mg/l	APHA 22nd EDN -4500-CN E	BDL (<0.05)	BDL (<0.05)	BDL (<0.05)	BDL (<0.05)	BDL (<0.05)
28	Lead as Pb	mg/l	APHA 22nd EDN -3113 B	BDL (<0.01)	0.13	0.10	BDL (<0.01)	BDL (<0.01)
29	Zinc as Zn	mg/l	APHA 22nd EDN -3111 B	0.056	0.288	0.041	0.056	0.011
30	Total Chromium as Cr	mg/l	APHA 22nd EDN -3113 B	BDL (<0.03)	BDL (<0.03)	BDL (<0.03)	BDL (<0.03)	BDL (<0.03)
31	Nickel	mg/l	APHA 22nd EDN -3113 B	BDL (<0.02)	BDL (<0.02)	BDL (<0.02)	BDL (<0.02)	BDL (<0.02)

32	Aluminum as Al	mg/l	APHA 22nd EDN -3500-Al-B 2012	BDL (<0.03)	BDL (<0.03)	BDL (<0.03)	BDL (<0.03)	BDL (<0.03)
33	Total Suspended Solids	mg/l	IS : 3025 Part 17-1984 (Reaff: 2002)	5	8	3	4	2
34	Anionic Surfactants as MBAS	mg/l	APHA 22ND EDITION	BDL (<0.025)	BDL (<0.025)	BDL (<0.025)	BDL (<0.025)	BDL (<0.025)
35	Dissolved Oxygen as O2	mg/l	IS:3025:Part-38:1989 (Reaff:2003)	7.3	6.3	7.8	7.7	7.6
36	Chemical Oxygen Demand	mg/l	IS:3025:Part-58:2006	10	22	8	8.6	4.8
37	Bio-Chemical Oxygen Demand at 27°C for 3 days	mg/l	IS:3025:Part-44:1993 (Reaff:2003)	<2	2.6	<2	<2	<2
38	Total Coliforms	MPN/100ml	IS 1622 (1981) (Reaff – 2014)	33	300	12	9	Absent
39	E coli	MPN/100ml	IS 1622 (1981)(Reaff – 2014)	Absent	26	Absent	Absent	Absent

3.13.3 Observations

Ground Water

The analysis of groundwater results indicate that the average pH ranges in between 6.06–6.91, TDS ranges from 52 mg/l – 354 mg/l, Total Hardness ranges from 22 mg/l - 172 mg/l,

Surface Water

The analysis of Surface water results indicate that the average pH ranges in between 7.42 – 8.58, TDS ranges from 97 mg/l - 260 mg/l, Total Hardness ranges from 56 mg/l - 110mg/l, iron content ranges from 0.05 mg/l – 0.35 mg/l, nitrate content ranges from BDL (<1) – 4 mg/l was observed DO ranges from 6.3 mg/l – 7.8 mg/l was observed.

3.14 Soil Environment

3.14.1 Soil analysis

The present study of the soiltively quality establishes the baseline characteristics and this will help in future in identifying the incremental concentrations if any, due to the operation of the proposed Project. The sampling locations have been identified with the following objectives;

- To determine the baseline soil characteristics of the study area and
- To determine the impact of proposed project on soil characteristics

Five locations within the study area were selected for soil sampling. At each location, soil samples were collected from three different depths viz., 30 cm, 60 cm and 100 cm below the surface. The samples were analyzed for physical and chemical characteristics. The details of the soil sampling location are presented in **Table 3.18** and shown in **Figure 3.14.** The results are presented in **Table 3.19** and compared with Standard Soil Classification presented in **Table 3.20.**

Table 3.18 - Soil Sampling Locations

Location Code	Location	Geographical Location	Direction wrt to project site	Distance wrt project site in km
S1	Project site	21°46'23.8"N; 83°59'34.6"E	-	-
S2	Thelkoloi	21°45'36.6"N; 84°00'41.9"E	SE	2.46
S3	Gumakarama	21°45'57.6"N; 84°04'24.1"E	E	8.41
S4	Talabira	21°44'17.3"N; 83°57'55.0"E	SSW	4.78
S5	Khinda	21°44'27.8"N; 83°58'57.6"E	SSW	3.37
S6	Brajrajnagar	21°49'08.1"N;	NW	8.03

		83°55'55.3"E		
S7	Kukurjangha	21°48'52.7"N; 83°59'02.6"E	NNW	4.65
S8	Jharsuguda	21°51'35.0"N; 84°01'01.7"E	NNE	9.91

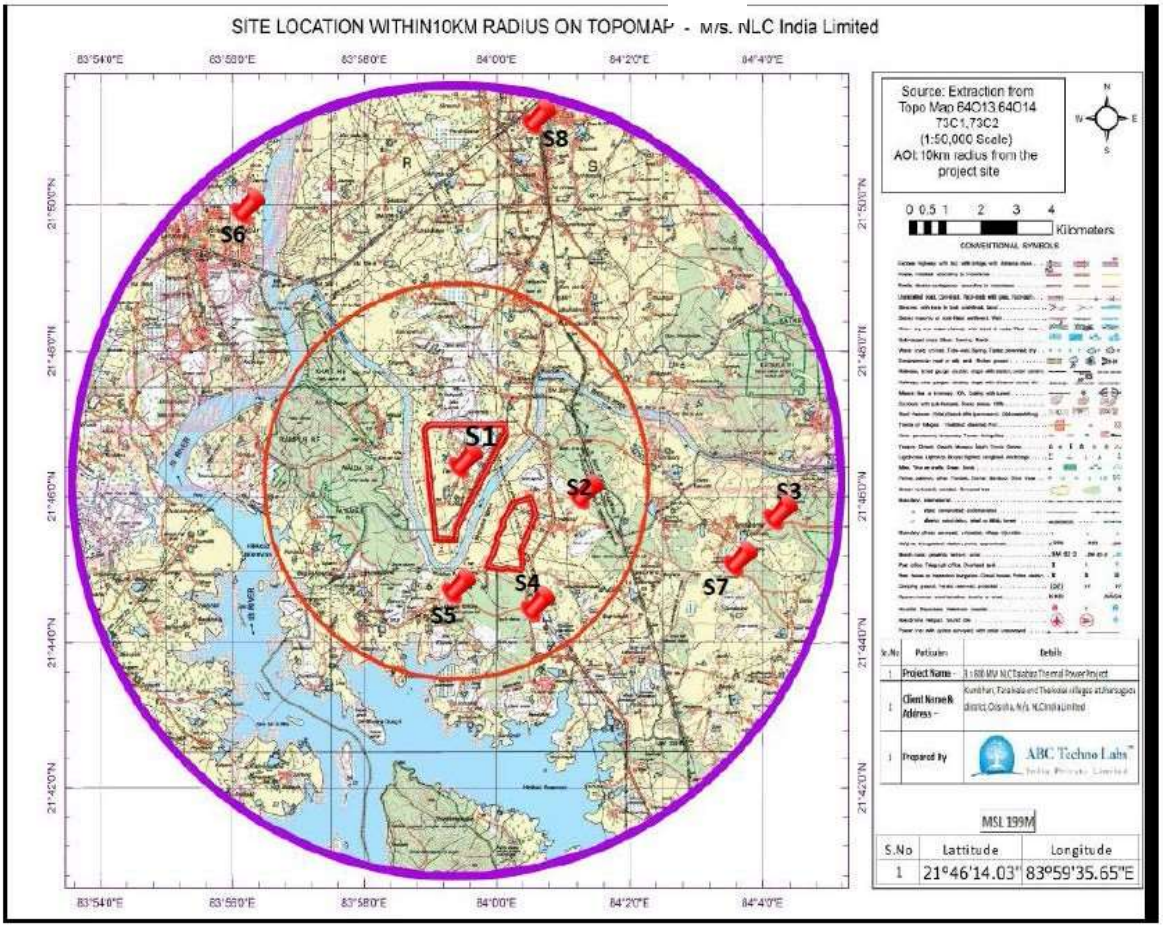


Figure 3.14 - Map Showing The Location of Soil Sampling Stations

3.14.2 Presentation of Results

The results of the soil analysis are tabulated in **Table 3.19** Standard soil classification is given in **Table 3.20**.

Table 3.19 - Soil Quality Results

S. No	Parameters	Test Method	S1	S2	S3	S4	S5	S6	S7	S8
1	pH (1:5 Suspension)	IS -2720(Part 26) 1987(RA 2011)	6.74	6.33	6.94	7.22	6.81	6.54	6.92	7.22
2	Bulk Density	FAO Chapter 3, ABCTL/SOIL/SOP 1	1.25	1.18	1.33	1.18	1.29	1.22	1.33	1.21
3	Electrical conductivity, mS/cm (1:5 Suspension)	IS -14767:2000 (RA 2010)	0.118	0.072	0.093	0.136	0.061	0.082	0.178	0.047
4	Total Nitrogen as N, Kg/ha	IS -14684:1999, Reaff:2008	366	478	302	620	296	339	412	507
5	Available Phosphorous, Kg/ha	FAO Chapter 3, ABCTL/SOIL/SOP 2	31.4	19.8	24.8	41.5	66.5	52.8	29.1	56.9
6	Available Potassium, Kg/ha	FAO Chapter 3, ABCTL/SOIL/SOP 7	213	298	307	191	271	173	296	224
7	Exchangeable Calcium as Ca, m.eq/100g	FAO Chapter 3, ABCTL/SOIL/SOP 4	4.15	6.96	8.14	6.23	9.14	5.88	7.85	8.94
8	Exchangeable Magnesium as Mg, m.eq/100g	FAO Chapter 3, ABCTL/SOIL/SOP 5	1.82	2.39	2.74	3.14	4.21	1.77	3.06	4.56
9	Exchangeable Sodium as Na, meq/100g	FAO Chapter 3, ABCTL/SOIL/SOP 6	1.03	1.78	1.24	1.96	1.41	2.62	2.88	0.92
10	Organic matter (%)	IS 2720 (Part 22):1972,	0.22	0.17	0.13	0.21	0.17	0.15	0.23	0.16

		Reaff:2010								
11	Texture Classification	Robson Pipette Method	Sandy Clay	Clay	Sandy Clay	Loam	Sandy Clay	Clay	Clay	Clay
12	Sand (%)	Robson Pipette Method	47.5	28.3	49.6	42.4	47.3	35.6	31.6	27.1
13	Clay (%)	Robson Pipette Method	36.4	57.1	35.1	26.8	42.4	44.7	51.8	52.6
14	Silt (%)	Robson Pipette Method	16.1	14.6	15.3	30.8	10.3	19.7	16.6	20.3
15	Copper as Cu, mg/kg	EPA 3050 B & 7000B	8.22	11.5	5.78	5.44	12.1	7.56	9.54	6.32
16	Zinc as Zn, mg/kg	EPA 3050 B & 7000B	11.6	21.5	17.3	16.4	23.9	28.1	16.3	15.3
17	Manganese as Mn, mg/kg	EPA 3050 B & 7000B	36.8	62.8	71.4	83.1	55.2	67.5	50.5	62.6
18	Iron as Fe, mg/kg	EPA 3050 B & 7000B	1214	1814	920	1364	1563	808	1564	1173
19	Lead as Pb, mg/kg	EPA 3050 B & 7000B	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)
20	Cadmium as Cd, mg/kg	EPA 3050 B & 7000B	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)
21	Chromium as Cr, mg/kg	EPA 3050 B & 7000B	6.96	7.85	11.4	5.36	8.14	12.7	5.22	6.74
22	Arsenic as As, mg/kg	EPA 3050 B & 7000B	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)
23	Mercury as Hg, mg/kg	EPA 7471A	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)

BDL – Below Detection Limit

Chemical Parameters	Ranking				
	Very Low	Low	Moderate	High	Very High
pH	<4, very Strongly Acidic	4-5, Strongly Acidic	5-8, Ideal for Plant Growth	8-9 Strongly Basic	>9 Very Strongly Basic
Electrical conductivity (µS/cm)	<2000, Nonsaline	2000-4000 Saline	4000-8000 Moderately Saline	8000-16000 Highly Saline	>16000 Extremely Saline
Total Nitrogen (%)	<0.05 Very Low	0.05-0.15 Low	0.15-0.25 Moderate	0.25-0.5 High	>0.5 Very High
Total Phosphorous (mg/kg)	<5 Very Low	5-10 Low	10-30 Moderate	30-60 High	>60 Very High
Sodium (mg/kg)	-	<200 Non Sodic	200-500 Moderate	>500 Sodic	
Potassium (mg/kg)	-	<150 Low	150-250 Moderate	250-800 High	>800 Very High
Calcium (mg/kg)	-	<1000 Low	1000-2000 Moderate	>2000 High	-
Magnesium (mg/kg)	<40 Very Low	40-100 Low	100-300 Moderate	>300 High	-
% Organic Matter	0.5-1.0 Very Low	1.0-2.0 Low	2.0-3.0 Moderate	3.0-5.0 High	>5 Very High

Table 3.20 - Standard Soil Classification

3.14.3 Observation

- The soil results were compared with soil standards. It has been observed that the pH of the soil was ranging from6.33 to 7.22 indicating the soils are Ideal for plant growth. The conductivity of the soil ranges from 0.047 to 0.118 mS/cm. Since the EC value is less than 2000 µS/cm, the soil is said to be Nonsaline in nature.
- The texture of the soil sample is predominantly clayey. Soil organic content varied from 0.13 to 0.23 % which indicates the very low level of organic matter.
- The available nitrogen content ranges between 302 to 620 mg/kg in the locality and the value of phosphorus content varies between 19.8 to 66.5 mg/kg. This indicates that the soil has high quantities of Nitrogen and Phosphorus.
- The potassium content varies from 173 to 307 mg/kg which indicates that the soils have moderate quantities of potassium.

3.15 Ecological Environment

An ecosystem is composed of plant and animal populations, and it differs from natural community designation in that it involves the total nutrient and energy economics of the system as well as the organisms involved. Ecosystems are self-maintained and self- contained. Natural ecosystems are invariably richer in species and more stable than those of artificially developed, due to their many inter-dependencies and inter-relationships.

The plant and animal populations in an area from recognizable associations called Natural communities. These are characterized by a few species called dominants. Natural communities have structure based on the life forms (e.g. grass) of the species that make them up. A hardwood forest has a given structure by virtue of the trees and shrubs that compose it. The species composition refers to the kinds of species making up to the community. The variety of species and their relative numbers are referred to as species diversity. A community composed of few species is called simple or one of Low diversity. A community composed of many species is called complex or one of high diversity. The greater the biotic diversity, the greater the number and kind of habitats for the inhabitants of the community Based on the physical setting and the kind of distribution of flora and fauna, the study area can be classified into crop, terrestrial and aquatic ecosystems.

Ecosystem shows complex inter-relationships between biotic and abiotic components leading to dependence, competition and mutualism. Biotic components comprise both plant and animal communities, interacting not only within and between

themselves but also with the abiotic components of the environment. The map showing the bio-geographic provinces of India is shown in Figure 3.13.

Generally, biological communities are good indicators of climatic and edaphic factors because of their strong relationships with them. The studies on the biological aspects of the ecosystem are important in Environment Impact Assessment studies for the suitability of natural flora & fauna. Information on the impact of environment stress on the community structure serves as an inexpensive and efficient early warning system to check the damage on a particular ecosystem. The biological environment includes mainly terrestrial and aquatic ecosystem.

A change in the composition of biotic communities under stress is reflected through a change in the distribution pattern, density, diversity, frequency, dominance and abundance of natural species of fauna and flora existing in the ecosystem. These changes over a span of times can be quantified and related to the existing environment.

3.15.1 Objectives of Ecological Studies

The objectives of ecological study during the period of EIA study may be outlined as follows:

- To characterize the environmental components like land, water, flora and fauna;
- To understand their present status;
- To understand carrying capacity of the ecosystem;
- To assess present bio-diversity; and
- To identify susceptible and sensitive areas.

3.15.2 Biogeographic zone, province and Forest type

This study has been carried out during January 2018 of study period for the purpose of providing an independent and comprehensive baseline assessment of the flora, terrestrial vertebrate, aquatic fauna and associated habitat values of the site and within 10 Km radius area around the NLCIL Talabira and a subsequent assessment of potential ecological impacts. The study area falls under the category of 6C- Deccan Peninsula – Eastern Highlands as far as the Indian Biogeographical Zones (*Rodger, Panwar, and Mathur 2000*) are concerned.

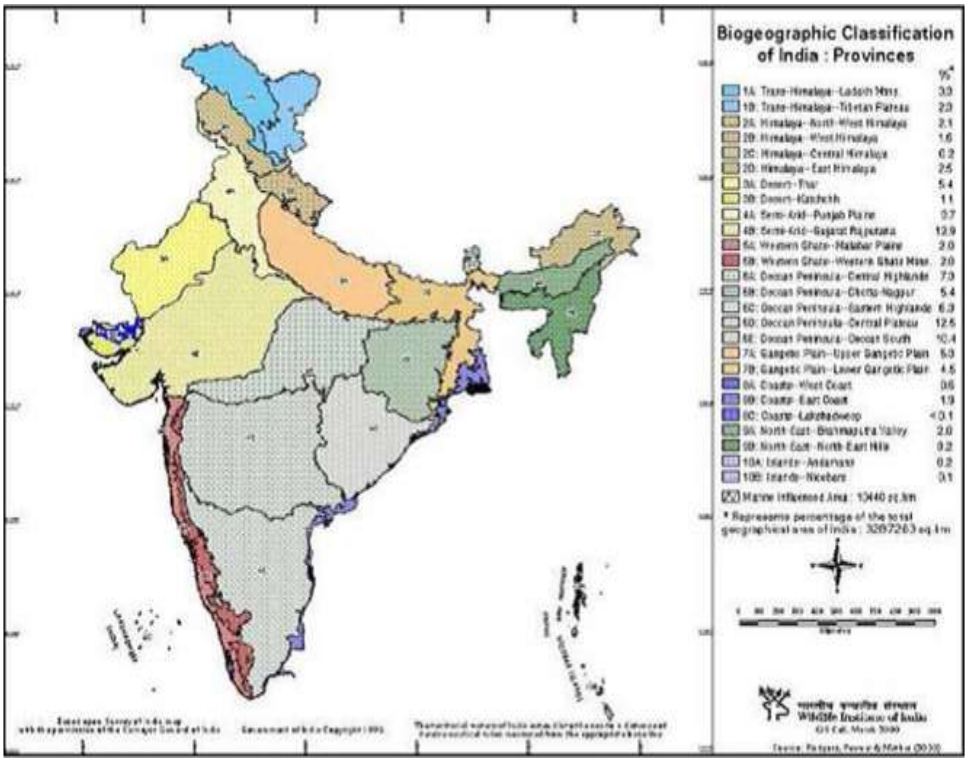
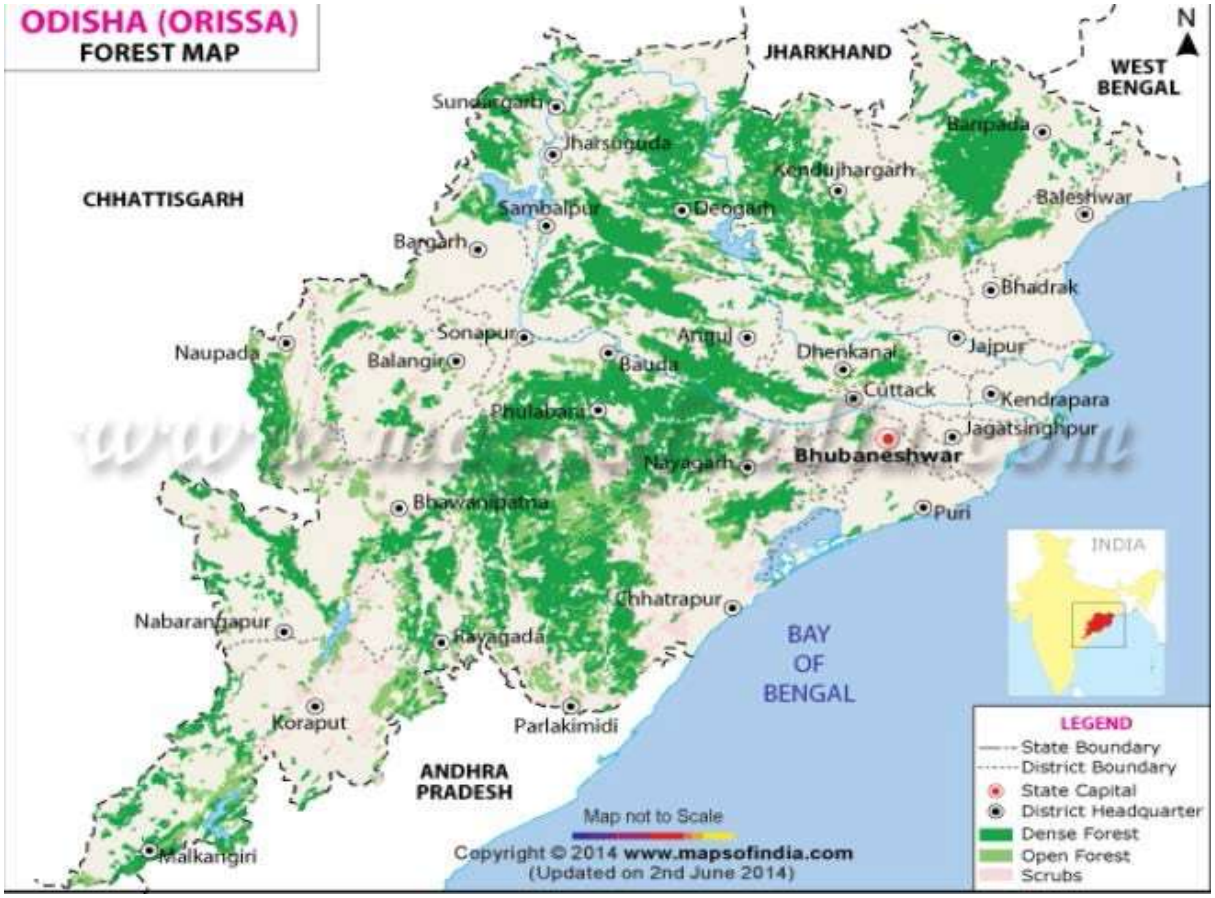


Figure 3.15: Map showing the Bio-geographic Provinces of India

The site is located near Taraikela village. The forest in the study area can be classified under sub group: (1) North Indian Moist Deciduous Forest and (2) North Indian Dry Mixed Deciduous Forest. According to Champion and Seth's 'Classification of Revised forest types of India' the forests of the study area has been broadly classified as moist peninsular Sal forest (3C/C2), Northern dry deciduous forest (5B/C2) and Dry deciduous scrub forest (5D/S1). The forest blocks of Jharsuguda forest divisions are geographically situated within the Northern tropical zone, which are far away from the sea, and the forests fall within the dry deciduous belt. The flora over most of the areas in the eastern region of project site has a predominance of Sal, the crop in areas is mostly paddy along with miscellaneous agriculture practices. Majority of the forest blocks had good percentage of Sal in the past, but due to continuous biotic interference and degradation of forests, the present status of Sal in the forests has suffered and it has now become associated with mixed and bamboo and palash forests in the form of patches and the quality of Sal has become degraded due to edaphic factors. It is the major species in the forests throughout the Reserve forest comprises in the study area).

There are 8 reserve forests in the study area and there are no wildlife sanctuaries, national parks biosphere reserves or migratory corridors of any sensitive species in the

study area.These are (i) Ghichamura R.F. (ii) Patrapali R.F.(iii) Malda R.F. (iv) Khait R.F. (v) Rampur R.F. (vi) Katikela R.F.(vii) Shriyapali R.F and (viii) Maulabhanja R.F.



The detailed ecological assessment of the study area has been carried out with the following objectives:

- To establish the present status of ecological conditions surrounding the project location;
- To study the existing anthropogenic stresses on the prevailing ecosystem.
- To identify and predict the likely impacts on the local ecosystem from the proposed activities;
- To list out floral species, terrestrial vertebrate and aquatic flora and fauna present within the study area, and significance status under The Wildlife (Protection) Act, 1972;
- To define ecological/conservation status of each species as per IUCN categories (Red Data List).

- To formulate mitigatory measures and a sustainable Environmental Management Plan (EMP) based on the likely impacts.

  During survey, following aspects were considered for ecological studies:
- Assessment of present status of flora and fauna;
- Identification of rare and endangered species of plants and animals (if any);
- Identification of ecologically sensitive areas within the study area;
- Assessment of migratory route of wildlife (if any); and
- Assessment of Aquatic Ecology with specific reference to aquatic birds and fishery resources.

3.15.3 Methodology Adopted for the Study

Terrestrial investigations for flora and fauna records were collected by random field survey and a checklist was prepared. During field survey, discussions with the local people were carried-out to collect information related to local biodiversity in and around the villages. The ecological status of the study area has been assessed based on the following methodology:

- Primary field surveys to establish primary baseline of the study area;
- Compilation of secondary information available in published literatures/ working plan was referred from State Forest Department.
- Site Verification and finalization in consultation with Project proponent, local inhabitants.
- Vegetation analysis through quadrate method using sampling plots of 20m x 20m.
  - ✓ 20m X 20m for tree species (record trees >20 cm in GBHOB /species);
  - ✓ 5m X 5m [four plots] was laid along diagonals wherein all the shrubs recorded.
  - ✓ 1m X 1m [five plots], one at the centre and four at one per quadrate] was laid and herbs, grasses in five plots to be noted.

❑ **Protocol for Sampling through Quadrate Method**

The standard method chosen for the assessment of plant diversity involves the use of square vegetation quadrates ('plots'). These quadrates were used to measure most vegetation attributes in most vegetation types. Quadrate locations marked by pegs or sometimes by grid system.
The study area is demarcated as 10 km from the periphery of project area based on the MoEF&CC guidelines. After demarcation, the study area is divided into sampling units,

i.e. the areas which are approximately true representative of the whole area, and were sampled for the identification of plant and animal species.

A. Floral Study

The assessment of the flora of the study area is done by an extensive field survey of the area.

- Plants species were identified based on their specific diagnostics characters of family, genus and species using available floral, other related literature and herbarium Botanical Survey of India (BSI).
- Besides the identification of plant species, information was collected on the vernacular names and uses of plants made by local inhabitants.
- Qualitative analysis of vegetation is made by two different methods such as floristic (by simple studying various genera and species of various plant groups i.e. herbs, shrubs, trees etc).

B. Phyto-sociology

A nested quadrates technique was used for sampling the vegetation. All the plots sampled were representative of most common types, sampling 20m x 20m for trees and 5m x 5m for shrubs, 1m x 1m for herbs square meter quadrates were laid. Selection of sites for sampling of vegetation is done by random sampling procedure. However, in general to study the phytosociological attributes, quadrates of 20m × 20m size for tree species are randomly laid out at each site at different elevations. Then the observation on the following parameters is recorded:

1. Name of the species.
2. Number of the occurrence of each species in each quadrate.

The field data for phytosociological studies was collected in the study area. Vegetation data was quantitatively analyzed for frequency, density and dominance using standard methodologies. The relative values of frequency, density, and dominance of all the recorded species was summed up to represent Importance Value Index (IVI). Not only IVI facilitates comparison between species of a community, but also the data collected on dispersion, number and cover can be profitably used in comparing the vegetation structure of two or more stands or of the same stand over a period of time. Vegetation structure with respect of varying environmental factors can also be studied through such studies in sets of varying environmental conditions. The IVI was determined as the sum of the relative frequency, relative density and relative dominance. It thus

Incorporate three important parameters that measures of productivity and diversity of every species therefore.

IVI = Relative frequency + Relative density + Relative dominance

C. Faunal Study

Ground surveys are carried out by trekking the study area for identification of important animal groups such as birds, mammals and reptiles for sampling of animals through the following methods.

- For sampling birds/ avifauna 'point sampling' along the fixed transects (foot trails) were done to record all the species of birds with the help of binoculars; field guides and photography for more than 1 hour on each transect (n=4).
- For sampling mammals, 'direct count on open width (20 m) transect' were used on the same transects. Besides, information on recent sightings/records of mammals by the locals was also collected from the study areas.
- 'Reptiles' mainly lizards were sampled by 'direct count on open width transects'.
- Secondary information collected from local villagers, published government data etc.

❑ **List of the endangered and endemic species as per the schedule of The Wildlife Protection Act, 1972**

Emphasis is given to identify avifauna and mammals to determine the presence and absence of Schedule-1 species, listed in The Wildlife Protection Act 1972, as well as in Red List of IUCN. Various methods used for study animals are as follows:

1. Point Survey Method: Observations were made at each site for 15-20 min duration.
2. Road Side Counts: The observer travelled by motor vehicles from site to site and all sightings were recorded.

3.15.4 Sampling Locations

The ecology and diversity survey was conducted in the 10 km radius in the study area and the surrounding area. It is observed that human settlements and large industrial units present within the study area of 10 km radius and many of villages have moderate ranges of plantations. Most of the vegetation area is in agricultural fields. During site assessment several floral species encountered within the 10 km radius area.

The following species were enlisted within the 10 km radius study area during the field visits as given in Table 3.21.

Table 3.21: Details of locations for plot survey

Sl.No.	Name of village	Plot No.	Lattitude	Longitude	Direction w.r.t Project site	Distance w.r.t Project site (Km)
1	Near Taraikela	EB1	21°46'8.46"N	83°59'30.51"E	SSE	0.5
2	Near Badmal	EB2	21°48'47.30"N	84° 0'11.43"E	NNE	4.4
3	Near Jamuapalli	EB3	21°49'12.63"N	83°57'36.54"E	NW	6
4	Near Bundia	EB4	21°46'43.35"N	83°55'35.42"E	W	6.6
5	Near Khinda	EB5	21°44'21.81"N	83°58'21.55"E	SW	4.2
6	Near Gumakarama	EB6	21°45'19.75"N	84° 2'52.09"E	SE	6.3

Source: ABC Techno Labs India Pvt. Ltd.

3.15.5 Floristic composition within the study area

The ecology and diversity survey was conducted in the 10 km radius in the study area and the surrounding area. During site assessment several floral species encountered within the 10 km radius area.

Besides Paddy, vegetables like tomato, potato, cabbage etc., maize, pulses and oil seeds are grown in the buffer zone. Banana, Guava, Mango are the most common and widely grown fruit trees in the buffer zone. The shrubby vegetation is between 1 to 2 m in height, withfew scattered trees growing in between. In fact the shrubs seen are mostlytree species but due to high biotic pressure are reduced to shrubs. The plantsencountered as shrubby vegetation are *Shorea robusta*(Sal),*Diospyros melanoxylon*(Kendu),*Pterocarpusmarsupium* (Piyasal),Gamhar *(Gmelina arborea),* Mahua *(Madhuca indica),* Charoli *(Buchananialanzan) etc. The understory consists of* Kendu *(Diospyros melanoxylon),*Dhawai *(Woodfordia fruticosa),* Ber *(Ziziphusnummularia), Lantana sp., Calotropis spp,* etc. The scattered trees standing in the scrublandare, *Madhuca indica, Pterocarpus marsupium* (Piyasal), *Ficus bengalensis* (Bot),*Azadirachta indica* (Neem), *Phoenix sylvestris* (Khajoor), *Borassus flabellifer* (Tal), *Cocosnucifera* (Narial). The herbs and grasses growing are*Achyranthes aspera, Tridaxprocumbens, Elephantopus scaber, Cynodon dactylon, Cyperus rotundus.*The list of flora observed in the buffer zone is given below:

Table 3.22: List of Flora observed in the study area

Sl.No	Scientific Name	Common name	Family	IUCN Conservation Status
Tree				
1	*Acacia Arabica*	Babul	Mimosaceae	Not assessed
2	*Terminalia arjuna*	Arjun	Combretaceae	Not assessed
3	*Mangifera indica*	Aam	Anacardiaceae	Data Deficient
4	*Ficus religiosa*	Aswatha	Moraceae	Not assessed
5	*Aegle marmelos*	Bel	Rutaceae	Not assessed
6	*Terminalia tomentosa*	Asan	Combretaceae	Not assessed
7	*Ficus benghalensis*	Bot	Moraceae	Not assessed
8	*Ziziphus mauritiana*	Ber	Rhamnaceae	Not assessed
9	*Buchanania lanzan*	Charoli	Anacardiaceae	Not assessed
10	*Pterocarpus marsupium*	Piasal	Fabaceae	Near Threatened
11	*Polyalthia longifolia*	Debdaru	Annonaceae	Not assessed
12	*Alstonia scholaris*	Chatim	Apocynaceae	Least Concern
13	*Anacardium occidentale*	Cashew	Anacardiaceae	Not assessed
14	*Ficus hispida*	Dumar	Moraceae	Not assessed
15	*Anogeissus latifolia*	Dhaura	Combretaceae	Not assessed
16	*Gmelina arborea*	Gamhar	Lamiaceae	Not assessed
17	*Eucalyptus sp.*	Eucalyptus	Myrtaceae	Not assessed
18	*Psidium guajava*	Guava	Myrtaceae	Not assessed
19	*Carica papaya*	Papaya	Caricaceae	Data Deficient
20	*Syzygium cumini*	Jamun	Myrtaceae	Not assessed
21	*Pongamia pinnata*	Karanj	Fabaceae	Least Concern
22	*Emblica officinalis*	Imli	Euphorbiaceae	Not assessed
23	*Artocarpus heterophyllus*	Kathal	Moraceae	Not assessed
24	*Diospyros melanoxylon*	Kendu	Ebenaceae	Not assessed
25	*Albizia lebbek*	Kalasiris	Mimosaceae	Not assessed
26	*Delonix regia*	Krishnachura	Fabaceae	Least Concern
27	*Swietenia mahagoni*	Mahogany	Meliaceae	Endangered
28	*Madhuca indica*	Mahua	Sapotaceae	Not assessed
29	*Azadirachta indica*	Neem	Meliaceae	Not assessed
30	*Butea monosperma*	Palash	Caesalpinaceae	Not assessed
31	*Moringa oleifera*	Sajna	Moringaceae	Not assessed
32	*Peltophorum pterocarpum*	Radhachura	Fabaceae	Not assessed
33	*Shorea robusta*	Sal	Dipterocarpaceae	Least Concern
34	*Tectona grandis*	Teak	Lamiaceae	Not assessed
35	*Cocos nucifera*	Narikel	Arecaceae	Not assessed
36	*Dalbergia sissoo*	Sishoo	Fabaceae	Not assessed
37	*Leucaena leucocephala*	Subabul	Fabaceae	Not assessed
38	*Phoenix acaulis*	Jangli Khajur	Arecaceae	Not assessed
39	*Borassus flabellifer*	Tal	Arecaceae	Endangered
40	*Schleichera oleosa*	Kusum	Sapindaceae	Not assessed
41	*Bombax ceiba*	Simili	Bombacaceae	Not assessed
42	*Bauhinia purpurea*	Kanchan	Fabaceae	Least Concern
43	*Diospyros montana*	Halda	Ebenaceae	Not assessed

Sl.No	Scientific Name	Common name	Family	IUCN Conservation Status
44	*Albizzia procera*	Tentra	Mimosaceae	Not assessed
45	*Annona squamosa*	Sitaphal	Annonaceae	Not assessed
46	*Cassia siamea*	Chakunda	Fabaceae	Least Concern
47	*Musa paradise*	Kadali	Musaceae	Not assessed
Shrubs				
1	*Datura metel*	Dhutura	Solanaceae	Not assessed
2	*Dendrocalamus strictus*	Salia	Poaceae	Not assessed
3	*Bambusa arundinaceae*	Kanta bans	Poaceae	Not assessed
4	*Lantana camara*	Naga airi	Verbenaceae	Not assessed
5	*Calotropis gigantea*	Arakha	Asclepidaceae	Not assessed
6	*Cassia fistula*	Sunari	Fabaceae	Not assessed
7	*Chromolaena odorata*	Poksunga	Asteraceae	Not assessed
8	*Helicteres isora*	Antia	Sterculiaceae	Not assessed
9	*Pavetta indica*	Kukur chhalia	Rubiaceae	Not assessed
10	*Vitex negundo*	Begunia	Lamiaceae	Not assessed
11	*Flemingia chappar*	Ranidantkathi	Fabaceae	Not assessed
12	*Commelina benghalensis*	Kanang-karai	Commelinaceae	Least Concern
13	*Jasminum sessiliflorum*	Kuruvilaangkodi	Oleaceae	Not assessed
14	*Morinda pubescens*	Mannanunai	Rubiaceae	Not assessed
15	*Sida cordifolia*	Berela	Malvaceae	Not assessed
16	*Ipomoea carnea*	Ipomea	Convolvulaceae	Not assessed
17	*Jatropha gossypifolia*	Lal Bheranda	Euphorbeaceae	Not assessed
18	*Bougainvillea glabra*	Kagajiful	Nyctaginaceae	Not assessed
Herbs				
1	*Cynodon dactylon*	Duba	Poaceae	Not assessed
2	*Cyperus rotundus*	Mutha	Cyperaceae	Least Concern
3	*Achyranthes aspera*	Apamaranga	Amaranthaceae	Not assessed
4	*Commelina benghalensis*	Kanasiri	Commelinaceae	Least Concern
5	*Amaranthus spinosus*	Kanta leutia	Amaranthaceae	Not assessed
6	*Andrographis paniculata*	Bhuin neem	Acanthaceae	Not assessed
7	*Elephantopus scaber*	Mayurchulia	Asteraceae	Not assessed
8	*Barleria prionitis*	Daskerenda	Acanthaceae	Not assessed
9	*Scoparia dulcis*	Badi justimadhu	Plantaginaceae	Not assessed
10	*Tridax procumbens*	Bisalyakarani	Asteraceae	Not assessed
11	*Sida cordifolia*	Bajramuli	Malvaceae	Not assessed
12	*Phyllanthus amarus*	Bhuin amla	Phyllanthaceae	Not assessed
13	*Evolvulus alsinoides*	Jyotismati	Convolvulaceae	Not assessed
14	*Croton sparsiflorus*	Ban Tulasi	Euphorbiaceae	Not assessed
15	*Ipomoea fistulosa*	Morning Glory	Convolvulaceae	Not assessed
16	*Centella asiatica*	Thankuni	Umbelliferae	Least Concern
17	*Ocimum tenuiflorum*	Tulsi	Tulsi	Not assessed
Climbers				
1	*Cuscuta reflexa*	Amar bel	Convolvulaceae	Not assessed
2	*Ipomoea staphylina*	Ipomaea	Convolvulaceae	Not assessed

Sl.No	Scientific Name	Common name	Family	IUCN Conservation Status
3	*Abrus precatorius*	Crab's eye	Fabaceae	Not assessed
4	*Tinospora cordifolia*	Guduchi	Menispermaceae	Not assessed
5	*Bauhinia vahlii*	Maloo Creeper	Caesalpiniaceae	Not assessed
6	*Asparagus racemosus*	Satamuli	Liliaceae	Not assessed

Source: ABC Techno Labs India Pvt. Ltd.

❑ Economically Important Flora of the study area

Agricultural Crops: Mostly 65-70% rain fed 25% irrigated by mediumirrigation project and small irrigation projects. Losingh, Lahanpur block is havingmajor irrigation sources and major cropping system. Paddy, Maize, Mustard,sesame, Groundnut, Green gram, Black gram, Horse gram are cultivated. Amongvegetables like tomato, potato, cauliflower, cabbage, chilly and cow pea, ginger,turmeric to some extent.

The important fruit plants in the study area are Mango (*Mangifera indica*), Papita (*Carica papaya*), Guava (*Psidium guajava*), Jamun(*Syzygium cumini*), Banana (*Musa paradisiaca*), Imli (*Tamarindus indica*)and Kanthal (*Artocarpus heterophyllus*).

Medicinal Plants: Some of the common medicinal species are Neem (*Azadirachta indica*), Amla (*Emblica officinalis*), Bael (*Aegle marmelos*), Akanda (*Calotropis gigantean*), Nayantara (*Catharanthus roseus*), Tulsi (*Ocimum sanctum*).

Minor Forest Produces:Almost all families belong to SC and ST involved in collection of NTFP. The main product is mouha (*Madhuca indica*) flower, apart from mouha they also collect Amla (*Emblica officinalis*), Bahada (*Terminalia bellirica*), Harida (*Terminalia chebula*) and Mango (*Mangifera indica*) fruits. Honey and Jhuna (resin from Sal tree) collection is infrequent in the study area.

Also Sal leaves and seeds, Kendu (*Diospyros melanoxylon)* leaves, Char seeds, fire wood collected by the locals.

Rare and Endangered Floral Species: Floristic survey of study area encounter 2 endangered species as IUCN guidelines are *Swietenia mahagoni* (Mahogany) and *Borassus flabellifer* (Tal).

❑ Phytosociological Analysis

Phytosociological parameters, such as, density, frequency, basal area and importance value index of individual species were determined in randomly placed quadrats of different sizes in the study area. Relative frequency, relative basal area and

relative density were calculated and the sum of these three represented Importance Value Index (IVI) for various species. For shrubs, herbs and seedlings, the IVI was calculated by summing up relative frequency, relative density and relative abundance.

Sample plots were selected in such a way to get maximum representation of different types of vegetation and plots were laid out in different part of the study area of 10 km radius. Analysis of the vegetation will help in determining the relative importance of each species in the study area and to reveal if any economically valuable species is threatened in the process. Phytosociological analysis of tree species is shown in Table 3.23.

Table 3.23: Phytosociological Analysis of Tree Species

Sl.No.	Scientific name	Local name	Total No.	Total no. of quad with sp.	Total No. of quad	Density	Relative Density	Frequency %	Relative Frequency	Abundance	Relative Abundance	IVI
Tree Species												
1	*Acacia arabica*	Babul	2	2	6	0.333	1.47	33.3	1.6	1.00	0.01	3.04
2	*Terminalia arjuna*	Arjun	5	5	6	0.833	3.68	83.3	3.9	1.00	0.04	7.59
3	*Mangifera indica*	Aam	5	4	6	0.833	3.68	66.7	3.1	1.25	0.04	6.81
4	*Ficus religiosa*	Aswatha	4	4	6	0.667	2.94	66.7	3.1	1.00	0.03	6.07
5	*Aegle marmelos*	Bel	2	2	6	0.333	1.47	33.3	1.6	1.00	0.01	3.04
6	*Terminalia tomentosa*	Asan	4	3	6	0.667	2.94	50.0	2.3	1.33	0.03	5.30
7	*Ficus benghalensis*	Bot	2	2	6	0.333	1.47	33.3	1.6	1.00	0.01	3.04
8	*Ziziphus mauritiana*	Ber	4	3	6	0.667	2.94	50.0	2.3	1.33	0.03	5.30
9	*Buchanania lanzan*	Charoli	3	3	6	0.500	2.21	50.0	2.3	1.00	0.02	4.55
10	*Pterocarpus marsupium*	Piasal	4	4	6	0.667	2.94	66.7	3.1	1.00	0.03	6.07
11	*Polyalthia longifolia*	Debdaru	3	3	6	0.500	2.21	50.0	2.3	1.00	0.02	4.55
12	*Alstonia scholaris*	Chatim	2	2	6	0.333	1.47	33.3	1.6	1.00	0.01	3.04
13	*Anacardium occidentale*	Cashew	2	2	6	0.333	1.47	33.3	1.6	1.00	0.01	3.04
14	*Ficus hispida*	Dumar	3	3	6	0.500	2.21	50.0	2.3	1.00	0.02	4.55
15	*Anogeissus latifolia*	Dhaura	2	2	6	0.333	1.47	33.3	1.6	1.00	0.01	3.04
16	*Gmelina arborea*	Gamhar	5	5	6	0.833	3.68	83.3	3.9	1.00	0.04	7.59
17	*Eucalyptus sp.*	Eucalyptus	2	2	6	0.333	1.47	33.3	1.6	1.00	0.01	3.04
18	*Psidium guajava*	Guava	2	2	6	0.333	1.47	33.3	1.6	1.00	0.01	3.04
19	*Carica papaya*	Papaya	2	2	6	0.333	1.47	33.3	1.6	1.00	0.01	3.04
20	*Syzygium cumini*	Jamun	2	2	6	0.333	1.47	33.3	1.6	1.00	0.01	3.04
21	*Pongamia pinnata*	Karanj	3	3	6	0.500	2.21	50.0	2.3	1.00	0.02	4.55
22	*Emblica officinalis*	Imli	3	3	6	0.500	2.21	50.0	2.3	1.00	0.02	4.55

Sl.No.	Scientific name	Local name	Total No.	Total no. of quad with sp.	Total No. of quad	Density	Relative Density	Frequency %	Relative Frequency	Abundance	Relative Abundance	IVI
23	*Artocarpus heterophyllus*	Kathal	2	2	6	0.333	1.47	33.3	1.6	1.00	0.01	3.04
24	*Diospyros melanoxylon*	Kendu	3	3	6	0.500	2.21	50.0	2.3	1.00	0.02	4.55
25	*Albizia lebbek*	Kalasiris	2	2	6	0.333	1.47	33.3	1.6	1.00	0.01	3.04
26	*Delonix regia*	Krishnachura	2	2	6	0.333	1.47	33.3	1.6	1.00	0.01	3.04
27	*Swietenia mahagoni*	Mahogany	1	1	6	0.167	0.74	16.7	0.8	1.00	0.01	1.52
28	*Madhuca indica*	Mahua	6	5	6	1.000	4.41	83.3	3.9	1.20	0.04	8.33
29	*Azadirachta indica*	Neem	5	5	6	0.833	3.68	83.3	3.9	1.00	0.04	7.59
30	*Butea monosperma*	Palash	5	4	6	0.833	3.68	66.7	3.1	1.25	0.04	6.81
31	*Moringa oleifera*	Sajna	2	2	6	0.333	1.47	33.3	1.6	1.00	0.01	3.04
32	*Peltophorum pterocarpum*	Radhachura	1	1	6	0.167	0.74	16.7	0.8	1.00	0.01	1.52
33	*Shorea robusta*	Sal	4	4	6	0.667	2.94	66.7	3.1	1.00	0.03	6.07
34	*Tectona grandis*	Teak	2	2	6	0.333	1.47	33.3	1.6	1.00	0.01	3.04
35	*Cocos nucifera*	Narikel	3	3	6	0.500	2.21	50.0	2.3	1.00	0.02	4.55
36	*Dalbergia sissoo*	Sishoo	1	1	6	0.167	0.74	16.7	0.8	1.00	0.01	1.52
37	*Leucaena leucocephala*	Subabul	3	3	6	0.500	2.21	50.0	2.3	1.00	0.02	4.55
38	*Phoenix acaulis*	Jangli Khajur	2	2	6	0.333	1.47	33.3	1.6	1.00	0.01	3.04
39	*Borassus flabellifer*	Tal	4	3	6	0.667	2.94	50.0	2.3	1.33	0.03	5.30
40	*Schleichera oleosa*	Kusum	2	2	6	0.333	1.47	33.3	1.6	1.00	0.01	3.04
41	*Bombax ceiba*	Simili	2	2	6	0.333	1.47	33.3	1.6	1.00	0.01	3.04
42	*Bauhinia purpurea*	Kanchan	2	2	6	0.333	1.47	33.3	1.6	1.00	0.01	3.04
43	*Diospyros montana*	Halda	4	4	6	0.667	2.94	66.7	3.1	1.00	0.03	6.07
44	*Albizzia procera*	Tentra	2	2	6	0.333	1.47	33.3	1.6	1.00	0.01	3.04
45	*Annona squamosa*	Sitaphal	2	2	6	0.333	1.47	33.3	1.6	1.00	0.01	3.04
46	*Cassia siamea*	Chakunda	3	3	6	0.500	2.21	50.0	2.3	1.00	0.02	4.55
47	*Musa paradise*	Kadali	5	4	6	0.833	3.68	66.7	3.1	1.25	0.04	6.81

Sl.No.	Scientific name	Local name	Total No.	Total no. of quad with sp.	Total No. of quad	Density	Relative Density	Frequency %	Relative Frequency	Abundance	Relative Abundance	IVI
	Total		136	129	282			1100.0				
Shrubs												
1	*Datura metel*	Dhutura	4	3	6	0.667	6.25	50.0	5.6	1.33	0.06	11.87
2	*Dendrocalamus strictus*	Salia	3	3	6	0.500	4.69	50.0	5.6	1.00	0.05	10.29
3	*Bambusa arundinaceae*	Kanta bans	5	4	6	0.833	7.81	66.7	7.4	1.25	0.08	15.30
4	*Lantana camara*	Naga airi	8	6	6	1.333	12.50	100.0	11.1	1.33	0.13	23.74
5	***Calotropis gigantea***	Arakha	9	6	6	1.500	14.06	100.0	11.1	1.50	0.14	25.31
6	***Cassia fistula***	Sunari	5	4	6	0.833	7.81	66.7	7.4	1.25	0.08	15.30
7	*Chromolaena odorata*	Poksunga	3	3	6	0.500	4.69	50.0	5.6	1.00	0.05	10.29
8	*Helicteres isora*	Antia	2	2	6	0.333	3.13	33.3	3.7	1.00	0.03	6.86
9	*Pavetta indica*	Kukur chhalia	2	2	6	0.333	3.13	33.3	3.7	1.00	0.03	6.86
10	*Vitex negundo*	Begunia	3	3	6	0.500	4.69	50.0	5.6	1.00	0.05	10.29
11	*Flemingia chappar*	Ranidantkathi	3	3	6	0.500	4.69	50.0	5.6	1.00	0.05	10.29
12	*Commelina benghalensis*	Kanang-karai	3	3	6	0.500	4.69	50.0	5.6	1.00	0.05	10.29
13	*Jasminum sessiliflorum*	Kuruvilaangkodi	1	1	6	0.167	1.56	16.7	1.9	1.00	0.02	3.43
14	*Morinda pubescens*	Mannanunai	2	2	6	0.333	3.13	33.3	3.7	1.00	0.03	6.86
15	*Sida cordifolia*	Berela	3	3	6	0.500	4.69	50.0	5.6	1.00	0.05	10.29
16	*Ipomoea carnea*	Ipomea	2	2	6	0.333	3.13	33.3	3.7	1.00	0.03	6.86
17	*Jatropha gossypifolia*	Lal Bheranda	3	2	6	0.500	4.69	33.3	3.7	1.50	0.05	8.44
18	*Bougainvillea glabra*	Kagajiful	3	2	6	0.500	4.69	33.3	3.7	1.50	0.05	8.44
	Total		64	54	108							
Herbs & Grasses												
1	***Cynodon dactylon***	Duba	20	6	6	3.333	25.64	100.0	12.2	3.33	0.26	38.14
2	***Cyperus rotundus***	Mutha	18	6	6	3.000	23.08	100.0	12.2	3.00	0.23	35.55

Sl.No.	Scientific name	Local name	Total No.	Total no. of quad with sp.	Total No. of quad	Density	Relative Density	Frequency %	Relative Frequency	Abundance	Relative Abundance	IVI
3	***Achyranthes aspera***	Apamaranga	5	4	6	0.833	6.41	66.7	8.2	1.25	0.06	14.64
4	*Commelina benghalensis*	Kanasiri	3	3	6	0.500	3.85	50.0	6.1	1.00	0.04	10.01
5	*Amaranthus spinosus*	Kanta leutia	2	2	6	0.333	2.56	33.3	4.1	1.00	0.03	6.67
6	*Andrographis paniculata*	Bhuin neem	2	1	6	0.333	2.56	16.7	2.0	2.00	0.03	4.63
7	*Elephantopus scaber*	Mayurchulia	3	3	6	0.500	3.85	50.0	6.1	1.00	0.04	10.01
8	*Barleria prionitis*	Daskerenda	2	2	6	0.333	2.56	33.3	4.1	1.00	0.03	6.67
9	*Scoparia dulcis*	Badi justimadhu	2	2	6	0.333	2.56	33.3	4.1	1.00	0.03	6.67
10	*Tridax procumbens*	Bisalyakarani	5	4	6	0.833	6.41	66.7	8.2	1.25	0.06	14.64
11	*Sida cordifolia*	Bajramuli	2	2	6	0.333	2.56	33.3	4.1	1.00	0.03	6.67
12	*Phyllanthus amarus*	Bhuin amla	2	2	6	0.333	2.56	33.3	4.1	1.00	0.03	6.67
13	*Evolvulus alsinoides*	Jyotismati	2	2	6	0.333	2.56	33.3	4.1	1.00	0.03	6.67
14	*Croton sparsiflorus*	Ban Tulasi	2	2	6	0.333	2.56	33.3	4.1	1.00	0.03	6.67
15	*Ipomoea fistulosa*	Morning Glory	3	3	6	0.500	3.85	50.0	6.1	1.00	0.04	10.01
16	*Centella asiatica*	Thankuni	2	2	6	0.333	2.56	33.3	4.1	1.00	0.03	6.67
17	*Ocimum tenuiflorum*	Tulsi	3	3	6	0.500	3.85	50.0	6.1	1.00	0.04	10.01
	Total		78	49	102							

The interpretation vegetation study results of the study area are presented in the following Table 3.24.

Table 3.24: Interpretation of Vegetation Results in the Study Area

Relative density	Relative density is found to be maximum for *Madhuca indica*– 4.41	Density of the primary species is found to be much higher in comparison with the other species.
Relative frequency	Maximum RF found to be 3.9 in case of *Madhuca indica*.	Vegetation community is heterogenous in nature
Relative Abundance	Maximum value observed in case of *Madhuca indica* is about 0.04.	*Madhuca indica* is the most common species found in the area.
Importance Value Index (IVI	The maximum IVI value observed in case of *Madhuca indica* is about 8.33.	The dominant species is *Madhuca indica*.

Source: ABC Techno Labs India Pvt. Ltd.

- **Biodiversity Indices**

Biodiversity index is a quantitative measure that reflects how many different types' species, there are in a dataset, and simultaneously takes into account how evenly the basic entities (such as individuals) are distributed among those types of species. The value of biodiversity index increases both when the number of types increases and when evenness increases. For a given number of type of species, the value of a biodiversity index is maximized when all type of species are equally abundant. Interpretation of Vegetation results in the study area is given in Table 3.24.

Table 3.25: Biodiversity Indices Results of the Study Area

Community	Biodiversity indices		
	Shannon-Wiener Index (H)	Simpson Diversity Index (1/D)	Species Evenness
Tree	3.76	0.98	0.25
Shrub	2.75	0.94	0.47
Herbs	2.39	0.87	0.43

Source: ABC Techno Labs India Pvt. Ltd.

From Table 3.25, it can be interpreted that shrubs community has higher diversity. While the herb community shows less diversity. It is also observed that most of the quadrates have controlled generation of plant species with older strands. Higher tree species diversity can be interpreted as a greater number of successful species and a more stable ecosystem where more ecological niches are available and the environment is less likely

to be hostile, environmental change is less likely to be damaging to the ecosystem as a whole.

3.15.6 Fauna in the study area

To prepare a detailed report on the status of faunal diversity within study area of 10 km radius around the proposed NLC Talabira TPP, field studies were conducted. Both direct (sighting) and indirect (evidences) observations methods were used to survey the faunal species around the study area. Additionally reference of relevant literatures (published/ unpublished) and dialogues with local villagers were also carried out to consolidate the presence of faunal distribution in the area (*Smith 1933-43, Ali and Ripley 1983, Daniel 1983, Prater 1993, Murthy and Chandrasekhar 1988*).

Mammals: No wild mammalian species was directly sighted during the field survey. Dialogue with local villagers located around the study area confirm presence of some wild animal in that area. Barking deer, Palm –Squirrel, Porcupine, Indian bush rat, Indian rat, Langur, Common Mouse, Common Mongoose, Indian Hare, Field mouse, Rhesus monkeywere observed during primary survey.

Avifauna: Since birds are considered to be the indicators for monitoring and understanding human impacts on ecological systems (*Lawton, 1996*) attempt was made to gather quantitative data on the avifauna by walk through survey within the entire study area and surrounding areas. From the primary survey, a total of 27 species of avifauna were identified and recorded in the study area. The diversity of avifauna from this region was found to be quite high and encouraging.

List of animals present in the study area are given below:

Table 3.26: List of Fauna observed in the study area

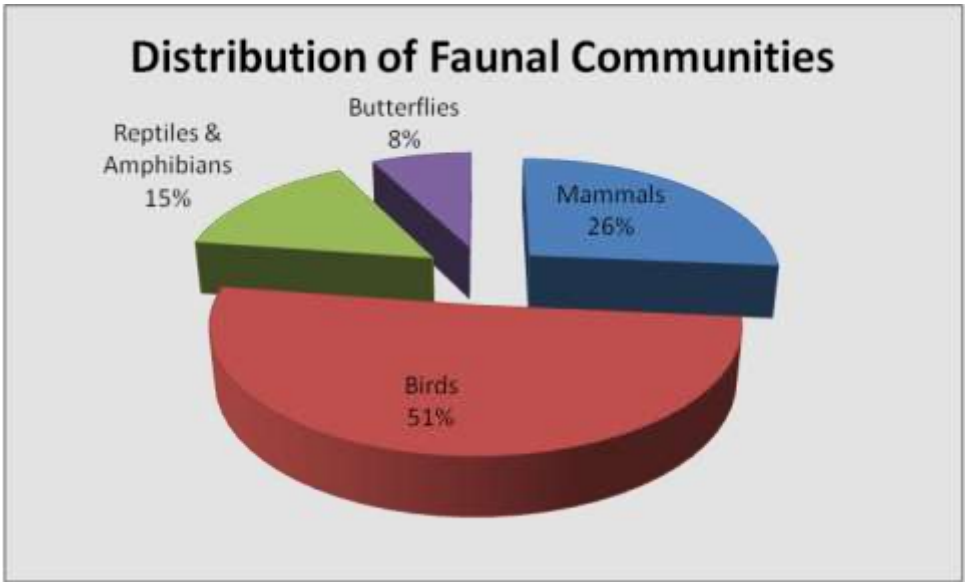
Sl.No.	Scientific name	English Name	Schedule of Wildlife Protection Act	IUCN Conservation Status	Method
Mammals					
1	*Muntiacus muntjak*	Barking deer	III	Least Concern	DS
2	*Funambulus pennanti*	Palm -Squirrel	IV	Not assessed	DS
3	*Hystrix indica*	Porcupine	IV	Least Concern	DS
4	*Vulpes bengalensis*	Fox	II	Least Concern	NS
5	*Golunda ellioti*	Indian bush rat	V	Least Concern	DS
6	*Rattus rattus*	Indian rat	IV	Not assessed	DS
7	*Presbytis entellus*	Langur	II	Not assessed	DS
8	*Mus musculus*	Common Mouse	IV	Not assessed	DS

Sl.No.	Scientific name	English Name	Schedule of Wildlife Protection Act	IUCN Conservation Status	Method
9	*Herpestes edwardsii*	Common Mongoose	IV	Least Concern	DS
10	*Lepus nigricollis*	Indian Hare	IV	Least Concern	DS
11	*Rattus norvegicus*	Field mouse	V	Least Concern	DS
12	*Felis chaus*	Jungle cat	II	Least Concern	NS
13	*Bandicota indica*	Rat	IV	Least Concern	DS
14	*Macaca mulatta*	Rhesus monkey	IV	Least Concern	DS
Birds					
1	*Acridotheres tristis*	Common Myna	IV	Least Concern	DS
2	*Dicrurus leucophaeus*	Ashy Drongo	IV	Least Concern	DS
3	*Actitis hypoleucos*	Common sandpiper	IV	Least Concern	DS
4	*Corvus splendens*	House crow	V	Least Concern	DS
5	*Dicrurus macrocercus*	Black drongo	IV	Least Concern	DS
6	*Coracias benghalensis*	Indian roller	IV	Least Concern	DS
7	*Passer domesticus*	House sparrow	IV	Least Concern	DS
8	*Alcedo atthis*	Small Blue Kingfisher	IV	Least Concern	DS
9	*Milvus migrans*	Black kite	IV	Least Concern	DS
10	*Cuculus canorus*	Common cuckoo	IV	Least Concern	DS
11	*Milvus migrans*	Pariah Kite	IV	Least Concern	DS
12	*Turdoides striatus*	Jungle Babbler	IV	Not assessed	DS
13	*Phalacrocorax niger*	Little cormorant	IV	Least Concern	DS
14	*Ardeola grayii*	Pond Heron	IV	Least Concern	DS
15	*Bubulcus ibis*	Cattle Egret	IV	Least Concern	DS
16	*Anastomus oscitans*	Open billed Stork	IV	Least Concern	DS
17	*Anas acuta*	Pintail	IV	Least Concern	DS
18	*Nectarinia asiatica*	Purple sun-bird	IV	Least Concern	DS
19	*Psittacula krameri*	Rose ringed parakeet	IV	Least Concern	DS
20	*Merops orientalis*	Green bee eater	IV	Least Concern	DS
21	*Cypsiurus balasiensis*	Asian palm swift	IV	Least Concern	DS
22	*Columba livia*	Rock pigeon	IV	Least Concern	DS
23	*Egretta garzetta*	Little Egret	IV	Least Concern	DS
24	*Vanellus indicus*	Red-wattled lapwing	IV	Least Concern	DS
25	*Streptopelia chinensis*	Spotted dove	IV	Not assessed	DS
26	*Picus squamatus*	Scaly-bellied Woodpecker	IV	Least Concern	DS
27	*Pycnonotus cafer*	Red Vented Bulbul	IV	Least Concern	DS
Reptiles & Amphibians					
1	*Calotes versicolor*	Common Garden Lizard	II	Not assessed	DS
2	*Bungarus caeruleus*	Common Krait	IV	Not assessed	NS
3	*Ptyas mucosus*	Dhaman	II	Not assessed	DS

Sl.No.	Scientific name	English Name	Schedule of Wildlife Protection Act	IUCN Conservation Status	Method
4	*Vipera russelli*	Russel's viper	II	Least Concern	DS
5	*Naja naja*	Indian cobra	IV	Not assessed	NS
6	*Eutropis macularia*	Common skink	--	Not assessed	DS
7	*Rana tigrina*	Common yellow frog	IV	Least Concern	DS
8	*Bufo melanostictus*	Toad	IV	Least Concern	DS
Butterflies					
1	*Pachliopta hector*	Crimson rose	-	Not assessed	DS
2	*Papilio demoleus*	Lime Butterfly	-	Not assessed	DS
3	*Junonia almana*	Peacock pansey	-	Least Concern	DS
4	*Neptis hylas*	Common sailor	-	Not assessed	DS

N.B: NS= Not sighted but included as per the information provided by villagers, DS = Direct Sighting

Source: ABC Techno Labs India Pvt. Ltd.



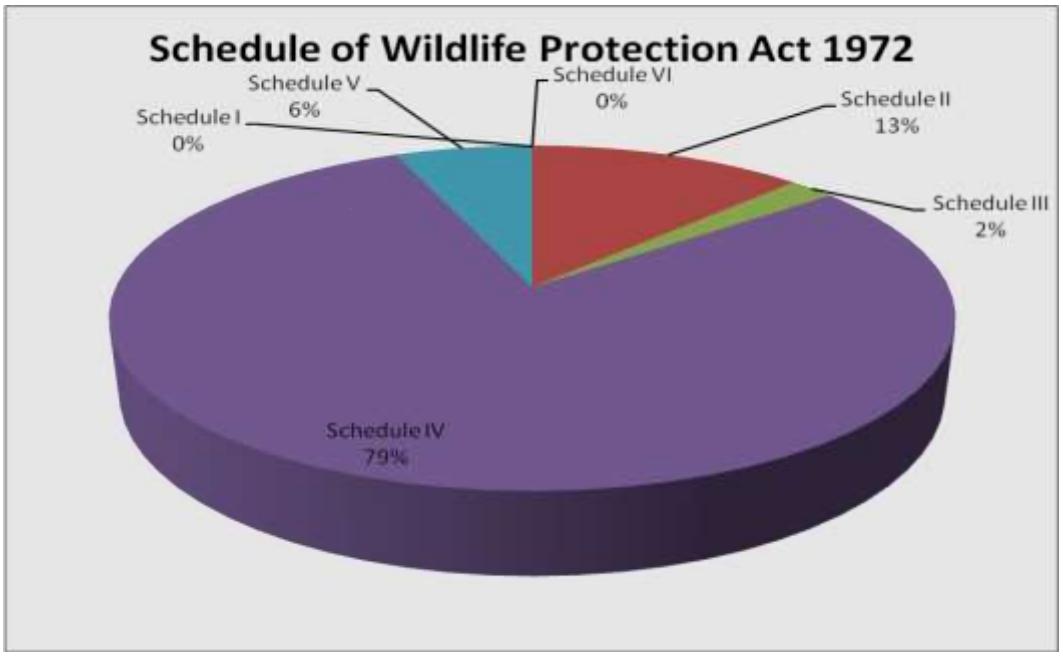
Livestock like cattle, buffalo, goat, poultry, duck, and pig are reared for dairy products, meat, egg and for agriculture purpose. Majority of cattle and buffalo are of local variety. Backyard poultry farms are mostly common in this area; however, some commercial poultry farms are also recorded in the study area.

The study area is marked with moderate population of flora and fauna. With reference to the Wildlife Protection Act 1972 total number of wildlife tabulated in this study can be characterized as given in the Table 3.27.

Table 3.27: Characterization of Fauna in the Study Area (As Per W.P Act, 1972)

Sl.No.	Schedule of Wildlife Protection Act 1972	No.of species	Remark
1	Schedule I	0	-
2	Schedule II	6	-
3	Schedule III	1	-
4	Schedule IV	38	-
5	Schedule V	3	-
6	Schedule VI	0	-

Source: ABC Techno Labs India Pvt. Ltd.



The detailed interpretation of flora and fauna identified within 10 km radius of the project site are tabulated In Table 3.28.

Table 3.28: Description of Flora & Fauna

Sl .No.	Type of Species	Core Zone
	Flora	
1	Endangered species	None of the species found
2	Endemic species	None of the species found
3	Grass lands	No grass lands
4	Natural vegetation/ Forest type	Buffer zone of this project comprise 8 reserve forest i.e. (i) Ghichamura R.F. (ii) Patrapali R.F. (iii) Malda R.F. (iv) Khait R.F. (v) Rampur R.F. (vi) Katikela R.F. (vii)
	Fauna	
1	Endangered species	None
2	Endemic Species	Not present

3	Migratory species	None
4	Migratory Corridors & Flight Paths	No corridors & flight paths
5	Breeding & Spawning grounds	None

Source: ABC Techno Labs India Pvt. Ltd.

3.15.7 Aquatic Ecology

The study area intersected by few natural drainage, rivers and ponds. A number of samples were investigated for enumeration of aquatic fauna. In order to study aquatic flora and faunal life one time survey was conducted during the pre-monsoon season. Major component of the aquatic life under the study area are listed below.

- *Aquatic macrophytes*
- *Phytoplankton and zooplankton*
- *Aquatic vertebrates like fish, amphibians etc.*

To assess the planktonic profile of Phytoplankton and Zooplankton, 4 water samples from a Ib River and Bheden River, Hirakud reservoir were collected at sub surface level. The aquatic ecological study was conducted in different water bodies of the study area and the flora and fauna was recorded.

❑ **Aquatic Flora**

The study area is moderately rich in floral diversity for both land and aquatic ecology as there is Bheden river and Ib river and some perennial natural canal is flowing close by of the project site through which water is passing. The aquatic vegetation consists of the following groups of plants in this area.

❑ **Significance of Plankton:**

Planktons can be broadly grouped into two categories those with plant origin are called 'Phytoplankton' and those with animal origin are called 'Zooplankton'.

▪ **Significance of Phytoplankton:**

Phytoplanktons are the major primary producers of organic matter in the aquatic ecosystem and especially oceans whose 90% productivity is from the planktons. Collectively, they directly or indirectly support the entire animal population. When the water column becomes shallow in spring, phytoplanktons are exposed to higher light intensity in the upper sunlight. Light is one of the major abiotic factors that favour the growth of phytoplankton. The massive buildup of phytoplankton in spring directly

contributes new organic carbon to support the zooplankton, which, in turn, benefits larger aquatic animals including fish, crustaceans, molluscs, birds.

Sl. No.	Species	Plankton Count (No.*10^3/L)			
		PP 1	PP2	PP3	PP4
1	*Cyclotella sp*	1.5	1.6	1.2	2.4
4	*Nostoc.sp*	1.2	1.6	2.3	2.4
5	*Nostoc.sp*	2.5	2.6	1.7	1.74
6	*Cyclotella sp*	0.56	1.1	0.65	0.8
7	*Navicula gracilis*	2	2.6	3.1	2.5
8	*Cyclotella sp*	1.1	1.8	1.5	2.2
9	*Zygnema sp.*	1.5	1.8	2.1	1.2
10	*Volvox Sp*	1.1	1.1	1.3	1.1
11	*Diatoma sp*	1.1	0.8	0.8	1.11
12	*Chlamydomonas Sp*	1.2	1.5	1.45	2.1
13	*Spirulina Sp.*	1.5	1.2	1.2	2.1
TOTAL		**15.26**	**17.7**	**17.3**	**19.65**

- **Significance of Zooplankton:**

The significance of zooplanktons is found in their role in transferring biological production from phytoplankton to larger organisms in the food web. A large number of phytoplankton species are grazed upon by the microscopic protozoans, tunicates, copepods and other crustaceans. These in turn become food for other animals further linking the food web. Therefore, variability in the production of planktons would affect the survival of young fish that depend on them.

Sl. No.	Species	Family	Plankton Count (No.*10^3/L)			
			ZP1	ZP2	ZP3	ZP4
1	Daphnia sp.	Cladocera	0.8	0.85	0.9	1
2	Cyclops sp.	Copepoda	0.85	0.87	0.76	0.95
3	Moina sp.	Cladocera	1.1	1.2	1.1	1.27
4	Paramecium sp.	Ciliates	1.1	0.9	0.5	0.8
5	Euglena sp.	Phytomastigophora	1.2	1.23	1.25	1.1
6	Cerocomonas	Flagellate	1.1	1.2	1	0.7
7	Brachinus sp.	Rotifera	0.6	0.55	0.68	0.8
8	Diaptomus sp.	Rotifera	0.5	0.11	0.28	0.3
TOTAL			7.25	6.91	6.47	6.92

- **Aquatic Fish Fauna**

Among all the aquatic life in the study area the fish fauna occupies an important place.

The fish fauna of the area includes:Major carps includes Catla, Rahu, Mirgai, Balia, Baligarda, Bansa pati, Chenga, Dandakiri, Gadisa, Jalanga.

Sl. No.	Common name	Scientific name
1	Balia	*Wallago attu*
2	Jallah	*Chela laubuca*
3	Bansapati	*Ailia coila*
4	Chital	*Notopterus chitala*
5	Gadisa	*Channa punctatus*
6	Kantia	*Mystus cavasius*
7	Baligarada	*Glossogobius giuris*
8	Mohurali	*Rasbora daniconius*
9	Phali	*Notopterus notopterus*
10	Pabata	*Ompok bimaculatus*
11	Pohale (Denga)	*Labeo bata*
12	Pohale (Chuna)	*Cirrhinus reba*
13	Rohi	*Labeo rohita*
14	Singi	*Heteropneustes fossilis*
15	Serena	*Puntius carnaticus*
16	Todi	*Mastacembelus armatus*

3.15.8 Environmental Sensitivity

As per MoEF&CC guideline, 10 km radius from the project site is considered as a study area for evaluating environmental sensitivity. The description of the environmental sensitivity of the proposed site is given below;

✓ **National Parks and Wild Life Sanctuaries**

There is no National Park & Wildlife Sanctuary present within 10 Km radius of the Project site.

✓ **Reserve Forests**

Buffer zone of this project comprise 8 reserve forest i.e. (i) Ghichamura R.F. (ii) Patrapali R.F. (iii) Malda R.F. (iv) Khait R.F. (v) Rampur R.F. (vi) Katikela R.F. (vii) Shriyapali R.F and (viii) Maulabhanja R.F are in the 10 Km from the study area.

✓ **Airport**

The Jharsaguda Airport at Jharsaguda is situated at a distance of 16 Km from the project site. The project site is not falling in aviation path.

✓ **Wetland**

No wetland notified under "The Ramsar Convention – 1971" or listed under "the National wetland Conservation Programme – 2009" is reported within 10 Km from project boundary.

✓ **Archaeological Protected Sites**

There are no archaeological protected sites falling within the 10 Km radius of the proposed NLCIL Talabira TPP.

3.16 Socio-Economic Environment

The assessment of socio-economic environment forms an integral part of an EIA study. Socio-Economic status of the population is an indicator of the development of the region. Any developmental project of any magnitude will have a bearing on the living conditions and on the economic base of the population in particular and the region as a whole. Similarly, the proposed activities will have its share of socio-economic influence in the study area. The section delineates the overall appraisal of society relevant attributes. Social Impact Assessment Report by NCDS, Bhubaneswar has been attached as annexure XII. The data collection for evaluation of the impact of the proposed project on socioeconomic aspects in the study area has been done through primary household survey and through the analysis of secondary data available for the study area.

3.16.1 Methodology

The methodology adopted in assessment of socio-economic condition is as given below;

- To assess Socio-Economic conditions of the Population
- Analysis of the identified social attributes like population distribution, availability of public utilities etc., through Census of India 2011
- Primary household survey to assess the present status of population of the study area

3.16.2 Sources of Information

As per the scope of this study, the information on socio-economic aspects has been gathered and compiled from several secondary sources. These include Taluk Office, Collectorate, Agriculture Department, Irrigation Department, Central Ground Water Board, Directorate of Census Operation, Jharsuguda etc. The demographic data has mainly been compiled from the Census of India 2011. The socio-economic details are briefly described in following sections.

This section includes the present status of the Socio-Economic Environment in the study area. To determine the baseline socio-economic pattern, at and around the project site, the required data have been obtained from the published data.

Socio-economic baseline data were collected for the following indicators:

- Demographic Structure
- Economic Structure
- Availability of Basic Amenities

The major demographic and economic structure of the study area is classified into population, literacy rate and workers details.

3.16.3 Settlement Pattern

The project site is proposed at Tareikela Village, Jharsuguda and Sambalpur District, Odisha. The area within 10 km radius from the project site has been considered as a study area.

3.16.3.1 Demography

Almost all villages in the study area are experiencing a rapid growth of population, which may be due to the process of urbanization and industrialization. The demographic structure of the study area was derived primarily from data of Census record of Odisha state covering two district Jharsuguda and Sambalpur and ten Taluka. The Demographic structures of each village in the study area as per Census 2011 are presented in **Table 3.29** and Summary of demographic structure is presented in **Table 3.30.**

3.16.3.2 Distribution of Population

The distribution of the population in the study area is given in **Table 3.29.**

Source: Census 2011 Jharsuguda and Sambalpur-District, State- Odisha; (* Total area is according to 2011 V.D)

Table 3.29 - Distribution of population in the study area

s.no	Villages	Area in hectares	Household	Population			Population(Age 0-6 years)			SC	ST
				TP	M	F	TP	M	F		
1	Tarekela	212	160	682	346	336	71	41	30	136	223
2	Thelkoloi	896	1039	3684	2030	1654	567	303	264	652	700
3	Hirma	1033	1033	4369	2237	2132	510	265	245	1081	1799
4	Patrapali	468	375	1539	783	756	172	80	92	271	343
5	Derba	1227	502	2200	1090	1110	287	130	157	192	1434
6	Khinda	1376	718	2807	1462	1345	388	204	184	976	641
7	Lapanga	1402	737	2884	1441	1443	348	178	170	654	733
8	Kurebega	308	310	1097	633	464	156	76	80	173	373
9	Marakuta	730	511	2214	1095	1119	248	114	134	713	874
10	Brajarajnagar	4144	17631	80403	41836	38567	9344	4894	4450	15083	8731
11	Malda	732	291	1181	603	578	102	56	46	160	491
12	Badimal	494	254	1037	517	520	112	53	59	183	372
13	Talabira	709	585	2150	1067	1083	259	125	134	294	595
14	Sardhapali	109	138	460	222	238	59	29	30	57	325
15	Bhurkamunda	654	364	1213	661	552	152	78	74	458	323
16	Kherual	355	144	622	359	263	62	33	29	75	78
17	Kukurjangha	437	310	1329	679	650	195	99	96	256	329
18	Rampur	434	267	1162	571	591	116	56	60	336	337
19	Dhubenchhaper	285	272	1028	539	489	128	69	59	304	383
20	Batlaga	47	109	443	230	213	71	35	36	182	175
21	Gumakarama	420	357	1437	739	698	161	80	81	297	516
22	Bansimal	223	112	412	211	201	39	18	21	112	7

s.no	Villages	Area in hectares	Household	Population			Population(Age 0-6 years)			SC	ST
23	Bamaloi	1197	607	2621	1285	1336	334	170	164	217	1764
24	Dumermunda	71	93	398	202	196	38	20	18	134	172
25	Baliput	127	67	315	161	154	39	18	21	39	76
26	Sripura	2392	524	1974	1030	944	221	122	99	634	635
27	Badmal	344	681	2875	1429	1446	365	163	202	852	568
28	jharsuguda	7047	21916	97730	50932	46798	12074	6254	5820	13870	16948
29	Bhagipali	203	67	261	125	136	38	17	21	78	123
30	Kharhiapali	995	372	1567	801	766	187	96	91	247	414
31	Sardhapali	109	138	460	222	238	59	29	30	57	325
32	Katapali	167	299	1372	701	671	125	66	59	165	354

sno	Villages	Liteartes			Main workers	Marginal workers	Non workers	Agricultural labourers		Household labourers		Other workers	
		TL	M	F				main	marginal	main	marginal	main	marginal
1	Tarekela	499	276	223	195	37	450	4	32	10	1	107	3
2	Thelkoloi	2711	1599	1112	1383	109	2192	8	9	36	12	1275	71
3	Hirma	2726	1578	1148	1398	375	2596	22	44	81	133	1114	189
4	Patrapali	1027	583	444	509	276	754	71	131	97	61	386	117
5	Derba	1284	744	540	687	272	1241	142	113	124	57	241	93
6	Khinda	1877	1075	802	930	326	1551	74	41	169	58	551	156
7	Lapanga	1927	1063	864	964	288	1632	29	61	216	87	668	136
8	Kurebega	775	501	274	140	259	698	6	6	2	30	119	218
9	Marakuta	1589	876	713	681	396	1137	21	126	94	167	519	88
10	Brajarajnagar	58609	32920	25689	22713	3048	54642	188	128	519	337	21771	2497
11	Malda	881	482	399	431	115	635	3	1	58	52	318	61
12	Badimal	680	372	308	467	87	483	23	12	51	1	216	63
13	Talabira	1392	756	636	898	230	1022	330	63	36	77	358	75
14	Sardhapali	252	141	111	162	137	161	72	131	15	-	37	-
15	Bhurkamunda	779	489	290	429	57	727	38	6	43	24	320	24

sno	Villages	Liteartes			Main workers	Marginal workers	Non workers	Agricultural labourers		Household labourers		Other workers	
16	Kherual	470	302	168	185	98	339	2	24	20	9	135	60
17	Kukurjangha	866	477	389	447	56	826	7	14	35	13	329	29
18	Rampur	857	463	394	248	88	826	1	9	5	21	154	56
19	Dhubenchhaper	770	442	328	493	24	511	54	5	109	2	281	16
20	Batlaga	280	163	117	8	166	269	-	50	-	11	8	105
21	Gumakarama	942	539	403	411	322	704	3	152	146	18	180	152
22	Bansimal	288	176	112	204	33	175	29	11	75	13	93	9
23	Bamaloi	1581	897	684	886	479	1256	32	7	282	292	453	160
24	Dumermunda	293	168	125	133	60	205	3	25	3	14	103	19
25	Baliput	245	131	114	76	15	224	4	12	1	-	44	1
26	Sripura	1384	793	591	365	297	1312	1	21	39	21	305	196
27	Badmal	2105	1152	953	775	169	1931	2	10	42	27	675	119
28	Jharsuguda	72732	40471	32261	29712	4911	63107	414	687	1044	414	27590	3624
29	Bhagipali	167	89	78	94	3	164	2	-	40	1	41	-
30	Kharhiapali	1167	641	526	431	504	632	9	89	48	278	254	92
31	Sardhapali	252	141	111	162	137	161	72	131	15	-	37	-
32	Katapali	966	529	437	386	83	903	111	72	2	-	131	10

Table 3.30: Summary of Demographic Structure in the Study Area

Sr.No	Demographic Parameters	Villages Details III Project Site Radius Area
1.	Name of States	Odisha
2.	Name of District	Jharsuguda, Sambhalpur
3.	No. of Tehsil	Ten
4.	No. of Total Villages	32
5.	Total No. of Households	50983
6.	Total Population	250953

7.	Sex ratio (N0. of female\ 1000 males)	927
8.	Scheduled castes	38938 (17.43%)
9.	Scheduled Tribe	41161(18.43%)
10.	Literate	162373(72.70%)
11.	Main Worker	67003 (22.27%)
12.	Marginal Worker	13457 (4.47%)
13.	Non Worker	143466 (47.68%)

Source: Primary Census Abstract– 2011, Jharsuguda and Sambalpur-District, State- Odisha

The salient features of Demographic Structure are as follows:

- The study area covers two districts Jharsuguda and Sambhalpur in Odisha State, Ten taluks and 32 villages.
- Total study area consisting of 29347 ha with the population density of 222 person / km^2.
- Total population in the study region (Census 2011) is worked out as 223326 out of which 116239 are male and 107687 female.
- Out of the total population, Scheduled Caste is 38938(17.43%) and Scheduled Tribe is 41161(18.43%).
- The literacy rate of the total population is worked out to 162373 (72.70%). Male literacy 31029 (13.89%), and female literacy is 71344 (31.94%)
- The total population of main worker, marginal worker and non-worker category are 67003(22.27%), 13457(4.472%) and 143466 (47.68 %) respectively.
- Sex ratio (number of females per thousand of males) in the region is recorded 927 indicating male population is marginally higher in the region as compared with the female.
- Total Child population in the study region (Census 2011) is worked out as 27027 out of which 13971(36.51%) are boys and 13056(48.31%) girls.

3.16.4 Availability Of Infrastructure

Availability of infrastructure and facilities denote the level of overall development in the study area. The list of industries, schools, colleges and hospitals located near the study area are presented in **Table 3.31** and shown in **Figure 3.16.**

Industries

- Sterlite Energy Limited
- Water Treatment Plant, Thelkoloi
- Aditya Birla Limited
- Bhushan Power & Steel Limited
- SPS Steel Ferro Manganese Limited
- Concast Steel and Power Limited
- Vedanta Aluminium Limited

- SMC Power Generation Limited

Institutions

- My Kids - Preschool
- Jharsuguda Engg School – College
- SNMT Govt. Girls College Jhunjhunu
- Padm Khumbharbandh College
- Lapanga High School
- Diet Itc

Hospitals

- JDS Multi Super Speciality Homoeopathic Hospital & Research Centre
- Sanjivani Hospital
- District Head Quarters Hospital
- Community Health Centre
- Rampur Sub-Area Dispensary
- Sripura Govt. Hospital
- Bpsl Hospital

Table 3.31 – Available Infrastructure

DIRECTION	VILLAGE/ CITY	WATER BODIES	INDUSTRIES	HOSPITAL	EDUCATIONAL INSTITUTIONS	NATIONAL PARKS/RF /PF
N	Marakuta, Hirma		Smc Power Generation Ltd	Sanjivani,Jds Mss	Jharsuguda Engg. School	
NNE	Jharsuguda , Badmal			District Head	Diet Itc	
NE	Dalki, Kurebagaa		Vedanta Ltd			
ENE			Vedanta Alumininium Power Plant			Katikela Rf
E				Sripura Govt., Bpsl		
ESE			Bhushan Power & Steel Ltd, Aditya Aluminium Power Plant			
SE	Derba				Lapanga High School	
SSE	Lapanga					
S		Hirakud Reservoi				
SSW	khinda	Bheden				
SW	Basupali					
WSW						
W						Patrapali
WNW		Ib River		Rampur Sub-area dispensary		
NW	Brairai -Nagar			Community Health		
NNW						

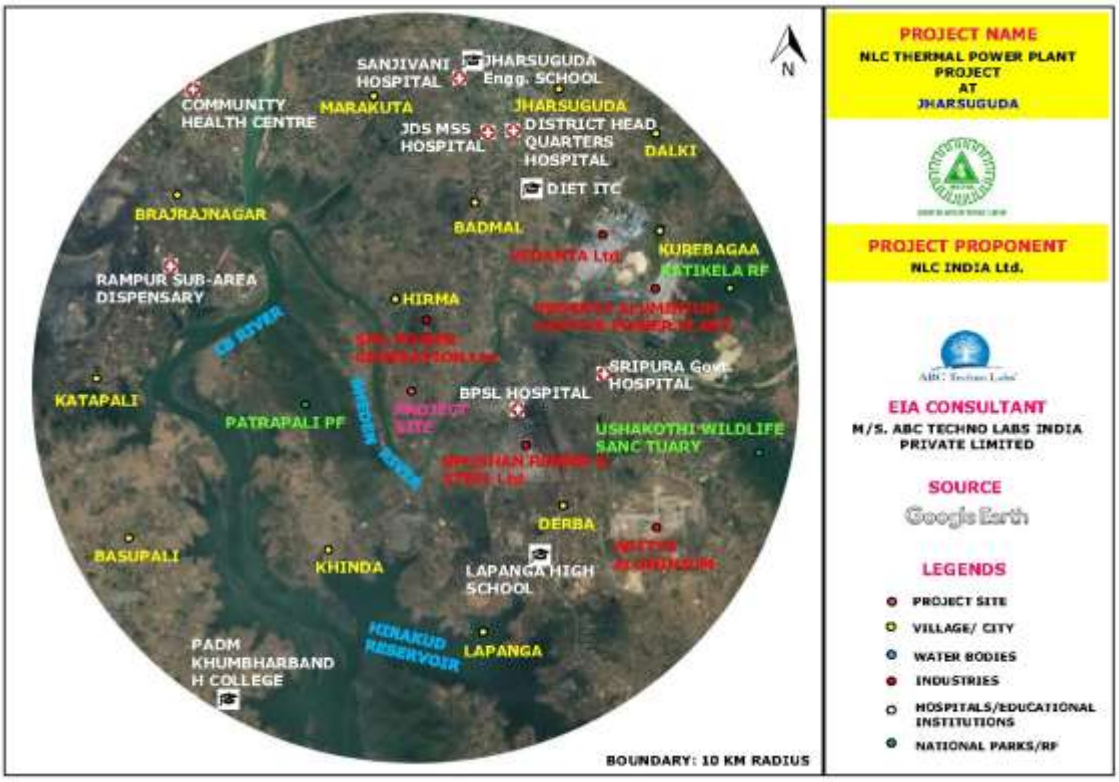


Figure 3.16 – Social Infra Map

Chapter 4 - Anticipated Environmental Impacts and Mitigation Measures

4.1 Introduction

Environmental impacts have been assessed considering present environmental setting of the project area, nature, and extent of the proposed activities. Suitable approach and methodology was adopted to ascertain likely impacts during construction and operation stage. Valued environmental components were identified during initial site visit followed by its detailed investigation during later stage of the study.

Prediction of environmental impacts is the most important component in the impact assessment study as it provides quantitative information on likely environmental impacts from a project well in advance. Several mathematical/statistical techniques and methodologies are available for predicting impacts from a developmental project on the surrounding physico-chemical, ecological and socio-economic components of environment. The results obtained from the predictions are superimposed over the baseline data (pre-project) to derive the ultimate (post-project) scenario of environmental quality status in the study area around the proposed project site. The quantitative impacts derived from predictions are also essential to delineate effective environmental management plan for minimizing the adverse impacts on the surrounding environment during construction and operation phases of the project.

The following sections identify the potential impacts on the environment from the proposed project based on the nature and extent of the various activities associated with the project implementation and operation, as well as the current status of the environmental quality at the project site. Both beneficial (positive) and adverse (negative) impacts are considered. The impact of the proposed 3x 800 MW is studied in two distinct phases:

- During the construction phase which may be regarded as temporary or short term;
- During the operation phase which would have long term effects.

The critical areas of environmental concern for which the impacts and their predictions are taken into consideration are listed below:

- Air Quality
- Noise
- Land and Soil
- Water Quality
- Hydrology and Drainage

- Terrestrial Ecology
- Socio-economic aspect

4.2 Identification of Likely Impacts

Every activity and operation has either adverse or beneficial impacts on environment. The environmental impact identification has been done based on proposed project activities.

The matrix showing the impacts during the construction and operation stage of the proposed project is given in table 4.1 and the description about the impacts and mitigation measures are given in table 4.2

Table 4.1 Matrix showing the impacts during the construction and operation stage of the proposed project.

	CHARACTERISTICS										PERSONS RESPONSIBLE FOR IMPACT DECREASE/PREVENTION ACTIONS
	PHYSICAL				BIOLOGICAL	SOCIO-ECONOMIC					
	SOIL QUAITY	AIR QUALITY	NOISE QUALITY	WATER QUALITY	FLORA AND FAUNA	INFRASTRUCTURE & TRANSPORT	WASTE MANAGEMENT	COMMUNITY HEALTH & SAFETY	OCCUPATIONAL HEALTH & SAFETY	EMPLOYMENT	
CONSTRUCTION PHASE											
SITE CLEARING & EXCAVATION	S/D	S/D	S/D			S/D		S/D	S/D	S/D	IMPLEMENTATION OF GOOD SITE MANAGEMENT PRACTICES SHALL BE THE RESPONSIBILITY OF ALL CONTRACTORS ON SITE UNDER SUPERVISION OF THE NLCIL NOMINATED PROJECT HEAD
CIVIL WORK	S/D	S/D	S/D	S/D		S/D	S/D	S/D	S/D	S/D	
TRANSPORTATION OF MACHINERY AND CONSTRUCTION MATERIALS	S/D	S/D	S/D			S/D		S/D	S/D	S/D	
STORAGE AND HANDLING OF CONSTRUCTION MATERIALS		S/D	S/D			S/D			S/D	S/D	
SUPPLY OF WATER, POWER, SANITATION FACILITIES				S/D		S/D				S/D	
ENGAGEMENT OF WORKERS								S/D	S/D	S/D	

OPERATION OF CONSTRUCTION MACHINERIES		S/D	S/D								
SOLID WASTE	S/D	S/D		S/D		S/D	S/D				
WASTE WATER				S/D		S/D					
OPERATIONAL PHASE											
NOISE			L/D					L/D	L/D		NLCIL MANAGEMENT
WATER USE				L/D							
AIR EMISSIONS		L/D						L/D	L/D		
SOLID WASTE							L/D				
LIQUID WASTE	S/D			S/D			L/D				
HAZARDOUS MATERIALS	S/D			S/D				L/D	L/D		
TRANSPORTATION OF COAL	L/D	L/D	L/D			L/D					
COAL HANDLING		L/D				L/D					
COAL BURNING		L/D									
FUGITATIVE EMISSION		L/D			L/D			L/D	L/D		
FLY ASH GENERATION	L/D			L/D		L/D					

D= DIRECT IMPACT	S= SHORT-TERM IMPACT	L= LONG TERM IMPACT		POTENTIAL POSITIVE IMPACT		POTENTIAL LOW/MEDIUM IMPACT		POTENTIAL HIGH IMPACT

4.3 Potential Impacts & Mitigation during Construction Phase

During the construction period, the impact on environment will be of temporary in nature, localized and short term with changes in the surrounding land use as compared to the current conditions. The potential impacts on water environment will arise due to discharge of washing of construction materials stockpiled, washing of concrete batching plant and discharge of untreated sewage of construction laborers. Similarly, potential impact on air environment will arise due to emission of fugitive dusts and vehicular emissions at the construction site. Mitigation measures will be required to minimize the adverse impacts on the surrounding environment.

The beneficial impacts during construction period will however be on the local people due to job prospectus and opportunities for local traders, suppliers and service providers.

Construction activities normally spread over pre-construction, preparatory construction, machinery installation and commissioning stages and end with the induction of manpower and start-up.

Pre-construction phase basically involves completion of all legal formalities with respect to the No Objection Certificates from the various statutory bodies, surveys/ studies required, acquisition of land, settlement of all issues related to compensation, if any, finalization of contract for procurement of machinery/ equipment, recruitment and hiring of requisite skilled, semi-skilled manpower and labour, provision of space and other facilities like water supply, disposal of wastewater and solid waste etc. on temporary basis for the contracted labour to be employed and provision for storage of machinery and materials to be used for construction.

Preparatory construction phase mainly consists of transportation of machinery, equipment and materials to the site for construction, demolition of existing structure, clearing and levelling of land, construction of foundations, buildings and approach roads.

Machinery installation and commissioning involve activities like fabrication work, cutting, welding and construction of buildings and other facilities, laying of cables and pipelines etc. It involves testing of plant for any type of leakages and designed capacity.

4.3.1 Air Quality

Impacts:

The sources of air emission during construction phase will include site clearing, demolition activities, vehicle movement, material storages and handling and operation of construction equipment. Emissions from them are expected to result in temporary degradation of air quality, primarily in the working environment affecting construction employees. However, Particulate Matter (PM10& PM2.5) rise in the ambient air will be coarse and will settle within a short distance close to the construction site. Hence, dust and other emissions are unlikely to spread sufficiently to affect the surrounding villages of the project site.

The impacts on the ambient air quality during construction phase will be temporarily for short duration and reversible in nature and restricted to small area. The emission of particulate matter during the construction phase will be generated from the activities like demolition, receipt, transfer and screening of aggregate, crushing activity, road dust emissions. In addition, emissions from various construction machinery fuelled by diesel and from mobile source will be in the form of CO, NOx and SO2.

Carbon dioxide and nitrogen oxides may be emitted from combustion of the petroleum products in project related vehicles, machinery, generators, and vessels/barges etc during the construction period. Their impact on air quality will not be significant as the pollutant emission activities (point and area sources) will be limited within the project boundary and the activities will be short term (only for construction period). However, this impact may further be minimized by adopting Environmental Management Plan. The emissions from stationary and mobile diesel engines with respect to their working/ movement are presented in **Table 4.2**.

Table 4.2: Exhaust Emissions for Stationary and Mobile Machinery

Source	PM_{10}	VOC	CO	NO_X	SO_2
Diesel exhaust emissions(idle)	0.043 g/min	0.208 g/min	1.57 g/min	0.917 g/min	18.8 S g/l
Diesel exhaust emissions(moving)	0.4 g/mile	3.18 g/mile	18.82 g/mile	8.5 g/mile	18.8S g/l

(Source: AP 42, Fifth Edition, Volume I, Chapter 13: Miscellaneous Sources of United State Environmental Protection Agency (USEPA))

Hence the impacts on the ambient air quality during construction phase will be temporarily for short duration and reversible in nature and restricted to small area.

Mitigation Measures:

- Vehicles delivering loose and fine materials like sand and aggregates shall be covered.
- Loading and unloading of construction materials shall be made at designated locations in project area with provisions of water fogging around these locations.
- Storage areas should be located downwind of the habitation area.
- Water shall be sprayed on earthworks periodically.
- Temporary tin sheets of sufficient height will be erected around the project site as a barrier for dust control.
- Regular maintenance of machinery and equipment. Vehicular pollution check shall be made mandatory.

- Only crushers consented by Odisha State Pollution Control Board shall be used.
- Regular water sprinkling of unpaved haulage roads.
- Mask and other PPE shall be provided to the construction workers.
- Diesel Generating (DG) sets shall be fitted with stack of adequate height as per regulations (Height of stack = height of the building + 0.2 √ KVA).
- Low sulphur diesel shall be used in DG sets as well as construction machineries.
- Air quality monitoring should be carried out during construction phase. If monitored parameters are above the prescribed limit, suitable control measures shall be taken.
- The Idling time of the construction equipment can be reduced by automatically shutting the engine off after a pre-set time without intervention from the operators.
- Plantation of trees around the project boundary will be maintained.

4.3.2. Noise Quality

Impacts:

The general noise levels during construction phase such as due to working of heavy earth moving equipment and machinery installation may sometimes go up to 90 dB(A) at the work sites in day time. The workers in general are be likely to be exposed to an equivalent noise level of 80-90 dB(A) in 8 hours shift for which all statutory precautions will be implemented. Use of proper personal protective equipment will further mitigate any adverse impact of noise to the workers.

The noise generation will be considerable during such type of large scale construction activities. Typical Noise sources during construction phases are mentioned in Table 4.3.

Table 4.3: Typical Noise Sources during construction phase

Description	Noise level
Dozers	95-100
Front Loaders	72-84
Backhoes	72-93
Tractors	76-96
Tippers/Trucks	82-94
Concrete Mixers	75-83
Concrete Pumps	81-83
Vehicular Traffic (Construction material and plant machinery)	85-98
DG Sets	90-95

Pumps	69-71
Cranes (movable)	75-86
Compressors	74-86
Pneumatic Wrenches	83-88
Jack hammer and rock drills	81-98
Pile drivers (peak)	95-105

Different phases of construction activities at project site are scheduled to take place for about 52 months. Necessary mitigation measures are required to be implemented during construction period such as proper placement of heavy machineries, following standard operating procedure etc.

This noise level will attenuate fast with increase in distance from noise source. Impacts due to noise during construction activities will be minimal since the settlements are of scattered nature. The noise generating activities will be restricted to day time only to the extent feasible. Overall, the impact of noise on the environment will be insignificant, reversible and mainly confined to the day hours. Noise generating construction activities will be carried during the day time only and this will effectively reduce the night time ambient noise level.

Mitigation Measures:

- All equipment shall be fitted with silencers and will be properly maintained to minimize its operational noise.
- Noise level will be one of the considerations in equipment selection which will favour lower sound power levels.
- Stationary noise making equipment shall be placed along uninhabited stretches.
- The timing for construction activities shall be regulated, such that all noise generating construction activities in odd hours say after school hours.
- The provision of temporary noise barrier (Barricading) shall be made near identified sensitive locations or near the noise source during construction.
- Plantation along the boundary wall shall be made at start of construction itself.
- Protection devices (ear plugs or ear muffs) shall be provided to the workers operating near high noise generating machines and their shifts shall be rotated.
- Noise measurements should be carried out to ensure the effectiveness of mitigation measures and develop a mechanism to record and respond to complaints on noise. Data shall be reviewed and analysed by the project manager for adhering to any strict measure.

- Smooth flow of traffic should be ensured on the internal road to avoid idling and honking of vehicles.

4.3.3. Water Quality

Impacts:

During the construction phase of proposed project, Water will be used for construction of civil structures, dust suppression and drinking purpose. The construction water requirement of the project would be met from Bedhan River through Barge mounted temporary pumping system. This may induce impact on local hydrology in specific cases if not taken care of specifically debris, mud etc. will be generated during construction. The likely impacts on water quality during the construction phase may mainly arise from inappropriate disposal of construction waste and wastewater generated from the construction sites. Wastewater generated from the site during the construction contains suspended materials, spillage and washings from the various areas. In addition to that, the presence of labours and other work force in the construction site will generate little quantity of wastewater during construction phase of the project. It is estimated that the total workforce will mainly come from the nearby areas and no construction camp is proposed at the project site. Hence, the domestic water requirement during construction phase will be limited to drinking water and for sanitation. All the domestic wastewater generated from the site will be sent to septic tanks followed by soak pits, so that it shall not contaminate the ground water in the nearby areas.

During the monsoon season, there are chances of wash out of mud and debris in the run-offs. This may result in suspended solids and turbidity in run offs water during the monsoon period. However, this impact will be temporary in nature and shall be lasting only for the duration of the construction period. Moreover, storm water run-offs will occur only during the monsoon seasons which last for about three months in the study area. Efforts will be made to reduce the suspended solids content of storm water run–offs by routing the storm water drains through settling tanks/catch pits.

The liquid effluents generated shall be collected and treated/ recycled. An independent plant effluent drainage system would be constructed to ensure that plant effluents do not mix with storm water drainage. Therefore, it is anticipated that there will be no significant impact on the surface water or ground water hydrology and water use of the area. Rain water harvesting will be carried out

Mitigation Measures:

- The drainage system of construction site will be connected to the existing drainage system at an early stage.
- All the debris resulting from the site shall be disposed off separately.
- Settling tanks shall be provided to prevent to discharge of excessive suspended solids.

- An oil trap shall be provided in the drainage line to prevent contamination by accidental spillage.
- Proper storm water management system shall be integrated in design phase and civil works shall be carried out accordingly at project site. Efforts will be made to reduce the suspended solids content of storm water run–offs by routing the storm water drains through settling pits.
- Toilets will be provided for construction workers and waste water generated from toilets will be treated in septic tank.
- During site development necessary precautions will be taken, so that the runoff water from the site gets collected in sedimentation tank for treatment. The treated water will be reused for construction purposes and for sprinkling on roads to control the dust emissions.
- The domestic wastewater generated from temporary toilets used by the work force will be diverted to septic tank followed by soak pit. Therefore, impact on water quality due to proposed unit would be insignificant.

4.3.4. Land use and land environment

Impacts:

The proposed project will be housed at two villages Taraikela and Kumbhari villages. The approximate area for the project is around 1447 acres.

The land environment would be impacted due to the demolition, construction related activities such as excavation of earth and earthwork, civil construction work etc. Land may also get contaminated around construction site, machine maintenance area, construction material storage and preparation site, and haulage road. However, all these impacts will be of temporary in nature.

The topography of the proposed project area is undulating with levels of the natural ground varying between RL (+) 197.0.m to RL (+) 211.0 m.Prior to construction, land will be developed through leveling and grading. To optimize cutting and filling quantities, the finished floor level of Plant area has been kept at RL (+) 203m.The formation level of western side green belt area is kept at 202.5 m and eastern side green belt area at 202.0 m.

Land use of surrounding area might not be affected for construction and pre construction activities of the project. But in future (post-construction phase) the land use of the surrounding area might be changed for the induced regional and local infrastructure development.

Constructions activities may change the visual landscape of the project area. Site clearanceactivities, gathering of equipment and construction materials, machinery and camp establishment on green field site may reduce the scenic beauty. Nevertheless, the impact is for a

short duration, and reversible as the project plan includes landscape planning, green belt development etc.

Mitigation Measures:

- Excavated soil from foundation work will be back filled.
- Surplus quantity of rubbish will be cleared and utilized to fill up low laying areas immediately after completion of construction activities.
- The top soil from the productive land area shall be preserved and reused for plantation purposes. It shall also be used as top cover of embankment slope of internal and peripheral roads for growing vegetation to protect soil erosion. It will be ensured that all excavated earth is utilised within site for levelling and road embankment purposes.
- All the raw materials required for construction will be stored in the designated area within the plant boundary.
- Construction debris will be removed continuously from the site
- Construction debris will be stored at a designated area to ensure they do not find their way to water bodies.

4.3.5. Soil Quality

Impacts:

As the construction activity will involve mainly excavation work with top soil being used for landscaping, no adverse impact is envisaged from the project during this phase.

Constructional activities like levelling, excavation and removal of existing vegetation would invariably disturb the soil of the area. The impacts on soil during construction phase shall be mainly due to loss of topsoil in the construction areas and contamination of the soils of surrounding area due to construction materials such as cement, sand, oils, etc. The disturbances would be more pronounced during the summer and monsoon seasons with strong rains.

Mitigation Measures:

The soil impact is temporary and shall be confined to the areas of construction only.

Appropriate soil conservation measures associated with improved construction techniques would minimize such local impacts.

- Fuel and lubricants shall be stored at the predefined storage location.
- The storage area shall be paved with gentle slope to a corner and connected with a chamber to collect any spills of the oils.
- Construction vehicles and equipment shall be maintained and refuelled in such a fashion that oil/diesel spillage does not contaminate the soil.

- All efforts shall be made to minimise the waste generation. Unavoidable waste shall be stored at the designated place prior to disposal.
- To avoid soil contamination at the wash-down and re-fuelling areas, "oil interceptors" shall be provided. Oil and grease spill and oil soaked materials are to be collected and stored in labelled containers (Labelled: WASTE OIL; and hazardous sign be displayed) and sold off to SPCB/ MoEF authorized Waste Oil Recycler.
- To prevent soil compaction in the adjoining productive lands, the movement of construction vehicles, machinery and equipment shall be restricted to the designated haulage route.
- Septic tank or mobile toilets fitted with anaerobic treatment facility shall be providedduring construction phase.
- Non-bituminous wastes should be dumped in borrow pits with the concurrence of landowner and covered with a layer of topsoil conserved from opening the pit.
- Bituminous wastes will be disposed of in an identified dumping site approved by theState Pollution Control Board.

4.3.6. Solid waste generation (Hazardous and Non-Hazardous) and Disposal
Impacts:

During construction phase, solid waste such as excavated soil, debris, stone, bricks, sand, metal waste, polythene sheets, etc. will be generated. This waste may contaminate soil at plant site temporarily and will be restricted to a small area. Excavated topsoil will be used for backfilling/ plantation and as soon as construction is over, all wastes from the site will be cleared with due care, meeting regulatory requirement, if any. The raw materials used for construction purpose, the packing material used for packing of various items used in creation of power plant infrastructure, and other procedures carried out during construction phase generates solid waste.

There is potential for accidental spills while re-fuelling or servicing vehicles and throughthe breakage due to wear and tear. Procedures for maintenance of equipment willensure that this risk is minimized and clean-up response is rapid if any spill occurs.During construction phase, waste oil will be generated as and when lubricating oil ischanged. Waste oil will be collected and stored in leak proof steel drums. The waste oildrums will be properly identified with label of what is contained both in local language(Oriya) and English. It will be mainly disposed of by selling to appropriate vendors as perHazardous Waste (Management, Handling and Transboundary Movement) Rules 2008& amendments thereafter.

Municipal solid waste generated by the construction work force will be minimal as mostof them will belong to local areas and no construction camps are proposed within theproject site. The

waste so generated will be collected, segregated and will be sent to thesolid waste disposal site/ land-fill allocated by the local administrative authorities. Henceimpacts will be insignificant, reversible and for short duration only. These impacts will beconfined to the construction site only and no adverse impact on the surroundings isanticipated.

Mitigation Measures:

- Oil and grease spill and oil soaked materials are to be collected and stored in labelled containers (Labelled: WASTE OIL; and hazardous sign be displayed) and sold off to SPCB/ MoEF authorized Waste Oil Recycler.
- Non-bituminous wastes should be dumped in borrow pits with the concurrence of landowner and covered with a layer of topsoil conserved from opening the pit.
- Bituminous wastes will be disposed of in an identified dumping site approved by the State Pollution Control Board.
- All construction waste shall be stored within the site itself. A proper screen will be provided so that the waste does not get scattered.
- Attempts will be made to keep the waste segregated into different heaps as far as possible so that further gradation and reuse is facilitated.

4.3.7. Socio-economic Environment

Impacts:

The construction will involve generation of a lot of employment, both direct and indirect, which will affect the economy of the study area. But these impacts will be temporary and will revert back to the original conditions once the construction work is over and the temporary labour force moves away. In addition to the employees of NLCIL, the labour strength engaged in the construction shall be about 1500 temporary contract employees and 250 direct employees depending upon construction activities. Most of the unskilled and semi-skilled labour will be available from the nearby villages and towns. Thus, impact on the physical and aesthetic resources will be minimal.

Further local skilled, semi-skilled and unskilled labourers will get direct and indirect employment during the construction phase. This might also result in a steep rise in agricultural wages in the surrounding villages, especially at the time of harvesting for short duration.

Hence, short-term positive impacts on socio-economic conditions of the area are anticipated during the construction phase.

The land acquisition will cause complete eviction of households in the project area. Most of these displaced households will migrate to nearby villages. Land acquisition means permanent loss of capital to land owner. This sudden loss of capital may cause economic recession in the affected families if compensation is not paid properly, which may ultimately lead to poverty. During Hiring employees, priority should be given to the affected people and the locals.

4.3.8. Hydrology and Drainage

The natural drainage system will be preserved and not altered due to the proposed project.

Storm water will be collected through storm water drains and will be stored in water bodies, planned to be distributed equally in the plant premises so that maximum rainwater will be recharged back to aquifer.

The project development will not alter any water body or pond. Therefore, no impact is anticipated on the hydrology of the study area.

4.3.9. Terrestrial Ecology

Impacts:

The activities of proposed project will be confined to the project site within the boundary of existing Plant premises. Actually the site is grassland with no tree cover and does not come under any forestry and agricultural activities. Present primary study revealed the presence of few shrubs like Calotropisprocera, Cassia sp and herb species (Partheniumhysterophorus, Argemonemexicana, Oxaliscorniculata,) along with seasonal grasses. These plant species are more vigorouslydistributed in the buffer zone and therefore, the present activities will not cause any significant loss of any important flora. Similarly the core zone of project area is not the habitat of any significant faunal species i.e. nests, dens etc.

Terrestrial flora can be affected by the dusty environment to be created due to vehicular movement during construction phase. Increment in the density of the dust particles (SPM) in the atmosphere can affect the surrounding plant/crop vegetation in following ways:

a) Blockage and damage to stomata

b) Reduction in chlorophyll content

c) Abrasion of leaf surface or cuticle

All these disturbances ultimately affect photosynthesis process and plant metabolism which leads to reduction in plant growth up to some extent.

Noise level of the project area will be increased during construction phase. Although there is no specific noise-sensitive flora has been recorded near to project site butavifauna and small animals can be affected by increased noise level. In such cases they can change their habitat.

Construction activities often require a considerable workforce and associated support services. The livelihood activities of this increased human population may contribute to local environmental impacts in terms of collecting firewood and food as well as enhancing recreational activities.

There will be a negligible discharge of effluent from the proposed plant which will be directly treated inside the plant. Safe guard for rainy season runoff will be taken to prevent any direct discharge from the plant to nearby river. As such the river ecology will not be affected.

Based on the field observations and interaction with local people and forest officials, it was noticed that the project area does not associated with any National Park/Wildlife Sanctuary/Conservation Reserve and there are no wildlife migratory routes present in the project area. Primary study also confirmed that there is no removal of any significant flora from the project area, no removal of prey of predatory animals and no noises disrupting breeding behaviour or use of breeding grounds.

Mitigation Measures:

Dust generation will be managed through the following:

- A regular water spraying on un-tackled roads used for transportation
- A periodic plantation of fast growing, evergreen, broad leaved, dust- resistant indigenous plant species (also proposed under Greenbelt Development Program). Any impacts associated with the congregation of labour can be managed through the following:
- No permanent camping in vegetation rich area and riverside
- A provision of fuel for labourers engaged in construction activities
- Restriction on poaching/hunting and removal of any vegetation
- Restriction on fishing

Improvement in the green cover under a regular plantation programme (Greenbelt Development Program) will not only increase the plant diversity in the area but also enhance the habitat for wildlife especially for avifauna.

The possible impacts and mitigation measures are given in **Table 4.4**

Table 4.4: Possible impacts and mitigation measures at construction stage

Discipline	Potential Negative Impacts	Probable Source	Mitigation Measures	Remarks
Air Quality	Increase in ambient dust (PM) and NO_X levels	Vehicular movements, excavation and levelling activity	• Sprinkling of water in the construction area and unpaved roads. Proper maintenance of vehicles. Restricting dust-generating activities, such as blasting or top soil removal, to calm wind conditions. Heavy vehicles moving offsite are covered. Vehicle speed on construction	Construction vehicles have to be maintained properly for Reducing air pollution levels from vehicle exhausts.

			Roads is restricted and vehicles are used only on dedicated construction roads and access points. • Visually monitored particulate emissions from diesel vehicles and carried out regular maintenance of equipment.	
Noise Quality	Increase in ambient noise level	Construction equipment and vehicle movement	• Limiting the hours of construction where practical. • The workers operating high noise machinery or operating near it are provided with ear plugs. The high noise generating stationary machinery will be located at central portion of the site. Construction equipment meets the noise and air emission levels as per EPA Rules, 1986. • Identification of alternate access roads to the site to facilitate one-way movement of traffic or reduction of traffic density on any particular road • Road surfaces are improved to withstand movement of heavy construction vehicles. • Appropriate signage and deployed flagmen should be assigned during peak traffic period to regulate the	Equipments are to be kept in good condition to keep the noise level within 90 dB (A). Workers will be provided with necessary protective equipment e.g. earplugs, earmuffs

			Movement of traffic.	
Water Quality	Increase in suspe solids due to soil run-off during heavy precipitation. Increase of water Pollutants	Loose soil at construction site Discharge of wastewater from construction	• During monsoon season run-off from construction site will be routed to a temporary sedimentation tank for settlement of suspended solids. • All wastewater discharges from construction site will be received in septic tanks with adequate capacity. • Oil handling and storage area has to be surfaced and provided with catch pit to intercept any accidental spillages.	---
Ecology	Clearing of Vegetation	Soil enabling activities	Landscaping and extensive plantation will be done.	Open spaces reserved will be green turfed and appropriate type of plantations will be done.
Socio-economics	Land oustees	Land Acquisition	The project site is already free from encumbrances, hence land acquisition and resultant rehabilitation and resettlement issues are not involved.	---
Excavated Material	Loss of excavated top soil	Excavation	The topsoil will be properly stored and used for greenbelt development. The construction debris will be used for levelling the low lying areas.	---
Traffic	Creation of Traffic	Material carrying vehicles	Improvement and widening of the existing access roads. Multiple accesses point to the	---

			Site have to be provided by establishing additional connecting roads.	

4.4 Potential Impacts during Operation Phase

The potential impacts during the Operation Phase have been identified within the project site as well as the study area of 10 km radial zone around the proposed project.

The basic environmental attributes likely to be affected due to the proposed power project are as follows:

- Air Environment
- Water Environment
- Land Environment
- Noise Environment
- Socio-economic Environment

The impact on each of the above components of environment are identified through cause condition network using appropriate mathematical model and evaluated through environmental evaluation system.

4.4.1. Air Environment

Impacts:

The pre-project (baseline) ambient air quality status in the study area during winter season of 2018 indicate that all the criteria pollutants are well within the prescribed NAAQS for industrial, residential, rural and other areas.

During operation phase, the air emissions will be from:

- TP plant Stacks
- Emergency Power Supply System – DG sets
- Coal Handling and stockpiles.

The ambient air quality in respect of air pollutants will change during the operation phase due to the operation of the proposed 3 x 800 MW project. Air borne pollution envisaged to be caused by wind and traffic movement from access roads. Also fugitive dust will be generated from handling and feeding of raw materials. There shall be fugitive dust during raw material handling, junction houses and transfer points.

It is however envisaged to control fugitive dust by water sprinkling as well as the use of bag filter. All transfer points and Belt Conveyors will be fully enclosed. Ventilated air shall pass through Bag Filters. SO2 originates mainly from combustion of fossil fuels. The flue gas from the Boilers shall be treated in ESP&FGD and then released through stacks of adequate height.

Adequate stack height will be provided for better dispersion of flue gas as per the guidelines of CPCB/CECB. In addition to that adequate greenbelt will be developed by the project proponent for further control of air pollution due to fugitive emissions at site. Compliance with the existing ambient air quality standards will be achieved by implementation of the measures as outlined in EMP. This needs to be coupled with the continuous monitoring of air pollutants within and around the project site as well as in adjoining areas. To assess the impact of air emissions from various continuous point sources, air dispersion modelling study was conducted with the help of AERMOD

4.4.1.1 Model Details

Air dispersion modelling can be used to predict atmospheric concentrations of pollutants at specific locations (receptors) over specific averaging times (i.e. annual, daily, and hourly). An atmospheric dispersion model accounts for the emissions from a source; estimates how high into the atmosphere they will go, how widely they will spread and how far they will travel based on temporal meteorological data; and outputs the pattern of concentrations that will occur for various exposure periods, thereby providing the exposure risks for different receptors.

A dispersion model is a series of equations describing the relationships between the concentration of a substance in the atmosphere arising at a chosen location, the release rate and factors affecting the dispersion and dilution in the atmosphere. The model requires information on the emission characteristics and the local meteorology. Modelling can also be used to predict future scenarios, short-term episodes, and long-term trends.

Nearby buildings and complex topography can have significant effects upon the dispersion characteristics of a plume. Buildings may cause a plume to come to ground much closer to the stack than otherwise expected, causing significantly higher substance concentrations. Plumes can impact directly on high buildings under certain meteorological conditions, which may trap emissions during low-level inversions. Based on the scope of the project, AERMOD would be an appropriate model to assess the ground level concentration within the project area and at ambient level outside of the plant boundary.

In order to conservatively estimate the maximum ground level operation, maximum operating conditions under maximum emission scenario is calculated.

Key steps of the assessment would include:

Emission to quantify emissions. The emission estimates will be based on manufacturers data on comparison with the scheduled operation; in the absence of manufacturers data, emission factors obtained from USEPA, AP-42 or emission estimates from similar operating facility will be used.

Obtaining local meteorological file, for months of monitoring for one season for the monitoring Period;

Model inputs with stack/vent related specifications such as height, type of stack, diameter, exhaust temperature, exit velocity, orientation of the stack, exhaust flow rate and emission rate. The following options of the stack arrangement has been considered for modelling purpose.

- Three no's individual stack of height 150 m.
- One twin flue and one single flue stack of height 150 m.

The regional meteorological data set from the data collected from the monitoring location is verified with the Indian Meteorological Data (IMD) repository. The onsite data is then processed using AERMET to produce the meteorological input files and on-site data to further enhance the detailed analysis of the atmospheric and dispersion conditions applicable to the project area.

The general process approach for AERMOD would include:

Process meteorological data using AERMET;

Obtain digital terrain elevation data;

Incorporate building downwash using BPIP-PRIME;

Characterize site - complete source and receptor information;

Perform terrain data pre-processing for AERMOD dispersion model using AERMAP;

4.4.1.2 Meteorological Data

Meteorological data collected from 1st January to 31st March 2018 has been given in Chapter 3 which indicates that the predominant wind direction is blowing from North-East to South-West. .The meteorological data consists of wind speed, direction, temperature and humidity recorded during the months of January through March, 2018, on an hourly basis. Wind speed, wind direction and temperature have been processed to extract the 8–hourly mean meteorological data for application in AERMOD

4.4.1.3 Emissions

The details of the emissions for the proposed sources are listed in Tables 4.5and 4.6. The emissions rates and stack parameters of the sources modelled for the proposed and Resultant concentrations after implementation of proposed project Table 4.7 In order to estimate the worst-case scenario (based on maximum sulphur and ash contents), the ground level concentration was computed considering the plant emissions.24-hourly average ground level concentrations of SOx, NOx, PM10 and PM2.5 were computed for 8-hour mean meteorological data of Months of January, February and March, 2018.

TABLE 4.5: EMISSION SOURCE

Case 1	Three no's individual stack of height 150 m
Case 2	One twin flue and one single flue stack of height 150 m

S.NO	PARTICULARS	UNIT	STACK 1	STACK 2	STACK 3
1.	Stack diameter	M	8	8	8
2.	Stack height	M	150	150	150
3.	Stack exist temperature	K	403	403	403
4.	Stack exist velocity	m/s	20	20	20
5.	Normal flow rate	Nm^3/hr	1005.3	1005.3	1005.3
6.	Emission				
	PM	g/s	25	25	25
	SO2	g/s	90	90	90
	NOx	g/s	90	90	90

Table 4.6: Emission Data and Stack Parameters for Proposed

Sl No.	Description	Values
1.	Height of Chimney in metres	As per MoEF 150 m
2.	Flue Gas Exit Temp (K)	418
3.	Flue Gas Exit Velocity (m/s)	20 maxm
4.	Flue Gas Flow Rate (Nm^3/s)	**
5.	Top Internal Diameter (m)	**
6.	Particulate Matter (PM) Emission Rate (g/s) or mg/Nm	30
7.	SO_2 (g/s) mg/Nm^3	100
8.	NO_2 (g/s) mg/Nm^3	100
9.	Total consumption of coal in Tons/Hr. per Unit	510
10.	Ash content (%)	45
11.	Sulphur content (%) (Design Fuel)	0.33
12.	Fly Ash generated (TPH)	200
13.	Bottom Ash generated (TPH)	50

Table 4.7 - Resultant concentrations after implementation of proposed project (Scenario 1 - Three no's individual stack of height 150 m.)

Sl. No.	Pollutant	Maximum Baseline Concentration, µg/m³	Predicted Incremental Increase GLC µg/m³	Resultant Maximum Concentration µg/m³	NAAQS Limits µg/m³
1.	Particulate Matter	79.60	1.25997	80.85997	100
2.	Sulphur Dioxide (SO_2)	11.70	4.36151	16.06151	80
3.	Nitrogen Dioxide (NO_2)	24.90	4.36151	29.26151	80

Table 4.8 - Resultant concentrations after implementation of proposed project (Scenario 2 - One twin flue and one single flue stack of height 180 m 150 m)

Sl. No.	Pollutant	Maximum Baseline Concentration, µg/m3	Predicted Incremental Increase GLC µg/m3	Resultant Maximum Concentration µg/m3	NAAQS Limits µg/m3
1.	Particulate Matter	79.60	0.79001	80.39001	100
2.	Sulphur Dioxide (SO2)	11.70	2.73358	14.43358	80
3.	Nitrogen Dioxide (NO2)	24.90	2.73358	27.63358	80

The predictions indicate that the contribution of the facility to the ambient air quality will be minimum and concentrations of Particulate Matter, SO_2 and NO_2 concentrations will be well within the prescribed limit for industrial, residential and rural zone even after proposed machineries comes into operation.

- **Findings**

Isopleths for 24 hourly average increases in GLCs are depicted in Figure 4.1 to 4.7 for all scenarios. Overall impact on existing ambient air quality shall be as per given hereunder in Table 4.8.

Table 4.8: Overall Impact on Existing Ambient Air Quality

Particulars	Predicted 24-Hour Average Maximum Concentration (µg/m³)		
	PM	SO_2	Nox
Scenario 1 Maximum GLCs	1.25997	4.36151	4.36151

Scenario 2 Maximum GLCs	0.79001	2.73358	2.73358
Maximum Predicted GLC	**1.25997**	**4.36151**	**4.36151**
Maximum Concentration Recorded in Ambient Air as Baseline	79.60	11.70	24.90
Maximum Projected Concentration in Ambient Air	**80.85997**	**16.06151**	**29.26151**

Source: ABC Techno Labs India Pvt. Ltd.

4.4.1.4 TERRAIN OF THE STUDY AREA

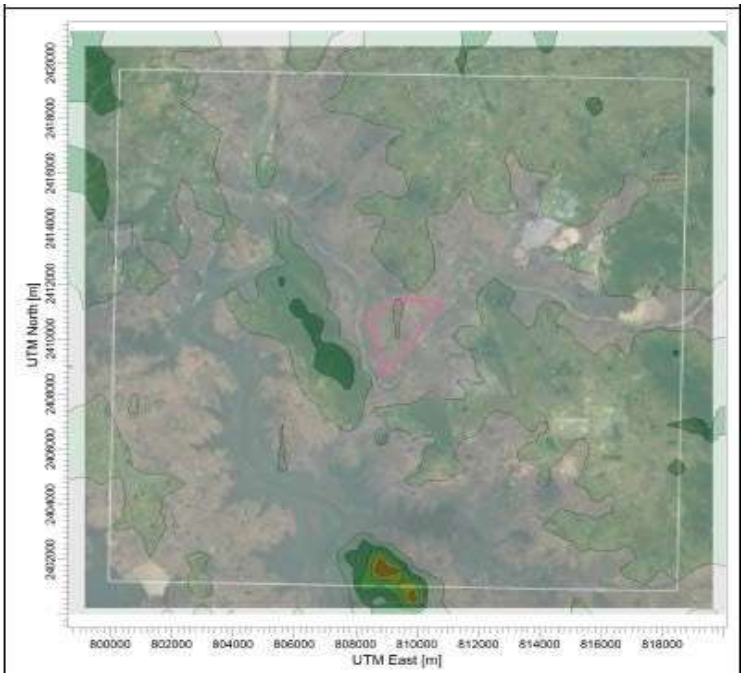


Fig 4.1: Terrain of the study area

4.4.1.5 Summary of Predicted Ground Level Concentrations:

The summary of maximum ground level concentrations (GLCs) for the proposed project and the Facility and its impact on the study area under the worstmeteorological scenario is listed in Table 4.7 and 4.8 respectively.

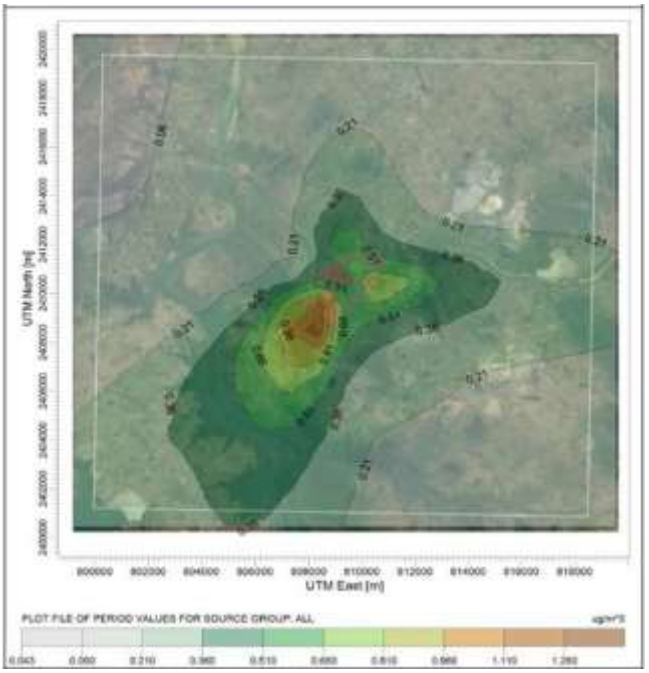


Figure 4.2 Maximum Ground Level Concentration for 24 - hours – PM (Scenario 1)

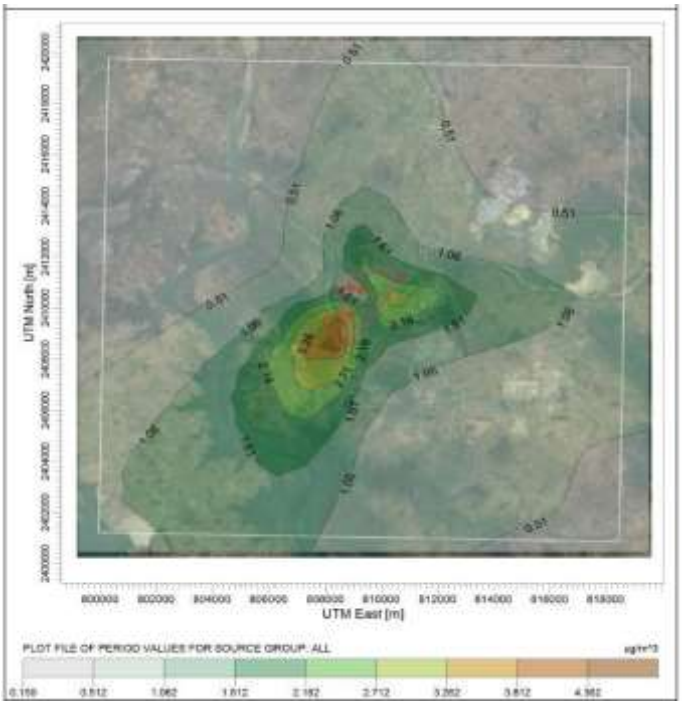


Figure 4.3 Maximum Ground Level Concentration - 24 hour - SO_2 (Scenario 1)

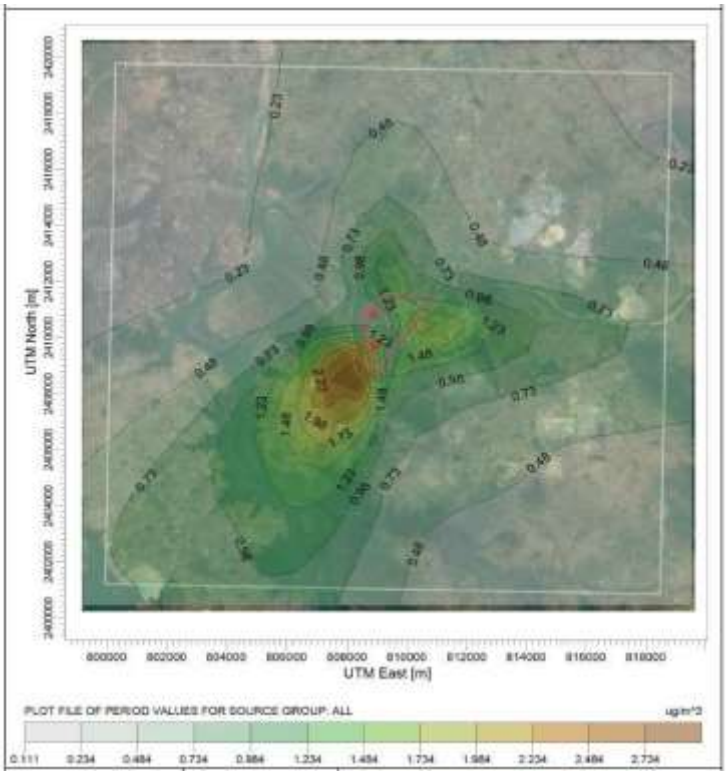


Figure 4.4: Maximum Ground Level Concentration - 24 hour - NO_2 (Scenario 1)

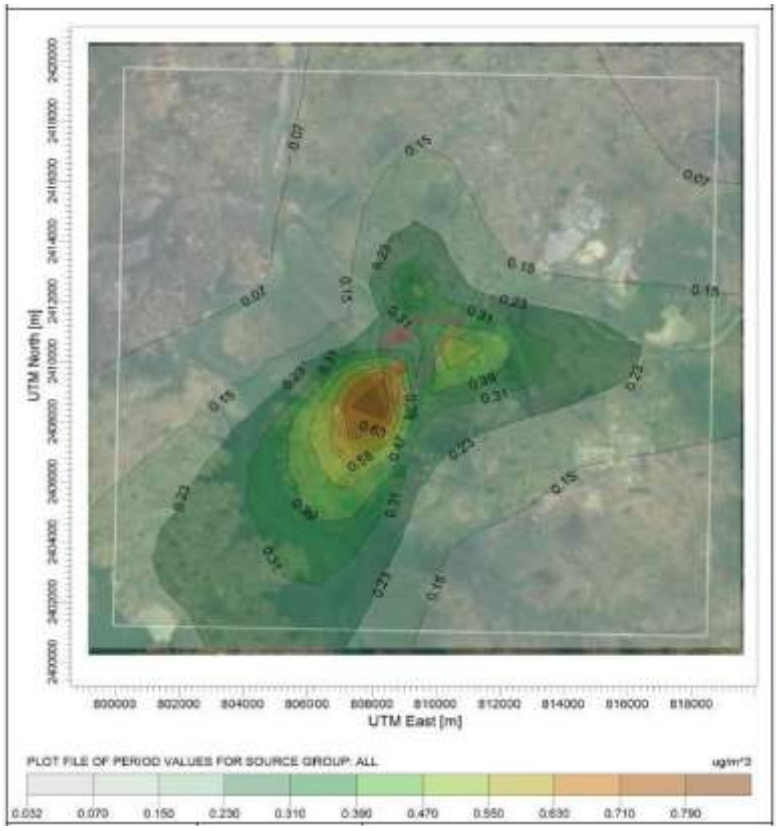


Figure 4.5 Maximum Ground Level Concentration for 24 - hours – PM (Scenario 2)

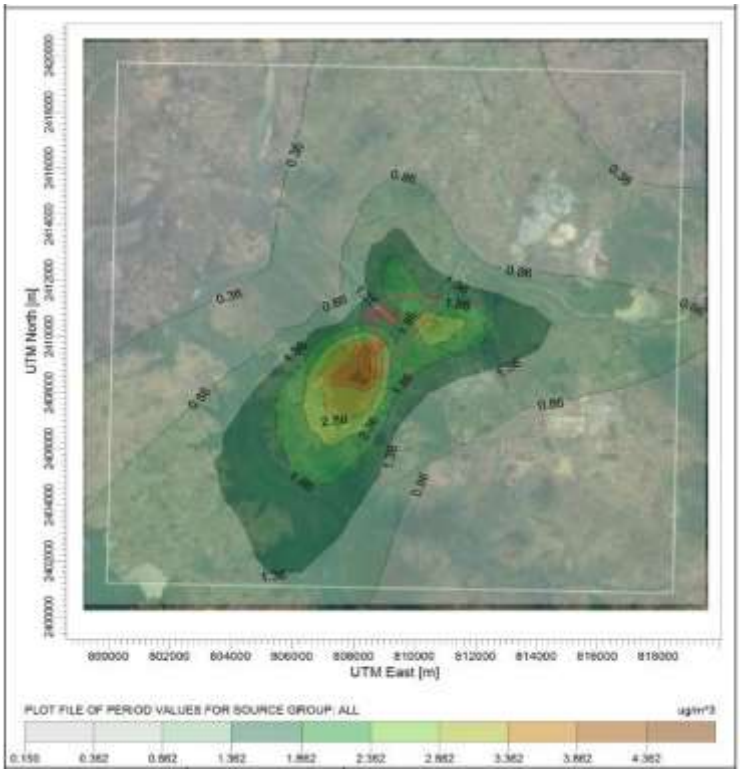


Figure 4.6 Maximum Ground Level Concentration - 24 hour - SO_2 (Scenario 2)

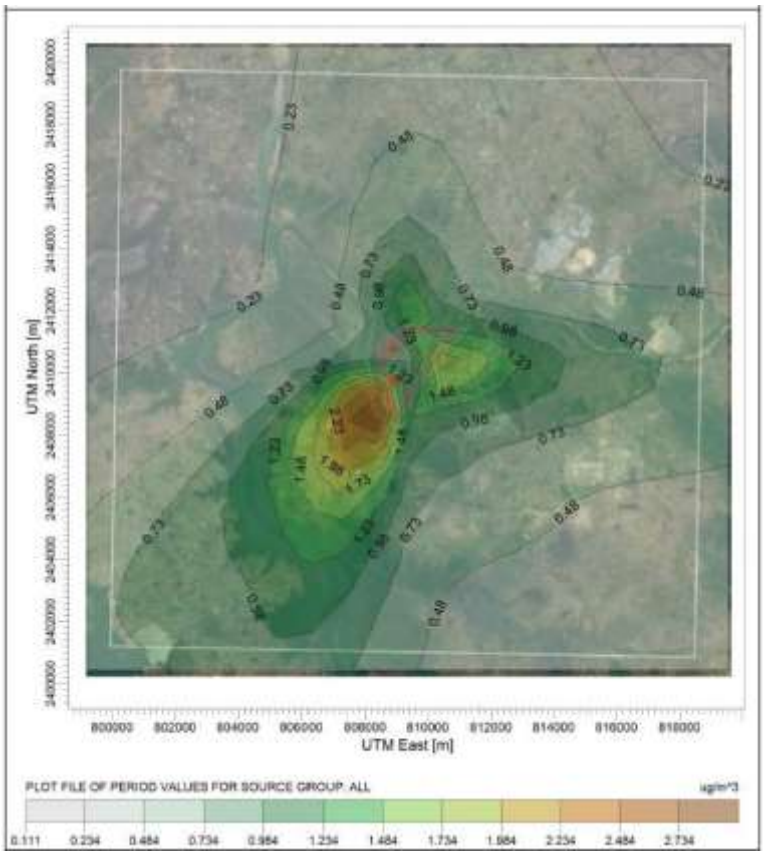


Figure 4.7: Maximum Ground Level Concentration - 24 hour - NO_2 (Scenario 2)

The above tables show that in the worst case scenario, the maximum ground Level concentration due to the proposed project and the Facility will be in the predominant South West direction and below the prescribed standards for each of the pollutants modelled. Modelling results consist of maximum concentrations (in $\mu g/m^3$) for each of the modelled substances. The concentration isopleths are shown in Figure 1 to Figure 3 and the summary of dispersion modelling results for each of the selected substances is given in Table 1. The modelling assessment was carried out for all the stack sources within the project site and the emissions were based on maximum operating conditions.

Cumulative impact on baseline ambient air quality, after the implementation of the proposed project has been arrived by superimposing the present baseline maximum air quality levels of each pollutant. The resultant ambient air quality after implementation of the proposed plant is given in Table 4.7.

Discussion

Table 4.7 and 4.8 show that the impacts from the proposed project and the Facility are well within the NAAQS standards. Therefore, there will be no adverse impacts on the agricultural productivity of the nearby areas. Highly efficient air pollution control systems will be adopted to mitigate particulate matter as well as gaseous emissions in the ambient environment.

Mitigation Measures:

Latest Pollution control equipment will be adapted to the once-through steam generator, for Compliance to latest MOEF&CC guidelines:

- Selective Catalytic Reactor (SCR)
- Flue Gas Desulphurization (FGD)
- Electrostatic Precipitator (ESP)

High efficiency electrostatic precipitators (ESPs) will be installed to limit the particulate emission to 30 mg/Nm3 to facilitate wider dispersion of particulate and gaseous pollutants. One single flue and one twin flue chimneys of 150 m height will be provided for wider dispersion of pollutants. On-line equipment will be provided for monitoring of stack emissions.

To control NOx emission, supercritical boilers having advanced low NOx generation system will be installed to limit the NOx emission as per latest environmental guidelines. FGD system will be installed in flue gas duct to the chimney as per latest environmental stipulation. The design and layout of steam generator and its auxiliaries will take into account wet Flue Gas Desulphurization (FGD) system to be installed taking suction from duct after ID fan and feeding the Desulphurized flue gases back to the chimney. For control of fugitive dust emissions within and around coal handling plant, dust extraction/suppression systems would be provided. Dust suppression System will also be provided in the coal stock yard.

Selective Catalytic Reduction (SCR) based De-NO**x** system and its auxiliaries for three (3) Number steam generators of 800MW nominal rating will be installed. The SCR System will be installed in each unit, to limit NoX emission below 100 mg/Nm^3 so as to meet the MOEF requirements. The SCR reactor will be arranged for gas flow from top to the bottom and arranged in the flue gas pass of the steam generator between economizer and air heater. The reagent will be ammonia/air mixture. The overall design of the SCR will be done considering all operating conditions, minimization of ammonia consumption and slip, prevention of formation of ammonium hydrogen sulphate and other ammonia components, which deactivate or plug up the catalysts, minimization of SO3-conversion, prevention of disturbances in downstream equipment, prevention of plugging by ash particles, especially "popcorn ash", maximising the life of the catalyst.

4.4.2. Water Environment

Impacts:

Consumptive water requirement for 2400 MW capacity project is estimated as 72 Cusecs. The water is proposed to be drawn from Hirakud reservoir at a point near the intake location of M/s Bhushan Steel and Power Ltd, at a distance of about 20 Km. In-principle approval of State Government is available. However, water drawl point location, pipe routing and other details need to be finalized in consultation with WRD, GOO.

No ground water source will be tapped in the project site for meeting the water requirements during operation of proposed plant. Detailed water drawl study has been undertaken in order to confirm the availability of requisite quantity of make-up water for the proposed project. Raw water requirement is worked out to be 7200 m^3/hr as per the attached composite.

Mitigation Measures

I. The Pre Treatment plant would be designed to remove suspended/colloidal matter in the raw water. Separate pre-treatment plant will be provided for meeting the CW system and Demineralization (DM) plant. A common chemical house will be provided to store chemicals such as chlorine, lime, alum & coagulant aid and respective lime, alum and coagulant dosing equipment such as tanks, pumps etc. for all the PT systems. Independent chemical preparation tanks and chemical dosing pumps will be provided for each PT system.

II. The Water PT plant for CW system will consist of three (3) clarifiers of reactor type/tube settler/ lamella type, of 2300 m^3/hr capacity, one number of aerator and one number of stilling chambers (common for all three clarifiers). The water PT plant for Potable water Plant will have two (2 x 100% capacity) gravity filters/pressure sand filter each of 100 m^3/hr for potable water purpose. The water PT plant for DM Plant will consist of One (1)

Tube settler/ Lamella clarifier or reactor type clarifier of230 m^3/hr capacity, one number of aerator and one number of stilling chambers and two (2 x 100% capacity) numbers of gravity filters/pressures and filters each of 150 m^3/hr.

III. There will be one standby gravity/pressure sand filter each for water PT- Potable water plant & PT-DM plant system. Water from the clarifiers will be led to clarified water storage tank or to the filters as the case may be. Water from the clarified water storage tank will be pumped to the HVAC make up system, Potable water system, Service water system, Make up to miscellaneous cooling system. For CW system, make up water will be supplied through pumps.

IV. From the gravity/pressure sand filters, filtered water would flow by gravity to respective filtered water reservoirs and filtered water would be pumped to DM plant and Potable water system.

V. Required hoists, cranes and weighing scales will be provided for handling pumps, chemicals, chlorine ton containers etc.

VI. The Water pre-treatment plants will be provided with required instrumentation, interlocks, controls, control panels to facilitate safe & reliable operation.

VII. The DM plant will be sized to meet the makeup water requirement of the steam cycle, make up to closed circuit auxiliary system, hydrogen generation plant, and stator water-cooling system. Considering the quality of water, it is proposed to adopt a service cycle of 20 hrs. For DM Plant.

VIII. The D.M. plant will consist of three (3) streams of 100 m^3/hr capacity (2W+1S) and each stream will comprise of Activated carbon filter, Cation exchangers, degasser system (comprising of degasser tower, degassed water tank, degassed water pumps and degasser blowers etc.), anion exchangers and mixed bed exchanger.

IX. The plant will be designed for semi-automatic operation with PLC/DDCMIS based control. Two (2) D.M. water storage tanks each of 2000 m^3capacity will be provided to store DM water. One neutralization pit will be provided for neutralizing the pH and discharging the effluent water from the DM plant.

X. Chlorination plant will be provided for chlorine dosing in the CW system to avoid the growth of algae and bacteria. Separate chlorination plants will be provided for water PT plant and CW system (at two locations).

XI. CW chlorination system would consist of Three (3) numbers of chlorinator-evaporator sets of 100 Kg/hr capacity. For PT system there will be Three (3) (3x50% capacity) numbers of chlorinator sets each of 20 Kg/hr capacity. Each chlorination system will be provided with required chlorine ton containers, instrumentation, panels, chlorine leak detectors etc. Complete chlorination plant will be located indoor.

XII. For maintaining the feed water purity condensate polishing plant will be provided in the feed water cycle at the downstream of condensate extraction pumps as per the existing practice. The condensate polishing plant will be of full flow, deep mixed resin bed type consisting of 3x50 % capacity service vessels for each unit.

XIII. The resins to be used would be strongly acidic cation and strongly basic anion type, appropriate for condensate polishing system. A common external regeneration facility will be provided along with one additional Mixed Resin Storage vessel. The exhausted charge of resins from the service vessel will be hydraulically transferred to the resin separation/ cation regeneration vessel for regeneration and reuse.

XIV. It is proposed to provide suitable chemical treatment programme of acid dosing and scale cum corrosion inhibitor for the CW system for control of CW system water chemistry at two locations. It is proposed to provide acid & chemical storage tanks and respective dosing pumps will as a part of CW treatment system.

XV. The plant will be provided with neutralization pits, disposal pumps with required corrosion measurement track, instrumentation for interlocks and controls, control panels etc. to facilitate safe &reliable operation

4.4.3. Noise Environment

During normal operation phase, there are two types of noise generation sources expected at the proposed coal based thermal power plant. Stationary sources due to operation of heavy duty machinery at the project site like Compressors, Pumps, Turbines, Boilers, etc. Mobile sources corresponding to mainly vehicular traffic for staff mobilization, material transport, and fuel transport to project site etc. Materials loading and unloading at conveyors will also generate some noise. The impacts from these sources are predicted separately as given in following sections:

4.4.3.1 Mobile Sources

Vehicular traffic on approach roads to project site in connection with material transportation, staff mobility including township activities and fuel transportation are the considerable mobile noise sources due to proposed project.

Due to the proposed project, it is estimated that number of vehicles plying per day on approach roads to the project site will increase. However, with proper mitigation measures and by adopting good practices these will be kept below the prescribed levels. The noise levels generated in the plant due to transport vehicles will be confined within the boundary and with attenuation after greenbelt and construction of boundary wall the impact of noise levels on surroundings will be negligible.

4.4.3.2 Stationary Sources

Considerable noise could be generated from steam turbines, cooling towers pumps, transformers, compressors, feed water pumps, air intake fans/blowers etc. Steam turbines are the major noise sources.

The noise generation from major equipment will be restricted through manufacture specifications like STGs: 85 dB (A) at a distance of 1 meter; Boiler feed pumps, Compressors: 90 dB (A) at a distance of 1 meter etc. to comply the regulatory standards. These sources have been considered for prediction of cumulative impact on ambient noise levels at nearby human settlements as well as the occupational exposure to workers within the project premises. Sound pressure generated by the noise making sources decreases logarithmically with the distance from the source due to energy dissipation in wave divergence form. In noise propagation there is usually an additional decrease in sound pressure level with distance from source due to atmospheric effects and or physical interceptions by structures, barriers etc. existing along the transmission path.

Mitigation Measures:

The project does not envisage any continuous stationary source of noise. The proposed green belt development will further attenuate the noise emanating from the individual industries. Thus, the ambient noise generated from stationary and mobile sources will be controlled.

4.4.4. Ecology

Impacts:

The impacts associated with the proposed project are listed below:

Loss of species

The activities of proposed project will be confined to the project site within the boundary of Plant complex. The project site does not come under any forestry and multi crop agricultural activities.

Present primary study revealed the presence of few shrubs like Calotropisprocera, Cassia sp and herb species (Partheniumhysterophorus, Argemonemexicana, Oxaliscorniculata,) along with seasonal grasses. These plant species are more vigorously distributed in the buffer zone and therefore, the project construction activities will not cause significant loss of any important flora. Similarly the core zone of project area is not the habitat of any significant faunal species i.e. nests, dens etc.

Gaseous pollution

Due to different vehicular movement and project operation activities the concentration of air pollutants can be increased. These pollutants can affect the surrounding vegetation and nearby agricultural crops.

Dust Generation

Terrestrial flora can be affected by the dusty environment to be created due to vehicular Movement during construction and operation phase. Increment in the density of the dust particles (SPM) in the atmosphere can affect the surrounding plant/crop vegetation in following ways:

a) Blockage and damage to stomata

b) Reduction in chlorophyll content

c) Abrasion of leaf surface or cuticle

All these disturbances ultimately affect photosynthesis process and plant metabolism which leads to reduction in plant growth up to some extent.

Noise Pollution

Noise level of the project area will be increased during construction and operation phase. Although there is no specific noise-sensitive flora has been recorded near to project site but avifauna and small animals can be affected by increased noise level. In such cases they can change their habitat.

Congregation of Labour

Construction activities often require a considerable workforce and associated support services. The livelihood activities of this increased human population may contribute to local environmental impacts in terms of collecting firewood and food as well as enhancing recreational activities.

Mitigation Measures:

Gaseous pollution

The SO2 in ambient air is reported in this study is low and the levels of other air pollutants are also low. Development of multi-layer plantation (green belt) around the proposed project area will help to mitigate gaseous pollution within and around the project area.

Dust Generation

Dust generation will be managed through:

- A regular water spraying on un-tackled roads used for transportation
- A periodic plantation of fast growing, evergreen, broad leaved, dust- resistant indigenous plant species (also proposed under Greenbelt Development Program)

Effluent discharge

There will be a negligible discharge of effluent from the proposed plant which will be directly treated inside the plant. The treated water will be used for various activities within the plant premises. Safe guard for rainy season runoff will be taken to prevent any direct discharge from the plant to nearby river. As such, the river ecology will not be affected.

Congregation of Labour

The impacts will be managed through:

- No permanent camping in vegetation rich area and riverside
- A provision of fuel for labourers engaged in construction activities
- Restriction on poaching/hunting and removal of any vegetation

Based on the field observations and interaction with local people and forest officials, it was noticed that the project area does not associated with any National Park/Wildlife Sanctuary/Conservation Reserve and there are no wildlife migratory routes present in the project area. Primary study also confirmed that there is no removal of any significant flora from the project area, no removal of praying with prays of predatory animals and nonoises disrupting breeding behaviour or use of breeding grounds. Improvement in the green cover under a regular plantation programme (Greenbelt Development Program) will not only increase the plant diversity in the area but also enhance the habitat for wildlife especially for avifauna.

Greenbelt Development Programme

Increasing vegetation in the form of greenbelt is one of the preferred methods to keep the pollution under control. Plants serve as a sink for pollutants, act as a barrier to break the wind speed as well allow the dust and other particulates to settle out there. It also helps to reduce the noise level up to some extent. The main objective of the green belt is to provide a buffer / barrier between the sources of pollution and the surrounding areas. The green belt helps to capture the fugitive emissions and attenuate the noise apart from improving the aesthetics quality of the region. Of the total area of the proposed project site (core zone) 33% area shall be developed as a green belt along the periphery of the plant. The goal of installation a greenbelt would also be to maximize both ecological functionality and scenic beauty of the project area. Some greenery is already existed in the project area. The greenbelt area will cover the 33% of the total project area and this greenbelt of different thickness will be established systematically. Ideal size of greenbelt shall be between 10 and 50 meter wide and run the length of roads, major structures and open spaces. Width depends on the availability of land.

Selection of species

Local or indigenous species will be preferred under this programme and the species those have dust & noise tolerant capacity, enhance aesthetics and develop a habitat for wildlife especially for avifauna will be introduced. A plantation of sound and dust receptor as well as aesthetically valuable species is proposed which will help in reduction of pollution (both atmospheric & noise), reduction of stress and beautification of the area. Hardiness, longevity, a minimum of wind through and breakage, attractiveness and minimal maintenance requirement are some qualities of species which are to be taken into consideration during selection. A standard

spacing of 3m and 2m for tree and shrub species respectively will be taken into consideration, whereas the pit size will be recommended as 45 cm x 45 cm x 5 cm for trees and 30 cm x 30 cm x 30 cm for shrubs. Selection of the plant species will also be based on the growth and morphological characters i.e. height, crown cover and also on the basis of their adaptability in the region. Following types of species are proposed under greenbelt development:

- Native Plant Species- drought resistance
- Species that can minimize noise level
- Species that can absorb dust
- Habitat Improvement Species
- Fruit Species to enhance the Food Availability for Wildlife

By reviewing the various literatures, following plant species has been chosen for greenbelt development listed in Table 4.9.

Table 4.9: List of Plant species to be planted

S.No	Species	Common Name
1	*Acacia arabica*	Babul
2	*Terminalia arjuna*	Arjun
3	*Mangifera indica*	Aam
4	*Ficus religiosa*	Aswatha
5	*Aegle marmelos*	Bel
6	*Terminalia tomentosa*	Asan
7	*Ficus benghalensis*	Bot
8	*Ziziphus mauritiana*	Ber
9	*Buchanania lanzan*	Charoli
10	*Pterocarpus marsupium*	Piasal
11	*Polyalthia longifolia*	Debdaru
12	*Alstonia scholaris*	Chatim

Greenbelt around the Project area

In the context of air pollution attenuation, greenbelts will be developed around the project in a manner so as to effectively reduce the pollution caused by project activities. Design of effective greenbelts involves consideration of meteorological, physio-chemical, biological, and horticultural aspects relevant to pollutant source and the area where greenbelt has to be established. Such plantation will be carried out in three different layers. Species like Ficus hispida and Delonix regia will be planted inner side of the greenbelt (1st row), Albezialebbek, Ficus species, Holoptelia and Jamun will be planted in the middle of the greenbelt (2nd row) whereas species like Dalberziasissoo, and A. indica species will be planted outside layer (3rd row) of greenbelt.

Roadside plantation

The roadside plantation will be carried out with the species having the properties of control dust pollution and maintain the aesthetic value. Buteamonosperma, Holopteliaintegrifolia, Syzygiumcumini and Albezialebbek will be planted under this plantation.

Avenue plantation in adjacent residential colony

Tree species like Butea monosperma, Delonix regia, Emblica officinais, and Polyalthia longifolia will be used for such type of plantation along with shrubs Bougainvillea sp, Dodoneasp, Hibiscus rosasinenis, and Neriumodorum. The purpose of such plantation is to fill the blank areas with greenery and strengthen scenic beauty.

4.4.5. Waste Generation

Impacts:

The wastes generated at project site fall in categories of hazardous and non-hazardous solid wastes, which are to be managed as per the prevailing regulatory norms. The wastes generated from the plant will be segregated into Hazardous and non-Hazardous wastes.

Non- Hazardous Waste

The solid/semi solid wastes envisaged from the proposed project are spent oils, lubricants, and chemicals etc. from the process units and clarifier sludge from raw water treatment plant, oily sludge from wastewater treatment plant as well as biological sludge from sewage treatment plant. Coal dust will be generated generally at the conveyor transfer points, coal unloading area and coal stockpile area. Hence, coal transfer points and coal stock yard will be provided with dust suppression / dust extraction facilities. Further, in order to arrest the coal dust generation, all conveyors will be provided with enclosed galleries. The bottom portion of all the conveyor galleries will be provided with seal plates within the power plant area and at road crossing. Dust collection system will also be provided at coal bunkers to evacuate dust and hazardous gases like Methane from the coal bunkers. Collected dust will be returned to either the associated belt conveyor or to the coal bunker.

Hazardous Waste

The hazardous wastes generated from the proposed project will be waste oil and grease drained out of gear boxes and other equipment. The above waste will be disposed as per the Hazardous Waste Management Rules to the licensed vendors.

4.4.6. Socio-Economic Impacts

Impacts:

The proposed project and its infrastructure development will have positive benefit to the people in the area. The project will boost further development of the area in conformity with the 12th Five Year Plan goal: inclusive growth and development, reducing regional disparity in development. The project will induce direct benefit of generating employment, business opportunities. Thus the project will support strategic needs of the communities and villages in

The area. The economic point of view, the project will generate demand as employment will Help people earn money and people will have ability to pay for consumption. It will certainly generate demand for few folds. When there is demand, the entrepreneurs will find business opportunities. They will start new business ventures. Small traders, service sector will get boosted in the region.

Another direct benefit will be that the infrastructure development in the area such as road, schools, health facilities, drinking water facilities, market facilities, processing facilities etc.

Cluster of Villages – Villages will have benefit of several facilities including roads, means of transport, banks, market outlets, etc. It will save time, travel savings, easy access, amenities provide economic opportunities thus boost the local micro level economy.

Sector Development – Agriculture, other economic activities: In migration of professional, skilled manpower will generate demand for local produce especially vegetable, grains, fruits, etc. Several local festivals, events, will be useful in promoting marketing of local produce / commodities. It will boost demand for the local produce, traditional artisans, local raw material and even local human resources.

Livelihood – As mentioned earlier, the employment generation will help generate income for the needy and deserving households. Those local youths (skilled, educated), get a good earning job. At the same time in-migration will boost demand for several goods, services, commodities. It will create a pressure to improve productivity of natural and human resources in the area. The local producers will have a good say in marketing, terms of trade. Since the project is in public domain without any dictating terms, the benefits will be distributed amongst all needy and deserving and those who are active and enthusiastic. CSR Activities will help focus on poor households with special schemes.In addition to this major benefit to the country the proposed project also will be providing tangible and intangible benefits to the people over all.

Employment potential associated directly with project

The lack of adequate employment generation is one of the most pressing economic and social problems in the project area at the moment, much as in the rest of India. But the problem seems to be even more acute in this State than elsewhere, given the sharper declines in employment expansion that have been noted.

The proposed project will be providing number of direct employment opportunities to the locals as skilled and unskilled primarily once it is commissioned. During construction it is expected that local people will have direct employment as construction workers. The employment opportunities for skilled will also be available based on skill set.

Indirect Employment Potential

Additionally, indirect employment opportunities will create jobs at local/regional level due to contractual, marketing and associated jobs directly with the project. The other related

Employment due to transportation requirement, supply of essential items and services to the Project site and other community services will be plenty. The possibility of development of trades and occupations linked with the project beneficiated personnel like dairy, poultry, commercial shops etc. is also expected to boost the local employment levels.

Employment in these sectors will be permanent based on own initiatives and interest of the individual. Involvement of unskilled labor requirement will be continuous basis depending on the requirement of contractor at site. A major part of this labor force will be hired from local villages.

Improvements in the local infrastructure:

The proposed project is expected to develop the local infrastructure of the region in developing road network, water supply, health etc. It also proposes to help sustain the development of this area including further development of physical infrastructural facilities.

Improvements in the socio economic situation:

The following changes in socio-economic status are expected to take place with this project.

- Due to increased income levels and raising consumption levels through multiplier effect there will be positive impact on economics of the region.
- Under CSR activities, the Project will train people for increasing their employability in the plant
- There will be increased revenue to the state in the form of taxes & duties which will find its way to support and development of the region over all.
- Project will also help in the development of social infrastructures/such as.
- Education facilities
- Banking facilities
- Post offices and Communication facilities
- Medical facilities
- Recreation facilities
- Business establishments
- Plantation and parks
- Community facilities

4.4.7 Flood Risk Impact

National institute of Hydrology, Roorkee, Uttarakhand carried out a Hydro-geological study for NLCIL to assess the impact of flood at the project site.

4.4.7.1 Flood Scenario at the Project Site

The project site is located near Kumbhari and Tareikela villages on south west of Brijraj Nagar town on Sambalpur Rourkela highway in Jharsuguda district. The geographical extent of the

proposed project area lies along both banks of Bhedan river, which is a tributary of IB river. The peak floods in Bhedan river due 50 year and 100 year return period flood are estimated to be 9956.07m^3/s and 11278.65 m^3/s respectively.

Under pre-project condition the maximum water level in the river varies from 201.5 m to 199 m along the river stretch from cross-section 3 to cross-section 13 for 50 year return period flood. The flood levels are estimated to be about 0.4 m higher in case of 100 year return period flood. The potential source of flooding at the plant site can be due to the flooding fromBhedan river in the areas below RL202 m level.

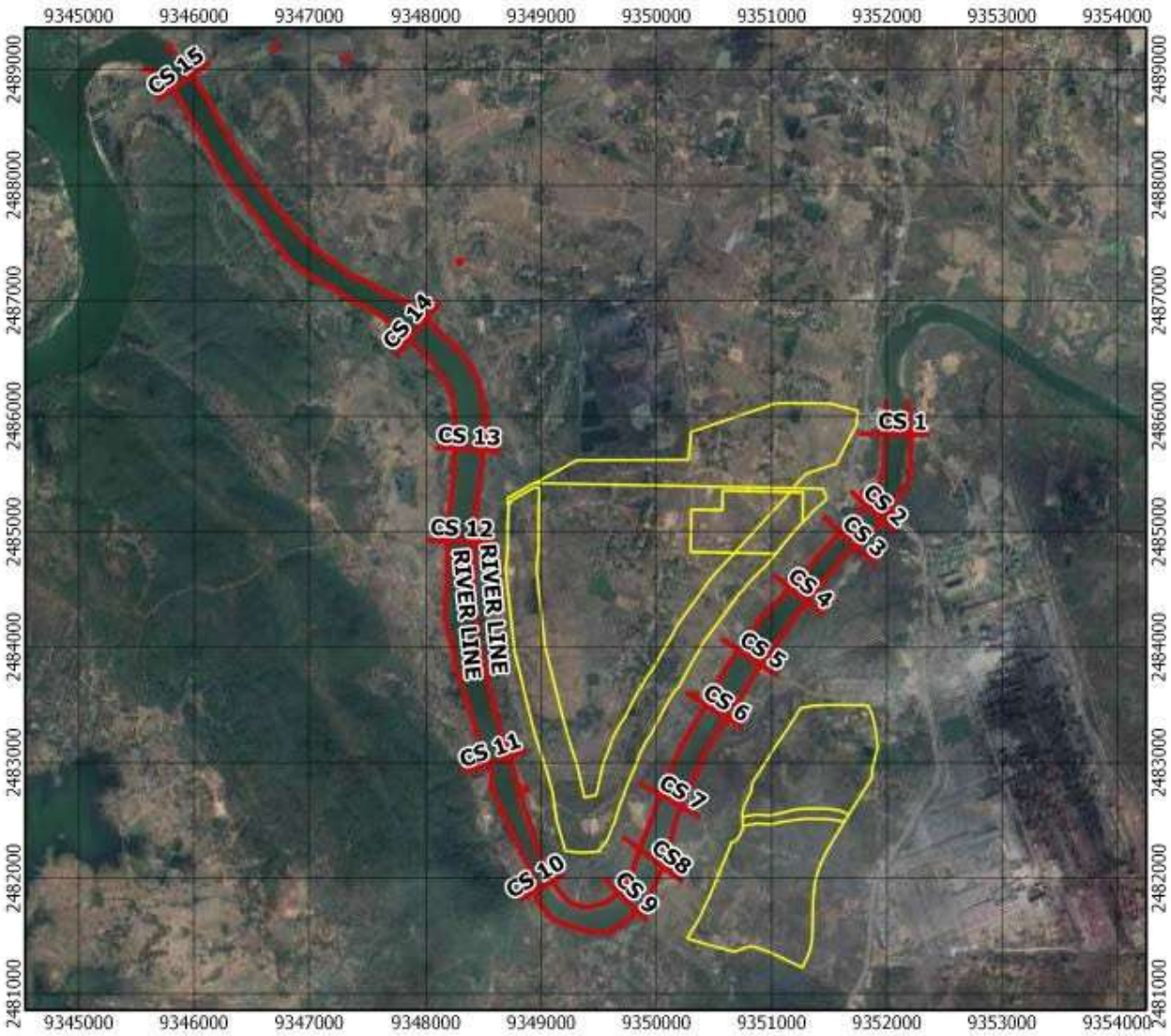


Fig 4.8. : Location of river cross section

4.4.7.2 Risk Mitigation Measures

It is suggested that embankment is to be constructed on both banks, as construction of embankments only in right bank (main plant area) will not be able to protect the ash pond area. However, instead of creating embankment along the left bank of river,

Selective protection to only ash dyke can be made as per requirement. The water level in river with proposed embankment varies from 203.1 m to 200.6 m along the river reach form CS3 to CS 13 for 100 year return period flood.

It is also observed that at present embankment of different stretches along the right bank are not flooded in the modelling study. However, the embankment is not continuous and need to be strengthened. It is observed that the main plant area has negligible flow from the upstream area and can be easily diverted along the plan boundary/ periphery road. However, two natural stream/nallah, are flowing in and around the ash pond area flowing from east (from Bhushan plant) to west and joins Bhedan River. The drain in the north of proposed ash pond area of NLCIL will not interfere with the proposed ash pond area of NLCIL. The other drain (D2) passes through the proposed ash pond area of NLCIL and joins to Bhedan River.

Two alternatives for the drain D2 are analyzed. The first alternative is to leave the alignment of drain D2 as it is, dividing the ash pond area in two portions and area north of drain may be used for fly ash pond and area south of drain may be used for bottom ash pond. In this case there will be very little modification in the present alignment of the drain as the drain may be straightened and strengthened with capacity in the area between the fly ash pond and bottom ash pond .However, the drain caries discharge from Bhushan plant area including discharge from iron ore washing plant etc. Hence it will be difficult for controlling water quality in the drain section where it passes through the ash pond area. As second alternative, it is proposed to divert the drain along the boundary of ash pond area in by diverting to firsts outh and then west direction. However, it is to be noted that in two stretches the cutting would be in the range of about 8 m to maintain bed slope of drain. The estimated peak runoff in the drain for 50 year and 100 year return period are 55.5 m^3/s and 61.3 m^3/s. Both unlined trapezoidal section with a side slope of 1.5:1 (H:V) and lined rectangular section drains are designed for longitudinal slope of 0.0015 m/m (1.5 m/km) to carry the estimated runoff.

The possible impacts and mitigation measures are given in the **table 4.12**

Table 4.12 Possible impacts and mitigation measures in operational stage

Discipline	Potential Negative Impacts	Probable Source	Mitigation Measures	Remarks
Air Quality	Increase in dust (PM) and gaseous pollutants in ambient air	Vehicular traffic, Stack emissions from DG sets	• Usage of low sulphur fuel in DG sets. • Adequate stack height will be provided for the generators for dispersion of pollutants. • Motor able roads in the building are paved to reduce dust emission. • Restricting the speed of the vehicles inside the site. • Internal roads will be maintained properly for free movement of vehicles. • Green belt will be developed which acts as pollutants	Emissions from DG sets and AAQ levels shall be maintain below regulatory standards
Noise	Increase in noise levels	DG sets operation, Vehicle movement, pump house	• Acoustic enclosure is provided for D.G. sets. • Restricting the speed of the vehicles inside the site. • Pumps / equipment are designed to conform to noise levels prescribed by regulatory agencies	Green belt will also be developed all along the boundary wall for attenuating the noise
Water Resources	Depletion of ground / surface water source	Water usages in different location s	• Rain water harvesting structures will be constructed to recharge the ground water. • Rainwater from the roof top will be taken to recharge trench constructed near all the buildings. • Selection & use of native species of vegetation to reduce landscape water requirement. • Minimizing the paved surfaces to minimize the storm water runoff volume thereby increases the aquifer recharge. • An effective storm water management plan will be implemented. • Storm water drains will be	Conducting water audit to increase the water conservation measures

Water Quality	Deterioration of quality of receiving water body, if any	Sewage discharge from various sources	Sewage from the buildings will be conveyed to the Sewage Treatment Plant. The treated sewage from STP will be reused for green belt development, toilet flushing. Excess treated sewage will be disposed to local body for avenue plantation.	The treated sewage will be regularly monitored for its confirmation to the regulatory standards.
Traffic	Increase of vehicle count in existing road	Additional vehicle movement	Improvement of infrastructure, use of modern emission standard vehicles for transportation, provision of the proper parking yard and evaluate impact of traffic density and vehicular emissions	Proper roads will reduce the dust emissions to a great extent.
Solid waste	Impact on human health	Domestic usage	The plant will have two different systems for ash disposal – conventional wet slurry disposal with ash water re-circulation for bottom ash and High Concentration Slurry Disposal (HCSD) for fly ash.	-
Demography and Socio-economics	Strain on existing amenities like water sources and sanitation and infrastructure facilities	Influx of people of Project	All ultra-modern work environments shall be provided inside the project site.	The project would generate employment both directly and indirectly which will enhance overall socioeconomic development and quality of lifeof people.
Terrestrial Ecology	Impact on plant Species	Vehicular movement and emissions from Stack	• It is proposed to develop lawns and green cover. • Part of the treated wastewater from domestic uses will be used for greenbelt development.	As emissions will be within limits, no active damage to vegetation is expected.
Fire and Safety	Accidents /disasters related to fire and safety	Domestic firing	• Prepare DMP and implement DMP. • A well-laid firefighting system and fire extinguishers will be installed as per fire safety norms • Regular fire safety training and mock drills will also be conducted.	

Chapter 5 - Analysis of Alternative Site and Technology

5.1 Alternative site Analysis:

This section explains the various considerations from technological point of view to set up the proposed power plant. Three alternative sites were visited by site selection team of NLCIL comprising of members from Power Station Engineering, Talabira Project site official at Sambalpur, Regional Office, Bhubaneswar and Advisor (Power) from New Delhi supported by local revenue officials in August, 2016 and Nov. 2016.The location of alternative sites on map is placed at **Annexure-III.** The salient details of alternative sites are briefly given in the **table 5.1**below:

Table 5.1 Alternative site details

SL.NO	FACTORS	SITE-I	SITE-II	SITE-III
1	Location	Near Babuchakli, Bausen and Jahrmunda villages in Rengali Tehsil at a distance of about 6 km South of Rengali town	Near Hadumunda, Tolibahal and Bamloi villages in Rengali Tehsil at a distance of about 4 kms North of Rengali town	Near Kumbhari & Taraikela villages at a distance of approx. 12 Kms South West of Brijaraj Nagar in Jharsuguda
2	Area	2500 acres comprising of 800 acres single crop agriculture land, 1200 acres Govt. land and 500 acre forest land was identified in 2004 by NLCIL. Now, lot of social forest have been developed at the Government land and 2/ 3 crops are being taken in the agriculture field in scattered way	1500 acreswas identified on the Survey of India Topo-sheet clearing the reserve forest area and habitation for further examination. During site visit, it was observed that many large scale industries lot of habitation has come up in the vicinity of the project site. Large extent	1200 acres near Kumbhari village for plant area and 500 acres near Thelkolai village (For Ash disposal)

		with the help of tube wells within the project site.	of the identified land has been acquired by the industries for development of colonies and many private dwelling units have also come up there.	
3	Land type & Ownership	The net available area after leaving the above is of the order of about 500 acres.	Reserve forest area and habitation. Now, about 500 acres land in patches available	Mostly barren land with few patches of single crop (rain fed) agricultural land
4	Probable water source	Hirakud reservoir(1.5 km)	Hirakud reservoir (15 km)	Hirakud Reservoir (20 kms.)
5	Approach road	Sambalpur-Jahrsuguda State highway-south of Rengali town	Sambalpur-Jahrsuguda State highway- north of Rengali town	Sambalpur-Jahrsuguda State highway – 1 kms
6	Distance from Talabira- II & III mine blocks	15 km (bridge is needed over spread of Hirakud reservoir)	15 km (bridge is needed over Bhedan river and ROB is needed for crossing the highway)	2 km across Bhedan river (Pipe conveyor envisaged for Bhedan river crossing)
7	Other	Lot of social forest have been developed at the Govt land and 2/3 crops are being taken in the agriculture field in scattered way. **Net available area is about 500 acres not sufficient for siting large TPP**	Large extent of the land has been acquired by the industries and many private dwelling units also come up there. **Available land in patches not sufficient for siting large TPP**	**The available land is sufficient for siting large TPP. However,** 2nos. Bridges on Bhedan River to be constructed for coal transportation and ash

Analysis of Alternative Site

Amongst the above cited alternatives, Site-III near Kumbhari and Tareikela villages has been considered as selected project site.

Site-I near Babuchakli, Baunsen and Jharmunda villages in Rengali Tehsil is not considered suitable since sufficient land for development of large capacity project is not available and coal source is also at a longer distance.

Site-II near Hadumunda, Tolibahal and Bamloi villages in Rengali Tehsil is not considered suitable since sufficient land for development of large capacity project is not available and coal source is also at a longer distance.

Site-III near village Kumbhari and Tareikela villages in Jharsuguda & Sambalpur districts is considered suitable and selected for development of 3200 MW capacity coal based thermal power project.

The site selection is based on the following considerations:

1. Availability of Land
2. Availability of reliable source of water (Hirakud reservoir) in close vicinity
3. Availability of road and railway access
4. Environmental aspects
5. Availability of infrastructural facilities
6. Conformity to Siting Criteria of MOEF
7. Talabira II & III captive coal mine is allocated to NLCIL which is at a distance of 2 km from the project side
8. The proposed Thermal Power Plant will cater to the power demand of the Tamil Nadu1500 MW, Kerala 400 MW, Pondicherry 100 MW and Home state (Odisha) 400 MW.As per preliminary study carried out by CEA, transfer of 2000 MW power to Southern region would be possible through existing inter regional transmission network and hence off take of generated power would not be a concern.
9. No archaeological sites, notified ecological sensitive areas like national park, wildlife sanctuary etc. exist within 10km periphery of the project site.

Capacity **:** 3X800 MW - Present proposal

Mode of Operation **:** Base Load

5.2 Alternative Technology Analysis:

The Steam Generator & Steam Turbine Generator technology & unit configuration (to achieve higher efficiency), environmental aspects and cost optimization were examined in detail for setting up of this project so as to maintain minimal pollution, water optimization (zero discharge) and reuse of waste products in the plant.

5.3 Steam Generator Technology and Unit Size:

For 3x 800 MW TPH capacity, the NLCIL has opted to install Steam Generators (SG) of super-critical, once through type, water tube, direct pulverized coal fired, top supported balanced draft furnace, single reheat, radiant, dry bottom type, which is suitable for outdoor installation. The gas path arrangement shall be single pass (tower type) or two pass type rated to deliver superheated steam at 281 kg/cm^2 (a) & temp of 603°C. The reheat steam temperature would be of 603°C. The SG would be designed to handle and burn Heavy Fuel Oil (HFO) and Light Diesel Oil (LDO) as secondary fuel up to 30% SG MCR (maximum continuous rating) capacity for flame stabilization during low-load operation. For unit light up and warm up purposes, light diesel oil (LDO) would be used with air atomization.

The steam generator unit will be provided with electrostatic precipitators. The ESP will have adequate number of ash hoppers provided with electric heaters. Microprocessor based ESP controller will be provided.

The ESP will be designed to control particulate matters in flue gas to a maximum of 30 mg/Nm^3. In order to meet the latest notification of MoEF in respect of SOx and NOx emissions, **Flue Gas Desulphurization (FGD)** shall be implemented as a separate turnkey EPC package and **NOx abatement equipment** (low NOx burners & SCR) shall be included in the scope of Steam Generators (SG) supplier.

5.4 Steam Turbine Technology

The steam turbine shall be tandem compound, single reheat, regenerative, condensing, multi cylinder design with separate HP, separate IP and separate LP casing(s) OR combined HP-IP and separate LP casing(s), directly coupled with generator suitable for indoor installation. Turbine shall be capable of operating continuously with valves wide open (VWO) to allow 105% of EMCR steam flow to the turbine at rated main steam and reheat steam parameters. The steam turbine generator shall also be capable of delivering at generator terminals at least 105% of rated output (Guaranteed Output) without any constraints with all the valve wide open, rated

Steam condition and condenser pressure as optimized by TG supplier targeting lowest heat rate With 0% makeup.

5.5 Coal Handling Plant (CHP) System:

The raw coal stock shall be maintained at the mine end across Bhedan River. External Coal Handling System (from Talabira mines up to Crusher House in plant area) shall comprise of two (2) Identical & parallel streams of 3000 TPH rated capacity each to deliver coal from Talabira mines up to Transfer Tower in mine area. Keeping in view the crossing of Bhedan River, single Pipe Conveyor System of 3000 TPH is envisaged for coal transportation from mine to Crusher House in the plant area. After crushing coal can be directly fed to power plant bunkers or diverted to the crushed coal stock yard. 2 nos Stacker cum Reclaimers shall be provided at the crushed coal stock yard for stacking and reclaiming the crushed coal.

Internal Coal Handling System consisting of two (2) identical & parallel streams to operate at rated capacity of 3000 TPH each are envisaged to cater the fuel requirements of 3X800MW Units.

5.6 Associated Transmission System:

The power generated from the project will be evacuated through 765 KV transmission lines up to the nearest 765/400 kV Pooling Substation of Central Transmission Utility i.e. Power Grid Corporation of India Limited (PGCIL) and 400 kV to State Transmission Utility. Construction power shall be drawn at 33 kV level. Unit start-up power requirements shall be met by back charging of one transmission line at 765 kV/400 kV level. The present provisions for power evacuation are tentative and shall be reviewed based on the finalized ATS of the project by PGCIL. Commitment from PGCIL shall be obtained for the necessary infrastructure for power evacuation from the proposed generating station, by erecting transmission lines as deemed fit and necessary.

Chapter 6 - Environmental Monitoring Plan

6.1 Need for environmental monitoring plan

An Environmental Monitoring Plan provides feedback about the difference between existing environmental scenario and the impacts due to project on the environment and helps to judge the adequacy of the mitigation measures in protecting the environment.

The purpose of the monitoring program is to ensure that the intended environmental measures are achieved and result in desired benefits. To ensure proper implementation of the Environment Monitoring Programme, it is essential that an effective monitoring program is designed and carried out.

The broad objectives of the environment monitoring program are:

- 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 at the plant and are operating satisfactorily.
- To suggest ongoing improvements in mitigation measures, if required, for subsequent effective monitoring.

Based on the findings of the EIA study, various mitigation measures have been proposed, which have been detailed out in EMP.A well-defined environmental monitoring program would be followed for the proposed project. For effective monitoring of the individual components of environment and for compliance of Environmental Standards it is required to set up a separate department "Environmental Management Cell" (EMC) to look after inspection / monitoring / compliance relating to environment. It would be ensured that trained and qualified staff supervises the monitoring of ambient air, stack gases, effluents, noise etc. to see that prescribed standards laid down are complied.

6.2 Monitoring Schedule

Environmental monitoring schedules are prepared covering various phases of project advancement, such as constructional phase and regular operational phase.

6.3 Monitoring Schedule during Constructional Phase

The proposed 3 X 800 MW Coal Based Thermal Power Project envisages setting up boilers, generators, condensers, cooling water system, coal handling system, ash handling system, coal

plant, ESPs, switchyard and othercivil, mechanical and electrical plant and equipment. The construction activitiesinvolve clearing of vegetation, mobilization of construction material andequipment. The construction activities are expected to last for over four years. Environmental monitoring plan for constructional phase is given in **table 6.1**

Table 6.1 Matrix of Environmental Monitoring Plan during construction stage

S.No.	Aspect	Source of Impact	Monitoring Methods and Parameters	Frequency of Monitoring	Monitoring Agency
1	Local Manpower	Construction Works	Contractor's report No. of people working in the project	Monthly	HR Department of NLCIL India limited
2	Soil Erosion	Excavation, disposal, cut & fill for site levelling and internal roads, disposal	Survey& observation; Extent and degree of erosion;	Monthly	EMC of NLCIL India limited
3	Biodiversity	Land clearing activities; Fauna in the project area	Composition of flora & fauna	Twice in a year	EMC of NLCIL India limited
4	Re-vegetation & Greenbelt development	Land Clearing & disposal works	Survey & observation; Survival rate of species planted; Density of vegetation	Half Yearly	Environmental Management Cell of NLCIL

5	Water Quality	Water Drawal for Construction/	Quality/Quanti ty as per Indian Standards	Monthly	EMC of NLCIL India limited
6	Waste Water Quality	Excavation, disposal, sewage disposal, land clearing activities	Surveys & sample collection and field measurements for turbidity, pH, TDS, BOD, COD, Oil & Grease, DO and other chemical parameters	Monthly	EMC of NLCIL India limited
7	Air Quality	Operation of DG sets, transportation of construction materials, road construction, construction of utilities	Survey & observations; Levels of PM10, SO2 and NOx	Monthly	EMC of NLCIL India limited
8	Public Health	Dust, Noise, Influx of labours	Regular medical check- ups	Quarterly	EMC of NLCIL India limited
9	Solid waste/ Hazardous Waste Management	Equipment's involved Construction, Operation maintenance	Quality and Quantity monitoring as per Solid waste/Hazard ous waste	Half Yearly	EMC of NLCIL India limited

			rules		

6.4 Monitoring Schedule during Operational Phase

During operational stage, continuous air emissions from power boilers, wastewater, non-hazardous waste such as ash, hazardous used oily wastes will be generated. The following attributes which merit regular monitoring based on the environmental setting and nature of project activities are listed below:

- Source emissions and ambient air quality;
- Water and wastewater quality (water quality, effluent & sewage quality etc);
- Solid and hazardous waste characterization (fly ash, bottom ash)
- Noise levels (equipment and machinery noise levels, occupational exposures and ambient noise levels)
- Ecological preservation and afforestation.

The following routine monitoring programme as detailed in **Table 6.2** will be implemented at site.

Table 6.2 Matrix of Environmental Monitoring Plan during operation phase

S.No	Aspect	Source Impact of	Monitoring Methods and Parameters	Frequency	Monitoring Agency
1	Water Quality Quantity &	Surface Ground quality the Area & water within Project A provision for long-term monitoring of ground water table in the study area using Piezometer will be provided.	Surveys, sample collection & field measurement	Quarterly	EMC of NLCIL/Odisha State Environmental Board/ State Pollution

2	Effluent Quality	Quality of effluent discharged and reused	ETP sample collection & quality analysis	Daily (Internal); Monthly (Third Party)	control board
3	Ambient Air Quality	Emission from utility and process	Ambient Air quality monitoring at 2-3 locations at plant boundary (SO2, NOx, PM10) Stack emission monitoring (Boiler, Process & DG)	Ambient Monthly (24 hourly);	
			Work area ambient air quality monitoring as per Factories	Monthly	
4	Noise Levels	Noise Levels compliance with respect to industrial standards	Ambient Equivalent Sound Pressure Levels (Leq) at day and Night time at4 to 6 locations	Monthly	
		Monitoring of Occupational Noise Levels	Near the noise generating sources	Fortnightly	

5	Biological Environment	Horticulture/ Greenbelt Development	Survival rate of plants and shrubs	Half Yearly	
6	Solid Waste Management	Disposal of waste	Tracking of waste collection, segregation and disposal	Fortnightly	
8	Hazardous Waste	Disposal of Hazardous	Tracking of hazardous	Fortnightly	
	Management	Waste	waste collection, segregation, storage and disposal		

6.5 Air Quality Monitoring and Data Analysis

The environmental monitoring shall be carried out by EMC of NLCIL within their industry premises. The environmental monitoring programme shall indicate parameters, location and frequency and it shall be formulated as per the stipulations laid by Odisha SPCB/CPCB/MoEF&CC in their respective Environmental Clearance/Consent To Establish (CTE)/Consent To Operate (CTO). As per the latest guidelines from CPCB, online effluent quality, ambient air quality and stack monitoring is provided and it shall be connected to SPCB/CPCB server.

6.5.1 Stack Emission Monitoring

The emissions from all the stacks will be monitored continuously online basis. The real time stack monitoring data will be displayed publicly at entrance gate. The exit gas temperature, velocity and pollutant concentrations will be measured. Any unacceptable deviation from the design values will be thoroughly examined and appropriate action will be taken. The online stack monitoring data will be crosschecked with manual monitoring using portable stack monitoring kit

6.5.2 Workspace Monitoring

The concentration of air borne pollutants in the workspace/work zone environment will be monitored periodically. If concentrations higher than threshold limit values are observed, the

source of fugitive emissions will be identified and necessary measures taken.

6.5.3 Ambient Air Quality Monitoring

The ground level concentrations of PM10, PM2.5, SO_2, NO_X, Hg and other 8 parameters in the ambient air will be monitored at continuously and results will be displayed at prompt place at the plant main gate &in the township. Any abnormal rise will be investigated to identify the causes and appropriate action will be initiated. Greenbelt will be developed for minimizing dust propagation. The ambient air quality data will be transferred and processed in a centralized computer facility equipped with required software. Trend and statistical analysis will be done.

6.5.4 Water & Wastewater Quality Monitoring & Data Analysis

Methods prescribed in "Standard Methods for Examination of Water and Wastewater" prepared and published jointly by American Public Health Association (APHA), American Water Works Association (AWWA)/CPCB is recommended. Regular walk down checks are made within the plant in each area of the plant separately and is controlled through daily planning meetings. All the wastewater streams in the project area will be regularly analyzed for flow rate and physical and chemical characteristics. Such analysis is carried out for wastewater at the source of generation and at the point of entry into the wastewater treatment plant. These data will be properly documented and compared against the design values for any necessary corrective action. This is checked on a daily basis.

6.5.5 Monitoring of Noise Levels

Noise levels in the work zone environment such as boiler house, cooling tower area, DG house will be monitored. The frequency will be once in a month in the work zone. Similarly, ambient noise levels near habitations will also be monitored once in a month. Audiometric tests will be conducted periodically for the employees working close to the high noise sources. Periodic checks and walk down checks are made on shift basis and any abnormality is attended immediately.

6.6 Compliance Reports

As a part of environmental monitoring programme, following compliance reports shall be submitted to OPCB/ CPCB/ Regional Office of MoEF&CC.

- Half yearly compliance reports in respect of the stipulated prior environmental clearance terms and conditions on June 01 and December 01 of every calendar year
- Environmental statement (Form-V) for the financial year ending March 31 to SPCB on or before September 30 every year
- Format for maintaining records of hazardous waste if any in Form-3 as per Hazardous Waste (Management, Handling and Transboundary movement) Rules, 2008
- Format for maintaining hazardous waste imported and exported in Form-10 as per Hazardous Waste (Management, Handling and Transboundary movement) Rules, 2016
- Safety data sheet for hazardous chemicals shall be maintained as per schedule-9 of MSIHC rules, 1989 (amended 2000)
- Format for maintaining notification of major accident in schedule-6 as per MSIHC rules, 1989 (amended 2000).

6.7 Green Belt Development Programme

During operation phase, periodic monitoring of plantation growth, manuring, watering, pruning, and replacement will be performed in order to properly maintain vegetation, greenbelt, landscape and green cover. It is suggested to plant shrubs or plants with 1 or 2 m height in utility corridor to avoid bird nesting/resting on the plants.

Chapter 7 - Additional Studies

7.1 Public Consultation

This chapter describes the public consultation, risk assessment and disaster management plan, Fire Safety Systems, Occupational Health and Safety, Social Impact Assessment. In line with the procedure laid down in EIA Notification dated 14th September, 2006, EIA study has been conducted for the proposed Project complying with the ToR issued by MOEF&CC vide letter dated March 23rd, 2017, file no - J-13012/14/2017 – IA, I (T). A copy of the above mentioned letter is enclosed in Annexure I.

Based on the above the baseline data has been collected and analyzed for one complete year ambient data monitoring.

The present EIA Report has been prepared based on one non Monson seasonal baseline data monitoring.

Odisha State Pollution Control Board conducted public hearings on 10.01.2020 & 13.11.2019 at the premises of Durga Mandap Field of Villlage Thelkoli, Tahsil Rengali in Sambalpur district, Odisha & Gariadihi UP School in Tareikela Village, Jharsuguda District respectively. The copy of the action plan towards the issues raised during the public hearing are attached as **Annexure XIII** and thereafter application for accord of environmental clearance will be submitted to MOEF&CC, New Delhi.

7.2 Risk Assessment

Hazard is defined as a chemical or physical condition that has the potential for causing damage to people, property or the environment. Hazard identification is the first step in the risk analysi sand entails the process of collecting information on:

- The types and quantities of hazardous substances stored, handled and disposed in the location;
- The location of storage tanks & other facilities.
- Potential hazards associated with the spillage and release.
- The starting point of the risk analysis study is the identification of hazards and selection of scenarios that are then addressed for further analysis. Hence, all the components of a process/ system/ plant 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.
- Risk analysis follows an extensive hazard analysis. It involves the identification and assessment of risks the neighboring populations are exposed to as a result of hazards

Present. This requires a thorough knowledge of failure probability, credible accident Scenario, vulnerability of population etc. Much of this information is difficult to get or generate. Consequently, the risk analysis is often confined to maximum credible accident studies.

The proposed power plant will utilize about 11.37 million tonnes of coal annually at 85 % PLF. As coal is subject to spontaneous combustion it may catch fire given the slightest opportunity. This fire hazard is greatly influenced by the amount of airflow through the mass of coal.

7.2.1 Approach

Risk involves the occurrence or potential occurrence of some accidents consisting of an event or sequence of events. The risk assessment study covers the following:

- Identification of potential hazard areas
- Identification of representative failure cases
- Visualization of the resulting scenarios in terms of fire (thermal radiation) and explosion
- Assess the overall damage potential of the identified hazardous events and the impact zones from the accidental scenarios;
- Assess the overall suitability of the site from hazard minimization and disaster mitigation point of view
- Furnish specific recommendations on the minimization of the worst accident possibilities
- Preparation of broad Disaster Management Plan (DMP), On-site and Off-site Emergency Plan, which includes Occupational and Health Safety Plan.

7.2.2 Methodology

The risk contours should be plotted on the plant layout map clearly showing which of the proposed activities would be affected in case of an accident taking place. Based on the same, proposed safeguard measures should be provided. Measures to guard against fire hazards should also be provided.

A preliminary hazard identification and risk assessment was undertaken to quantify the possible fire and occupational health risks associated with the operation of the project at the designated location. The good engineering practices suggested by the Central Pollution Control Board for risk assessment in industries (CPCB document Probes/133/2009-10) and CPR-18E risk assessment procedures' guidelines which are widely accepted by the Ministry of Environment and Forests (MoEF&CC) India, have been adopted while assessing the residual risks associated with the operations of the project with specific reference to fire hazards, chemical exposure hazards, occupational hazards and natural hazards. As part of the risk assessment, a preliminary

Review on the hazardous materials and chemicals proposed to be handled at the site were Reviewed and the storage capacities and design features of such hazardous materials were also reviewed while assessing the residual risks. Occupational health hazards such as exposure to dust emissions, thermal stress and work-zone levels were also studied. Based on the findings of the risk assessment study, a preliminary risk management plant has been developed as per the applicable rules and guidelines; wherever possible, good engineering and management practices are suggested to minimize any intolerable risks.

Hazard due to storage of chlorine

Chlorine to the tune of 1 to 2 ppm will be dosed into the cooling water circulation line to avoid bio fouling in the system. Considering about 80000 m^3/hr. of water in circulation in the cooling tower, the maximum Chlorine consumption will be in the order of 4000 Kg/day. About 68 chlorine ton-containers (900 Kg each) will be stored a dedicated isolated and closed room near the cooling tower area. Chlorine tonners will be stored as per the BIS code IS: 4263-1967 (Code of Safety for Chlorine).

Chlorine is soluble in alkalis and only slightly soluble in water, approximately one (1%) percent at 9.4°C. Above this its solubility decreases with rise in temperature up to the boiling point of water at which it is completely insoluble. Neither liquid nor gaseous chlorine is explosive or flammable, but both react readily with many organic substances, usually with the evolution of heat and, in some cases, resulting in explosion. Chlorine gas is extremely irritating to the mucous membranes, the eyes and the respiratory tract. If the duration of exposure or the concentration of chlorine-is excessive, it will cause restlessness, throat irritation, sneezing and copious salivation. In extreme cases, lung tissues may be attacked resulting in pulmonary edema. Inhale lowest published toxic concentration TCL0 is 15 ppm and Inhale lowest published lethal concentration is 430 ppm.

Hazard due to storage of Ammonia

3 x 500 m^3 capacity ammonia tank for SCR and 6 x 500 m^3 capacity ammonia tank for FGD system.

Hazard due to storage of HFO/LDO

2 x 500 KL capacity tanks for LDO and 2 x 2500 KL capacity for HFO tanks will be provided. LDO oil tank will be provided for auxiliary boiler with a dyke designed for 100% containment. Furnace oil falls under Class 3 combustible material as per OISD standards and hence the possible fire hazards will be less significant. Hence, these fuels will undergo only pool fire scenario in the presence of any ignition source. Since the quantity of furnace oil proposed to be

Stored will be very small. In order to assess the heat radiation from the pool fire scenario of Accidental spills from furnace oil (full bore rupture of the storage tank), consequence modeling was undertaken using DNV PHAST software. For the purpose of the consequence modeling, it has been assumed that due to mechanical failure of the tank, entire inventory of the furnace will be retained in the dyke. In the presence of external fire such as electrical fire or vehicular exhaust sparks etc., the contents in the dyke will catch fire and release thermal energy. The predicted heat radiation levels due to pool fire of furnace oil pool fire scenario are presented in Annexure IX.

7.3. Construction Phase Safety Management Plan

7.3.1. General Safety Aspects

The possible safety hazards during the construction phase are primarily limited to material transport, construction and erection of material and structures and working at heights etc. The possible occupational safety hazards with the above mentioned activities are electrical hazards at the construction activity, falling from heights, slips and fall of equipment such as cranes etc.

In order avoid the occupational safety hazards, The Indian Codes and Standards (IS18001: 2007, IS - CED 29(7778) and 15793:2007) on construction safety best practices shall be adopted by all the contractors and sub-contractors. All the sub-contractors shall have a written health and safety and environment policy. The principal contractor will be responsible for implementing and monitoring the occupational safety programs at the construction sites. Workers & Supervisors should use the safety helmet and other Requisite Personal Protective Equipment according to job & site requirement. They should be trained to use personal protective equipment. No loose clothing should be allowed while working near rotating equipment or working at heights. Visitors should not be allowed access to construction sites unless accompanied by or authorized by a competent person and provided with the appropriate protective equipment. Where natural lighting is not adequate, working light-fittings or portable hand-lamps should be provided at workplace on the construction site where a worker will do a job. Emergency lighting should be provided for personnel safety during night time to facilitate standby lighting source, if normal system fails. Artificial lighting should not produce glare or disturbing shadows.

7.4 Safety Hazards during Operational Phase

7.4.1 Hazardous Operations

Unlike other process industries, power project does not handle any major flammable materials (Class A and Class B Flammable material) except small quantities of furnace oil for boiler start up conditions. Other hazardous materials that will be handled at the power plant will be small

Quantities of Chlorine used as biocide in the cooling tower. In general about 2 to 5ppm of Chlorine is doped in the cooling water circulation line for this purpose. Both Hydrochloric acid and Sodium Hydroxide will be used for generation of the De-Mineralization Plant resin beds. Two day storage tanks of capacity 2000 m3 each with adequately designed dyke system will be installed in the DM plant area. Although coal is not a self-igniting compound at ambient temperatures, prolonged exposure to heat during the hot summer days, may lead to partial ignition due to the presence of volatile compounds in the coal. Based on the preliminary analysis, the major fire hazards envisaged are from storage and handling of furnace oil at the Mill site.

7.4.2 Safety Aspects of Storage of Furnace Oil

The following safety measures will be adopted for handling of flammable Oil.

1. A collection pit for any spillage will be provided near the fuel tank dyke.
2. The transfer hose pipelines and truck discharge line will be connected to a temporary earth arrangement as per BIS codes to avoid any static electricity.
3. Dyke area of the largest tank volume as per OISD standards will be provided to retain the oil spills.
4. A level indicator with alarm will be provided for the fuel tanks.
5. The fuel transfer pumps & motors will be of fire proof type and will be located outside the dyke area.

7.4.3 Risk Mitigation Measures for the Storage and Handling of Coal

Although coal fires are infrequent, there is a possibility of coal fires at the coal stockyards during the summer conditions due to burning of volatile compounds. Coal stockyard fires can be avoided by providing proper stacking design to prevent air movement inside the coal lumps, minimizing the duration of coal storage at the site and water sprinkling operations to maintain adequate moisture. Power plants store, transfer, and use coal; therefore, careful handling is necessary to mitigate fire and explosion risks.

Recommended measures to prevent minimize, and control fire hazards at proposed power plants include:

- Use of automated combustion and safety controls
- Proper maintenance of boiler safety controls
- Implementation of startup and shutdown procedures to minimize the risk of suspending hot coal particles (e.g., in the crusher) during startup
- Regular cleaning of the facility to prevent accumulation of coal dust (e.g., on floors, ledges, beams, and equipment)

- Removal of hot spots from the coal stockpile (caused by spontaneous combustion) and Spread until cooled, avoid loading of hot coal into the pulverized fuel system
- Use of automated systems such as temperature gauges or carbon monoxide sensors to survey solid fuel storage areas to detect fires caused by self - ignition and to identify risk points
- For planned outages, operators should take every precaution to ensure that all idle bunkers and silos are completely empty and also verify by visual checks.
- Bunkers and silos should be thoroughly cleaned by washing down their interior walls and any interior structural members but not their horizontal surfaces. Idle bunkers and silos that contain coal/lignite should be monitored frequently for signs of spontaneous combustion by using CO monitors, infrared scanning, or temperature scanning.
- Firefighting systems and fire hydrant systems shall be installed at all hazard prone areas such as coal stock yards, bunkers and silos as per the applicable fire safety standards.

7.4.5 Occupational Safety Management and Surveillance Program

The Ministry of Labour and Employment, Government of India has a nodal organization viz. Directorate General Factory Advice Service and Labour Institutes (DGFASLI) in dealing with Occupational Safety and Health issues in Industries. The Directorate General Factory Advice Service and Labour Institutes (DGFASLI) is the technical arm of the Ministry on matters connected with Occupational Health in the manufacturing and port sectors.

The Factories Act, 1948 provides for appointment of qualified Medical Practitioners and Certifying Surgeons to examine young persons engaged in dangerous manufacturing processes and to ensure medical supervision in case of illness due to the nature of manufacturing processes. The Factories Act, 1948 also provides for notification of certain occupational diseases as listed in the Third Schedule of the Act. As per Section90 of the Factories Act, 1948, the State Govt. is vested with the powers to appoint a Competent Person to conduct inquiry into the causes of any accident or notifiable diseases.

The following measures needs to be implemented in the work places to enhance occupational health:

1. Identify and involve workers in assessing workplace risks,
2. Assess and consider employees' needs when planning and organizing work,
3. Provide advice, information and training to employees, as well as mechanisms for employee feedback such as a suggestion scheme,

4. Occupational health surveillance and Occupational health audit, To develop a system of creating up to date data base on mortality, and morbidity due to Occupational diseases and use it for performance monitoring of the same and
5. Extending support to the state government for effective enforcement of the health provisions stipulated under section 41F of the Factory Act by equipping them with work environment monitoring technologies

The occupational health safety system should be headed by a competent and qualified safety office that will be supported by a team of safety volunteers from each plant and department within the facility. The safety team will take up a detailed task based risk assessment studies and will develop task based safety procedures and work permit systems. The safety team should record the near misses in the plant and take necessary corrective action to minimize the occupational risks.

A dedicated occupational health center shall be developed consisting the following facilities:

1. A full time doctor may be appointed to monitor the day-to-day occupational health aspects and also to provide medical advice to the workers, employees and residents of the colony,
2. Minimum facilities such as oxygen cylinder for emergency medical use, two bed clean room for first aid applications, first aid kits as per the Factories act,
3. ECG and X-ray facilities, Peak Expiratory flow Meter to check the lung function.
4. As a part of the surveillance program, the following minimum medical expansion may be undertaken during the pre-employment phase: 1. General physical examination and blood pressure, 2. X-Ray of chest & ECG, 3. Sputum examination,4. Detailed routine blood & urine examination, 5. Audiometry and 6. Spirometry.
5. As part of the routine and annual medical examinations on the persons working in the high noise generating areas, stress areas and dust exposure areas, a comprehensive surveillance program may be adopted.
6. Medical records - A record-keeping system for holding results of medical examinations and reports of symptoms will be needed as part of the health surveillance scheme. These are confidential medical records relating to individuals.
7. As part of the health surveillance programme, workers should be informed of the confidential results of each assessment and of any implications of the findings, such as the likely effects of their continuing to work with vibration.

7.5 Risk Reduction Opportunities

The following opportunities shall be considered as a potential means of reducing identified risks during the detailed design phase:

- Buildings and plant structures shall be designed for cyclone floods and seismic events to Prevent structural collapse and integrity of weather (water) proofing for storage of dangerous goods;
- Provision for adequate water capacity to supply fire protection systems and critical process water;
- Isolate people from load carrying/mechanical handling systems, vehicle traffic and storage and stacking locations;
- Installation of fit-for-purpose access ways and fall protection systems to facilitate safe access to fixed and mobile plant; Provision and integrity of process tanks, waste holding tanks and bunded areas as per relevant standards;
- Containment of hazardous materials;
- Security of facility to prevent unauthorized access to plant, introduction of prohibited items and control of onsite traffic; and
- Development of emergency response management systems commensurate with site specific hazards and risks (fire, explosion, rescue and first aid).

7.6 Fire Protection and Fire Fighting Systems

A comprehensive fire detection and protection system is envisaged for the complete power station. This system shall generally be as per the recommendations of TAC (INDIA)/ IS: 3034 & NFPA- 850.The following protection systems are envisaged:

- Hydrant system for complete power plant covering main plant building, boiler area, turbine and its auxiliaries, coal handling plant, all pump houses and miscellaneous buildings of the plant. The system shall be complete with piping, valves, instrumentation, hoses, nozzles, hose boxes/stations etc.
- Automatic high velocity water spray system for all transformers located in transformer yard and transformers having rating 7.5 MVA and above located within the boundary limits of plant, Main and unit turbine oil tanks and purifier, Oil canal, generator seal oil system, lube oil system for turbine driven boiler feed pumps, boiler burner fronts, fuel oil station in boiler, etc. This system shall consist of QB detectors, deluge valves, projectors, valves, piping & instrumentation.
- Automatic medium velocity water spray system for cable vaults and cable galleries of main plant, switch yard control room and ESP control room consisting of smoke detectors, linear heat sensing cable detectors, deluge valves, isolation valves, piping, instrumentation, etc.

- Automatic medium velocity water spray system for coal conveyors, transfer points, Stacker reclaimer, consisting of QB detectors, linear heat sensing cables, deluge valves, nozzles, piping, instrumentation, etc.
- Automatic medium velocity water spray system for LDO tanks consisting of QB detectors, deluge valves, nozzles, piping, instrumentation, etc.
- Automatic fire detection cum sprinkler system for crusher house along with alarm valves, sprinkler nozzles, piping, instrumentations etc.
- Automatic Foam injection system for fuel oil / storage tanks consisting of foam concentrate tanks, foam pumps, in-line inductors, valves, piping &instrumentation etc.
- For protection of Central control room, Control equipment room, Programmer room, UPSroom, etc. Inert Gas extinguishing system as per NFPA-2001 would be opted.
- Fire detection and alarm system - A computerized analogue, addressable type Fire detection and Alarm system shall be provided to cover the complete power plant.

Following types of fire detection shall be employed.

1. Multi-sensor type smoke detection system
2. Photo electric type smoke detection system.
3. Combination of both multi-sensor type and photo electric type smoke detection systems.
4. Linear heat sensing cable detector.
5. Quartzoid bulb heat detection system.
6. Infra-red type heat detectors (for selected coal conveyors)

- Portable and mobile extinguishers, such as pressurized water type, carbon-dioxide type, foam type, dry chemical powder type, will be located at strategic locations throughout the plant.
- CW blow down shall be used for supply of fire water. An alternate connection from raw water line shall also be provided as a back-up source for fire water. It is proposed to provide two numbers of Steel tanks for storage of fire water system. Fire water pumps shall be located in the fire water pump house and horizontal centrifugal pumps shall be installed in the pump house for hydrant and spray system and the same shall be driven by electric motor and diesel engines as per the regulations of TAC. The water for foam system shall be tapped off from the hydrant system network.
- For the above fire water pumping station, automatic pressurization system consisting of jockey pumps shall be provided.
- Complete Instrumentation and Control System for the entire fire detection and protection system shall be provided for safe operation of the complete system.

7.7 SOCIAL IMPACT ASSESSMENT

The proposed project may cause natural resource degradation, ecological and human health risks, unless the development is planned properly and implemented in an environmentally sustainable manner. In this manner all developmental projects have direct as well as indirect relationship with socioeconomic aspect, which also include public acceptability for new developmental projects. The social impacts are also discussed earlier as an outcome of baseline data collection. Subsequent table summarizes social impact matrix for the project.

Some of the likely impacts are listed below:

- Social inequalities, conflict and loss of agricultural production
- Social dispute; conflict between locals and outsiders, child labour
- Social disputes and child labour.
- Hazard to health of locals and factory workers.
- Disturbances in social sentiment change in quality of life of the affected people etc.
- Health hazards and interference of plant growth (dust accumulation over the plant).
- Increase in accidents, road congestion, traffic jams, with and Implication on community health.
- Gender discrimination in employment

Direct Benefits

Employment Generation

Majority of the workforce required for the Power Plant would be filled with local employees, as seen in other industry. Thus, there would be direct generation of jobs in the region comprising of people working in the industrial units.

There would be a mix of manufacturing industry sectors setting up their units at the III project Site. These require different numbers of people to be employed depending upon the scale and nature of their machinery.

7.8 Disaster Management Plan

An onsite emergency plan is attributed to the response plan that contains and minimizes the effects due to emergencies within the installations which have a potential to cause damage to people and facilities within the installation premises.

The On-site and offsite emergencies has been considered the risk contours and the consequence analysis results are attached as Annexure IX.

Chapter 8 - Project Benefits

The proposed project is expected to bring significant socio-economic and environmental benefits both at local and global level as listed below:

8.1 Increased Power Supply

The utility electricity sector in India has one National Grid with an installed capacity of 349.29 GW as on 31 Dec'2018. Renewable power plants constituted 21.2% of total installed capacity. India is the world's third largest producer and third largest consumer of electricity. Electric energy consumption in agriculture was recorded highest (17.89%) in 2015-16 among all countries. The per capita electricity consumption is low compared to many countries despite cheaper electricity tariff in India.

India has adequate power generation capacity but lacks adequate infrastructure for supplying electricity to all needy people. In order to address the lack of adequate electricity supply to all the people in the country by March 2019, the Government of India launched a scheme called "Power for All". This scheme will ensure continuous and uninterrupted electricity supply to all households, industries and commercial establishments by creating and improving necessary infrastructure. It's a joint collaboration of the Government of India with states to share funding and create overall economic growth.

GOI has set a Solar PV capacity addition target of 175 GW by 2022, including a roof top solar capacity of 75 GW. There has been a continual declining trend in the tariffs being bid for new solar installations. It may be noted that when the subsidies and tax breaks end in the medium/long term, the solar power tariffs are expected to rise. Further, Solar power is neither produced all day nor throughout the year. The solar plants will be operating for 6-8 hours during day time on clear weather conditions.

Grid connectivity, land requirement per MW installation, cost of Storage devices (for making solar power available on 24/7 basis) etc., are some key issues which tilt the balance still in favour of coal based thermal projects.

Various agencies namely World Bank, Dun & Bradstreet and Niti Ayog have indicated that thermal plants, mainly coal based plants will remain back bone of Indian power sector. The power supply contribution from coal based plants is, however, expected to fall from 72% in

2015 to 63% in 2032 and solar contribution will increase from less than 1% to 15 % during The same period.

Power is the wheel for any development of surrounding villages, region & States. The project is expected to generate around 17.9 Billion units of electricity per year which will meet the growing energy deficit in the beneficiary states and will have a tremendous positive impact on enhancement in the economic growth of home State of Odisha and Southern States of Tamil Nadu, Kerala &Puducherry.

The benefits may be realized either as upcoming of industries and its allied ancillary units. Other benefits would be generation of either direct or indirect employment to the locals. The ensured and reliable supply of power to upcoming industries and surrounding region would be a boon for development of the region.

8.2 Physical and Social Infrastructure

The following physical infrastructure facilities will further improve due to the proposed project.

- Road transport facilities
- Educational facilities
- Housing facilities
- Banking facilities
- Post office & communications
- Recreation facilities
- Water supply and sanitation
- Power supply

8.3 Employment Potential

The proposed project has the following potential of employment:

- Temporary employment of 1500 people and 250 Direct during construction phase.
- Long-term employment of up to 700 direct people and 400 contract people in the operation and maintenance of the power station.
- Moreover, the proposed project will also generate additional jobs by local business in the supply of goods and services.

8.3.1 Construction Phase

The proposed 3 X 800 MW coal based thermal power project will provide a significant amount of direct and indirect employment opportunities to the local people with different skills and trades. The proposed project needs employees during construction and operation of plant. The

Manpower required for the proposed project is estimated to be 1500 temporary contractors Employees and 250 direct employees during construction phase.

Indirect employment opportunities to local people in contract works in construction and operation, supply of materials, transportation, supply of goods and services to power plant and other community services. Demand of housing for rental accommodation will be increased. Markets with vegetables and other commodities will be developed due to the increased inflow of residents. A large number of small and medium scale industries, physical & social infrastructure facilities will emerge due to the increase in the availability of power.

8.3.2 Operational Phase

Long-term employment of up to 700 direct people and 400 contract people in the operation and maintenance of the power station.

Considering that most of the skilled personnel proposed to be employed for the proposed project would be from outside the study area and unskilled/ semiskilled personnel will be from within the study area, the proposed project would add to the population in the study area which results in better scope for indirect employment etc.

Unskilled people and limited skilled people (depending on availability) will be hired from local population. People expected to come to the study area from outside are expected to be educated and especially skilled. In addition, some secondary developments like opening of new schools, 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.

In addition to the direct employment mentioned above, there will be indirect employment of local people by utilizing their expertise in different areas like horticulture, site clearing etc. Also, due to secondary development in the study area, employment opportunities will be generated.

8.4 Other Benefits

Besides above, the following direct /indirect benefits will be available to the locality as well as the region due to the project.

- People will get employment and business opportunity in the project and project activities.
- Small to big business opportunity will emerge in the areas which will provide further employment and revenue to the local people.
- With good infrastructure in the area, small to medium projects will be set uplinked with proposed project to provide raw materials and use of waste. Area will be converted into industrial hub with small to medium industries.

- In view of the paucity of skilled labourers, company will train local people though vocational Training programs based on their educational qualification and adaptability.
- Company will provide Health care, vocational education and clean drinking water and other infrastructures facilities with the advice of local Panchayats and district administration. Company though various programs will work closely with local administration of the state Govt. run various programs to monitor health of women and young children.
- The Company will take part in Govt. Pilot Project to encourage children for education. Meritorious students of the weaker sections will be provided scholarship for study in higher education.

Thus area as whole will be benefited through the proposed project.

9.1 Introduction

The Environmental Management Plan (EMP) is the synthesis of all proposed mitigation and monitoring actions, set to a time frame with specific responsibility assigned and follow-up actions defined. EMP is a plan of actions for avoidance, mitigation and management of the negative impacts of the project. Environmental enhancement is also an important component of EMP. A detailed set of mitigation measures have been compiled in view of the likely impacts associated with the proposed expansion project. Mitigation measures have been suggested for both the construction and operation phase of the project.

9.2 The Environmental Management Plan

The EMP consists of a set of mitigation, monitoring and institutional measures to be undertaken during the design, construction and operation (post-construction) stages of the project. The plan also includes the actions needed for implementation of these measures. The major components of the EMP are:

- Mitigation of potentially adverse impacts,
- Monitoring during project implementation and operation
- Integration of EMP with project planning, design, construction and operation
- Institutional Arrangements

The EMP has been designed keeping in view the regulatory and other requirements to ensure the following:

i. Minimum disturbance to the native flora and fauna
ii. Compliance with the air, water, soil and noise quality norms.
iii. Conservation of water to the extent possible through rain water harvesting, wastewater recycling.
iv. Conservation of Energy/Utilization of renewable energy.

The environmental impacts due to different project activities and mitigation are detailed in Chapter – 4. Action which needs larger management focus are captured and strengthened in the following sections along with the responsibilities and feedback mechanism.

9.3 CONSTRUCTION PHASE

The construction phase impacts would be mainly due to civil works such as site preparation comprising heavy earthmoving, site grading, RCC foundations; construction material and machinery transportation, fabrication and erection etc..

The construction phase impacts will be temporary and localized phenomenon except the change in the land use pattern. The environment management to be implemented during the construction phase is as below:

- Temporary huts for construction Labours shall be arranged within the project boundary.
- The site grading, partial level rising as required at project site shall be planned keeping in view the natural drainage around the project site.
- The vehicles used for transportation of construction material shall be certified within valid PUC.
- The trucks carrying cement and sand should be covered in order to prevent the fugitive emissions due to material handling.
- Temporary shed shall be developed in order to store the construction material inside the project premises.
- The machinery used for construction purpose shall be properly maintained and serviced.
- It should be ensured that diesel powered vehicles and construction machinery are properly maintained to minimize the exhaust emissions as well as noise generation
- The construction debris generated shall be properly stored in the shed and later should be used for leveling of low lying area and road construction.
- Regular water sprinkling shall be done in the storage area and roads within the plant boundary for dust suppression.
- Though the effect of noise on the nearby inhabitants due to construction activity will be insignificant as per the proposed plot plan, noise prone activities should be restricted to the extent possible during day time in order to have minimum noise impact during night time.
- Onsite workers should be strictly instructed to use noise protection devices like earmuffs in noise prone area.
- Hazardous materials such as lubricating oil, compressed gases, paints and varnishes are required during construction phase which should be stored properly as per the safety regulations at isolated places.

- Accidental spillages of oil from construction equipment and storage sites should be Prevented.
- The fuel used for the machines should be of good quality.
- Proper arrangement shall be made to prevent to washout of construction material during the monsoon season. Temporary shed of brick should be constructed during the monsoon season for the storage of construction material.
- Adequate drinking water/sanitation facilities shall be provided for the contract workmen.
- Proper storm water management system shall be integrated in design phase and civil works shall be carried out accordingly at project site.
- Once the construction phase is completed, proper clean-up of the plant area shall be done and the construction debris and the other waste shall be disposed off at the low lying areas.

9.4 Operation Phase

Based on the impacts discussed in the chapter-4 due to the upcoming power project on the air environment, water environment, land environment, noise environment, Biodiversity and socio economic environment a detailed environment management plan is proposed in order to mitigate the impacts identified. The various types of pollution from the power plant are categorized under the following types:

- Air pollution.
- Water pollution.
- Solid waste/ hazardous waste generation
- Noise pollution.
- Bio ecological environment / Green belt

The various proposed pollution control systems are described in the following sections.

9.4.1 Air Environment

9.4.1.1 Air Pollution Control System

- **ELECTROSTATIC PRECIPITATOR**

High efficiency electrostatic precipitators (ESPs) of 99.9% will be installed to control the emission of fly ash particles. The precipitators will be designed to limit the particulate emission to 30 mg/Nm^3 under all design conditions.

- ***Stack***

To facilitate wider dispersion of particulate and gaseous pollutants, one single flue concrete chimney of appropriate height per unit above plant grade level are envisaged for this project. The chimneys will be provided with arrangements for undertaking stack emissions monitoring. The facility for online continuous flue gas monitoring system will also be installed and it will be connected to SPCB/CPCB Server.

- ***FGD***

Flue Gas Desulphurization (FGD) system will be installed for controlling and limiting SO_2 emission to 100 mg/Nm^3 under all operating conditions.

- ***NOx Control System***

The appropriate low NOx burners will be installed for controlled NOx emission. In addition, De-NOx system such as Selective Catalytic Reduction (SCR) system will be installed in boiler for controlling and limiting NOx emission within 100 mg/Nm^3 under all operating conditions. The De-NOx system will be installed as a part of main plant Steam Generator EPC package.

- ***Mercury Control System***

Mercury will be captured through the fore said air pollutant control systems. However, adoption of other effective mercury pollutant control system will also be explored at a later date during detailed design stage.

- ***Dust Extraction and Suppression System***

For control of fugitive dust emissions within the coal handling plant and coal / stockyard and around all other dust vulnerable area, adequate no. of dust extraction / suppression systems will be provided. Necessary Greenbelt development will be done in and around all the available spaces of the plant to arrest the fugitive emissions.

All the internal roads will be asphalted to mitigate all possible fugitive dust emission due to vehicular movement. Water spraying will be practiced frequently at all dust generating areas during construction period

9.4.1.2 Control of Fugitive Emissions

Following area/ operation has been identified from which fugitive emission may occur.

- Loading/ unloading of coal at mines and project site.
- Transportation from mines to plant
- Stacking of coal/ Coal storage area.
- Transfer of coal from storage yard to screening, crusher house and coal storage bin.
- Fugitive emission from fly ash storage area.

9.4.1.3 Coal handling

Following environment management system will be adopted to control fugitive emissions.

- Unloading of coal by dumpers will be carried out with proper care avoiding dropping of the materials from height. Also the material will be moist by sprinkling water while unloading at the project site as well as the loading points at mines.
- Transportation of coal from mines to plant shall be done by Belt conveyor system and pipe conveyor for crossing of Bhedan River. The coal shall be moist in order to prevent the fugitive emissions during transportation.
- Due to the blowing wind there shall be fugitive emissions in the coal storage area. The same shall be prevented by regular water sprinkling in the storage area. The storage area shall be covered from all the four sides by wind shields.
- Crushing and screening operation should be carried out in enclosed area. Centralized de dusting facility (collection hood and suction arrangement) followed by de dusting unit like bag filter and final discharge of emission done through a stack in order to control fugitive particulate matter emissions. Particulate matter emission level in the stack should not exceed 30 mg/Nm3. Water sprinkling arrangement should be provided at raw material heaps and on land around the crushing and screening units.
- Work area including the roads surrounding the plant shall be asphalted or concreted.
- Enclosure should be provided for belt conveyors and transfer points of belt conveyors.

The above enclosures will be rigid and permanent and fitted with self-closing doors and close fitting entrances and exits, where conveyors pass through the enclosures. Flexible covers shall be installed at entry and exit of the conveyor to the enclosures, minimizing the gaps around the conveyors.

9.4.1.4 Fly ash handling

Control techniques for fugitive dust emission from ash storage pond, involves watering, chemical stabilization, reduction of surface wind speed with windbreaks or source enclosures. Watering, the most common and, generally, least expensive method, provide only temporary dust control.

The use of chemicals or treat-exposed surfaces provides longer dust suppression, but will be costly. Effective control of fugitive emissions will be achieved by either of the following ways, in isolation or in combination. By providing a containment enclosures to the dust-generating source (there by isolating/containing the source from wind currents) in order to contain the air borne emissions within the enclosures. The same shall be achieved by providing a wall at the

Periphery of the ash pond/ loading unloading area/ ash silo. The height of the wall will be Decided during detail engineering.

By suppressing the dust by spraying water so that the dust settles down & remain suppressed till the moisture evaporates. The detailed design of dust suppression system for the ash pond will be taken up during engineering. The SPM in the vicinity of the ash storage pond shall be maintained below statutory norms. The details fly has handling system is discussed in upcoming sections.

9.4.2 Water Management

The water treatment system of the project comprises of Water Pre-treatment Plant, Water Demineralizing Plant, Chlorination Plant, Condensate Polishing Plant, and CW Treatment Plant.

An effluent management scheme consisting of collection, treatment, recirculation and disposal of effluents will be implemented in order to optimize the make-up water requirement as well as liquid effluent generation.

The liquid effluents will be collected and treated/ recycled as per the following design philosophy:

- The filter backwash water of PT Plant will be collected and recycled back to the inlet of clarifiers.
- The sludge from clarifiers of Water PT Plant will be collected in a sump/ pit and will be pumped to bottom ash slurry sump for disposal to ash dyke.
- The waste effluents from neutralization pits of DM Plant and Condensate Polishing Plant will be collected in the respective neutralization pits and neutralized before pumping to the Ash slurry sump.
- Re-Circulating type Cooling Water (C.W) system with Induced Draft Cooling Towers (IDCT) will be provided with C.W blow down from cold water side to ensure no thermal pollution. Major Part of CW system blow down would be used for fly ash handling, bottom ash handling and coal dust suppression and FGD system. The unused blow down if available will be led to RO system. The permeate of RO system is used as a CW make up. The reject of RO system will be used for CHP Dust suppression.
- A coal particle settling pond will be provided to remove coal particles from coal handling plant waste. Decanted water will be pumped back to the coal dust suppression system.

- Service water effluent collected from plant drains will be led to a sump. From the Sump the service water will be pumped up to tube settler/ clarifier for treatment of suspended solids. Treated service water will be sent back to service water tank to the extent possible for re-use.
- The plant will have two different systems for ash disposal – conventional wet slurry disposal with ash water re-circulation for bottom ash and High Concentration Slurry Disposal (HCSD) for fly ash. HCSD system will require less quantity of water and there will be no effluent from the fly ash disposal site.
- RO system for ZERO discharge: Unused cooling tower blow down (CTBD) water will be used as feed water to RO plant. The purpose of RO system is to remove the dissolved solids from the water to produce specified quantity of CW make up. Reject water from RO trains will be led to CHP dust suppression tank.
- The sewage from plant and township will be treated in a sewage treatment plant. An independent plant effluent treatment system would be constructed and efficient operation of various treatment schemes will be ensured so that the quality of treated effluent conforms to relevant standards, prescribed by regulatory agencies.

The treated sewage/ effluents conforming to prescribed standards will be utilized for CHP dust suppression, Ash handling system and the balance shall be used for development of green belt/ plantation to achieve zero liquid discharge.

9.4.2.1 Rainwater Harvesting

Rain water harvesting from Roof Tops shall be provided for township using Ferro Cements Tanks. For the power plant, the rain water collected during rains shall be led to inplant reservoir for use in plant make up system

The system of harvesting water from rooftops is useful mainly for drinking water purposes. In this system rain water falling on the roofs can be collected through a system of pipes and semicircular channel of galvanized iron or PVC and is stored in tanks in a suitably sized storage tank for providing sufficient water for reasonably long duration.

On the rooftop, as well as at the entry to the tanks simple filters are placed to remove dust and other particles. A simple diversion system is provided to keep out dirt from season's first rain or rain after a long gap, which may bring along accumulated dirt from the roof.

The package of rain water harvesting provides a system of pipes for collecting rainwater from roofs and a 3000 liters Ferro cement tank for each household. The choice of Ferro cement for Tank construction is guided by consideration of optimizing cost and performance

Characteristics. If cheaper options with equal strength and longevity are available elsewhere These can be adopted after due consultation with the beneficiaries.

It is proposed that all the rainfall runoff (not contaminated and entire year's partial rainwater runoff) inside the Plant shall be collected through Road side drains and let out into the Rain Water Harvesting Pond (RWHP) which is located at the lowest contour of the plant as far as feasible so that it can effectively collect all the rain water by gravity. Water from rain water harvesting pond shall be recycled to raw water reservoir and utilized in Plant.

In addition to that, it is proposed that the buildings inside the Plant shall be designed to take care of Rain Water Harvesting & Ground Water Recharging.

Needless to say if the present capacity of the tank is found inadequate and necessity for larger capacity tank is subsequently felt for the villagers who find the technology suitable another storage tank of similar or slightly larger capacity 5000 liters can be provided.

9.4.3 Noise Pollution

The major noise generating sources are the turbines, turbo-generators, compressors, pumps, fans, coal handling plant etc. from where noise is continuously generated. Acoustic treatment/equipment design will be done to control the noise level below 90dB (A). Wherever required, the workers will be provided with protective equipment such as ear plugs/ ear muffs.

9.4.4 Solid Waste Management

Ash will be the major solid waste generated from the power project. An ash management scheme will be implemented consisting of dry collection of fly ash, supply of ash to entrepreneurs for utilization and promoting ash utilization to maximum extent and safe disposal of unused ash. The plant will have two different systems for ash disposal – conventional wet slurry disposal with ash water re-circulation for bottom ash and High Concentration Slurry Disposal (HCSD) for fly ash. HCSD system will require less quantity of water.

Fly Ash management

- The fly ash generated will be collected and stored in fly ash silos. The fly ash silos shall be located near plant boundary for issuance to user industries as well as provision shall be kept for loading in wagons for long distance transportation through railway system.
- Regular water sprinkling shall be done in the fly ash storage area.

- The fly ash from ash silos shall be transported in Ash Bulkers/ dumpers to user Industries. Provision shall be kept for disposal of unused ash from generation point to the ash disposal area through HCSD system.
- The fly ash generated will be sold to brick/cement manufacturers

9.4.4.1 Ash Handling System

- **Ash Handling System**

The bottom ash will be extracted and disposed off in wet form. The fly ash will be conveyed in dry form from the hoppers of electrostatic precipitator, economizer, air pre-heaters and SCR, and will be taken to buffer hoppers for its onward transportation in dry form to storage silos near plant boundary for utilization. Alternatively, coarse fly ash from economizer, air pre-heaters and SCR will be conveyed in wet form to ash slurry sump for onward disposal to ash dyke.

The unutilized fly ash will be disposed off in ash disposal area during the initial 5-7 years. Thereafter, the mine void created in the Talabira mines will also be used for ash disposal at a later date after completing necessary studies and obtaining clearance from MOEF.

- **Bottom Ash Handling System**

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

In case of continuous BA extraction system involving submerged scrapper conveyors, the bottom ash from both units is pumped to the common Bottom ash slurry disposal pump house via water impounded bottom ash hopper in case of jet pump system or by BA slurry transportation pump in case of SSC System.

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

Economizer ash will be handled in wet form. Economizer ash slurry from economizer hoppers will also be led to the bottom ash hopper for further pumping to slurry sump of the common Bottom ash slurry disposal pump house.

Air pre-heater ash will be handled in wet form. Ash from air pre-heater hoppers will be Removed as slurry by feeder ejectors to a slurry tank for further removal to slurry disposal pump house using jet pumps/ centrifugal pumps.

From the Bottom ash slurry disposal pump house, BA and Coarse ash slurry will be pumped to the ash dyke by BA slurry duty pumps. No pits will be permitted in the boiler bottom area to accommodate the water impounded hoppers.

- **Fly Ash Handling System.**

Pneumatic conveying system (either vacuum system or pressure system) will be employed for conveying of fly ash from the electrostatic precipitator hoppers in dry form. This dry ash will be taken to buffer hoppers in each unit. The dry ash buffer hoppers will be located adjacent to the ESP. Dry ash from buffer hoppers will be transported either to HCSD ash silos or to main storage silos near the plant boundary. The transportation system will be provided for each unit for transportation from buffer hoppers to the either set of silos. The user industries will take the dry fly ash from the main storage silos either in Bulkers/ closed tankers or in open tankers. The silos will also have rail loading facility.

- **Ash Slurry Disposal system**

Both Bottom ash and fly ash will be disposed-off into the identified Ash Disposal Area till such time nearby mine void is made available for ash disposal. Subsequent to completion of required studies/ investigations and obtaining requisite clearances from MOEF, the fly ash will be disposed-off to void created after removal of coal in Talabira mines. The bottom ash will continue to be disposed-off into the Ash Disposal Area.

- **Bottom ash slurry disposal**

The bottom ash and coarse ash slurry from the units will be transported from bottom ash slurry pump house by BA slurry duty pumps to the identified Ash pond area. There will be three streams, viz., one (1) working stream, one (1) stand-by and one (1) maintenance stand-by streams per unit. All the pumping streams will be provided with its individual disposal pipes. No crossover is envisaged in the disposal piping.

- **Fly ash slurry disposal**

The fly ash collected in HCSD silos will be mixed with water in an agitator tank at controlled rate to obtain the desired high concentration. This high concentration slurry will be further pumped to Fly ash pond at ash pond area for initial period and subsequently to mine void area. For switch over to mine void, it is envisaged that new pipe pedestals will be provided and the HCSD Piping will be dismantled and re-erected on these new supports. There will be two (2) working

Stream for each unit and three (3) common standby HCSD stream for all three units, totaling 9 nos. Each stream will consist of one (1) no HCSD pump. All the pumping streams will be provided with its individual disposal pipes. All HCSD pumps & HCSD silo aeration blowers will be located in HCSD pump house.

- **Ash Water Recirculation System**

It is proposed to provide ash water re-circulation system to meet the requirements of environmental authority. Decanted water from the bottom ash pond will be led to the plant area using 2x 100 % capacity ash water recirculation pumps and the same will be conveyed through pipe from ash dyke to plant area. This water will be used further in the ash handling system. Blow down of ash water from the system will be carried out to maintain the system scale free. Normal make up to the ash water system will be from CW blow down water. However provision will also be kept for operating ash water system on "Once Through" mode also i.e. when ash water is not available for recirculation. During "Once Through" mode operation, additional makeup will be met from the plant raw water supply. Bottom ash pond fugitive dust suppression system is provided. Seepage water pump & piping for bottom ash disposal area is also envisaged.

9.4.4.2 Ash Disposal Area

For ash disposal, about 340 acres of land is identified. The proposed land is located adjacent to the plant area. The ash disposal area is planned in an area of about 300 acres. Balance 40 acres of land will be occupied by Over Flow Lagoon, Sedimentation Basin & associated dykes, ash slurry pipe line corridor, maintenance road etc along the periphery of the dyke and recirculation system facilities. A nallah passing through the ash dyke area will be diverted towards west of the Ash dyke.

9.4.5 Green Belt Development Programme

In order to reduce the air pollutants concentration and to reduce the windblown dust to escape from the project premises to the nearby localities and to resist the noise generated due to plant activity and as source to uptake the wastewater generated to some extent, it is recommended to develop green belt around the periphery of the plant, surrounding the coal storage yard, Ash dyke, and along the road side. There won't be any relocation of existing trees in the near vicinity of the project site as far as possible.

The total green belt area of about 252 acres has been demarcated for the proposed project in the layout. A green belt has been planned all around the main plant area except the switchyard

Side. In addition, extensive afforestation and plantation activities will be undertaken in all Available spaces within the main plant and township areas. Further, avenue plantation will be undertaken along roadside in Plant and Township areas.

9.4.6 Recommended Plants for Green Belt Development

Greenbelts are an effective mode of control of air pollution, where green plants form a surface capable of absorbing air pollutants and forming a sink of pollutants. Leaves with their vast area in a tree crown, sorbs pollutants on their surface, thus effectively reduce pollutant concentration in the ambient air. Often the adsorbed pollutants are incorporated in the metabolic pathway and the air is purified. Plants grown to function as pollution sink are collectively referred as greenbelts.

An important aspect of a greenbelt is that the plants are living organism with their varied tolerance limit towards the air pollutants. A green belt is effective as a pollutant sink only within the tolerance limit of constituent plants.

Apart from function as pollution sink, greenbelt would provide other benefit like aesthetic improvement of the area and providing suitable habitats for birds and animals.

9.4.7 Post Operational Monitoring Programme

Regular monitoring of pollutants in different environmental disciplines like ambient air, stack emission, treated waste water, etc. will be conducted and the data will be submitted to State Pollution Control Board regularly. The monitoring locations will be finalized in consultation with State Pollution Control Board. The plant will be equipped with all necessary equipment and manpower for ensuring effective monitoring.

9.4.8 Rehabilitation & Resettlement

An appropriate Rehabilitation and Resettlement plan will be implemented for the project affected persons in consultation with State Government and in line with its R&R policy. Socio Economic survey with Cultural resources Mapping and Infrastructure survey is under process in line with Odisha R&R policy. That Industrial Development Corporation of Odisha (IDCO) through Nabakrishna Choudhary, Verification of PAP is under progress. Considering the social Responsibility of the company and Development of the project Affected Measures, the project strict to follow R&R package to be approved by Honorable Collector and District Magistrate of Odisha R&R policy and subsequent amendment from time to time. R&R policy for Talabira Mines II &III OCP of NLCIL where already approved and under implementation& is attached as Annexure XVI.

9.4.9 Institutional Set-Up

The post operational monitoring Programme will be under the supervision of the Environmental Management Group (EMG) at the project site. The station will be equipped with all necessary instrumentation/ equipment and manpower required for ensuring effective monitoring. The EMG at site will interact with State Pollution Control Board on all environmental issues during operation of the station.

9.5 Renewable energy and reduction in carbon footprint

The prime objective of NLCIL is Sustainable power generation. To ensure minimum degradation of the environment due to the operation of the power station various measures shall be introduced towards achieving this objective. As a part of the agreement under Kyoto Protocol the CDM has been introduced to enable trading of Certified Emission Reduction (CER) between the developed countries and the developing countries. Although, this issue is being exhaustively deliberated to establish long ranging solutions, accordingly, it is proposed to have supercritical boilers at the proposed Power Project. In view of the increased efficiency (2.4%) of super - critical boiler as compared to sub-critical boiler, the coal consumption per unit of electricity generation would be lower with consequent reduction in CO2 emissions. The reduction in CO2 emissions would be of the order of 0.26 million tons per year. For the entire life of the plant (i.e. 25 years), it would be of the order of about 6.5 million tons. Since the super-critical technology is still under implementation stage in India, operation of super-critical boilers using the low grade Indian coal is challenging and technology barriers will have to be overcome. Investment costs for plant with super-critical boilers is higher as compared to the plant with sub-critical boilers.

The Solar Photo Voltaic (PV) installation on Rooftop of various buildings of Thermal Power Project shall be carried out preferably on shadow free area in such a way that the generation is maximized on each building Rooftop suitable for installation of Solar PV power plants. List of buildings identified for installation of rooftop Solar PV power are as follow.

- Main Power House
- Stores
- CHP Control Room
- Workshop
- Admin Building
- Canteen Building,
- Service Building

- Fire Station Building
- Fuel Oil buildings

Roof-Top Solar PV Plant

A Roof-Top Solar PV Plant is proposed to be installed on rooftop of all suitable buildings in power plant premises.

Technical Requirements for Rooftop Solar Power Plant

Shadow free roof top area having proper drainage such as TG building, service building, Admin building, switchyard building etc.

Total distributed load of the roof top PV due to panels, supporting structures, equipments and concrete blocks etc. and imposed load will not be more than 100 kg /m2.

Proper approach to the roof top through lift / staircase.

Availability of water for panel washing.

Proposed technology

Crystalline Solar Photo Voltaic technology is proposed for the roof tops.

Proposed Scheme

The actual solar radiation available in the area of project will be measured to access the potential of power generation.

Approx. 15 m^2 area per kW is required for roof top solar. Effective area for utilization for roof top solar PV on rooftop building will be estimated after detailed study.

Solar PV panels shall be mounted on the roof through non-corrosive module mounting structure. The support structure shall not disturb the water proofing of the roof.

Panel should be inclined at the angle preferably equal to the latitude, facing towards south

The total generation is estimated to be approx. 1300-1400 units per year from 1000 W solar PV roof top plant.

The power generated in Direct Current (DC) by PV modules shall be converted to Alternating Current (AC) through string inverters or central inverter and shall be injected to nearest available LT/HT switchgear assigned through isolation or step-up transformer. Accordingly provision of spare LT/HT module in the switchgear shall be made.

Solar PV Plant on roof top of thermal power project to be developed as an EPC package which Includes design, supply, erection and commissioning etc. including one year operation and maintenance after commissioning.

Metering for the purpose of monitoring of generation & internal accounting shall be done at the injection point in compliance to provisions of Central Electricity Authority (Installation and Operation of Meters) Amendment Regulations, 2013.

The O&M of the solar PV plant after completion of one year of operation by the bidder shall be ensured by site O&M department.

9.6 Environment Management System

The major environmental considerations involved in the construction and operation of the thermal power station, will be taken up by a full-fledged multi-disciplinary Environmental Management Division (EMD) with key functions of environmental, safety and occupational health for management of the entire plant and surrounding environment.

The EMD will comprise a team of environmental engineers, chemists, horticulturists, safety specialists and well-trained staff for operation and maintenance of pollution control equipment. Staff training programmes in the areas of environment, ambient air, water quality monitoring, solid waste management, noise abatement, and safety and health aspects would be conducted. The pollution control equipment would be provided with spares and maintenance facilities.

- A full fledge Environment Management Cell will be developed for the proposed project with the entire necessary infrastructure.
- The cell shall be managing the proposed project.
- A proper record shall be maintained by the cell for the quantity of fuel and water consumption along with the different types of waste generated.
- A regular monitoring program shall be carried out for various environment parameters.
- Proper environment & safety policy should be planned.
- The environment management cell comprising experienced and qualified personnel reporting to the Power Station In-charge regarding environmental performance and monitoring of environmental quality shall be created.
- Environmental Management Cell (EMC) will meet at least once a month to assess the progress and analyze the data collected for the month. Any deviation/variation noticed shall be immediately taken into consideration for improvement of the same. Yearly

Action plan of EMP will be updated with respect to results achieved and proposed Activities for next year.

During operational phase of the proposed power plant, overall implementation of EMP lies with the project proponent for compliance. In order to have effective implementation of EMP, the following structure of Environment Management Cell as shown in **Fig.9.1**is followed.

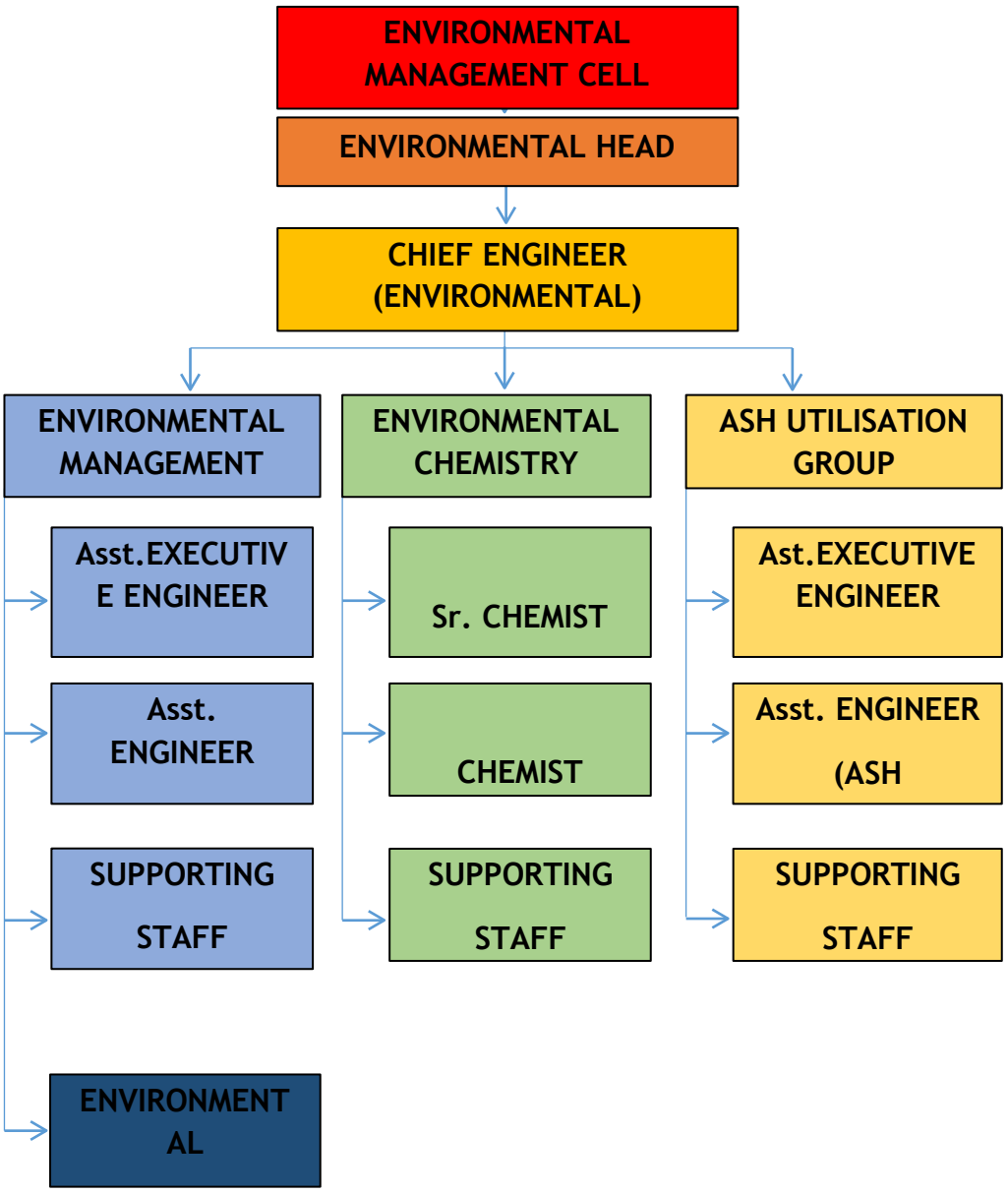


Figure 9.1: Environment Management Department

The major duties and responsibilities of Environmental Management Cell shall be as given below:

- To implement the environmental management plan
- To assure regulatory compliance with all relevant rules and regulations
- To ensure regular operation and maintenance of pollution control devices.
- To minimize environmental impacts of operations as by strict adherence to the EMP
- To initiate the environmental monitoring as per approved schedule
- Review and interpretation of monitoring as per approved schedule and corrective measures in case monitoring results are above the specified limits
- Maintain documents of good environmental practices and applicable environmental laws as ready reference
- Maintain environmental related records
- Coordination with regulatory agencies, external consultants, monitoring laboratories
- Maintain of log of public complain and the action taken.
- Environmental Audit

Allocation of Resources, Responsibility and Authority will results in successful implementation of EMP during construction and operational phase.

EMD will be equipped with full-fledged Environmental laboratory to monitor Air, Water and SW generated during the operation and maintenance of the project site. The HOD of EMD will transmit periodic reports like Stack Emission, AAQ, Fly ash utilization etc to SPCB as per the statutory requirements.

9.7 Corporate Environmental Responsibility (CER)

The Board of Directors of NLCIL in its 426th meeting held on 9.11.2012 had approved the Corporate Environment Policy (enclosed at Annexure- X). The CER activities will be carried out in line with approved Corporate Environment Policy and as per OM No. 22-65/2017-IA.III dated 01.05.2018 of MOEF&CC. The proposed project is falling under Greenfield Category. NLCIL will contribute a Capital cost of Rs. 40.18 Crores (0.25% of the project cost) for Corporate Environment Responsibility (CER) in line with the of Ministry's guidelines.

S.No	Activities	1st year	2nd year	3rd year	4th year	5th year	Total Cost (In Lakhs)
1	Infrastructure Development (Roads, class rooms, tanks, solar, electrical facilities)	700	600	500	500	400	2700

2	Education/skill development			200		100	300
3	Drinking water supply		200			70	270
4	Sanitation	50	50	50	50	50	250
5	Health	100	100	100	100	100	500
	Total	850	950	850	650	720	4020

Objectives of this policy are to:

- ✓ Adopt environment sound operating systems, practices and procedures.
- ✓ Strive to progressively bring about an improvement in the environmental performance of our facilities by adopting Eco-friendly techniques/processes for optimal use of energy and to reduce hazardous emission and wastes.
- ✓ Create environment awareness amongst its employees and develop programs for environment protection.
- ✓ Comply with the relevant statutory Rules & Regulations and devise appropriate standards on other cases wherever required.
- ✓ Maintain highest standards of vigilance and preparedness to respond to emergencies supplemented with mutual aid of neighboring facilities and Government agencies.
- ✓ Program reviews and evaluation to measure progress of compliance with the policy.

9.8 Environmental Training

To achieve the objective of pollution control, it is essential not only to provide best pollution control system but also to provide trained manpower resources to operate the same. The regular in-house training Programme should cover the following:

- Awareness of pollution control and environmental protection.
- Knowledge of norms, regulations and procedures.
- Occupational health and safety.

9.9 Budgets for Implementation of EMP and Monitoring Plan

The budget for implementation of mitigation measures and environmental management plan to mitigate the potential adverse environmental impacts during operation phase is suggested in **Table 9.1**.

TABLE 9.1: BUDGET FOR IMPLEMENTATION OF EMP & MONITORING PLAN

S. No	Description	(Cost in crore)	
		Capital Cost	Recurring Cost Per Annum
1.	Green Belt/Horticulture	5	0.05
2.	Rain Water Harvesting	2	0.02
3.	Municipal Waste Management (STP and solid waste disposal facility)	3	0.03
4.	Ash Disposal	150	1.5
5.	Environmental Monitoring	6	0.06
6.	Water Management including ETP	20	0.2
7.	Air Pollution Control including ESP, SCR, FGD and chimney	1250	12.5
8.	Environmental Awareness and Training	3	0.03
	Total	**1439**	**14.39**

9.10 Corporate Social Responsibility (CSR)

NLCIL will dovetail its CSR activities in a manner that it facilities the fulfilment of the National Plan Goals and objectives, as well as the developmental goals of the government so as to ensure gender sensitivity, skill enhancement, entrepreneurship development and employment generation by co-creating value with local institutions /people. Activities related to Sustainable Development will form a significant element of the total initiatives of CSR.CSR Policy of NLCIL is attached as annexure X.

Chapter 10 Summary & Conclusion

10.1. Prelude

The present study is aimed at identifying the potential environmental impacts due to the various project activities, assessment of impact, assessment of the associated risks and at developing an environmental management and monitoring plans for proper mitigation of any adverse environmental impact as well as a disaster management plan to take actions during the case of emergency. In this study, the various activities likely to take place during the construction and operation phases of the project have been analyzed in relation to the baseline condition of different environmental components. The key points considered in this study are described in the following sections.

An environmental Impact Assessment Study has been carried out and assessed for the proposed project based on the TOR prescribed by MOEF&CC and baseline quality data collected for the study area. Identification and anticipation of the potential environmental impacts due to the proposed project with a delineation of appropriate impact mitigation measures in an Environmental Management plan during both construction and operation phases is provided in this EIA report.

The proposed project will ensure that the industrial activities relevant to the project are environmentally sound with no adverse impacts posed on the natural environment in the surrounding area.

10.2. Regulatory Compliance

The project is yet at its technical investigation stage. Prior to its implementation, it will be necessary to acquire all the necessary clearances from the Government of India, as per all the applicable national regulations. Key clearances include obtaining the No Objection Certificate from the Odisha State Pollution Control Board (OSPCB) under The Water (Prevention and Control of Pollution) Act, 1974 and Rules, 1975; The Air (Prevention and Control of Pollution) Act, 1981 and Rules, 1982; and Environmental Clearance from the Ministry of Environment and Forests, Government of India, under the EIA Notification, 2006, The Environment (Protection) Act, 1986 and Rules, 1986.

10.3. Environmental Impacts and Mitigation Measures

The project entails various impacts on the study area, some negative and some positive. Impacts will be more during the operation phase. The main impact is associated with the generation of SO2, NOx, PM10 andPM2.5 from various power generation processes and their impact on the Nearby areas. However, with mitigation measures like ESP's, use of coal with low Sulphur

Content, low NOx burners & SCR for NOx control and FGD for Sox control these will be reduced to have minimum impact in the study area. The effluent generated during operational phase will be treated to meet the permissible norms and will be utilized for green belt development and other industrial purposes within the plant. The fly ash from the plant is proposed to be collected 100% through dry ash extraction systems and used for various applications. Thus the changes in air, water environment with the implementation of proper mitigation measures would allow compliance with appropriate standards and confine negative impacts within acceptable limits.

Based on the comprehensive environmental impact assessment conducted, the following are contemplated:

- If during the course of operation of the project, it is been found that the air emissions are more than the stipulated standards then additional precautionary measures will be taken by installing the pollution control devices at the source of generation.
- Since regulations are fast changing in India, NLCIL will keep itself updated with respect to applicable laws and take appropriate actions in case the provisions in some regulations undergo change.
- Most of the impacts envisaged are due to operation activities. Systems of periodic auditing and reporting will be adopted during the construction period to ensure that the Environmental Management Plan is adhered to.
- NLCIL and its team of consultants and contractors will develop a strategy for effective communication with local people. On the whole it can be concluded that the impacts due to installation of additional unit with the adoption of mitigation measures established by the EIA Process, would allow compliance with appropriate standards and confine negative impacts within acceptable limits.
- The proposed power plant will be adopting the new power plant regulations by installing efficient pollution control systems and FGD and hence the emissions of SO2 from the power plant will be several folds lower than that of the current power plant emission scenario in India. This will further help to achieve very low ground level concentration of SO2, NOx and PM during the operational phase without any appreciable change from the background levels.
- The proposed facility will utilize the lowest possible water consumption of 3.0 m3/MWHR as per the new power plant regulations and also it has been proposed to completely recycle and reuse the waste water generated from the plant to achieve

Zero discharge. Hence the possible impacts on the ecological and biological Environment in the surface water bodies in the region will be insignificant.

- NLCIL intends to spend 2% of net profit towards various CSR programs in coming years, which will benefit the local people in several folds and the social and cultural environmental will be enhanced. The project will give an impetus to induced industrial growth in region.
- The proposed project is structured to be in line with the requirements of MoEF&CC/CPCB.
- Thus, it can be concluded that with the judicious and proper implementation of the pollution control and mitigation measures, the proposed project can proceed without any significant negative impact on the environment.