मुख्य महाप्रबंधक/परियोजना व व्यापार विकास का कार्यालय
OFFICE OF THE CHIEF GENERAL MANAGER
PROJECTS & BUSINESS DEVELOPMENT

NLC India Limited
('Navratna' - Government of India Enterprise)
CIN No.: L93090TN1956GOI003507
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Lr.No: CGM/PBD/NTTPP/MoEF&CC/EC/137/2020 19.06.2020

To,
The Member Secretary (Thermal),
Ministry of Environment, Forest and Climate Change (MoEF&CC),
Indira Paryavaran Bhawan, Aliganj,
Jor Bagh Road,
New Delhi- 110003.

Sir,

Sub: Proposed 3 X 800 MW NLC Talabira Thermal Power Project (NTTPP) at Kumbhari & Tareikela villages in Jharsuguda District and Thelkoloi Village in sambalpur District, Odisha by M/S NLC India Ltd- Submission of EIA Report for Environmental Clearance under 1(d), Thermal Power Plants - Reg.

Ref: 1. MoEFCC ToR Letter NO. J-13012/14/2017-IA.I (T) dated 27.12.2017,
2. 39th EAC meeting dated 10/04/2020

We have presented salient details regarding proposed 3 X 800 MW NTTPP power plant vide 2nd reference cited. The queries raised in the Minutes of meeting, replies are uploaded in PARIVESH portal.

Considering the above and significance of the project for development of the Nation, we request you to kindly consider our proposal for grant of Environmental clearance.

Thanking you,

Your's faithfully,
For NLC India Ltd.,

DPVS 19/6/2020

Deputy General Manager,
Projects and Business Development.

S. No.	ADS Reply for 39th Agenda meeting at 10th April 2020	Action Plan
1	The proposed location for ash pond is adjacent to Bhedan river. Committee has observed that if the ash pond is allowed close to River, there is a chance of breach of ash pond in future which will pollute river body. Similar incidents happened with other power plants where the ash pond was located next to Bhedan river. Further, the proposed ash pond location has one nallah passing in between and a village nearby. The sufficient distance of minimum 500 m is to be left in between ash pond and river body.	HCSD concept of ash disposal is being adopted for slurry disposal. In HCSD system, slurry gets hardened after disposal, and hence no pollution of river due to any possible breach is envisaged. Also as per norms the min distance of 500m is left between the river body & ash dyke. The Nalla passing through proposed Ash Dyke shall be remodelled and diverted as per NIH Roorkee report. The copy of the NIH report is already included in the EIA report as Annexure IV.
2	Socio-impact assessment study is not carried out.	Socio-impact assessment (SIA) study brief has been detailed in section 3.16 of chapter 3 in the EIA report and SIA report for main plant area in Jharsuguda district carried out by NCDS, Bhubaneswar is attached as **annexure XII** to the EIA report. The SIA Public Hearing is also successfully completed. SIA study for Ash Dyke area is under progress.
3	Water sustainability study has not been carried out.	Water Resource Department (DoWR) wide letter dated 05.09.2019 has accorded water commitment of 90 cusec from Hirakund reservoir out of industrial quota without curtailing allocation for irrigation. Water commitment letter from GOO is attached as **annexure XI.** Water sustainability study is attached as **Annexure XX**
4	Action plan to address public hearing issues is not available.	Response and action plan to the issues raised during Public Hearing is included in the EIA report and also attached with the revised proposal as Annexure XIII

5	Land use and revenue status of proposed project area is not given.	Land use and revenue status of Land use and revenue status of proposed project area duly certified by State Revenue dept. is enclosed as **Annexure XIX.**. It may be noted that Land for corridors for makeup water system, Transmission lines to PGCIL pooling station, and Transmission lines to Lapanga sub station of state govt. shall be identified at a later date after completion of survey by respective agencies and Land details shall be known thereafter. Out of 1447 acres of the overall project land requirement, presently 1221 acres of land has been already identified. Balance 226 acres shall be identified later
6	Cumulative impacts of existing industries within the study area are not considered	The baseline ambient data monitoring carried out at the project site takes care of the present pollution loading due to the cluster of industries in the vicinity of the project area. The modelling has been carried out to indicate incremental pollution levels due to implementation of this project. The details are indicated in chapter 4 of the EIA report Cumulative impacts within the study area were analyzed and explained in chapter 4 section 4.4 in the EIA report.
7	The compliance to recommendations given by sub-committee during its visit are not met.	Compliance to recommendations are addressed and is listed after ToR Compliance in the EIA report.
8	Proposed only 17% greenbelt (252 acres) of the total project area. There is no greenbelt proposed around periphery of ash pond.	About 252 acres of land (more than 33% of the main plant area) will be developed under afforestation and greenbelt. The overall land requirement for the project is proposed as 1447 acres, out of which the plant area is 602 acres and reservoir is 88 Acres thus making the plant area as 690 acres. As per CEA norms, one third of plant area needs to be earmarked for green belt, which works out to 230 acres for NTTPP, whereas 252 acres of green belt is envisaged. As suggested, Green belt shall be provided around the periphery of Ash Dyke.
9	The project is 200 m away from Bhedan	The plant boundary wall and the ash dyke

	river. Minimum distance from HFL needs to be verified	shall be at a distance of 500m from the Bhedan river. As suggested during the visit of Sub Committee of EAC and also suggested in the NIH report, 20 meter wide bund strengthening around the Bhedan river on either side shall be carried out.
10	Patralpali Forest is 700 m from the project. Exact location needs to be shown on the map.	The drawing showing the Patrapali forest is enclosed. It may be noted that the most of the Patrapali forest area is part of Talabira II & III Captive mining Blocks of NLCIL. The forest clearances (Stage I & Stage II) for diversion of forest land in the mining area have already been obtained and Exact location on the Google earth is attached as annexure XVI
11	Details of transportation of coal such as Conveyor belt and its route map from Talabira mines to Project is to be provided.	Coal from the mine coal stock yard shall be transported by belt conveyor upto the transfer point in mine area (about 01 Kms) and thereafter through pipe conveyor (crossing the Bhedan river) upto the power plant (about 900 mtrs). Schematic Drawing for coal transportation is attached as Annexure XVII in the EIA report.
12	Map showing Water intake point and route for transportation pipelines are to be shown.	The map showing the location of water intake and the tentative pipeline route from the intake pump house upto the power plant is attached as **Annexure XVII** to the EIA report. A technical report including this map has already been submitted to Water Resource Department (DoWR) for principle approval. DoWR shall make the site visit shortly. Detailed route survey shall be carried out to finalize the pipeline route thereafter.
13	Coal linkage document of MoC states that it is to be used for power plants at Tuticorin TPS, Guatampur TPS (Kanpur) & Sirkhaji TPS (Nagapattinam). There is no mention of present project	Coal linkage document mentioning the present project is enclosed as **Annexure XVIII**
14	Environmental Management Plan (EMP) and its cost does not provide breakup of FGD and other pollution control. Water consumption in the FGD, in case of wet lime dosing, and management of gypsum including its land requirement shall be	Cost Breakup of FGD and other pollution control measures of EMP is now included in section 9.1 of the EIA report. The Water Balance Diagram (WBD) included in the EIA report take into account the consumption of water for wet limestone based FGD as per

	provided in the EIA report.	MOEF norms. Limestone storage & handling system and Gypsum storage & handling system areas are earmarked in the plant layout. Marketing of Gypsum will be employed for Management of gyspsum, and excess if any, will be backfilled in mine voids.
15	As shown the EIA, the maximum flood level of 100 years submerges ash pond area and part plant area. Justification is to be provided.	The plant boundary wall and the ash dyke shall be at a distance of 500m from the Bhedan river. During the visit of Sub Committee of EAC, it was observed that earth from the river bank have been removed illegally which causes submergence and accordingly it was suggested to go for bund strengthening. The NIH report is based on historical data of 100 years return period. In the report, 20 meter wide bund strengthening around the Bhedan river on either side shall be carried out. The plant formation level to be kept at RL of min 202 meter. Details give in chapter 4 of the EIA report
16	Project is part of IB valley and Jharsuguda critically polluted area. The additional precautionary measures to be proposed to prevent pollution load in the region.	IB valley is SPA which is 4 km away from project site, Additional precautionary measures proposed to prevent pollution load in the region is given in section 9.9 of chapter 9 in the EIA report. The ambient data monitoring carried out at the project site takes care of the present pollution loading in the project area. The proposed project is envisaged to adopt supercritical parameters and installation of FGD, SCR, High Efficiency ESP, Green Belt, Dust Supression/Extraction systems to prevent air pollution, Zero Liquid Discharge (ZLD) is proposed to prevent water pollution. Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF.
17	Reply and commitment to issues raised in Public hearing to be submitted.	Response and action plan to the issues raised during Public Hearing is included in the 7th chapter of EIA report and also attached as

		Annexure XIII with the revised proposal.
18	The NOC from DFO Jharsuguda is not available regarding impact of proposed project on forest and wildlife.	NOC from Sambalpur DFO obtained and is attached as Annexure V. NOC from DFO Jharsuguda Ranger visited the site and submitted the report to DFO, It will be obtained within 3 three months.
19	w.r.t. Sub-committee recommendations, it was replied that these were almost complied. No details provided	Compliance to recommendations are addressed after TOR Compliance in the EIA Report.
20	Social Impact Assessment, it was referred to EIA. Summary of socio economic status of study area is not provided.	Socio-impact assessment (SIA) study report for main plant area in Jharsuguda district is attached to the EIA report. The SIA Public Hearing is also successfully completed. SIA study for Ash Dyke area is under progress. Summary of socio economic status of study area are given in section 4.4.7.2 of chapter 4 in the EIA report and SIA report for Jharsuguda is attached as annexure XII
21	Diversion of nallah in ash pond area, it referred to NIH area drainage report. Salient recommendations of NIH, diversion proposal was not furnished.	Salient recommendations of NIH Roorkee in respect of Nallah diversion is included in section 4.4.7.2 of chapter 4 of EIA report. The complete report of NIH Roorkee is also enclosed as Annexure IV to the EIA report.
22	Cumulative impacts of emissions, it referred to EIA report. The Cumulative impact considering several power plants, mines, alumina and steel plants located within the study area. However, no cumulative impacts were carried out	The baseline ambient data monitoring carried out at the project site takes care of the present pollution loading due to the cluster of industries in the vicinity of the project area. The modelling has been carried out to indicate incremental pollution levels due to implementation of this project. The details are indicated in the EIA report. Cumulative impacts within the study area were analyzed and explained in chapter 4 section 4.4 in the EIA report.

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

FINAL EIA REPORT

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

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)
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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 Dec 27th, 2017, 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

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**

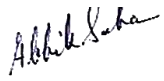
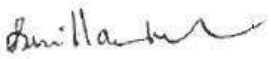
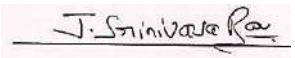
Signature :

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	

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. **NABET/EIA/1922/RA0155** & Issue Date: 02 March 2020

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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 compliance is attached after TOR compliance 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.	Ficus species will be raised in and around the temples 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 attached as Annexure V and Regarding NOC from DFO Jharsuguda Ranger visited the site and report submitted to DFO expecting within three months (August 2020).
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 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

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 and in Chapter 5 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 and PH action plan 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 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 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 What has been specified by CEA from time to time. Item wise break up of land requirement shall be provided.	Land requirement has been optimized (meeting the CEA norms) and given in section 2.3 of chapter2 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 and in Annexure XIX
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 on the map duly authenticated by the Chief Wildlife Warden of the State or an officer authorized by him.	NIL
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 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. As per MoEF&CC latest notification, 100 percent fly ash utilization is to be achieved progressively within 4 years starting with 50% in 1st year and 70% & 90% in 2nd & 3rd year respectively of plant commissioning. 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 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.	The water requirement is optimized by adopting the concept of zero discharge as per latest MOEF Norms. Details of source of water are given in section 2.8 of chapter 2 and water balance diagram as annexure VIII 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. It will be ensured that the diversion does not disturb the natural drainage pattern of the area.
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 of 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.	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.
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 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. sustainability even in lean season is detailed in Annexure XX
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 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
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 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.	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.
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 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 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.	Yes, it will be provided

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
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 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 i n Ocupational health. 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.

	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 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 hrs).	NA
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 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 o f 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.	Cumulative impacts details are given in section 4.4. of chapter 4 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.	The radioactive and Heavy meatal content in coal is below detectale limits as per the information of MDO.
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 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 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 in the EIA report.

	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 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 Invariably provided. Mock drills shall be suitably carried out from time to time to check the efficiency of the plans drawn.	Disaster Management Plan (DMP) along with risk assessment study is covered in chapter 9.

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 widely.	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 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 Months.	Additional plantation in vacant space in the project area will be done. In addition plantation in degraded forest area will be undertaken.
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 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?	Organization structure of the EMG department is given in chapter 9 in the EIA report.
d	Does the company has compliance management system in place where in 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 (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. CO2 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)	NA
2.	Not with standing 1 (i) above, data on (d) & (e) above shall be worked out and reported.	NA

Sub-committee recommendations		
1	In the vicinity of the proposed power plant, cluster of power plants, Integrated steel plants, Alumina plants, Open cast Coal Mines etc are existing, cumulative pollution level to be assessed by considering all the point sources including the proposed TPS.	The baseline ambient data monitoring carried out at the project site takes care of the present pollution loading due to the cluster of industries in the vicinity of the project area. The modelling has been carried out to indicate incremental pollution levels due to implementation of this project. The details are indicated in chapter 4 of the EIA report The cumulative pollution level assessed considering the industries in the vicinity and the results are given in section 4.4 of EIA Report.
2	Along the riverbanks, the PP should construct a bound of Minimum width of 20 m having elevation of atleast 202 m AMSL. The PP may construct the bund in consultation with Irrigation Department of Water Resource Department and state Forest Department for their guidance and necessary permission	As recommended EAC and as per the NIH Roorkee, bund strengthening is proposed which will be carried out in accordance with Irrigation dvn/WRD of Odisha
3	Due to construction of boundary wall after leaving 500 m width from the HFL, the villagers shall not have direct access to their agricultural land. Therefore an approach along the boundary wall of power plant should be constructed so that villages can have easy access to their agricultural fields.	An access road surrounding the project area has been planned for villagers.
4	As per Hon'ble supreme court, no construction within 500m width from the HFL shall be proposed. The area requiring for construction of over bridges should be included in the proposed project. And accordingly necessary permission to be taken from the competent authorities.	The area required for bridges and approach roads has already been considered under corridors. The coordinates for the bridges will be firmed up during detailed engineering and approval/ permissions from the competent authorities will be obtained.
5	Due to paucity of land and keeping agricultural land unaffected, construction of Raw water Reservoir may be shifted toward the existing water pond and re-aligned accordingly. Space provision for construction of 4th unit of 800MW may not be kept at the existing proposal as lot of agricultural land is getting affected	The raw water reservoir has been shifted north wards and area reduced from 126 acres to 88 acres and the project layout is planned for three units of 800MW.

6	Before any construction is taken up in either of the areas, the transmissons lines are to be shifted.	Noted Sir. OPTCL has been approached to carry out the diversion of transmission lines. Survey for the same by OPTCL is under progress
7	The course of Nala exists in the proposed Ash pond areas should not be diverted and necessary protection measures such as proper lining at both banks, etc.. To be provided. Ash pond area requires to be re-aligned so that the village shall remain outside of the boundary of the proposed ash pond area and fresh lay out map, in this regard, to be submitted.	The ash pond area has been realigned such that village remains outside the boundary. The nalla requires diversion as if original alignment is maintained, the dyke has to divide and the ash disposal area gets reduced. Secondly as per the drainage study this routing is not recommended. Alternative II, rerouting along the boundary southwards is suggested by NIH Roorkee.
8	Green Belt between the village and the proposed ash pond will be developed. Fresh water available in the existing water bodies in the proposed project should be reused for construction work to minimize requirement of fresh water. No ground water shall be drawn for construction work.	Green belt between the village and the proposed ash pond will be developed. No ground water is envisaged. For construction purposes, fresh water available in the existing water bodies in the proposed project will be reused for construction work to the extent possible to avoid or minimize requirement of fresh water.
9	Wind barrier shall be erected to arrest fugitive dust in coal Handling Plant area.	Wind barrier is being provided.

Executive Summary

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.**

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).

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 RF – 0.7 km, Malda RF – 3.18 km) within 10 km radius.The exact location of Patrapali RF – 0.7 km from the project site is attached as Annexure XVII. There are no notified ecologically sensitive areas in the study area. Environmental Settings of the Study area is given in Table-1.1 .Google map, Topomap and the site photographs of the project site is shown in Fig 1.1, Fig 1.2 and Fig 1.3 respectively.

Table 1-1 Environmental 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 III(Moderate 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 power plant(5.4Km ENE)

Figure 1-1 : Google Earth Image of the Project Site

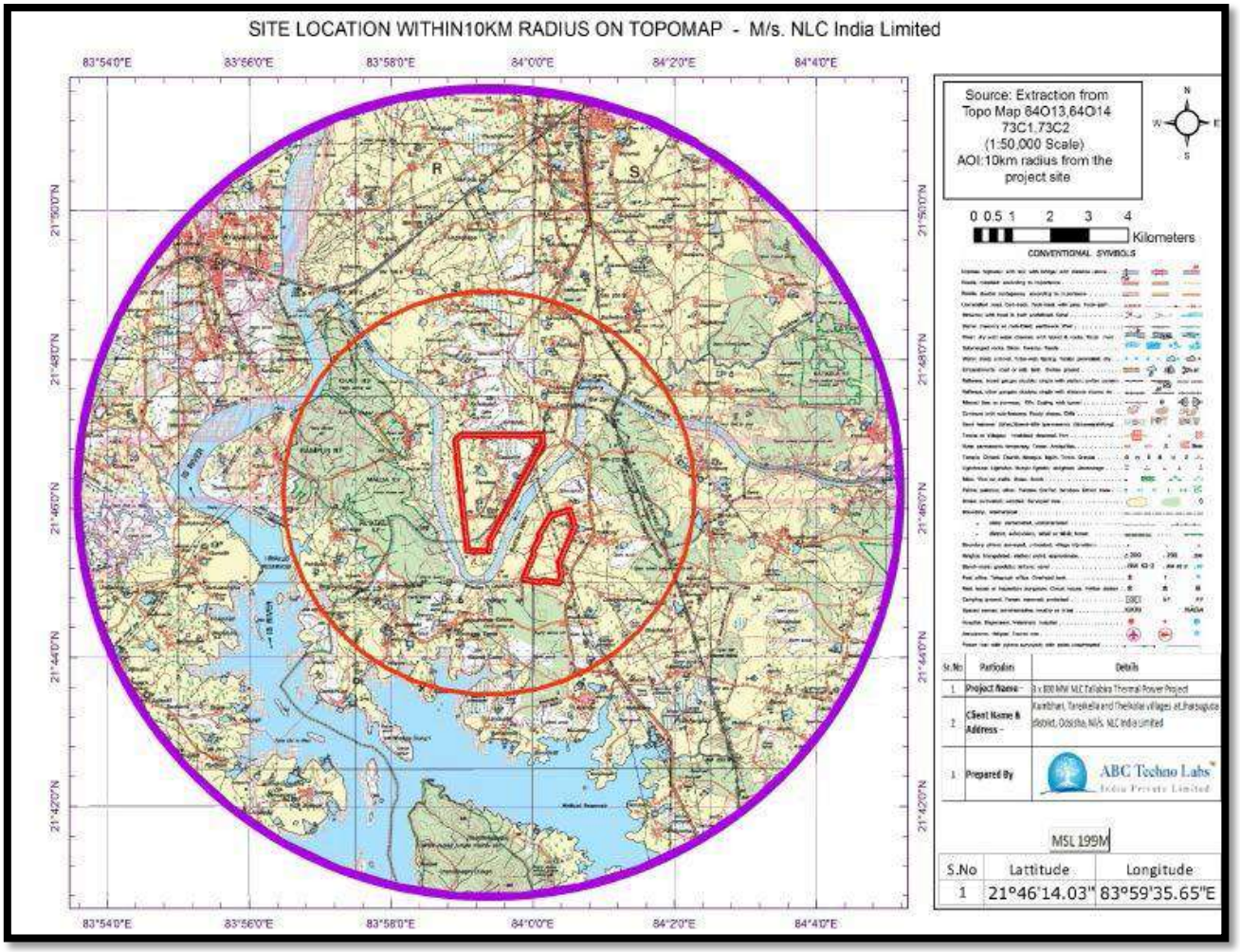


Figure 1-2 Topomap of the Project Site

Figure 1-3 : Site Photographs

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.

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)

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

The highest 98th percentile concentration of NO_2 (24.90 µg/m^3) was recorded at the project site-Tareikela (AAQ1). At all the sampling locations, the NO_2 concentrations were within the standard of 80

µg/m^3 set by the CPCB, with the lowest (8.40 µg/m^3) being recorded at the New Ash Pond (AAQ9). The highest 98th percentile concentration of CO (0.193mg/m^3) was recorded at the project site-Tareikela (AAQ1). At all the sampling locations, the CO concentrations were within the standard of 2 mg/m^3 set by the CPCB, with the lowest (0.170 mg/m^3) being recorded at Khinda and Patrapali (AAQ3,5).At all sampling locations, the recorded concentrations of Ammonia were below 5 µg/m^3, which is considered BDL (Below Detection Limit). The standard set by the CPCB is 400 µg/m^3 of NH_3.

The highest 98th percentile concentration of Ozone (14.77µg/m^3) was recorded at the Kantatikra (AAQ10). At all the sampling locations, the Ozone concentrations were within the standard of 100 µg/m^3 set by the CPCB, with the lowest (0 µg/m^3) 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%)

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.

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.

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.

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.

1 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 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.

1.1 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.

1.2 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.

1.3 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.

1.4 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**

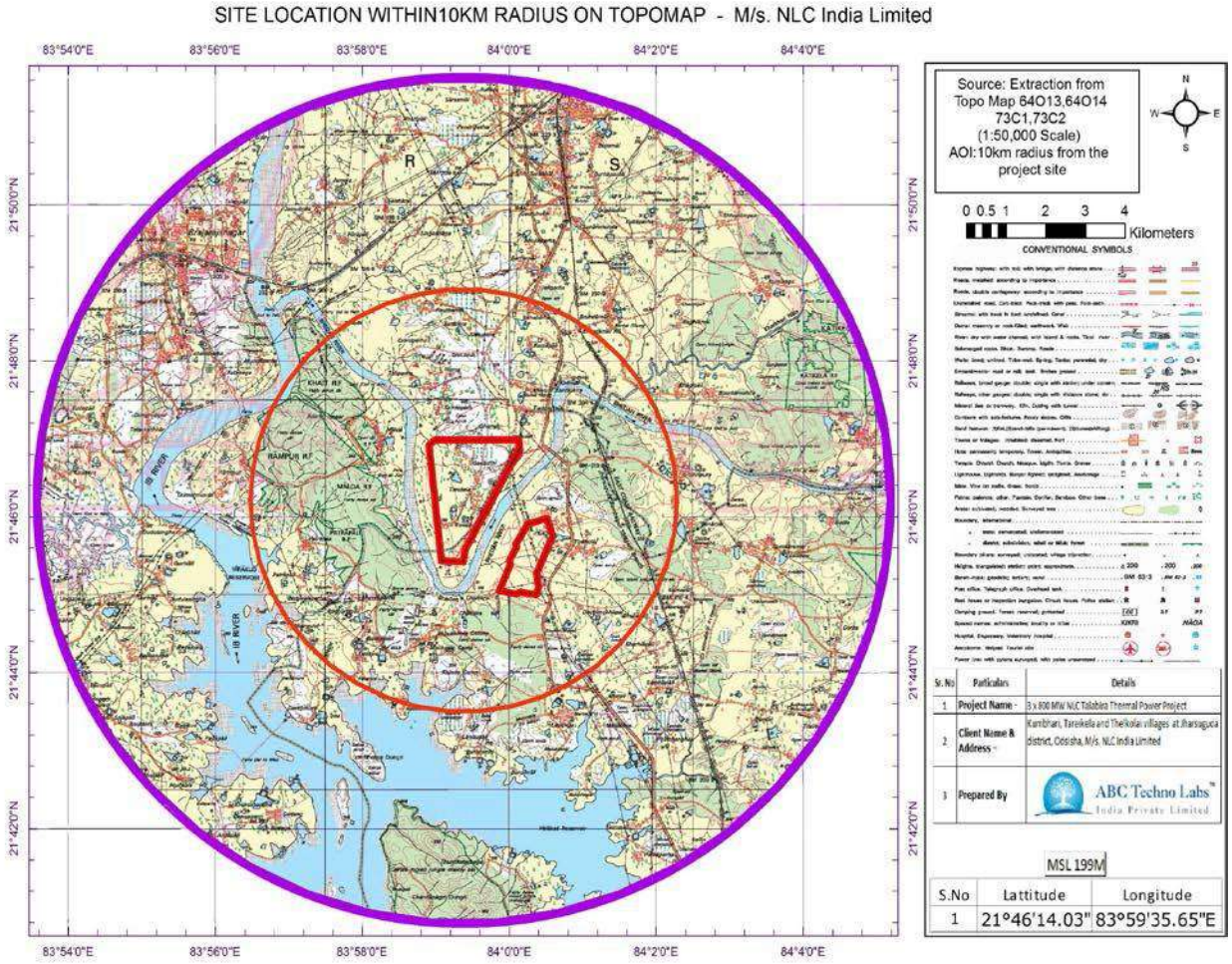


Figure 1-2 Topomap of the Project Site

1.5 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.

1.6 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.

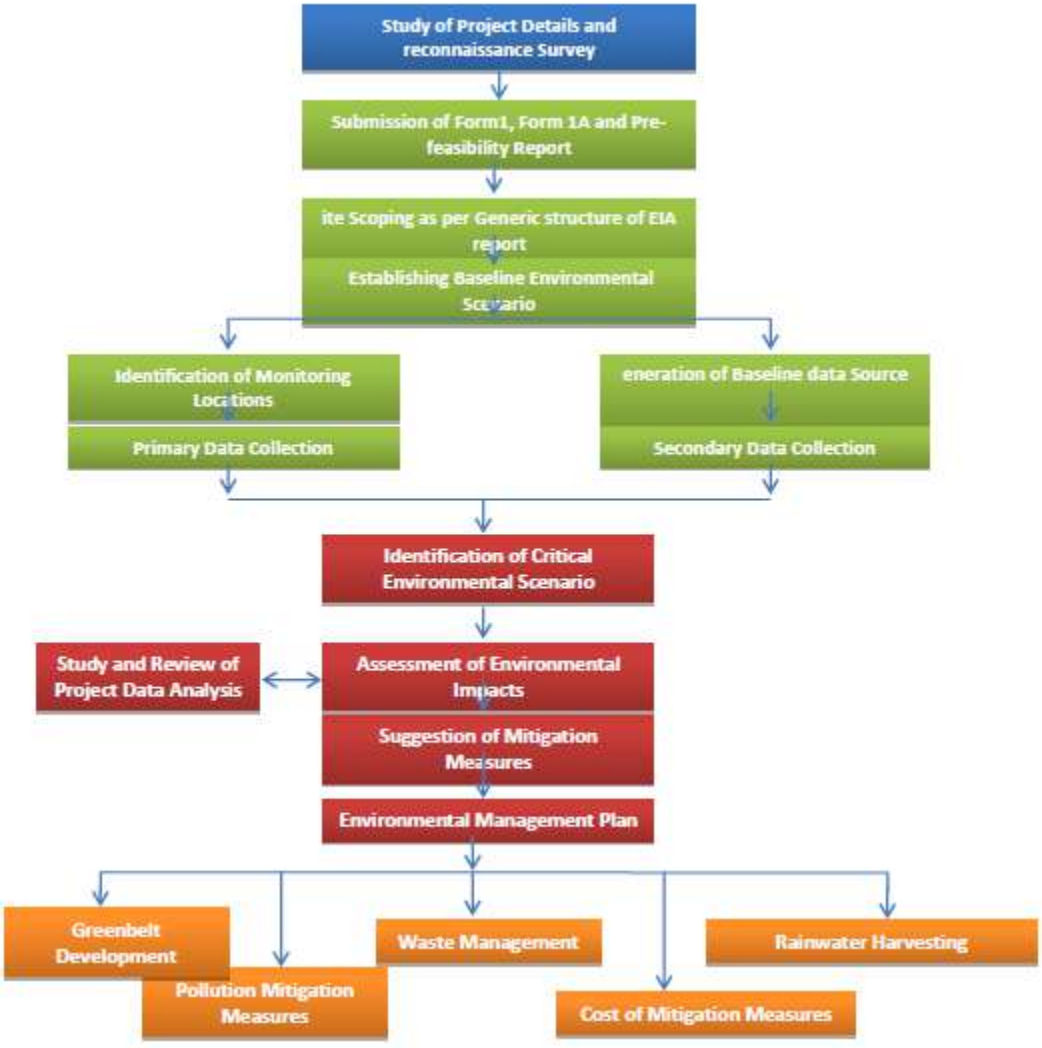


Figure 1-3 Methodology Adopted for EIA study

1.7 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.

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.

2.2.1 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
Sub Total		**942 Acres**
4	Corridors	100 Acres
5	Ash disposal area	340 Acres
6	Township	50 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

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.

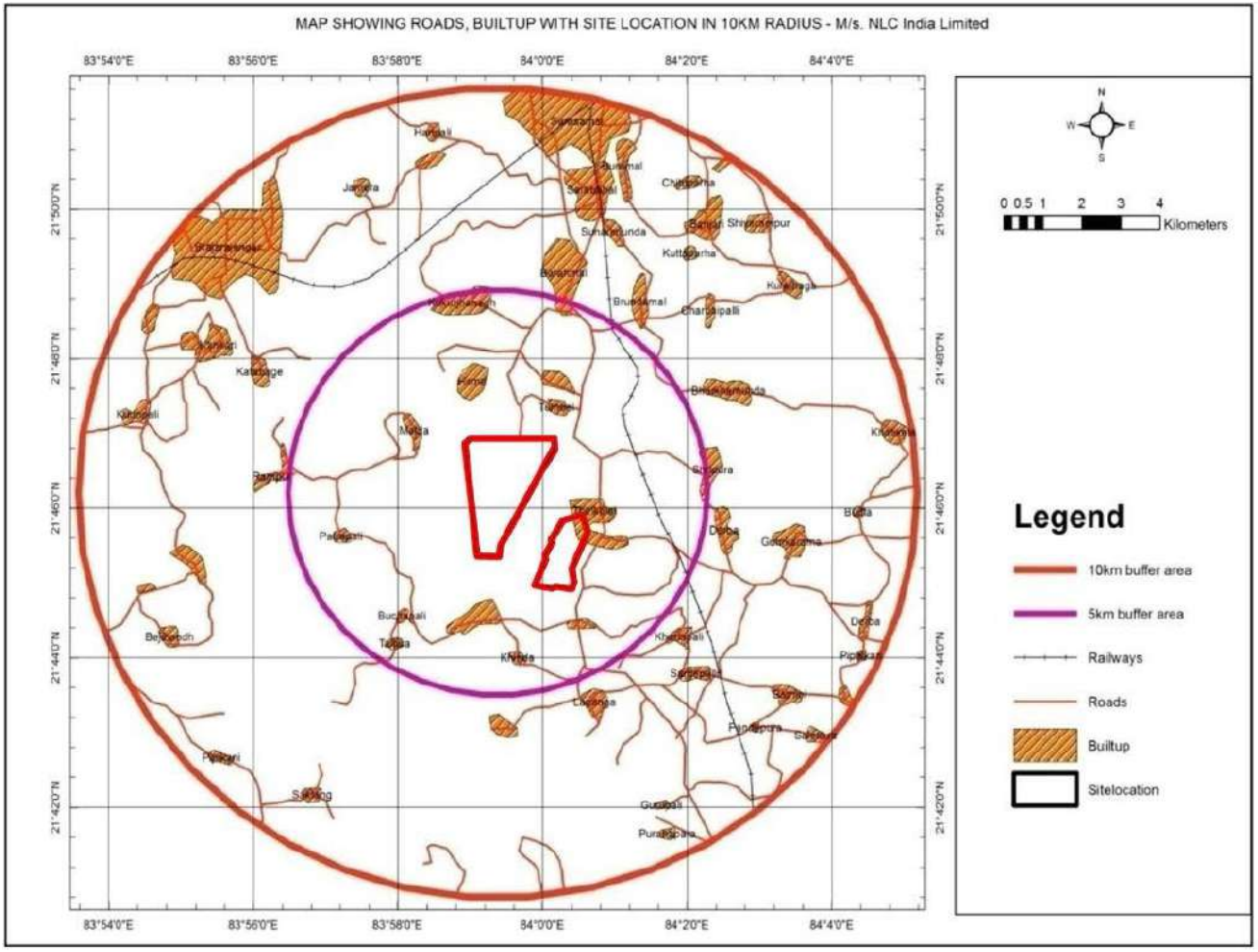


Figure 2-2 Major Roads in and Around the Project Site

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

2.7.1 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.

2.7.2 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.

2.7.3 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. The water intake point and route for transportation pipelines is shown in figure below. Water balance diagram is enclosed as Annexure VIII

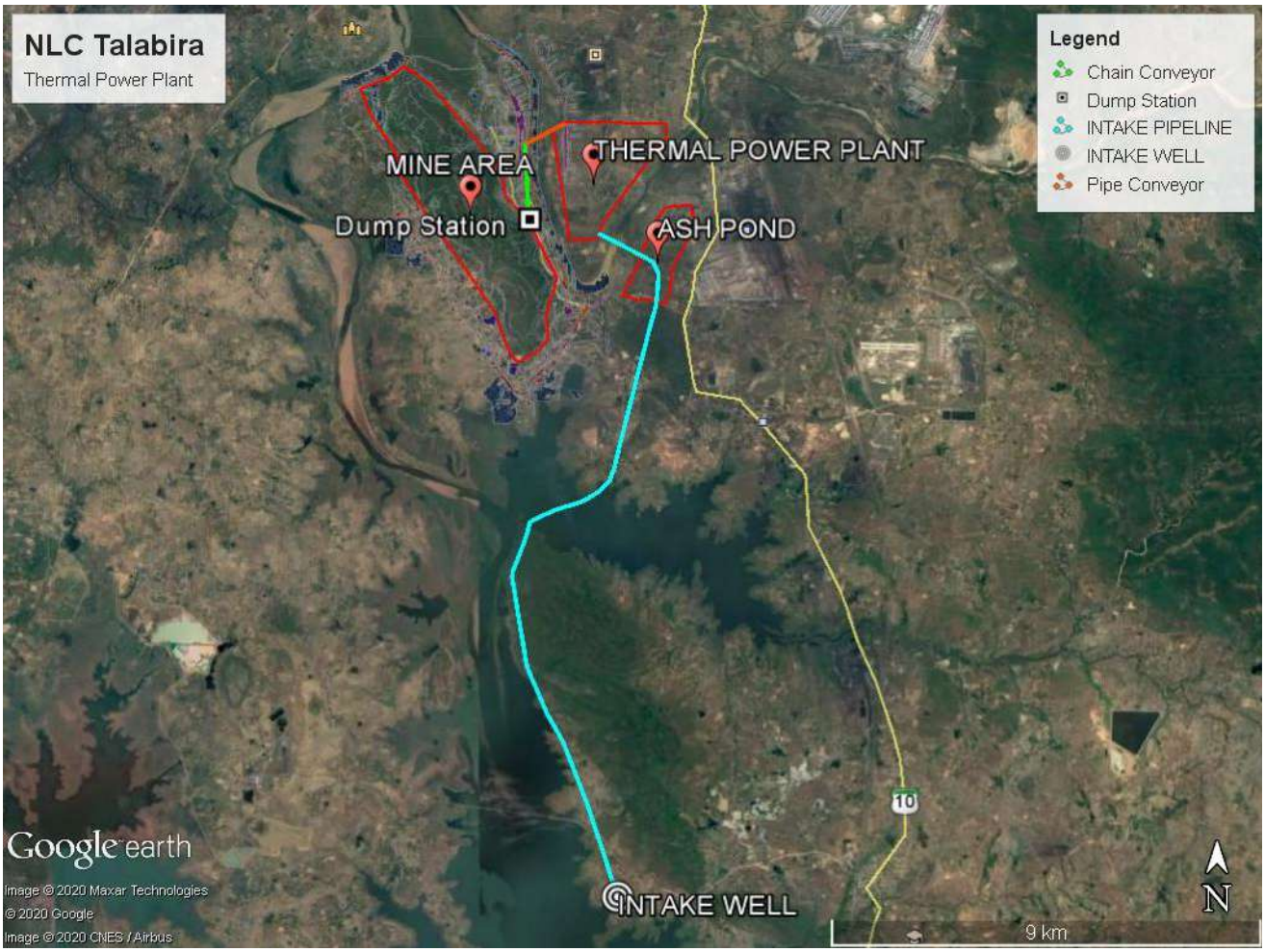


Figure 2-3 Water Pipeline transportation route Map

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. The water drawl point location, pipe routing and other details need to be finalized in consultation with WRD, GOO is attached as Annexure XVIII.

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.

2.10 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.

2.11 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.

2.12 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.

2.13 Stacker/Reclaimer Foundations

The Stacker/Reclaimer rails will be supported on RCC raft, which in turn will be supported on open foundation. The Coal transportation route Map is given in below Figure

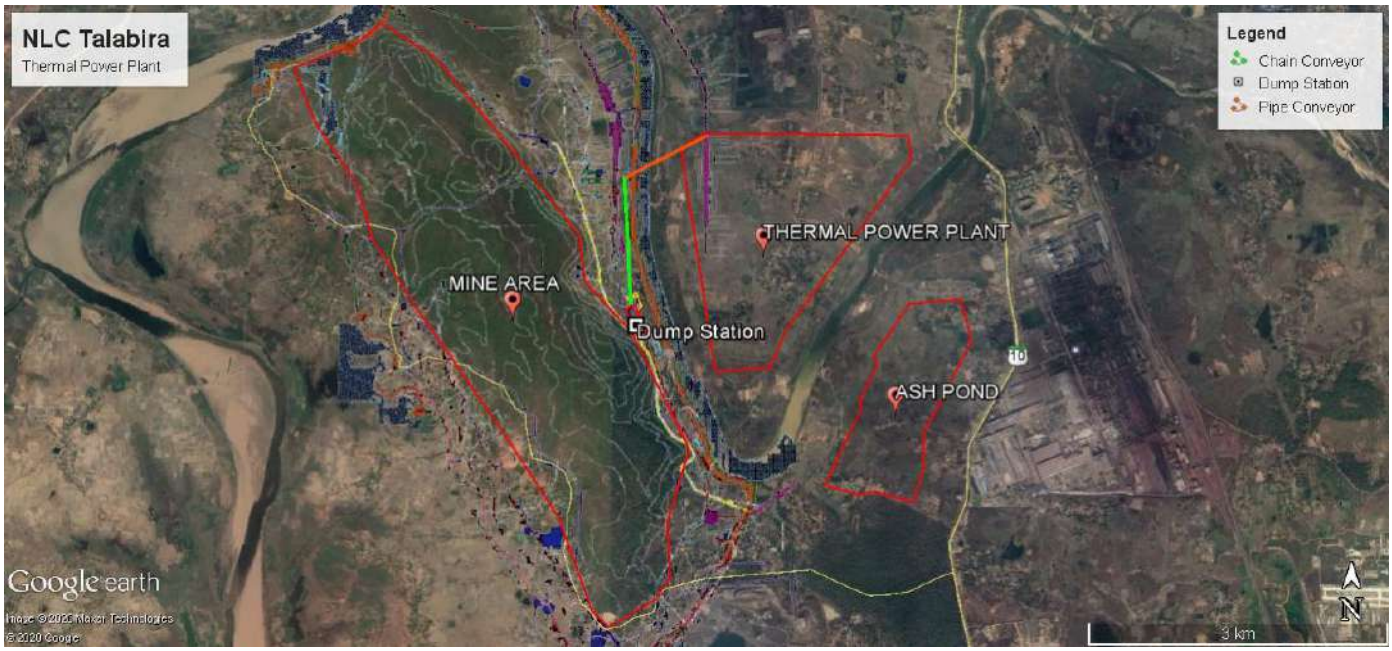


Figure 2-4 : Coal transportation route Map

2.14 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.

2.15 Water treatment system

2.15.1 Water pre-treatment plant

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.

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 x100% 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.

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.

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.

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

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

2.15.2 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.

2.15.3 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.

2.15.4 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.

2.15.5 **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.

2.15.6 **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.

2.15.7 Wastewater treatment system

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

2.15.8 Effluent treatment system

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

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

The sludge from clarifiers of Water PT plants will be collected and sent to 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 common neutralization pits and neutralized before pumping to ash slurry sump for final disposal.

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

II. 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.

III. 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

IV. 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.

V. Balance effluents will be mixed in CMB and finally reused in horticulture point using of

2 x 100% capacity pumps.

2.16 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.

2.17 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.

2.18 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.

2.19 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).

2.20 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

2.21 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 (CO_2, 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

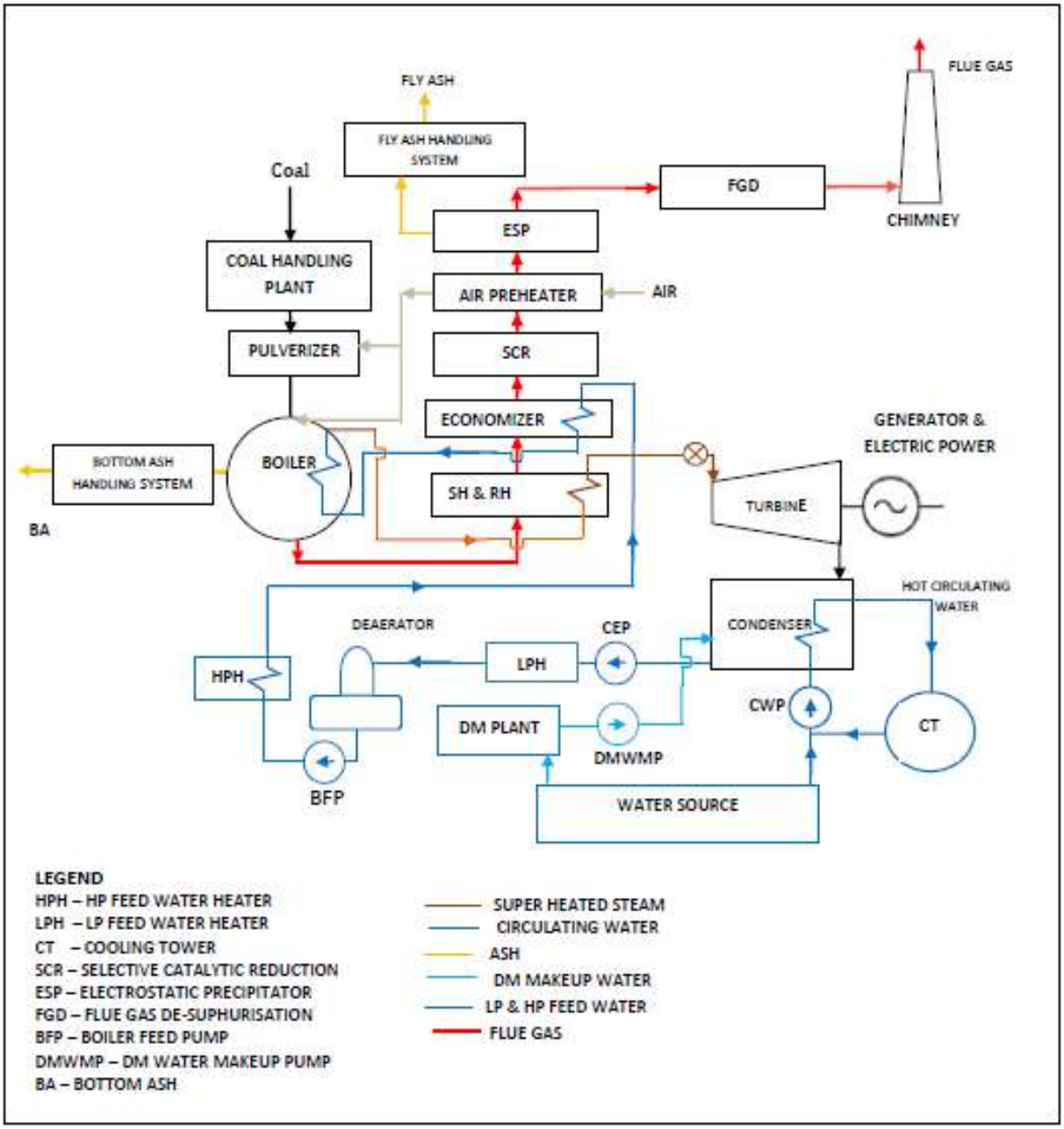


Figure 2-5 Process Flow Diagram for Coal Based Thermal Power Plant

2.21.1 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)

2.22 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.

2.22.1 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.

2.22.2 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.

2.22.3 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.

2.22.4 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.

2.22.5 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.

2.22.5.1 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.

2.22.6 Selective Catalytic Reduction (SCR)

Selective Catalytic Reduction (SCR) based De-NOx 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.

2.17.2 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:

- Elemental Hg (O)
- Oxidized Hg (2+)
- 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.

2.22.7 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.

2.22.7.1 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.

2.22.7.2 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.

2.22.8 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.

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.	al 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 III Moderate (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 Network	Frequency	Measurement Method	Remarks
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	
Oxides of Nitrogen (NO_x)			Arsenite Modified Jacob & Hochheiser	
Total Volatile Organic Compounds		--	EPA Method TO 17	
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 Specifition within the 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 influence area	Once in season	Collected and analyzed as per IUCN Red Data 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.

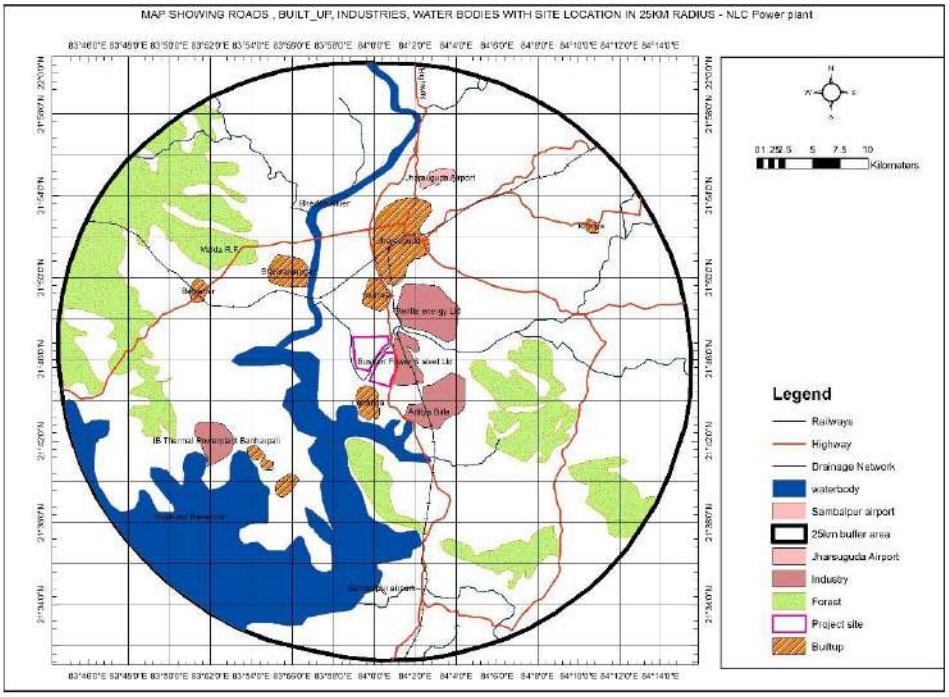


Figure 3-1 : Land use map of the Project site

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

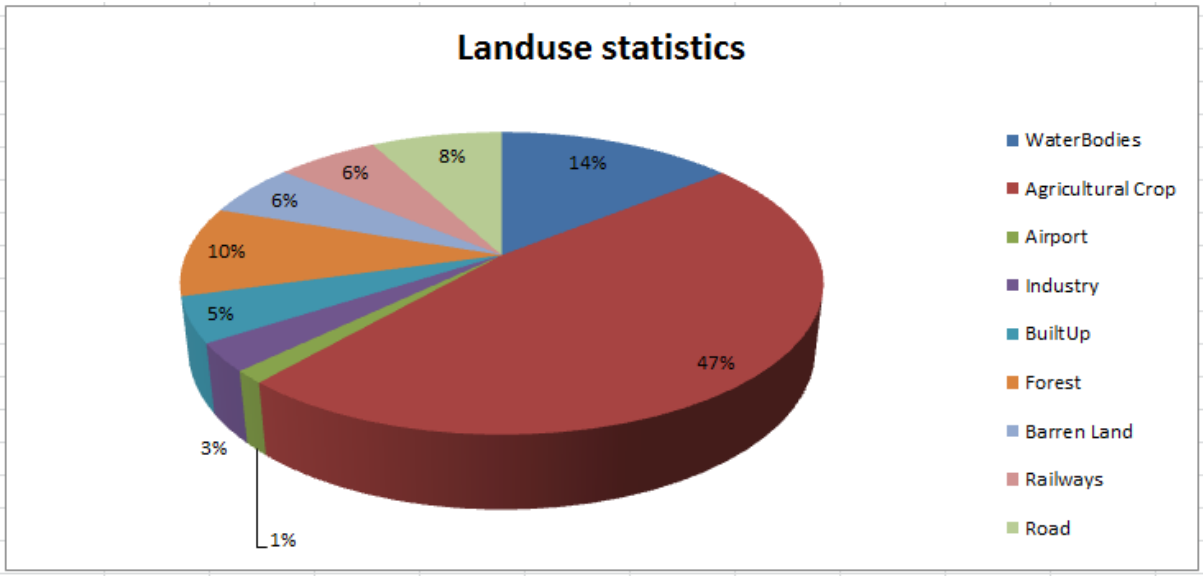


Figure 3-2 : Graphical Presentation of Land Use Statistics

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.

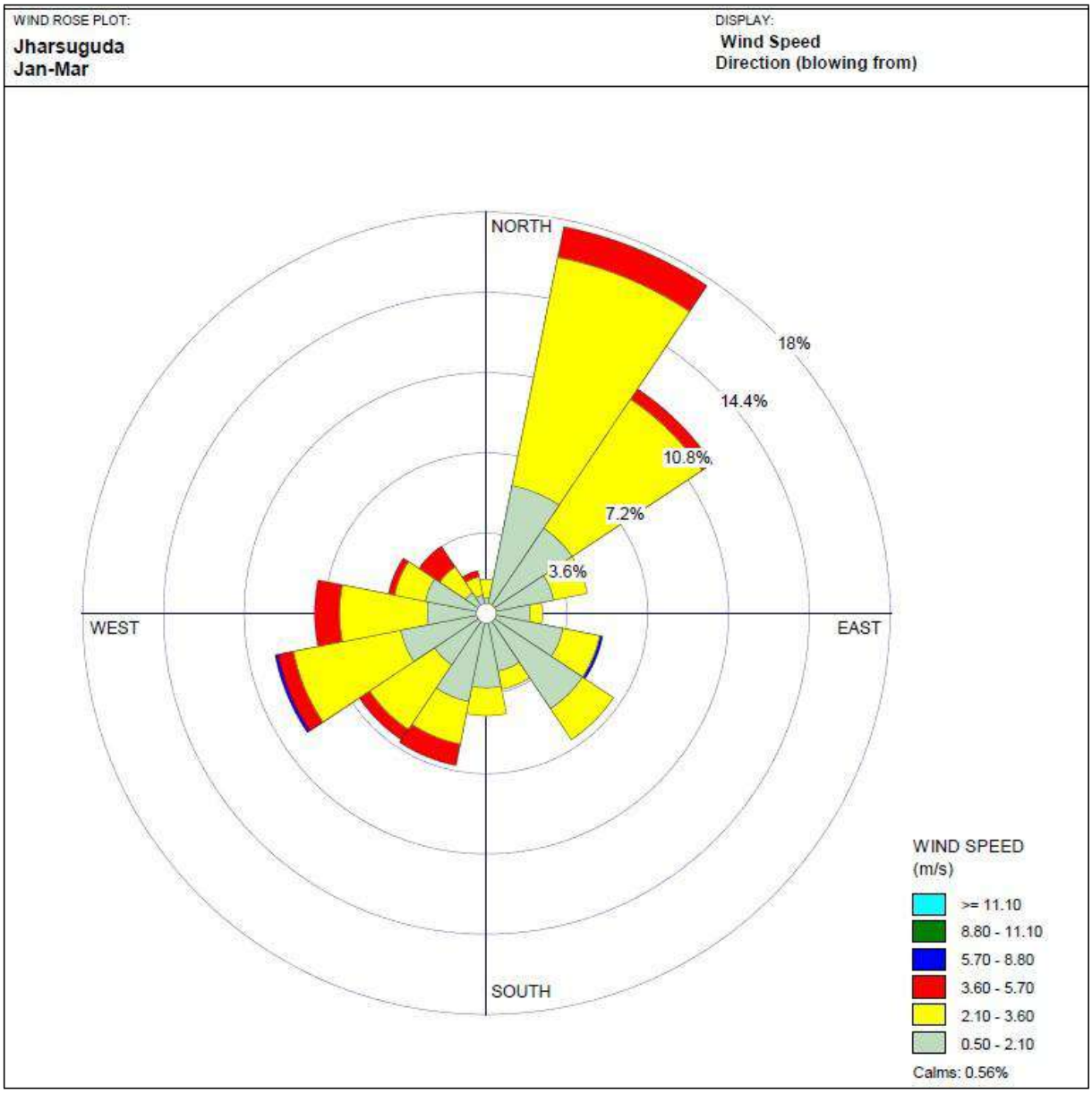


Figure 3-3– Combined Wind rose for the months of January, February and March 2018

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)		e 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 3.4.

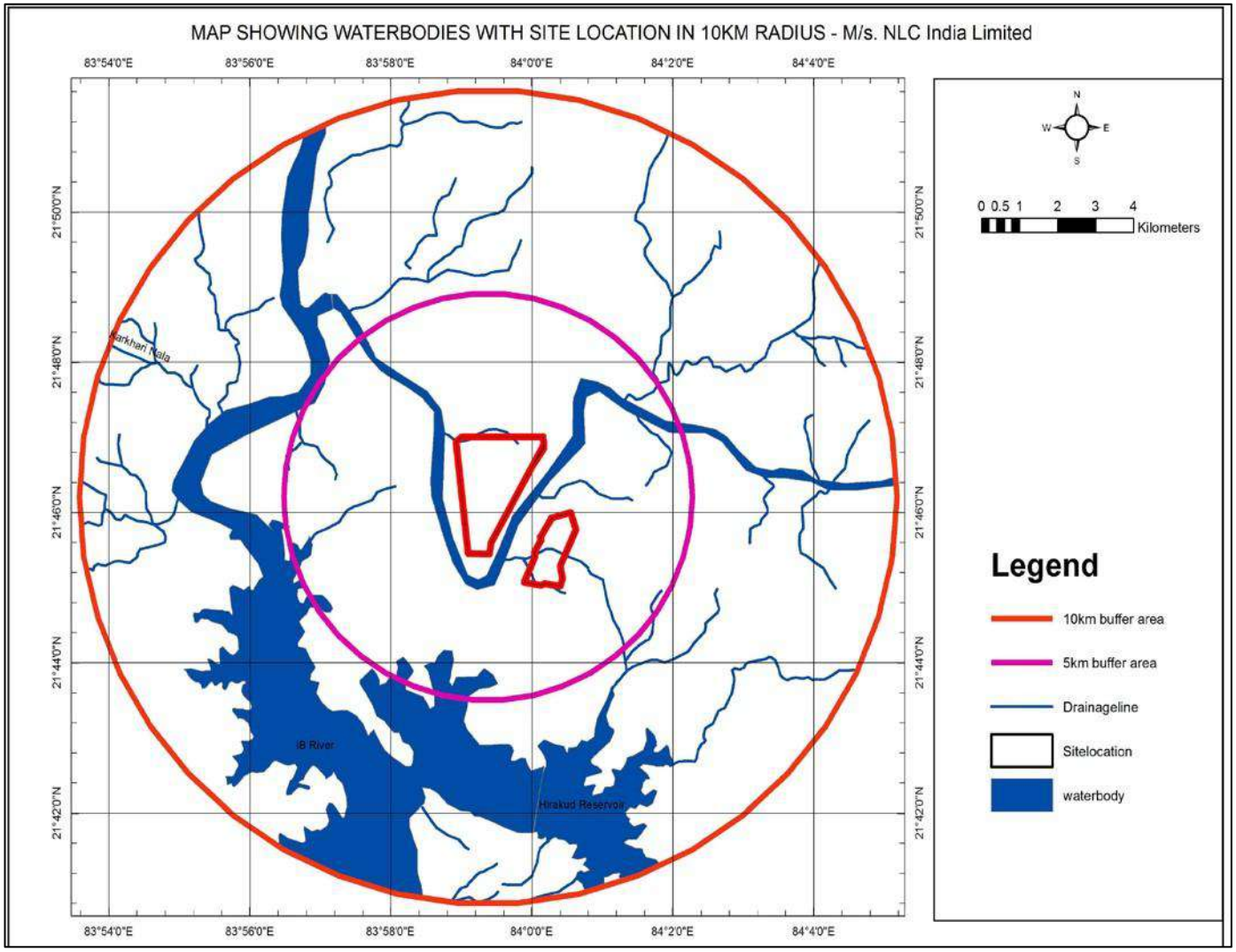


Figure 3-4 Drainage Map (10 Km) of the Project Site

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 Basundhara riverwhich 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. 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.

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

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.

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

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. 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.

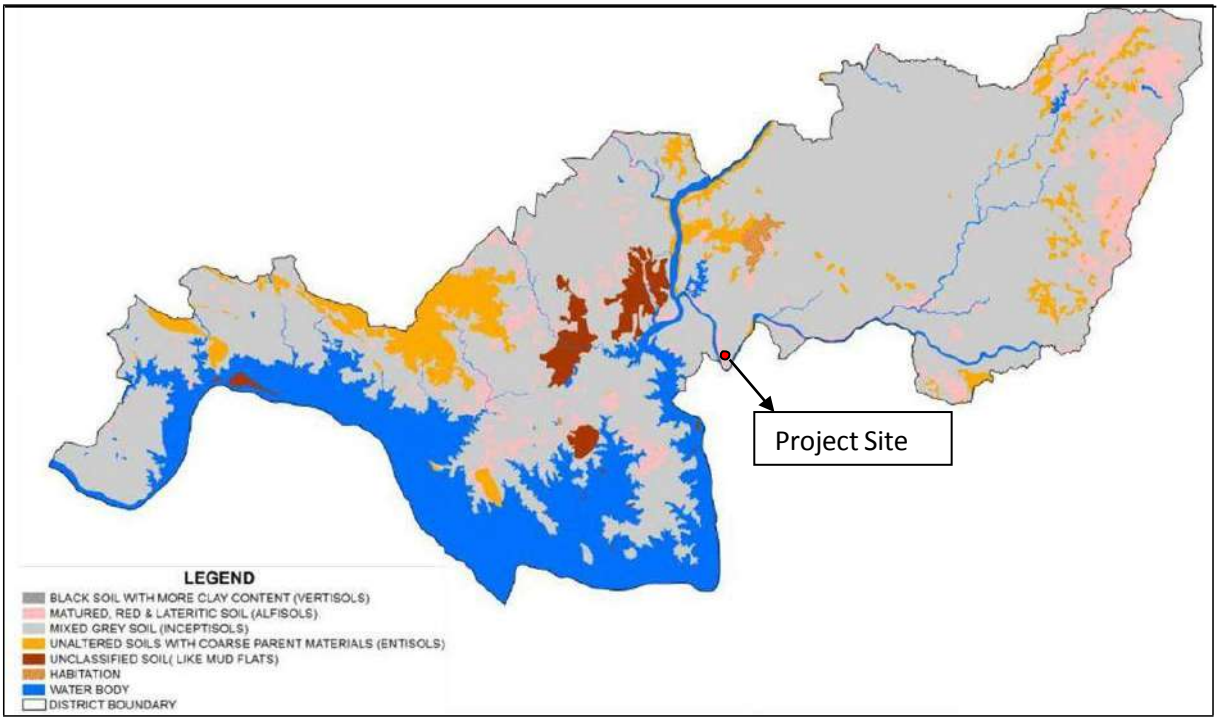


Figure 3-5 Soil Resource Map of Jharsuguda District

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 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.

3.7.1 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.

3.7.2 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.

3.7.3 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

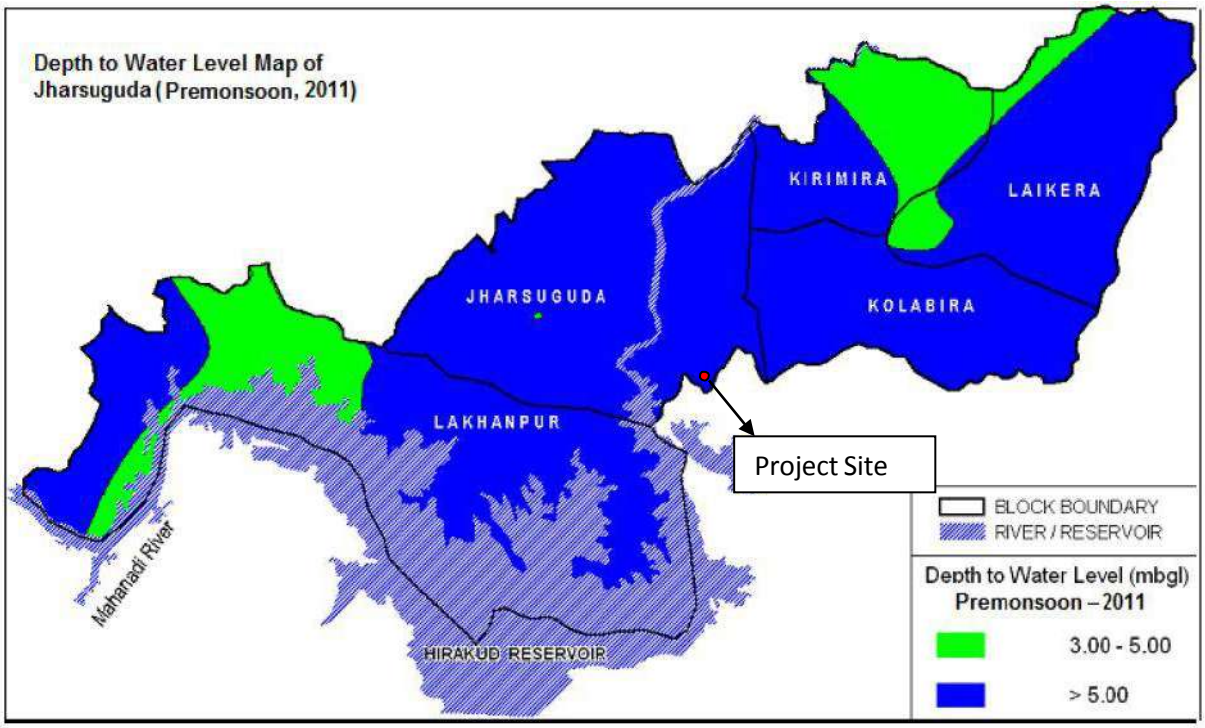


Figure 3-6 Depth to Water Level Map (Pre Monsoon)

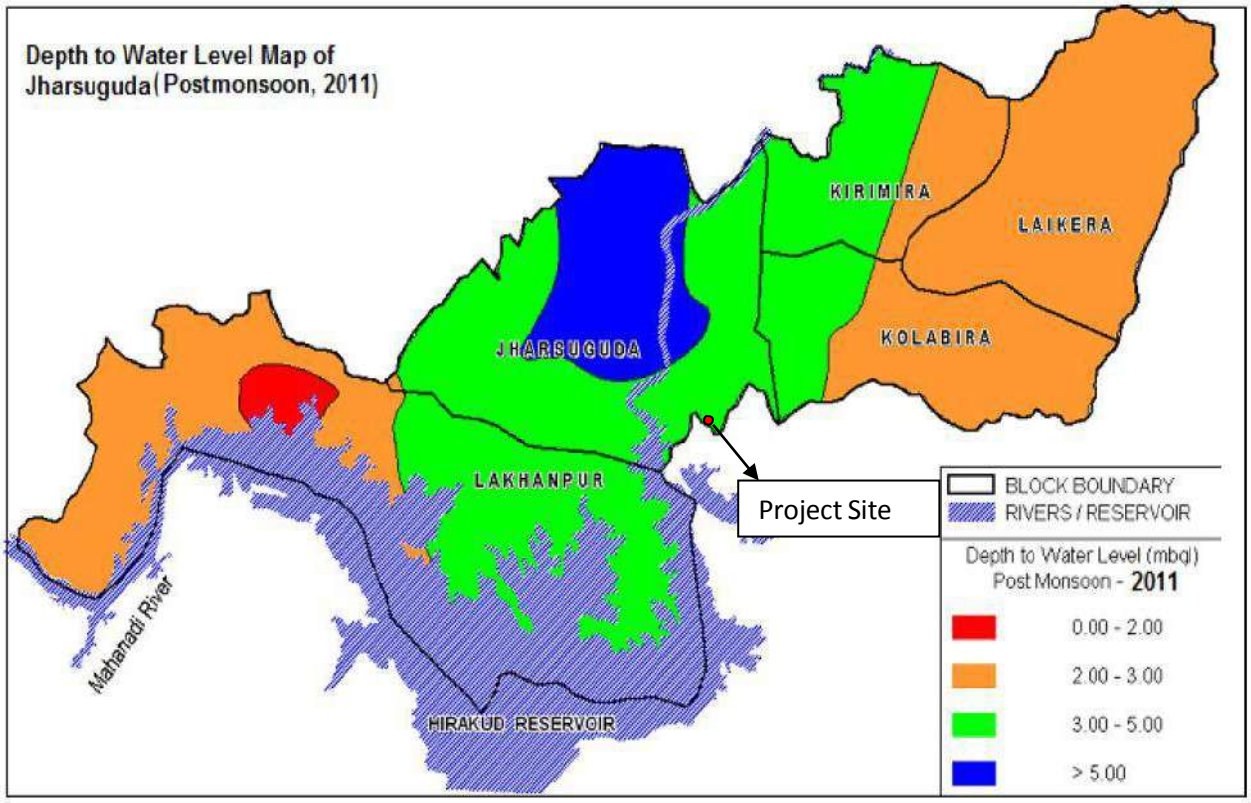


Figure 3-7 – Depth to Water Level Map (Post Monsoon)

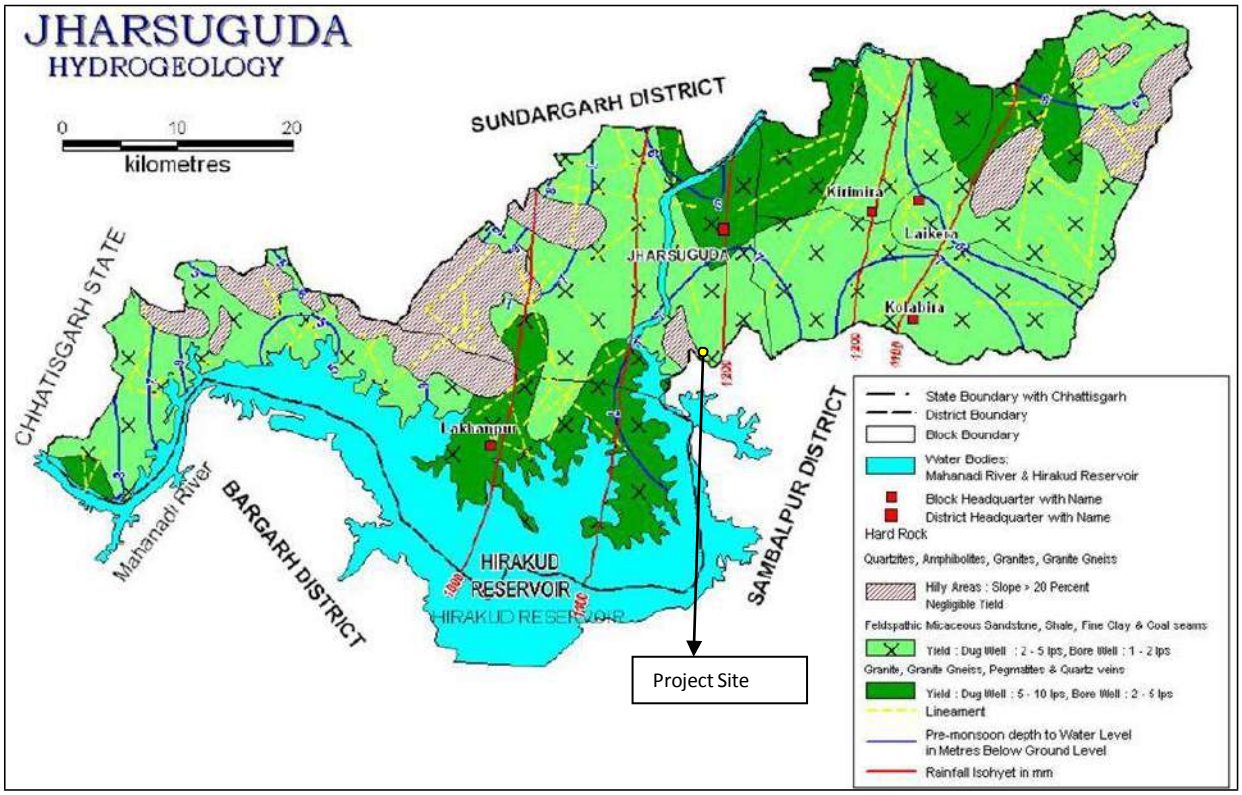


Figure 3-8 Hydrogeology Map of Jharsuguda District

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	Lakhanp	4416	1169	3647	566	3081	26.47	Safe
	District	17266	3876	14533	1849	12684	22.45	Safe

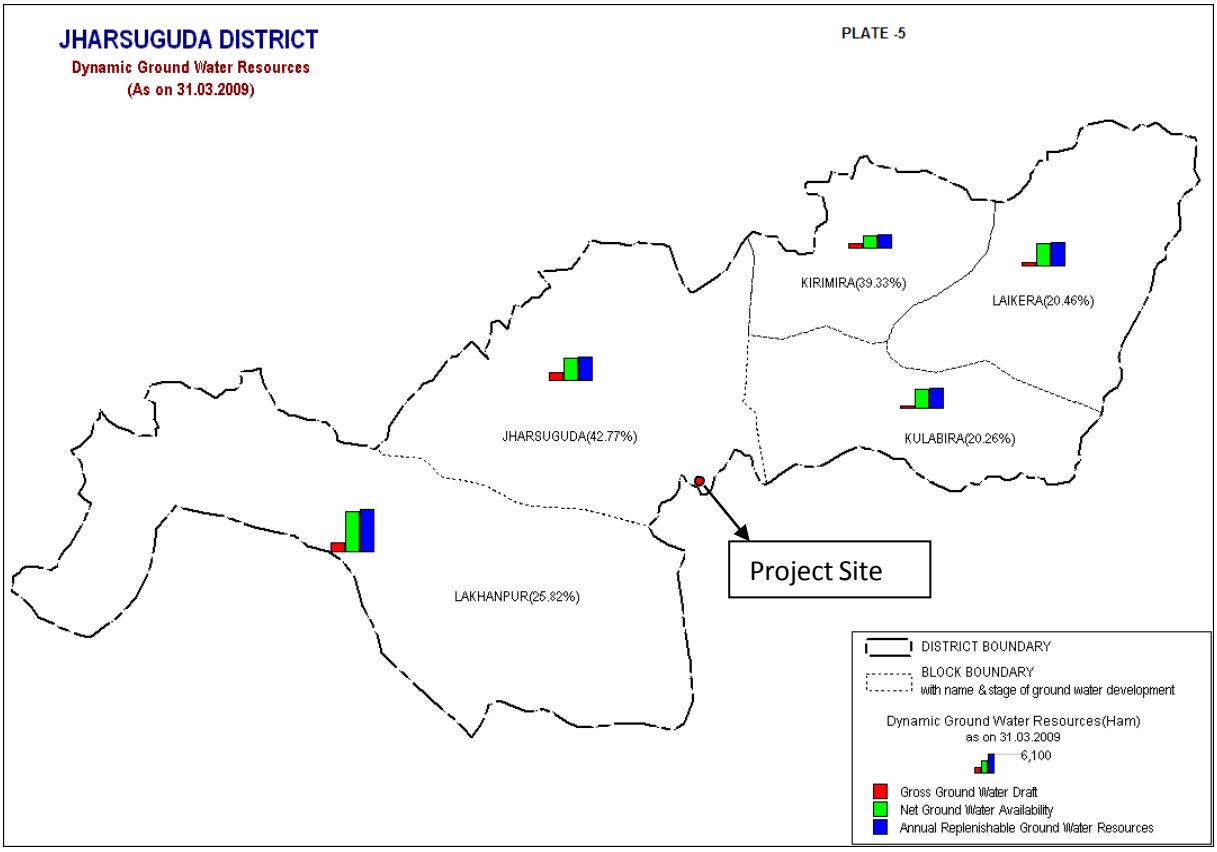


Figure 3-9 Ground Water Resources Map of Jharsuguda District

3.9 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 Jharsuguda and sambalpur districts comes under Seismic zone III.

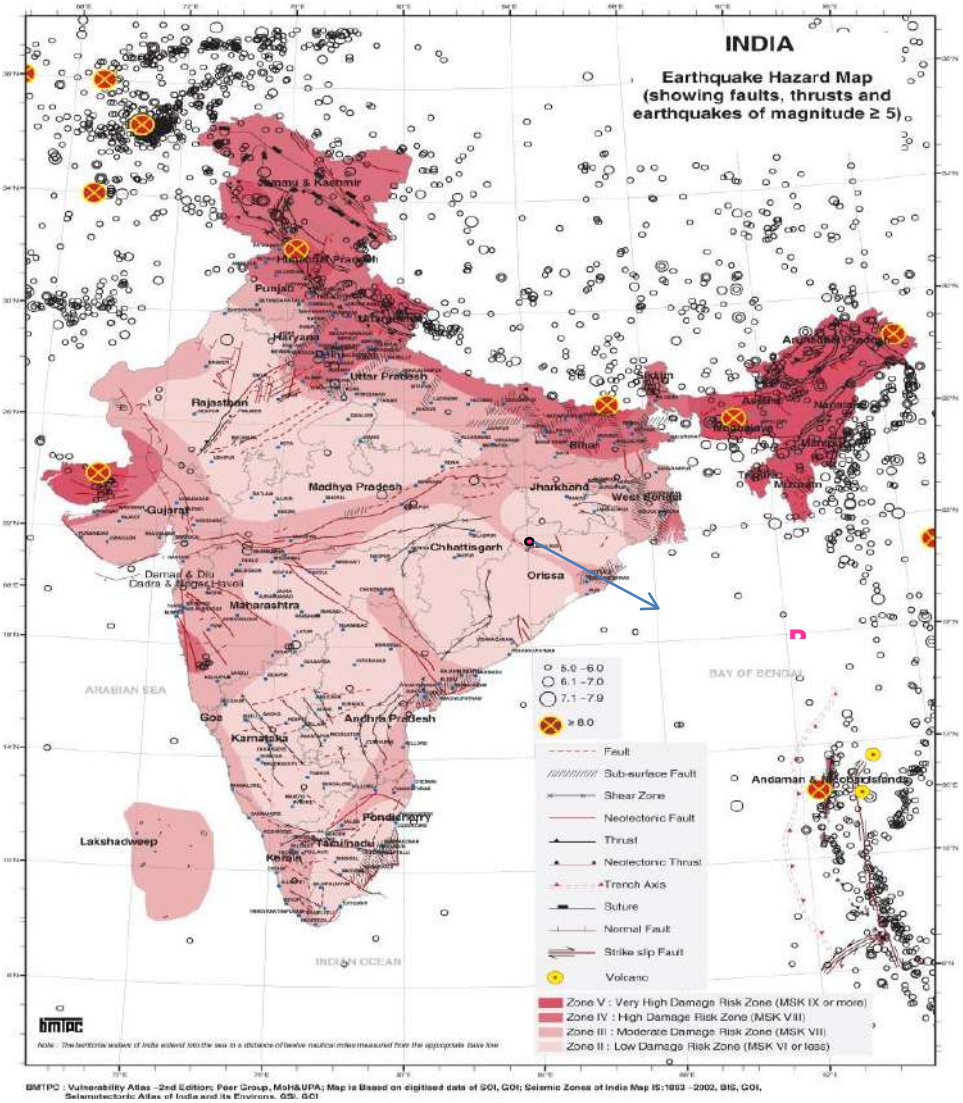


Figure 3-10 Map Showing Seismic Tectonic Zone

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).

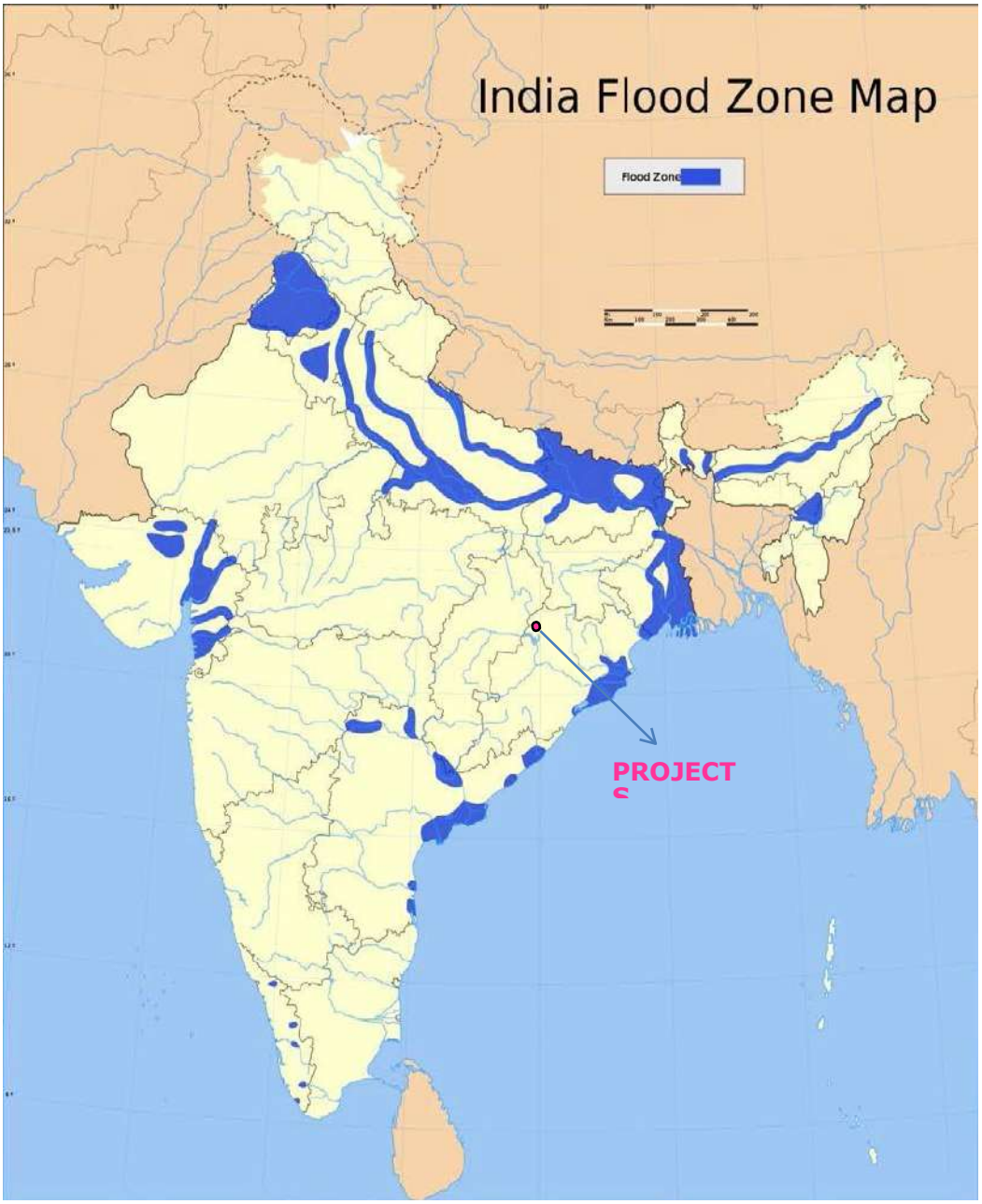


Figure 3-11 Flood Hazard Zone of the Area

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 Sample (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 3.10** and shown in **Figure 3.12.**

Table 3-10 Ambient Air Quality Monitoring Locations

Air sampling location	Location	Geographical location	Direction with the respect to project	Distance with respect to project	Environmental Setting
AAQ1	Project site	21°46'20.0"N;	-	-	Rural
AAQ2	Thelkoloi	21°45'36.8"N;	ESE	2.47	Rural
AAQ3	Khinda	21°44'21.2"N;	SSW	3.90	Rural
AAQ4	Talabira	21°44'15.4"N;	SSE	4.09	Rural
AAQ5	Patrapali	21°45'37.5"N;	WSW	4.21	Rural
AAQ6	Brajrajnagar	21°49'09.6"N;	NW	8.08	Industrial
AAQ7	Jharsuguda	21°51'34.5"N;	NNE	9.90	Commercial
AAQ8	Rampur	21°46'40.2"N;	WNW	5.51	Rural
AAQ9	New Ash Pond	21°45'07.5"N;	SE	2.90	Rural
AAQ10	Kantatikra	21°46'35.7"N;	W	9.66	Rural

3.12 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.

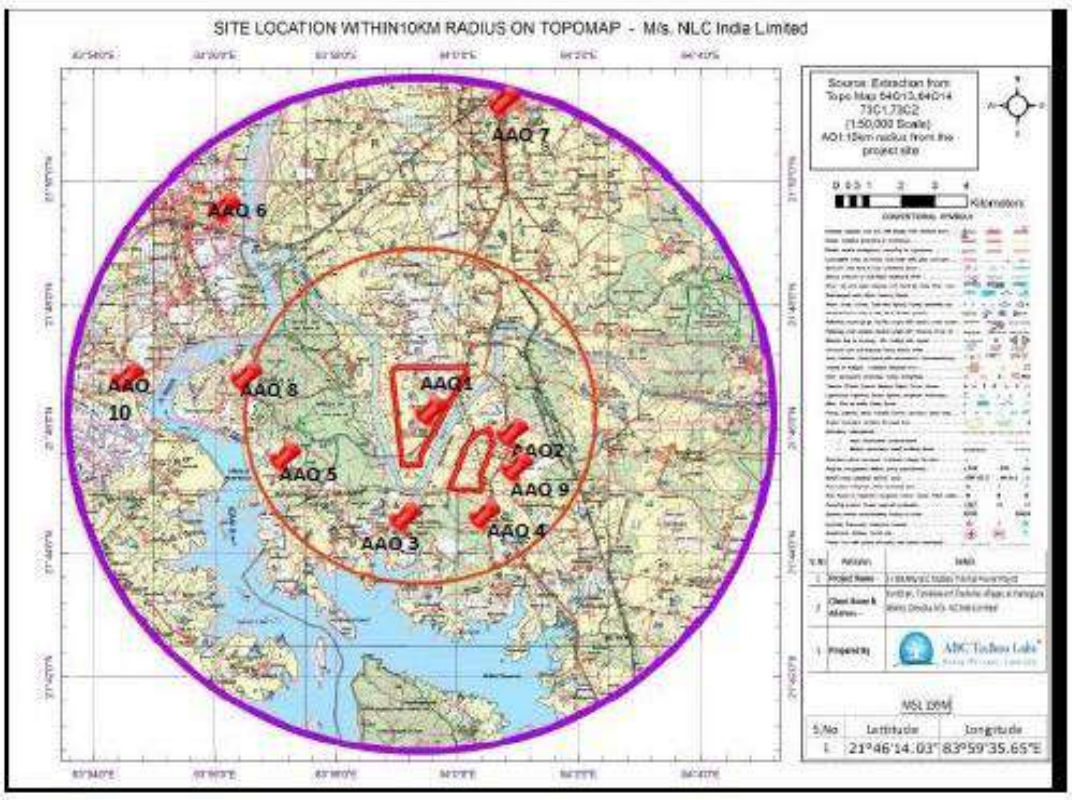


Figure 3-12 – Map Showing Air Quality Monitoring Stations Locations

3.12.1 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 $PM_{2.5}$.

3.12.2 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 gets 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	EPA METHOD TO – 17
6	Carbon Monoxide, mg/m³	IS 5182 (Part 10): 1999 (RA 2014)
7	Mercury	EPA IO-5

3.12.3 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/Residenti al / 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																
AAQ2	Thelkoloi																
AAQ3	Khinda																
AAQ4	Talabira																
AAQ5	Patra-pali																
AAQ6	Brajraj-nagar	BDL				BDL				BDL				BDL			
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**			

3.12.4 Observations

PM10: 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).

3.13 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.

3.13.1.1 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

3.13.2 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.

3.13.3 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

3.13.3.1 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:

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

3.13.4 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.

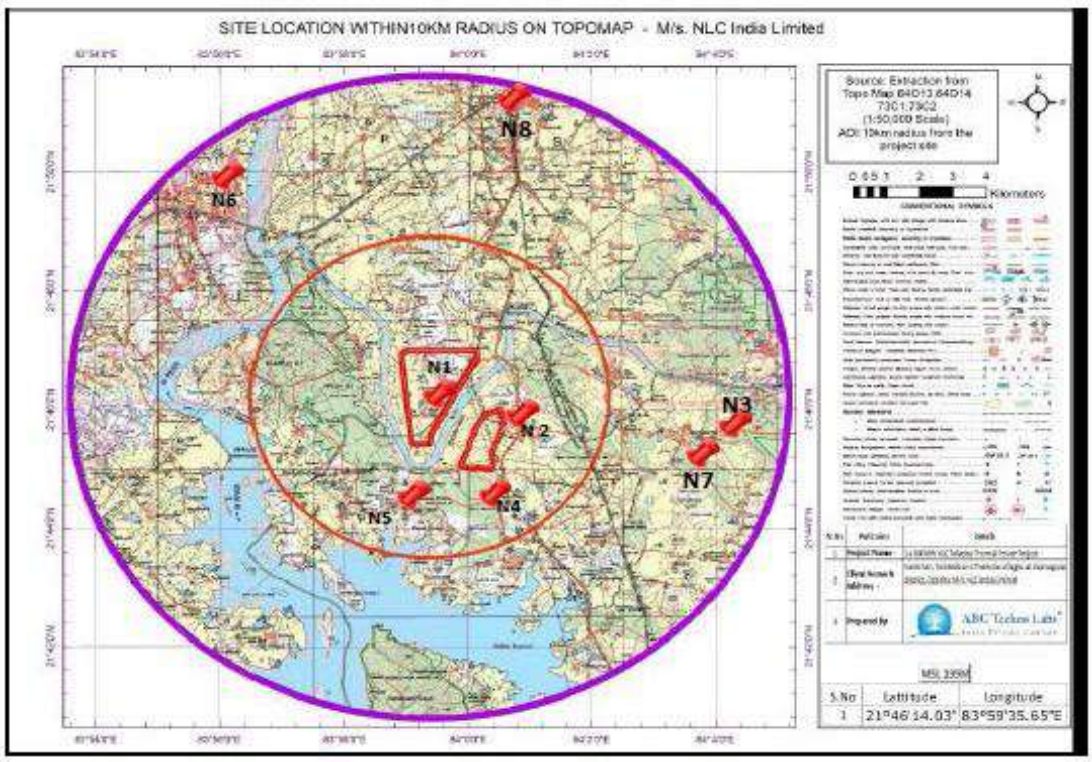


Figure 3-13 Map Showing the Location of Noise Level Monitoring Stations

3.13.5 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.

3.13.6 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.

3.13.7 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.

3.14 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)".

3.14.1 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)	h 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

3.14.2 Water Source for the Project

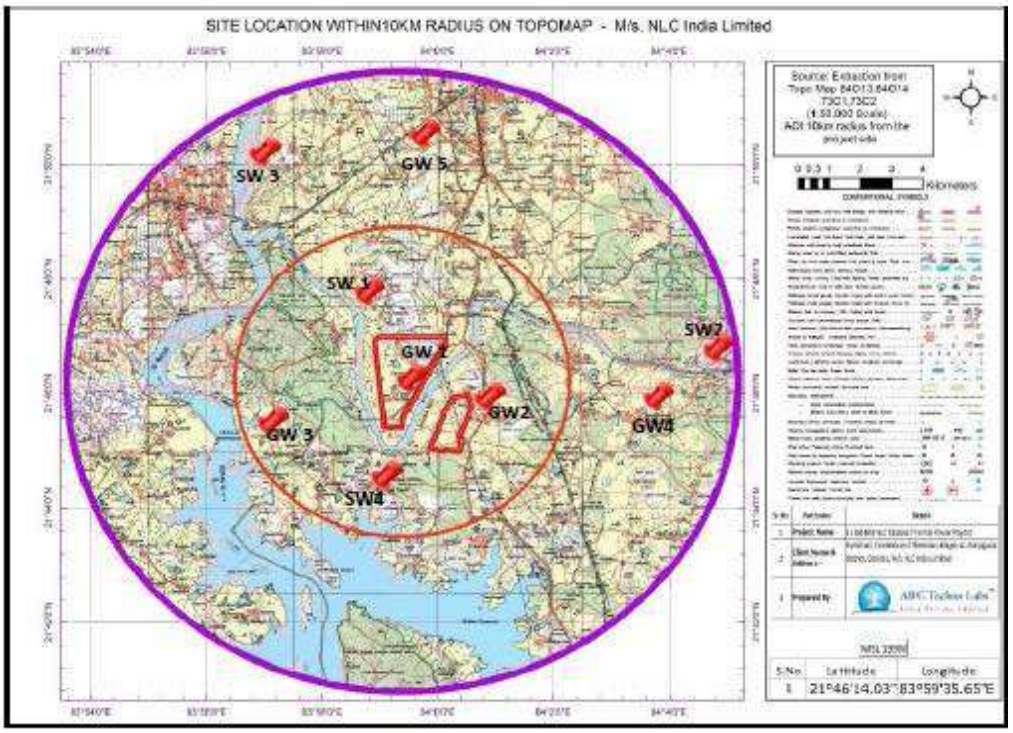


Figure 3-14 map showing water quality monitoring locations

3.14.3 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:2 003)	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
11	Fluoride as F	mg/l	APHA 22nd EDN -4500-F	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	Not Specified	8	9	11	54	18
15	Potassium as K	mg/l	IS : 3025 Part 45-1993	Not Specified	1	1	1.3	12	2.6
16	Calcium as Ca	mg/l	IS : 3025 Part 40-1991	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,	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)	Absent	<2	<2	<2	<2	<2
33	E coli	MPN/ 100ml	IS 10500 -1622 (1981)	Absent	<2	<2	<2	<2	<2

BDL – Below Detection Limit

	Parameters	Unit	Test method	SW1	SW2	SW3	SW4	SW5
	Colour	Hazen	APHA 22ND EDITION	5	8	3	3	1
	Odour	-	APHA 22ND EDITION	No Odour	No Odour	No Odour	No Odour	No Odour
	Turbidity	NTU	IS : 3025 Part 10-1984	3.3	3.2	2	1.9	0.8
	pH at 25°C	-	IS : 3025 Part 11-1983	7.64	8.58	7.51	7.42	8.05
	Electrical Conductivity	µS/cm	IS : 3025 Part 14-1984	238	452	183	206	198
	Total Dissolved Solids	mg/l	IS : 3025 Part 16-1984	132	260	97	110	106
	Total Hardness as $CaCO_3$	mg/l	IS : 3025 Part 21-1983	76	110	60	56	64

	Total Alkalinity as $CaCO_3$	mg/l	IS : 3025 Part 23-1986(Reaff:2003)	77	130	60	64	68
	Chloride as Cl	mg/l	IS : 3025 Part 32-1988	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	21	54	12	17	13
16	Potassium as K	mg/l	IS : 3025 Part 45-1993	3.5	4.5	2	2.3	3
17	Calcium as Ca	mg/l	IS : 3025 Part 40-1991	20	30	14	16	19
18	Magnesium as	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	mg/l	APHA 22nd EDN -3500-Mn	BDL	0.14	BDL	BDL	BDL
21	Phenolic compounds as	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	BDL	BDL	BDL	BDL	BDL
23	Mercury as Hg	mg/l	APHA 22nd EDN -3112B	BDL	BDL	BDL	BDL	BDL
24	Cadmium as Cd	mg/l	APHA 22nd EDN -3113 B	BDL	BDL	BDL	BDL	BDL
25	Selenium as Se	mg/l	APHA 22nd EDN -3113B	BDL	BDL	BDL	BDL	BDL
26	Total Arsenic as	mg/l	APHA 22nd EDN -3113 B	BDL	BDL	BDL	BDL	BDL
27	Cyanide as CN	mg/l	APHA 22nd EDN -4500-CN	BDL	BDL	BDL	BDL	BDL

28	Lead as Pb	mg/l	APHA 22nd EDN -3113 B	BDL	0.13	0.10	BDL	BDL
29	Zinc as Zn	mg/l	APHA 22nd EDN -3111 B	0.056	0.288	0.041	0.056	0.011
30	Total Chromium	mg/l	APHA 22nd EDN -3113 B	BDL	BDL	BDL	BDL	BDL
31	Nickel	mg/l	APHA 22nd EDN -3113 B	BDL	BDL	BDL	BDL	BDL
32	Aluminum as Al	mg/l	APHA 22nd EDN -3500-Al-	BDL	BDL	BDL	BDL	BDL
33	Total Suspended	mg/l	IS : 3025 Part 17-1984	5	8	3	4	2
34	Anionic Surfactants as	mg/l	APHA 22ND EDITION	BDL (<0.025)	BDL (<0.025)	BDL (<0.025)	BDL (<0.025)	BDL (<0.025)
35	Dissolved	mg/l	IS:3025:Part-38:1989	7.3	6.3	7.8	7.7	7.6
36	Chemical Oxygen	mg/l	IS:3025:Part-58:2006	10	22	8	8.6	4.8
37	Bio-Chemical Oxygen Demand at 27°C for 3	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

3.14.4 Observations

3.14.5 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,

3.14.6 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.

3.15 Soil Environment

3.15.1 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; 83°55'55.3"E	NW	8.03
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

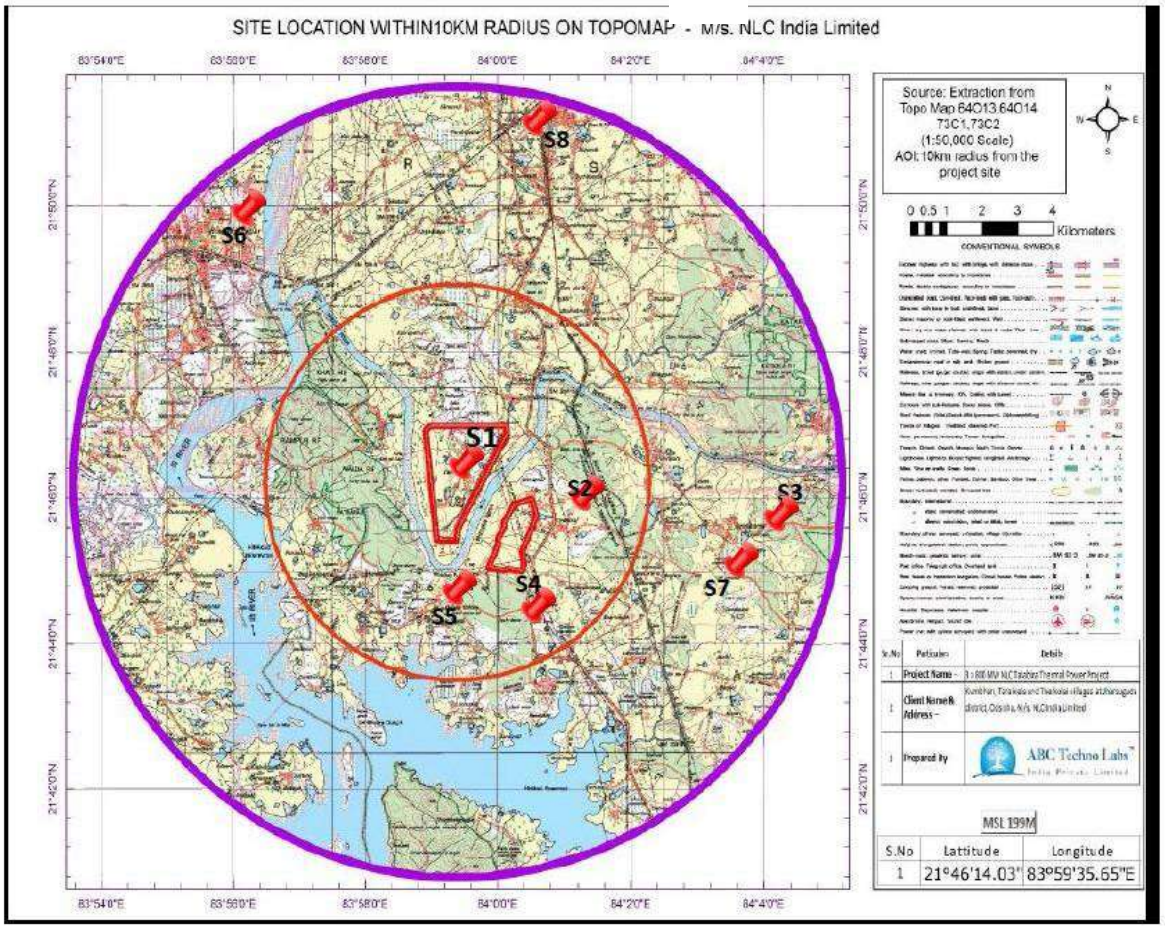


Figure 3-15 Map Showing the Location of Soil Sampling Stations

3.15.2 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, Reaff:2010	0.22	0.17	0.13	0.21	0.17	0.15	0.23	0.16
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**

3.15.3 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.

3.16 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.

3.16.1 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.

3.16.2 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.

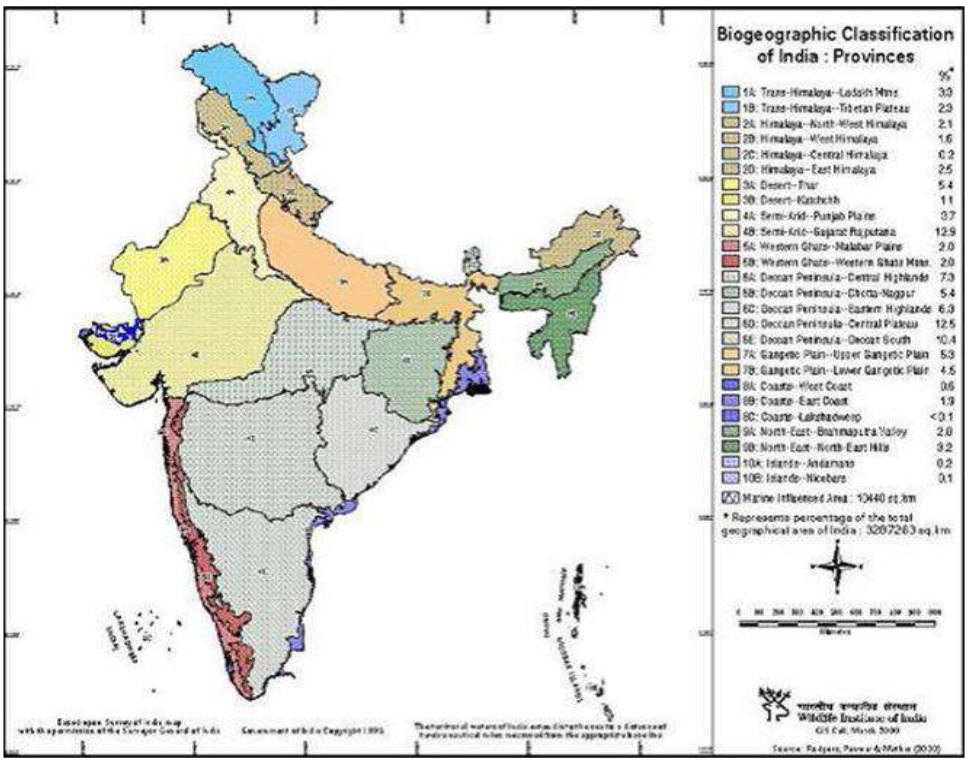
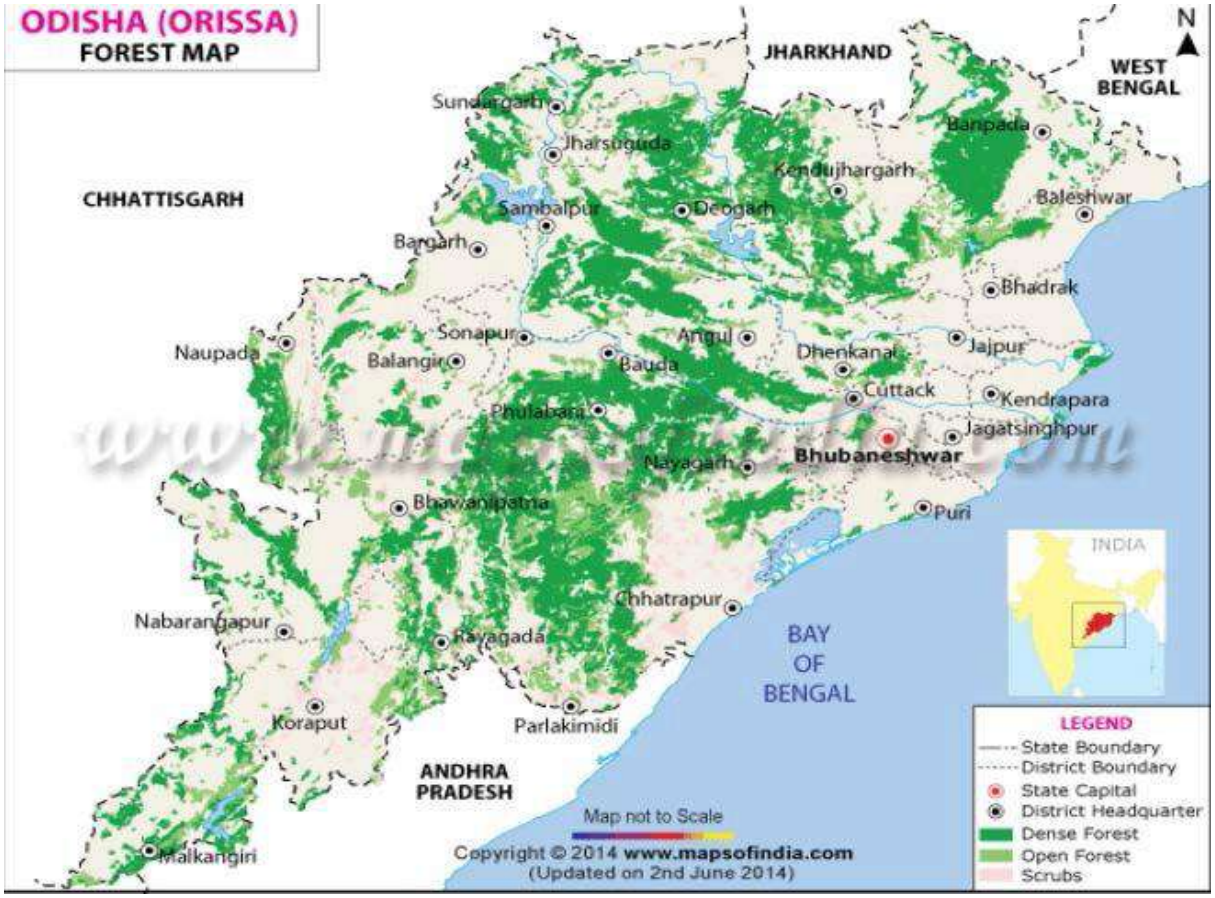


Figure 3-16 Map showing the Bio-geographic Provinces of India

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 (v) R.F.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.

3.16.3 **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.

3.16.4 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.

3.16.5 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 3-21 : 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*), and 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.

3.16.6 **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	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**	**Total No. of quad**	**Density**	**Relative Density**	**Frequency %**	**Relative Frequency**	**Abundance**	**Relative Abundance**	**IVI**
	Total		136	129	282			1100.0				
Shrubs												
	Datura metel	Dhutura		3	6	0.667	6.25	50.0	5.6	1.33	0.06	11.87
	Dendrocalamus strictus	Salia		3	6	0.500	4.69	50.0	5.6	1.00	0.05	10.29

	Bambusa arundinaceae	Kanta bans		4	6	0.833	7.81	66.7	7.4	1.25	0.08	15.30
	Lantana camara	Naga airi		6	6	1.333	12.50	100.0	11.1	1.33	0.13	23.74
	Calotropis gigantea	Arakha		6	6	1.500	14.06	100.0	11.1	1.50	0.14	25.31
	Cassia fistula	Sunari		4	6	0.833	7.81	66.7	7.4	1.25	0.08	15.30
	Chromolaena odorata	Poksunga		3	6	0.500	4.69	50.0	5.6	1.00	0.05	10.29
	Helicteres isora	Antia		2	6	0.333	3.13	33.3	3.7	1.00	0.03	6.86
	Pavetta indica	Kukur chhalia		2	6	0.333	3.13	33.3	3.7	1.00	0.03	6.86
	Vitex negundo	Begunia		3	6	0.500	4.69	50.0	5.6	1.00	0.05	10.29
	Flemingia chappar	Ranidantkathi		3	6	0.500	4.69	50.0	5.6	1.00	0.05	10.29
	Commelina benghalensis	Kanang-karai		3	6	0.500	4.69	50.0	5.6	1.00	0.05	10.29
	Jasminum sessiliflorum	Kuruvilaangkodi		1	6	0.167	1.56	16.7	1.9	1.00	0.02	3.43
	Morinda pubescens	Mannanunai		2	6	0.333	3.13	33.3	3.7	1.00	0.03	6.86
	Sida cordifolia	Berela		3	6	0.500	4.69	50.0	5.6	1.00	0.05	10.29
	Ipomoea carnea	Ipomea		2	6	0.333	3.13	33.3	3.7	1.00	0.03	6.86
	Jatropha gossypifolia	Lal Bheranda		2	6	0.500	4.69	33.3	3.7	1.50	0.05	8.44
	Bougainvillea glabra	Kagajiful		2	6	0.500	4.69	33.3	3.7	1.50	0.05	8.44
	Total		64	54	108							
Herbs & Grasses												
	Cynodon dactylon	Duba	20	6	6	3.333	25.64	100.0	12.2	3.33	0.26	38.14
	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
	Achyranthes aspera	*Apamaranga*		4	6	0.833	6.41	66.7	8.2	1.25	0.06	14.64
	Commelina benghalensis	*Kanasiri*		3	6	0.500	3.85	50.0	6.1	1.00	0.04	10.01
	Amaranthus spinosus	*Kanta leutia*		2	6	0.333	2.56	33.3	4.1	1.00	0.03	6.67
	Andrographis paniculata	*Bhuin neem*		1	6	0.333	2.56	16.7	2.0	2.00	0.03	4.63
	Elephantopus scaber	*Mayurchulia*		3	6	0.500	3.85	50.0	6.1	1.00	0.04	10.01
	Barleria prionitis	*Daskerenda*		2	6	0.333	2.56	33.3	4.1	1.00	0.03	6.67
	Scoparia dulcis	*Badi justimadhu*		2	6	0.333	2.56	33.3	4.1	1.00	0.03	6.67
	Tridax procumbens	*Bisalyakarani*		4	6	0.833	6.41	66.7	8.2	1.25	0.06	14.64
	Sida cordifolia	*Bajramuli*		2	6	0.333	2.56	33.3	4.1	1.00	0.03	6.67
	Phyllanthus amarus	*Bhuin amla*		2	6	0.333	2.56	33.3	4.1	1.00	0.03	6.67
	Evolvulus alsinoides	*Jyotismati*		2	6	0.333	2.56	33.3	4.1	1.00	0.03	6.67
	Croton sparsiflorus	*Ban Tulasi*		2	6	0.333	2.56	33.3	4.1	1.00	0.03	6.67
	Ipomoea fistulosa	*Morning Glory*		3	6	0.500	3.85	50.0	6.1	1.00	0.04	10.01
	Centella asiatica	*Thankuni*		2	6	0.333	2.56	33.3	4.1	1.00	0.03	6.67
	Ocimum tenuiflorum	*Tulsi*		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 3.22.

Table 3-22 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
Relative	Maximum RF found to be	Vegetation community is
Relative Abundance	Maximum value observed in case of *Madhuca indica* is about	*Madhuca indica* is the most common species found in
Importance Value Index (IVI	The maximum IVI value observed in case of *Madhuca*	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 3.23.

Table 3-23 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.

3.16.7 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 3-24 List of Fauna observed in the study area

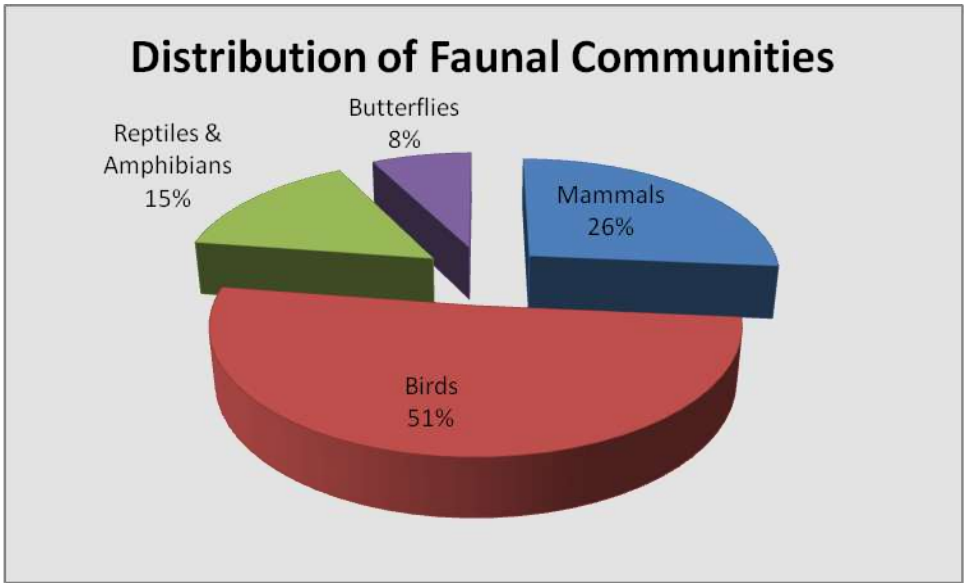
Sl.No.	Scientific name	English Name	Schedule of Wildlife Protection Act	IUCN Conservation Status	Method
Mammals					
1	*Muntiacus muntjak*	Barking deer	III	Least Concern	DS

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
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	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	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	IV	Least Concern	DS
25	Streptopelia chinensis	Spotted dove	IV	Not assessed	DS

26	Picus squamatus	Scaly-bellied	IV	Least Concern	DS
27	Pycnonotus cafer	Red Vented Bulbul	IV	Least Concern	DS
		Reptiles & Amphibians			
1	Calotes versicolor	Common Garden	II	Not assessed	DS
2	Bungarus caeruleus	Common Krait	IV	Not assessed	NS
3	Ptyas mucosus	Dhaman	II	Not assessed	DS
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	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

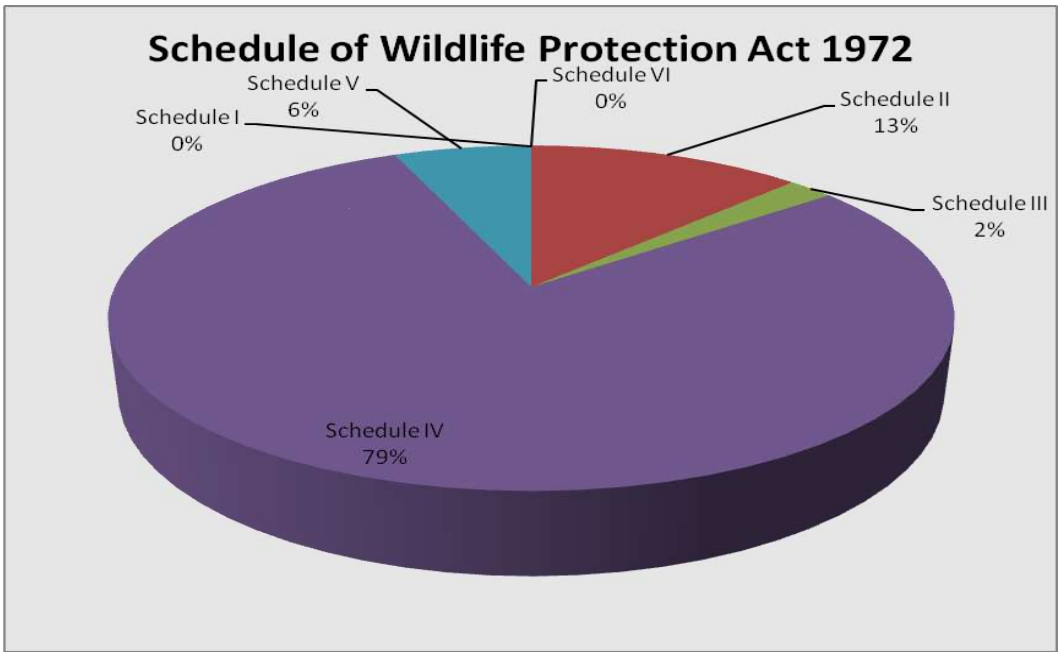
poultry farms are mostly common in this area; however, some commercial poultry farms are also recorded in the study area.

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	o.of specie	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.



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

Table 3-25 Description of Flora & Fauna

Sl	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.
	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.

3.16.8 **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 ontributes 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*

3.15.2 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.

3.16.9 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

3.16.10 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.

3.16.11 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.

3.16.12 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.

3.16.13 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)

3.16.13.1.1.1 **Table 3.29 - Distribution of population in the study area**

s.no	Villages	Area in hectares	Household	Population			Population(Age 0-6 years)				
				TP		F	TP	M			
1	Tarekela	21	160	682	346	336	71	4		136	223
2	Thelkoloi	89	1039	3684	2030	1654	567	303	264	652	700
3	Hirma	1033	1033	4369	2237	2132	510	265	245	1081	1799
4	Patrapali	46	375	1539	783	756	172	8		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	30	310	1097	633	464	156	7		173	373
9	Marakuta	73	511	2214	1095	1119	248	114	134	713	874
10	Brajarajnagar	4144	17631	80403	41836	38567	9344	4894	4450	15083	8731
11	Malda	73	291	1181	603	578	102	5		160	491
12	Badimal	49	254	1037	517	520	112	5		183	372
13	Talabira	70	585	2150	1067	1083	259	125	134	294	595
14	Sardhapali	10	138	460	222	238	59	2			325
15	Bhurkamunda	65	364	1213	661	552	152	7		458	323
16	Kherual	35	144	622	359	263	62	3			
17	Kukurjangha	43	310	1329	679	650	195	9		256	329
18	Rampur	43	267	1162	571	591	116	5		336	337
19	Dhubenchhaper	28	272	1028	539	489	128	6		304	383
20	Batlaga	47	109	443	230	213	71	3		182	175
21	Gumakarama	420	357	1437	739	698	161	80		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

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

Table 3-26 Summary of Demographic Structure in the Study Area

Sr.No	Demographic Parameters	Villages Details 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%)

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.

The SIA study has been conducted by by DCOR Consulting Private Limited applying cross-sectional study design and the overall design and framework of the study was guided by the RFCTLARR act and was developed and executed under the technical guidance of the SIA unit. The study team comprising of the following personnel having prior experience of undertaking socio-economic and resettlement & rehabilitation studies were engaged for the data collection.

i) Satyanarayan Mohanty- Team Leader

ii) Sibabrata Behera - Survey Co-ordination

iii) Pranay Das – Report preparation

iv) Gopal Krushna Bhoi, Sukanta Swain, Sarat Dash, Tapas Kandi, Hemanta Pradhan, Suryamani Pradhan, Pabitra, Kanaka Manjari Rout-Field Supervision and Data Collection

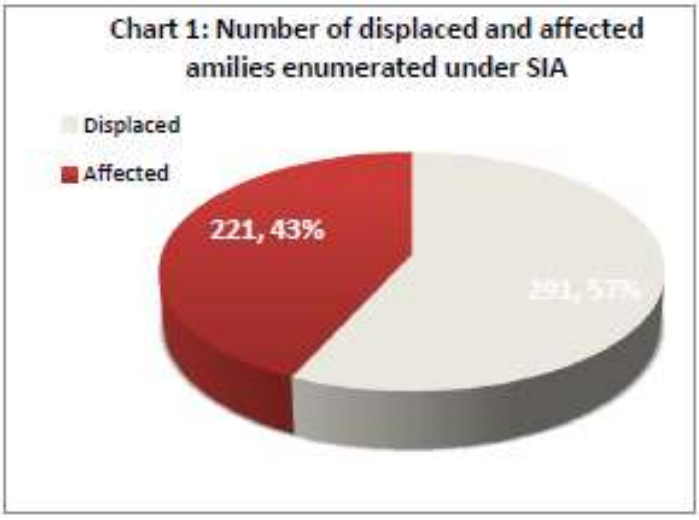
v) Sibabrata Behera and Anup Samanta- Data Analyst

The study site for SIA included the village Tumbekela,Tareikela, Hirma,Kumbhari and Luhurenkachhar of Jharsuguda Tahasil in Jharsuguda district where 753.13 acres of private land will be acquired for the proposed project.

The SIA study enumerated a total of 512 families from the list given for survey of which 291 will be displaced as their residential areas is going to be acquired and 221 families will be affected as their land is going to be acquired for setting up of the proposed industry in the five villages. The expected displaced people were residing in village Tareikela,Kumbhari and Gariadihi Kisan Pada (a hamlet of Hirma village) and the expected affected people were from village Tumbekela,Tireikela, Kumbhari and Hirma.

Name of the Village	No of families enumerated	No of displaced families	Percentile	No of affected families	Percentile
Hirma	124	39	31.5%	85	68.5%
Kumbhari	163	123	75.5%	40	24.5%
Tareikela	136	129	94.9%	7	5.1%
Tumbekela	89	0	0.0%	89	100.0%
Total	512	291	62.0%	221	38.0%

Figure 3-17 Village wise number of Displaced and affected families enumerated under SIA



Source: Social Impact Assessment by DCOR Consulting Private Limited

Project benefits

Firstly, Establishment of industries and allied activities will provide direct and indirect employment opportunities to the local population in general and project affected persons in particulars. It will be an engine for employment, wealth and technical skill. It will lead to improved standards of the entire society as a whole and improve the economic conditions.

Secondly, it will help the local people to earn their livelihood/supplement to their income by setting up of shops/selling food and other items near the industrial sites.

Thirdly, infrastructure on health, education, communication etc. will be developed in and around the area and the locals will avail the benefit of these. It leads to prosperity and cause the availability of better and more foods, clothing and gives longer life expectancy.

Fourthly, small and ancillary industries will be set up to cater the need of major industries. The local people will get direct and indirect employment opportunities there also.

Fifthly, Electricity is a basic human need and essential requirement for all facets of our life. Power development is one of the key infrastructure elements for the socio-economic growth of the country. The entire Indian Economy hinges on the availability of reliable and quality power at competitive rates to rural India for its overall growth and to Indian Industry to make it globally competitive. The power sector is in a crucial juncture today. With the implementation of large capacity addition through solar projects, the sector has started showing signs of shift from “regulated & protected” to a market driven environment of business. In addition, the thermal power stations are having the responsibility to comply with more stringent environment norms for sustainable development.

Lastly, the proposed project NLC Talabira Thermal Power Plant (3x800 MW) is to be implemented by NLCIL to supply power to Southern States of Tamil Nadu, Kerala and Puducherry and the home state Odisha. The home state is willing to avail 400 MW power from this project.

Public views and opinion

Relocation of all interested displaced families to a suitable place or resettlement colony nearer to the proposed project with road connectivity. The people preferred to stay nearby place to the proposed project and did not want to go faraway place.

Some of the villagers from Kumbhari and Gariadihi Kisan Pada opined that they want a residential colony nearer to their present village. When asked about the preferred location and why, they cited a vacant land in front of SMC Power to be converted into the resettlement colony for them. They told that

as many of the villagers are working in SMC Power and in other nearby industries/plants and their Panchayat is Hirma where they would collect their PDS ration and other facilities like Old Age Pension, Widow Pension etc. they preferred to stay there. Some of the respondents from Tareikela expressed their views on choice of a patch of land in Badmal village (vacant government land located behind Badmal PS) which would be their suitable place for stay.

There should be health care facility and educational institutions for dependents, community centre (Kalyan Mandap) , temples, market complex, electricity and drinking water supply and pond in the vicinity of the colony.

There should be Anganwadi centres, youth club, Kirtan Mandap (Bhajan Mandali) and play ground in the Resettlement Colonies.

People from Tareikela wanted to shift Goddess Samaleswari Temple and Radha Krishna Temple (now they are worshipping) in their Resettlement Colony where as people from Kumbhari wanted to shift their Lord Shiv and Hanuman temple (now worshipping) to the Resettlement Colony.

Availability of Suitable job and employment opportunities in the proposed project to the head of the household/ children/dependents of displaced and affected families.

Formation of a society and involving the dependents of displaced and affected families in various developments work in the proposed project so that they will earn their livelihood. This initiative will benefit the unemployment people from the displaced and affected families who have crossed age limit for job.

Project proponent recommended commitment based on SIA findings

The following recommendations may be considered by the project proponent for social impact management or mitigation.

1) Majority of the people of the proposed project area wanted to vacate their homes provided that they would get suitable monetary compensation for their land, houses and immovable assets. According to them the cost of land is highest in the area. So they should be compensated accordingly.

2) People of Kumbhari and Tareikela own land nearby to/on the bank of the river Bheden in and around their village. The proposed project maps shows exclusion of those patch of land. But the people raised their demand for acquisition of those patch of land as they will face problem in cultivation after their relocation. So the company should acquire that patch of land for tree plantation or any other purpose.

3) Fisherman community from Kumbhari camp locally called as "Majha"/Keuta are earning their livelihood by fishing in Bheden River. So after their displacement, priority should be given to restore their livelihood by other means.

4) Vocational or skill training of the displaced and affected family members who have educational qualification of more than 8th standard.

5) Engage the vocationally trained family members in the project or other ancillary units for earning income. More focus may be given to engage the BPL (Below Poverty Line) families.

6) People from the displaced and affected families should have accessibility for free diagnostic and treatment in modern health care facilities preferably in the company hospital.

7) Children/dependents of the displaced and affected families should be given free education in the company managed school. People assumed that the company would establish best school for children of their employees where their children should get admission and free education.

8) Relocation of Adivasi Kanyashram School of of Kumbhari to the Resettlement colony.

9) Provide training and market linkage support to the women family members through Self Help Groups (SHGs) functioning in the resettlement colony and affected area.

10) Provide revolving fund support to the women SHGs or link them with the formal financial institutions for availing loan to start individual or group income generating activities.

11) Facilitate or provide agriculture extension services to the people of affected villages for adoption of improved agriculture practices, which would increase the productivity and income from agriculture.It will help agriculture carried out by the affected families more remunerative.

12) Special tree plantation drive should be undertaken in and around the project area. There are large industries like Bhusan Steel & Power, Vedanta Alumina and SMC Power & Steel in nearby areas. People of the proposed project area (both displaced and affected) opined that they were suffering from pollution. The project should take care of the environment so that people of the periphery villages would not suffer from pollution. People of the area are suffering from pollution. So the project authority should take all necessary measures to minimize all forms of pollution i.e. water, air, land etc.

13) The beneficiaries of Old Age and Widow Pension as well as people availing rations under PDS (Public Distribution System) will face problem in getting it after their shift to resettlement colonies. The panchayat office is located in Hirma village. So the authority should address the issue and facilitate the process of availing Social Security Pension and rations to the displaced people.

14) Effort may be made to link the left out widows and aged persons with various social security schemes like old age pension scheme, widow pension scheme, ration through PDS, etc.

15) Provide resettlement benefits to the people who staying in the displaced villages that do not owned land.

16) The majority of the displaced and affected families opted for cash assistance (apart from the cash compensation they will receive for acquisition of land).

17) Regular health checkup may be conducted in the affected villages to improve maternal and child health & nutrition status, on construction of toilets and stopping open defecation. Mobile health clinic should be rolled out for treatment of the needy in the affected villages.

18) People were observed very sentimental when talked about their displacement. They are staying since generations and are emotionally attached to the land and community. They anticipated that they may not stay like the present set up and would miss their kith and keen. So the project authorities should take care of the choice of the people regarding their resettlement.

19) Saplings or seedlings for fruit or non-fruit bearing trees may be provided to the affected families for plantation to compensate the loss of trees owned by the families in the displaced villages. Community plantation drive may be initiated in the affected villages.

20) Last but not the least, people were not against development or set up of industries. If genuine demands of the people are fulfilled, then they would vacate their villages and allow the proposed project authorities to start their construction/activities there.

Concluding remarks

To conclude, the SIA study revealed heavy loss of land and income will happen due to the acquisition of land under the project. The adverse effects of the project may be overcome by restoration of livelihood, providing employment opportunities, skill building and vocational training like ITI, Diploma, Computer, Driving, Tailoring etc. for engagement of the displaced and affected family members in the project or various project ancillary units for income and also by promoting income generation skill among the women mass through SHGs like Tailoring, Khali Stitching, Mushroom cultivation etc. with a market linkage support and by taking up community awareness generation on health & nutrition and plantation drive.

3.16.14 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

3.16.14.1.1.1 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

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 Aluminiinium 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	Brajrai -Nagar			Community Health		
NNW						

Table 3-27– Available Infrastructure

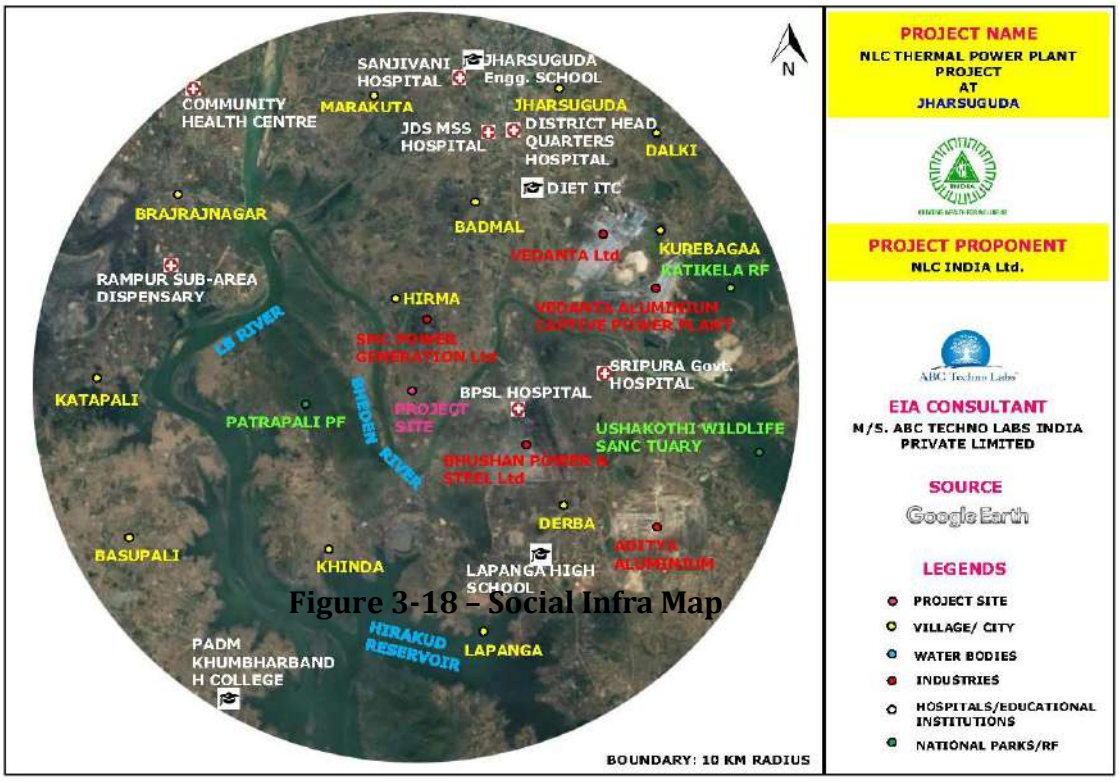


Figure 3-18 – Social Infra Map

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 & OCCUPATIONAL HEALTH & SAFETY		EMPLOYMENT	
CONSTRUCTIO											
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		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		
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	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					
											NLCIL MANAGEMENT

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

4.4 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.

4.4.1 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.

4.4.2 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 4-3Typical 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.

4.4.3 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.

4.4.4 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

4.4.4.1 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.

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

4.4.6 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.
- 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.

4.4.6.1 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.

4.4.7 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.

4.4.8 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.

4.4.9 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.

4.4.10 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.

4.4.11 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.

4.4.12 **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.	
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.	---
Soil	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.	---

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 Movement of traffic.	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
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.	---
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.	---

4.5 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.

4.5.1 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. SO_2 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

4.5.2 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;

4.5.3 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

4.5.4 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/s	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)	35
14	Gypsum Ash generated from FGD (TPA)	0.3

- 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,	Predicted Incremental Increase GLC	Resultant Maximum Concentration	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 4-9 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.

4.5.5 TERRAIN OF THE STUDY AREA

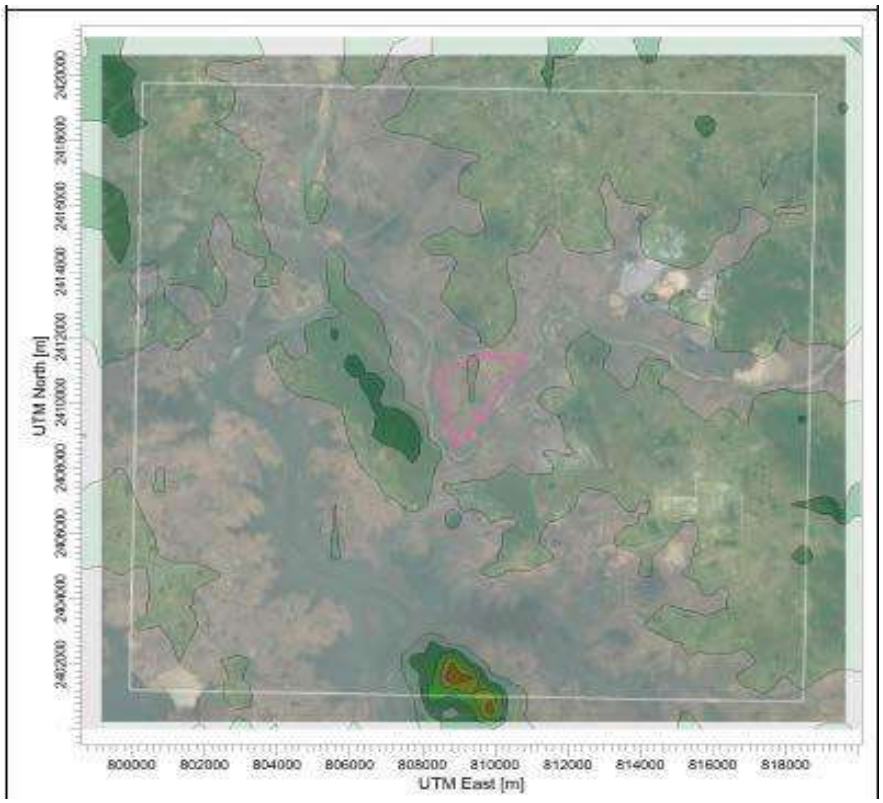


Figure 4-1 : Terrain of the study area

4.5.6 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.

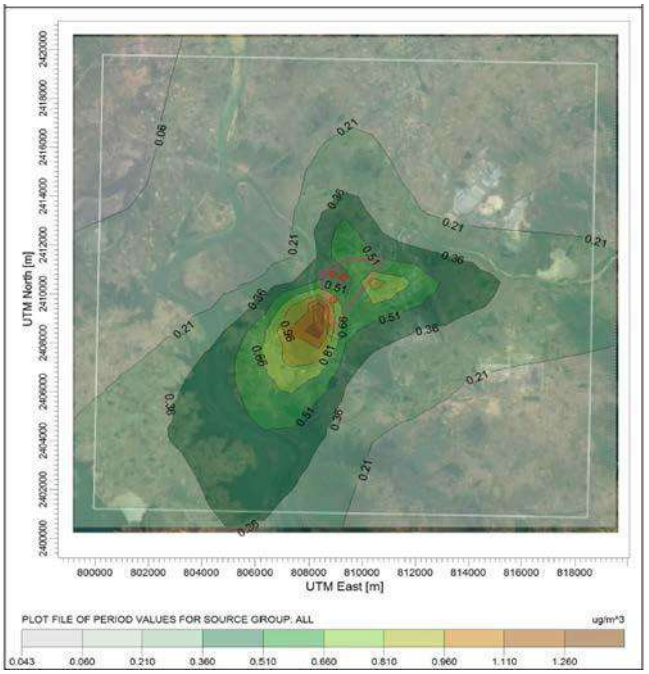


Figure 4-2 Maximum Ground Level Concentration for 24 - hours – PM (Scenario 1)

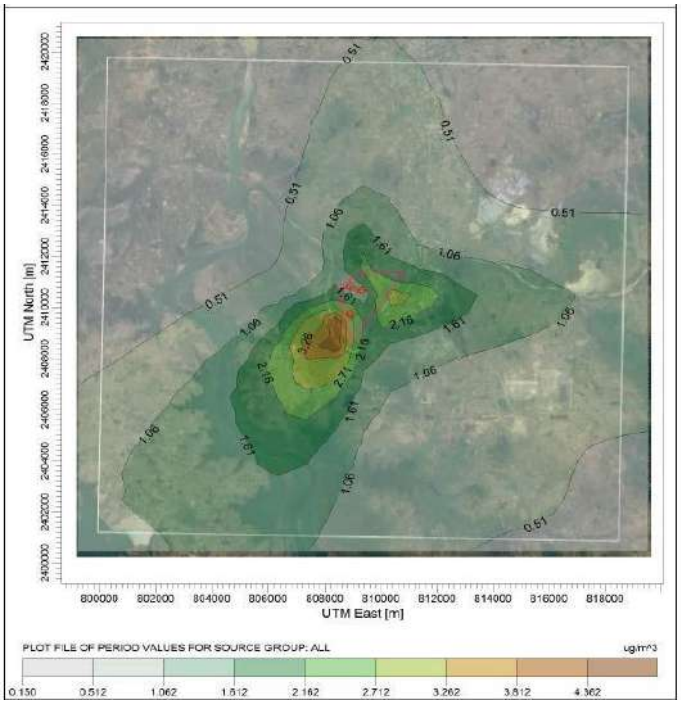


Figure 4-3 Maximum Ground Level Concentration - 24 hour - SO_2 (Scenario 1)

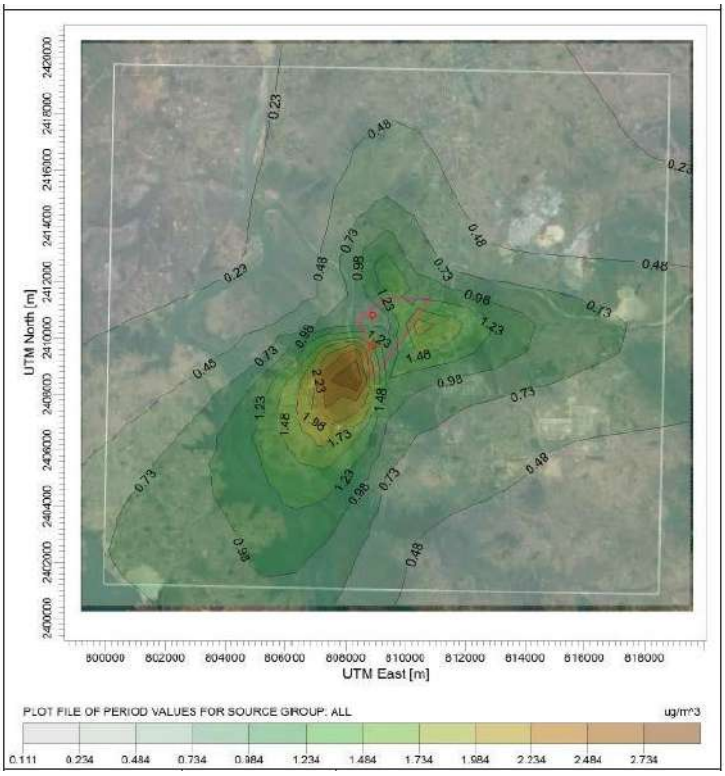


Figure 4-4 : Maximum Ground Level Concentration - 24 hour - NO_2 (Scenario 1)

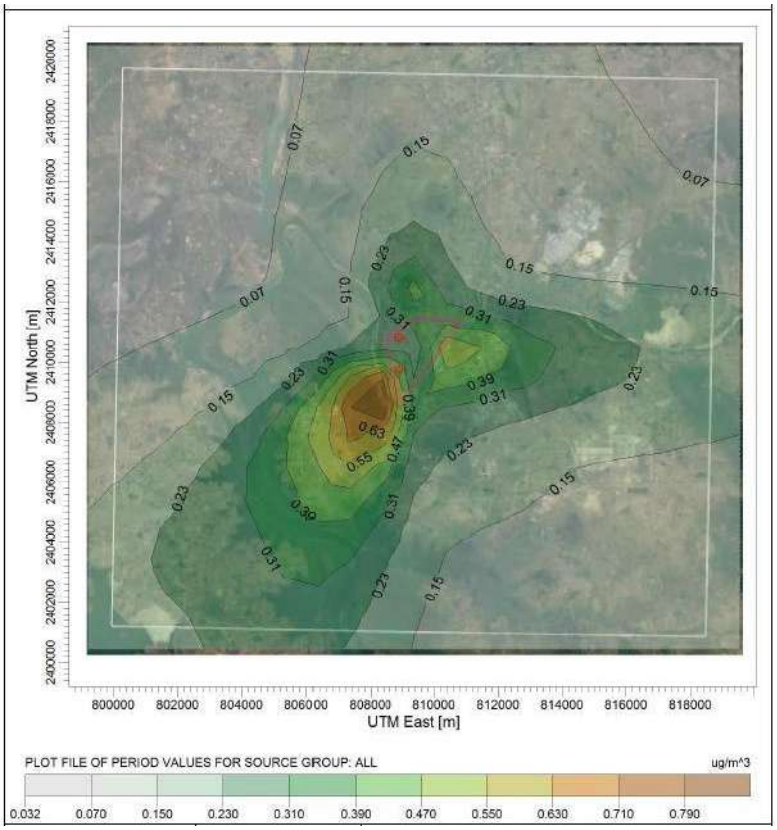


Figure 4-5 Maximum Ground Level Concentration for 24 - hours – PM (Scenario 2)

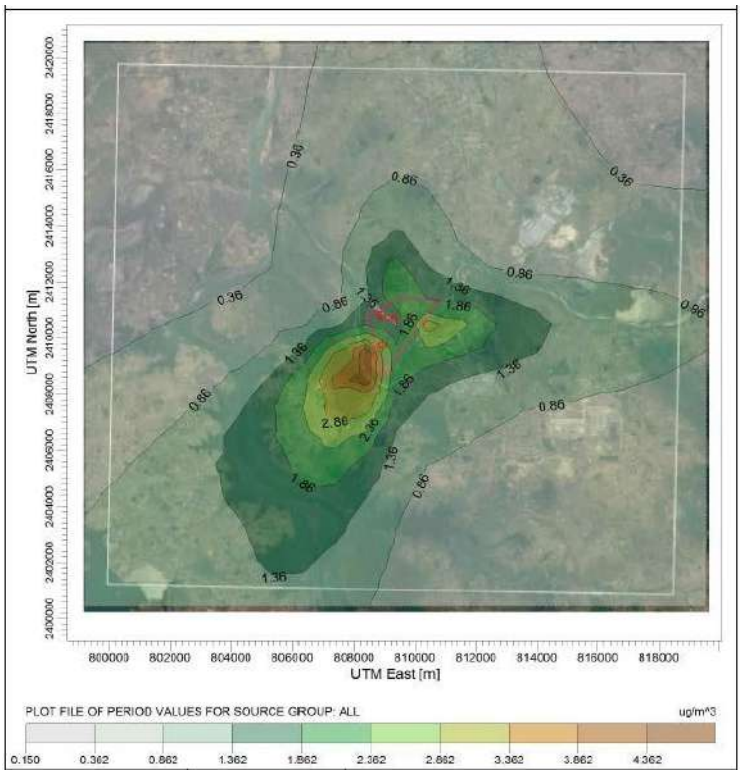


Figure 4-6 Maximum Ground Level Concentration - 24 hour - SO_2 (Scenario 2)

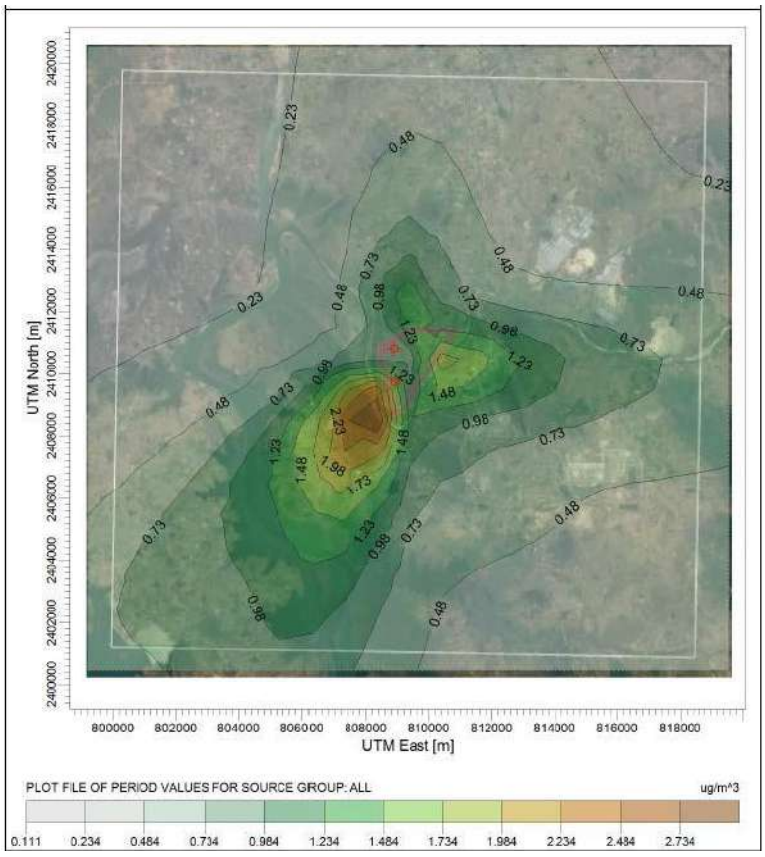


Figure 4-7 Maximum Ground Level Concentration - 24 hour - NO_2 (Scenario 2)

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 µg/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 considering the surrounding industries such us power plant, Bhusen steel plant and mining activity 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 below.

Table 4-10 : Resultant concentrations after implementation of proposed project along with the exisiting industries in the vicinity (Cumultive impact)

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	1.8613	81.4613	100
2.	Sulphur Dioxid - (SO2)	11.70	8.4058	20.1058	80
3.	Nitrogen Dioxid - (NO2)	24.90	8.1125	33.0125	80

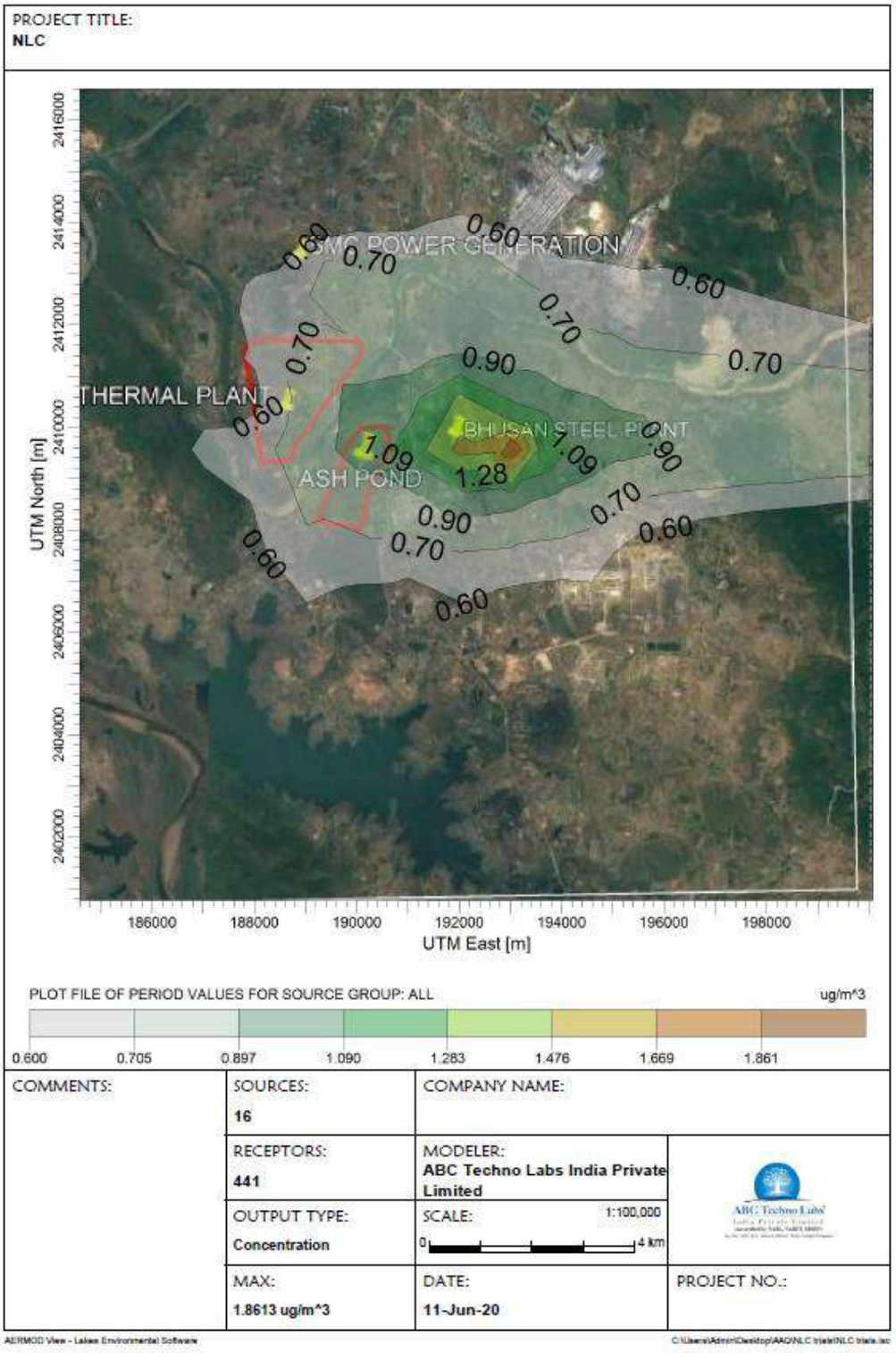


Figure 4-8 Maximum Ground Level Concentration - PM (Cumulative)

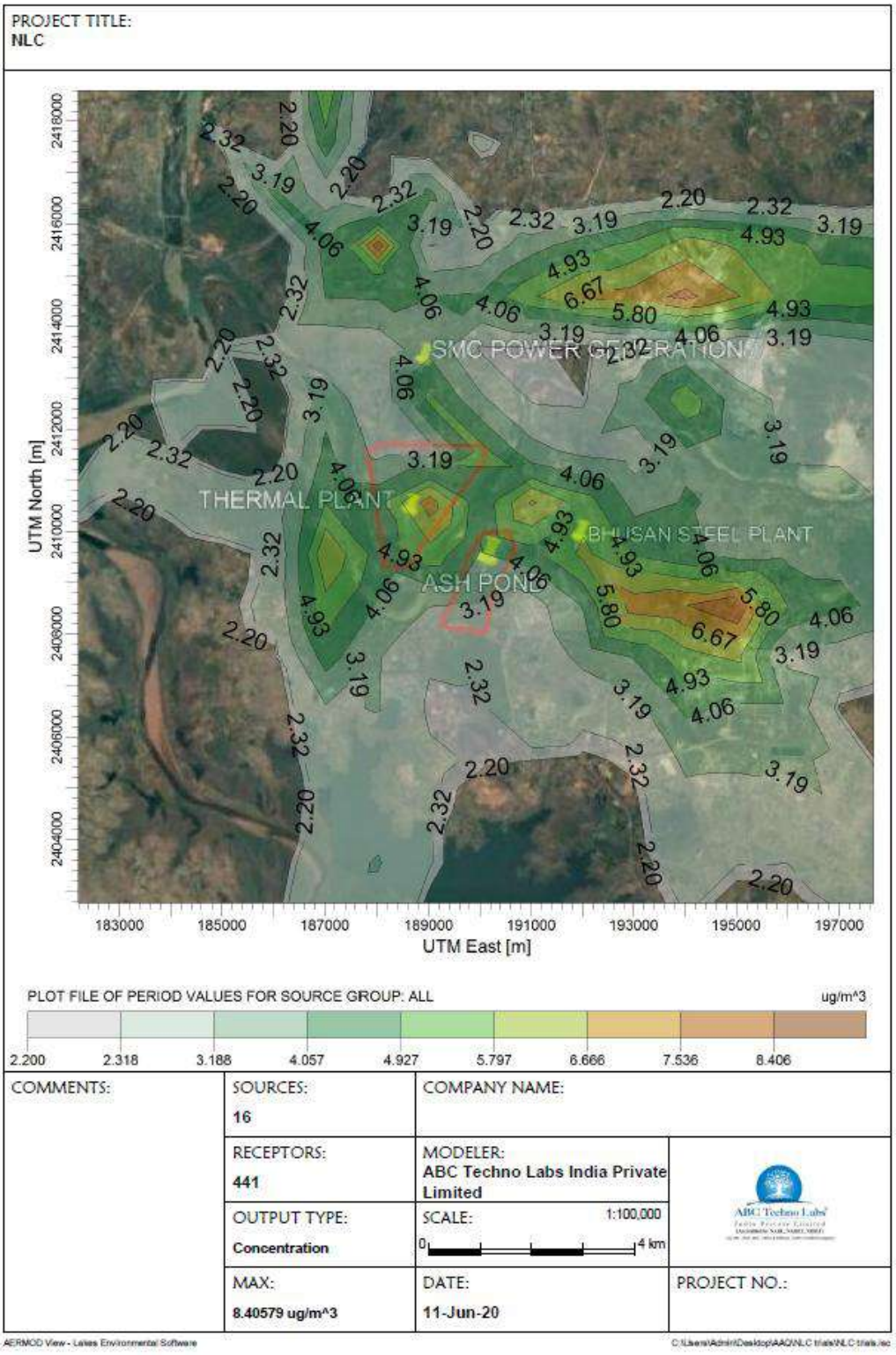


Figure 4-9 ***Maximum Ground Level Concentration - SO2 (cumulative)***

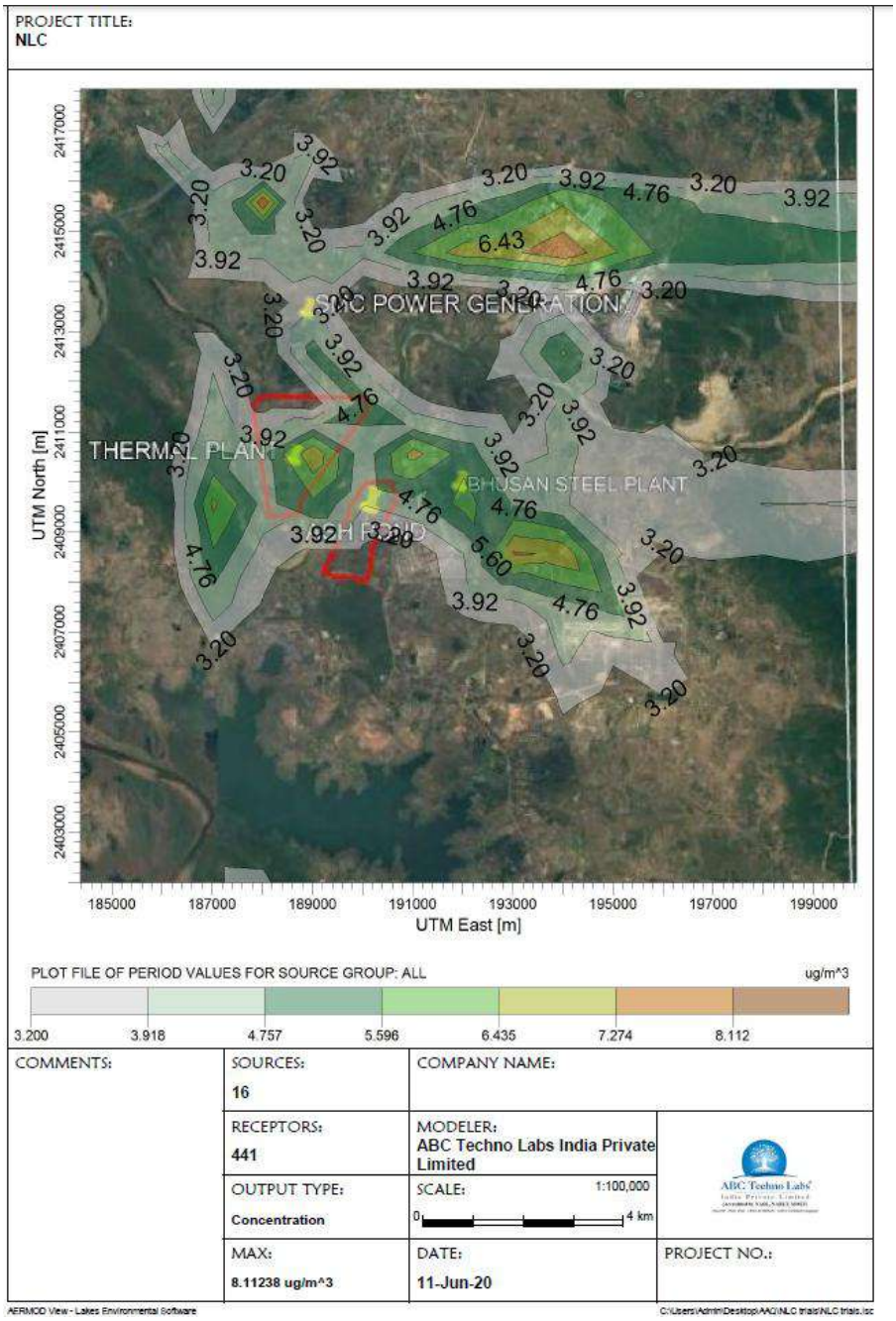


Figure 4-10 Maximum Ground Level Concentration - NO2 (cumulative)

4.6 Discussion

The maximum monitored background ambient air quality values were reported to be 11.70, 24.90 and 79.60 µg/m³ for SO2, NOx and PM, respectively. The cumulative maximum worst case incremental GLCs of the study area were recorded to be 8.40 µg/m³ for SO2, 8.11 µg/m³ for NOx and 1.86 µg/m³ for PM.. The predicted maximum worst case background concentrations are expected to be 20.10 µg/m³ for SO2, 33.01 µg/m³ for NOx and 81.46 µg/m³ for PM within 10 km radius of the study area. Air pollution dispersion modeling was carried out for prediction of incremental GLCs for SO2, NOx and PM for 10 km

radius. The results for pollutant concentrations are predicted at all AAQMS. Result indicated that predicted back ground concentrations at all AAQSM for SO2, NOx and PM are well within the stipulated standards. Hence, ambient air quality at all AAQMS will remain within the stipulated 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.

4.6.1 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/Nm^3 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-NOx 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.

4.7 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 m3/hr as per the attached composite. Most of the wastewater generated will be recycled and reused. The effluent recycling / reuse system will be designed for maximum reuse of all the plant effluents.

4.7.1 Mitigation Measures

1. 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.
2. 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)

I. 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.

II. 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.

III. 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.

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

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

VI. 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.

VII. 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.

VIII. 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.

IX. 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).

X. 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.

XI. For maintaining the feed water purity condensate polishing plant will be provided in

XII. 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

4.8 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:

4.8.1 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.

4.9 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.

During normal operations of the plant, ambient noise levels will increase only close to the turbines but this will be confined to within few hundred metres of the sources. Since the turbine shall be housed, the noise will confine to within the wall and will not have significant impact outside boundary limit. Noise levels will increase greatly during bleeding-off of excess steam. But such incidents are rare and will last only for few minutes using CUSTIC 3.2 computer model have been drawn to assess the noise levels at the plant boundary considering major noise sources of the proposed new units of the plant and other industries in the vicinity of the plant

From the below figure it can be noted that the noise level at the plant boundary is below 10 dB(A) which will then gradually decreases. Predicted noise level within the power project boundary will be well within the National Ambient Air Quality Standard in respect of noise for industrial area.

Figure 4-11 Maximum Noise Levels -(cumulative)

Mitigation Measures:

Workplace noise is also generated. The exact noise level generation from working place will be identified only after commissioning of the plant. The operational noise levels of the plant will be measured once the operation of the plant starts.

The steam turbine generators will be housed in closed buildings, which will considerably reduce the transmission of noise from the steam turbine generators to the outside environment. The inlet air and exhaust gas streams will be provided with silencers for noise reduction. Generally there will not be any operators near the steam turbine generator on a continuous basis. However, maintenance personnel working within the steam turbine generator building will be provided with adequate protection against noise. The steam turbine generator will also be housed in a closed building thereby reducing the transmission of noise to outside environment.

All the equipment in the power plant are designed / operated to have the noise level not exceeding 85 - 90 dB(A) measured at a distance of 1.0 m from the equipment. Also, all the measures will be taken to limit the noise levels at the plant boundary within stipulated limits.

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.

4.10 Ecology

Impacts:

The impacts associated with the proposed project are listed below:

4.10.1 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 (Parthenium hysterophorus, Argemone mexicana, 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.

4.11 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.

4.11.1 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:

- Blockage and damage to stomata
- Reduction in chlorophyll content
- 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.

4.11.2 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.

4.12 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.

4.12.1 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.

4.12.2 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)

4.13 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 laborers 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 behavior 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.

4.14 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. The plant area is 602 acres and reservoir is 88 Acres. As per CEA norms, one third of plant area needs to be earmarked for green belt, which works out to 230 acres for NTTPP, where as 252 acres of green belt is envisaged. 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. 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.

4.15 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 standardspacing 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 4-11 : 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.

4.16 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.

4.17 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.

4.18 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.

4.19 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.

4.20 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.

4.21 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.

4.22 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.

4.23 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.

4.23.1 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.

4.23.2 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

OTHER IMPACTS

Power supply situation of the surrounding area will improve, as proposed power project will add up to 3X 800 MW electricity. This will drastically improve the power situation of not only the surrounding area but to other dist. also. The industries will get regular and better availability of power for their production. Other services and industries will also improve their outcome.

4.24 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.

4.24.1 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.

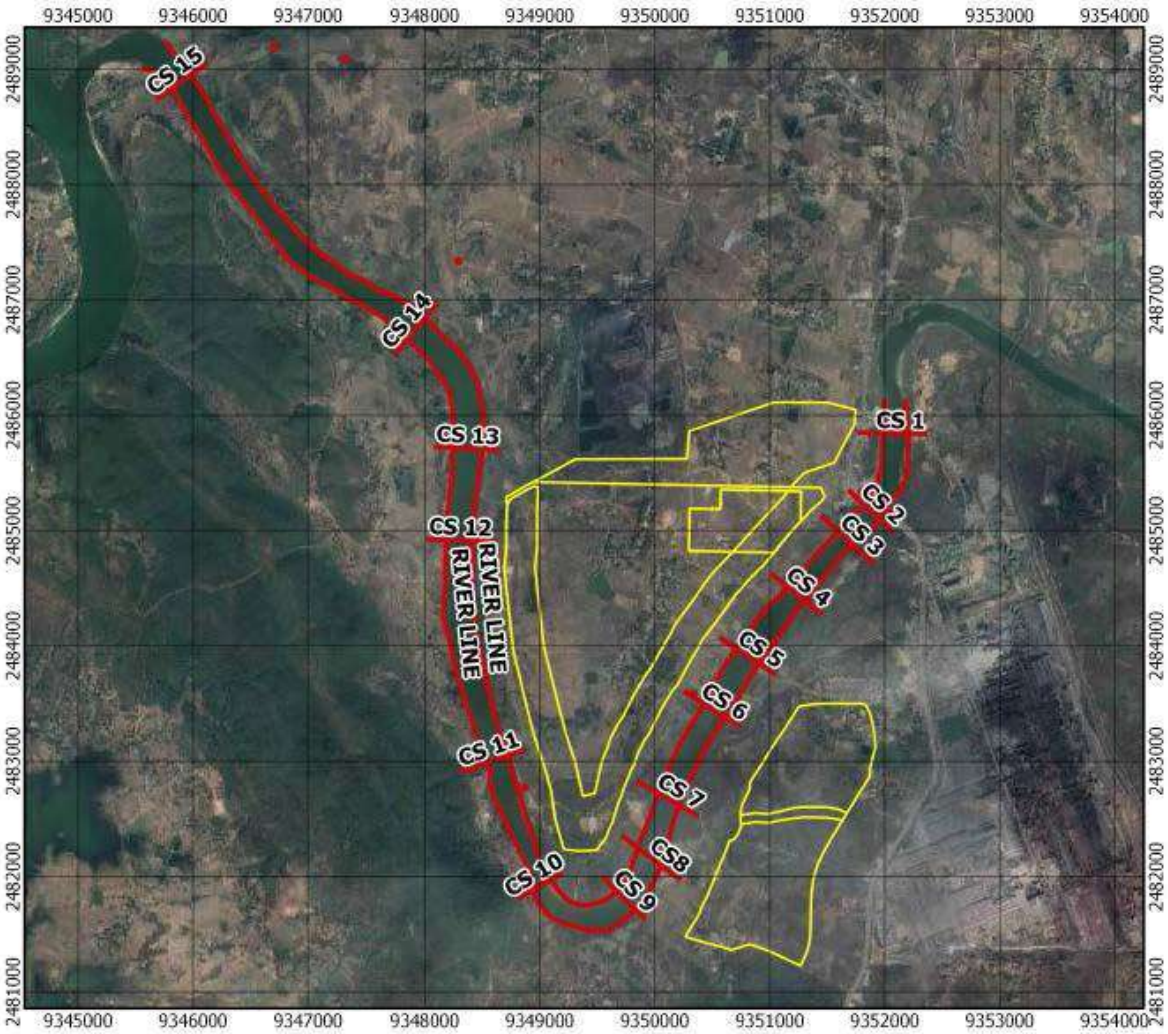


Figure 4-12 Location of river cross section

4.24.2 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. Two natural stream/nallah (D1 and D2) are observed in and around the ash pond area flowing from east to west and joins Bhedan River. However, at present after construction of Bhushan plant both the drains D1 and D2 carries discharge from the of Bhushan plant area as shown in below Figure 4.9.

Figure 4-13 : Existing topographic features and drainage network

It seems the drain D1 carries discharge from coal handling unit of Bhushan plant. However, this drain D1 is in the north of proposed ash pond area of NLCIL and it will not interfere with the ash pond area of NLCIL. It seems the drain D2 carries discharge from the Bhushan plant area including discharge from iron ore washing plant. Moreover, this drain D2 passes through the proposed ash pond area of NLCIL and joins to Bhedan river.

Alternative 1

The first alternative is to leave the alignment of drain D2 as it is, dividing the ash pond area in two portions as shown in Figure 4.10. The area north of drain may be used for fly ash pond and the area south of drain may be used for bottom ash pond. Under this scheme the will very little modification in the present alignment of the drain D2. The drain D2 may be straightened and strengthened with capacity in the area between the fly ash pond and bottom ash pond.

Disadvantages:

If the out let of drain to Bhedan river is not properly regulated there will be chances of back water flow in

to the drain during high floods when water level in Bhedan river rises up to RL 201.2 m. Further as discussed earlier this 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. Keeping these in view other alternative to modify the drain alignment is discussed in next section.

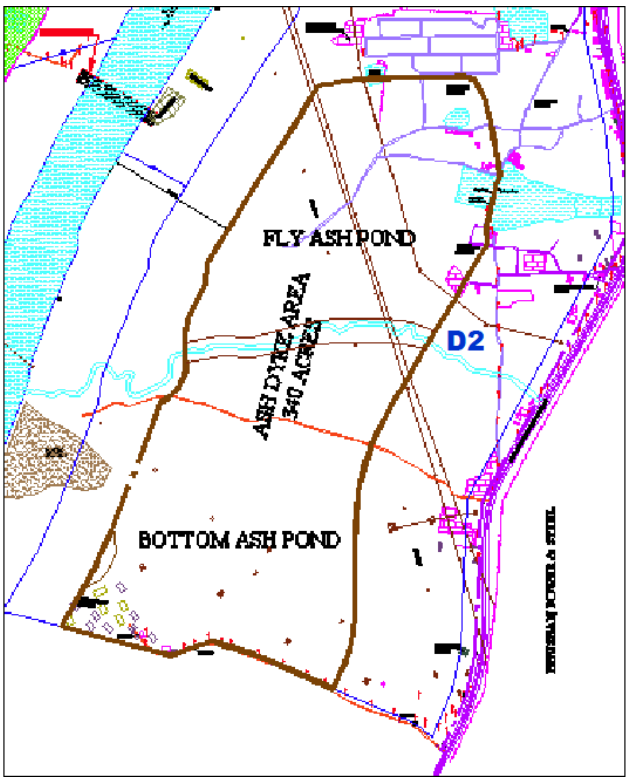


Figure 4-14Layout of drain D2 for Alternative 1

Alternative 2

The existing and proposed alignment for drain D2 is shown in Figure. The existing alignment Figure 4.11.1 as A-B-C-D. As alternative 2 it is proposed to divert the drain from point B to E along the boundary of ash pond area. The total length from B to E will be about 2.73 km. The present ground elevation and profile along the alignment B-E is shown in Figure 4.11.2. It is to be noted that in two stretches the drain cutting would be in the range of about 8 m for maintaing bed slope of drain as shown in Figure 4.12. The 3d surface plot of ash pond area is also shown in Figure 4.13, where the two relatively high ground are clearly visible.

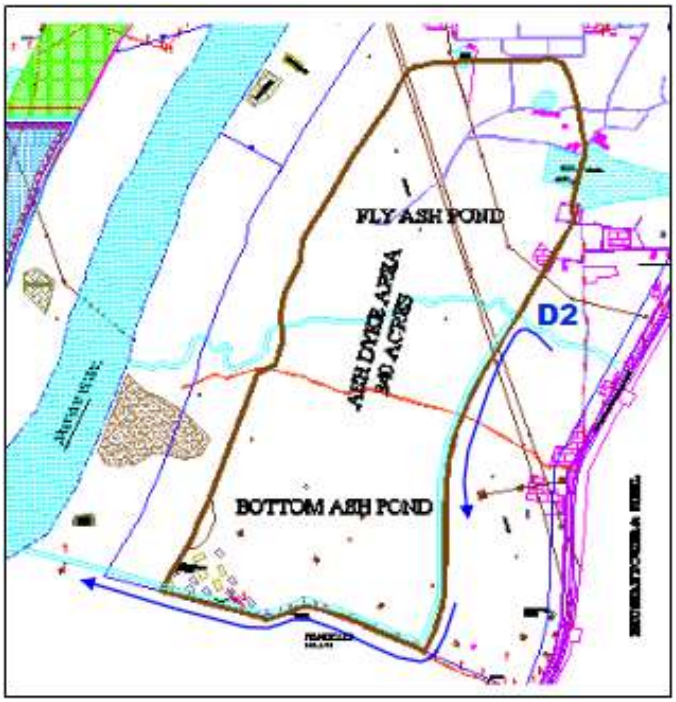


Figure 4-15 Satellite image showing Drain 2 for alternative 2

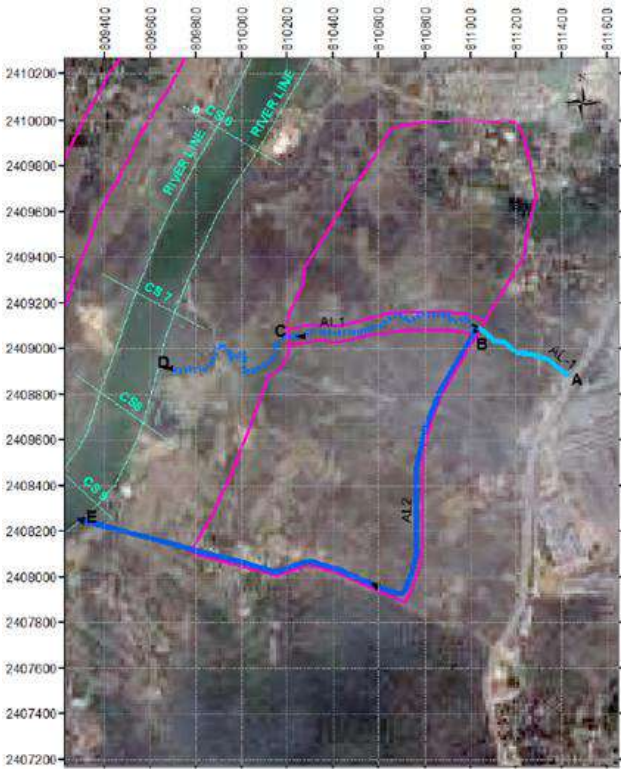


Figure 4-16 Layout of Drain D2 for Alternative 2

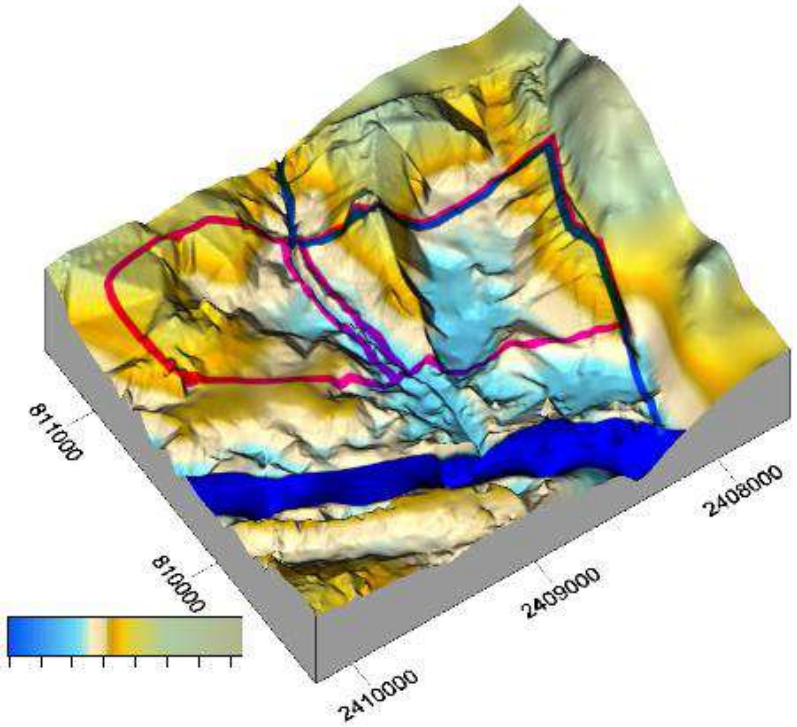


Figure 4-17 : 3D Surface map of Ash Pond Area

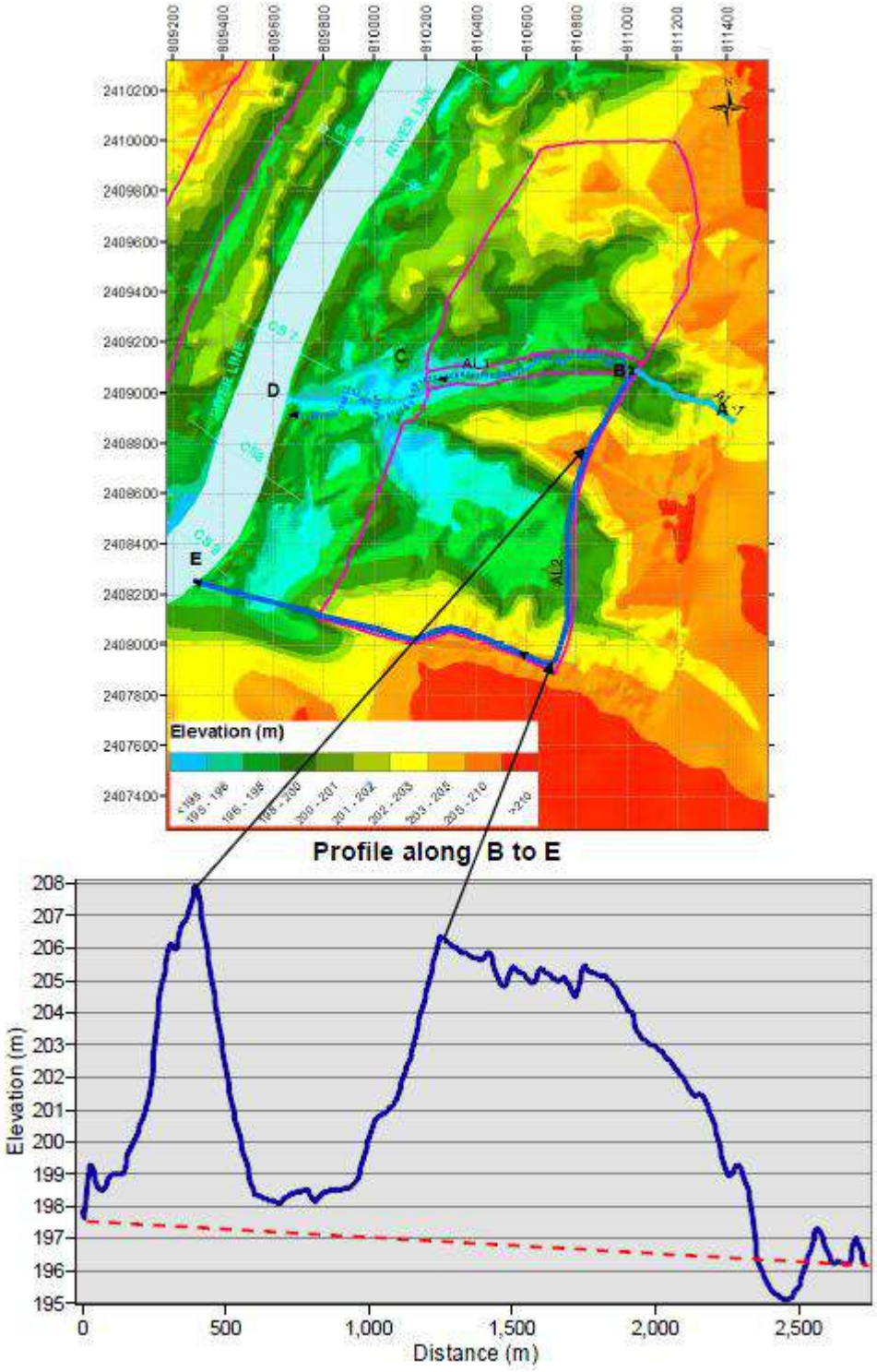
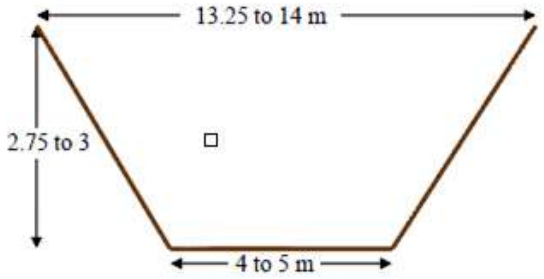


Figure 4-18 : DEM & ELEVATION PROFILE ALONG ALIGNMENT 2

Design of Drain D2

The catchment area contributing runoff to the drain D2 is about 6 km2. The catchment area is mainly industrial with some agricultural/ grass land etc. Hence, weighted runoff coefficient of 0.7 is adopted. The 1 hour rainfall intensity of 50 year and 100 year are 48 mm/h and 53 mm/h respectively. The estimated peak runoff for 50 year and 100 year are 55.5 m3/s and 61.3 m3/s. The cross-section of the drains are designed according the Indian

Standard, IS 10430:2000 (BIS, 2006). Trapezoidal section with side 1.5:1 (H:V) and longitudinal slope of 0.0015 m/m (1.5 m/km) is designed (Figure 5.31). The drain sections are designed for velocity less than 2 m/s and Manning's roughness coefficient (n) values of 0.025. The Free board recommended in the standard are: 0.75 m for discharge greater than 10 m3/s and 0.6 m for discharge less than 10 m3/s. However, the dimension and section many be altered as per land availability and site requirement maintaining the estimated peak discharge 55.5 m3/s and 61.3 m3/s for 50 year and 100 year return periods. As an alternative lined rectangular drain sections are also designed with Manning's roughness coefficient (n) values of 0.013 as shown in Figure 4.14.



Cross-section of drain D2

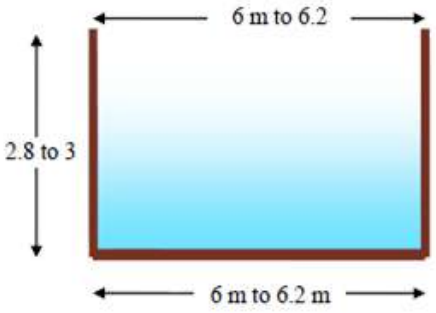


Figure 4-19 **Rectangular lined C.S of Drain D2**

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	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 absorber. • Roadside tree plantation will be restored and maintained.	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 be developed which acts as noise absorber.	Green belt will also be developed all along the boundary wall for attenuating the noise
Water Quality	Deteriorat io n of Quality of receiving water body, if any	Sewage dischar ge 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 counting existing road	Additional vehicle movem ent	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.

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 constructed to collect the excess runoff within the compound. • Water efficient fixtures and devices can be used.	Conducting water audit to increase the water conservation measures
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 life of 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
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.	

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 5.1below:

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 District
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 with the help of tube wells within the project site.	1500 acres was 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 of the identified land has been acquired by the industries for development of colonies and many private dwelling units have also come up there.	1200 acres near Kumbhari village for plant area and 500 acres near Thelkolai village (For Ash disposal)
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 disposal.

5.2 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

5.3 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.

5.4 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.

5.5 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.

5.6 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.

5.7 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.

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/ Operation	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 areas	Quality and Quantity monitoring as per Solid waste/Hazardous waste rules	Half Yearly	EMC of NLCIL India limited

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 & Parameters	Frequency	Monitori ng 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/O disha State Environm ental Board/ State Pollution control board
2	Efflu ent Qual ity	Quality of effluent discharged and reused	ETP sample collection & quality analysis	Daily (Internal); Monthly (Third Party)	
3	Ambient Quality Air	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) Work area ambient air quality monitoring as per Factories act	Ambient Monthly (24 hourly);	
4	Noise	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 Environm ent	Horticulture/ Greenbelt Development	Survival rate of plants and shrubs	Half Yearly	
6	Solid Waste Managemen t	Disposal of waste	Tracking of waste collection, segregation and disposal	Fortnightly	
8	Hazard ous Waste Manage	Disposal of Hazardous Waste	Tracking of hazardous waste collection,segregation, storage and disposal	Fortnightly	

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.

6.6 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

6.6.1 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.

6.6.2 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.

6.6.3 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.

6.7 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.

6.8 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).

6.9 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.

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 the PH minutes are detailed below T hereafter application for accord of environmental clearance will be submitted to MOEF&CC, New Delhi.

Time bound action plan for issues raised during the public hearing:

S.NO.	Public Hearing Queries	Response by (NLCIL)	Action plan
	Shri Surendra Sahu, Hirma		
1	He said that Jharsuguda & IB Valley are coming under the list of CEPI (Comprehensive Environment Pollution Index). As per CPCB, Jharsuguda & IB Valley area have been declared as one of the most critically polluted area in the state. As per Green Peace & Wetland International South Asia report, Jharsuguda is one of area in the state where major 802 emitting industries exists. In this report, it has been stated that water quality of Hirakud	• NLCIL shall take all measures to reduce the pollution from proposed Thermal power project as per MoEF&CC guidelines. No water shall discharge in any water bodies and maintain ZLD. • As HCSD concept of ash disposal is being adopted the slurry gets hardened after disposal, and hence no pollution of river due to any possible breach is envisaged. Also as per norms the min distance of 500m is left between the river body &	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant. • R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.

	Reservoir contains high concentration of Fecal Coliform & Total Coliform as well as fluoride concentration is in dangerous level. The pollution level will be further increased if the proposed thermal power project will be established in the Kumbhari Tareikela area. As per the EIA report prepared by NLC India. IB river is located 3.8 Km. Bheden river is 0.5 Km & Hirakud Reservior is 4.3Km from the proposed project. These rivers are getting polluted due to the already existing industries located nearby. Whether the Govt has carried out any survey regarding the carrying capacity of the area at which such large project will propose to be established. If the survey has been done, then it shall be placed before the general public otherwise the power plant project should not be allowed in the area. If the proposed project will be established, then the nearby rivers and Hirakud reservoir water will be get polluted due to emission of C02, N02, S02 from combustion of coal in the proposed power plant. As the proposed ash pond of the project will be located near the Bheden river, in the future the same will be buried with ash. Apart from that, the forest species in the reserved forest will be diminished due to establishment of the proposed project. Ground water will be also contaminated with fluoride and other toxic element due	ash dyke. • The Nalla passing through proposed Ash Dyke shall be remodelled and diverted as per NIH Roorkee report. • Existing Ponds in the plant area are shown in the area plan drawing in EIA report. • Total Number of Project Affected Families (PAF) and Project Dispalced Families (PDF) in the Thermal power project site is already covered in the EIA report. • NLCIL will provide all infrastructural facilities at R&R colony such as Road, school, Primary health center, Post Office, Bank, Market, cremation site, community hall, Temple etc. • The unit has proposed sanitation facilities during construction phase with soak pit& septic tanks/Bio Toilets to prevent contamination. During Operation Phase, STP will be installed so that the treated sewage water meet the standards prescribed by regulatory authorities for recycling. The liquid effluents from ETP will be collected and treated/ Recycled generally as per design Philosophy. • The back wash water of Pre Treatment (PT) plant will be collected and recycled back to CW system clarifier. • The sludge from clarifier of water PT plant will be collected and sent to ash slurry sump for disposal to ash dyke. • Cooling water system blowdown would be used for coal dust suppression system Ash handling plant and FGD	

	to such proposed project. He also stated that, in addition to 1B & Bheden river, there is one Nalla namely Gadgadi Nalla flowing nearby which confluence with Bheden river, and the same has not been reflected in the EIA report prepared by NLC India Limited There are also 11 nos. of Ponds exist in the Hirma village at which the proposed project will be established and the same were also not reflected in the EIA. Some other existing units like MCL, SPS Sponge, and LN Metallics are located nearby the proposed power projects which were not mentioned in the EIA. No clear figure on rehabilitation, resettlement and employment to the displaced people due to the proposed project has been mentioned in the EIA. Approximately 12000 family of 60 nos. of villages will be affected due to this proposed project. For the sake of Society, environment and economic protection, he finally opposed the proposed thermal power project. He submitted the written representation read out by him	system excess CW blowdown will pass through system for reuse. • A coal silting pond particles from coal handling plant waste & Decanted water will be pumped back to the coal dust suppression system. • An Ash Management scheme will be implemented consisting of dry collection of ash, supply of ash to Brick/ Paver Manufacturers for utilization. • NTTPP unit has already included latest technologies in respect of wastewater treatment to achieve Zero Liquid Discharge (ZLD), Flue Gas De-Sulphurisation system for Sox control, high efficiency Electrostatic precipitators for fugitive dust control, selective catalyst reduction for reduction of NOx. In addition to this, dense green belt will be developed all along our project boundaries which will lead to reduction of Air Pollution. NLCIL will ensure Zero Liquid Discharge Scheme, High Efficiency Electro-Static Precipitators (ESPs) of 99.9% & Fly ash management scheme to protect Water, Air & Soil contamination respectively. • As per the latest notification of MoEF& CC, with the installation of FGD, the height of chimney to be kept as per the Standards.	
	Mr. Ananta, Parivesh Surakshya ,lanamanch, Jharsuguda		

2	**Shri. Ananta** introduced himself as a Social Activist and welcomed the public. He requested the panel to cancel the public hearing of the proposed 3x800MW thermal power project. He said that Jharsuguda & IB Valley are coming under the list of CEPI (Comprehensive Environment Pollution Index). As per CPCB, Jharsuguda & IB Valley area have been declared as one of the most critically polluted area in the state. Before completion of his speech, local villagers came to the podium and opposed his speech. They also tore his written representation and did not allow to speak further. Executive magistrate along with police personnel's controlled the local villagers to maintain peace and discipline. After few minutes public hearing continued normally with intervention of ADM by giving the opportunity to the local affected villagers to speak first & then others.	• All control measures as given in the EIA-EMP report shall be taken up and implemented fully for control of pollution. • Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF.	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant.
	Shri. Rudra Bariha, Luhurenkachhar		
3	He welcomed the panel and put his views that, if the plant comes, NLC company will acquire complete land of Luhrenkachhar, Tariekela and Kumbhari right up to the bank of river which is left out. He also expressed that; if their demands will not be fulfilled then they will face a lot of problems, both economically and environmentally.	• Land rates finalized by the District collector as per the Right to Fair compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (RFCTLARR) Act. 2013 will be paid by NLCIL. • R&R benefits as finalized by the Rehabilitation and periphery development Advisory committee (RPDAC) will be extended to PAPs by NLCIL.	• R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy. • Approach road for villagers along with construction of boundary wall shall be made 6 months before operation of the plant outside the plant boundary for use of the villagers.

	Shri Bharat Koudi, Kumbhari		
4	He welcomed the panel along with the public and stressed upon the effective measures to be taken by the company to control the air and water pollution caused by the flyash generated from the proposed project. He has further stated that if the company wants to acquire land for industrialization they may take all the land instead of leaving 500 meters from river bank as these land will become useless for them due to pollution & distance of their new habitation.	• All control measures as given in the EIA-EMP report shall be taken up and implemented fully for control of pollution. • Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF.	• Approach road for villagers along with construction of boundary wall shall be made 6 months before operation of the plant outside the plant boundary for use of the villagers.
	Shri Rabindra Rohidas, Tareikela		
5	He told that, since many industries like Vedanta, Bhushan & SMC have already been developed in the nearby area of the proposed site, he is not denying to establish another thermal plant in their village area. But he suggested that the affected people must be provided with the best land Rate, Rehabilitation & Resettlement (R&R) benefits and also to acquire the complete land up to the bank of the river at both sides outside of the plant area.	• Land rates finalized by the District collector as per the Right to Fair compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (RFCTLARR) Act. 2013 will be paid by NLCIL. • R&R benefits as finalized by the Rehabilitation and periphery development Advisory committee (RPDAC) will be extended to PAPs by NLCIL.	• R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.
	Shri Gorang Jagat, Tareikela		
6	He said that, if the proposed project will come up the nearby river and land will be affected. The river will not be fit for potable use for human consumption. Since many factories already exist all around their village area and there is pollution all around, if another company will be set up there will be no tangible change so it may be done. Govt. should take initiative to take necessary	• Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF. • NLCIL will ensure Zero Liquid Discharge Scheme & Fly ash management scheme using HCSD scheme to protect land, water & air contamination. • R&R benefits as finalized by the Rehabilitation and	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant. • R&R benefits will be done as per RPDAC guidelines and will be completed immediately after

	steps to protect the environment from pollution. Also the villagers who will be displaced due to the project should be resettled within the same panchayat area with proper R&R package.	Periphery Development Advisory Committee (RPDAC) will be extended to PAPs by NLCIL. • NLCIL will provide all infrastructural facilities at R&R colony such as Road, school, Primary health center, Post Office, Bank, Market, cremation site, community hall, Temple etc. • The location of R&R is under discussion with State Govt. and care should be taken for PAP colony is in same panchayat subject to the approval & allotment from the Government.	approval of policy.
	Shri Pitambar Kisan, Gariadihi		
7	He stated that, he does not have any problem with the upcoming project but the left out area (500 meter) from the river bank sides should be acquired fully.	• All control measures as given in the EIA-EMP report shall be taken up and implemented fully for control of pollution. • Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF.	• Approach road for villagers along with construction of boundary wall shall be made 6 months before operation of the plant outside the plant boundary for use of the villagers.
	Shri Sriram Garia, Tareikela		
8	He expressed that, no doubt 100 percent pollution exists in this area. If the coming factory will be established the administration should take appropriate measures to protect the environment from pollution. Besides the displaced families should be resettled by providing proper and better environment.	• Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF. • NLCIL will ensure Zero Liquid Discharge Scheme & Fly ash management scheme using HCSD scheme to protect land, water & air contamination. • R&R benefits as finalized by the Rehabilitation and Periphery Development Advisory Committee (RPDAC) will be extended to PAPs by NLCIL. • NLCIL will provide all infrastructural facilities at	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant. • R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.

		R&R colony such as Road, school, Primary health center, Post Office, Bank, Market, cremation site, community hall, Temple etc. • The location of R&R is under discussion with State Govt. and care should be taken for PAP colony is in same panchayat subject to the approval & allotment from the Government.	
	Shri Madhusudan Kisan, Tareikela		
9	He suggested that, whether factory will be established or not, pollution will bound to happen in view of existing factories. Rather, it is better if the factory comes in the area. He welcomed the proposed thermal power project as they will get displaced to a better environment. But in lieu of that, they should provide better land compensation, employment, Rehabilitation & Resettlement and other benefits and facilities like school, colleges and temples	• Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF. • NLCIL will ensure Zero Liquid Discharge Scheme & Fly ash management scheme using HCSD scheme to protect land, water & air contamination. • R&R benefits as finalized by the Rehabilitation and Periphery Development Advisory Committee (RPDAC) will be extended to PAPs by NLCIL. • NLCIL will provide all infrastructural facilities at R&R colony such as Road, school, Primary health center, Post Office, Bank, Market, cremation site, community hall, Temple etc. • The location of R&R is under discussion with State Govt. and care should be taken for PAP colony is in same panchayat subject to the approval & allotment from the Government.	• R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.
	Shri Gorang Kisan, Gariadihi		

10	He urged the media personnel to place the issues regarding pollution in their area before the district administration. He also expressed that, if the person gets displaced, what will be the livelihood for their survival. He demanded that, company as well as administration should consider to provide proper infrastructure like road, school, R&R benefits, and jobs and also free electricity to the affected villagers. People are unable to cultivate there land due to pollution. Hence these should be examined and proper decision to be taken in this matter. Give us five resettlement villages with the nomenclature of our existing five villages with all facilities.	• As far as possible, the area for Rehabilitation & Resettlement (R&R) establishment shall be within the same Panchayat. Presently area for R&R establishment has been identified in the same Panchayat, Hirma and application for same has already been submitted to District Officials. The Location shall be finalized as per the land allotment by state Government.	• R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.
	Dilip kumar Badhai, Hirima, Ex-Sarpanch.		
11	He pointed out that the name of the project " Talabira Thermal power Plant " should be changed first and the same should be named after their Panchayat (Hirma). The company should establish their office in Hirma Panchayat. Agreement should be made with the displaced villagers that everyone along with their generations should get the employment. The people affected by pollution due to the proposed project will be given first priority in employment, contract jobs and other facilities. Appropriate steps must be taken for free movement of persons near upcoming infrastructural development of the company.	• NLCIL will provide all infrastructural facilities at R&R colony such as Road, school, Primary health center, Post Office, Bank, Market, cremation site, community hall, Temple etc. • As far as possible, the area for Rehabilitation & Resettlement (R&R) establishment shall be within the same Panchayat. Presently area for R&R establishment has been identified in the same Panchayat, Hirma and application for same has already been submitted to District Officials. The name of Project is "NLC Talabira Thermal Power Project" and submitted to other Government Departments earlier and approvals already obtained. Currently, NLCIL is providing temorary employment through	• R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.

		contract agencies with minimum wages protection and about 50% of the vacancies arising in various contract works are alotted to Project Affected Persons (PAPs) based on qualifications. In addition to that, monetary assitance will also be provided in leiu of Employment, as per the R&R policy/act announced by the appropriate state Government. • Approach road for villagers along with construction of boundary wall shall be made 6 months before operation of the plant outside the plant boundary for use of the villagers.	
	Japamali Bhainsa, Tumbekela		
12	He welcomed the panel along with the public. He expressed that, he used to drink and take bath in clean river water, but now it has been polluted. He cannot go his 15 acre river bank land as ash is disposed in the surroundings. Though his land is not getting acquired still then he will be most affected by pollution caused by the project. He also agreed with the earlier views of Dilip Badhai, regarding the name of the project to be in the name of one of the displaced villages.	• It is hereby informed that 100% fly ash will be utilized as per MoEF& CC fly ash notification. • The name of Project "NLC Talabira Thermal Power Project" and submitted to other Government Departments earlier and approvals already obtained. • Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF. • Approach road for villagers along with construction of boundary wall shall be made 6 months before operation of the plant outside the plant boundary for use of the villagers.	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant.
	Khirod Marai, Kumbhari		

13	He stated that if the land will be acquired by the company, then company should take all land without leaving any land	• Taking over of additional land between the Bedhan river and the presently identified Land in the plant layout will be decided as per discussions in the RPDAC meeting.	• Approach road for villagers along with construction of boundary wall shall be made 6 months before operation of the plant outside the plant boundary for use of the villagers.
	Giridhari Kanta, Ex Sarpanch Hirma		
14	He welcomed the panel along with the public. He said that, company should provide proper compensation for land displaced person due to the proposed thermal power project. The project authority should also provide houses as it is for the land affected people. Adequate measures must be taken to avoid pollution of the existing water bodies of the villages.	• Pl Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF. • NLCIL will ensure Zero Liquid Discharge Scheme & Fly ash management scheme using HCSD scheme to protect land, water & air contamination. • R&R benefits as finalized by the Rehabilitation and Periphery Development Advisory Committee (RPDAC) will be extended to PAPs by NLCIL. • NLCIL will provide all infrastructural facilities at R&R colony such as Road, school, Primary health center, Post Office, Bank, Market, cremation site, community hall, Temple etc. • The location of R&R is under discussion with State Govt. and care should be taken for PAP colony is in same panchayat subject to the approval & allotment from the Government.	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant. • R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.
	Rambha Dhila, Kumbhari		
15	She introduced herself as a Social Activist and welcomed the public. School arrangement be made for the education for the children of displaced families. Proper resettlement and jobs should	• As per EIA report itself, CER fund of Rs. 3 Crores (Approx.) will be utilized towards Education & skill development. • Air & water pollution control measures shall be as	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of

	be provided to Project Affected Families (PAF's). Proper steps should be taken to protect environment from pollution.	detailed in the EIA report shall be provided to meet latest environmental norms by MOEF.	the plant.
	Lal Bihari Seth, Tumbekela		
16	He stated that, employment should be given to the affected people. Open agreement should be done to provide employment, house and road. Project proponent should acquire the entire land of 500m left along the river bank. But the plant should come and he supported the project subject to fulfillment of above conditions.	• Currently, NLCIL is providing temporary employment through contract agencies with minimum wages protection and about 50% of the vacancies arising in various contract works are allotted to Project Affected Persons (PAPs) based on qualifications. As HCSD concept of ash disposal is being adopted the slurry gets hardened after disposal, and hence no pollution of river due to any possible breach is envisaged. Also as per norms the min distance of 500m is left between the river body & ash dyke.	• R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.
	Jitendra Bhainsa, Tumbekela		
17	He welcomed the proposed project. He suggested that, company should construct Goshala at appropriate place to prevent road accident due to cattles. He also added that, employment should be given to land affected persons with special priority for ladies. The existing local ponds should be renovated by the project authority. Health Camp should be organized for land affected people in the area. Project proponent should provide proper land compensation, service to the PAF's and PDF's and acquire the entire land of 500m left along the river bank. Adequate measures shall be taken to protect the	• Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF. • Medical facilities and other infrastructural facilities will be created and fund of Rs.5 Crores (Approx.) for the same has been allocated under CER Programme. Health Camp will be organized by NLCIL. Mobile medical van already in operation in the affected villages. NLCIL will provide all infrastructural facilities at R&R colony such as Road, school, Primary health center, Post Office, Bank,	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant. • R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.

	environment from pollution.	Market, cremation site, community hall, Temple etc.	
	Shankar Prasad Birtia, Kumbhari		
18	He expressed that, entire land should be taken up by the Company and they along with the administration should write to the villagers regarding the facilities provided by the project. If one inch of land is left out then they will debar the project and if entire land will be taken then they will welcome the project. Houses and jobs should be provided to the all affected people who are more than 18 yrs of age and education facility should be provided.	• As per EIA report itself, CER fund of Rs. 3 Crores (Approx.) will be utilized towards Education & skill development. • Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF. Currently, NLCIL is providing temporary employment through contract agencies with minimum wages protection and about 50% of the vacancies arising in various contract works are allotted to Project Affected Persons (PAPs) based on qualifications. As HCSD concept of ash disposal is being adopted the slurry gets hardened after disposal, and hence no pollution of river due to any possible breach is envisaged. Also as per norms the min distance of 500m is left between the river body & ash dyke.	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant. • R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.
	Budharam Garia, Kumbhari		
19	He said that, If factory comes then they will lose their homestead land and they will start begging. He opposed the proposed project.	• Pl refer response as per Sr. No. 15 above	• R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.
	Parsuram Puta, Tumbekela		
20	He told that, the area is already polluted; hence the project authority should take necessary measures to control the pollution.	• Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF.	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of

			the plant.
	Ranjan Kumar Bhainsa, Kantatikera		
21	He welcomed the public and said that, all the elders have already told about pollution matter and he has nothing to say about this. He also added that the project authority should give priority for employment to the local people basing on their qualification.	• NLCIL will support/ Provide skill development programmes for PAPs to enhance expertise on priority areas. As per EIA report itself, CER fund of Rs. 3 Crores (Approx.) will be utilized towards Education & skill development. • Currently, NLCIL is providing temporary employment through contract agencies with minimum wages protection and about 50% of the vacancies arising in various contract works are allotted to Project Affected Persons (PAPs) based on qualifications.	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant.
	Santanu Panigrahi, Tareikela		

22	He strongly opposed the establishment of proposed project on the ground that due to the industries like Vedanta, Bhushan etc the water of the river has been polluted and the people of the area are drinking polluted water also people eating fish from the polluted water of river and their getting affected by certain diseases. The existing nearby industries like Vedanta& Bhushan are discharging SO_2, NO_x and other chemicals to the atmosphere, if further new plant comes then environment will be severely deteriorated. People maintaining their livelihood and depending on forest produce will be largely affected. Soil conservation will be affected.	• NTTPP unit has already included latest technologies in respect of wastewater treatment to achieve Zero Liquid Discharge (ZLD), Flue Gas De-Sulphurisation system for Sox control, high efficiency Electrostatic precipitators for fugitive dust control, selective catalyst reduction for reduction of NOx. • In addition to this, dense green belt will be developed all along our project boundaries which will lead to reduction of Air Pollution. NLCIL will ensure Zero Liquid Discharge Scheme, High Efficiency Electro-Static Precipitators (ESPs) of 99.9% & Fly ash management scheme to protect Water, Air & Soil contamination respectively. • Air & water pollution control measures shall be as detailed in the EIA report shall be providede to meet latest environmental norms by MOEF.	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant.
	Vishnu Panigrahi, Tareikela		
23	We have no knowledge about the environment. By establishing new project in this area the environment of this area will be affected badly. We should protect our villages from pollution leaving behind any politics.	• NTTPP unit has already included latest technologies in respect of wastewater treatment to achieve Zero Liquid Discharge (ZLD), Flue Gas De-Sulphurisation system for Sox control, high efficiency Electrostatic precipitators for fugitive dust control, selective catalyst reduction for reduction of NOx.	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant.
	Madhav Prasad, Tareikela		

24	Involvement of any agents should be avoided and each and every one shall be treated equally. Preventive measures shall be taken for the health care of both humans and cattle's.	• As per EIA report itself, CER fund of Rs. 7.5 Crores (Approx) will be Utilized towards Health & Sanitation. Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF. • Pl refer response as per Sr. No. 01 above	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant. • R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.
	Sudhakar Sah, Hirma		
25	Due to establishment of SMC, Vedanta, Bhushan the environment of this area has already been largely affected. No steps were taken by the administration to protect the environmental issues therefore we the people of Sirpura, Badmal and Hirma panchayat should be united to stand for protection of the environment of this area. Sudhakar Sah being the last speaker, Presiding Officer once again requested if anybody other than the above speakers if interested and Mr. Anant who could not complete his speech to come forward & submit their presentation. But no more person have come forward for giving presentation even after repeated the call.	• NTTPP unit has already included latest technologies in respect of wastewater treatment to achieve Zero Liquid Discharge (ZLD), Flue Gas De-Sulphurisation system for Sox control, high efficiency Electrostatic precipitators for fugitive dust control, selective catalyst reduction for reduction of NOx.	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant. R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.

S.No.	**Questions by the Participants**	**Response by (NLCIL)**	**Time Bound Action Plan**
	Sri Subrakanta Samal Lapanga		
1.	He welcome the project .He demanded the company to take all possible pollution control measure before operation of the plant.	• Proposed project is based on supercritical technology meeting all the environmental norms. • NTTPP unit has already included latest technologies in respect of wastewater treatment to achieve Zero Liquid	It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant.

		Discharge (ZLD), Flue Gas De-Sulphurisation system for Sox control, high efficiency Electrostatic precipitators for fugitive dust control, selective catalyst reduction for reduction of NOx.	R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.
	Sri Santosh Kumar Nath (Ex Serviceman) Thelkoloi		
2.	He claimed that he was saying on half of Villagers of Thelkoloi village and the villages are against the project. He further stated that they are opposing this project and are not going to allow NLC India Limited to establish the ash pond. He further stated that they are opposing this project and are not going to allow NLC India Limited to establish the ash pond.	• Proposed project is based on supercritical tech meeting all the environmental norms. • As HCSD concept of ash disposal is being adopted the slurry gets hardened after disposal, and hence no pollution of river due to any possible breach is envisaged. Also as per norms the min distance of 500m is left between the river body & ash dyke. The ash pond area has been realigned such that village remains outside the boundary.	It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant.
	Sri Laxmikanta Seth , Khinda		
3.	He welcome the project and stated they are living near the proposed project of ash pond adequate pollution control measure should be taken.	• Proposed project is based on supercritical tech meeting all the environmental norms. • NTTPP will be established with clean Technology leading to prevention and control of pollution. • NTTPP unit has already included latest technologies in respect of wastewater treatment to achieve Zero Liquid Discharge (ZLD), Flue Gas De-Sulphurisation system for Sox control, high efficiency Electrostatic precipitators for fugitive dust control, selective catalyst reduction for reduction of NOx.	It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant. R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.
4	**Sri Sanjib Pradhan**		
	He Welcomed the project	• Proposed project is based on supercritical tech meeting all the environmental norms. • NTTPP will be established with clean Technology leading to prevention and control of pollution.	

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.

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.

7.3 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.

7.3.1 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.

7.3.2 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.

7.3.3 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.

7.4 Construction Phase Safety Management Plan

7.4.1 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.

7.5 Safety Hazards during Operational Phase

7.6 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.

7.7 Safety Aspects of Storage of Furnace Oil

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

- A collection pit for any spillage will be provided near the fuel tank dyke.
- 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.
- Dyke area of the largest tank volume as per OISD standards will be provided to retain the oil spills.
- A level indicator with alarm will be provided for the fuel tanks.
- The fuel transfer pumps & motors will be of fire proof type and will be located outside the dyke area.

7.8 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.

7.9 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:
- Identify and involve workers in assessing workplace risks,
- Assess and consider employees' needs when planning and organizing work,
- Provide advice, information and training to employees, as well as mechanisms for employee feedback such as a suggestion scheme, 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
- 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:

- 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,
- 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,
- ECG and X-ray facilities, Peak Expiratory flow Meter to check the lung function.
- 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.
- 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.
- 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.
- 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).

7.10 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.

- Multi-sensor type smoke detection system
- Photo electric type smoke detection system.
- Combination of both multi-sensor type and photo electric type smoke detection systems.
- Linear heat sensing cable detector.
- Quartzoid bulb heat detection system.
- Infra-red type heat detectors (for selected coal conveyors)
- Portable and mobile extinguishers, such as pressurized water type, carbon-dioxide type, foam type, dry chemical powder type, will be located at strategic locations throughout the plant.
- CW blow down shall be used for supply of fire water. An alternate connection from 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.

7.11 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

7.12 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.

7.13 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.

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.

8.4 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.

8.5 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.

8.6 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 - ENVIRONMENTAL MANAGEMENT PLAN

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

I. The EMP has been designed keeping in view the regulatory and other requirements to ensure the following:

II. Minimum disturbance to the native flora and fauna

III. Compliance with the air, water, soil and noise quality norms.

IV. Conservation of water to the extent possible through rain water harvesting, wastewater recycling.

V. 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

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.

9.4.1.2 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.

9.4.1.3 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.

9.5 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.

9.5.1 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 storagetank of similar or slightly larger capacity 5000 liters can be provided.

9.5.2 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.

9.6 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.

9.7 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

9.7.1 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.

9.7.2 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.

9.7.3 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.

9.7.4 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.

9.7.5 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.

9.7.6 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.

9.7.7 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.

9.8 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

9.8.1 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.

9.8.2 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.

9.9 Proposed technology

Crystalline Solar Photo Voltaic technology is proposed for the roof tops.

9.9.1 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.

9.10 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.9.1is followed.

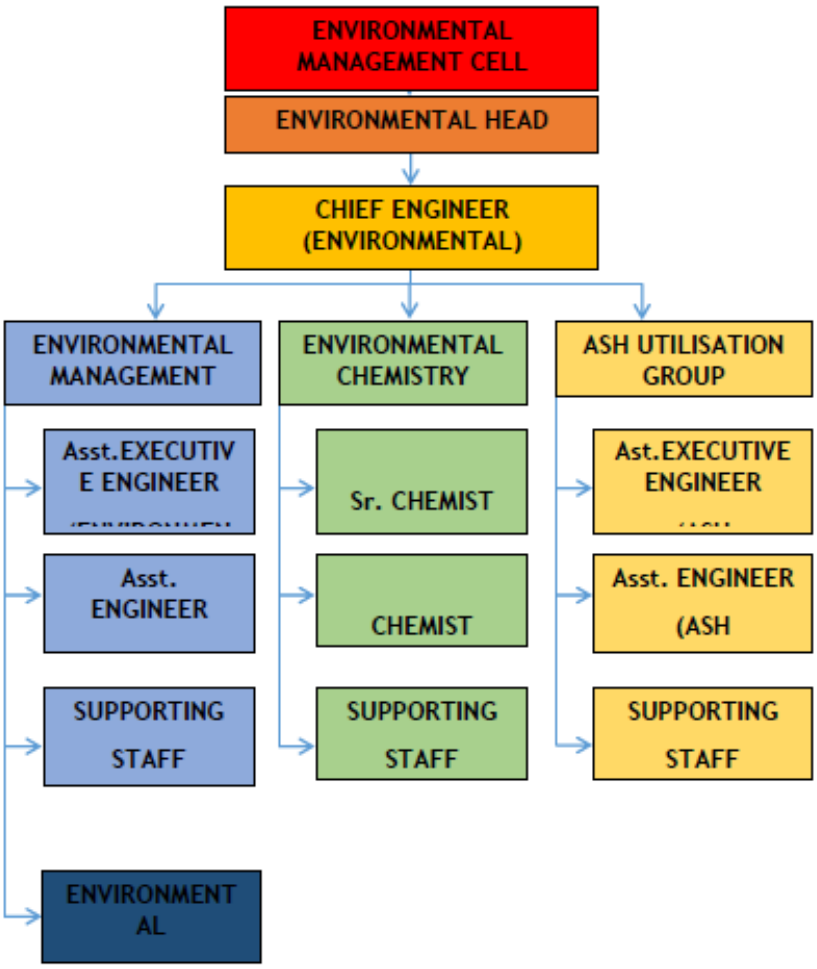


Figure 9-1 Environment Management Department

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.

9.11 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 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

9.11.1 **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.

9.12 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.

9.13 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: Construction Phase

S. No	Description	(Cost in crore)	
		Capital Cost	Recurring Cost Per Annum
1.	Green Belt/Horticulture	1	0.01
2.	Environmental Monitoring	1	0.01
3.	Dust Suppression System	1.20	0.12
4.	Soak pit& septic tanks/Bio Toilets for construction	0.50	0.01
5.	Environmental Awareness, safety and Training	1	0.01
	Total	4.7	0.16

Table 9-2 : BUDGET FOR IMPLEMENTATION OF EMP & MONITORING PLAN Operation Phase

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)	2	0.03
4.	Ash Disposal	150	1.5
5.	Environmental Monitoring	6	0.1
6.	Water Management including ETP including RO for ZLD	20	0.2
7.	Air Pollution Control -ESP	120	1.2
8.	Air Pollution Control -SCR	264	2.64
9.	Air Pollution Control - FGD	800	0.08
10.	Air Pollution Control - chimney	66	0.7
11.	Dust Suppression System	2.0	0.02
12.	PT Plant	35	0.4
13.	DM Plant	25	0.03
14.	Environmental Awareness & Training	3	0.03
	Total	**1500**	**7.0**

Additional Precautionary measures proposed to prevent pollution load :

Based on the information stated in the NTTPP report and also an independent assessment on the baseline environmental status and also prediction of impacts the following conclusions are made

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. The SCR System will be installed in each unit, to limit NoX emission below 100 mg/Nm3 so as to meet the MOEF requirements. 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. 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 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.

The proposed facility will utilize the lowest possible water consumption of 3 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. Hence the possible impacts on the ecological and biological environment in the surface water bodies in the region will be insignificant.

NTTPP intends to spend about Rs. Rs. 40.18 Crores towards various CER programs in 5 years, which will benefit the local people in several folds and the social and cultural environmental will be enhanced.

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.

9.14 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.

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.

11 DISCLOSURE OF CONSULTANT

11.1 Introduction

This chapter describes about the environmental consultant engaged in preparation of EIA report for the proposed setup of 2400 MW 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.

11.2 The Consultant: ABC Techno Labs India Private Limited

ABC Techno Labs India Private Limited (formerly ABC Environ Solutions Pvt. Ltd.) is an ISO 9001, ISO 14001 & OHSAS 18001 Certified Company & leading Environmental Engineering & Consultancy Company constantly striving towards newer heights since its inception in 2006. Our Company is dedicated to provide strategic services in the areas of Environment, Infrastructure, Energy, Engineering and Multilab.

It is the first firm to be accredited by NABET (National Accreditation Board for Education and Training), Quality Council of India, as an EIA Consultant, approved for carrying out EIA studies and obtaining environmental clearance for various sectors such as Thermal Power Plants, Infrastructure, Industrial Estates / Complexes/ Areas, Mining, Township & area development and Building construction projects etc. ABC Techno Labs is equipped with in-house, spacious laboratory, accredited by NABL (National Accreditation Board for Testing & Calibration Laboratories), Department of Science & Technology, Government of India.

Since establishment ABC Techno Labs focus on sustainable development of Industry and Environment based on sound engineering practices, innovation, quality, R&D and most important is satisfying customers need. The company has successfully completed more than 100 projects of variety of industries, in the field of pollution control and environmental management solutions. The company is also dealing in the projects of waste minimization and cleaner production technology.

The team of technocrats and scientist are well experienced to deal with the design, Manufacture, Fabrication, Installation, commissioning of Effluent / Wastewater treatment plants, Sewage Treatment plants, and Combined Treatment plants. The company is having well experienced team of Scientists & Engineers who are looking after environmental projects & well equipped analytical laboratory with a facility including analysis of physical, chemical and biological parameters as per the requirements of the State Pollution Control Board and our clients.

11.3 Services of ABC Techno Labs India Private Limited

Environmental Services

- Environmental Impact Assessment (EIA)
- Environmental Management Plan (EMP)
- Social Impact Assessment (SIA)
- Environmental Baseline data collection for Air, Meteorology, Noise, Water, Soil, Ecology, Socio-Economic and Demography etc;
- Environmental Monitoring
- Socio Economic Studies
- Resettlement & Rehabilitation Plan
- Ecological & Human Health Risk Assessment Studies
- Ecological Impact Assessment
- Environmental Management Framework
- Solid Waste Management
- Hazardous Waste Management
- Internship & Training

Turnkey projects

- Water Treatment Plants
- Sewage Treatment Plant
- Recycling & Water Conservation Systems
- Zero Discharge System

Other services

- Operation & Maintenance of Water & Waste Water Plants
- Water & Waste Water Treatment Chemicals
- Pilot Plant studies
- Feasibility studies & preparation of budgetary estimates

Laboratory services

- Chemical Testing
- Environmental Testing
- Microbiological Testing
- Food Testing
- Metallurgical Testing

11.4 Sectors Accredited By NABET

S. No.	Sectors Name
1.	Mining of minerals (Opencast only) Mining (Open cast and Underground)
2.	Offshore Oil and gas exploration, development & productions
3.	Irrigation projects only
4.	Thermal Power Plant
5.	Mineral Beneficiation including palletisation
6.	Metallurgical industries (sec. ferrous only)
7.	Cement Plants
8.	Petroleum refining industry
9.	Leather/skin/hide processing industry
10.	Chemical Fertilizers
11.	Pesticides industry and pesticide specific intermediates
12.	Petro-chemical Complexes (industries based on processing of petroleum fractions & natural gas and/or reforming to aromatics)
13.	Synthetic organic chemicals industry (dyes & dye intermediates; bulk drugs and intermediates excluding drug formulations; synthetic rubbers; basic organic chemicals, other synthetic organic chemicals and chemical intermediates)
14.	Distilleries
15.	Sugar Industry
16.	Oil & Gas transportation pipeline (crude and refinery /Petrochemical products) passing through national parks / sanctuaries / coral reefs / ecologically sensitive areas including LNG Terminal
17.	Isolated storage & handling of hazardous chemicals (As per threshold planning quantity indicated in column 3 of Schedule 2 & 3 of MSIHC Rules 2016)
18.	Airports
19.	Industrial estates/ parks/ complexes/ Areas, export processing zones(EPZs), Special economic zones (SEZs), Biotech parks, Leather complexes
20.	Ports, harbours, jetties, marine terminals, break waters and dredging
21.	Highways, Railways, transport terminals, mass rapid transport systems
22.	Common effluent treatment plants (CETPs)
23.	Common municipal solid waste management facility (CMSWMF)
24.	Building and large construction projects including shopping malls, multiplexes, commercial complexes, housing estates, hospitals, institutions
25.	Townships and Area development Projects

11.5 Study Team

ABC Techno Labs India Private Limited has carried out this Environmental Impact Assessment (EIA) study. The multidisciplinary team included expertise in Environmental Impact Assessment, Air & Water pollution & Control measures, Noise Control measures, Ecology & bio-diversity, Land use, Geology, Environmental Chemistry and Socio-Economic planner. The team members involved in EIA study area:

S.No.	Name of the Expert/s	Functional Areas
1)	Mrs. Vijayalakshmi	EIA coordinator FAE –Noise & Vibration
2)	Mr. Thillai Govidarajan	FAE -Geology
3)	Mr. Abhik Saha	FAE –Water Pollution & Prevention control
4)	Dr. Muthiah Mariappan	FAE –Air Pollution Prevention & control
5)	Dr. Muthiah Mariappan	FAE –Industrial Solid Waste
6)	Mr. Sushil Meshram	FAE –Socio-Economy
7)	Mr. Abhiksaha	FAE –Ecology &Biodiversity
8)	Mr. Thillai Govidarajan	FAE –Hydrogeology
9)	Mr. Sameer Deshpande	FAE –Soil Conservation
10)	Mr. K. Vijayalakshmi	FAE –Air Quality modelling & Prediction
11)	Dr. J.S.Rao	FAE –Land Use
12)	Mrs. Vijayalakshmi	FAE –Risk & Hazard

Quality Council of India

National Accreditation Board for Education & Training

CERTIFICATE OF ACCREDITATION

ABC Techno Labs India Private Limited, Chennai

"ABC Tower", 400, 13th Street, SIDCO Industrial Estate North Phase, Ambattur, Chennai 600098

Accredited as Category – A organization under the QCI-NABET Scheme for Accreditation of EIA Consultant Organizations: Version 3 for preparing EIA-EMP reports in the following Sectors:

Sl. No.	Sector Description	Sector (as per)		Cat.
		NABET	MoEF&CC	
1	Mining of minerals including open cast/ underground mining	1	1 (a) (i)	A
2	Offshore and onshore oil and gas exploration, development & production	2	1 (b)	A
3	River Valley projects	3	1 (c)	A
4	Thermal power plants	4	1 (d)	A
5	Mineral beneficiation including pelletisation	7	2 (b)	B
6	Metallurgical industries (ferrous & non-ferrous)	8	3 (a)	B
7	Cement plants	9	3 (b)	A
8	Petroleum refining industry	10	4 (a)	A
9	Asbestos milling and asbestos based products	12	4 (c)	A
10	Leather/skin/hide processing industry 4	15	4 (f)	A
11	Chemical Fertilizers	16	5 (a)	A
12	Petro-chemical complexes	18	5 (c)	A
13	Petrochemical based processing	20	5 (e)	A
14	Synthetic organic chemicals industry	21	5 (f)	A
15	Distilleries	22	5 (g)	A
16	Pulp & paper industry excluding manufacturing of paper from waste paper and manufacture of paper from ready pulp without bleaching	24	5 (i)	A
17	Sugar industry	25	5 (j)	B
18	Oil & gas transportation pipeline, passing through national parks/ sanctuaries/coral reefs / ecologically sensitive areas including LNG terminal	27	6 (a)	A
19	Isolated storage & handling of hazardous chemicals	28	-	B
20	Airports	29	7 (a)	A
21	Industrial estates/ parks/ complexes/ Areas, export processing zones/EPZs), Special economic zones (SEZs), Biotech parks, Leather complexes	31	7 (c)	A
22	Common hazardous waste treatment, storage and disposal facilities (TSDFs)	32	7 (d)	A
23	Ports, harbours, break waters and dredging	33	7 (e)	A
24	Highway	34	7 (f)	A
25	Common Effluent Treatment Plants (CETPs)	36	7 (h)	B
26	Common Municipal Solid Waste Management Facility (CMSWMF)	37	7 (i)	B
27	Building and construction projects	38	8 (a)	B
28	Townships and Area development projects	39	8 (b)	B

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in RAAC minutes dated Jan 17, 2020 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no. QCI/NABET/ENV/ACO/20/1257 dated March 02, 2020. The accreditation needs to be renewed before the expiry date by ABC Techno Labs India Private Limited, Chennai following due process of assessment.

Sr. Director, NABET	Certificate No.	Valid till
Dated: March 02, 2020	NABET/ EIA/1922/ RA 0155	May 24, 2022

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to QCI-NABET website.

ANNEXURES

ANNEXURE I

TOR

GM/P & BD
No: 001
Dt: 02.01.18

No. J-13012/14/2017 - IA.I (T)
Government of India
Ministry of Environment, Forest and Climate Change

Indira Paryavaran Bhawan,
3rd Floor, Vayu Wing
Jor Bagh Road,
Aliganj, New Delhi-110003

Dated: 27.12.2017

To

The Chief General Manager
Projects & Business Development,
M/s NLC India Ltd.,
Corporate Office, Neyveli – 607801.

Phone No. 04142-252286; Fax: 04141-252645; E-mail: cgm.pbd@nlcindina.com.

Sub: 3x800 MW NLC Talabira Thermal Power Project at Village Khumberi, Taraikela and Thelkolai, Tehsil and District Jharsuguda, Odisha by M/s NLC India Ltd.-reg. ToR

Sir,

The undersigned is directed to refer your online application no. **IA/OR/THE/67938/2017** dated 5.9.2017 w.r.t the aforesaid project.

2. The proposal is for setting up of 3x800 MW Talabira Thermal Power Plant in Odisha which will be implemented in two stages, i.e. Stage-I: 3x800 MW and Stage-II: 1x800 MW.

3. The plant and Township of the project are located near Kumbhari and Taraikela villages, on south west of Brajarajnagar town, on Sambalpur-Rourkela highway in Jharsuguda district and ash disposal area is located near Thelkolai village in Sambalpur district. The project site is approachable from Sambalpur–Jharsuguda highway after crossing Bedhen river bridge *via* state PWD road. Two separate 4 lane roads from Sambalpur-Jharsuguda highway have been envisaged for main approach to the project site. The nearest airports are at Bhubaneswar at a distance of 350 km and Raipur airport is at a distance of approx. 290 km. Nearest railway station is located at Jharsuguda at a distance of 11 km on Howrah-Nagpur main (trunk) section.

4. The project has been planned in the identified 1,511 acres of land comprising of Plant area – 661 acres, Green Belt - 250 acres, Ash Disposal Area – 400 acres, Common Township – 100 acres and Corridors - 100 acres. Proposal for acquisition of land is to be submitted to IPICOL. Additional land (approximately 60 acres) for make up water pipelines from Intake Pump House at Hirakud Reservoir up to plant shall be taken up on right of way basis after finalization of its alignments.

5. There is not forest land involved in the proposed project. There are no national parks, wildlife sanctuaries and other protected areas notified under Wildlife Protection Act, 1972 within 10 km radius of the project.

6. Coal requirement is 11 MTPA having GCV of 3,700 Kcal/kg, Station Heat Rate 5of 2,163 kcal/kwh at PLF of 85%. Ministry of Coal, Govt. of India vide Order No. 103/1/ 2016-NA dated 02.05.2016 have allotted Talabira-II & III captive coal mining blocks in Odisha to NLCIL. The rated capacity of Talabira-II & III mines is 20 MTPA. Talabira mines were initially envisaged to supply coal to proposed 4,000 MW Sirkali project in Tamil Nadu.

7. Consumptive water requirement for present stage of 2,400 MW is 60 Cusec (80 cusecs for ultimate capacity). The water is proposed to be drawn from Hirakud reservoir at a distance of about 20 km. In-principle approval of State Govt. has been obtained. However, the point of water drawal, pipe routing and other terms are yet to be finalized with WRD. Additional water requirement for FGD plant would be 2 cusec/unit i.e. 6 cusec for all the three units. Thus, the total consumptive water requirement shall be 66 cusecs (88 cusecs for all 4 units).

8. Total project cost is Rs. 16,073.86 crores. The proposed Environmental Consultant for carrying out EIA/EMP studies is "ABC Techno Labs India Private Limited" who is QCI-NABET accredited consultants.

9. Sub-committee conducted the site visit on 04.11.2017. The report and recommendations of the sub-committee are available at Ministry's website at Minutes of 13th EAC (Thermal Power) held on 28.11.2017.

10. The proposal has been considered by the Re-constituted EAC (Thermal Power) in its 10th and 13th meetings held on 25.9.2017 and 28.11.2017 respectively. Based on the recommendations of the Re-constituted EAC (Thermal Power) in its meeting held on 28.11.2017, recommendations of the sub-committee site visit dated 4.11.2017 and the information/clarifications and documents submitted by you with regard to the above-mentioned project proposal, **the Ministry hereby prescribes the following TOR along with the standard ToR (as applicable)** for preparation of the EIA and EMP Report.

i) *All the recommendations made in the site visit of the Sub-committee dated 4.11.2017 shall be followed.*

ii) *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.*

iii) *Ficus species to be raised in and around the temples.*

iv) *Even though the proposed area is far from any wildlife sanctuary, a specific recommendations of Chief Wildlife Warden on the impacts of proposed project on wildlife is to be obtained.*

v) *The social impact assessment due to proposed project is to be conducted and a report shall be submitted.*

vi) 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.

vii) Vision document specifying prospective long term plan of the project shall be formulated and submitted.

viii) Latest compliance report duly certified by the Regional Office of MoEF& CC for the conditions stipulated in the environmental and CRZ clearances of the previous phase(s) for the expansion projects shall be submitted.

ix) 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.

x) 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.

xi) 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.

xii) 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.

xiii) Layout plan indicating break-up of plant area, ash pond, green belt, infrastructure, roads etc. shall be provided.

xiv) Land requirement for the project shall be optimized and in any case not more than what has been specified by CEA from time to time. Item wise break up of land requirement shall be provided.

xv) Present land use (including land class/kism) 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.

xvi) 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.

xvii) The land acquisition and R&R scheme with a time bound Action Plan should be formulated and addressed in the EIA report.

xviii) 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.

xix) 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 on the map duly authenticated by the Chief Wildlife Warden of the State or an officer authorized by him.

xx) 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.

xxi) 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.

xxii) 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.

xxiii) 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.

xxiv) The water requirement shall be optimized (by adopting measures such as 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 re-circulation of effluents.

xxv) 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.

xxvi) 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.

xxvii) 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.

xxviii) 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 of 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.

xxix) 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.

xxx) Detailed plan for rainwater harvesting and its proposed utilization in the plant shall be furnished.

xxxi) Feasibility of near zero discharge concept shall be critically examined and its details submitted.

xxxii) Optimization of Cycles of Concentration (COC) along with other water conservation measures in the project shall be specified.

xxxiii) Plan for recirculation of ash pond water and its implementation shall be submitted.

xxxiv) 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 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.

xxxv) 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.

xxxvi) 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.

xxxvii) If the area has tribal population it shall be ensured that the rights of tribals are well protected. The project proponent shall accordingly identify tribal issues under various provisions of the law of the land.

xxxviii) 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.

xxxix) While formulating CSR schemes it shall 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.

xl) 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 dependant on land falling in the project, as well as, population who were dependant on land not owned by them.

xli) 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.

xlii) 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. Health 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.

xliii) One complete season site specific meteorological and AAQ data (except monsoon season) as per latest MoEF 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 of 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.

xliv) 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 hrs).

xlv) A list of industries existing and proposed in the study area shall be furnished.

xlvi) 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 windrose and isopleths should also be shown on the location map. The cumulative study should also include impacts on water, soil and socio-economics.

xlvii) Radio activity and heavy metal contents of coal to be sourced shall be examined and submitted along with laboratory reports.

xlviii) Fuel analysis shall be provided. Details of auxiliary fuel, if any, including its quantity, quality, storage etc should also be furnished.

xlix) 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

l) Details of transportation of fuel from the source (including port handling) to the proposed plant and its impact on ambient 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.

li) 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.

lii) 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.

liii) 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.

liv) 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 invariably provided. Mock drills shall be suitably carried out from time to time to check the efficiency of the plans drawn.

lv) 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 widely.

lvi) 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.

lvii) 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 months.

lviii) Corporate Environment Policy

i. 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.

ii. 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.

iii. 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.

iv. 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.

All the above details should be adequately brought out in the EIA report and in the presentation to the Committee.

lix) Details of litigation pending or otherwise with respect to project in any Court, Tribunal etc. shall invariably be furnished.

11. Besides the above, the following general points shall be followed:

a. All documents to be properly referenced with index, page numbers and continuous page numbering.
b. Where data is presented in the report especially in table, the period in which the data was collected and the source should invariably be indicated.
c. Where the documents provided are in a language other than English, an English translation should be provided.
d. The Questionnaire for environmental appraisal of thermal power projects as devised earlier by the Ministry shall also be filled and submitted.
e. The consultants involved in the preparation of EIA/EMP report after accreditation with Quality Council of India (QCI) / National Accreditation Board of Education and Training (NABET) would need to include a certificate in this regard in the EIA/ EMP reports prepared by them and data provided by other organization / Laboratories including their status of approvals etc. In this regard circular no. F.No. J-11013/77/2004-IA-II (I) dated 2nd December, 2009 is posted on the Ministry's website http://www.moef.nic.in may be referred.

In addition to the above, information on the following may also be incorporated in the EIA report.

1. Is the project intended to have CDM-intent?

(i) If not, then why?
(ii) If yes, then

a. Has PIN (Project Idea Note) (or PCN (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 Tons/MWH or Kg/KWH)
e. Amount of CO_2 in Tons/year expected to be reduced from the baseline data available on the CEA's web-site (www.cea.nic.in)

2. Notwithstanding 1(i) above, data on (d) & (e) above shall be worked out and reported.

12. **The Environmental Clearance shall be applied only after fuel and water linkages are firmed up.**

13. After preparing the Draft EIA (as per the generic structure prescribed in Appendix-III of the EIA Notification, 2006) covering the above mentioned issues, the same shall be submitted to the SPCB for conducting the public hearing as per procedure of EIA notification 2006. The issues emerged during public hearing shall be further incorporated in the Draft EIA/EMP report. The final EIA/EMP report along with public hearing report and the requisite documents (*including written objections, if any*) shall be submitted to the Ministry for appraisal by the Expert Appraisal Committee for consideration of awarding environmental clearance under the provisions of Environmental Impact Assessment notification dated September 14, 2006.

14. The TORs prescribed shall be valid for a period of **three years** from the date of issue for submission of final EIA/ EMP reports, after public consultation.

(Dr. S. Kerketta)
Director

Copy to:

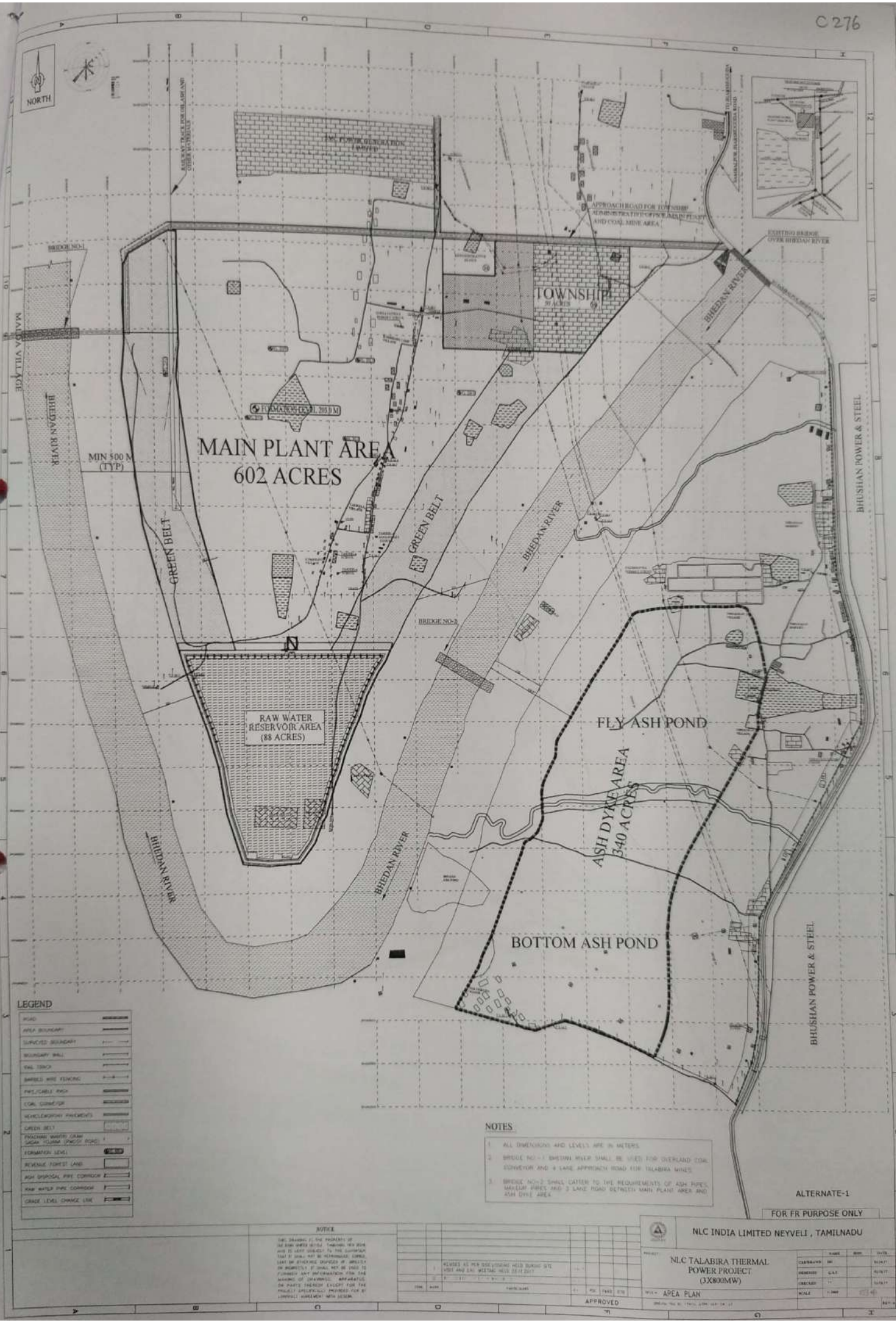
1. The Secretary, Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi 110001.
2. The Chairman, Central Electricity Authority, Sewa Bhawan, R.K. Puram, New Delhi-110066.
3. The Chairman, Central Pollution Control Board, Parivesh Bhawan, CBD-cum-Office Complex, East Arjun Nagar, Delhi- 110032.
4. The Additional Principal Conservator of Forests (APCCF), Regional Office (EZ), Ministry of Environment, Forests and Climate Change, A/3, Chandesekharpur, Bhubaneswar – 751023.
5. The Principal Secretary, Department of Forest and Environment, Government of Odisha, Bhubaneshwar.
6. The Chairman, Orissa State Pollution Control Board, A-118, Nilkanta Nagar, Unit – VIII, Bhubaneshwar- 751 012.
7. The District Collector, Jharsuguda District, Govt. of Odisha, Jharsuguda.
8. Guard/Monitoring file.
9. Website of MoEF&CC.

(Dr. S. Kerketta)
Director

ANNEXURE II

LAYOUT PLAN

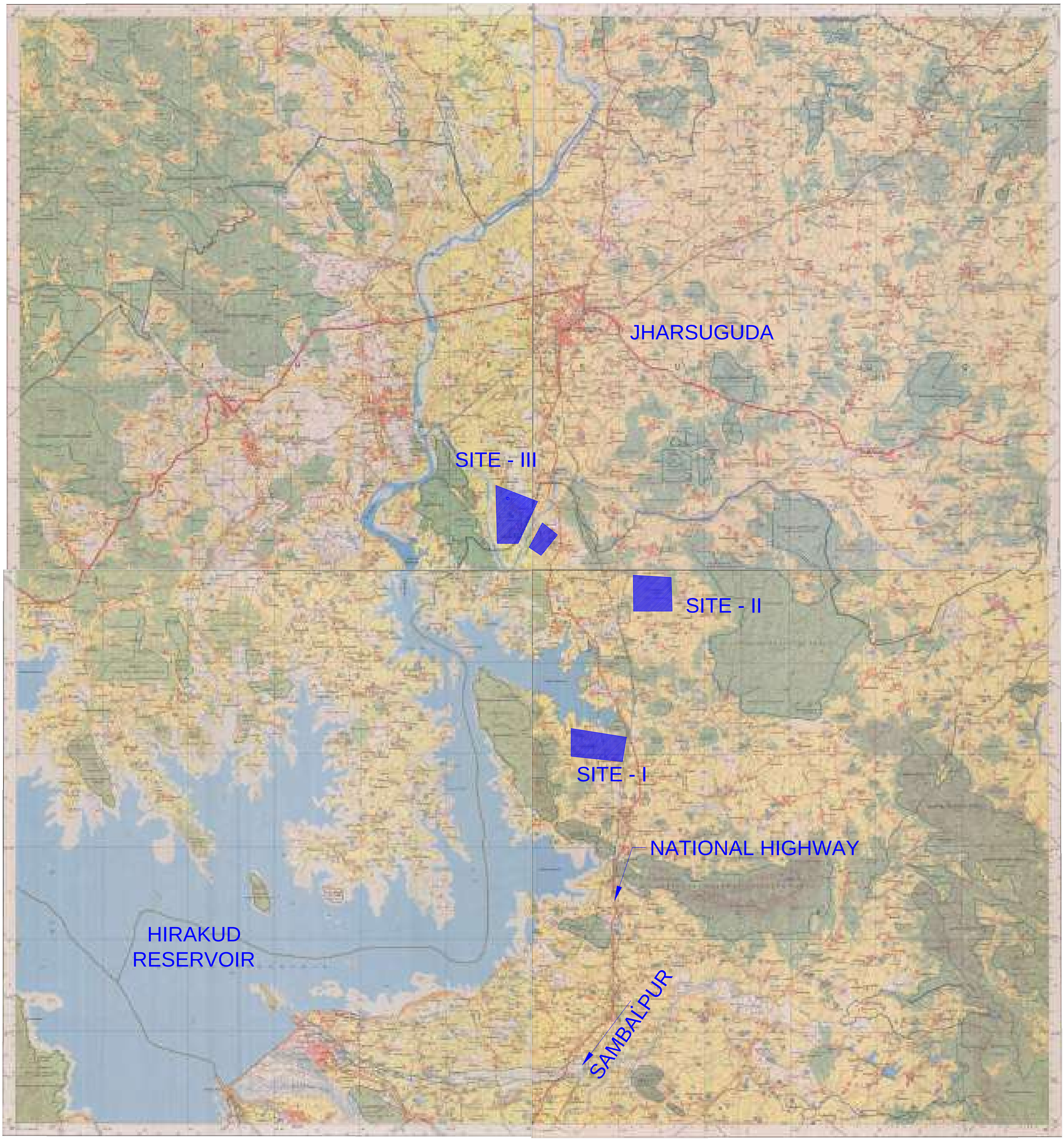
C276


NORTH
TOWNSHIP
59 ACRES
MAIN PLANT AREA
602 ACRES
MIN 500 M (TYP)
RAW WATER RESERVOIR AREA (88 ACRES)
FLY ASH POND
ASH DYKE AREA 340 ACRES
BOTTOM ASH POND
BHEDAN RIVER
GREEN BELT
BRIDGE NO-1
BRIDGE NO-2
EXISTING BRIDGE OVER BHEDAN RIVER
APPROACH ROAD FOR TOWNSHIP ADMINISTRATIVE OFFICE, MAIN PLANT AND COAL MINE AREA
BHUSHAN POWER & STEEL
MATLA VILLAGE
LEGEND
NOTES
1. ALL DIMENSIONS AND LEVELS ARE IN METERS.
2. BRIDGE NO-1 ACROSS RIVER SHALL BE USED FOR OVERLAND COAL CONVEYOR AND 4 LANE APPROACH ROAD FOR TALABIRA MINES.
3. BRIDGE NO-2 SHALL CATTER TO THE REQUIREMENTS OF ASH PIPES, MAINTENANCE ROAD AND 2 LANE ROAD BETWEEN MAIN PLANT AREA AND ASH DYKE AREA.
ALTERNATE-1
FOR FR PURPOSE ONLY
NLC INDIA LIMITED NEYVELI , TAMILNADU
NLC TALABIRA THERMAL POWER PROJECT (3X800MW)
AREA PLAN
APPROVED

ANNEXURE III
ALTERNATIVE SITE

ANNEXURE II

LOCATION PLAN OF ALTERNATIVE SITES

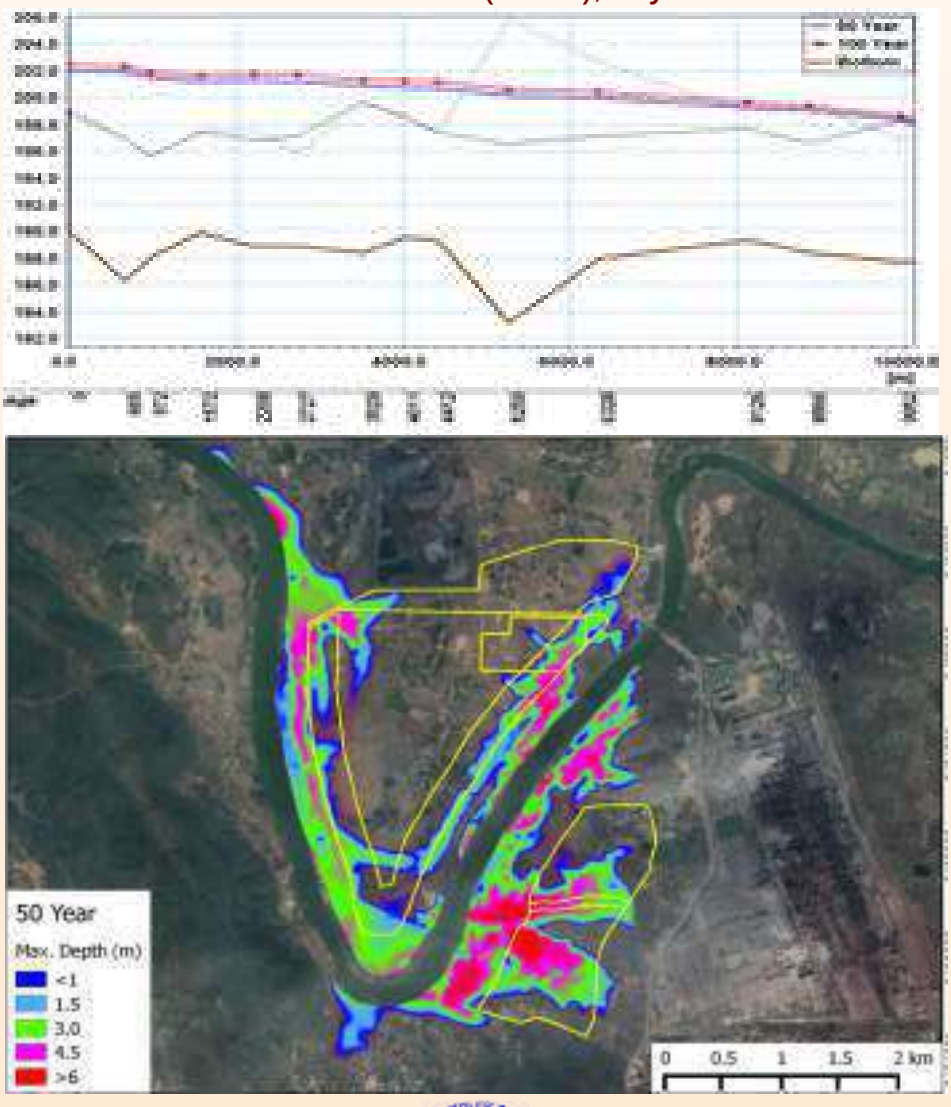


ANNEXURE IV
HYDROGEOLOGICAL REPORT

Area Drainage Study for NLC Talabira Thermal Power Project, Stage I (3x800 MW)

Sponsored by

NLC India Limited (NLCIL), Neyveli



NATIONAL INSTITUTE OF HYDROLOGY
ROORKEE – 247 667, UTTARAKHAND

October, 2018

Area Drainage Study for NLC Talabira Thermal Power Project, Stage I (3x800 MW)

Study Group

J. P. Patra, Scientist C & PI
Rakesh Kumar, Scientist G & Head SWHD
Pankaj Mani, Scientist E
R. P. Pandey, Scientist G

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE – 247 667

Executive Summary

NLC India Ltd (NLCIL) formerly, Neyveli Lignite Corporation Limited, a Navaratna enterprise of Government of India (GoI) is an existing, profit making, public sector enterprise engaged in mining of lignite and generation of power through lignite based thermal power plants. Now, NLCIL is planning to implement a 3200 MW NLC Talabira TPP in 2 Stages (Stage-I - 3x800 MW and Stage-II – 1x800 MW at a later date) with linkage to Talabira-II & III captive coal blocks allocated to NLCIL, which are situated in very close proximity to 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 study envisages identification of various flooding sources, estimation of maximum floods and their routing to the plant site for estimating the maximum flood level. Further, this study also includes analysis of local drainage pattern and final disposal point for the storm water and plant drainage.

The Digital Elevation Model (DEM) of the study area is prepared from surveyed contour for the plant area, spot heights; contours digitized from the SOI toposheets and SRTM data. The basin boundary and river networks are delineated from the DEM using HEC-GeoHMS and various catchment characteristics are estimated. The catchment area of Bhedan river at proposed plant site is about 3185.5 km^2. Synthetic Unit Hydrograph is developed using the catchment characteristics and following the guideline given in Flood Estimation Report. Daily rainfall data of ten raingauge stations in and around the catchment are procured from IMD, Pune and the annual 1-day maximum rainfall series are extracted for rainfall frequency analysis. Regional rainfall frequency analysis using L-moments approach is carried out for estimating rainfall of various return periods. The robust frequency distribution among twelve frequency distribution is identified based on L-moments ratio diagram and Z_i^{dist} –statistic criteria. Generalized Extreme Value (GEV) is identified as the robust frequency distribution for this case. The 1-day annual maximum rainfall for 25 year, 50 year and 100 year return periods are estimated to be 27.25 cm, 31.04 cm and 34.86 cm respectively. The design flood hydrograph are developed by convoluting the SUH with estimated hourly incremental design rainfall. The peak floods in

Bhedan river due 50 year and 100 year return period flood are estimated to be 9956.07 m^3/s and 11278.65 m^3/s respectively.

The flood routing study has been carried out using MIKE FLOOD package (a coupled 1D and 2-D flow analysis). The bathymetry of the flood plain around the plant site has been created from the DEM. The spills from catchment drainage and local rainfall have been simulated in MIKE-21. The 1-D model in Mike 11 is prepared for the study reach of Bhedan river using surveyed river cross-section at fifteen locations and 2-D model in Mike 21 is developed for both main plant area and ash pond area using 10m cell size. 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 from Bhedan rive in the areas below RL202 m level. As a protection measure, construction of embankments on both left and right bank is also analysed for various return period floods. 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/nall 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 analysed. 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 first south 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.

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1 ABOUT THE PROJECT

National Institute of Hydrology, Roorkee was assigned the project "Area Drainage Study for NLC Talabira Thermal Power Project, Stage I (3x800 MW)" sponsored by the NLC India Ltd., Neyveli. The original scopes of work are:

1. To visit the Tareikela & Kumbhari villages in Jharsuguda District of Odisha, under take extensive site visit of the entire area for getting acquaintance with the prevailing conditions and discussions with concerned officials regarding the studies & collection of all relevant input data.
2. Study the existing natural drainage pattern/ system, available information in form of reports, literature, satellite imageries etc. having a bearing on the storm water drainage system for the entire project area and its adjoining area in 25 km periphery. The study shall include review of topographical/ permanent features in the study area.
3. Review and analysis of rainfall data/ information to arrive at the design storm scenarios.
4. Review and analysis of relevant Survey of India Topographical sheets in 25 km.
5. Periphery, site specific topographical survey report and satellite imageries.
6. Estimation of flood hydrograph for a return period of 50 years considering historical as well as design rainfall to suggest complete scheme for storm water drainage system of the proposed project and to suggest augmentation/ modifications in existing storm water drainage system connected to natural nallas/ streams including diversion of nallas, if found necessary.
7. Final Discharge point(s) of Area Drainage to be decided in consultation with NLCIL and local authorities.
8. Suggesting protection measures if any for the Tareikela & Kumbhari villages in Jharsuguda District of Odisha.

2 DESCRIPTION OF STUDY AREA

2.1 General

NLC India Ltd (NLCIL) formerly, Neyveli Lignite Corporation Limited, a Navaratna enterprise of Government of India (GoI) is an existing, profit making, public sector enterprise engaged in mining of lignite and generation of power through lignite based thermal power plants. NLCIL was established by GoI in 1956, following the discovery of lignite deposits in Neyveli, Tamil Nadu. NLCIL has lined up a number of projects including expansion/augmentation of its existing mines and power plants, setting up of green-field mines & power plants, acquisition of power assets, acquisition of overseas mine assets, setting up of wind and solar power plants across the country. Now, NLCIL is planning to implement a 3200 MW NLC Talabira TPP in 2 Stages (Stage-I - 3x800 MW and Stage-II – 1x800 MW at a later date) with linkage to Talabira-II & III captive coal blocks allocated to NLCIL, which are situated in very close proximity to 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 nearest airports are at Bhubaneswar at a distance of 350 km and Raipur airport is at a distance of approx. 290 km. Nearest railway station at Jharsuguda on Howrah-Nagpur main (trunk) section is at a distance of 11 km. The geographical extent of the proposed project area lies along both banks of Bhedan river, which is a tributary of IB river. The location of the site is given in Figure 2.1.

2.2 Climate and Rainfall

The Jharsuguda district is characterized by a hot dry summer. The maximum temperature in the month of May is about 46 °C. It has an average rainfall of about 1527 mm. From April to August the wind blows from south and southwest whereas from September onwards wind blows from North West.

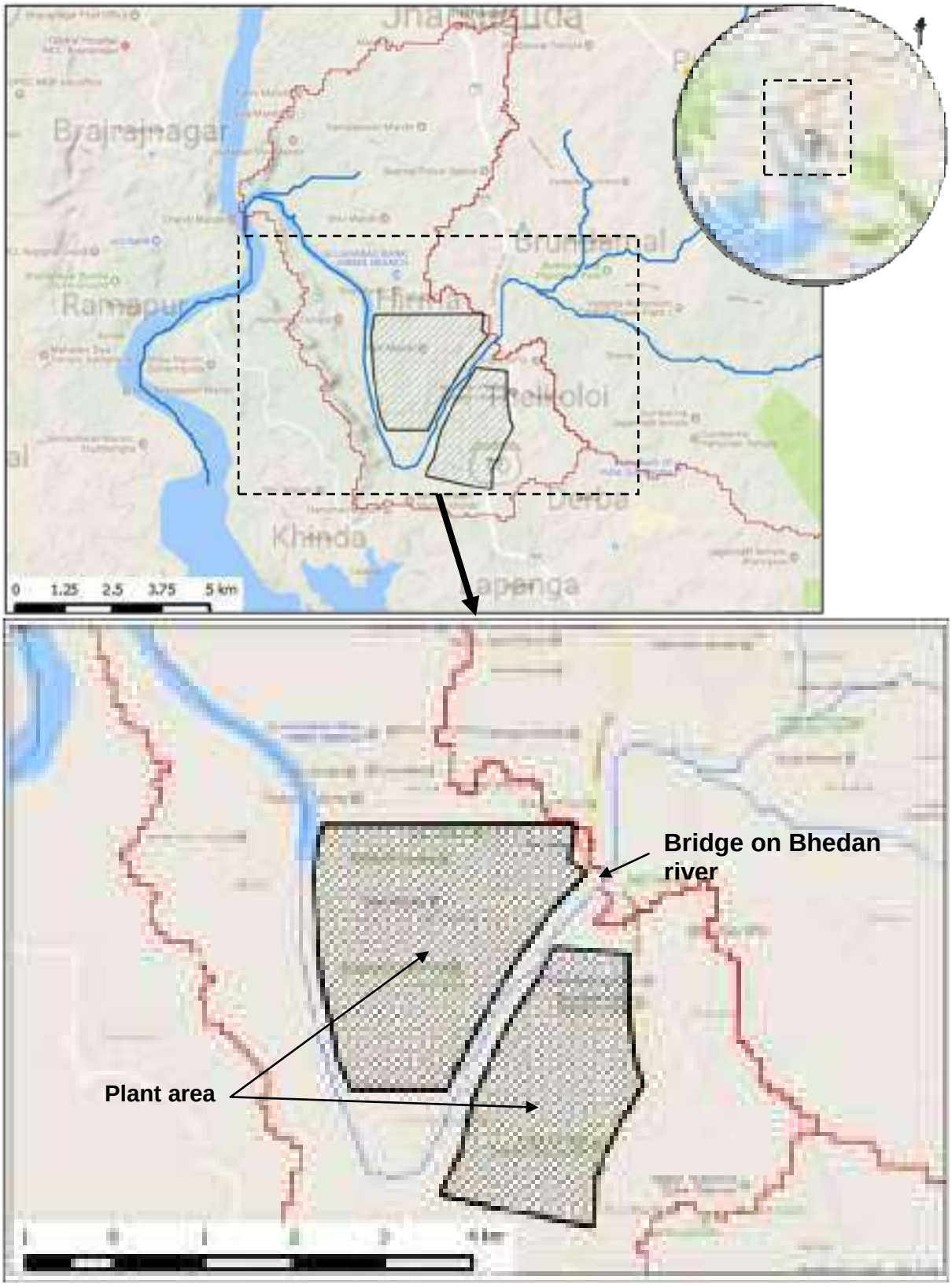


Figure 2.1: Index map of the study Area

3 DATA AVAILABILITY

This chapter describes data availability for design flood estimation using the deterministic approach based on unit hydrograph method and L-moments based rainfall and flood frequency analysis.

3.1 Data Availability for Unit Hydrograph Analysis

The observed data for application of the unit hydrograph approach were not available. Hence, in this study the synthetic unit hydrograph and hourly time distribution was derived using the flood estimation report of the CWC (1997) for Mahanadi Subzone 3 (d). The CWC report is based on the detailed synthetic unit hydrograph studies carried out by utilizing the data of 16 representative catchments. Total four available Survey of India toposheets of 1:50,000 scales (Figure 3.1) were used along with surveyed contour map and SRTM DEM for deriving catchment characteristics.

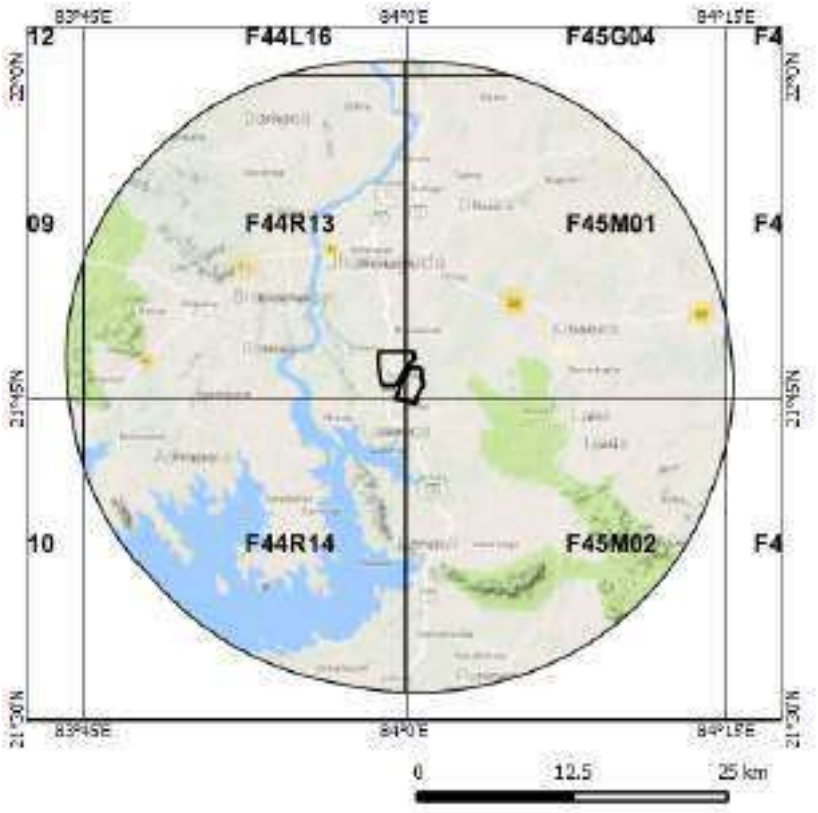


Figure 3.1: Layout of toposheets used in this study.

3.2 Data Availability for Rainfall frequency Analysis

Daily rainfalls for ten rain gauge stations namely: Deogarh, Jamankiru, Jharsuguda, Kirimira, Kolobira, Kuchinda, Kusumi, Kutra, Laikera_BL_II and Sambalpur (Figure 3.2) were obtained from IMD. The details of rainfall data available are given in Table 3.1. The values of annual 1 day maximum rainfall at these stations are given in Annexure I.

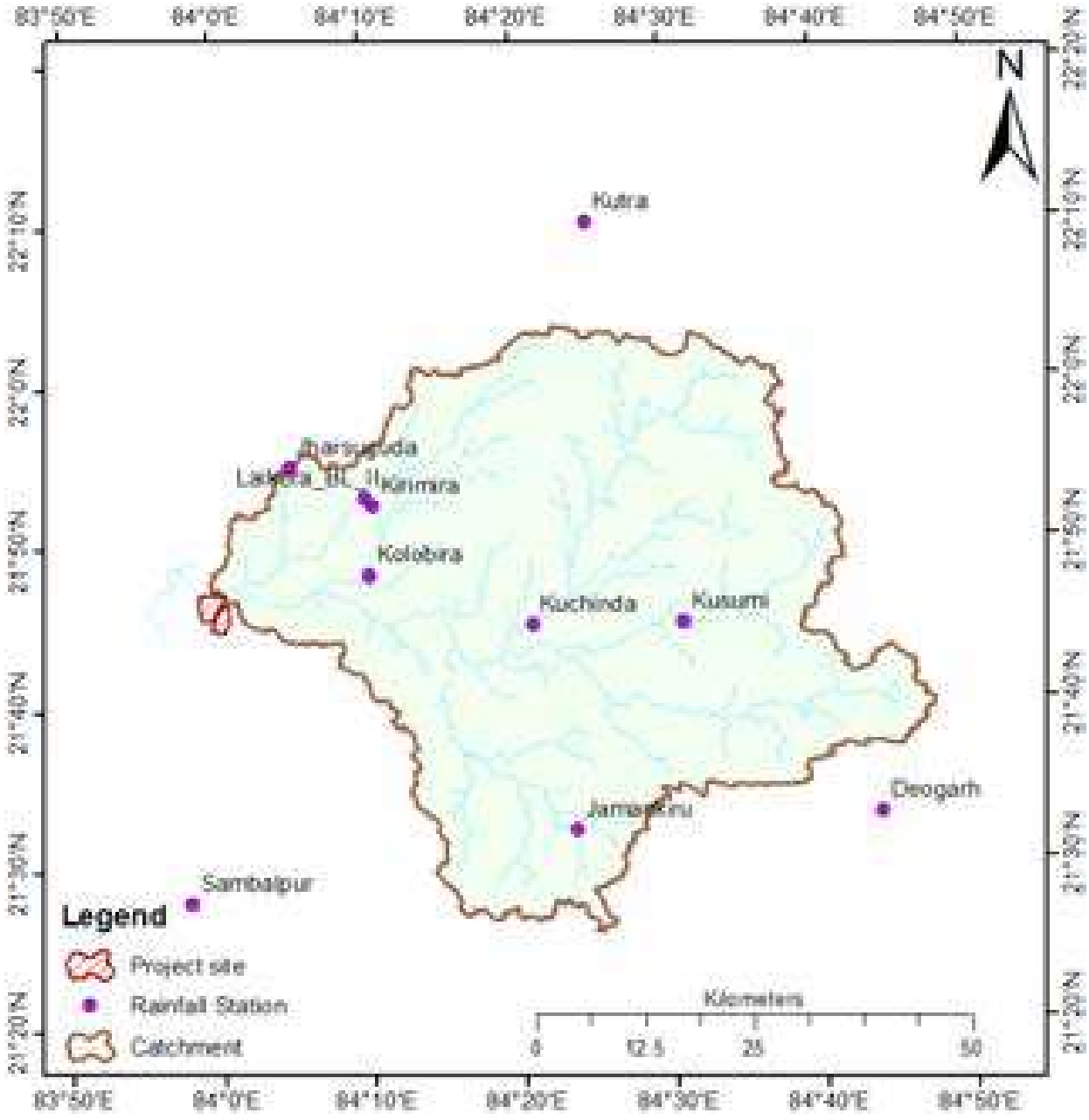


Figure 3.2: Rain-gauge stations

Table 3.1 Details of rainfall data availability.

Rainfall Station	Period of availability	Total data available period
Deogarh	1992 to 2014	20
Jamankiru	1967 to 2016	42
Jharsuguda	1960 to 2013	53
Kirimira	1981 to 2016	23
Kolobira	1981 to 2016	24
Kuchinda	1971 to 2016	25
Kusumi	1960 to 2013	44
Kutra	1991 to 2016	23
Laikera_BL_II	1967 to 2016	36
Sambalpur	1960 to 2013	53

3.3 Data Availability for flood routing

The topgraphic survey of project site in both banks of Bhedan river was provided by NLCIL. The cross-section of survey Bhedan river at fifteen locations was carriedout through external survey agency by NIH during the month of June 2018. These locations are shown in Figure 3.3 and the surveyed cross-section at location CS3 is shown in Figure 3.4. The survey report is given in Appendix I. The river networks are digitized from the SOI toposheets. The bathymetry is prepared from surveyed contour elevations.

Figure 3.3: Location of river cross-section

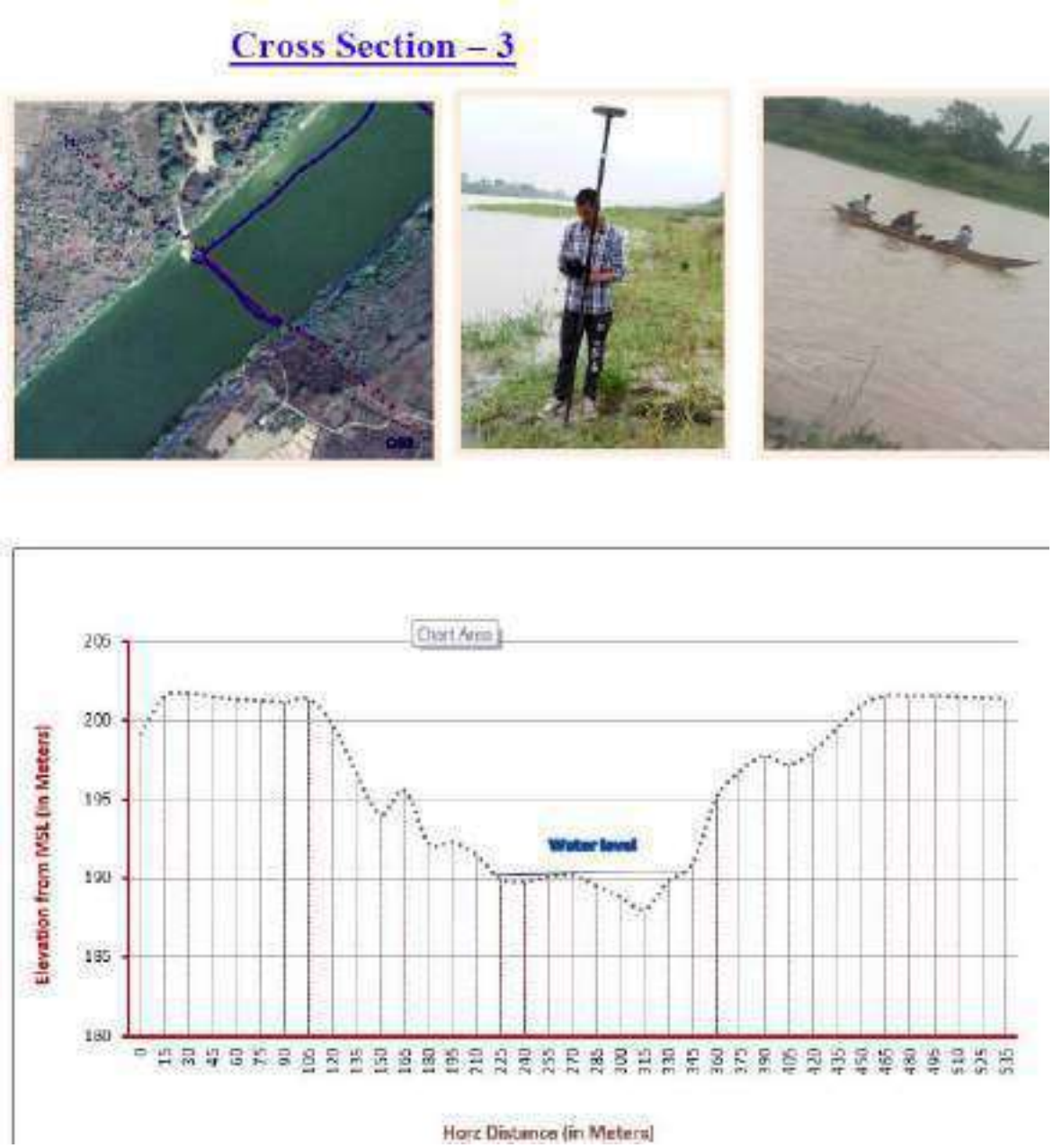


Figure 3.4: River cross-section at location CS3.

4 METHODOLOGY

The methodology used for estimation of design flood using the synthetic unit hydrograph approach and methodologies for analyzing flood inundation this flood described as follows.

4.1 Estimation of Rainfalls of Various Return Periods Using L-Moments Based Rainfall Frequency Analysis

The following aspects of methodology of L-moments based regional frequency relationship for gauged catchments as well as ungauged catchments are discussed as follows.

(i) Probability weighted moments (PWMs) and L-moments,
(ii) Data screening and missing value correction,
(iii) Test of regional homogeneity,
(iv) Frequency distributions used,
(v) Goodness of fit measures, and
(vi) Development of relationship between mean annual peak flood and catchment area.

In this study at-site rainfall frequency analysis and regional frequency analysis (Kumar and Chatterjee, 2005; Kumar et al., 2011) has been applied as discussed in Chapter 5.1.

4.1.1 Probability weighted moments (PWMs) and L-moments

L-moments of a random variable were first introduced by Hosking (1990). Hosking and Wallis (1997) state that L-moments are an alternative system of describing the shapes of probability distributions. Historically they arose as modifications of the probability weighted moments' (PWMs) of Greenwood et al. (1979).

4.1.1.1 Probability weighted moments (PWMs)

Probability weighted moments are defined by Greenwood et al. (1979) as:

$$M_{i,j,k} = \int_0^1 x(F)^i \ (F)^j (1-F)^k \, dF \qquad (1)$$

where, $F = F(x) = \int_{-x}^{x} f(x)\,dx$ is the cumulative density function and x (F) is the inverse of it; i, j, k are the real numbers. The particularly useful special cases of the PWMs α_k and β_j. are:

$$\alpha_k = M_{1,0,k} = \int_0^1 x(F)\,(1-F)^k\,dF \quad (2)$$

$$\beta_j = M_{1,j,0} = \int_0^1 x(F)\,(F)^j\,dF \quad (3)$$

These equations are in contrast with the definition of the ordinary conventional moments, which may be written as:

$$E(X^r) = \int \{x(F)\}^r\,dF \quad (4)$$

The conventional moments or "*product moments*" involve higher powers of the quantile function x(F); whereas, PWMs involve successively higher powers of non-exceedance probability (F) or exceedance probability (1-F) and may be regarded as integrals of x(F) weighted by the polynomials F^r or $(1-F)^r$. As the quantile function x(F) is weighted by the probability F or (1-F), hence these are named as probability weighted moments.

However, PWMs are difficult to interpret as measures of scale and shape of a probability distribution. This information is carried in certain linear combinations of the PWMs. These linear combinations arise naturally from integrals of x(F) weighted not by polynomials F^r or $(1-f)^r$ but by a set of orthogonal polynomials (Hosking and Wallis, 1997).

4.1.1.2 L-moments

Hosking (1990) defined L-moments as linear combination of probability weighted moments. In general, in terms of α_k and β_j, L-moments are defined as:

$$\lambda_{r+1} = (-1)^r \sum_{k=0}^{r} p^*_{r,k}\,\alpha_k = \sum_{k=0}^{r} p^*_{r,k}\,\beta_k \quad (5)$$

where, $p^r_{r,k}$ is an orthogonal polynomial (shifted Legender polynomial) expressed as:

$$p^*_{r,k} = (-1)^{r-k}\,{}^rC_k\,{}^{r+k}C_k = \frac{(-1)^{r-k}(r+k)!}{(k!)^2\,(r-k)!} \quad (6)$$

L-moments are easily computed in terms of probability weighted moments (PWMs) as given below.

$$\lambda_1 = \alpha_0 = \beta_0 \quad (7)$$

$$\lambda_2 = \alpha_0 - 2\alpha_1 = 2\beta_1 - \beta_0 \quad (8)$$

$$\lambda_3 = \alpha_0 - 6\alpha_1 + 6\alpha_2 = 6\beta_2 - 6\beta_1 + \beta_0 \quad (9)$$

$$\lambda_4 = \alpha_0 - 12\alpha_1 + 30\alpha_2 - 20\alpha_3 = 20\beta_3 - 30\beta_2 + 12\beta_1 + \beta_0 \quad (10)$$

The procedure based on PWMs and L-moments are equivalent. However, L-moments are more convenient, as these are directly interpretable as measures of the scale and shape of probability distributions. Clearly λ_1, the mean, is a measure of location, λ_2 is a measure of scale or dispersion of random variable. It is often convenient to standardise the higher moments so that they are independent of units of measurement.

$$\tau_r = \frac{\lambda_r}{\lambda_2} \quad \text{for} \quad r = 3, 4 \quad (11)$$

Analogous to conventional moment ratios, such as coefficient of skewness τ_3 is the L-skewness and reflects the degree of symmetry of a sample. Similarly τ_4 is a measure of peakedness and is referred to as L-kurtosis. These are defined as:

L-coefficient of variation (L-CV), (τ) = λ_2 / λ_1

L-coefficient of skewness, L-skewness (τ_3) = λ_3 / λ_2

L-coefficient of kurtosis, L-kurtosis (τ_4) = λ_4 / λ_2

Symmetric distributions have $\tau_3 = 0$ and its values lie between -1 and +1. Although the theory and application of L-moments is parallel to that of conventional moments, L-moments have several important advantages. Since sample estimators of L-moments are always linear combination of ranked observations, they are subject to less bias than ordinary product moments. This is because ordinary product moments require squaring, cubing and so on of observations. This causes them to give greater weight to the observations far from the mean, resulting in substantial bias and variance.

Zafirakou-Koulouris et al. (1998) mention that like ordinary product moments, L-moments summarise the characteristics or shapes of theoretical probability distributions and observed samples. Both moment types offer measures of distributional location (mean), scale (variance), skewness (shape), and kurtosis (peakedness). The authors further mention that L-moments offer significant advantages over ordinary product moments, especially for environmental data sets, because of the following:

i. L-moment ratio estimators of location, scale and shape are nearly unbiased, regardless of the probability distribution from which the observations arise (Hosking, 1990).

ii. L-moment ratio estimators such as L-C_v, L-skewness, and L-kurtosis can exhibit lower bias than conventional product moment ratios, especially for highly skewed samples.

iii. The L-moment ratio estimators of L-C_v and L-skewness do not have bounds which depend on sample size as do the ordinary product moment ratio estimators of C_v and skewness.

iv. L-moment estimators are linear combinations of the observations and thus are less sensitive to the largest observations in a sample than product moment estimators, which square or cube the observations.

v. L-moment ratio diagrams are particularly good at identifying the distributional properties of highly skewed data, whereas ordinary product moment diagrams are almost useless for this task (Vogel and Fennessey, 1993).

4.1.2 Data screening and missing value correction

In flood frequency analysis, the data collected at various sites should be true representative of the annual maximum peak flood measured and must be drawn from the same frequency distribution. The first step in flood frequency analysis is to verify that the data are appropriate for the analysis. The preliminary screening of the data must be carried out to ensure that the above requirements are satisfied. Errors in data may occur due to incorrect recording or transcription of the data values or due to shifting of the gauging site to a different location as well as due to changes in the measuring practices or as a result of water resources development activities. Tests for outliers and trends are well established in the statistical literature (e.g., Barnett and Lewis, 1994; W.R.C., 1981; Kendall, 1975). For comparison of data observed from different sites, some techniques such as double mass plots or quantile-quantile plots are commonly used.

Hosking and Wallis (1997) mention that in the context of regional frequency analysis using L-moments, useful information can be obtained by comparing the sample L-moment ratios for different sites, incorrect data values, outliers, trends and shifts in the mean of a sample can all be related to L-moments of the sample. A convenient amalgamation of the L-moment ratios into a single statistic, a measure of discordancy between L-moment ratios of a site and the average L-moment ratios of a group of similar sites, has been termed as "discordancy measure", D_i.

4.1.2.1 Discordancy measure

The aim of the discordancy measure is to identify those sites from a group of given sites that are grossly discordant with the group as a whole. Discordancy is measured in terms of the L-moments of the data of the various sites as defined below (Hosking and Wallis, 1997). Suppose that there are N sites in the group. Let $u_i = [t^{(i)} \quad t_3^{(i)} \quad t_4^{(i)}]^T$ be a vector containing the t, t_3 and t_4 values for site i: T denotes transposition of a vector or matrix. Let

$$\bar{u} = N^{-1}\sum_{i=1}^{N} u_i \tag{12}$$

be (unweighted) group average. The matrix of sums of squares and cross products is defined as:

$$A = \sum_{i=1}^{N}(u_i - \bar{u})(u_i - \bar{u})^T \tag{13}$$

The discordancy measure for site i is defined as:

$$D_i = \frac{1}{3}N(u_i - \bar{u})^T A^{-1}(u_i - \bar{u}) \tag{14}$$

The site i is declared to be discordant if D_i is larger than the critical value of the discordancy statistic D_i given in Table 4.1.

Table 4.1 Critical values of discordancy statistic, D_i
(adapted from Hosking and Wallis, 1997)

No. of sites in region	Critical value	No. of sites in region	Critical value
5	1.333	10	2.491
6	1.648	11	2.632
7	1.917	12	2.757
8	2.140	13	2.869
9	2.329	14	2.971
		≥ 15	3

For a discordancy test with significance level α an approximate critical value of $\max_i D_i$ is (N-1)Z/(N-4+3Z), where Z is the upper $100\alpha/N$ percentage point of an F distribution with

3 and N-4 degrees of freedom. This critical value is a function of α and N, where $\alpha = 0.10$. D_i is likely to be useful only for regions with $N \geq 7$.

4.1.3 Test of regional homogeneity

A test statistic H, termed as heterogeneity measure has been proposed by Hosking and Wallis (1993). It compares the inter-site variations in sample L-moments for the group of sites with what would be expected of a homogeneous region. The inter-site variation of L-moment ratio is measured as the standard deviation (V) of the at-site LCV's weighted proportionally to the record length at each site. To establish what would be expected of a homogeneous region, simulations are used. A number of, say 500 data regions are generated based on the regional weighted average statistics using a four parameter distribution e.g. Kappa or Wakeby distribution. The inter-site variation of each generated region is obtained and the mean (μ_v) and standard deviation (σ_v) of the computed inter-site variation is obtained.

Let the proposed region has N sites with site i having record length n_i and sample L-moment ratios $t^{(i)}$, $t_3^{(i)}$, and $t_4^{(i)}$. The regional average L-CV, L-Skewness and L-Kurtosis weighted proportionally to the sites' record length for example, t^R mentioned below. The various steps involved in computation of heterogeneity measure (H) are mentioned below.

(i) Compute the weighted regional average L moment ratios

$$t^R = \sum_{i=1}^{N_s} n_i \, t^{(i)} \Big/ \sum_{i=1}^{N_s} n_i \qquad (15)$$

The value of t_3^R and t_4^R can also be computed similarly by replacing $t^{(i)}$ by $t_3^{(i)}$, and $t_4^{(i)}$.

(ii) Compute the weighted standard deviation of at site LCV's ($t^{(i)}$)

$$V = \left[\sum_{i=1}^{N} n_i \, (t^{(i)} - t^R)^2 \Big/ \sum_{i=1}^{N} n_i \right]^{½} \qquad (16)$$

(iii) Fit a general 4-parameter distribution (Kappa or 4 parameter Wakeby etc.) to the regional average L-moment ratios, t^R, t_3^R and t_4^R.

(iv) Simulate a large number of regions say 500 having same record lengths as the observed data of the proposed region.

(v) Repeat steps 1 and 2 for each of the 500 simulated regions and calculate the weighted standard deviations for each simulated region and take it as v_1, v_2, v_3,…….v_{500}.

(vi) Compute the mean (μ_v) and standard deviation (σ_v) of the values obtained in step (v).

(vii) Compute the Heterogeneity measure H as given below.

$$H = \frac{V - \mu_v}{\sigma v} \tag{17}$$

The criteria established by Hosking and Wallis (1993) for assessing heterogeneity of a region is as follows.

If $H < 1$	Region is acceptably homogeneous.
If $1 \leq H < 2$	Region is possibly heterogeneous.
If $H \geq 2$	Region is definitely heterogeneous.

4.1.4 Frequency distributions used

The following twelve frequency distributions have been used in this study.

i. Extreme value (EV1)/ Gumbel distribution
ii. General extreme value (GEV)
iii. Logistic (LOS)
iv. Generalized logistic (GLO)
v. Normal (NOR)
vi. Generalized Pareto (GPA)
vii. Generalized normal (GNO)
viii. Uniform (UNF)
ix. Pearson Type-III (PT3)
x. Kappa (KAP) and
xi. Wakeby (WAK)
xii. Exponential (EXP)

The details about these distributions and relationships among parameters of these distributions and L-moments are available in literature (e.g. Hosking and Wallis, 1997) and the same are summarized below.

4.1.4.1 Extreme value type-I distribution (EV1)

Extreme Value Type-I distribution (EV1) is a two parameter distribution and it is popularly known as Gumbel distribution. The quantile function or the inverse form of the distribution is expressed as:

$$x(F) = u - \alpha \ln(-\ln F) \quad (18)$$

Where, u and α are the location and scale parameters respectively, F is the non-exceedence probability viz. (1-1/T) and T is return period in years.

4.1.4.2 General extreme value distribution (GEV)

General Extreme Value distribution (GEV) is a generalized three parameter extreme value distribution. Its theory and practical applications are reviewed in the Flood Studies Report (NERC,1975). The quantile function or the inverse form of the distribution is expressed as:

$$x(F) = u + \alpha \{1 - (-\ln F)^{k}\}/ k ; \qquad k \neq 0 \quad (19)$$

$$x(F) = u - \alpha \ln(-\ln F) \qquad k = 0 \quad (20)$$

Where, u, α and k are location, scale and shape parameters of GEV distribution respectively. EV1 distribution is the special case of the GEV distribution, when k = 0.

4.1.4.3 Logistic distribution (LOS)

Inverse form of the Logistic distribution (LOS) is expressed as:

$$x(F) = u - \alpha \ln\{(1-F) / F\} \quad (21)$$

Where, u and α are location and scale parameters respectively.

4.1.4.4 Generalized logistic distribution (GLO)

Inverse form of the Generalized Logistic distribution (GLO) is expressed as:

$$x(F) = u + \alpha [\, 1 - \{(1-F) / F\}^{k} \,] / k; \qquad k \neq 0 \quad (22)$$

$$x(F) = u - \alpha \ln\{(1-F) / F\}; \qquad k = 0 \quad (23)$$

Where, u, α and k are location, scale and shape parameters respectively. Logistic distribution is the special case of the Generalized Logistic distribution, when k = 0.

4.1.4.5 Generalized Pareto distribution (GPA)

Inverse form of the Generalized Pareto distribution (GPA) is expressed as:

$$x(F) = u + \alpha \{ 1 - (1-F)^k \} / k; \qquad k \neq 0 \tag{24}$$

$$x(F) = u - \alpha \ln(1-F) \qquad k = 0 \tag{25}$$

where, u, α and k are location, scale and shape parameters respectively. Exponential distribution is special case of Generalized Pareto distribution, when k = 0.

4.1.4.6 Generalized normal distribution (GNO)

The cumulative density function of the three parameter Generalized normal distribution (GNO) is given below.

$$F(x) = \phi\left[-k^{-1}\log\{1-k(x-\xi)/\alpha\}\right] \tag{26}$$

where, ξ, α and k are its location, scale and shape parameters respectively. When k = 0, it becomes normal distribution with parameters ξ and α. This distribution has no explicit analytical inverse form.

4.1.4.7 Pearson Type-III distribution (PT-III)

The inverse form of the Pearson type-III distribution is not explicitly defined. Hosking and Wallis (1997) mention that the Pearson type-III distribution combines Gamma distributions (which have positive skewness), reflected Gamma distributions (which have negative skewness) and the normal distribution (which has zero skewness). The authors parameterize the Pearson type-III distribution by its first three conventional moments viz. mean μ, the standard deviation σ, and the skewness γ. The relationship between these parameters and those of the Gamma distribution is as follows. Let X be a random variable with a Pearson type-III distribution with parameters μ, σ and γ. If $\gamma > 0$, then $X - \mu + 2\sigma/\gamma$ has a Gamma distribution with parameters $\alpha = 4/\gamma^2$, $\beta = \sigma\gamma/2$. If $\gamma = 0$, then X has normal distribution with mean μ and standard deviation σ. If $\gamma < 0$, then $-X + \mu - 2\sigma/\gamma$ has a Gamma distribution with parameters $\alpha = 4/\gamma^2$, $\beta = |\sigma\gamma/2|$.

If $\gamma \neq 0$, let $\alpha = 4/\gamma^2$, $\beta = |\sigma\ \gamma/2|$, and $\xi = \mu - 2\sigma/\gamma$ and Γ (.) is Gamma function. If $\gamma > 0$, then the range of x is $\xi \leq x < \infty$ and the cumulative distribution function is:

$$F(x) = G\left(\alpha, \frac{x-\xi}{\beta}\right) \Big/ \Gamma(\alpha) \tag{27}$$

If $\gamma < 0$, then the range of x is $-\infty < x \leq \xi$ and the cumulative distribution function is:

$$F(x) = 1 - G\left(\alpha, \frac{\xi - x}{\beta}\right) \Big/ \Gamma(\alpha) \tag{28}$$

4.1.4.8 Kappa distribution (KAP)

The kappa distribution is a four parameter distribution that includes as special cases the Generalized logistic (GLO), Generalized extreme value (GEV) and Generalized Pareto distribution (GPA).

$$x(F) = \xi + \alpha\left[1 - \left\{(1-F)^h / h\right\}^k\right] / k \tag{29}$$

where, ξ is the location parameter, α is the scale parameter.

When h = -1, it becomes Generalized logistic (GLO) distribution; h = 0 is the Generalized extreme value (GEV) distribution; and h = 0 is the Generalized Pareto (GPA) distribution. It is useful as a general distribution with which to compare the fit of two and three parameter distributions and for use in simulating artificial data in order to assess the accuracy of statistical methods (Hosking and Wallis, 1997).

4.1.4.9 Wakeby distribution (WAK)

Inverse form of the five parameter Wakeby (WAK) distribution is expressed as:

$$x(F) = \xi + \frac{\alpha}{\beta}\left\{1 - (1-F)^{\beta}\right\} - \frac{\gamma}{\delta}\left\{1 - (1-F) - \delta\right\} \tag{30}$$

where, ξ, α, β, γ, and δ are the parameters of the Wakeby distribution.

4.1.5 Goodness of fit measures

In a realistically homogeneous region, all the sites follow the same frequency distribution. But as some heterogeneity is usually present in a region so no single distribution is expected to provide a true fit for all the sites of the region. In regional flood frequency analysis the aim is to identify a distribution which will yield reasonably accurate quantile estimates for each site of the homogeneous region. Assessment of validity of the candidate distribution may be made on the basis of how well the distribution fits the observed data. The goodness of fit measure assesses the relative performance of various fitted distributions and help in identifying the robust viz. most appropriate distribution for the region. A number of methods are available for testing goodness of fit of the proposed flood frequency analysis models. These include Chi-square test, Kolmogorov-Smirnov test, descriptive ability tests and the predictive ability tests. Cunnane (1989) has brought out a comprehensive description of the descriptive ability tests and the predictive ability tests. Apart from the aforementioned tests the recently introduced L-moment ratio diagram based on the approximations given by Hosking (1991) and the goodness of fit or behaviour analysis measure for a frequency distribution given by statistic Z_i^{dist} described below, are also used to identify the suitable frequency distribution.

4.1.5.1 L-moment ratio diagram

The L-moment statistics of a sample reflect every information about the data and provide a satisfactory approximation to the distribution of sample values. The L-moment ratio diagram can therefore be used to identify the underlying frequency distribution. The average L-moment statistics of the region is plotted on the L-moment ratio diagram and the distribution nearest to the plotted point is identified as the underlying frequency distribution. One big advantage of L-moment ratio diagram is that one can compare fit of several distributions using a single graphical instrument (Vogel and Fennessey, 1993).

4.1.5.2 Z_i^{dist} Statistic as a goodness-of-fit measure

In this method also the objective is to identify a distribution which fits the observed data acceptably closely. The goodness of fit is judged by how well the L-Skewness and L-Kurtosis of the fitted distribution match the regional average L-Skewness and L-Kurtosis of the observed data. The goodness-of-fit measure for a distribution is given by statistic Z_i^{dist}.

$$Z_i^{dist} = \frac{\left(\bar{\tau}_i^R - \tau_i^{dist}\right)}{\sigma_i^{dist}} \tag{31}$$

where $\bar{\tau}_i^R$ - weighted regional average of L-moment statistic i, τ_i^{dist} and σ_i^{dist} are the simulated regional average and standard deviation of L-moment statistics i for a given distribution.

The distribution giving the minimum $\left|Z^{dist}\right|$ value is considered as the best fit distribution. When all the three L-moment ratios are considered in the goodness-of-fit test, the distribution that gives the best overall fit when all the three statistics are consider together is selected as the underlying regional frequency distribution. According to Hosking (1993), distribution is considered to give good fit if $\left|Z^{dist}\right|$ is sufficiently close to zero, a reasonable criteria being $\left|Z^{dist}\right| \leq 1.64$.

Let the homogeneous region has N_s sites with site i having record length n_i and sample L-moment ratios t_i, t_{3i} & t_{4i}. Steps involved in computation of statistic Z_i^{dist} are:

i. Compute the weighted regional average L-moment ratios.

$$t^R = \frac{\sum_{i=1}^{N_S} n_i t_i}{\sum_{i=1}^{N_S} n_i} \tag{32}$$

The values of t_3^R and t_4^R are computed similarly by replacing t_i by t_{3i} and t_{4i} respectively.

ii. Fit the candidate distribution to the regional average L-moment ratios t^R, t_3^R and t_4^R and mean = 1.

iii. Use the fitted distribution to simulate a number of regions, say 500, having same record length as the observed data.

iv. Repeat step 1 for each simulated region and the weighted regional average for the simulations are taken as t_1^R, t_2^R ... t_{500}^R and similarly for t_3^R & t_4^R.

v. Compute the mean $\left(\tau_i^{dist}\right)$ and standard deviation $\left(\sigma_i^{dist}\right)$ for the values computed in step 4 above for each L-moment statistic i.

vi. Goodness-of-fit measure Z_i^{dist} is computed as $Z_i^{dist} = \frac{\bar{\tau}_i^R - \tau_i^{dist}}{\sigma_i^{dist}}$ (33)

vii. Repeat the steps 2 to 6 for each of the distributions. Distribution giving the minimum $\left|Z_i^{dist}\right|$ value for the L-moment statistics is identified as the best fit distribution.

4.2 Preparation of Digital Elevation Model

The four toposheets of 1:50,000 scales obtained from Survey of India were scanned, geo-referenced and projected to 44 North zone of WGS1984 UTM projected coordinate system. Then all the contour lines, spot heights and bench marks from the toposheets are digitised to polyline and point shape files with help of ArcMap. Further, the surveyed contours line and point elevation of plant area provided by NLCIL are imported to ArcGIS from Auto Cad file. The DEM is prepared with help of Topo to Raster tool of spatial analyst in ArcMap, which interpolates a hydrologically correct raster surface from point, line, and polygon data. The SRTM DEM is used in for remaining upper portion of the catchment. The prepared DEM of the study area is shown in

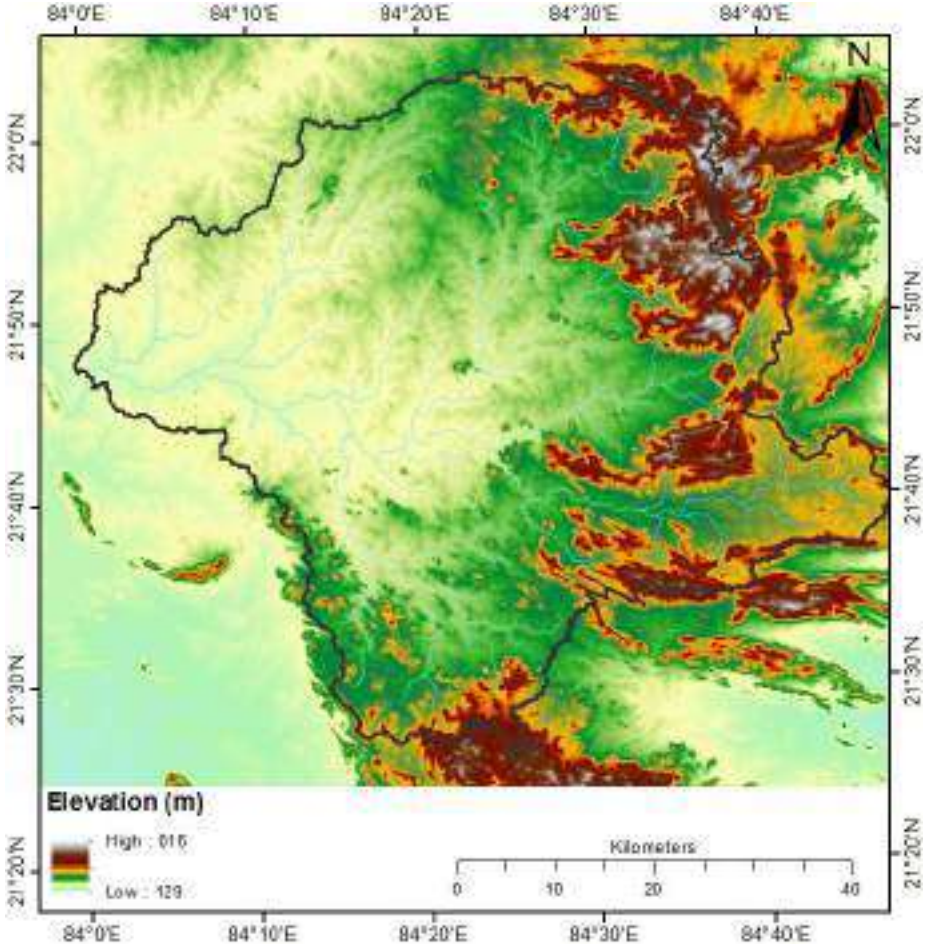


Figure 4.1.

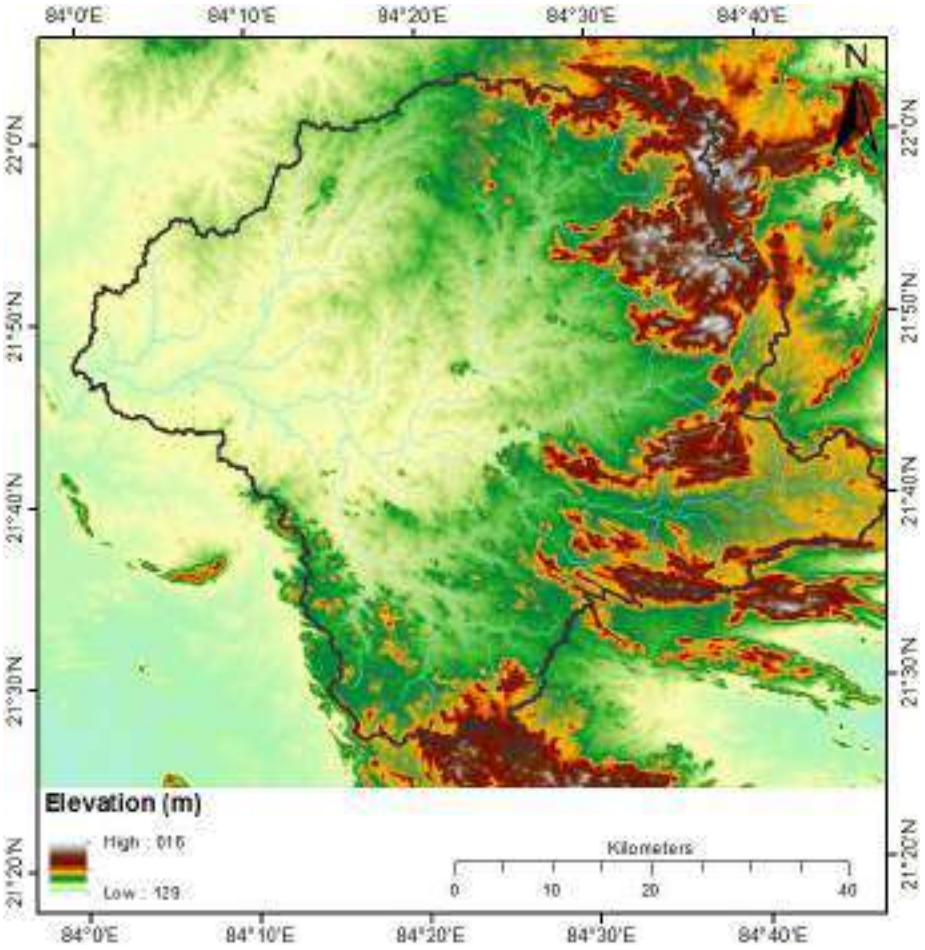


Figure 4.1: Digital elevation model of the study area

4.3 Catchment Delineation and Estimation of Catchment Characteristics

Initially a wide extent of generated DEM has been used to delineate the drainage network for the whole catchment. The HEC-GeoHMS 5.0 package in ArcGIS 9.3 is used for delineating catchments and their characteristics.

4.4 Derivation of Synthetic Unit Hydrograph

The various parameters of the synthetic unit hydrograph are derived from the Flood Estimation Report (CWC, 1993). Detail description of parameter and their relationships are given in Table 4.2. As mentioned in the CWC (1997) report the relationships are for 1-hour unit hydrograph (1-h UH).

Table 4.2 Relationships for estimating 1-h UH parameters for the study area

Sl. No.	Parameters	Relationship
1	Time in hours from the centre of unit rain fall duration to the peak of unit hydrograph.	$t_p = 1.757\left(LL_c/\sqrt{S}\right)^{0.261}$
2	Peak discharge of unit hydrograph per unit area of catchment ($m^3/s/ km^2$)	$q_p = 1.260\left(t_p\right)^{-0.725}$
3	Width of UH in hours at 50 percent of peak discharge	$W_{50} = 1.974\left(q_p\right)^{-1.104}$
4	Width of UH in hours at 75 percent of peak discharge	$W_{75} = 0.961\left(q_p\right)^{-1.125}$
5	Width of the rising limb of UH in hours at 50 percent peak discharge	$WR_{50} = 1.150\left(q_p\right)^{-0.829}$
6	Width of the rising limb of UH in hours at 75 percent peak discharge	$WR_{75} = 0.527\left(q_p\right)^{-0.932}$
7	Base width of unit hydrograph in hours	$T_B = 5.411\left(t_p\right)^{0.826}$
8	Peak discharge of unit hydrograph in m^3/s	$Q_p = q_p \times A$

Where, L = Length of the main stream (km), L_c = Centoridal longest flow path (km), S = Equivalent stream slope (m/km), A= Area of the catchment (km^2).

4.5 Estimation of Flood Hydrographs

Flood hydrographs for various return periods were estimated for 1-day maximum rainfall. The steps for estimating flood hydrographs are discussed in following sections.

4.5.1 Design loss rate

Generally infiltration index and the initial losses values are derived from the available rainfall-runoff records for the severe storms in the basin. Assuming the basin would be saturated at the time of design storm the minimum infiltration rate and initial losses values would be considered. The minimum infiltration rate and minimum initial loss, thus obtained, are used to compute the effective rainfall of design storm. For this the initial losses must be subtracted first from the rainfall increments and thereafter a uniform loss rate equal to the minimum infiltration index is applied. Here, a loss rate of 0.15 cm/h is used as recommended in the CWC (1997) report.

4.5.2 Base flow for design flood

Base flow is the portion of stream flow that comes from the sum of deep subsurface flow and delayed shallow subsurface flow. CWC (1997) has analyzed total 129 flood events for estimating base flow. The recommended value of base flow 0.1 $m^3/s/km^2$ for Subzone-3(d) is used in this study.

4.5.3 Time adjustment of design rainfall

To determine the maximum depths for unrestricted periods and also to obtain short duration (less than 24-hours) increments of rainfall required for small and medium sized catchments, it is necessary to adjust the depth-duration curve of the design storm based on daily data. The Manual on estimation of design flood (CWC, 2001) analysed time distribution pattern of storms in the area for which adequate self recoding rain-gauge data are available. In the manual, depth duration analyses of maximum rainfall depths for standard duration of 6, 12, 18, 24, 36, 48 hours etc., were obtained for each of the storms and expressed as percentage of the total storm depth. Enveloping percentages are then obtained and applied to adjust the design rainfall based on observational day data. In absence of hourly rainfall data it is recommended to apply a factor of 1.15 to convert 1-day maximum rainfall to 24-h maximum rainfall.

4.5.4 Design storm duration

The duration of storm rainfall which causes maximum discharge in a drainage basin is called design storm duration. The flood hydrographs due to 1-day maximum rainfall for various return periods are estimated.

4.6 Estimation of Design Flood Hydrographs

The flood hydrographs are estimated by first calculating annual maximum rainfall at each rain-gauge station for various return periods obtained from L-moments based rainfall frequency analysis. Then regional rainfall for the study area is also calculated. The 24 hour rainfall is divided in to incremental hourly rainfall according to time distribution provided in the CWC (1997) report. To obtain the critical sequence of rainfall the largest of increments is placed against the peak of UH, then the next largest against the next UH ordinate and so on until all rainfall increments get arranged. Then the sequence is reversed to get the critical sequence for all spells. In case of 24-h duration rainfall the first and second 12 h blocks are interchanged to get critical situation. The design loss rate is subtracted from the hourly rainfall to obtain effective rainfall hyetograph and the direct

runoff hydrograph is estimated by convoluting this effective rainfall with UH. Finally, the base flow is added to obtain design flood hydrograph.

4.7 Flow Simulation and Flood Modelling

The flooding in Bhedan river reach due to design floods has been modelled using coupled MIKE 11 and MIKE 21 model. The MIKE 21 has been dynamically linked to the MIKE 11 model, into a single package called MIKE FLOOD developed at the Danish Hydraulic Institute (Rungo and Olesen, 2003) is widely used for flood inundation studies. (Sanders, 2007; Chatterjee et al., 2008; Patro et al., 2009 and Pramanik et al, 2010). The methodology and the working principal of MIKE FLOOD are being discussed in the following sections.

4.7.1 Flow modelling by Mike 11 hydrodynamic model

MIKE 11 is a versatile and modular engineering tool for modelling hydrodynamic conditions in rivers, lakes/reservoirs, irrigation canals and other inland water systems. It is a fully dynamic modelling tool for the detailed analysis, design, management and operation of both simple and Complex River and channel systems (DHI, 2004). The hydrodynamic (HD) model is the nucleus of the MIKE 11 modelling system and forms the basis for simulation of flood inundation. The HD model is capable of simulating unsteady flow in a network of rivers. The result of HD simulation consists of a time series of water level and discharges at various points along the river system. MIKE 11 HD provides a choice among three different flow descriptions, namely kinematics, diffusive and dynamic wave approaches. MIKE 11 HD solves the Saint-Venant equations to obtain the hydrodynamic state of the river networks. The post-processor tool of MIKE 11 is the MIKEVIEW, which helps to view and analyze the results through graphical and animated interfaces.

4.7.1.1 Governing Equations

The governing equations in MIKE 11 are 1-D (one-dimensional) and shallow water type, which are the modifications of basic Saint-Venant equations. These are transformed to a set of implicit finite difference equations, and solved using double sweep algorithm (Abbot and Ionescu, 1967). The computational grid comprises of alternating Q and H_1 points automatically generated by the model, on the basis of user requirements (Figure 4.2). Q points are always placed midway between neighbouring H_1 points. H_1 points are located at cross sections or at equidistant intervals, in between if the distance between cross-sections is greater than the maximum space interval, dx specified by the users (dx=1000 m in the present setup).

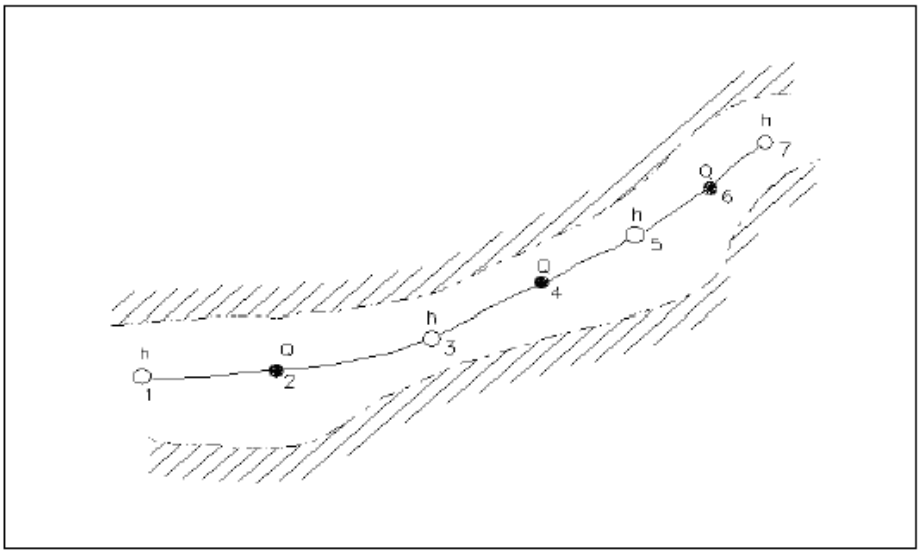


Figure 4.2 : MIKE 11 computational grids

4.7.1.2 MIKE 11 model setup

In the present study, the MIKE 11 model setup is prepared by defining following five input parameters:

1. Layout of river/ canal network
2. Cross section data definition
3. Defining hydrodynamic boundary conditions
4. Setting the HD parameters
5. Fixing the simulation parameters

4.7.1.3 Layout of river networks

The layout of MIKE 11 river networks are prepared by digitizing the scanned and geo-referenced topographical map of the study area in the MIKE 11 network editor tool. Figure 4.3 presents the digitized river reach of about 12.7 km for the study area. The space interval between consecutive points are kept finer (*dx=1000m*) to get accurate representation of the river network.

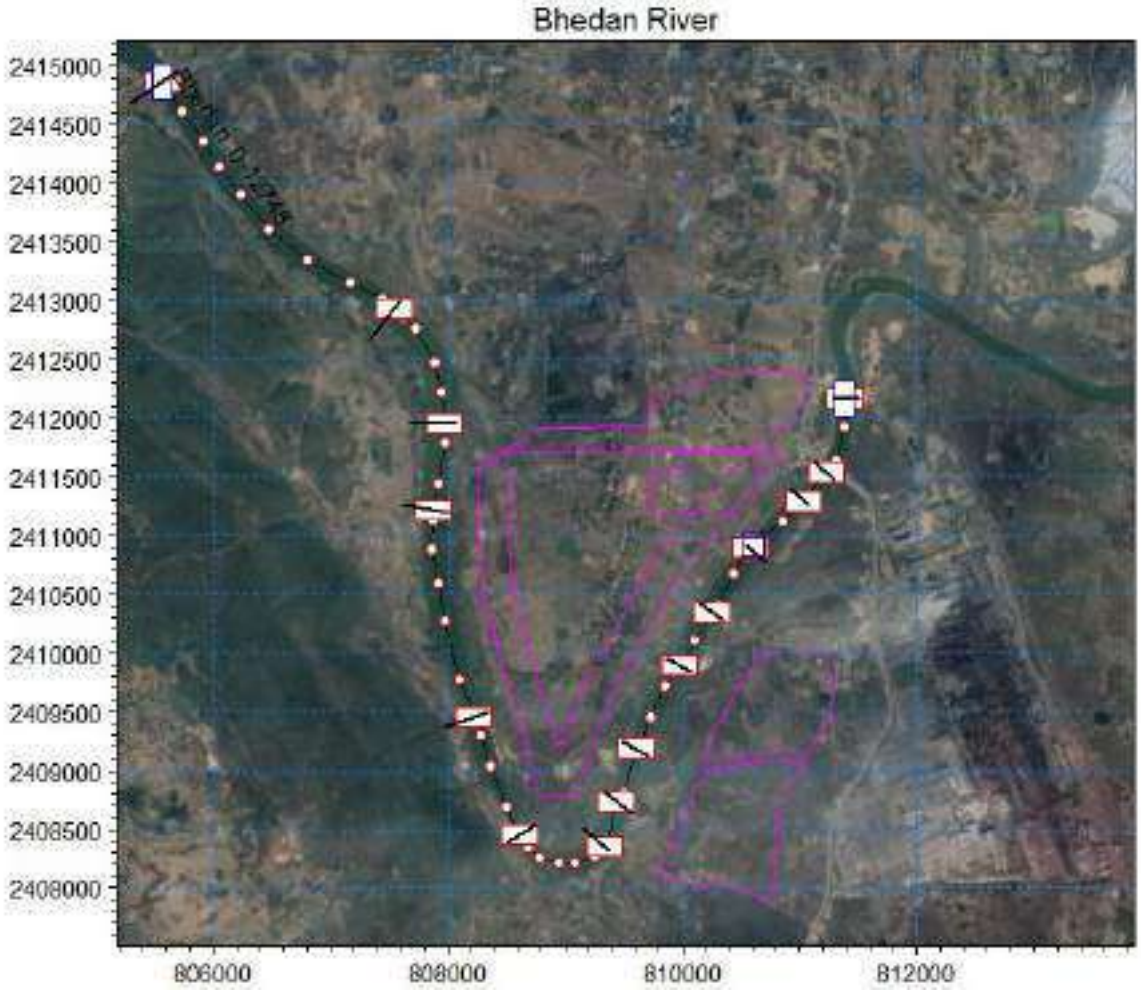


Figure 4.3: Mike-11 river network setup

4.7.1.4 Cross section data definition

The topographical description of the area to be modelled is achieved through the specification of cross-sections of the river, which lie approximately perpendicular to the direction of flow. Cross-sections are specified by a number of *x*-*z* co-ordinates where *x* is the transverse distance from a fixed point (often left bank top) and *z* is the corresponding bed elevation. Physically there should be a sufficient number of cross-sections to define adequately the variation in river shape. In the present study the actual measured cross-sections are used at fifteen locations. The *x*-*z* co-ordinates are entered as raw data in the cross-section editor. The raw data are then automatically processed into a form used in the hydrodynamic calculations, i.e. the hydraulic parameters; cross-sectional area, hydraulic radius and width are calculated for a number of elevations between a minimum and a maximum which are either determined automatically or may be user specified.

4.7.1.5 Hydrodynamic boundary condition definition

Boundary conditions are required at all model boundaries, i.e. upstream and downstream ends of model branch which are not connected at any junction. The boundary conditions may be internal or external. The internal boundary condition includes the specifications at nodal points and structures, whereas the external boundary condition includes the specification of constant values of *H* or *Q* or time varying values of *Q* or *H* at start and end points. In the present setup there is only one branch having two open hydrodynamic boundaries. The upstream boundary condition is provided with design flood hydrographs of 50 year and 100 year return period floods. The downstream boundary condition is given as uniform flow i.e. system calculated rating curve.

4.7.1.6 Setting the HD parameters

The HD parameters, in the present study, include the initial conditions of water level and discharge, friction coefficient (*n*) and output parameters options. Initial conditions are required to avoid the dry bed conditions. The n value is specified as 0.025. The global value for the initial condition for water level is kept at a low value of 0.01m to avoid dry bed conditions.

4.7.1.7 Fixing the simulation parameters

Before running the model simulation, control parameters such as simulation period, simulation time step, data to be stored and storage time have to be specified. The simulation periods are specified by start and end dates specified by year, month, day and hour and minute. MIKE 11 checks the actual time and reads all the data given in the time series during the simulation. There exists a versatile relationship between the time step and the computational distance (*dx)* to define the Courant number given below, which is widely considered to choose the time step for the model simulation.

$$\text{Courant number } (C_R) = \frac{\Delta t\left(V + \sqrt{gy}\right)}{\Delta x} \tag{36}$$

Where, Δt = time step, V= mean flow velocity (m/s), y = water level (m) and Δx = dx-max. If there is a large value of dx, the time step should be chosen so small that the C_R value should be low. Low value of C_R is needed to avoid instability during the model simulation. In the present setup the time step is kept very low as 2 seconds because the dx value is larger, i.e., 1 km. The simulation has been performed for 109 h period starting from 01-09-2018 08:00 AM to 05-09-2018 08:00 AM (four days). These dates are hypothetical.

4.7.1.8 Calibration and validation of MIKE 11

Calibration of a model is the process of adjusting model parameters to obtain a close agreement between the observed and the simulated outputs. Validation of the calibrated model is essential to check the calibration precision. Observed stage/discharge data of the river are not available for the calibration and validation process.

4.7.2 Two-Dimensional flow modelling by Mike 21 HD model

MIKE 21 HD is the basic computational hydrodynamic model of the entire MIKE 21 system. MIKE 21 HD simulates the water level variations and flows in response to a variety of forcing functions in creeks, rivers, lakes, estuaries, bays and coastal areas. The water levels and flows are resolved on a rectangular grid covering the area of interest. MIKE 21 HD is able to model the wide range of conditions likely to be encountered in inland waterways and their floodplains.

MIKE 21 system solves the full, time dependent, non-linear equations of continuity and conservation of momentum equation as given below.

$$\frac{\partial \zeta}{\partial t} + \frac{\partial p}{\partial x} + \frac{\partial q}{\partial y} = \frac{\partial d}{\partial t} \tag{37}$$

$$\frac{\partial p}{\partial t} + \frac{\partial}{\partial x}\left(\frac{p^2}{h}\right) + \frac{\partial}{\partial y}\left(\frac{pq}{h}\right) + gh\frac{\partial \zeta}{\partial x} + \frac{gp\sqrt{(p^2 + q^2)}}{C^2.h^2} - \frac{1}{\rho_w}\left[\frac{\partial}{\partial x}(h_{xx}) + \frac{\partial}{\partial y}(h_{xy})\right] - \Omega_q - f(V)V_x + \frac{h\partial}{\rho_w \partial x}(p_a) = 0 \tag{38}$$

Where, ζ= surface elevation (m), t = time (sec), p= flux density in x direction ($m^3/s/m$), x, y = space coordinates (m), d = time varying water depth (m), h = water depth (m), g= acceleration due to gravity (m/s^2), C= Chezy resistance coefficient ($m^{1/2}/s$) (in the model resistance may also be defined using Manning's coefficient and the equation is transformed accordingly), Ω_q= Coriolis parameter (s^{-1}), ρ_w = density of water and $f(V)$ = wind friction factor.

The solution is resolved using an implicit finite difference scheme of second order accuracy. MIKE 21 includes a special statistical feature for inundation mapping. Often information like the maximum depth, the time of the maximum depth, the maximum velocity and the time of the maximum velocity are sought as the most significant information of a flood study. This information is easily determined on the basis of output data from MIKE 21 using the statistical post-processing routine of the MIKE 21 package.

4.7.2.1 MIKE 21 HD model set up

For the simulation of MIKE FLOOD, MIKE 21 set up is required, because the former is a coupled unit of both MIKE 11 and MIKE 21 simulations. MIKE 21 model has many basic input parameters like; bathymetry, simulation period, boundary, source and sink, mass budget, flood and dry, and hydrodynamic parameters like; initial surface elevation, boundary, source and sink, eddy viscosity, resistance, wave radiation, wind condition etc. In the present study, parameters defining bathymetry, point source, precipitation initial surface elevation, flood and dry thresholds have been used. The resolution of the prepared bathymetry is 10m × 10m is shown in Figure 4.4. The computational time step (Δt) is set to lower value of 2 seconds for different simulations. The prepared MIKE 21 setup, in the present study, is executed to check the error, however the simulation file (*.m21) is used as input to execute MIKE FLOOD, which is described below.

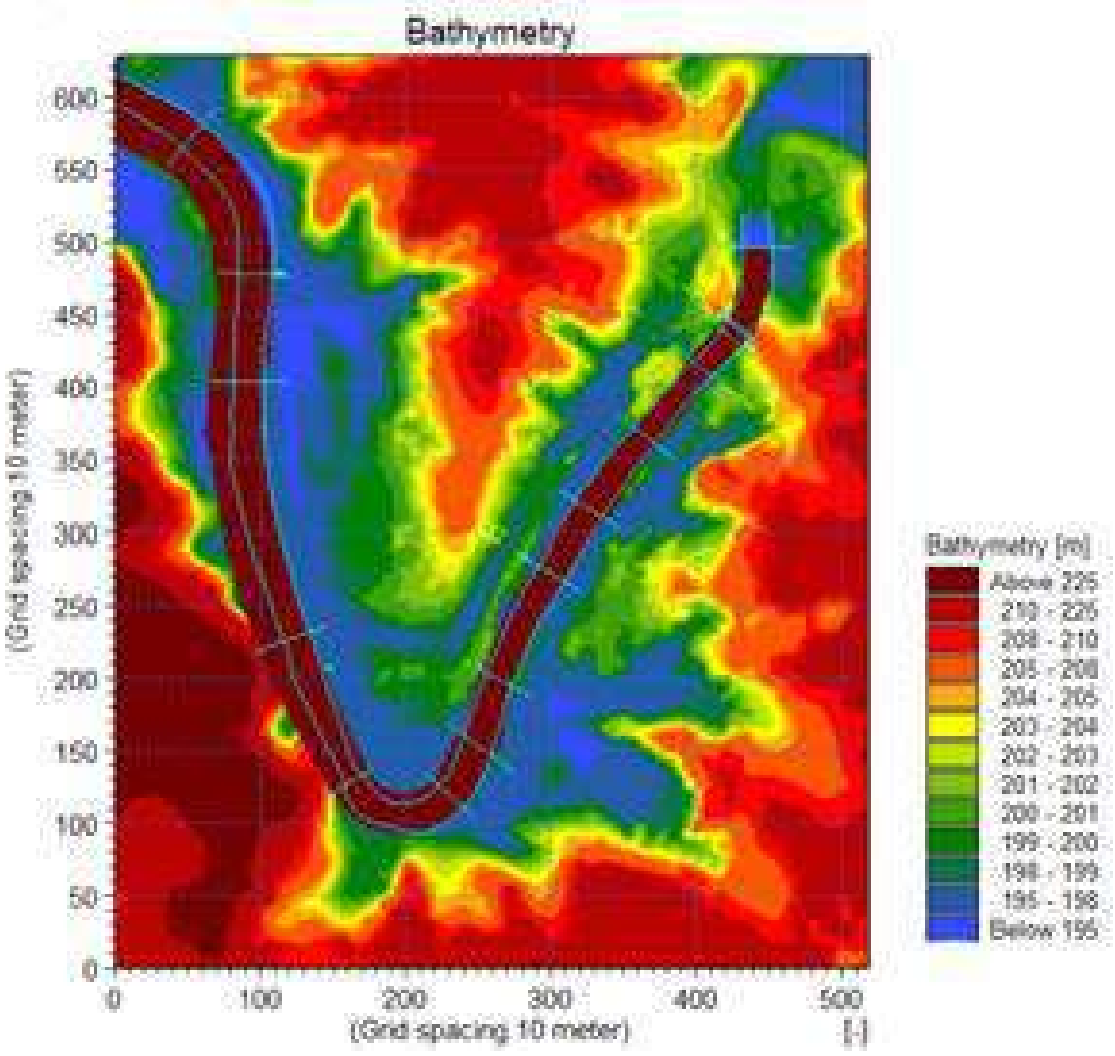


Figure 4.4: Bathymetry of the study area

4.7.3 Flood inundation modelling by MIKE FLOOD

MIKE FLOOD couples MIKE 11 and MIKE 21 into a single system (Figure 4.5). Using a coupled approach, MIKE FLOOD enables to extract the best features of both MIKE 11 and MIKE 21 to simulate floods, while at the same time avoiding many of the limitations of resolution and accuracy encountered when using MIKE 11 or MIKE 21 separately. There are four types of links available in MIKE FLOOD to couple the MIKE 11 river system with the MIKE 21 cells. They include, Standard link, Lateral links, Structure link and Zero flow link. The standard link is the standard linkage in MIKE FLOOD, where one or more MIKE 21 cells are linked to the end of a MIKE 11 branch. This type of link is useful for connecting a detailed MIKE 21 grid into a broader MIKE 11 network, or to connect an internal structure or feature inside a MIKE 21 grid. The lateral link allows a string of MIKE21 cells to be laterally linked to a given reach in MIKE 11, either a section of a branch or an entire branch. Flow through the lateral link is calculated using a weir equation or a *Q-H* table. This type of link is particularly useful for simulating overflow from a river channel onto a floodplain, where flow over the river levee is calculated using a weir equation. The structure link takes the flow terms from a structure in MIKE 11 and inserts them directly into the momentum equations of MIKE 21. The zero flow link is defined to prohibit the flow across the cell in a particular direction of X or Y. In this study, the lateral links have been used to couple the MIKE 11 model with MIKE 21 along the river reach.

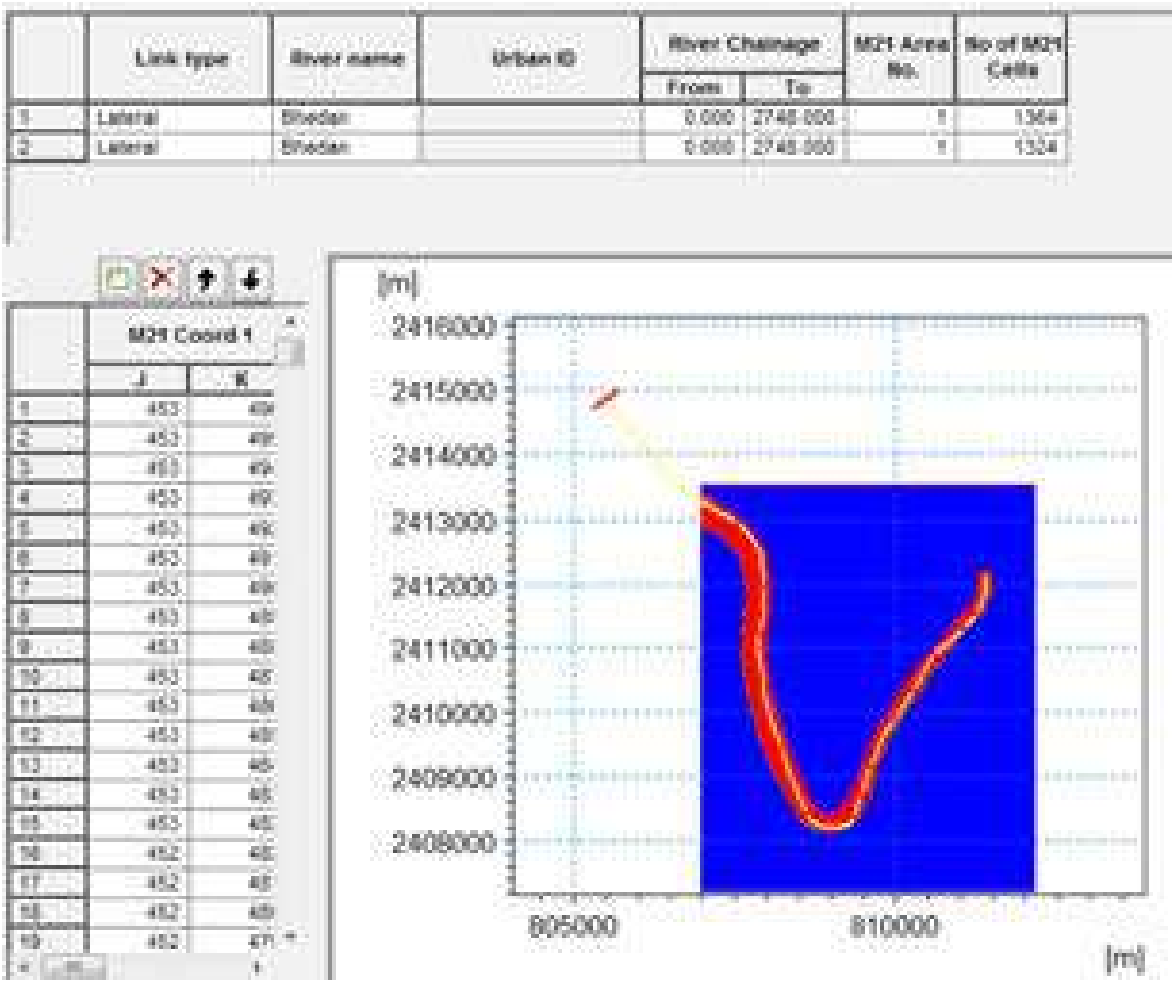


Figure 4.5: Coupling of Mike-11 and Mike-21

4.8 Safe Grade Elevation

The maximum flood level or the high water level (above Indian Mean Sea Level, IMSL) is arrived at from the model results for the most severe flooding condition at the plant site. National Disaster Management Authority, Government of India recommends the plinth levels of all the buildings 0.6 m above the drainage/ flood submersion lines (NDMA, 2008). In fact sufficient freeboard provides an extra measure of flood protection above the base flood elevation to account for waves, debris, hydraulic surge or insufficient data. The NDMA guideline recommends preparing the flood inundation maps using topographical maps at 1:10,000 scale with contours of 0.5/1.0 m and digital elevation model (NDMA, 2008). The present study has been carried out with topographical maps at 1:50,000 scale and contours of 20 m interval for basin area and 0.5 m for the plant area.

4.9 Drainage Design

4.9.1 Runoff Estimation

Run-off from drainage basin is that fraction of precipitation which generates overland flow. It thus represents the output from the drainage basin in a given unit of time. For a given precipitation, initial losses due to the evapotranspiration, infiltration and depression/retention storage requirements have to be first satisfied before the commencement of run-off. After these losses are met, the excess rainfall moves over the land surface which is called overland flow and involves building up of a storage over the surface draining off the same till it reaches the catchment outlet. Estimation of runoff from given storm event can be computed either by commonly used deterministic methods such as Rational method, time area method, unit hydrograph method or statistical method.

4.9.2 Peak runoff rate

The volume of runoff increases as more and more surface flow reaches the Drainage Basin outlet till the last drop of water drains to the basin outlet from its remotest location. The time taken by a raindrop to reach the watershed outlet from the most remote point of the watershed is called time of concentration 'tc'. It is obvious that if the rainfall continues beyond the time of concentration the run-off will be constant and at the peak value pertaining to the respective areas under analysis. Therefore, the determination of the peak flow is essentially required for sizing urban drainage system as well as in study of stream flooding characteristics.

4.9.2.1 Rational method

The Rational method can provide satisfactory estimates for peak discharge on small catchments /sub-catchments which are often the cases related to Urban Drainage.

The basic equation of Rational Method is given as follows:

$$Q = CIA \text{ , For } t \geq t_c$$

Where, Q is Peak Flow; C is Runoff coefficient; Ii is Rainfall intensity; A is area of Catchment.

For commonly used units a proportionality factor k is used such as

$$Q = 0.278\ CIA$$

Where, Q is Peak discharge in m^3/sec; c = Runoff coefficient; i = Rainfall intensity, mm/hr A = Drainage area, Km^2.

Rational method is based on following assumptions:

a) The peak flow occurs when the entire basin is contributing to the flow.

b) The rain fall intensity is uniform over the entire catchment area.
c) The rain fall intensity is uniform over time duration equal to the time of concentration.
d) The frequency of the computed peak flow is the same as that of the rain fall intensity corresponding to the Return Period of the 'Design Storm'.

4.9.2.1.1 Runoff coefficient

The runoff coefficient C is a function of the ground factor and accounts for integrated effects of rain fall interception such as infiltration, depression storage etc in transit of the peak rate of runoff. The runoff coefficient depends on rain fall intensity and duration as well as on the catchment characteristics as discussed in the earlier section. During a rain storm the runoff coefficient increases as the soil gets saturated that is the greater the rain fall intensity, the lower the relative effect of rain fall losses on the peak discharge and therefore higher the runoff coefficient. Recommended values of C depending upon duration of rain fall, shape and character of catchment are given Table 4.3. Further the runoff coefficients for various land use type are given in Table 4.4 (Source: MDOT Drainage Manual). For flat slopes or permeable soil, lower values shall be used and for steep slopes (2:1 or steeper) or impermeable soil, higher values shall be used.

Weighted average of runoff coefficients

Weighted average of 'C' values of different type of urban sectors is calculated by the following formula

$$\text{Weighted average C} = \frac{C_1A_1+C_2A_2+C_3A_3+\ldots\ldots\ldots}{A_1+A_2+A_3\ldots\ldots\ldots}$$

Where, C_1, C_2, C_3 ..... are runoff coefficients of sectors.

A_1, A_2, A_3..... are areas of respective sectors.

Table 4.3: Runoff coefficients (Source: Storm Water Drainage Manual)

Duration t, minutes	**10**	**20**	**30**	**45**	**60**	**75**	**90**	**100**	**120**	**135**	**150**	**180**
Weighted Average Coefficients												
Sector concentrating in stated time												
a) Impervious	.525	.588	.642	.700	.740	.771	.795	.813	.828	.840	.850	.865
b) 60% Impervious	.365	.427	.477	.531	.569	.598	.622	.641	.656	.670	.682	.701
c) 40% Impervious	.285	.346	.395	.446	.482	.512	.535	.554	.571	.585	.597	.618
d) Pervious	.125	.185	.230	.277	.312	.330	.362	.382	.399	.414	.429	.454
Rectangle (length=4 x width) concentrating in stated time												
a) Impervious	.550	.648	.711	.768	.808	.837	.856	.869	.879	.887	.892	.903
b) 50% Impervious	.350	.442	.499	.551	.590	.618	.639	.657	.671	.683	.694	.713
c) 30% Impervious	.269	.360	.414	.464	.502	.530	.552	.572	.588	.601	.614	.636
d) Pervious	.149	.236	.287	.334	.371	.398	.422	.445	.463	.479	.495	.522

Table 4.4: Runoff coefficients for Rational Formula (*Source: MDOT Drainage Manual*)

Type of Drainage Area	**Runoff Coefficient, C**
Concrete or Asphalt Pavement	0.8 – 0.9
Commercial and Industrial	0.7 – 0.9
Gravel Roadways and Shoulders	0.5 – 0.7
Residential – Urban	0.5 – 0.7
Residential – Suburban	0.3 – 0.5
Undeveloped	0.1 – 0.3
Berms	0.1 – 0.3
Agricultural – Cultivated Fields	0.15 – 0.4
Agricultural – Pastures	0.1 – 0.4
Agricultural – Forested Areas	0.1 – 0.4

4.9.3 Design Storm

The intensity of storms increases with increase in recurrence interval or storm return period or frequency. Rain storms of larger return periods are generally recommended for structures entailing huge investment as well as pose a big threat to human lives and property if they fail or collapse such as big dams, bridges and such other irrigation or flood protection structure. Nevertheless the urban drainage may have to have a compromise between the cost of investment in drainage projects and damage and inconvenience caused by occurrence of higher frequency of storm event. Inconvenience caused by flooding to an hour or two may be allowed rather than recommending higher frequency of storm for

designing urban drainage system. The Storm Water Drainage Manual advocates considering the following criteria for selecting design storm return period.

(i) Cost of drainage system
(ii) Intensity of storm
(iii)Price of property
(iv)Loss of Business & stoppage of Techno-commercial activities
(v) Loss of Life

i. **Cost of drainage system:** The cost of the system predominantly depends on the sizes of drains and that varies with the intensity of storm event.

ii. **Intensity of storm:** If higher intensity of storm occurs over the urban drainage basin having a designed drainage system with lower intensity of Design Storm, flooding is likely to occur entailing the damages to life and property.

iii. **Price of property:** High priced area in the urban drainage basin may sustain more damage cost wise than the low priced area.

iv. **Loss of Business & stoppage of Techno-commercial activities:** Loss of Business and stoppage of Techno-commercial activities due to flooding / water logging may result in considerable economic & socio-environmental losses.

v. **Loss of Life:** Densely populated area may suffer more damages to life than the thinly populated area.

In selecting a 'Design Storm' return period within this perspective a rational and judicious approach may have to be exercised. Firstly a street flooding for a few hours may not damage life and property save inconvenience in the routine life of the community. In case of higher intensity of storm and consequent flooding, damages will be more pronounced in the high priced and thickly populated area than the low priced and thinly populated area.

4.9.4 Drain section

The drain around proposed plant area is designed to safely carry the runoff generated due to 100 year return period rainfall. The cross-section of the drains are designed according to the Indian Standard, IS 10430:2000 (BIS, 2006). Trapezoidal section drains with side slope 1.5:1 (H:V) and longitudinal slope of 0.001 m/m (1.0 m/km) is designed using Mannings formula. The drain sections are designed for velocity less than 2.0 m/s and Manning's roughness coefficient (n) values of 0.025. The Free board recommended in the standard and used in this study are: 0.75 m for discharge greater than 10 m^3/s and 0.6 m for discharge less than 10 m^3/s. A typical cross-section of the drain is shown in Figure 4.6.

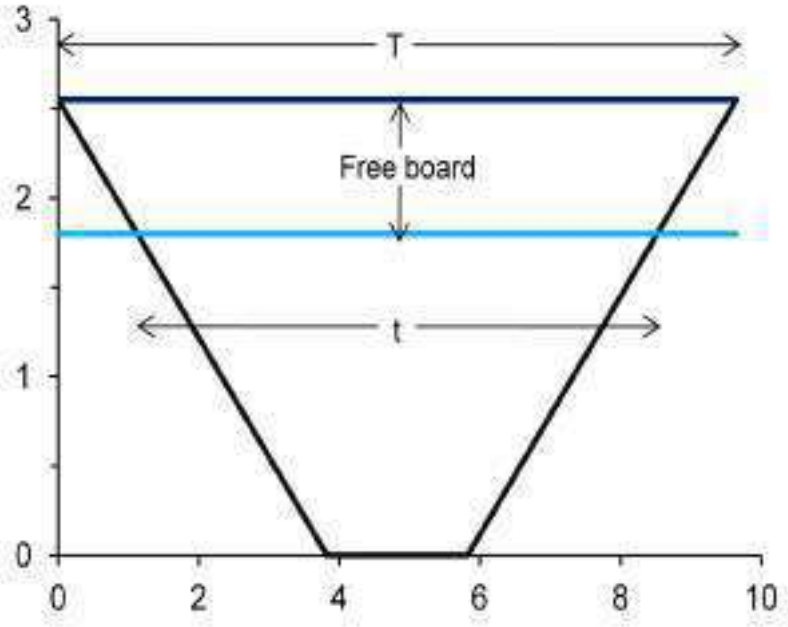


Figure 4.6: Typical Cross-section of the drain.

$$Q=VA \qquad V=\frac{k}{n}R^{2/3}S^{1/2} \qquad R=\frac{A}{P} \qquad A=\frac{y}{2}(b+T)$$

$$P=b+y\left(\sqrt{1+z_1^2}+\sqrt{1+z_2^2}\right) \qquad T=b+y(z_1+z_2)$$

5 ANALYSIS AND RESULTS

5.1 Estimation of 1-day Annual Maximum Rainfall Values

The annual 1-day maximum rainfall series for all ten stations are given in Figure 5.1 (Tabular value given in annexure I). The Box plot of 1 day annual maximum rainfall is shown in Figure 5.2.

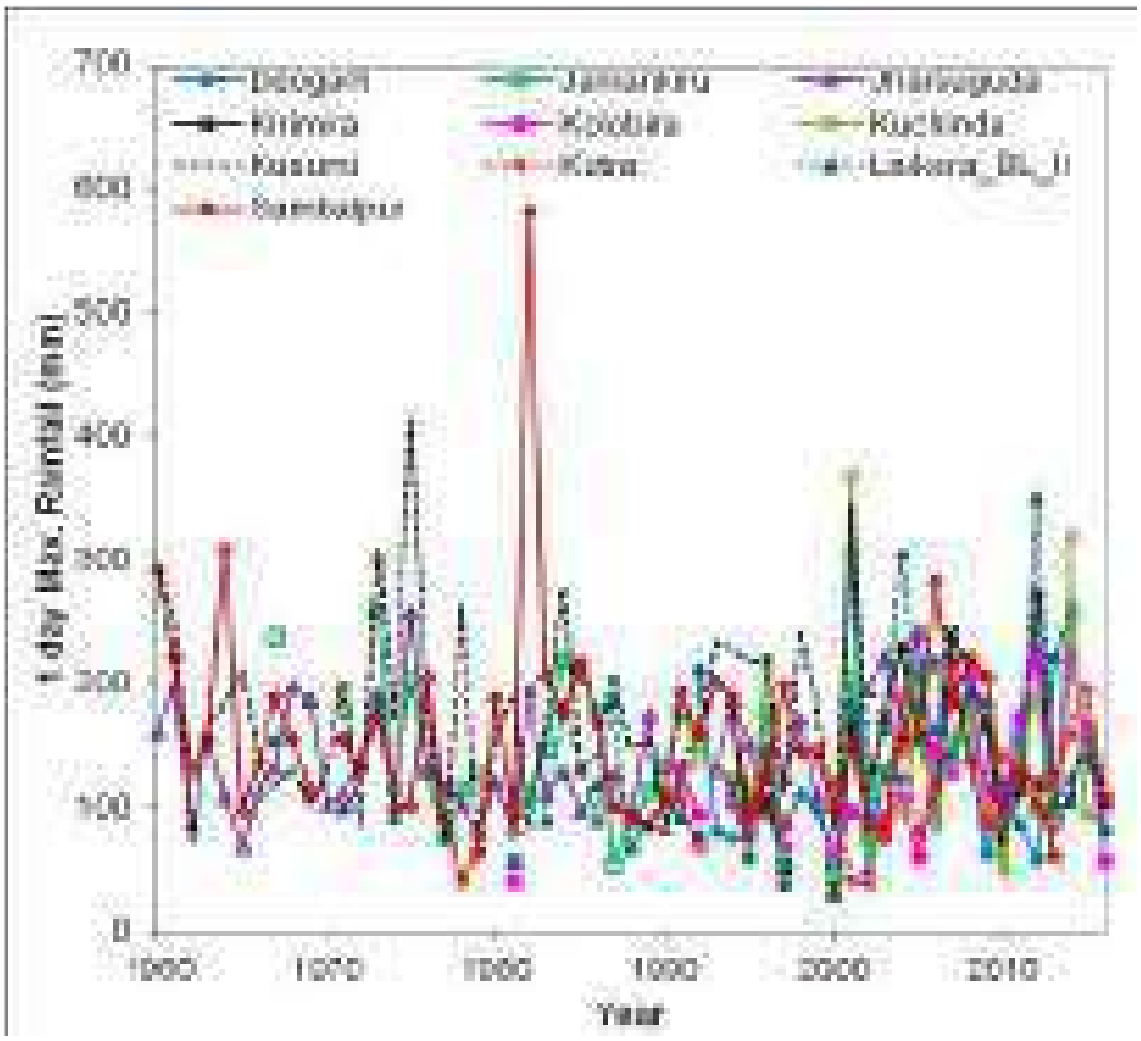


Figure 5.1 : Annual 1-day maximum rainfall.

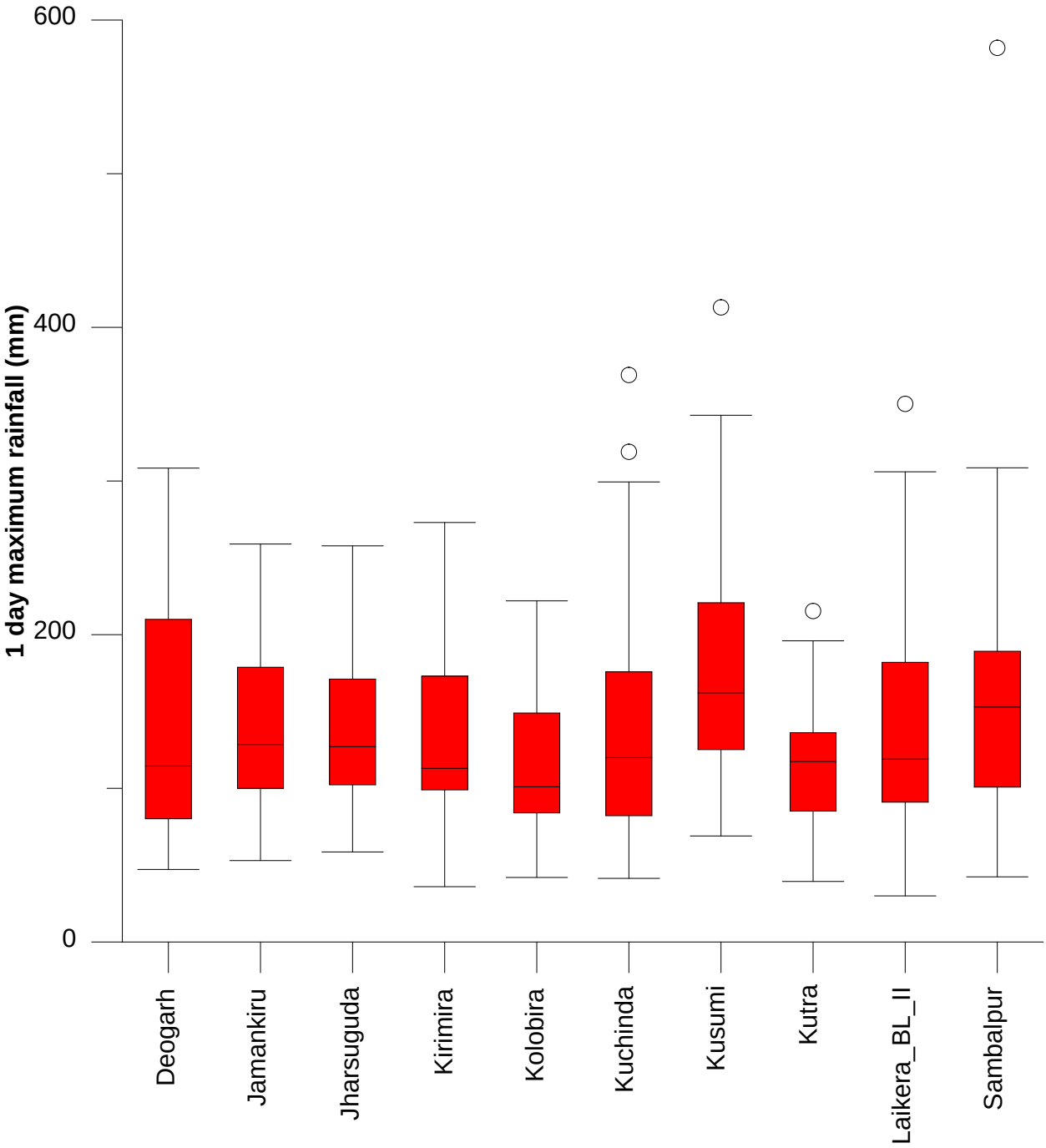


Figure 5.2: Box plot of 1 day annual maximum rainfall.

5.2 Estimation of 1-Day Rainfall of Various Return Periods using L-Moments Based Flood Frequency Analysis

Estimation of 1-day rainfall of various return periods using the L-moments based flood frequency analysis is described as follows.

5.2.1 Identification of robust distribution for 1-day maximum rainfall

Regional rainfall frequency analysis has been carried out using the L-moments approach. The robust frequency distribution for the study area has been identified based on Z_i^{dist} Statistic and L-moment ratio diagram. The Z_i^{dist} Statistic for various distributions for the region is given in Table 5.1. Figure 5.3 show the L-moments ratio diagram for regional of 10 rain-gauge stations. Based on the Z_i^{dist} Statistic and L-moment ratio diagram robust frequency distributions have been identified for the regional rainfall frequency analysis procedure. The parameters for various distributions for 1-day maximum rainfall are given in Table 5.2. The first row of the parameter values (Table 5.2) shows the robust identified frequency distributions. The growth factors or site-specific scale factor ($R_T/\overline{R}$) are computed by dividing rainfall quantile (R_T) by the annual mean maximum rainfall of a rain gauge station ($\overline{R}$) as given in Table 5.3. The 1-day maximum rainfall for various return periods are estimated by multiplying the respective growth factor with mean annual maximum rainfall of the station as given in Table 5.4.

Table 5.1 Z_i^{dist} – Statistic of various distributions for 1-day annual maximum rainfall

S. No.	Distribution	Z_i^{dist} –statistic
1.	**Generalized Extreme Value (GEV)**	**0.14**
2.	Generalized Normal (GNO)	0.18
3.	Pearson Type III (PE3)	0.92
4.	Generalized logistic (GLO)	1.93
5.	Generalized Pareto (GPA)	3.88

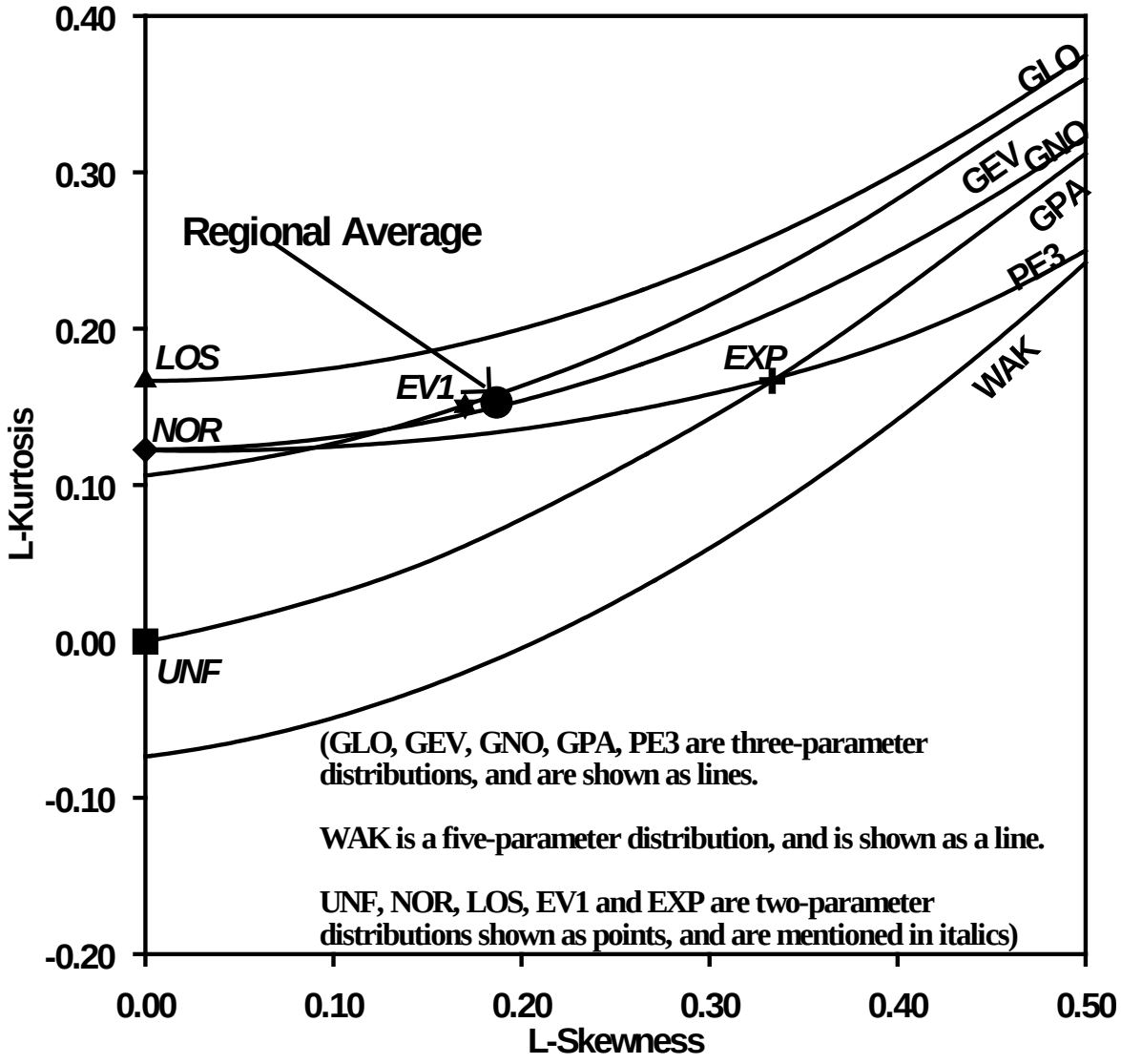


Figure 5.3: L-moments ratio diagram for Regional for 1-day annual maximum rainfall

Table 5.2 Parameters of various distributions for 1-day annual maximum rainfall

Distribution	**Parameters of the Distribution**				
GEV	**ξ =0.786**	**α = 0.354**	**K=0.27**		
GNO	ξ =0.916	α = 0.419	K=0.386		
PE3	ξ =1.000	α = 0.464	K=1.134		
WAK	ξ =0.284	α = 1.802	β= 5.780	γ=0.482	δ = -0.072

Table 5.3 Values of growth factors ($R_T/\overline{R}$) for 1-day annual maximum rainfall

Distribution	**Return period (Years)**						
	2	10	20	25	50	100	200
GEV	**0.917**	**1.607**	**1.880**	**1.967**	**2.241**	**2.517**	**2.798**
GNO	0.916	1.610	1.878	1.964	2.228	2.495	2.764
PE3	0.914	1.622	1.881	1.962	2.205	2.442	2.672
WAK	0.916	1.620	1.896	1.982	2.241	2.488	2.722

Table 5.4 1-day annual maximum rainfall (mm) for various return periods

Return period (Years)	**Growth factors**	**Rainfall (mm)**
2	0.917	127.021
10	1.607	222.598
20	1.88	260.413
25	1.967	272.464
50	2.241	310.418
100	2.517	348.649
200	2.798	387.572

5.3 Estimation of Synthetic Unit Hydrograph

The various catchments delineated from DEM using HEC-GeoHMS are shown in Figure 5.4. The catchment characteristics are given Table 5.5 and parameters of SUH derived using these characteristics are given in Table 5.6. The 1-h Synthetic Unit Hydrograph plotted using above parameters is shown in Figure 5.5 and the ordinates are given in Table 5.7.

Figure 5.4: Delineated sub basins.

Table 5.5 Catchment characteristics of three sub basins

Sl. No.	Characteristics	Value
1	Length of main stream (L) (km)	116.5
2	Centoridal longest flow path (L_c) km	53.2
3	Equivalent slope (S) (m/km)	1.28
4	Area (A) (km^2)	3185.5

Table 5.6 Parameters of Synthetic Unit Hydrograph.

Sl. No.	**Parameters & Relationship**	**Value**
1	$t_p = 1.757\left(LL_c/\sqrt{S}\right)^{0.261}$ (h)	16.5
2	$q_p = 1.260\left(t_p\right)^{-0.725}$ ($m^3/s/km^2$)	0.165
3	$W_{50} = 1.974\left(q_p\right)^{-1.104}$ (h)	14.429
4	$W_{75} = 0.961\left(q_p\right)^{-1.125}$ (h)	7.295
5	$WR_{50} = 1.150\left(q_p\right)^{-0.829}$ (h)	5.12
6	$WR_{75} = 0.527\left(q_p\right)^{-0.932}$ (h)	2.83
7	$T_B = 5.411\left(t_p\right)^{0.826}$ (h)	54.82
8	$Q_p = q_p \times A$ (m^3/s)	525.608

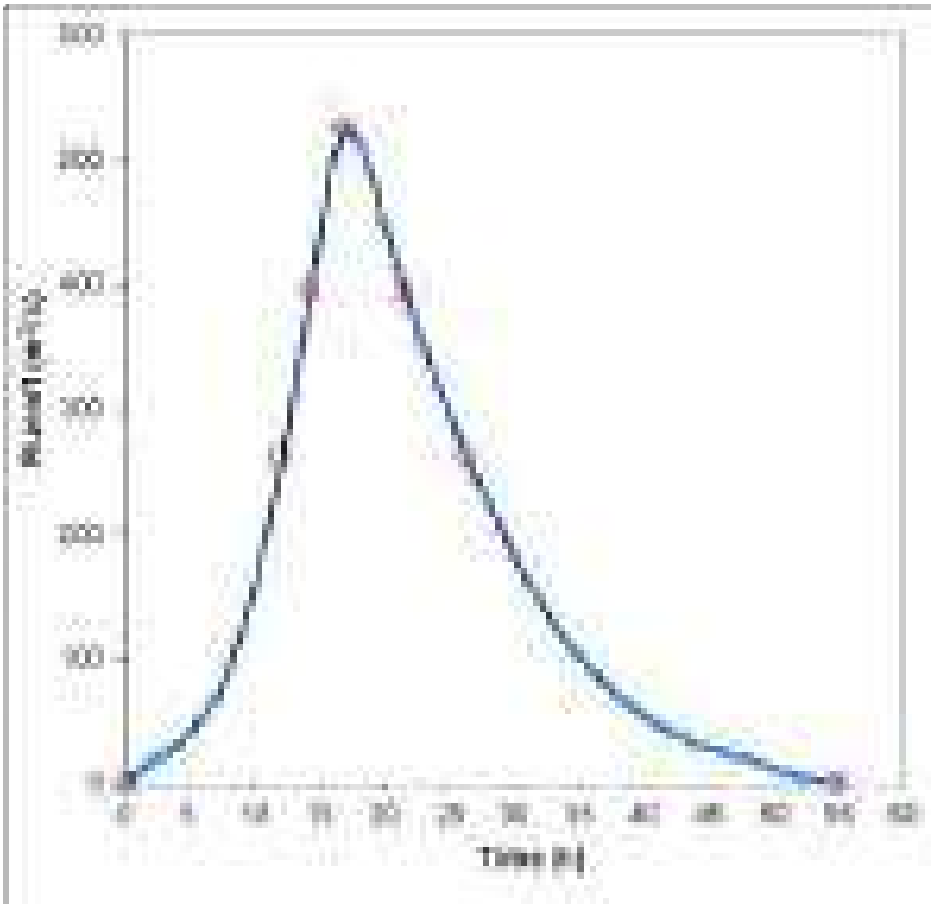


Figure 5.5: 1-h unit hydrograph.

Table 5.7 Ordinates of 1-h unit hydrograph.

Time (h)	Runoff (m^3/s)	Time (h)	Runoff (m^3/s)
0	0	28	225
1	8.5	29	205
2	17	30	182
3	23	31	162
4	30	32	145
5	39	33	128
6	53	34	115
7	67	35	102
8	92	36	90
9	122	37	80
10	158	38	70
11	203	39	62
12	253	40	54
13	310	41	47
14	370	42	42
15	433	43	38
16	498	44	31
17	525.608	45	28
18	515	46	25
19	488	47	22
20	450	48	20
21	413	49	15
22	380	50	12
23	350	51	8
24	320	52	5
25	296	53	4
26	270	54	2.211
27	246	55	0

5.3.1 Base flow for design flood

On this basis, the design base flow of 0.1 m^3/s per sq. km. of the catchment area has been recommended and in this study also the recommended base flow has been adopted. In the present study base flow is estimated to be 318.55 m^3/s.

5.3.2 Rainfall depth duration frequency

The design storm (T_d) varies between $T_d=1.1 \times t_p$ and $T_d= T_B$. In this case 24 h rainfall is considered.

5.3.3 Temporal Distribution

The temporal rainfall distribution for 24 h duration is provided in the in the CWC report. This provides rainfall increments at unit duration. Then, the incremental depths are arranged in critical order for each bells of 12 h duration as mentioned in the Manual on Estimation of Design Flood (CWC, 2001). For this the largest of increments is placed against the peak of UH, then the next largest against the next UH ordinate and so on until all rainfall increments get arranged. Then the sequence is reversed to get the critical sequence for all spells. In case of 24-h duration rainfall the first and second 12 h blocks are interchanged to get critical situation.

5.4 Estimation of Flood Hydrographs

After applying clock hour correction the 50 year and 100 year return period 24-h maximum are found to be 35.7 cm, and 39.9 cm respectively. These values are also in close agreement with the values given in CWC (1997) report. The areal reduction factor of 0.78 is adopted. The areal rainfall in the catchment are estimated to be 27.84 cm and 31.28 cm for 50 year and 100 year return period respectively. The time distribution of rainfall was adopted according to the CWC (1997) report. The Commutative rainfall distribution for 24-h storm duration is show in Figure 5.6. The design loss rate of 0.15 cm/h is adopted. The hourly effective rainfall hyetograph for 24 h duration for 50 and 100 year return period are shown in Figure 5.7. Base flow has been estimated using the 0.1 $m^3/s/km^2$ for the catchment area and added to estimated direct runoff hydrograph for estimating flood hydrographs. The Peak flood for 50 year and 100 year return period are found to be 9956.07 m^3/s and 11278.65 m^3/s respectively and the flood hydrographs are shown in Figure 5.8. The ordinates of rainfall and flood hydrographs are given in annexure II.

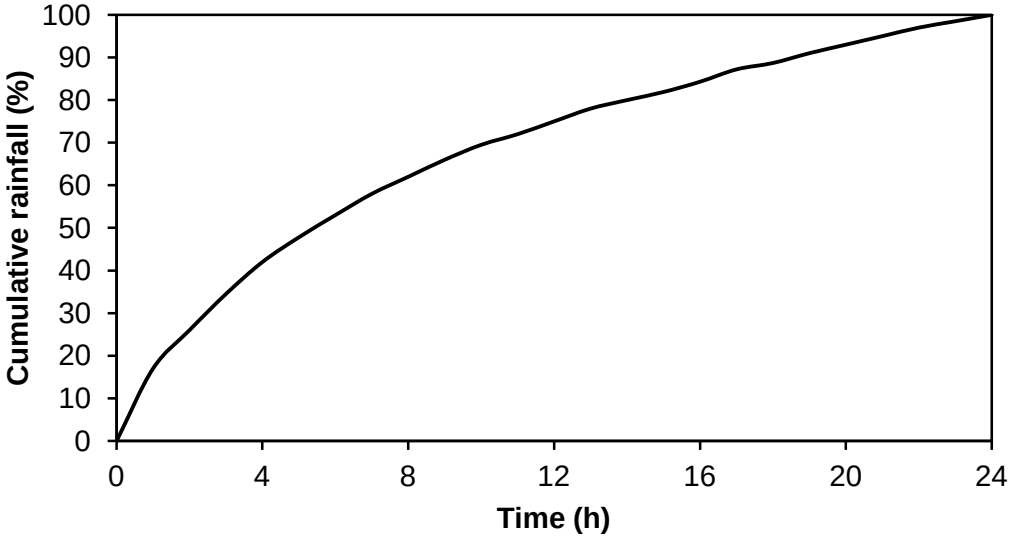
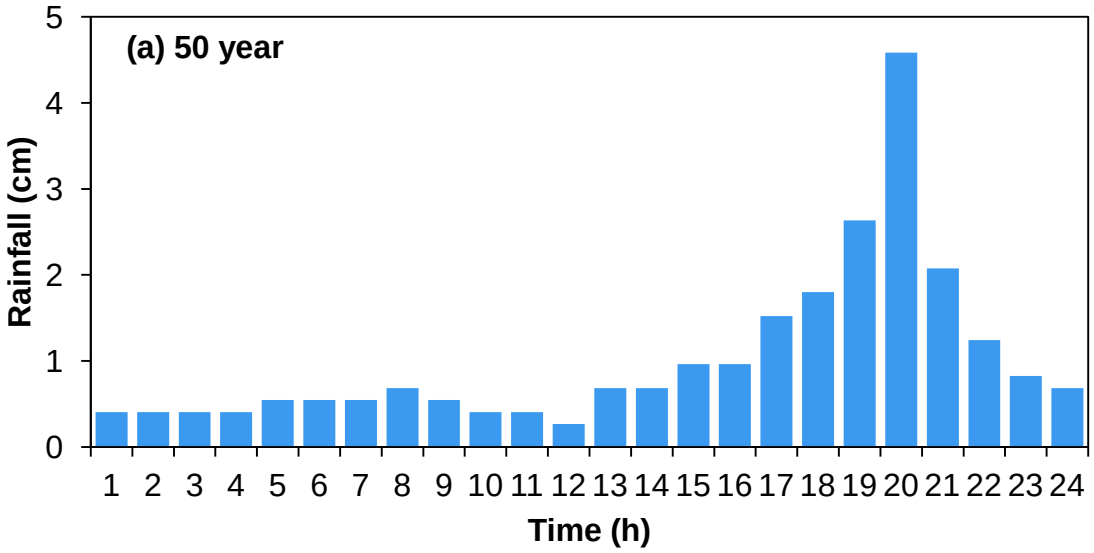


Figure 5.6: Time distribution curve for the 24-h rainfall



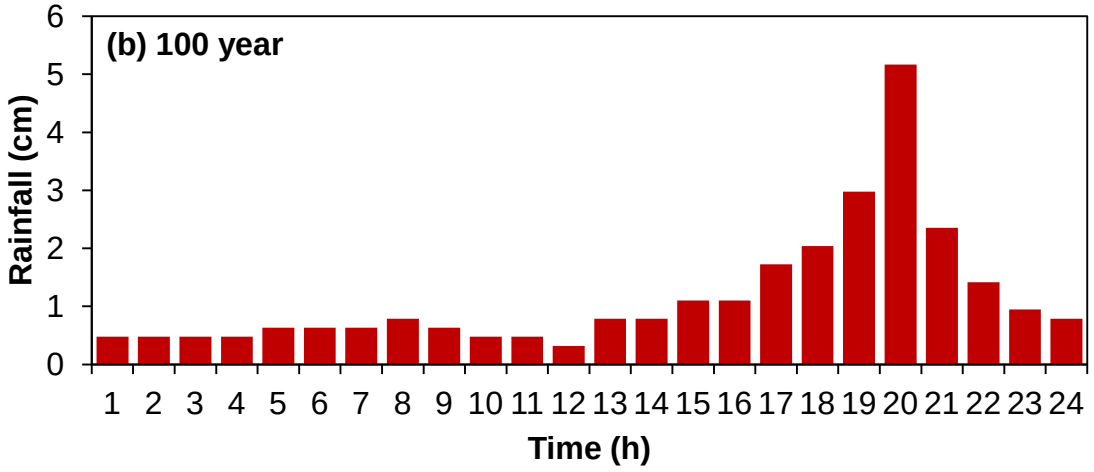


Figure 5.7: Effective rainfall hyetograph for 1-day duration

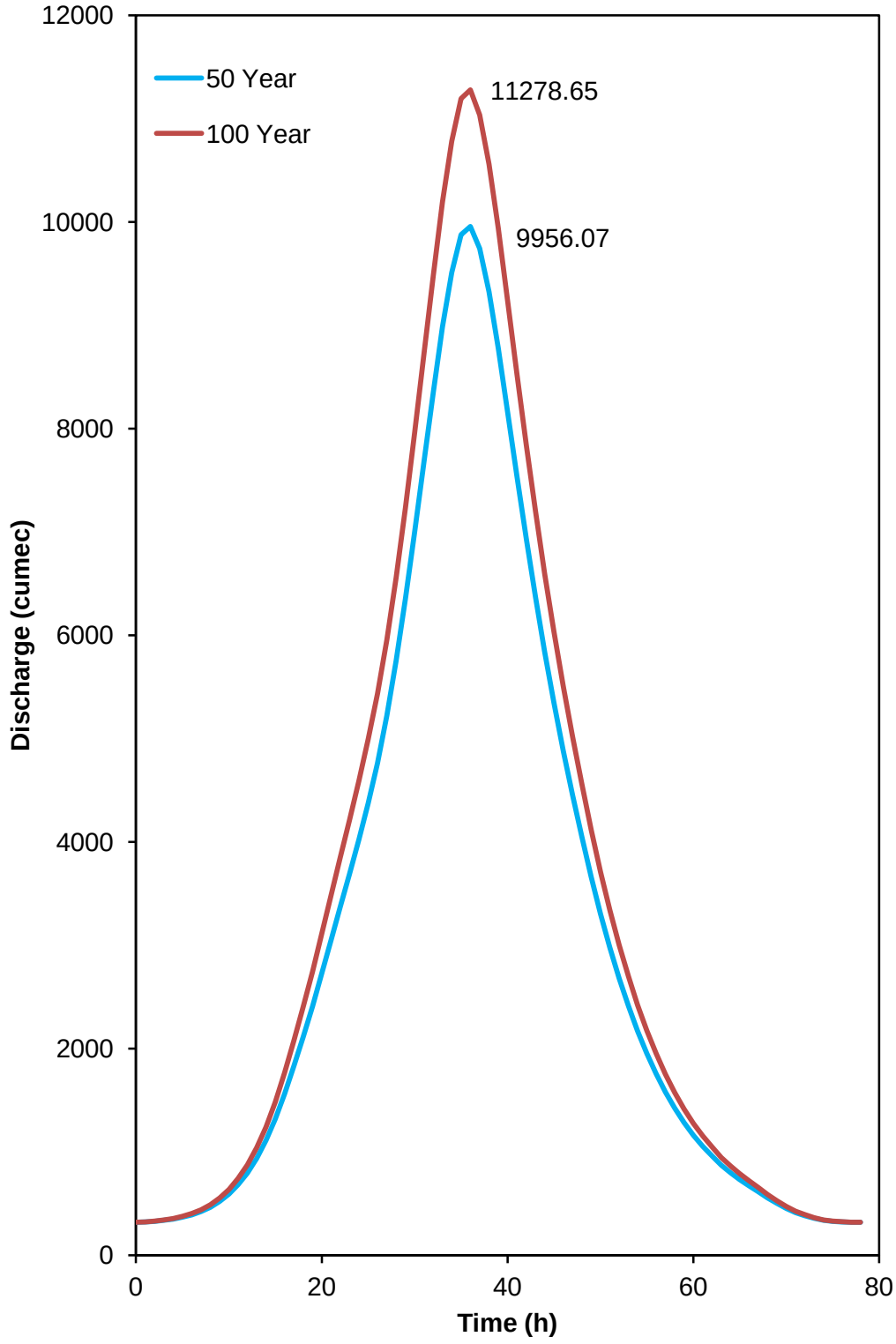


Figure 5.8: Design flood hydrographs for various return periods.

5.5 Existing Features

The satellite image and land use land cover (LULC) maps within 25 km radius is shown in Figure 5.9 and Figure 5.10 respectively. The LULC mainly consists of agriculture, built up, barren land and water bodies (river, reservoir, and stream). There are also some forest covers with in 25 km radius. The various landforms is shown in geomorphologic map (Figure 5.11).

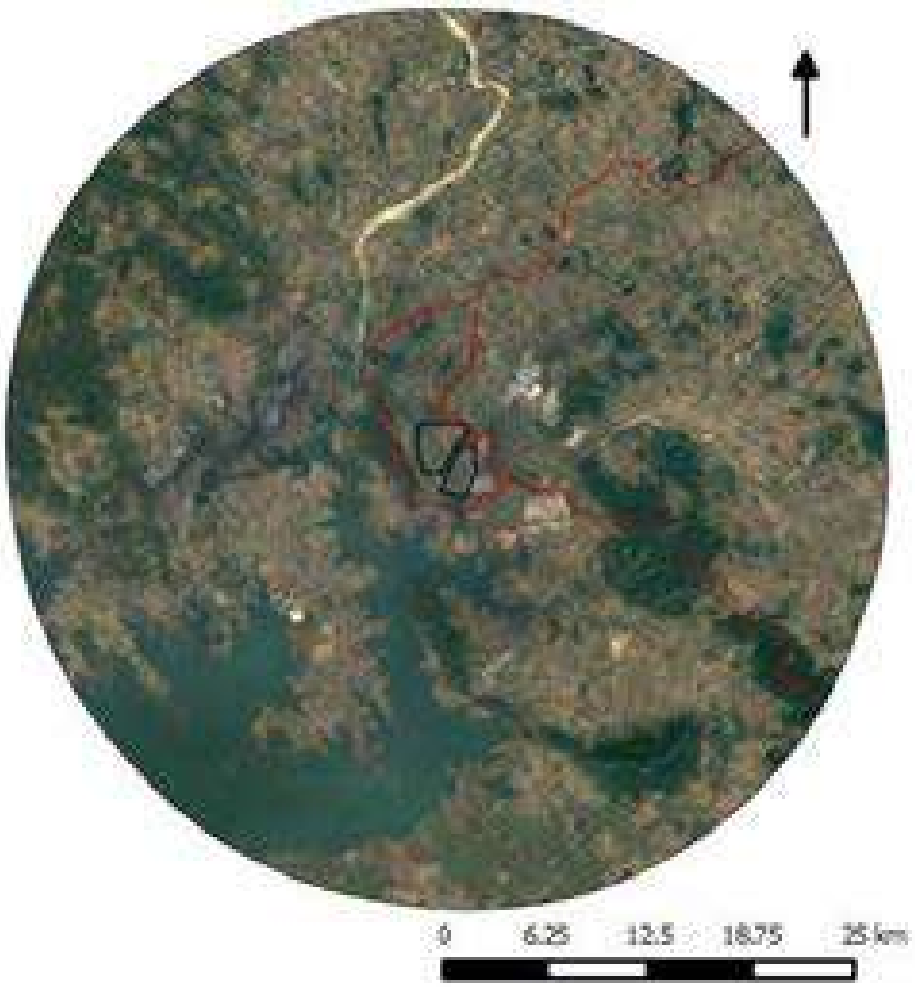


Figure 5.9: Satellite images in 25 km buffer zone

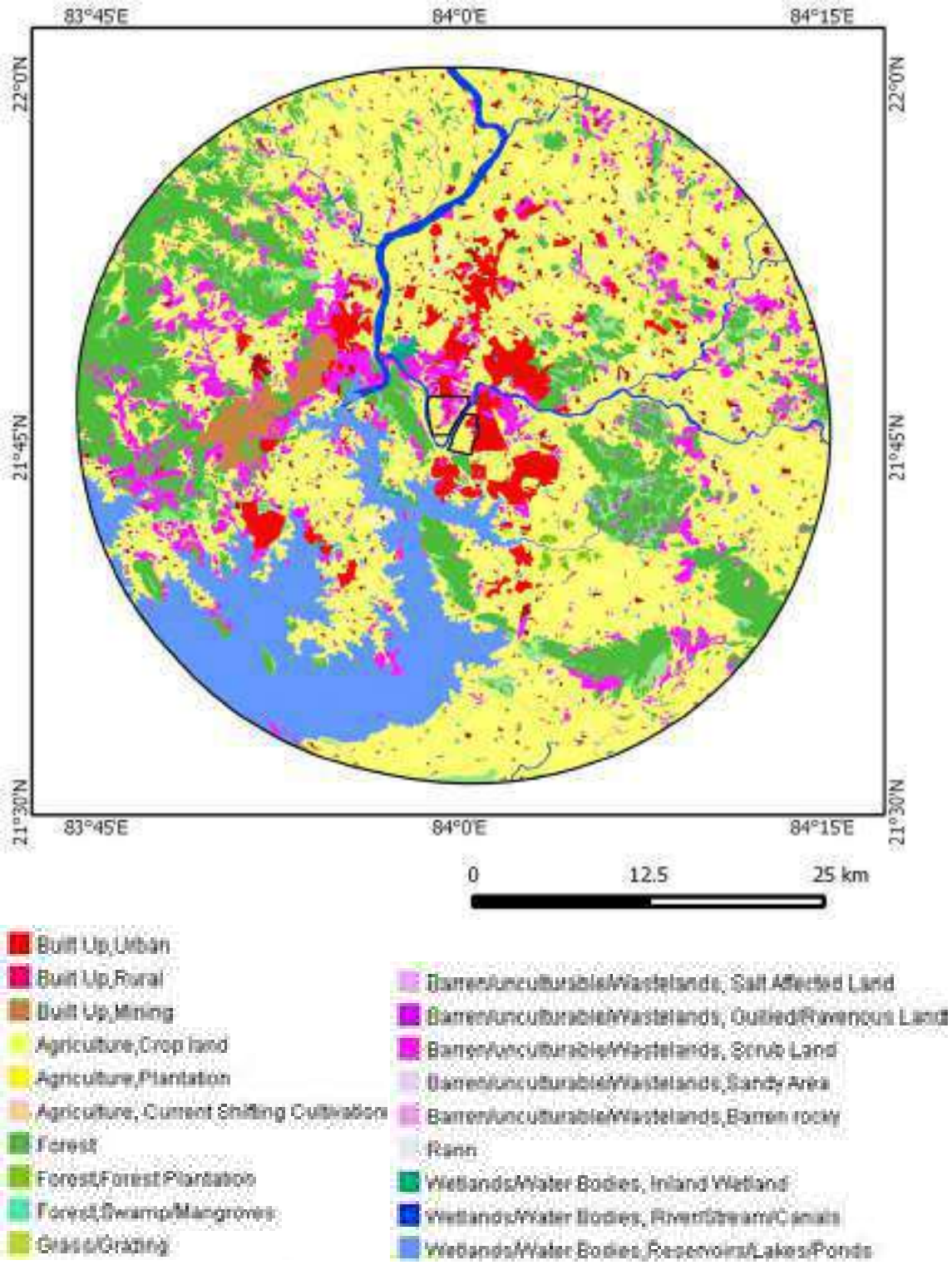


Figure 5.10: Land use land cover map of 25 km buffer zone

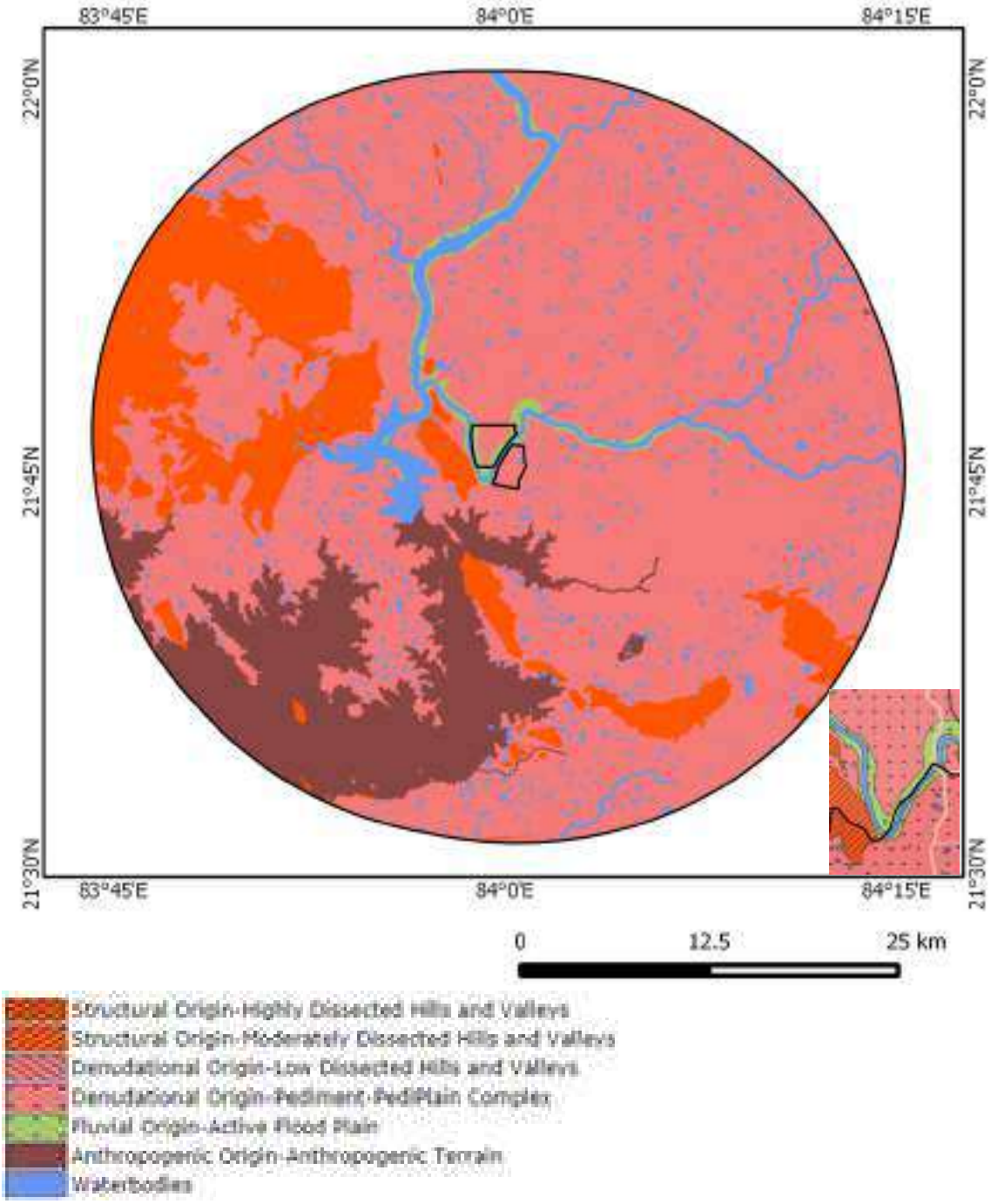


Figure 5.11: Geomorphology in 25 km buffer zone

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5.6 Flood Inundation Modelling

The layout of Bhedan river reach with cross-section locations and chainage in bracket is shown in Figure 5.12. The areal extent of flooding with flood depth for 50 year and 100 year return period flood is shown in Figure 5.13 and Figure 5.14 respectively. The maximum water surface elevation along the river for 50 year and 100 year return period flood is shown in Figure 5.15 and Figure 5.16 respectively. Comparison maximum water level at various locations (chainage) along the river reach is shown in Figure 5.17. The tabular value of maximum water level for 50 year and 100 year return period flood is given in Table 5.8. It is observed that the difference in water level for 50 year and 100 year return period flood varies between 0.3 m to 0.5 m.

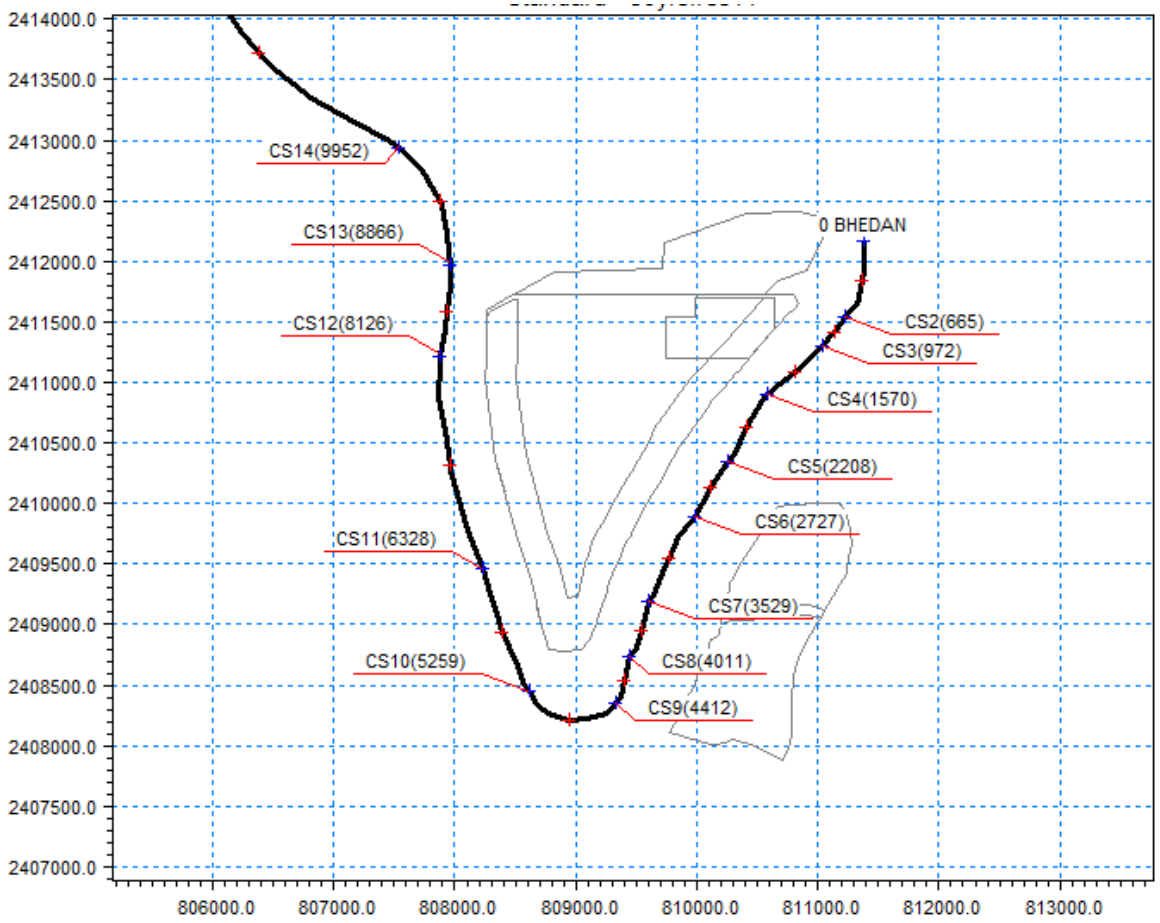


Figure 5.12: Layout in Mike-11 result viewer

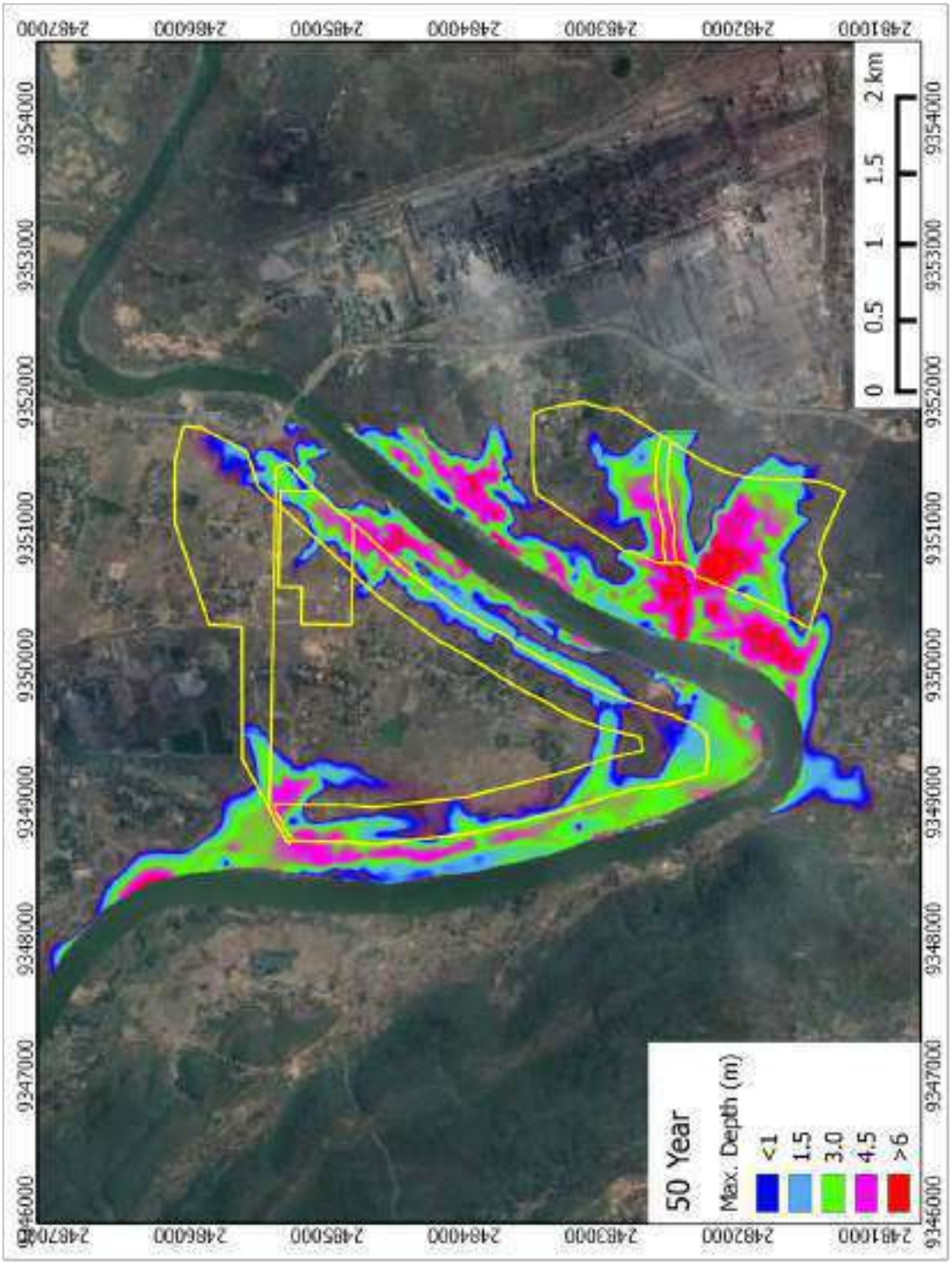


Figure 5.13 : Maximum flood inundation depth for 50 year return period flood

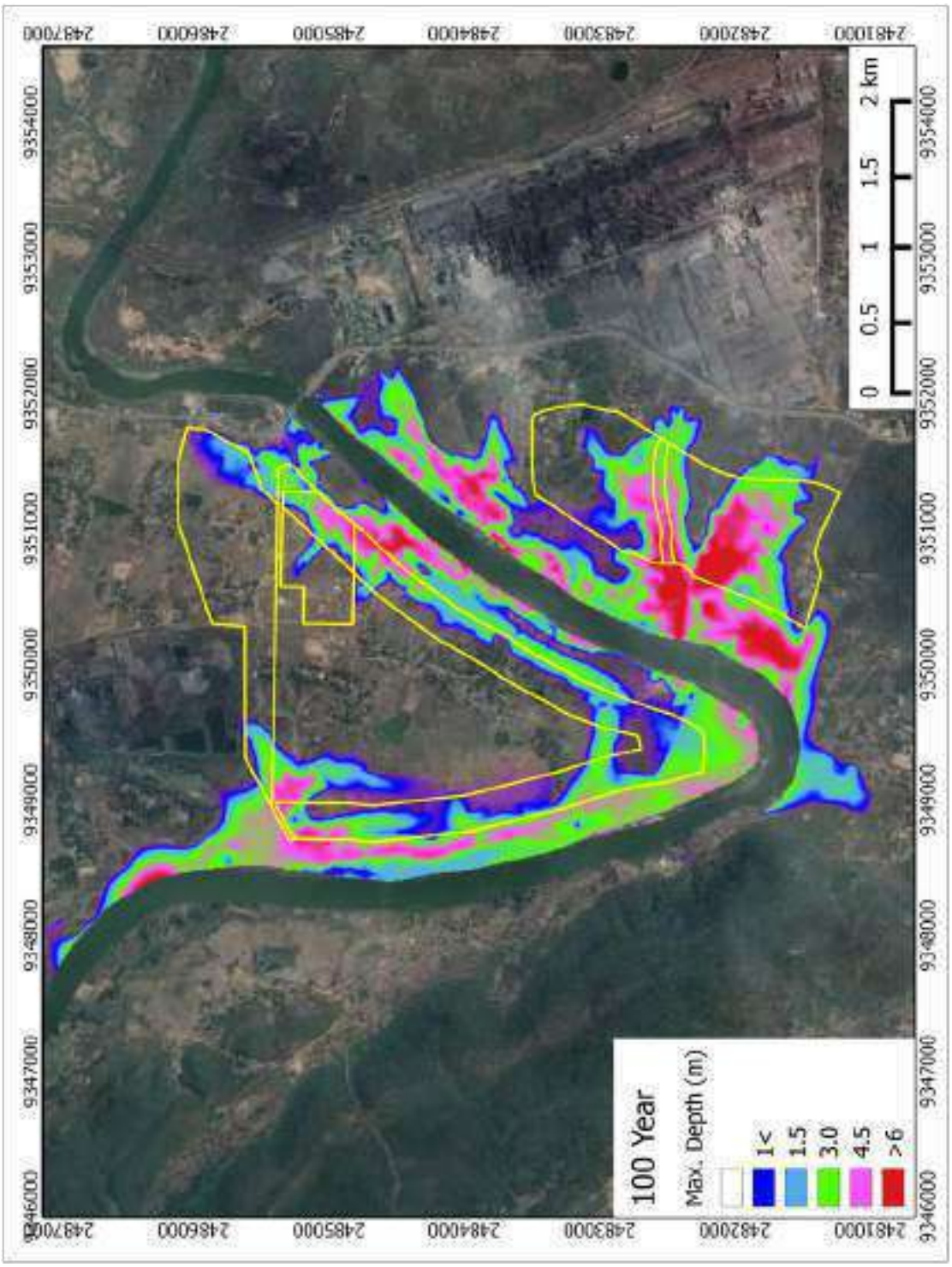


Figure 5.14 : Maximum flood inundation depth for 100 year return period flood

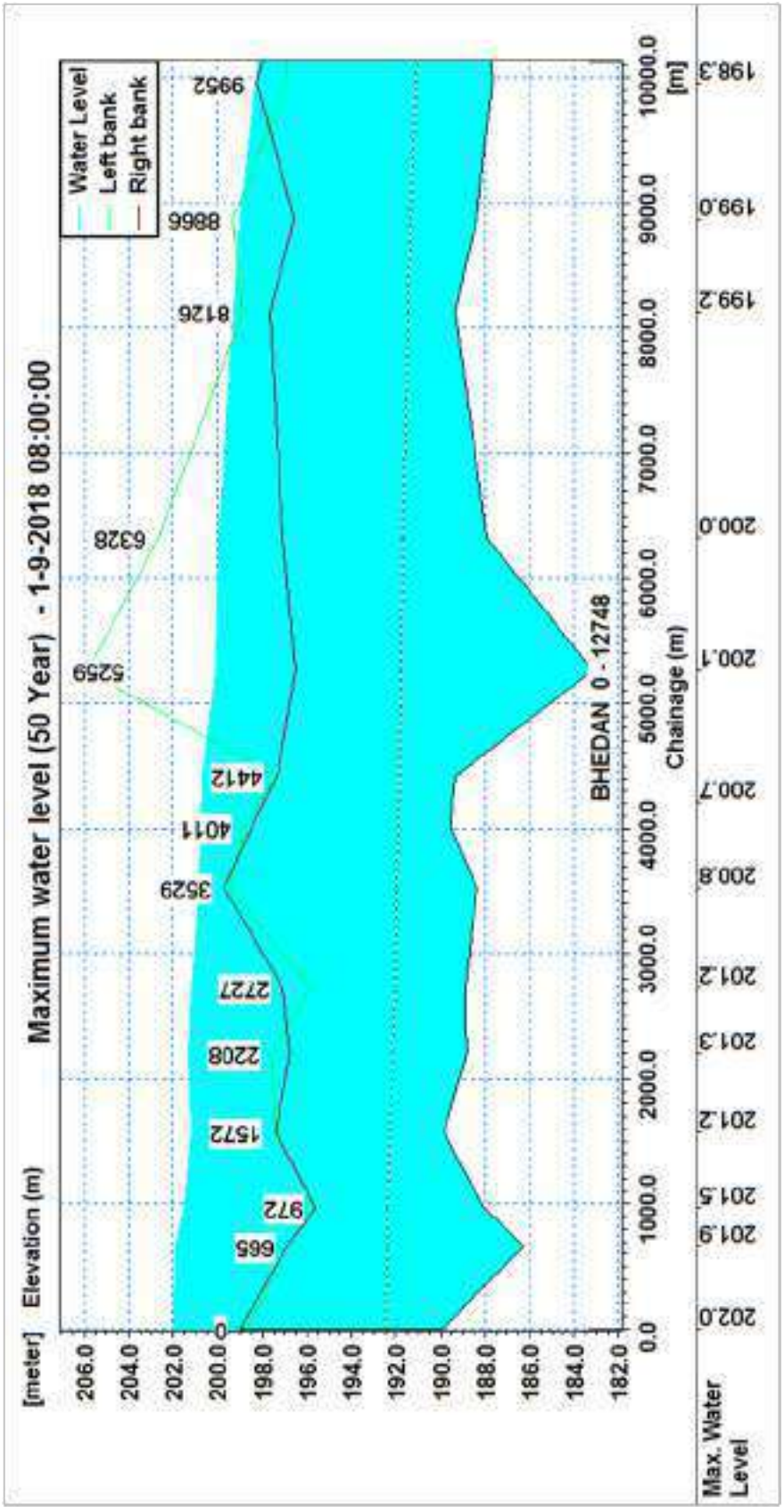


Figure 5.15 : Maximum Water surface profile for 50 year return period flood

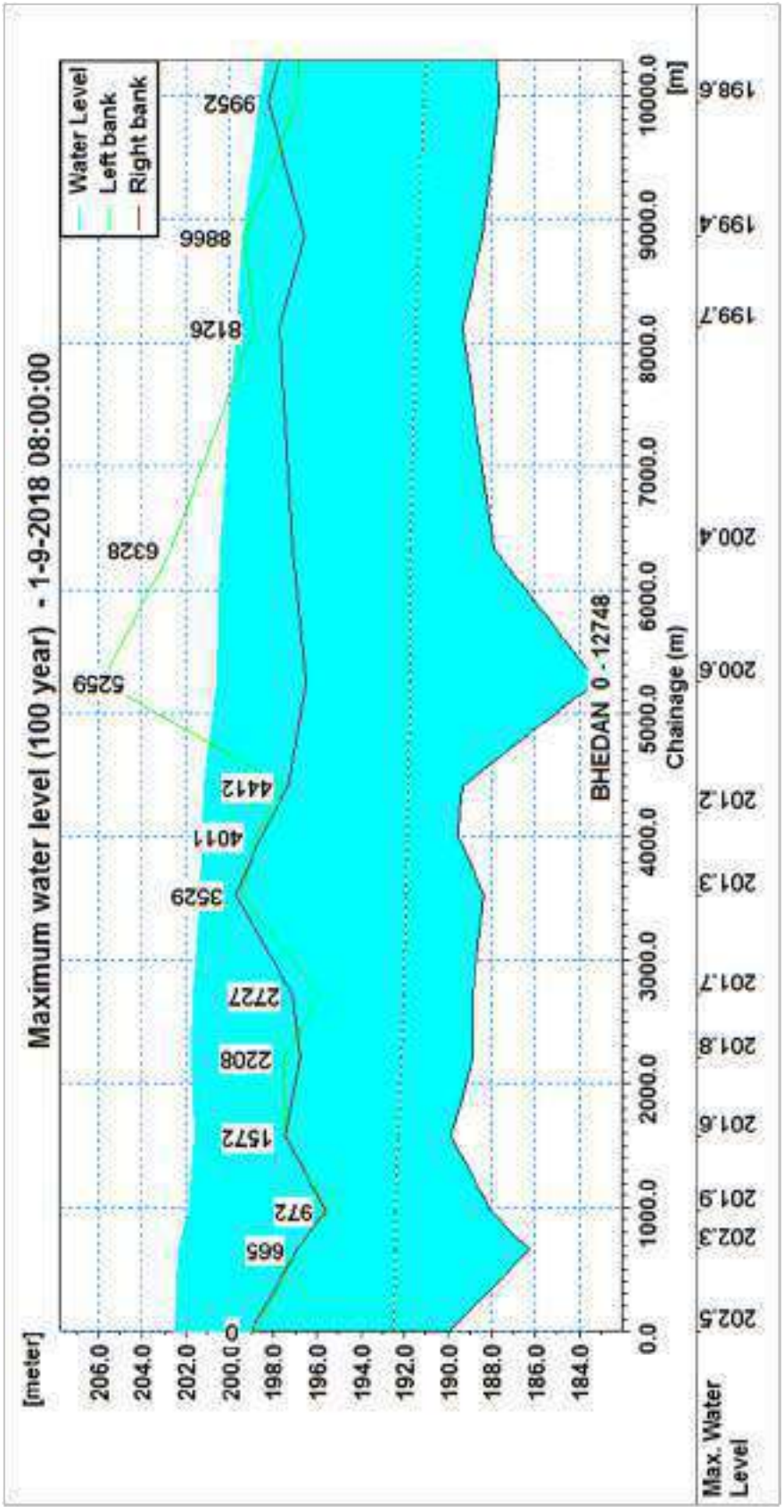


Figure 5.16 : Maximum Water surface profile for 100 year return period flood

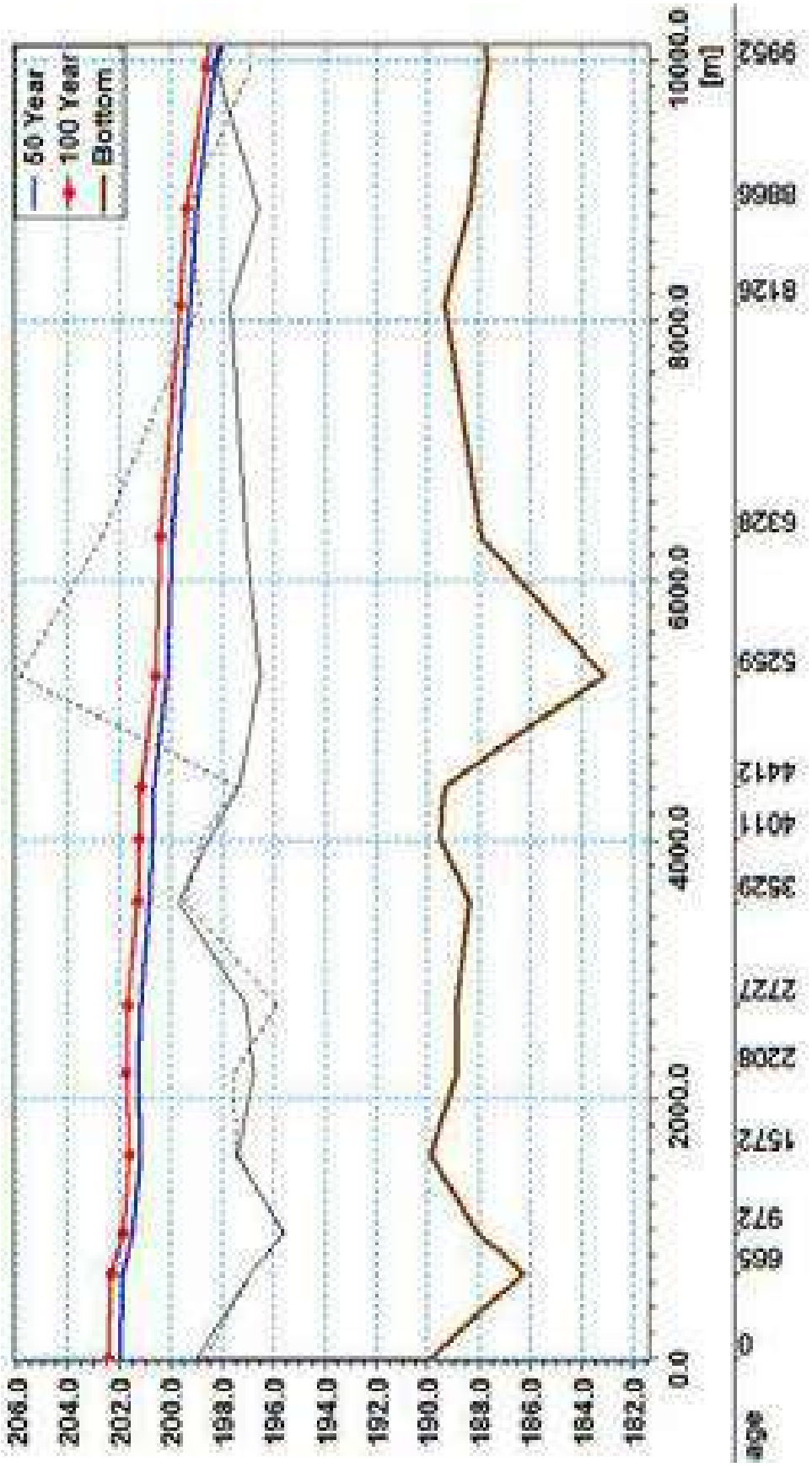


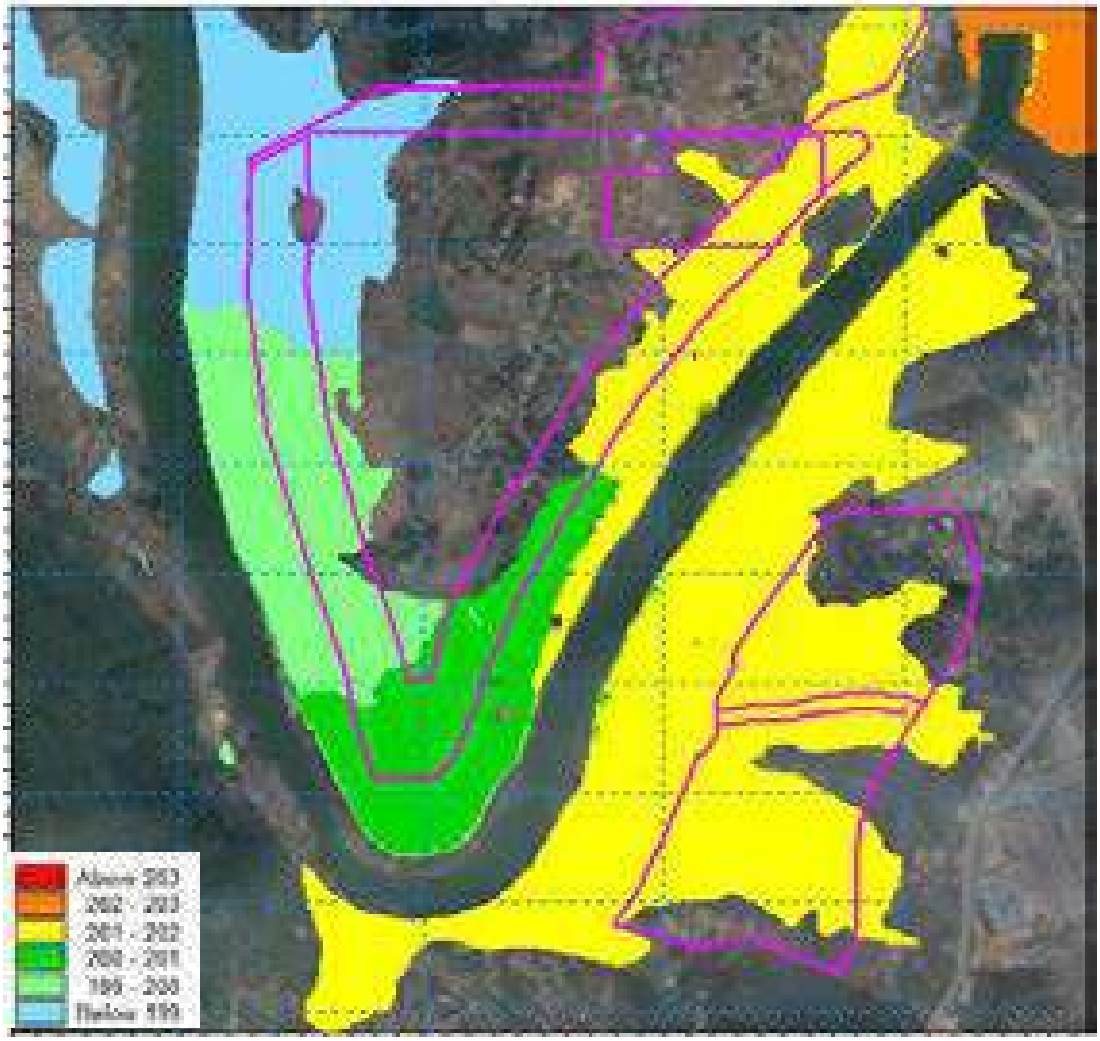
Figure 5.17 : Comparison of maximum water surface profile without embankment

Table 5.8: Maximum water level

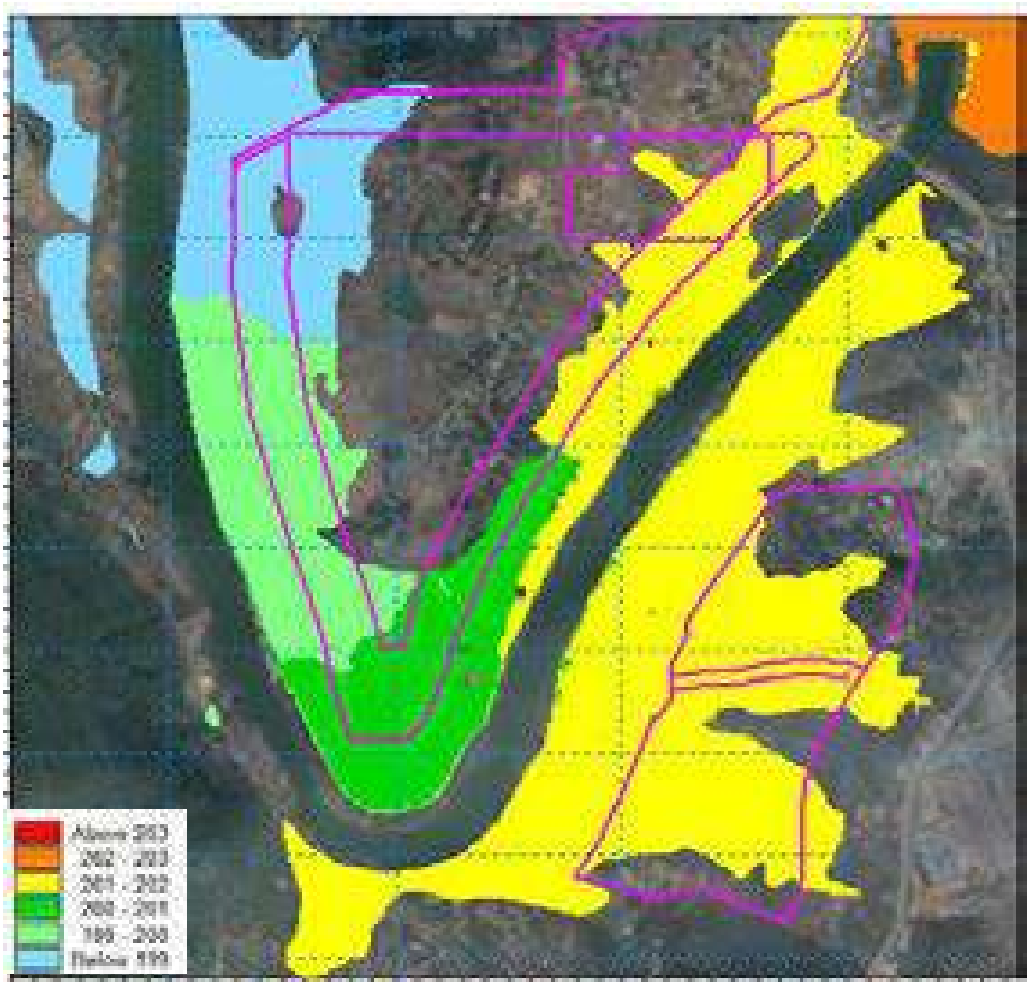
Location	**50 Year**	**100 Year**
CS2(665)	201.9	202.3
CS3(972)	201.5	201.9
CS4(1570)	201.2	201.6
CS5(2208)	201.3	201.8
CS6(2727)	201.2	201.7
CS7(3529)	200.8	201.3
CS8(4011)	200.7	201.2
CS9(4412)	200.7	201.2
CS10(5259)	200.1	200.6
CS11(6328)	200.0	200.4
CS12(8126)	199.2	199.7
CS13(8866)	199.0	199.4
CS14(9952)	198.3	198.6

5.7 Flood Protection Measures

As discussed in the previous section, under present scenarios some portion of the proposed plant site and ash pond are likely to get inundated due to estimated flood for 50 year and 100 year return period. The ground level of these areas may be raised above the flooding level as shown in Figure 5.18. From the Figure 5.18, it may be noted that the ground level should be above 202 m.



(a) Inundation map for 50 year flood



(b) Inundation map for 100 year flood

Figure 5.18: Inundation map for various flood estimates

Further, construction of embankments on both left and right bank is also modelled to analyse the height of embankment. It is proposed 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. The water surface profile along the river reach for 50 year and 100 year return period flood with construction of embankment is shown in Figure 5.19 and Figure 5.20 respectively. The Comparison maximum water surface profile along the river reach for various return period floods with embankment is shown in Figure 5.21. The water level at various location of river reach with embankment for 100 year return period flood is given in Table 5.9. The actual water level with embankments in Bhedan in the reach may be lower as mentioned in Table 5.9, as there will be flooding in the upstream where there is no protection measure. However, it is advisable to construct the embankment considering water level given in Table 5.9 as it would cater for future development in upstream like embankment, land filling etc. Sufficient freeboard etc. should also be provided for the embankments.

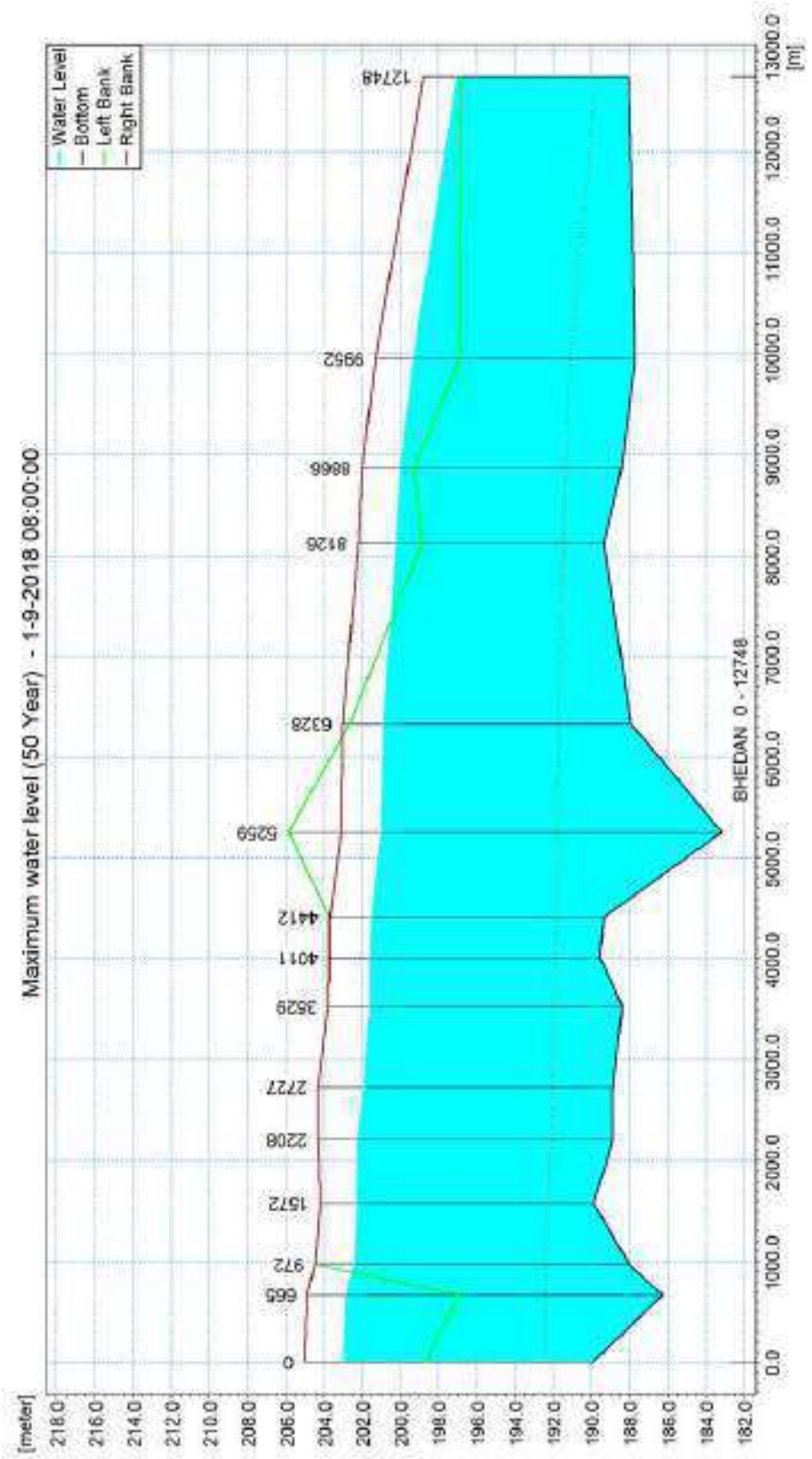


Figure 5.19 : Comparison of maximum water surface profile for 50 year with embankment

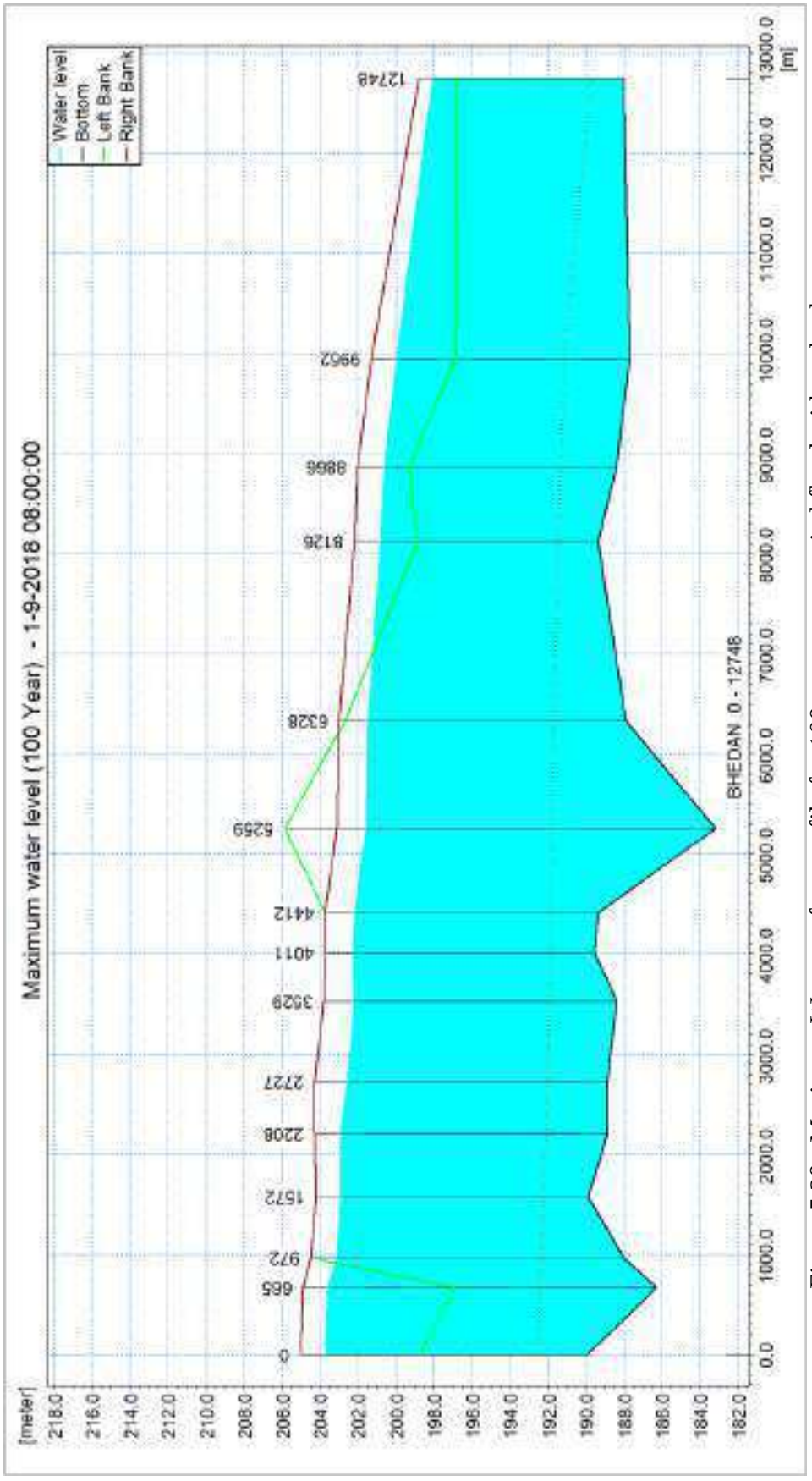


Figure 5.20 : Maximum Water surface profile for 100 year return period flood with embankment

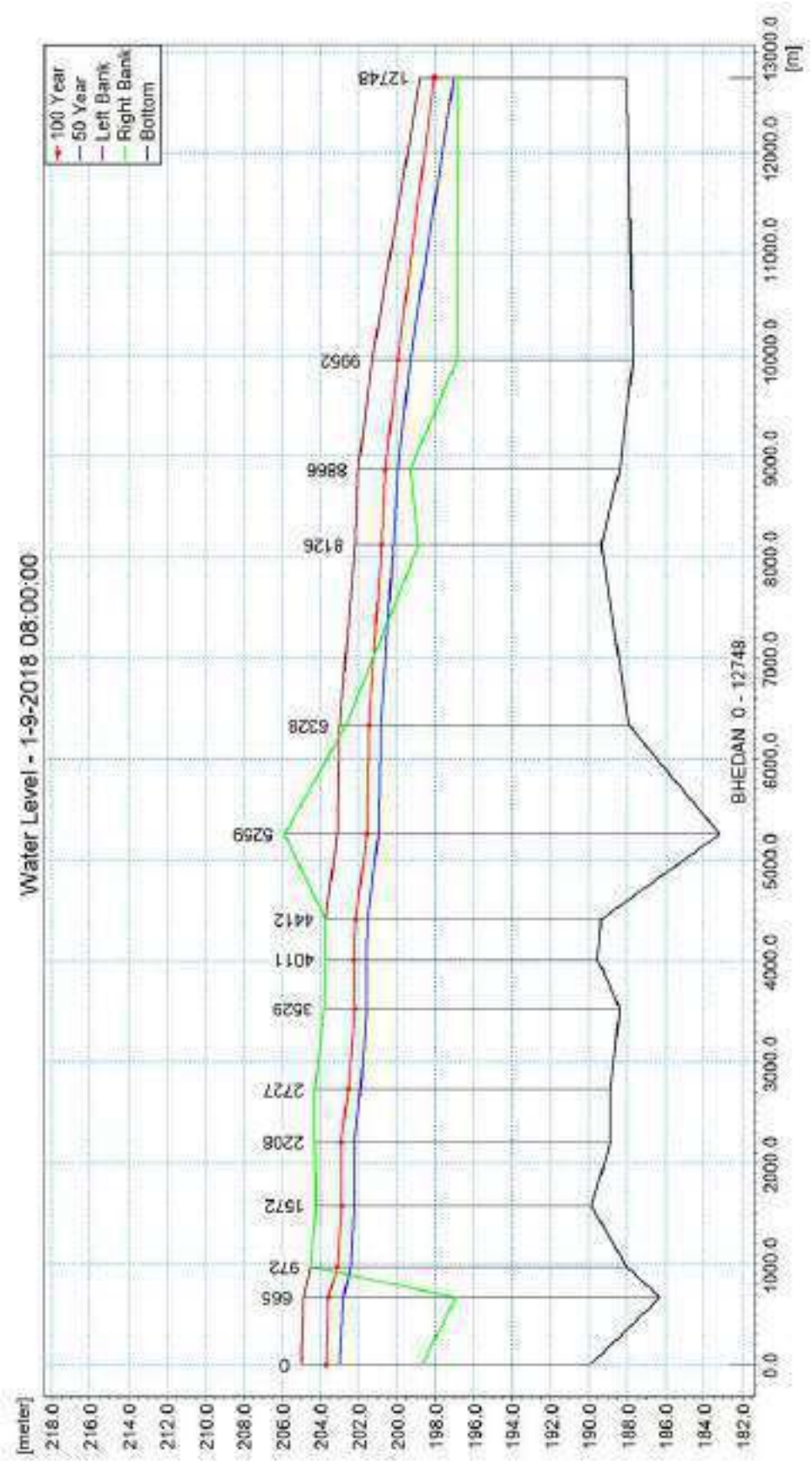
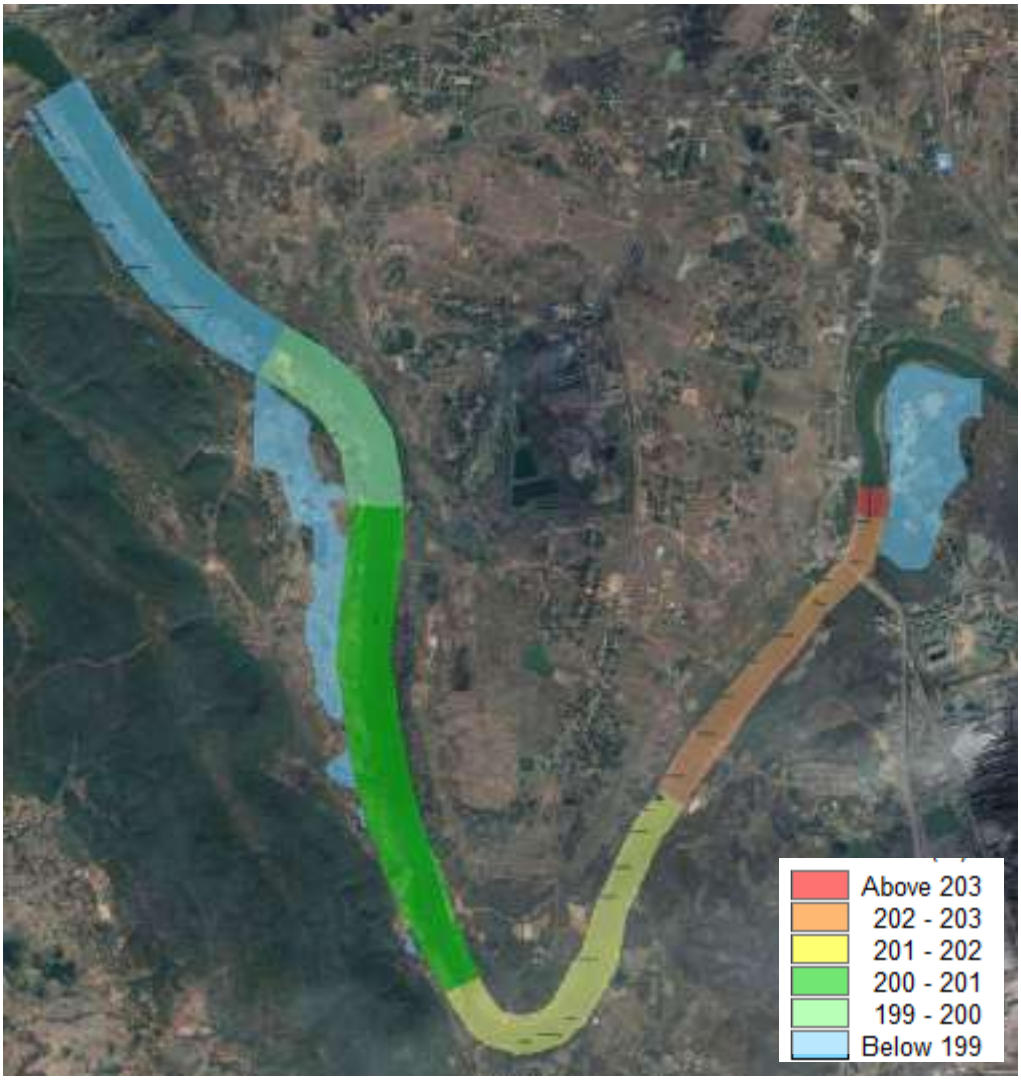
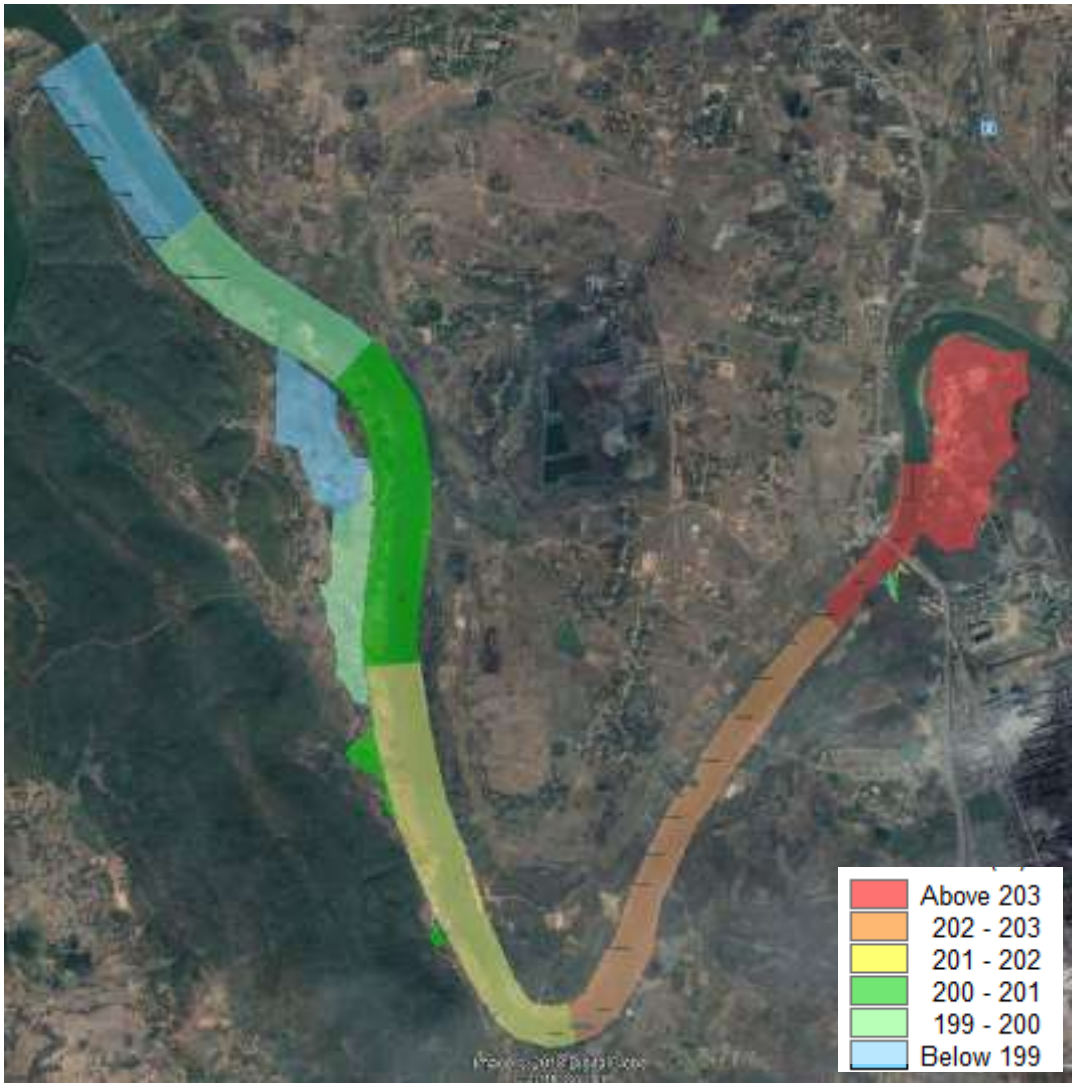


Figure 5.21 : Comparison maximum water surface profile for various return period flood with embankment



(a) Inundation map for 50 year flood



(b) Inundation map for 100 year flood

Figure 5.22: Inundation map for various flood estimates

Table 5.9: Water level with embankment for 100 year return period flood

Location	Water level with embankment	Top of the proposed embankment	UTM Coordinate			
			Left Bank		Right Bank	
			X	Y	X	Y
CS2(665)	203.5	204.50	811300.72	2411477.80	811130.78	2411622.00
CS3(972)	203.1	204.10	811070.50	2411261.30	810929.50	2411401.80
CS4(1570)	202.9	203.90	810719.91	2410780.60	810550.52	2410921.30
CS5(2208)	202.9	203.90	810360.57	2410269.70	810139.98	2410425.70
CS6(2727)	202.5	203.50	810076.72	2409846.40	809865.26	2409960.70
CS7(3529)	202.2	203.20	809708.96	2409124.30	809496.91	2409245.60
CS8(4011)	202.2	203.20	809580.45	2408626.80	809332.63	2408812.40
CS9(4412)	202.1	203.10	809376.44	2408308.30	809154.97	2408511.30
CS10(5259)	201.6	202.60	808498.37	2408375.40	808753.00	2408534.20
CS11(6328)	201.5	202.50	807973.09	2409374.10	808345.22	2409492.00
CS12(8126)	200.8	201.80	807630.59	2411263.80	808014.80	2411197.30
CS13(8866)	200.6	201.60	807669.89	2411961.60	808075.06	2411961.40
CS14(9952)	200.0	201.00	807337.38	2412673.40	807599.60	2413001.60

5.8 Drainage Pattern for Plant Area

The drainage pattern surrounding proposed plant area with their watershed boundary is shown in Figure 5.23. Further the delineated drainage pattern and digitized stream networks from SOI toposheet (Figure 5.24) are also digitized and compared. In general, the main plant area has negligible flow from the upstream area and can be easily diverted along the plan boundary/ periphery road. Two natural stream/nall (D1 and D2) are observed in and around the ash pond area flowing from east to west and joins Bhedan river. However, at present after construction of Bhushan plant both the drains D1 and D2 carries discharge from the of Bhushan plant area as sheen in Figure 5.24 and Figure 5.25. It seems the drain D1 carries discharge from coal handling unit of Bhushan plant. However, this drain D1 is in the north of proposed ash pond area of NLCIL and it will not interfere with the ash pond area of NLCIL. It seems he drain D2 carries discharge from the Bhushan plant area including discharge from iron ore washing plant as seen in photographs of Figure 5.25. Moreover, this drain D2 passes through the proposed ash pond area of NLCIL and joins to Bhedan river. Two alternatives for the drain D2 are analysed as discussed below.

Figure 5.23: Existing topographic features and drainage network

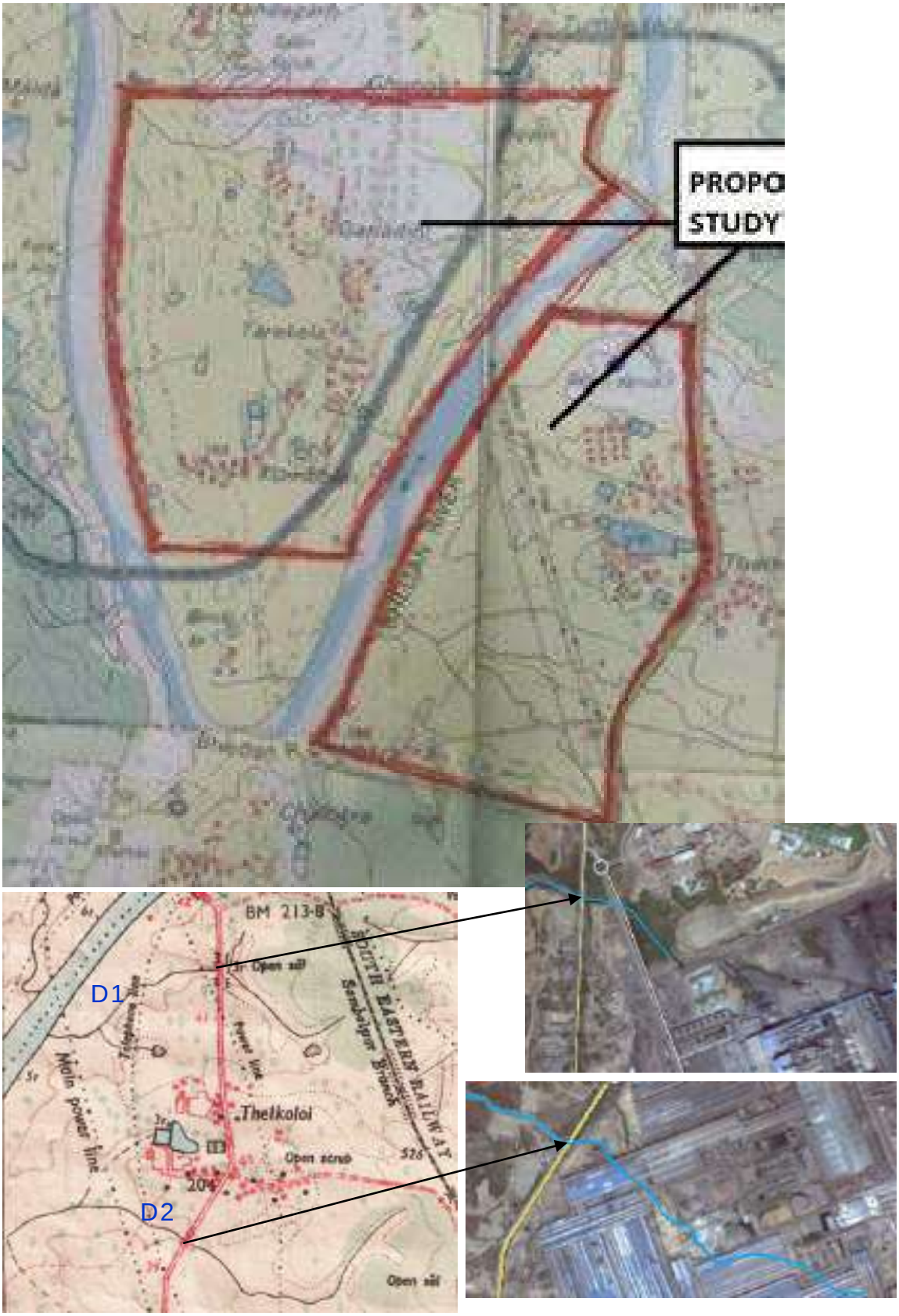


Figure 5.24: Main drains in the project area

Figure 5.25: Drainage pattern over the time

5.8.1 Alternative 1

The first alternative is to leave the alignment of drain D2 as it is, dividing the ash pond area in two portions as shown in Figure 5.26. The area north of drain may be used for fly ash pond and the area south of drain may be used for bottom ash pond. Under this scheme the will very little modification in the present alignment of the drain D2. The drain D2 may be straightened and strengthened with capacity in the area between the fly ash pond and bottom ash pond. However, it will have following disadvantages. If the out let of drain to Bhedan river is not properly regulated there will be chances of back water flow in to the drain during high floods when water level in Bhedan river rises up to RL 201.2 m. Further as discussed earlier this 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. Keeping these in view other alternative to modify the drain alignment is discussed in next section.

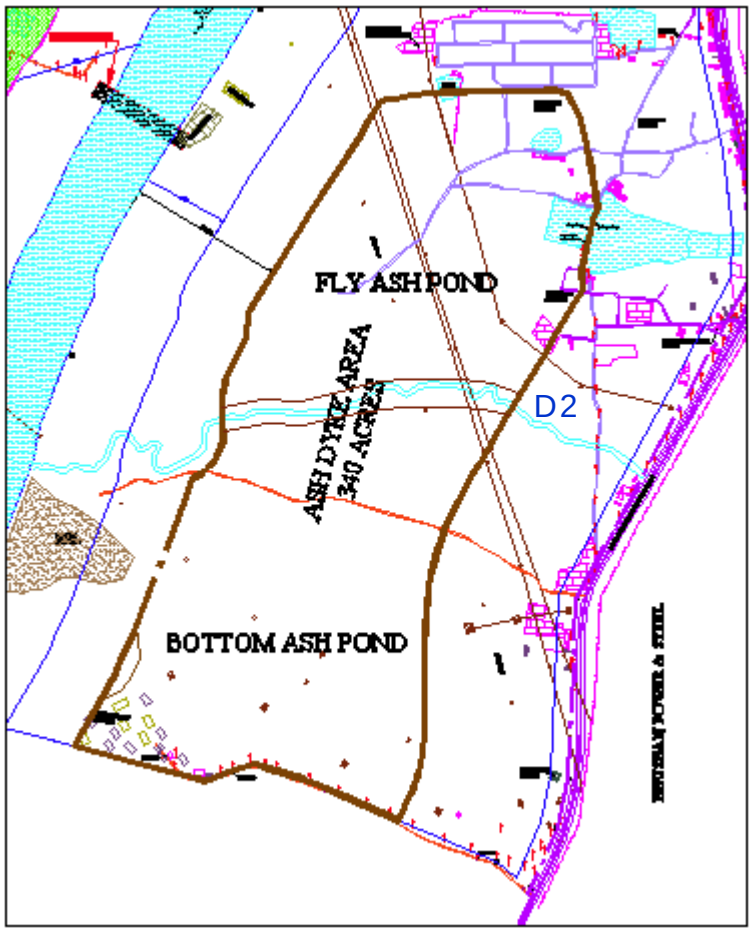


Figure 5.26: Layout of drain D2 for alternative 1

5.8.2 Alternative 2

The existing and proposed alignment for drain D2 is shown in Figure 5.27 and Figure 5.28. The existing alignment and alternative 1 is shown in Figure 5.28 as A-B-C-D. As alternative 2 it is proposed to divert the drain from point B to E along the boundary of ash pond area. The total length from B to E will be about 2.73 km. The present ground elevation and profile along the alignment B-E is shown in Figure 5.29. It is to be noted that in two stretches the drain cutting would be in the range of about 8 m for maintaing bed slope of drain as shown in Figure 5.29. The 3d surface plot of ash pond area is also shown in Figure 5.30, where the two relatively high ground are clearly visible.

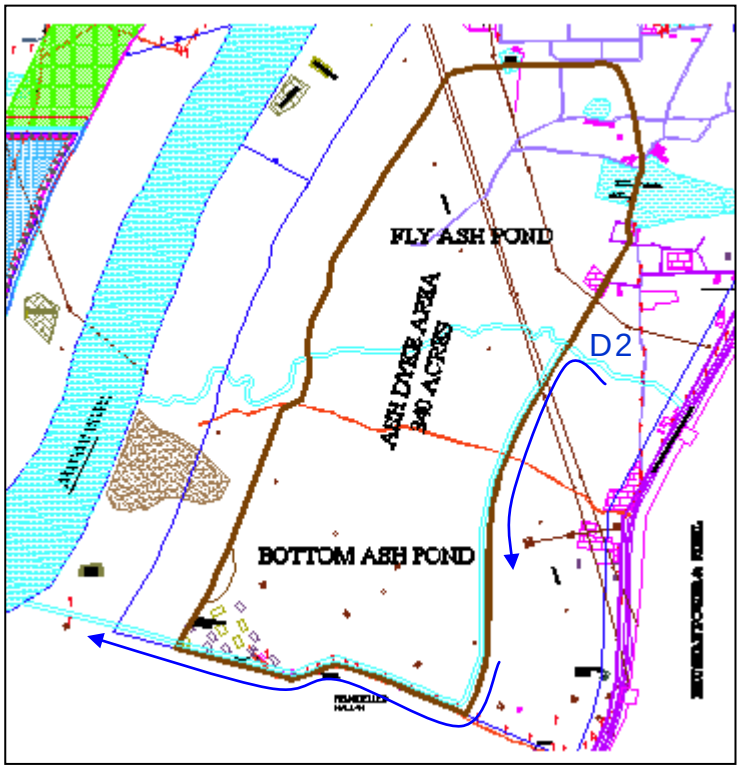


Figure 5.27: Layout of drain D2 for alternative 2

Figure 5.28: Layout of drain D2 for alternative 2 over satellite image

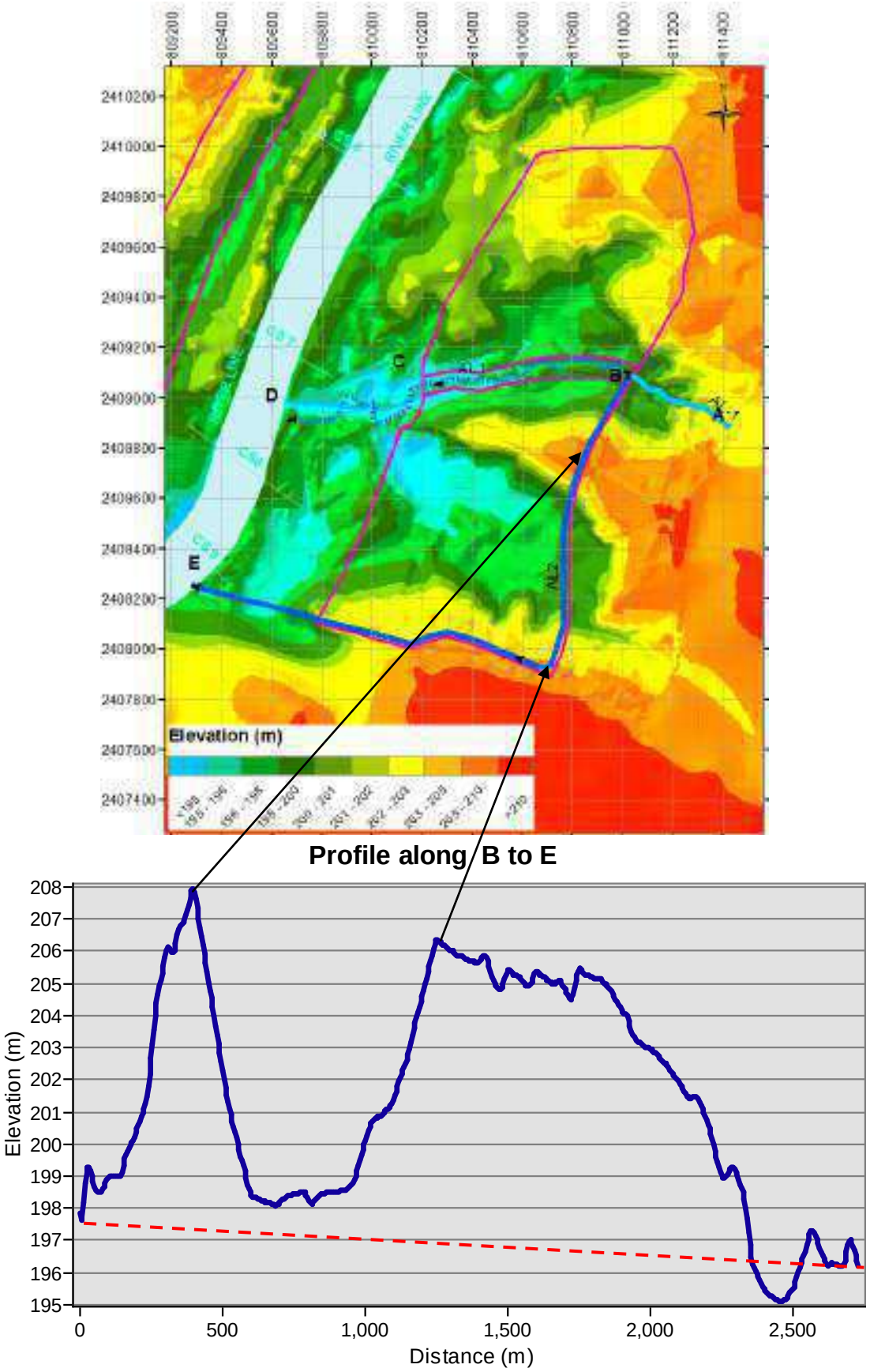


Figure 5.29: DEM and elevation profile along alignment 2.

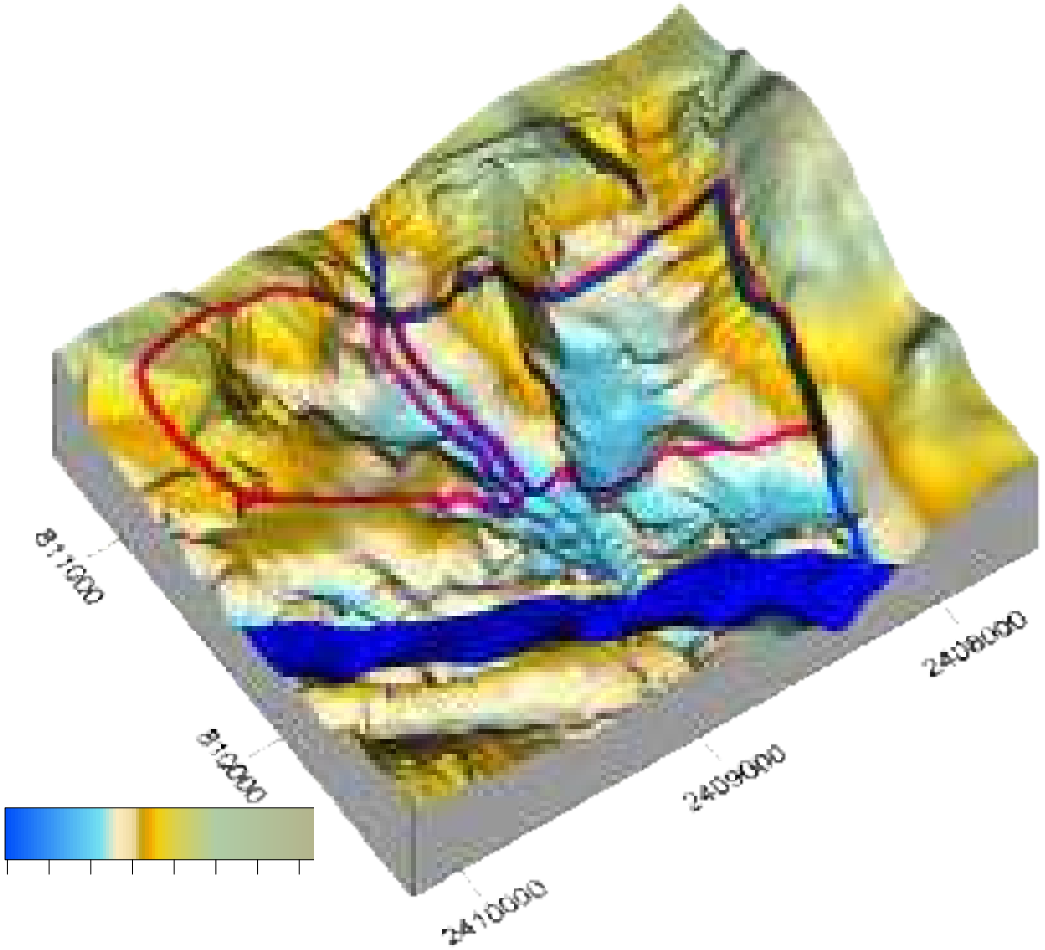


Figure 5.30: 3D surface map of ash pond area

5.9 Design of Drain D2

The catchment area contributing runoff to the drain D2 is about 6 km^2. The catchment area is mainly industrial with some agricultural/ grass land etc. Hence, weighted runoff coefficient of 0.7 is adopted. The 1 hour rainfall intensity of 50 year and 100 year are 48 mm/h and 53 mm/h respectively. The estimated peak runoff for 50 year and 100 year are 55.5 m^3/s and 61.3 m^3/s. The cross-section of the drains are designed according the Indian Standard, IS 10430:2000 (BIS, 2006). Trapezoidal section with side 1.5:1 (H:V) and longitudinal slope of 0.0015 m/m (1.5 m/km) is designed (Figure 5.31). The drain sections are designed for velocity less than 2 m/s and Manning's roughness coefficient (n) values of 0.025. The Free board recommended in the standard are: 0.75 m for discharge greater than 10 m^3/s and 0.6 m for discharge less than 10 m^3/s. However, the dimension and section many be altered as per land availability and site requirement maintaining the estimated peak discharge 55.5 m^3/s and 61.3 m^3/s for 50 year and 100 year return periods. As an alternative lined rectangular drain sections are also designed with Manning's roughness coefficient (n) values of 0.013 as shown in Figure 5.32.

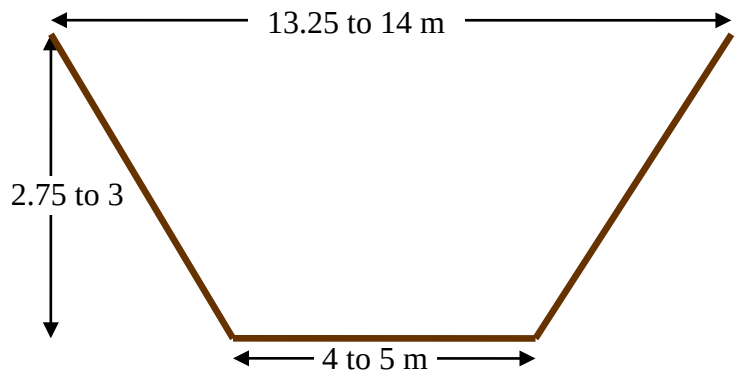


Figure 5.31 Cross-section of drain D2

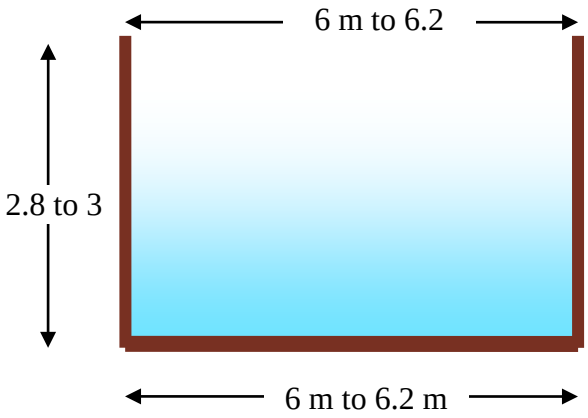


Figure 5.32: rectangular lined cross-section of drain D2

6 CONCLUSIONS

Based on study following conclusions are drawn:

1 The Digital Elevation Model (DEM) of the study area is prepared from surveyed contour for the plant area, spot heights; contours digitized from the SOI toposheets and SRTM data. The basin boundary and river networks are delineated from the DEM using HEC-GeoHMS and the catchment characteristics are estimated.

2 Synthetic Unit Hydrograph is developed following the guideline of Flood Estimation Report (CWC, 1993) and estimated catchment characteristics.

3 The daily rainfall data for ten raingauge stations are procured from IMD, Pune and the annual 1-day maximum rainfall series is extracted for rainfall frequency analysis.

4 Generalized Extreme Value (GEV) is identified as the robust frequency distribution following the regional rainfall frequency analysis using the L-moments approach. The robust frequency distribution is identified based on L-moments ratio diagram and Z_i^{dist} –statistic. The 1-day annual maximum rainfall for 25 year, 50 year and 100 year return periods are estimated as 27. 25 cm, 31.04 cm and 34. 86 cm respectively.

5 The design flood hydrograph are developed by convoluting the SUH with estimated design rainfall. The peak floods in Bhedan river due 50 year and 100 year return period rainfall for 1 day are estimated to be 9956.07 m^3/s and 11278.65 m^3/s respectively.

6 The flood inundation study for 50 year 100 year return period flood is carried out using the coupled 1D- and 2-D hydrodynamic model Mike Flood. The 1-D model in Mike 11 is prepared for the study reach of Bhedan river using surveyed river cross-section at fifteen locations. The 2D model in Mike 21 is developed for both main plant area and ash pond area using 10m cell size.

7 Under pre-project condition the maximum water level in the river varies from 201.5 m to 199 m along the river stretch from CS3 to CS 13 for 50 year return

period flood. The flood levels are about 0.4 m higher in case of 100 year return period flood.

8 The potential source of flooding at the plant site can be due to the flooding from Bhedan rive in the areas below RL202 m level. Hence, the safe grade level is recommended to be above RL 202 m.

9 Further, construction of embankments on both left and right bank is also analysed for various return period floods. 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.

10 The water level in river with 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 present embankment of different stretches along the right bank are not flooded in the modelling study. However, presently the embankment is not continuous.

11 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/nall are observed in and around the ash pond area flowing from east (from Bhushan plant) to west and joins Bhedan river.

12 The drain in the north of proposed ash pond area of NLCIL will not interfere with the 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 analysed.

13 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.

14 As second alternative, it is proposed to divert the drain along the boundary of ash pond area in by diverting to first south 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.

15 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. The Trapezoidal section drains are designed with a side slope of 1.5:1 (H:V) and longitudinal slope of 0.0015 m/m (1.5 m/km) to carry the runoff generated locally.

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Annexure-I

Annual 1 day maximum rainfall (mm) at various stations

Year	Deogarh	Jamankiru	Jharsuguda	Kirimira	Kolobira	Kuchinda	Kusumi	Kutra	Laikera_BL_II	Sambalpur
1960			161.6				295.8			290.7
1961			197.9				254.2			220.4
1962			85.4				72.5			131
1963			155.4				164.6			156.4
1964			109.6				184.2			308.6
1965			67.6				211.4			98.3
1966			113.8				135.5			136.7
1967		237	132				116		156	188.5
1968			197.9				132.6			156
1969			186.6				101.1			113.2
1970			102				129			
1971		180	110.6			198.3	200.6		100	156.2
1972			137.8				85.2			131.3
1973		259	190.9			299.4	308.4		185	174.2
1974		114	102.3				170.2		94.1	101.4
1975		203.2	257.8				413			102.2
1976		128	131.4				180			205
1977		75	116.4				69			87.2
1978		115	103				265			42.4
1979		126	81.4				70			63.4
1980			120.3				160			188.1
1981		100	82.2	57	42		188		57.5	94
1982		112	196				83.1			581.9
1983		147	110.2				164.2		91	206.8
1984		219	128				278.6		182	177
1985		205	97.7				130.6		132	216.8
1986		178.8	118.3				143.2		91	167.8
1987		55	127.1				209.2		187	100.8
1988		87	92.3				148.2		68	95.6
1989		113	174.3				155.6		86	86.4
1990		132.6	83.2				84.8		112	107.8
1991		176	118.7	126	133	120	129.6	105	94	193.1
1992	210	153			96	139	158	68	78	159.6
1993	80.2		130.8				233.8			200.8
1994	74.8	123	185.6	178	104	121.4	227.4	119	115	189.2
1995		101	152.7	86	78	60	217	74	62	95.6
1996		177	96.6	108	147	218.5	220.8	123	146	126
1997	84	53	123.4	52	68	41.4	110.4	91	40	199

Year	Deogarh	Jamankiru	Jharsuguda	Kirimira	Kolobira	Kuchinda	Kusumi	Kutra	Laikera_BL_II	Sambalpur
1998	110.5		170.8				243.8			146.3
1999	99.8		110.6				188.2			146.2
2000	62.6	55	58.6	36	65	45.8	82.8	119	30	99.2
2001	308.4	205	169.5	166	98	369	342.8	42	185	152.9
2002	47.2	75	195.1	111	85	78.6	125.2	39.4	98	84.2
2003	125	129	220.8	173	90	80.4		85.2	165	75.6
2004	122.5	150	170.3	230	108	99		189.8	306	155.8
2005		214	241.5	156	61	168.4		76.4	180	159
2006	162.9	86.8	98.7	105	149	94.8		117.4	220	283
2007	221.3	196.6	143.8	240	128	141.8		215.4	144	184
2008	138.6	153.2	191.8	210	207	175.8		136.2	195	220.8
2009	62.5	123.2	90.4	166	115	96.2		86.8	187	206.4
2010	118.6	54	76.7	72	96	50.2		144.2	85.2	99
2011	86.5	155	171.1	113	173	144.2		124.8	125.5	128.2
2012	58.4	98.6	224.4	273	221	192.6		100	350.2	120
2013	220	94	118.8	99	84	86.6	92.9	126	105.2	60.5
2014	263.1	256		106	222	319		160	123	
2015		154.4		162	165	95.4		196	142.2	
2016		106		105	58	82.2		110	83.3	

Annexure-II

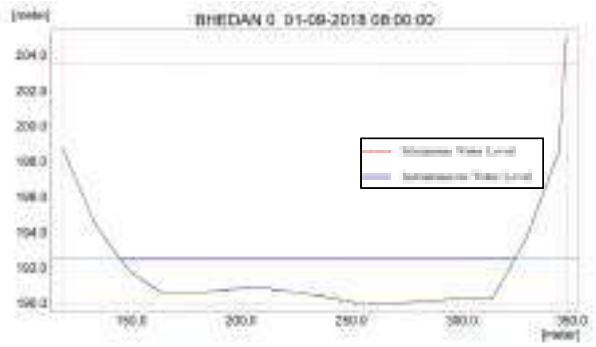
Effective rainfall and Runoff for various return period

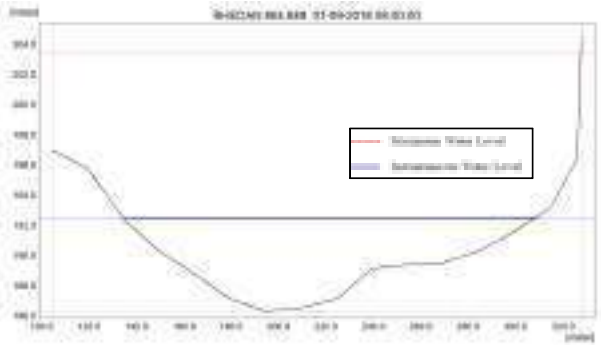
Time (h)	50 Year		100 Year	
	Rainfall (cm)	**Runoff (m^3/s)**	**Rainfall (cm)**	**Runoff (m^3/s)**
1	0.407	318.55	0.476	318.55
2	0.407	322.01	0.476	322.6
3	0.407	328.93	0.476	330.69
4	0.407	338.29	0.476	341.64
5	0.546	350.5	0.632	355.92
6	0.546	367.55	0.632	375.81
7	0.546	391.49	0.632	403.69
8	0.685	421.95	0.788	439.17
9	0.546	464.75	0.632	488.96
10	0.407	521.01	0.476	554.45
11	0.407	592.33	0.476	637.53
12	0.268	682.88	0.319	743.05
13	0.685	795.51	0.788	874.31
14	0.685	937.59	0.788	1039.73
15	0.964	1110.56	1.101	1240.96
16	0.964	1318.91	1.101	1483.1
17	1.521	1563.45	1.727	1767.11
18	1.799	1832.73	2.039	2079.42
19	2.634	2116.05	2.978	2407.29
20	**4.583**	2410.51	**5.167**	2747.15
21	2.077	2732.64	2.352	3117.37
22	1.242	3055.67	1.414	3487.88
23	0.825	3371.46	0.945	3849.63
24	0.685	3690.58	0.788	4214.54
25		4020.99		4591.56
26		4374.84		4994.31
27		4762		5433.81
28		5221.53		5954.04
29		5754.9		6556.7
30		6356.57		7235.56
31		7009.76		7971.63
32		7686.18		8733.2
33		8359.81		9490.88
34		8983.29		10191.4
35		9510.77		10783.21
36		9877.73		11193.63
37		**9956.07**		**11278.65**
38		9744.14		11036.34

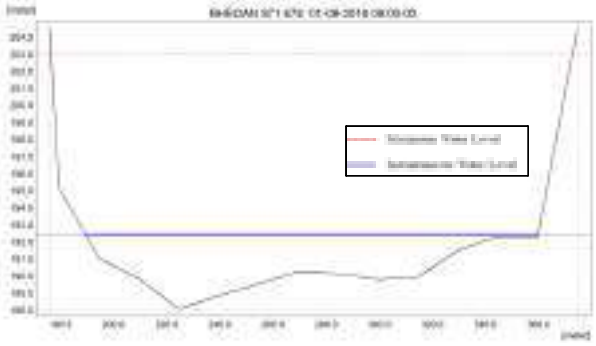
Time (h)	50 Year		100 Year	
	Rainfall (cm)	Runoff (m^3/s)	Rainfall (cm)	Runoff (m^3/s)
39		9327.15		10562.34
40		8776.83		9937.24
41		8160.22		9236.33
42		7537.67		8528.11
43		6937.19		7844.8
44		6367.24		7196.2
45		5842.61		6599.1
46		5346.57		6034.74
47		4883.76		5508.27
48		4453.51		5018.87
49		4049.69		4559.68
50		3660.42		4117.19
51		3303.34		3711.28
52		2978.34		3341.78
53		2679.6		3002.11
54		2413.23		2699.16
55		2171.08		2423.81
56		1953.01		2175.84
57		1756.48		1952.37
58		1580.09		1751.85
59		1423.35		1573.65
60		1283.15		1414.27
61		1160.5		1274.82
62		1054.76		1154.56
63		961.38		1048.36
64		870.97		945.66
65		798.05		862.74
66		732.68		788.44
67		672.39		719.93
68		614.75		654.48
69		555.56		587.41
70		503.1		527.97
71		454.07		472.42
72		413.57		426.52
73		383.2		392.03
74		358.02		363.47
75		337.72		340.44
76		328.02		329.4
77		323.11		323.79
78		320.06		320.29
79		318.55		318.55

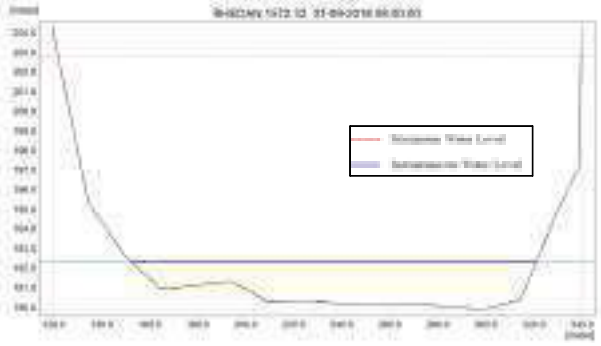
Annexure-III

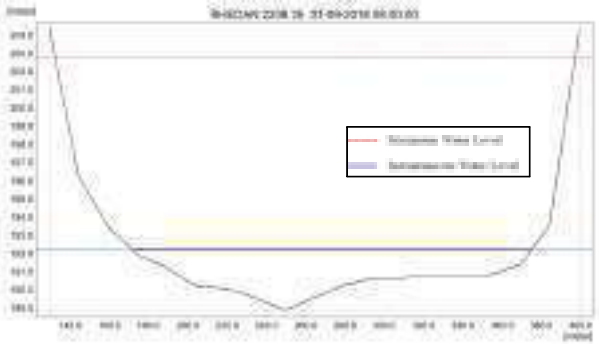
Cross Section profile with embankment

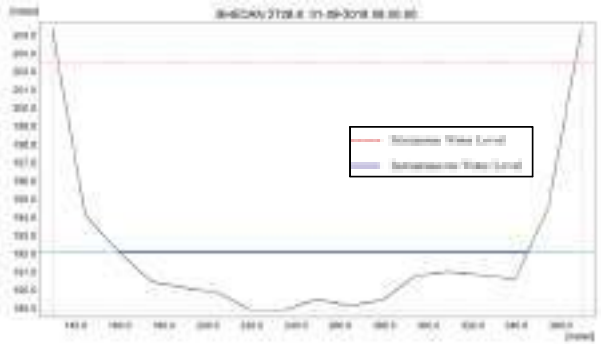


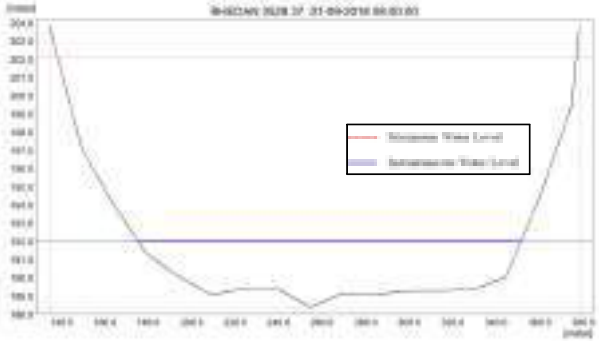


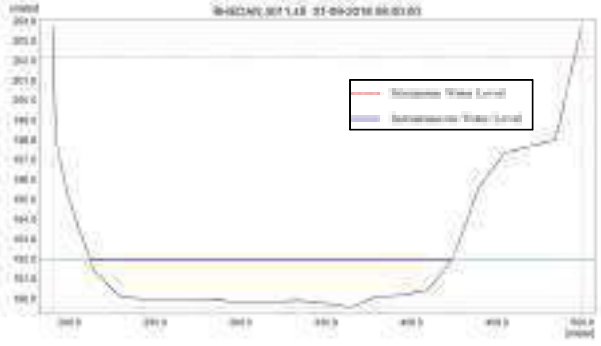


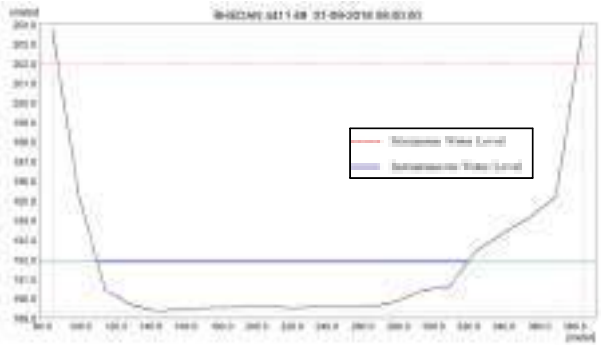


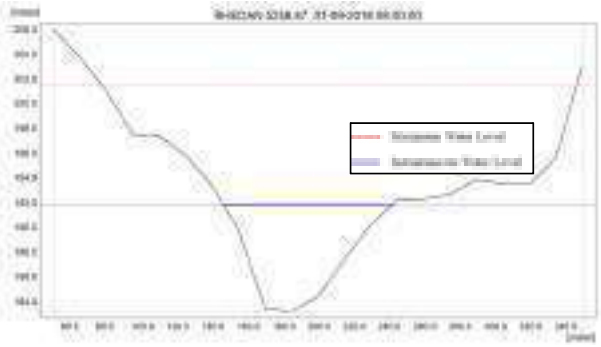


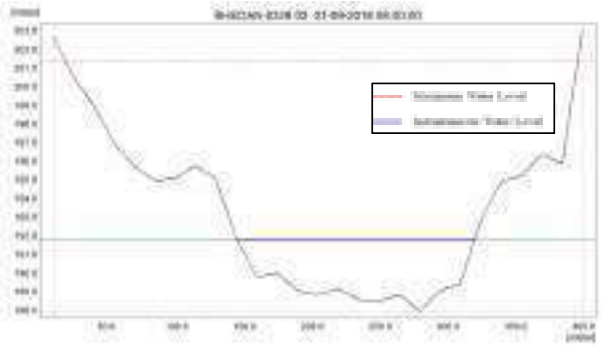


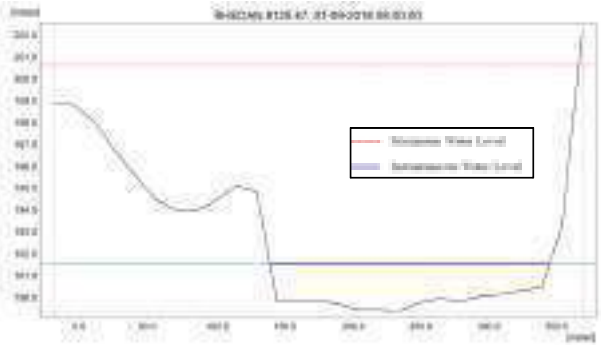


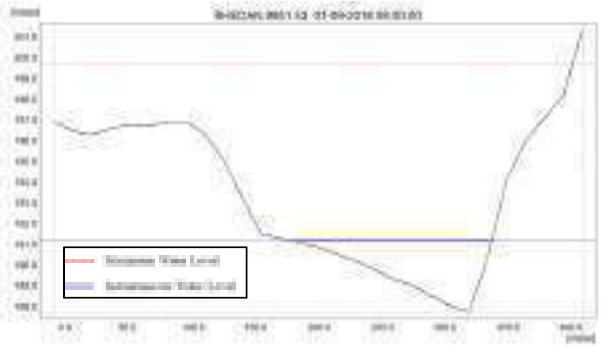












Appendix I

NATIONAL INSTITUTE OF HYDROLOGY

(Government of India Society under Ministry of Water Resources)
Jalvigyan Bhawan, Roorkee, Uttarakhand, India

RIVER CROSS-SECTION SURVEY WORK IN BHEDAN RIVER FOR FLOOD STUDIES FOR PROPOSED THERMAL POWER PLANT SITE AT JHARSUGUDA, ODISHA

Excelinnova CONSULTANCY

Email-Info@excelinnova.com

2018

CHAPTER-1

INTRODUCTION

1.1 General

Hydrographical survey deals with variation in channel characteristics in relation to variations in discharge. Two sets of variations take place: variations at a particular cross section (at-a-station) and variations along the length of the stream (downstream variations). Characteristics responsive to analysis by hydraulic geometry include width (water-surface width), depth (mean water depth), velocity (mean velocity through the cross section), sediment (usually concentration or transport, or both, of suspended sediment), downstream slope, and channel friction.

Cross-section survey of water bodies is a key part in hydro graphic engineering survey. Traditional methods of cross section survey of a river are intersection, theodolite stadia, electronic distance measurement, depth-surveying bar, lead line, hand lead survey and echo sounder are the main methods used for water bathymetry. These methods are not only prone to inaccuracy of instruments, distances, weather conditions, inter visibility and communication device, but also involved in tedious workload which leads to low efficiency. Some unfavourable factors such as the flow of the water and the nonlinear movement of the surveying ship make measuring the depth of the water more difficult.

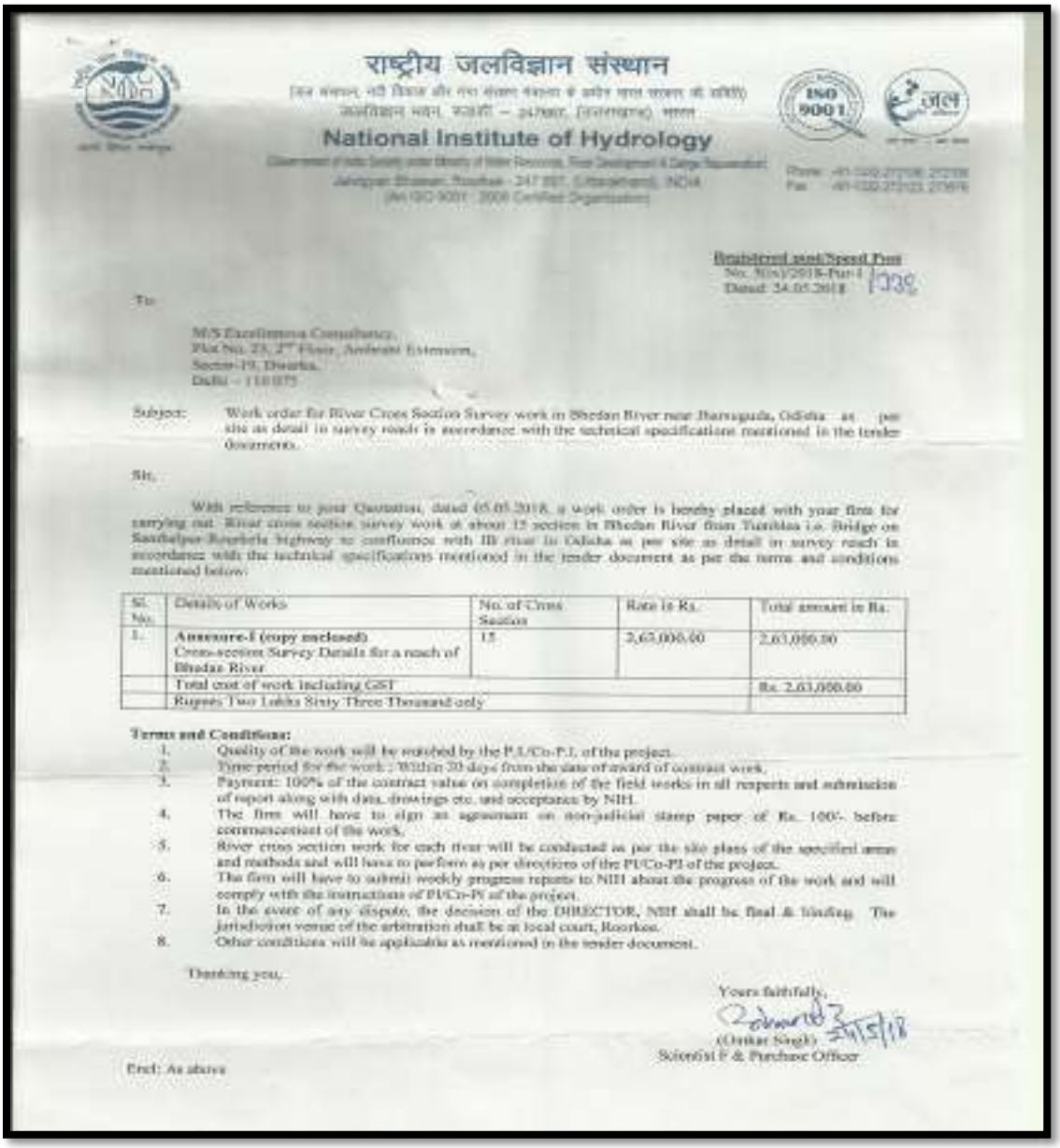
Now days the surveyor has opened a new avenue for the cross-section survey of rivers by latest high definition instruments like Digital Auto Level, Total Station, Echo-sunder and dual frequency DGPS (Static & RTK mode). Simultaneous utilization of latest technology and the shipboard sounding method (e.g. digital depth sounder with RTK DGPS) will greatly improve the accuracy and efficiency of cross-sectioning survey of rivers.

1.2 Background of the Project

The **National Institute of Hydrology**, Roorkee has placed a Work Order for **the "Cross Section Survey Work in Bhedan River as per Site"**.

National Institute of Hydrology (NIH) is a Government of India society under Ministry of Water Resources and has been functioning as a research Institute in the area of hydrology and water resources in the country since December 1978 in Roorkee. Main objectives of the institute are to undertake, support, promote and coordinate systematic and scientific research work in all aspects of Hydrology and Water Resources. The institute acts as a centre of excellence for transfer of technology, human resources development and institutional development in specialized areas of hydrology and conducts user defined, demand-driven research through collaboration with relevant national and international organizations. Total river survey length is around 14 KM to estimate the current river water capacity, sedimentation rate and water discharge.

1.3 Copy of Work Order



राष्ट्रीय जलविज्ञान संस्थान

National Institute of Hydrology

Registered post/Speed Post
No. NIH/2018-Pur-I/1039
Dated: 14.05.2018

To

M/S Excelinnova Consultancy,
Plot No. 23, 2nd Floor, Ambedkar Extension,
Sector-19, Dwarka,
Delhi – 110075

Subject: Work order for River Cross Section Survey work in Bhedan River near Jharsuguda, Odisha as per site as detail in survey reach in accordance with the technical specifications mentioned in the tender documents.

Sir,

With reference to your Quotation, dated 05.05.2018, a work order is hereby placed with your firm for carrying out River cross section survey work at about 15 section in Bhedan River from Tumbisa i.e. Bridge on Sambalpur-Rourkela highway to confluence with IB river in Odisha as per site as detail in survey reach in accordance with the technical specifications mentioned in the tender document as per the terms and conditions mentioned below:

Sl. No.	Details of Works	No. of Cross Section	Rate in Rs.	Total amount in Rs.
1.	**Annexure-I (copy enclosed)** Cross-section Survey Details for a reach of Bhedan River	15	2,63,000.00	2,63,000.00
	Total cost of work including GST			Rs. 2,63,000.00
	Rupees Two Lakhs Sixty Three Thousand only			

Terms and Conditions:

1. Quality of the work will be watched by the P.I./Co-P.I. of the project.
2. Time period for the work : Within 20 days from the date of award of contract work.
3. Payment: 100% of the contract value on completion of the field works in all respects and submission of report along with data, drawings etc. and acceptance by NIH.
4. The firm will have to sign an agreement on non-judicial stamp paper of Rs. 100/- before commencement of the work.
5. River cross section work for each river will be conducted as per the site plans of the specified areas and methods and will have to perform as per directions of the PI/Co-PI of the project.
6. The firm will have to submit weekly progress reports to NIH about the progress of the work and will comply with the instructions of PI/Co-PI of the project.
7. In the event of any dispute, the decision of the DIRECTOR, NIH shall be final & binding. The jurisdiction venue of the arbitration shall be at local court, Roorkee.
8. Other conditions will be applicable as mentioned in the tender document.

Thanking you,

Yours faithfully,

(Onkar Singh) 14/5/18
Scientist F & Purchase Officer

Encl: As above

Annexure - I

Survey Details for a reach of Bhedan River

River Cross-section survey in Bhedan river from *Tamblea* (Bridge on Sambalpur-Rourkela Highway) (aprox. 13 km) shown in blue line in Figure 1 (one time river cross section, extended beyond banks) at about 15 sections. The width of river cross-section to be surveyed will be about 500 m. The width of water spread is about 200 m (Figure 2).

The elevation data of river bed along with the latitude and longitude (X-Y in UTM44N) of observation point would be required. The levels shall be on the basis of GTS benchmarks in the vicinity. The contractor shall transfer the benchmark to the site. All levels shall be related to MSL based on GTS benchmark. The spacing between two surveyed points along the river cross sections should not be more than 1/10 of waterway width and should be placed when there is change in slope.

Along the river cross section, survey on land is to be carried out by Total Station/DGPS while the survey in waterway is to be carried out using echo-sounder. The horizontal coordinates of surveyed points should be in geographical/UTM coordinates while the vertical coordinate should be as above Mean Sea Level (MSL). The accuracy / least count of the instruments used in the survey should be clearly mentioned in the NIQ.

Survey report along with excel sheet containing geographical/ UTM-44N coordinate of permanent marks for river banks, The X, Z coordinates for river cross-sections and AutoCAD drawings for river cross sections are to be submitted after completion of work. Photographs and videos are to be made during the survey work and to be submitted in soft copy (DVD). The surveying agency is required to inform NIH regarding initiation of the work, so that officials from NIH may visit the surveying sites to monitor the survey work.

You are requested to quote your price for the above survey works including the applicable taxes. The number of cross-sections to be awarded for surveyed may vary from 10 to 15 depending on the availability of fund.

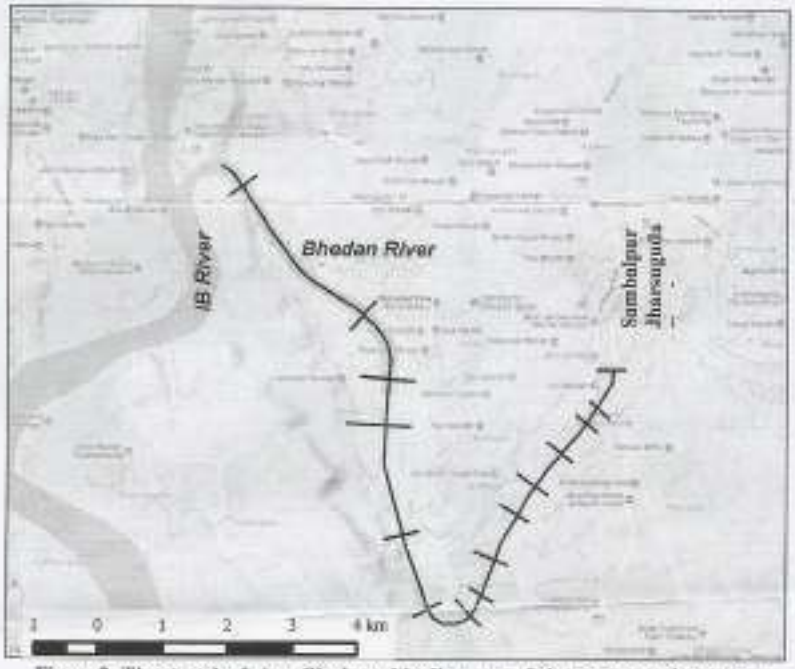


Figure 2: The stretch of river Bhedan with alignment of river cross sections survey.

The link for downloading KML file is given below:
https://drive.google.com/file/d/1e0lRGiHYvz0lmJUR66DR6yKmKo8Ra2qVp/view?usp=sharing

CHAPTER-2

RIVER CROSS SECTION SURVEY WORK IN BHEDAN RIVER AS PER SITE FOR FLOOD STUDIES FOR PROPOSED THERMAL POWER PLANT SITE AT JHARSUGUDA

2.1 Abstract

This project report summarizes the “Cross Section Survey Work in Bhedan River as per Site details” at Jharsuguda and Sambalpur district, Odisha. The task carried out survey of total 15 Cross Sections from Tumblea Bridge on Sambalpur-Rourkela Highway to Confluence with IB River (Apx.14km).

2.2 Bhedan River

Bhedan River is also known as Bhedar River. It is located at an elevation of 202 meters above sea level. Bhedan river flow east to west in between Jharsuguda and Sambalpur District in Odisha, Bhedan stream is tributary of IB river which further Confluence with Mahanadi river at Hirakud Dam. Major thermal power plants and coal-based industries are situated on the Bhedan and Ib river bank.

River Extent

Type: stream

Location: Odisha, Eastern India, India,

Latitude: 21° 48' 37" north

Longitude: 83° 56' 48.5" east

Elevation: 202 metres (662.73 feet)

2.4 Introduction

This section includes an overview of the River Cross Section Survey Work along the 14 km stretch of The Bhedan River, Jharsuguda and Sambalpur district, Odisha. The Bhedan river stretch passing through industrial area mainly Thermal power plant, the river course is mostly watery because the start of Monsoon session. The Bhedan river bank are full of scrub so it is challenging to establish the vertical control points.

Figure : shows the geographical location of the survey project area respectively longitude 83°57'0" E and latitude 21°48'0" N.

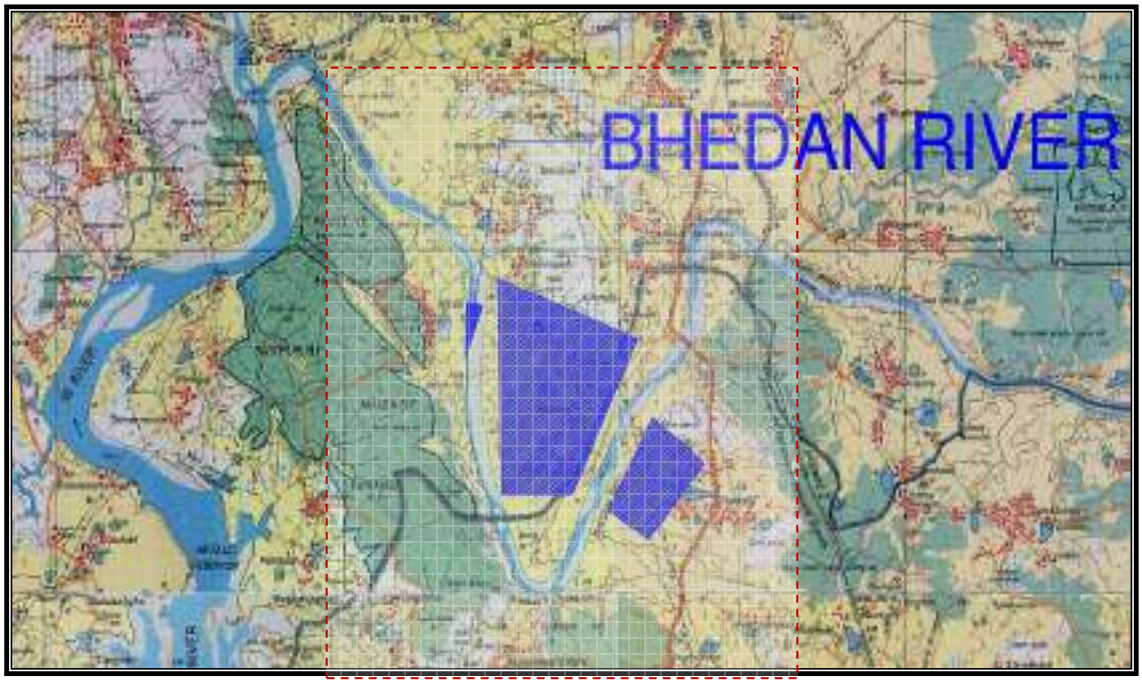


Figure No. 1

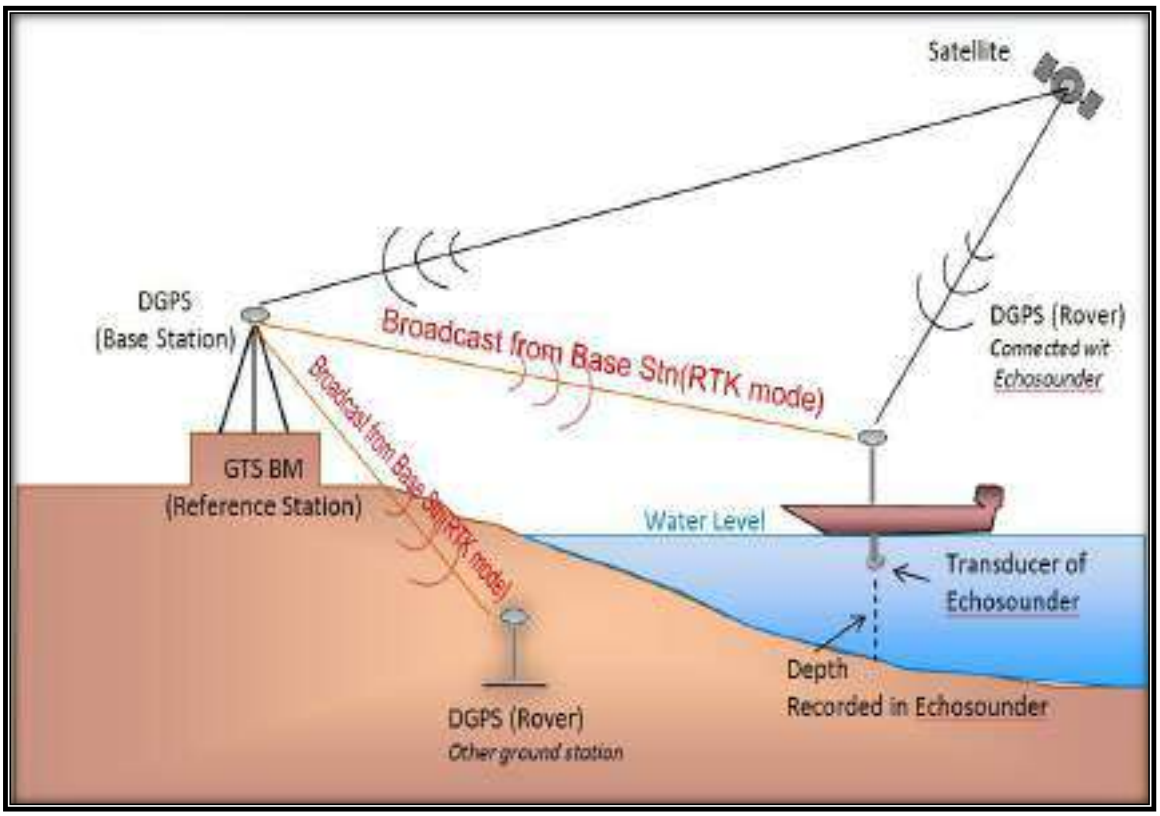
2.5 Method

The proposed Bhedan River cross section survey site running from Tumblea Bridge, Sambalpur - Rourkela Highway to Confluence with IB River (14 km).

According to the work order the accuracy of the work along the decided river course should be highly precise. High accuracy GPS positioning ("differential" GPS) technique has been used to carry out the subject work. Thus, with the help of this technique the project execution time is saved. Also, the nature of spatial correlation of the GPS measurement errors such as atmospheric delay, orbital errors, clock errors and other factors in GPS survey (which auto processed by DGSP post processing software) will be resolved and high accuracy will be maintained.

2.5.1 Methodology

Differential GPS is the primary survey reference for all types of present-day engineering and topographic survey activities. DGPS is a continuous, all-weather, worldwide, satellite-based electronic positioning system. It is available to the Civilian and is known as a standard positioning service. Over the past several years, a technique has been developed to process signals from two GPS receivers operating simultaneously to determine the 3-D coordinates (vector format) with a centimetre or millimetre accuracy (depend on DGPS model and single or dual frequency) between the two receivers. This technique is known as "differential positioning" (DGPS) and can produce real-time positions of a moving survey vessel.



Differential GPS real-time measurement of position of survey vessel

With the GPS signal corrections transmitted in real time from a reference receiver at a known location and the information from four or more visible satellites, a data processing is carried out in real time at the rover station, and the ambiguity resolution, position and accuracy of the rover station is obtained.

The critical requirements of the RTK techniques include:

- Simultaneous measurements from a minimum of two GPS receivers
- The separation of the base and rover should be less than 10 - 20km

An on-the-fly data link.

2.5.2 Instruments used in this project

DGPS: Trimble R4 GNSS System with 220 channels, delivers the accuracy and reliability required for precision surveying with superior tracking and RTK performance. With GPS L2C and the Japanese QZSS support included. It have millimetre-accuracy real-time positioning with RTK/STATIC data, and up to 10 Hz position updates and taking NMEA output when attached with Echo-Sounder.

Total station with complete accessories: -

The Sokkia DX-101AC Motorized Total Station will transform the way you survey, allowing you to confidently perform complex measurement tasks quickly and with an **accuracy of only 1-second**. Surveying professionals will enjoy the enhanced productivity gained with Sokkia's new Direct Aiming technology, powerful EDM and exclusive Long Range Communication technology.

Echo Sounder : Throughout the Hydrographic world the term 'Black Box' has become a euphemism for a device that has a minimal user interface and normally requires connection to a PC to be of any use. The SonarMite instrument uses the same 'Smart' integrated transducer technology used in the SonarLite system, in addition to highly reliable bottom tracking algorithms using DSP techniques the system also outputs a quality value associated with every depth measurement made.

Transducer Frequency: 235 KHz Active Transducer

Beam Spread 8 to 10 Degrees

Depth Range 0.30m to 75.00m (Software limited)

Accuracy +/-0.025m (RMS)

2.5.3 Referenced Station: A GTS (Great Trigonometrical Survey) Benchmark is a permanently fixed reference survey station(or point), having known elevation with respect to a standard datum(Mean Sea Level) .These point is established all over India by Survey Of India with greater precision. A Benchmark value is quite essential at any survey area, especially for reduction of observed sea level with respect to MSL or Chart Datum. GTS Benchmarks are available within a kilometre distance and can be easily transferred to the survey area by fly levelling using an automatic level measurement is a difficult task, consuming enormous amount of time and labour.

To eliminate this process in this project, we were finding a pre-existing TBM in the proposed survey area between Tareikela and Kumbharei villages, Jharsuguda Odisha. That TBM were already established nearby village and the RL is incorporated with GTS point. We cross check the pre-existing value using Digital Level. The details of base station (TBM 9) and cross check with two locations are given in table below.

Name	Northing (Y)	Easting(X)	RL Observation	Actual RL	Closing Error(mm)
TBM9	2411366.399	809645.084		210.759	Given by client
TBM2		Cross check	209.451	209.446	0.005
TBM6		Cross check	200.468	200.462	0.006

3.5.4 Topographical Surveys

The topographical survey work of Bhedan River portion will be carried out using DGPS by taking out cross-section of streams and taking spot levels at 10 m intervals or less depending upon the site conditions and as per the instruction of the Engineer- in-charge. The Cross-section survey is to be conducted for Bhedan River. The role of survey team will be to:

(i) Prepare a survey plan along with selection and fixation of additional Bench Marks,

(ii) Carried out cross section survey using modern and accurate levelling equipment's

3.5.5 Carry out cross section survey using modern and accurate leveling instruments,

Land survey equipment i.e. Digital level and DGPS (SP80 GNSS Receiver) deployed for carrying out topographical survey of land area. The prominent point i.e. natural or man- made features or any temporary or protection work will be clearly and accurately surveyed and will be shown in detail on topographic plan & cross section.

Level reading interval would generally be 10 meters but may be adjusted with respect of depending breaks of slope. All breaks of slopes such as embankment toes, top edges, berm, river bank, river terraces (if any) etc. would be recorded. The section would be nearly perpendicular to the flow of the channel. Start and end points of each section will be marked clearly and precisely on a detail base map of the area under study. Plan for conducting cross section survey will be prepared on the basis of latest river configuration and the proposed plan will be submitted in the form of a map for approval by NIH. The terrain under question is undulating with little highs and lows but this subtle difference in elevation is of utmost importance hence such changes would be recorded carefully. An accuracy of +1- 5cm would be maintained.

All topographic data would be acquired, stored and processed in a geo-referenced manner in user friendly standard format that can be accessed both by CAD programs such as Auto CAD .The survey carried out by selecting observation points very carefully, so that at no occasion any point or ground at which ground slope change is left unmarked and its level not taken. The observation points would be such that the curves, slopes, cross section, developed clearly and sufficiently reflect the relationship with general terrain and ground conditions. The survey team captured and integrate digital photographs and videos at appropriate resolution to reflect the status of all embankment assets and related infrastructure in the survey domain.

3.4.2.1 Hydrographic Survey of River

The sounding data shall be recorded and reported at an interval of 10m interval at the marked cross section site across the river. Soundings shall be carried out using suitable equipment, which yield accuracy of +0.025 m or better. Relevant environmental parameters, which effect accuracy of echo sounding, shall be measured regularly and

appropriate correction shall be applied. Bar Check equipment/tackle and its calibration shall be got approved from expert.

- Establishment of Vertical Control

The vertical control established by suitable water level gauges and Bench Marks within or near the survey area to reduce the soundings to an approved Chart Datum (C.D).

DGPS enabled sounding instrument to determine the position of points to be surveyed. While taking soundings vessel moved at a slow speed (not greater than knots).The procedures of this measurement will be taken:

- A base station must established first to get known coordinates of that point. For these works the minimum observation duration will be 2 hours

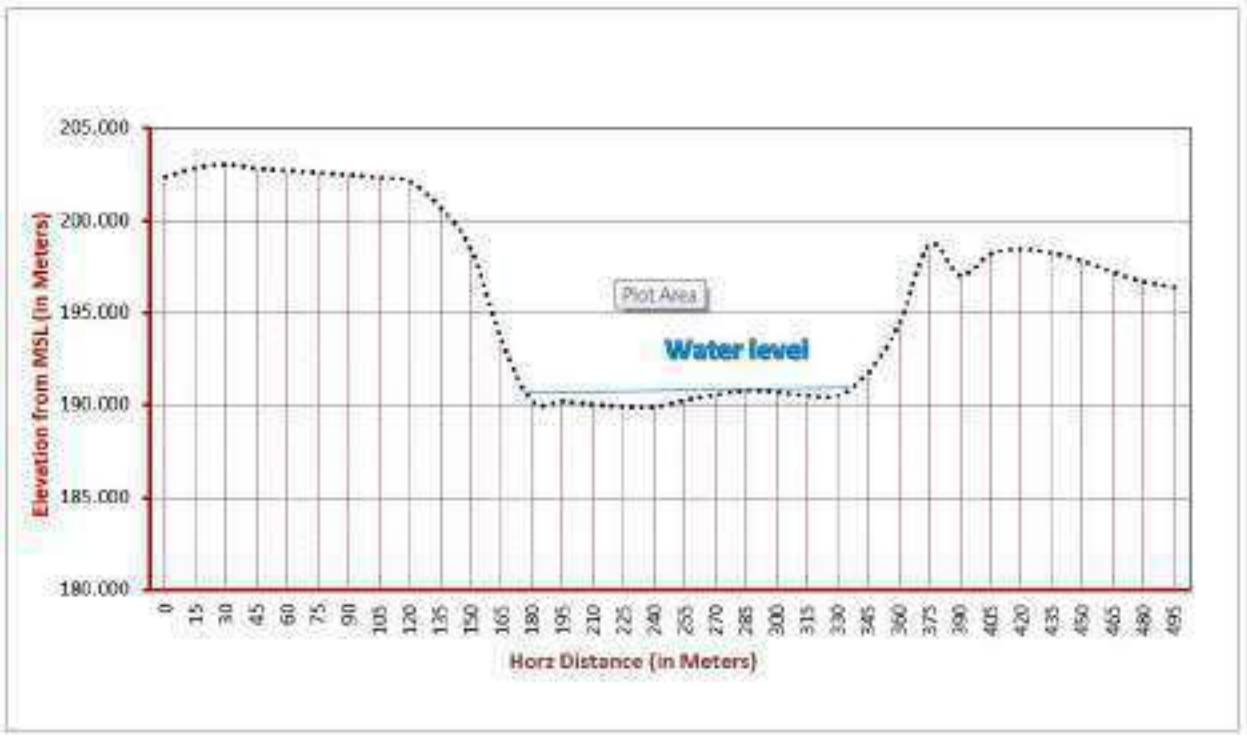
The instruments were then set up on board such as GPS with radio link as a rover, echo sounder, laptop that already installed with Sonar mite. After that, the measurement taken. The interval between sounding line will be as per TOR. The data collected every 1s in each sounding line. So, every 1s the depth and position will be collected in this measurement.

2.6 Result

The cross section survey lines are designed to be roughly perpendicular to the direction of the river course. The positions of the cross-sections control points are then selected in open fields and available prominent feature like road edge or culverts etc. are established. We could try each cross-section usually consists of two cross-section points and one in each side of the river. Finally, the 3-D coordinates (both plane coordinates and height) of the points are surveyed by DGPS receiver or total station. We used a high précised GTS BM as a Reference Station for maintaining accuracy of the 3d coordinates. The three-dimensional coordinates of each cross section line are input into a laptop computer. The geodetic datum parameters in the laptop computer are chosen prior for the computation of the results and the Universal Transverse Mercator (UTM 44 zone northern hemisphere projection) with datum WGS-84 coordinate system and are used in the survey. The unit of the measurements is meters and the area surveyed is located at geographical position of longitude 84° 00' 34.46" E to 83° 57' 23.35" E and latitude 21° 47' 10.23" N to 21° 48' 43.65" N respectively.

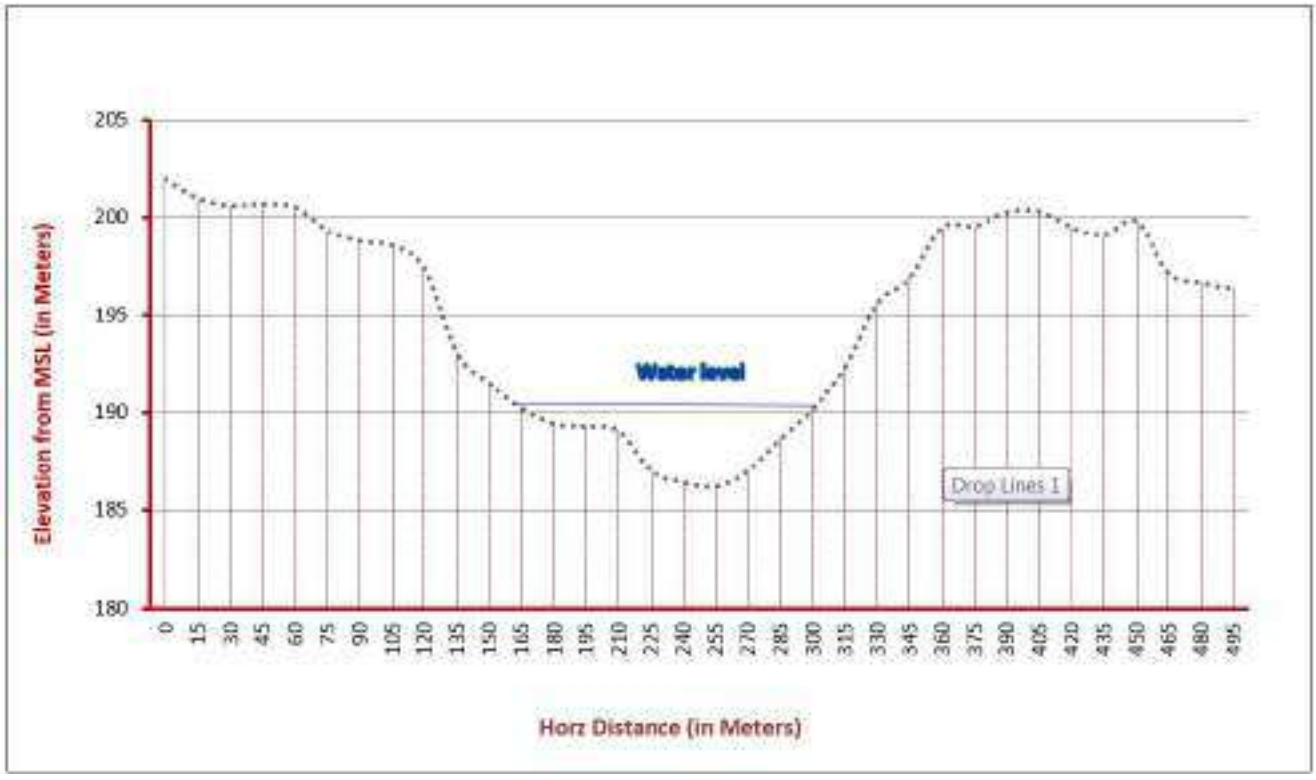
At last finally we have carried out the work of 15 cross-sections which are Tumblea Bridge on Sambalpur-Rourkela Highway to Confluence with IB River (Apx.15 km). The longitudinal profile views with photographs of the cross-sections are as follows.

Cross Section - 1



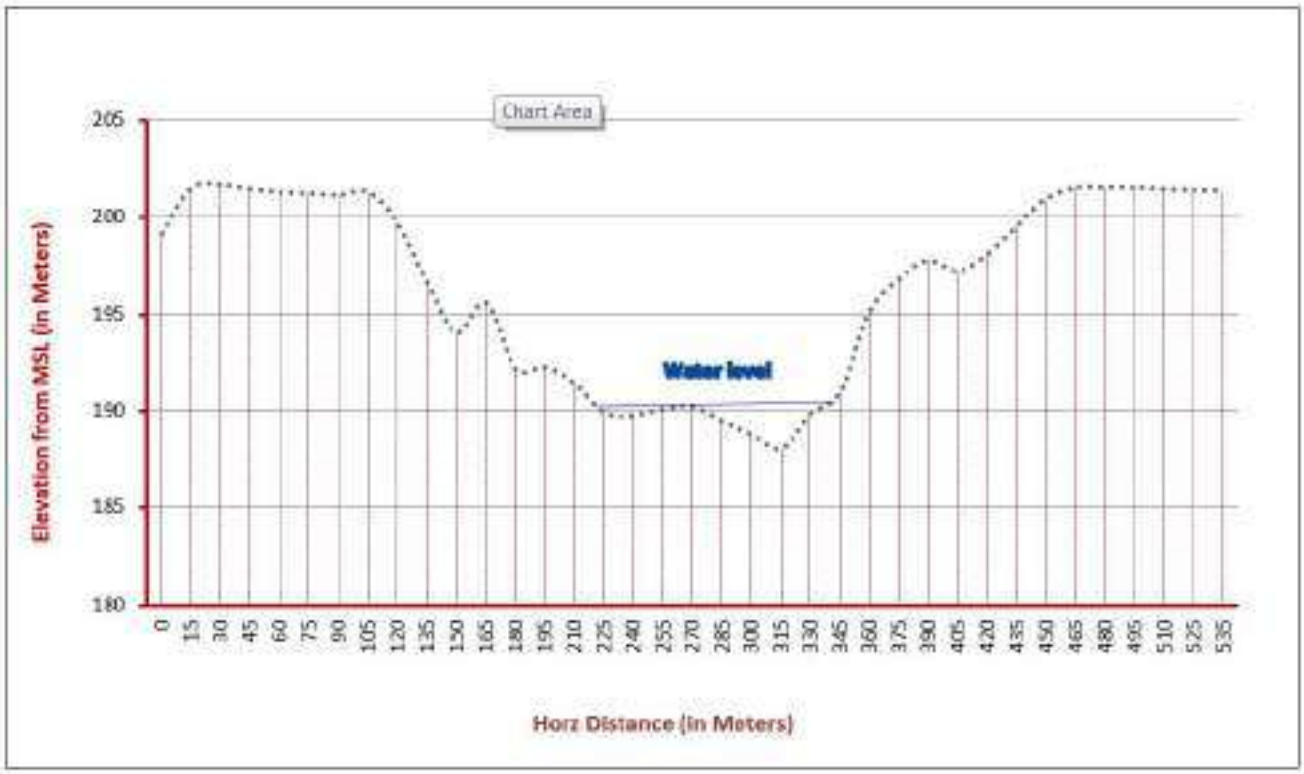
CROSS SECTION 01		
Chainage	**RL**	**Remarks**
0	202.362	
15	202.836073	
30	203.0000875	
45	202.7905352	
60	202.6896835	
75	202.5851793	
90	202.4725887	
105	202.3099194	
120	202.086608	
135	200.668958	
150	198.4176781	
165	193.4768848	
180	190.2011523	
195	190.2066824	
210	190.0432711	
225	189.9389895	
240	189.9212303	
255	190.2683263	
270	190.5747622	
285	190.8239424	
300	190.730536	
315	190.5183377	
330	190.5120565	
345	191.7901078	
360	194.3638458	
375	198.7068299	
390	196.9988018	
405	198.1773712	
420	198.4425666	
435	198.2319406	
450	197.8045302	
465	197.1784823	
480	196.6835214	
495	196.3745428	

Cross Section - 2



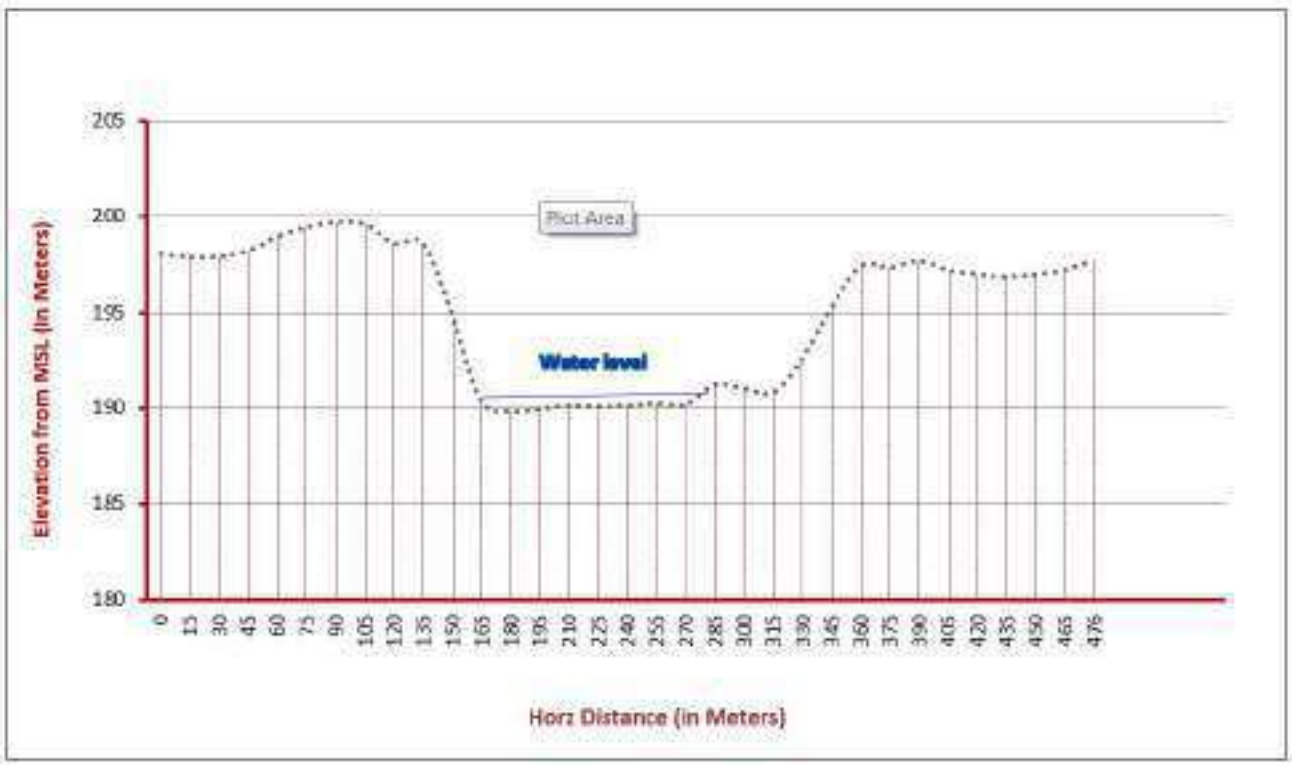
CROSS SECTION 02		
Chainage	**RL**	**Remarks**
0	201.95	
15	200.99	
30	200.62	
45	200.71	
60	200.54	
75	199.35	
90	198.82	
105	198.58	
120	197.44	
135	193.08	
150	191.53	
165	190.25	
180	189.46	
195	189.33	
210	189.10	
225	187.06	
240	186.47	
255	186.26	
270	187.05	
285	188.70	
300	190.22	
315	192.36	
330	195.68	
345	196.92	
360	199.52	
375	199.59	
390	200.30	
405	200.33	
420	199.52	
435	199.12	
450	199.85	

Cross Section – 3



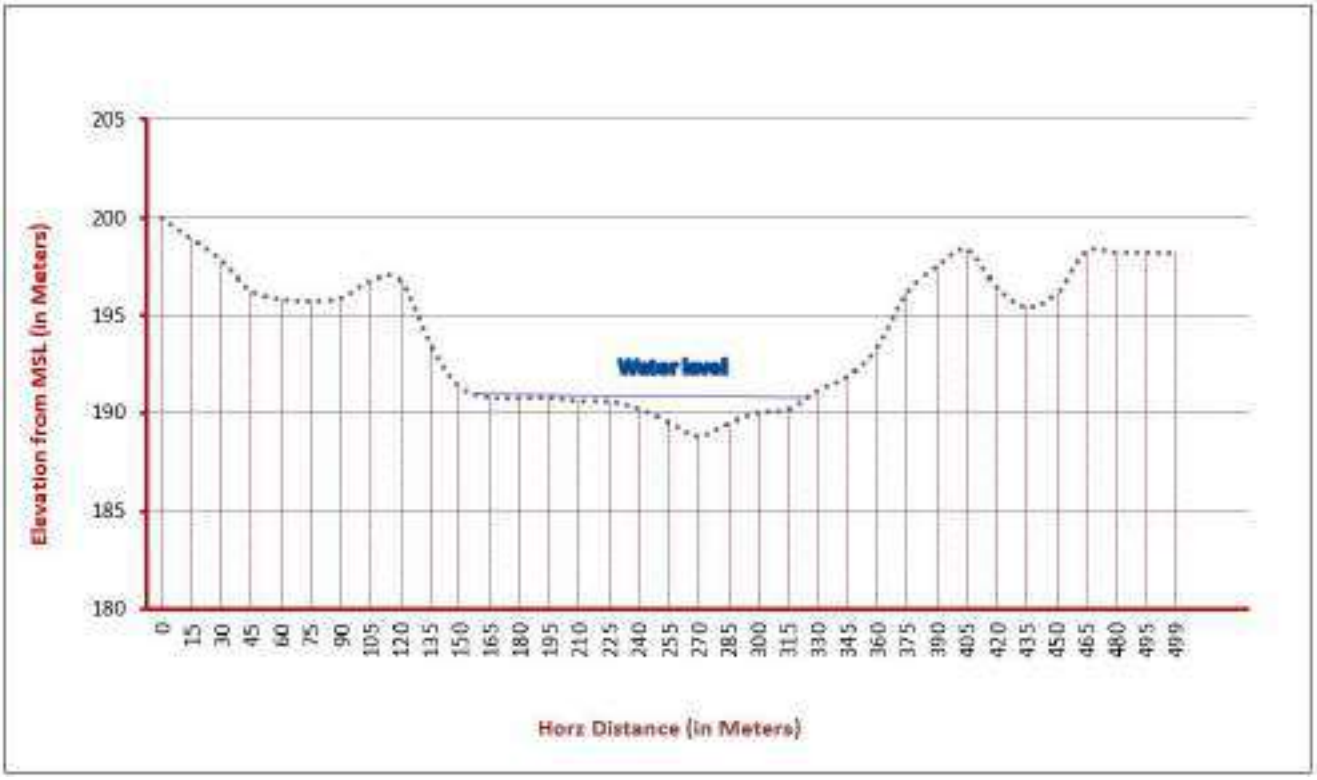
CROSS SECTION 03		
Chainage	**RL**	**Remarks**
0	199.17	
15	201.52	
30	201.69	
45	201.49	
60	201.33	
75	201.26	
90	201.16	
105	201.33	
120	199.72	
135	196.64	
150	194.03	
165	195.61	
180	192.19	
195	192.28	
210	191.45	
225	189.90	
240	189.76	
255	190.09	
270	190.22	
285	189.49	
300	188.81	
315	188.03	
330	189.82	
345	190.96	
360	195.12	
375	196.82	
390	197.78	
405	197.22	
420	198.11	
435	199.56	
450	201.00	
465	201.55	
480	201.55	
495	201.57	
510	201.48	
525	201.43	
535	201.40	

Cross Section - 4



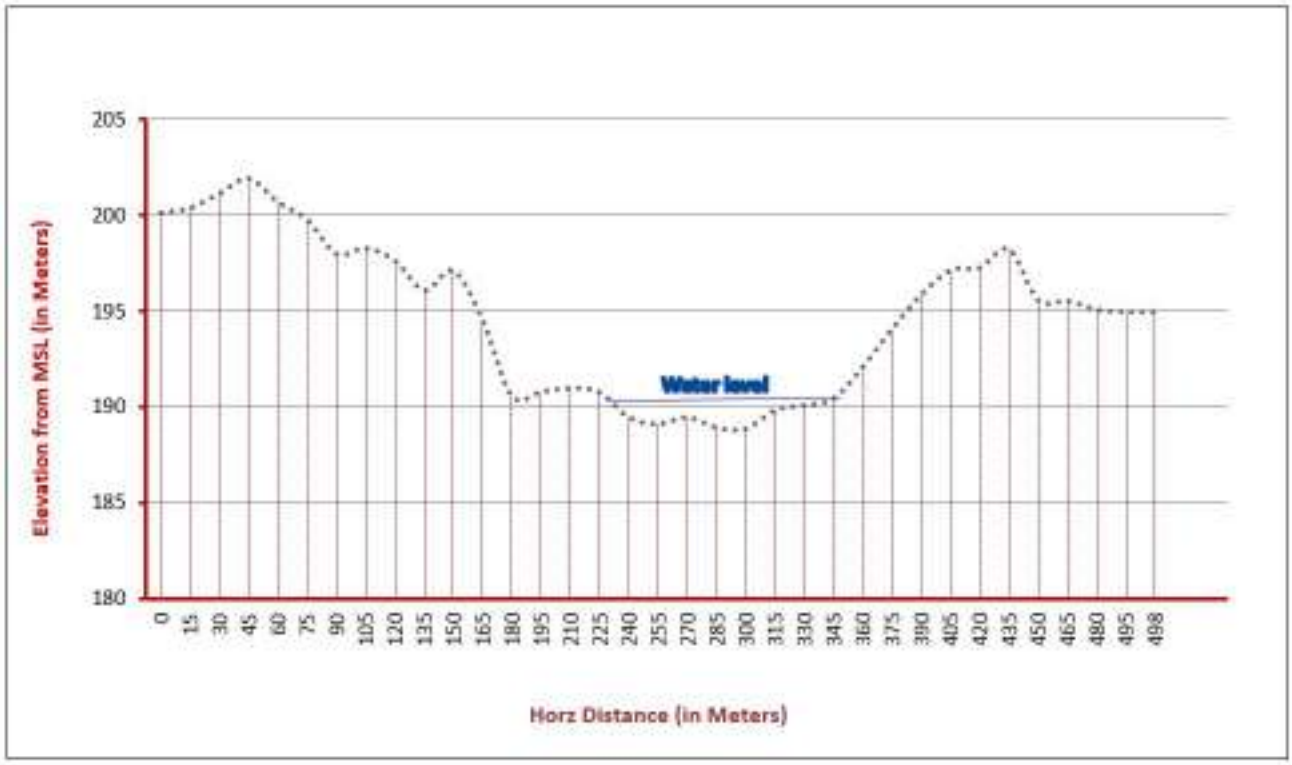
CROSS SECTION 04		
Chainage	**RL**	**Remark**
0	198.07	
15	197.89	
30	197.93	
45	198.25	
60	198.98	
75	199.46	
90	199.72	
105	199.60	
120	198.63	
135	198.60	
150	194.78	
165	190.34	
180	189.87	
195	189.99	
210	190.17	
225	190.12	
240	190.16	
255	190.28	
270	190.21	
285	191.28	
300	191.08	
315	190.89	
330	192.61	
345	195.30	
360	197.45	
375	197.35	
390	197.70	
405	197.22	
420	197.03	
435	196.89	
450	197.01	
465	197.23	
476	197.74	

Cross Section – 5



CROSS SECTION 05		
Chainage	RL	Remark
0	199.986	
15	198.927	
30	197.772	
45	196.26	
60	195.844	
75	195.747	
90	195.904	
105	196.782	
120	196.77	
135	193.54	
150	191.337	
165	190.804	
180	190.756	
195	190.77	
210	190.605	
225	190.588	
240	190.211	
255	189.532	
270	188.851	
285	189.511	
300	190.019	
315	190.17	
330	191.152	
345	191.892	
360	193.427	
375	196.179	
390	197.508	
405	198.369	
420	196.437	
435	195.433	
450	196.127	
465	198.268	
480	198.205	
495	198.205	
499	198.178	

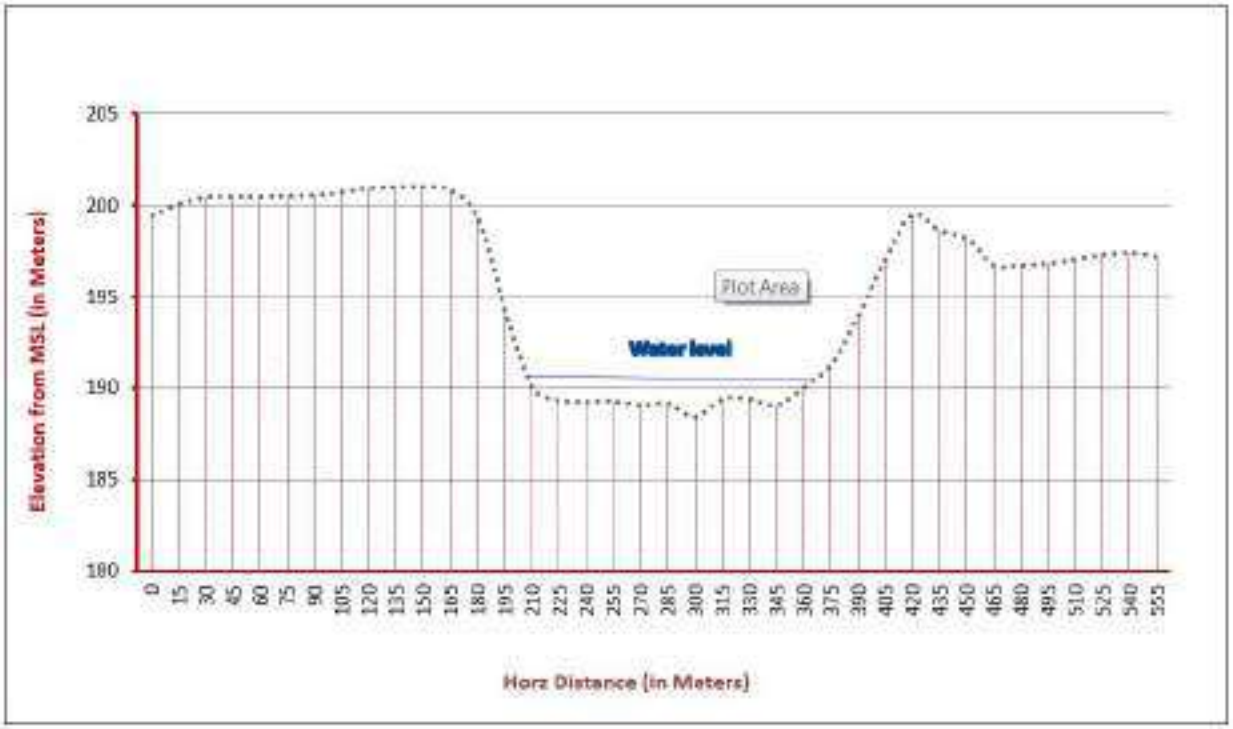
Cross Section - 6



CROSS SECTION 06

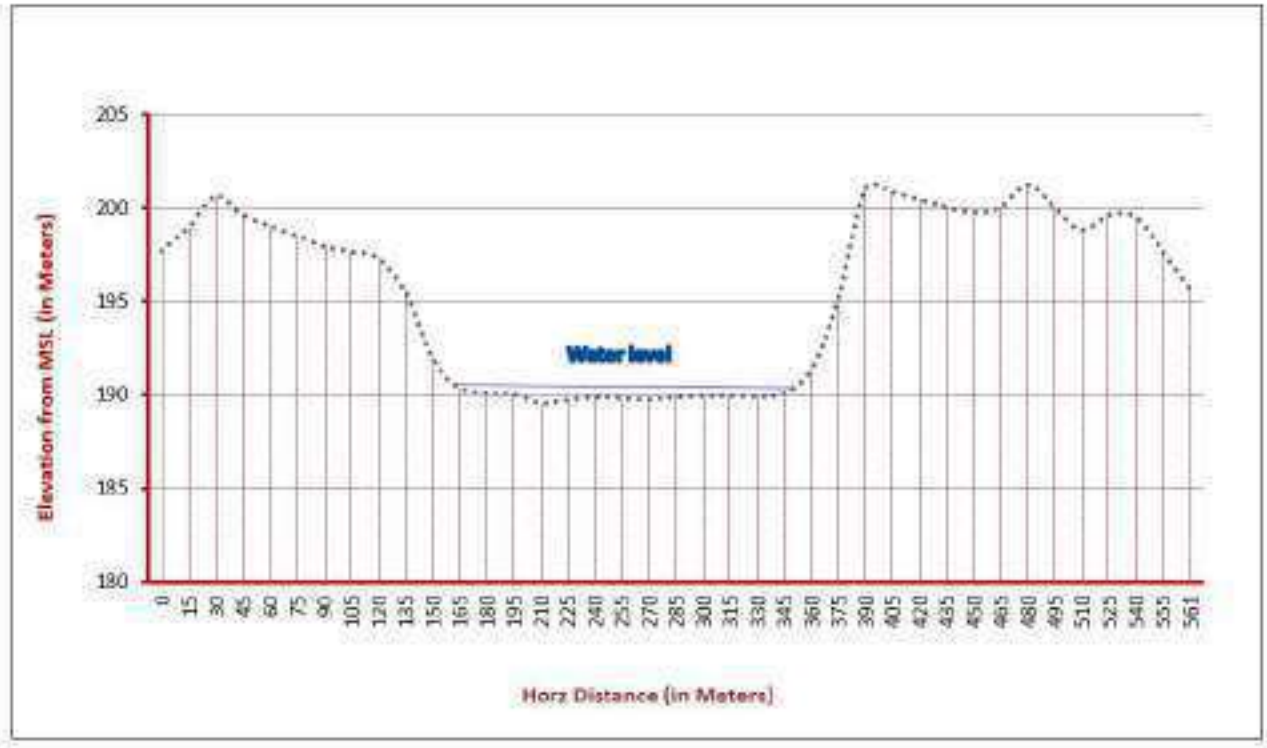
Chainage	RL	Remark
0	200.126	
15	200.386	
30	201.135	
45	201.917	
60	200.676	
75	199.761	
90	197.969	
105	198.284	
120	197.622	
135	196.079	
150	197.103	
165	194.505	
180	190.547	
195	190.787	
210	190.977	
225	190.762	
240	189.439	
255	189.099	
270	189.454	
285	188.918	
300	188.857	
315	189.82	
330	190.088	
345	190.433	
360	192.082	
375	194.059	
390	195.86	
405	197.124	
420	197.262	
435	198.226	
450	195.559	
465	195.532	
480	195.074	
495	194.958	
498	194.955	

Cross Section - 7



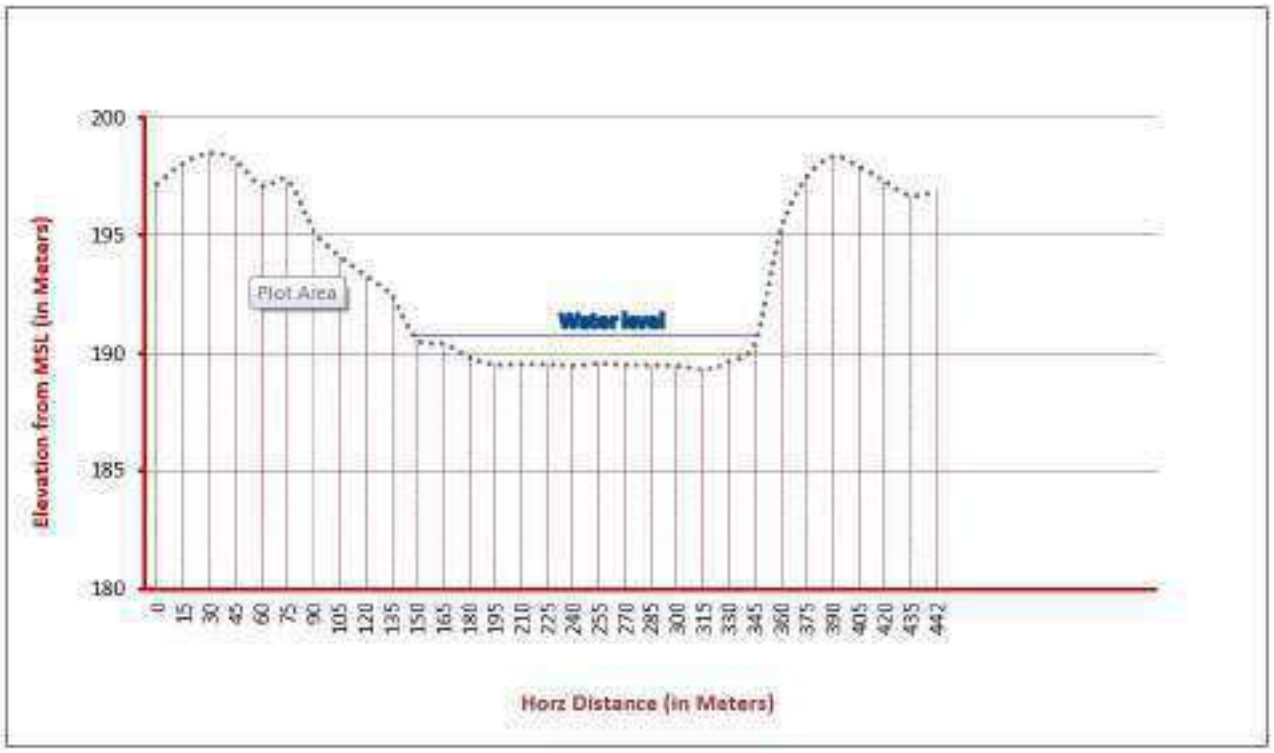
CROSS SECTION 07		
Chainage	**RL**	**Remark**
0	199.43	
15	200.048	
30	200.432	
45	200.459	
60	200.448	
75	200.497	
90	200.527	
105	200.696	
120	200.91	
135	200.981	
150	200.998	
165	200.795	
180	199.321	
195	194.258	
210	190.03	
225	189.32	
240	189.25	
255	189.263	
270	189.043	
285	189.129	
300	188.379	
315	189.38	
330	189.392	
345	189.034	
360	190.008	
375	191.256	
390	193.899	
405	197.02	
420	199.474	
435	198.591	
450	198.172	
465	196.701	
480	196.711	
495	196.806	
510	197.033	
525	197.26	
540	197.381	
555	197.161	

Cross Section - 8



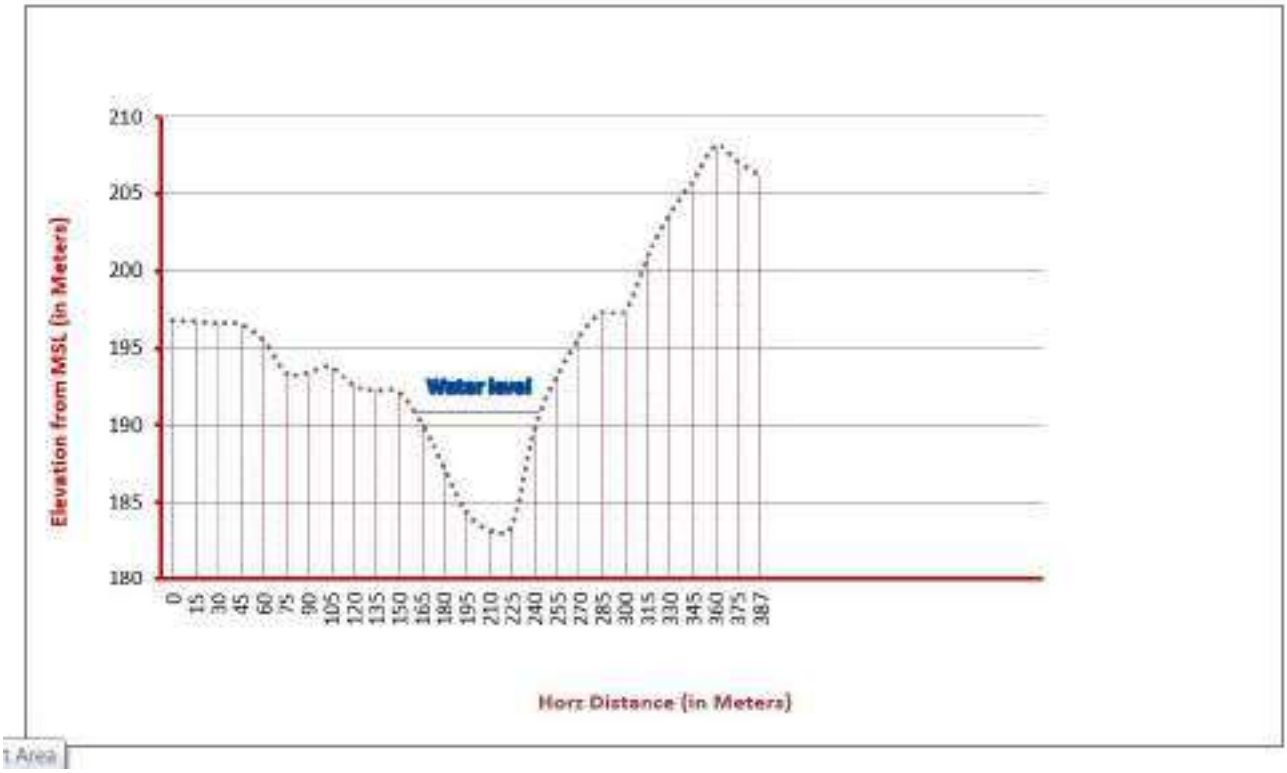
CROSS SECTION 08		
Chainage	**RL**	**Remark**
0	197.692	
15	198.993	
30	200.641	
45	199.641	
60	199.055	
75	198.518	
90	197.945	
105	197.644	
120	197.308	
135	195.562	
150	191.992	
165	190.383	
180	190.118	
195	190.055	
210	189.539	
225	189.73	
240	189.867	
255	189.806	
270	189.744	
285	189.861	
300	189.943	
315	189.961	
330	189.917	
345	190.071	
360	191.365	
375	195.034	
390	201.07	
405	200.854	
420	200.451	
435	200.042	
450	199.786	
465	200.016	
480	201.257	
495	200.046	
510	198.836	
525	199.631	
540	199.528	
555	197.693	
561	195.723	

Cross Section - 9



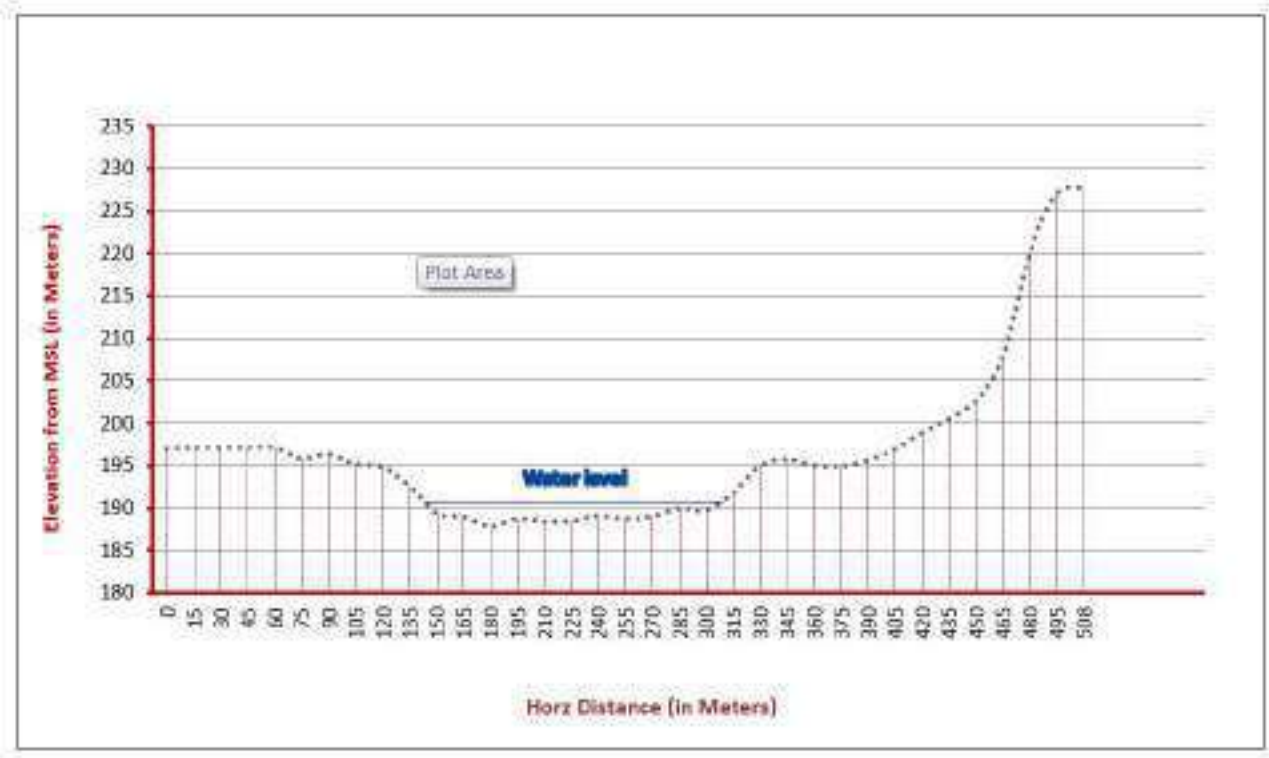
CROSS SECTION 09		
Chainage	**RL**	**Remark**
0	197.173	
15	198.03	
30	198.441	
45	198.145	
60	197.09	
75	197.314	
90	195.188	
105	194.123	
120	193.309	
135	192.425	
150	190.591	
165	190.425	
180	189.842	
195	189.559	
210	189.578	
225	189.57	
240	189.518	
255	189.599	
270	189.546	
285	189.531	
300	189.51	
315	189.356	
330	189.662	
345	190.411	
360	195.263	
375	197.412	
390	198.294	
405	197.878	
420	197.278	
435	196.686	
442	196.881	

Cross Section - 10



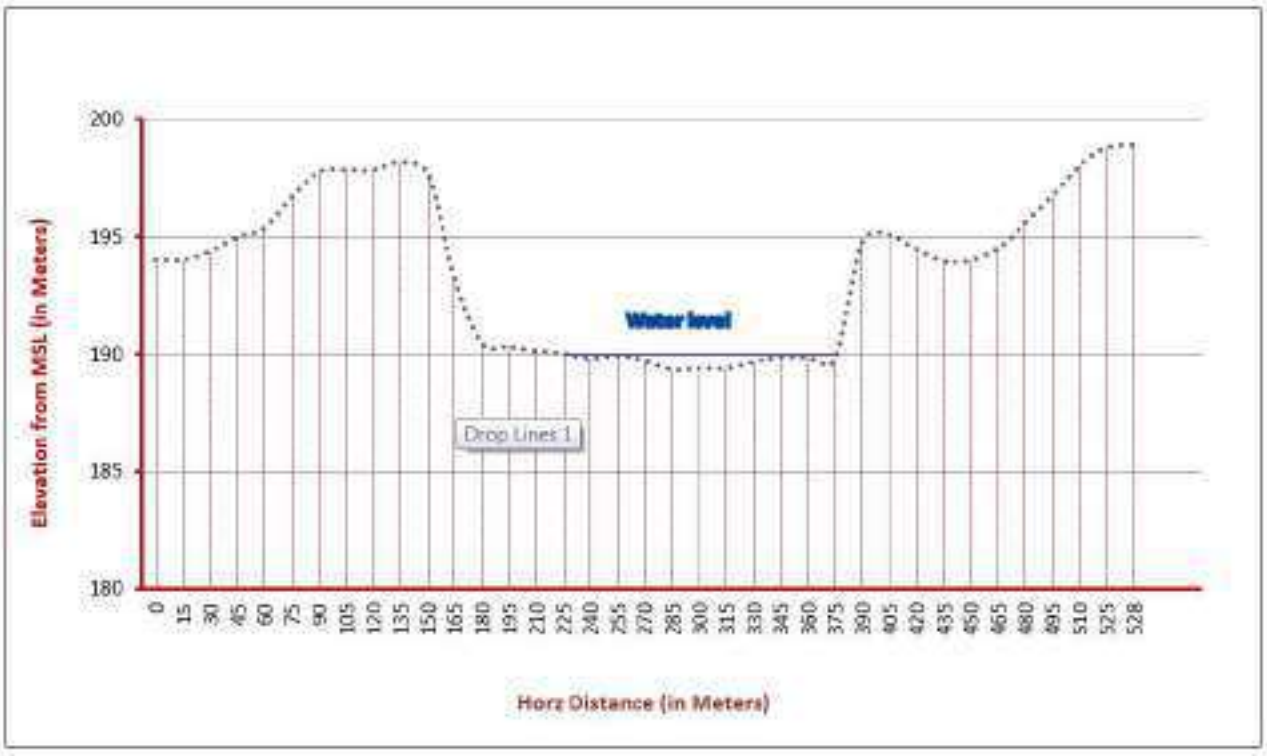
CROSS SECTION 10		
Chainage	**RL**	**Remark**
0	196.764	
15	196.711	
30	196.573	
45	196.539	
60	195.527	
75	193.398	
90	193.449	
105	193.811	
120	192.551	
135	192.234	
150	192.124	
165	190.124	
180	187.3	
195	184.315	
210	183.166	
225	183.381	
240	189.777	
255	193.285	
270	195.749	
285	197.341	
300	197.457	
315	200.982	
330	203.715	
345	205.881	
360	208.134	
375	207.103	
387	206.213	

Cross Section - 11



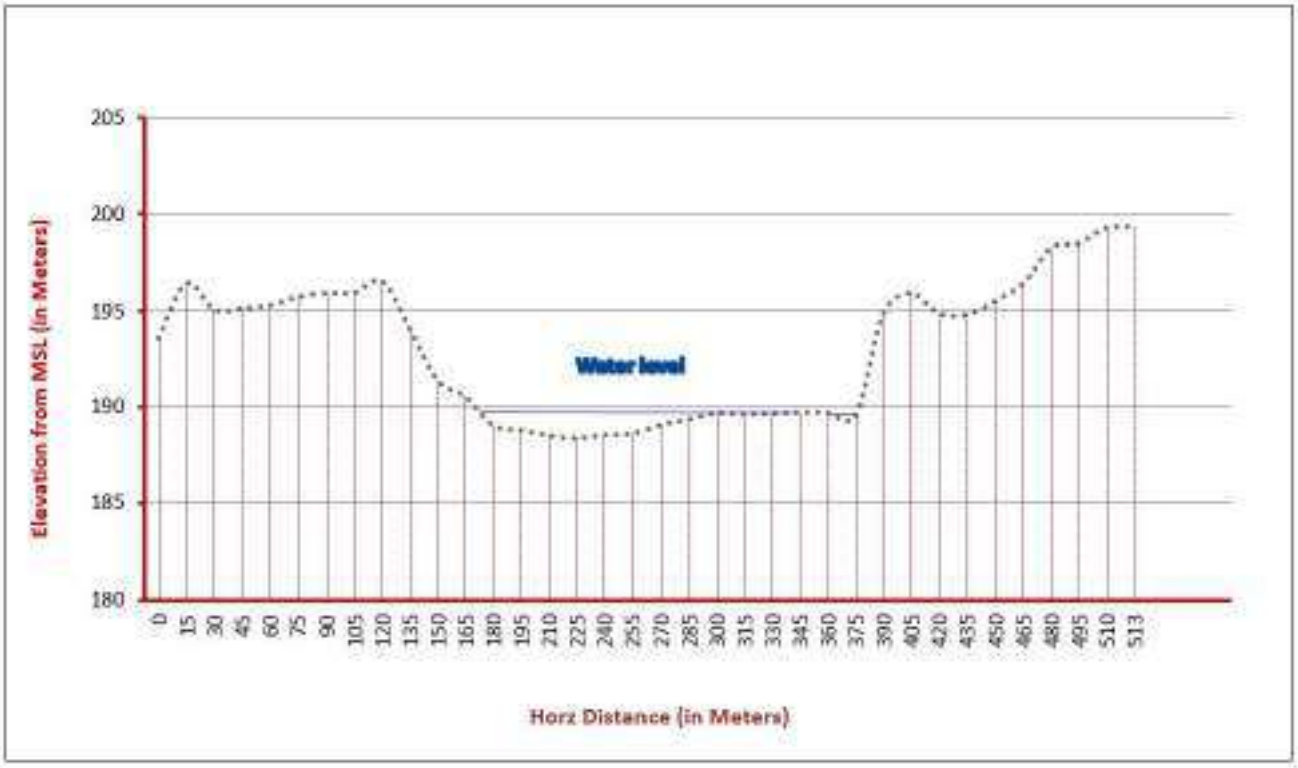
CROSS SECTION 11		
Chainage	**RL**	**Remark**
0	197.035	
15	197.108	
30	197.126	
45	197.102	
60	197.105	
75	195.806	
90	196.315	
105	195.166	
120	194.848	
135	192.702	
150	189.358	
165	189.002	
180	187.912	
195	188.772	
210	188.452	
225	188.515	
240	189.102	
255	188.772	
270	189.008	
285	189.977	
300	189.739	
315	191.815	
330	194.981	
345	195.723	
360	195.04	
375	194.888	
390	195.642	
405	196.913	
420	198.91	
435	200.476	
450	202.662	
465	207.723	
480	220.073	
495	226.985	
508	227.579	

Cross Section - 12



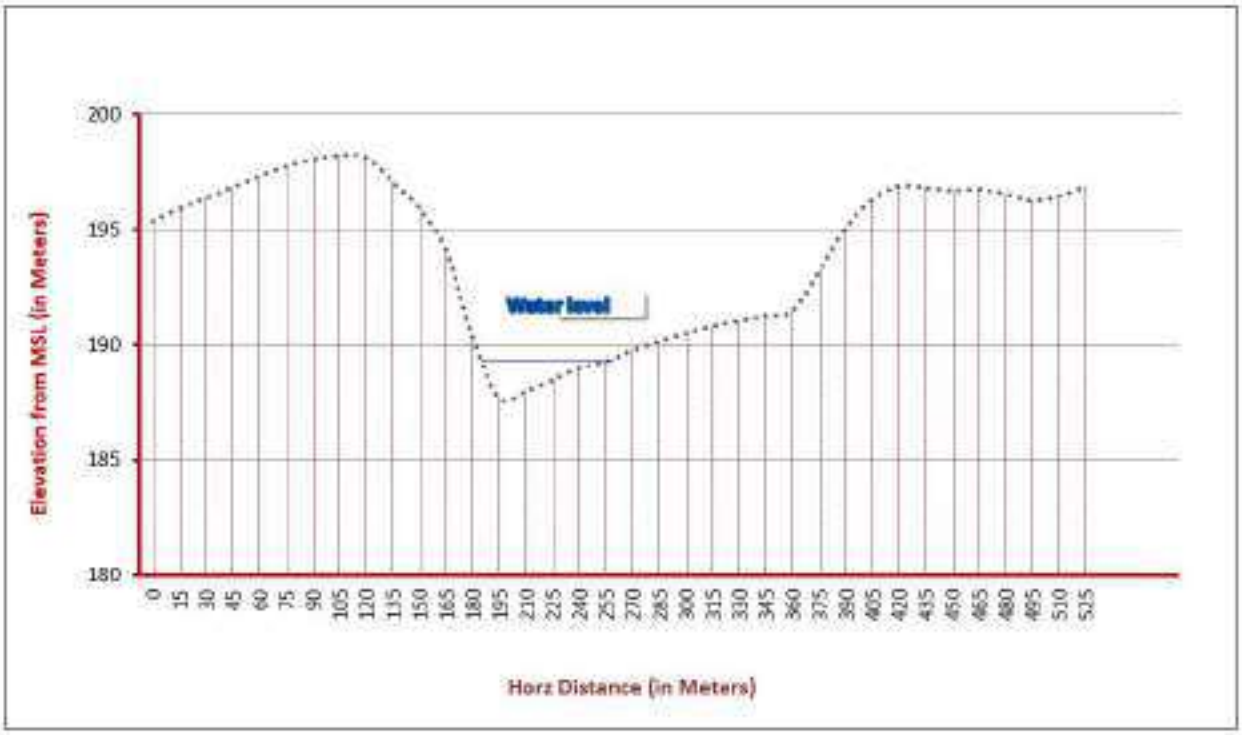
CROSS SECTION 12		
Chainage	**RL**	**Remark**
0	193.982	
15	193.964	
30	194.323	
45	194.975	
60	195.329	
75	196.636	
90	197.731	
105	197.823	
120	197.82	
135	198.146	
150	197.664	
165	193.215	
180	190.425	
195	190.293	
210	190.107	
225	190.003	
240	189.791	
255	189.909	
270	189.722	
285	189.352	
300	189.412	
315	189.408	
330	189.672	
345	189.852	
360	189.838	
375	189.762	
390	194.786	
405	195.082	
420	194.411	
435	193.919	
450	193.954	
465	194.48	
480	195.564	
495	196.703	
510	198.015	
525	198.763	
528	198.86	

Cross Section - 13



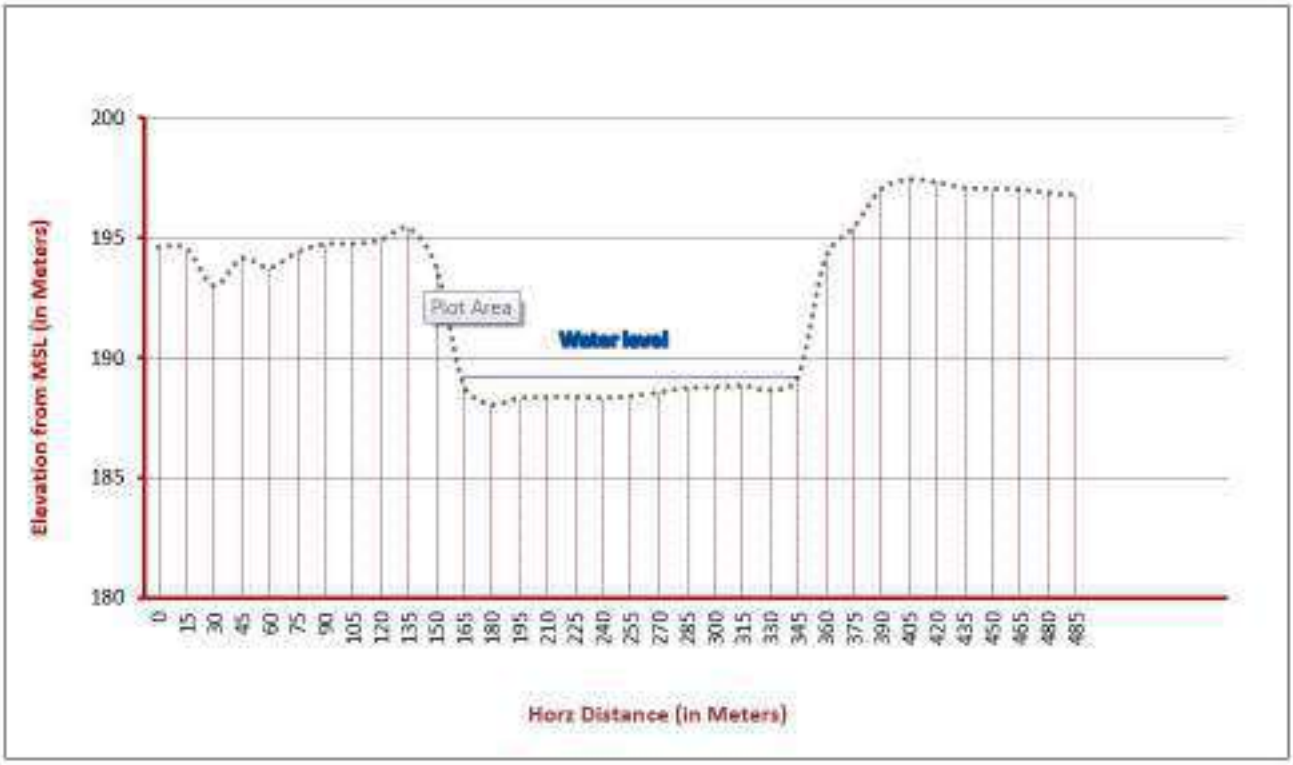
CROSS SECTION 13		
Chainage	**RL**	**Remark**
0	193.624	
15	196.494	
30	195.098	
45	195.165	
60	195.328	
75	195.769	
90	195.971	
105	195.974	
120	196.597	
135	194.091	
150	191.406	
165	190.567	
180	189.064	
195	188.83	
210	188.545	
225	188.401	
240	188.569	
255	188.644	
270	189.1	
285	189.4	
300	189.71	
315	189.654	
330	189.701	
345	189.758	
360	189.721	
375	189.54	
390	194.937	
405	195.975	
420	194.896	
435	194.853	
450	195.576	
465	196.492	
480	198.309	
495	198.522	
510	199.321	
513	199.326	

Cross Section - 14



CROSS SECTION 14		
Chainage	**RL**	**Remark**
0	195.361	
15	195.902	
30	196.348	
45	196.828	
60	197.311	
75	197.728	
90	198.033	
105	198.21	
120	198.128	
135	197.062	
150	195.93	
165	194.107	
180	190.321	
195	187.699	
210	188.003	
225	188.476	
240	188.987	
255	189.271	
270	189.756	
285	190.141	
300	190.495	
315	190.831	
330	191.054	
345	191.259	
360	191.459	
375	193.204	
390	195.084	
405	196.299	
420	196.89	
435	196.809	
450	196.696	
465	196.749	
480	196.538	
495	196.239	
510	196.44	
525	196.881	

Cross Section - 15



CROSS SECTION 15		
Chainage	**RL**	**Remark**
0	194.593	
15	194.543	
30	192.988	
45	194.129	
60	193.737	
75	194.388	
90	194.727	
105	194.735	
120	194.889	
135	195.389	
150	193.798	
165	188.847	
180	188.041	
195	188.306	
210	188.334	
225	188.359	
240	188.307	
255	188.384	
270	188.543	
285	188.718	
300	188.753	
315	188.833	
330	188.632	
345	189.153	
360	194.138	
375	195.406	
390	196.997	
405	197.421	
420	197.294	
435	197.067	
450	197.043	
465	197	
480	196.865	
485	196.782	

Appendix II

अभिकल्प कार्यालय विवरण
DESIGN OFFICE REPORT
M-3(d)/R-3/25/97

केन्द्रीय जल आयोग
CENTRAL WATER COMMISSION

महानदी उप अँचल - 3 (डी) का बाढ़ आँकलन विवरण (परिशोधित)

FLOOD ESTIMATION REPORT FOR MAHANADI SUB ZONE - 3 - (d) (REVISED)

जल विज्ञान निदेशालय
क्षेत्रीय अध्ययन
जल विज्ञान अध्ययन संगठन
नई दिल्ली - 110066

केन्द्रीय जल आयोग
भारत मौसम विभाग
अनुसंधान अभिकल्प एवं मानक संगठन
रेल मंत्रालय
पत्तनपती एवं परिवहन मंत्रालय
का संयुक्त कार्य

DIRECTORATE OF HYDROLOGY
(REGIONAL STUDIES)
HYDROLOGY STUDY ORGANISATION
NEW DELHI - 110066

A JOINT WORK OF
CENTRAL WATER COMMISSION
RESEARCH, DESIGNS AND
STANDARDS ORGANISATION
MINISTRY OF RAILWAYS
MINISTRY OF SHIPPING & TRANSPORT

फरवरी -1997
FEBRUARY - 1997

Flood Estimation Report for Mahanadi Subzone 3(d) - Revised was discussed and approved by the following members of Flood Estimation Planning and Co-ordination Committee in 54th meeting held on 10th October,1996 at R.D.S.O., Lucknow.

(Kailash Nath) (RS)
Director Hydrology
Central Water Commission
New Delhi

(Dr. D.S.Upadhyay)
Director (H)
India Meteorological Deptt.
New Delhi-

(B.M.Gupta)
Joint Director Stds/B&S
Research Design & Standards Organisation
Lucknow

FLOOD ESTIMATION REPORT OF MAHANADI

SUBZONE 3 (d)

(REVISED)

A METHOD BASED ON UNIT HYDROGRAPH PRINCIPLE
DESIGN OFFICE REPORT NO. M -3(d)/R-3/25/1996

HYDROLOGY (REGIONAL STUDIES) DIRECTORATE
CENTRAL WATER COMMISSION
NEW DELHI

Feb, 1997

FOREWORD

In the past the waterways of bridge structures on railways, roads, cross drainage works and spillways of minor tanks have generally been based on design flood worked out by empirical formulae. These formulae were evolved with a small data base for a particular region as available at various points of time. There was, therefore, a need for evolving a suitable rational method for estimating or updating the design floods of small and medium ungauged catchments.

For the purpose of evolving a method of estimation of design flood of desired frequency on regional basis by hydrometeorological approach, the country has been divided into 7 zones and 26 hydrometeorological homogenous subzones. So far, 21 flood estimation reports covering 24 subzones have been published.

In addition to above, there is also periodic revision of such subzonal reports, whenever additional data sets become available and sophisticated analysis becomes due. The flood estimation reports of Lower Ganga Plains subzone 1(g) and Lower Godavari subzone 3 (f), published in 1975 and 1981 respectively have already been revised and published. The present report is the revision of flood estimation report of Mahanadi subzone 3(d), published in the year 1982. It gives the method to compute design flood of 25/50/100 year return period for ungauged catchments located in Mahanadi subzone 3(d).

The report is a joint effort of Central Water Commission (CWC), India Meteorological Department (IMD), Research, Designs and Standards Organisation (RDSO) of Ministary of Railways and Ministry of Shipping and Transport (MOST).

I would like to place on record my appreciation of the cooperative efforts of the officers and staff of the four organisations in bringing out this report.

Ramesh Chandra

New Delhi, Feb, 1997.

(Ramesh Chandra)
Chairman, CWC

PREFACE

Design engineers essentially need the design flood of a specific return period for fixing the waterway vis-a-vis the design highest flood level (HFL) and foundation depths of bridges, culverts and cross drainage structures depending on their life and importance to ensure safety as well as economy. A casual approach may lead to under-estimation or over-estimation of design flood resulting in the loss and destruction of structure or un-economic structure with problematic situation.

The use of empirical flood formulae like Dickens, Ryves, Inglis etc. has no such frequency concept, though has the simplicity of relating the maximum flood discharge to the power of catchment area with constants. These formulae do not take into account the basic meteorologic factors of storm rainfall component and other physiographic and hydrologic factors, varying from catchment to catchment. Proper selection of constants in these empirical formulae is left to the discretion of design engineer, involving subjectivity.

Recognising the need to evolve a method for estimating design flood peak of desired frequency, the committee of engineers headed by Dr. A.N. Khosla have recommended, in their report that the design discharge should be the maximum flood on record for a period of not less than 50 years. Where adequate records are available, extending over a period not much less than 50 years, the design flood should be the 50-years flood determined from the probability curve prepared on the basis of the recorded floods during that period. In case, where the requisite data as above are not available, the design flood should be decided based on the ground and meteorological characteristics obtained on the basis of design storms necessitating the systematic and sustained collection of hydro-meteorological data at selected catchments in different climatic zones of India.

Economic constraints do not justify detailed hydrological and meteorological investigations at every new site on a large scale and on a long term basis for estimation of design flood with a desired return period. Regional flood estimation studies thus become necessary for hydro-meteorologically homogeneous regions in the country. Broadly, two main regional approaches, namely flood frequency and hydrometeorological approaches are open for adoption depending on the availability of the storm rainfall and flood data. The first approach involves long term discharge data observations for the representative catchments for subjecting the data to statistical analysis to develop a regional flood frequency model. The other approach needs concurrent storm rainfall and run-off data of the representative catchments over a period of 5 to 10 years to develop representative unit hydrographs of the catchments located in the region, so that synthetic unit hydrograph may be obtained for the region (subzones) and long term rainfall records at a large number of stations to develop design storm values. This approach has been adopted for preparing of flood estimation reports under short term and long term plan.

Under short term plan, the report on estimation of design flood peak utilising hydromet data available for 60 bridge catchments, spread throughout the country, was brought out in 1973, wherein the method has been recommended for estimating

the design flood peak for catchment areas ranging from 25 to 500 sq.km in the country.

Under long term plan, country has been divided into 26 hydro-meteorologically homogenous subzones. For preparing the flood estimation reports for these subzones, systematic and sustained collection of hydrometeorological data at the representative catchments, numbering 10 to 30, for a period of 5 to 10 years in different subzones has been carried out in a phased manner by different zonal railways since 1965 under the supervision and guidance of Bridges and Flood Wing of Research Designs and Standards Organisation of Ministry of Railways. Similarly, the Ministry of Transport had undertaken the collection of data for 45 catchments through Central Water Commission since 1979.

Hydrology Regional Studies Dte., Central Water Commission (CWC) carries out analysis of selected concurrent rainfall and flood data for the gauged catchments to derive unit hydrographs of mostly one hour duration on the basis of rainfall data, gauge and discharge data collected during the monsoon season. Representative unit hydrographs are obtained for each of the gauged catchments. The characteristics of the catchments and their unit hydrographs, prepared for several catchments in a subzone are correlated by regression analysis and the equations for synthetic unit hydrograph for the subzone are derived for estimating design flood for ungauged catchments. Studies are also carried out by the CWC to arrive at suitable recommendations for estimating loss rate and base flow for ungauged catchments.

India Meteorological Department (IMD) conducts depth - duration - frequency analysis of rainfall for each subzone to provide hydrometeorological input for estimation of design flood.

The subzonal reports incorporating studies carried out by CWC and IMD are prepared and published by CWC on approval of Flood Estimation Planning and Coordination Committee (FEPCC).

So far, following 21 flood estimation reports (FERs) covering 24 subzones have been published :

1.	Lower Ganga Plains subzone 1(g)	(1978)
2.	Lower Godavari subzone 3(f)	(1981)
3.	Lower Narmada & Tapi subzone 3(b)	(1982)
4.	Mahanadi subzone 3(d)	(1982)
5.	Upper Narmada & Tapi subzone 3(c)	(1983)
6.	Krishna & Pennar subzone 3(h)	(1983)
7.	South Brahmaputra subzone 2(b)	(1984)
8.	Upper Indo-Ganga Plains subzone 1(e)	(1984)
9.	Middle Ganga Plains subzone 1(f)	(1985)
10.	Kaveri Basin subzone 3(i)	(1986)
11.	Upper Godavari subzone 3(e)	(1986)
12.	Mahi & Sabarmati subzone 3(a)	(1987)
13.	East Coast subzones 4(a), (b) & (c)	(1987)
14.	Sone subzone 1(d)	(1988)
15.	Chambal subzone 1(b)	(1989)
16.	Betwa subzone 1(c)	(1989)
17.	North Brahmaputra subzone 2(a)	(1991)

18.	West Coast Region subzone 5(a) & (b)	(1992)
19.	Luni subzone 1(a)	(1993)
20.	Indravati subzone 3(g)	(1993)
21.	Western Himalayas zone 7	(1994)

Hydrometeorological inputs in the FERs at serial number 1 to 7 were based on self recording raingauges (SRRGs) data alone and consisted of (i) Isopluvial maps for 24 hour and / or shorter durations corresponding to 50 year return period (ii) Time distribution of storm rainfall and (iii) Point to areal rainfall ratios. However in the subsequent reports, IMD modified the methodology and prepared the hydrometeorological inputs based on conjunctive use of ordinary raingauge (ORG) and SRRG data. It was accordingly, decided by the FEPCC to revise the FERs at serial No. 1 to 7, so that these FERs also include same hydrometeorological components as given in the FERs at serial No. 8 onwards. It was further decided to revise hydrological study also of these reports. The hydrological study was to be revised based on the additional hydrological data, collected subsequent to the preparation of the original reports. The FER for Lower Ganga Plains subzone 1(g), published in 1974 and Lower Godavari subzone 3 (f), published in 1981, have already been revised where the hydrometeorological input has been included as per revised methodology.

Present report is the revision of the flood estimation report of Mahanadi subzone 3 (d) (report no M/5/1981) and deals with the estimation of flood of 25 year, 50 year and 100 year return period for small and medium catchments in the subzone . It covers parts of area of the river Mahanadi in the States of Orissa , Maharashtra, Madhya Pradesh and Bihar.

The rainfall-runoff data of 26 catchments having catchment area more than 25 Sq.km for a period of 5 to 10 years during the period 1958 to 1979 was collected by the Railways . Data of 16 catchments for 116 bridge years found suitable was utilised in study carried out earlier. In the present study, additional data of 31 bridge years for 5 catchments, collected subsequently alongwith the earlier data, thus totalling 147 bridge years has been used for unit hydrograph study .

The storm study has been conducted by IMD. The rainfall data of 210 O.R.G. stations maintained by IMD and State Governments, 28 S.R.R.G stations maintained by IMD in and around the subzone, have been utilised in the study. Short duration data (hourly/ half hourly rainfall) of the stations in the subzone maintained by RDSO was not utilised for the storm studies because of fairly dense net-work of IMD's SRRG data.

The report covers six parts. Part - I of the report Introduction " gives the summary of the earlier and revised studies. Description of the subzone detailing river system, rainfall, temperature and types of the soil is given in Part - II. Part- III brings out the synthetic unit hydrograph (SUH) relations to be used for ungauged catchments in the subzone.

The storm studies carried out by IMD are dealt in Part - IV of the report. Criterion and standards in regard to design flood of structures and procedures to compute the design flood of ungauged catchments are described in Part - V along with an illustrative example. Part - VI highlights the limitations, assumptions and conclusions.

The report on subzone 3 (d) is recommended for estimation of design flood for small and medium catchments varying in areas from 25 sq.km to 1000 sq.km. This report may also be used for catchments having areas upto 5000 sq.km, judiciously after comparing the neighbouring catchments having more or less similar characteristics. For catchments of areas less than 25 sq.km, the method given in the report No. RBF - 16 published by RDSO may be used.

The method adopted and conclusions arrived at, are subject to periodical review and revision in the light of adequate data being collected and analysed and also the advancements in theory and technique.

This report is a joint effort of Hydrology (Regional Studies) Dte., Central Water Commission (CWC) of Ministry of Water Resources, India Meteorological Department (IMD) of Ministry of Science and Technology, Research Designs Standards Organisation (RDSO) , Ministry of Railways and Ministry of Shipping and Transport (MOST).

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Oct.' 96

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PART -VI

ASSUMPTIONS, LIMITATIONS AND CONCLUSIONS

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ANNEXURES

PLATES

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SYMBOLS AND ABBREVIATIONS

SYMBOLS

As far as possible well recognised letter symbols in the hydrological science have been used in this report. The list of symbols adopted is given with the units.

A	Catchment Area in km^2.
ARF	Areal Reduction Factor.
C.G.	Centre of Gravity
Cumecs	Cubic metres per second
cms	Centimetres
D_{i-1} & D_i	Depths between the river bed profile (L-section) based on the levels of (i-1) and ith contours at the inter-section points and the level of the base line (datum) drawn at the point of study in metres.
E.R.	Effective Rainfall in cms.
Hr	Hour
H(RS),CWC	Hydrology (Regional Studies) Directorate, Central Water Commission, New Delhi.
I.M.D.	India Meteorological Department
in	Inches
km	Kilometres
L	Length of longest main stream along the river course in km.
L_c	Length of the longest main stream from a point opposite to centroid of the catchment area to the gauging site along the main stream in km.
L_i	Length of the ith segment of L-section in km.
M.O.S.T.	Ministry of Shipping and Transport (Roads Wing).
m	Metres
min	Minutes
mm	Millimetres
Q_p	Peak Discharge of Unit Hydrograph in cubic metres per second.
Q_{25}, Q_{50} and Q_{100}	Flood Discharge with return periods of 25-yr, 50-yr and 100-yr respectively in cumecs.
q_p	Peak Discharge of Unit Hydrograph per unit area in cumecs per sq.km.

R_{25} , R_{50} and R_{100}	Point Storm Rainfall Values for 25-yr,24-hour 50-yr 24-hour and 100-yr 24-hour return periods respectively in cm.
R.D.S:O.	Research Designs & Standards Organisation (Ministry of Railways),Lucknow.
S	Equivalent stream slope in m/km.
S.U.G.	Synthetic unit hydrograph
S.R.H.	Surface runoff hydrograph
D.R.H.	Direct runoff hydrograph
sec	Seconds
sq	Square
Sq.km	Square Kilometres, Km^2
T	Time duration of rainfall in hours
T_B	Base width of unit hydrograph in hours
T_D	Design Storm Duration in hours
T_p	Time from the start of rise to the peak of Unit Hydrograph in hours
t_p	Time from the centre of Unit Rainfall Duration to the Peak of Unit Hydrograph in hours
t_r	Unit rainfall duration adopted in a specific study in hours
U.G.	Unit hydrograph
W_{50}	Width of U.G. measured at 50% peak discharge ordinate (Qp) in hours.
W_{75}	Width of the U.G. measured at 75% peak Discharge Ordinate (Qp) in hours.
W_{R50}	Width of the rising side of U.G. measured at 50% peak Discharge Ordinate (Qp) in hours.
W_{R75}	Width of the rising side of U.G. measured at 75% peak Discharge Ordinate (Qp) in hours.
%	Percent.
Σ	Summation

PART - I

INTRODUCTION

Mahanadi subzone 3(d) is one of the 26 hydrometeorologically homogeneous subzones, into which the country has been divided for developing the regional methodology for assessing the design flood of small and medium catchments. Annexure-1.1 shows various subzones into which the country has been divided.

The flood estimation report of Mahanadi subzone 3 (d), (Design Office report No. M/5/1981) was published in 1982. The present report is revision of the earlier report.

The earlier report contained inputs for estimating the design flood of 50 year return period, whereas the present report provides inputs for estimating design floods of 25, 50 and 100 year return period.

1.1 Need for revision of report

Rainfall maps of 50 year return period for duration 15, 30 and 45 minutes and 1 3, 6, 9, 12, 15 and 24 hours were furnished in 7 flood estimation reports , published till 1983, viz.1(g), 2(b), 3(b), 3(c), 3(d), 3(f) and 3(h). These reports were based on data of sparse self-recording raingauge network. After bringing out 7 such subzonal reports, IMD modified the methodology, based on storm study, for preparing the rainfall maps using rainfall data of ORG and SRRG in and around the subzone.

FEPCC in its 51st meeting decided to revise these reports in a phased manner, incorporating the isopluvial maps prepared using ORG and SRRG data for 25, 50 and 100 year for 24 hour duration and other inputs. It was also decided by FEPCC to review and revise the hydrological study of these reports, utilizing additional rainfall-runoff data collected subsequent to the preparation of the reports.

1.2 Revised study

Hydrological and storm studies contained in the earlier report and in the revised report are as under:-

1.2.1 Hydrological study

The hydrological study carried out earlier was based on rainfall-runoff data of 16 catchments observed for a period of 5 to 10 years during the period 1958 to 1979. Representative unit hydrographs of 1 hr. duration were derived. The equations relating unit hydrograph parameters and basin parameters were developed for deriving 1-hr. synthetic unit hydrograph.

Subsequent to the preparation of the earlier report, additional data in respect of 2 key gauging sites (12 and 698), for a period of 13 years from 1982 to 1994 and 3 bridge

sites (235, 478 and 25) for a period of 1- 2 years was made available by RDSO. These data have been utilised in the present study .

Equivalent slope has been considered as one of the physiographic parameters in the revised study in place of statistical slope. Recommendations regarding the suitable values of loss rate and base flow have also been revised considering additional data .

The hydrological study carried out by CWC is given in Part-III of the report.

1.2.2 Storm Study

The published report contained isopluvial maps of 50 year return period for different durations, time distribution curves and areal to point rainfall ratios. The present report contains (i) isopluvial maps of 25, 50 and 100 year for 24-hours based on available rainfall data of ORG and SRRG in and around the subzone, (ii) short duration rainfall ratios for converting 24 hours rainfall to short duration rainfall, (iii) time distribution curves for storms of various durations and (iv) point to areal ratios for different durations. In the present study, IMD has utilised the rainfall data of 210 ORG maintained by IMD and State Govts. and 28 SRRG stations maintained by IMD. Besides this data, RDSO has also made available hourly/half hourly concurrent rainfall data in selected bridge catchments for conducting point to areal rainfall study . However, in the present study the necessity of this data did not arise because of the concurrent SRRG data from a dense network of IMD's stations in some districts of Orissa becoming available.

The storm studies carried out by IMD are given in Part-IV of the report.

1.3 Procedure to estimate design flood

PART-II

GENERAL DESCRIPTION OF THE SUBZONE

2.1 Location

Mahanadi subzone 3 (d) is located between East Longitudes 80^{0} 25' to 87^{0} and North Latitudes 19^{0} 15' to 23^{0} 35'. Plate-1 shows location of Mahanadi subzone on map of India. Annexure 1.1 shows list of various hydrometeorological subzones in India.

The subzone is bounded on the East by subzone 1-g (Lower Ganga Plains including Subernarekha and other East flowing rivers), on the West by subzone 3-f (Lower Godavari Basin) and subzone 3-c (Upper Narmada and Tapi Basin), on the North by subzone 1-d (Sone Basin) and on the South by subzone 3-g (Indravati Basin) and subzone 4-a (Circars) and the Bay of Bengal.

The subzone comprises parts of Maharashtra, Madhya Pradesh, Orissa, and Bihar.

2.2 River System

The area covered by the subzone is shown in Plate - 2. The subzone comprises of Mahanadi, Brahmani and Baitarani basins. The Mahanadi, Brahmani and Baitarani are peninsular rivers, outfalling into the Bay of Bengal. Important tributaries of Mahanadi river are Seonath, Hasdeo, Mand and Ib joining from North, and Jonk, Ong and Tel joining from South. The total length of Mahanadi river is about 850 Km. The river lengths of Brahmani and Baitarani are about 705 km and 333 km respectively. Hirakud Dam (multi-purpose project) in Orissa lies in the centre of the Mahanadi subzone.

The total drainage area of the subzone is 1,95,256 Sq.km, out of which catchment area of Mahanadi is 1,40,628 Sq.km, which is 72 % of the total area.

The catchment area of the Mahanadi, Brahmani, Baitarani rivers and free drainage area of the basin is given in Table 2.1.

Table 2.1 : Catchment Area

Sl. no.	Basin/ sub-basin	Drainage area (sq km.)
a)	Mahanadi	
	1) Northern tributaries	
	i) Seonath	30,500
	ii) Hasdeo	10,457
	iii) Mand	6,851
	iv) Ib	12,981
	2) Southern tributaries	
	i) Ong	4,688
	ii) Tel	18,390
	iii) Jonk	23,438
	3) Free drainage area	33,323
	Total area of Mahanadi basin	1,40,628
b)	Brahmani	35,337
c)	Baitarani	19,291
Total area of subzone		1,95,256

The Mahanadi, Brahmani and Baitarani outfall into the Bay of Bengal through a large number of channels in the Deltaic plains.

Plate-2 shows the river system/ gauge and discharge sites in the subzone.

2.3 General topographical features

2.3.1 Topography and relief

Plate-3 depicts the general topography of the subzone. About 50% of the area is hilly varying in height from 300 m to 1350 m. The remaining 50% of the area lies between 0 - 300 m on both sides of the Mahanadi river. The hilly area is mostly on the North, South and Southwest of the region.

2.3.2 Soils

Plate - 4 shows the different types of soils in the region. The red and yellow soils cover major part of the subzone. The red sandy, submontane and coastal alluvial soils cover the remaining part of the subzone.

2.3.3 Land use

Plate -5 shows broadly the land use of the subzone. The subzone has an extensive area under forest. Paddy is the main crop grown on the cultivable land. Most of the irrigated area is in Sambalpur district under the canals of Hirakud project. In the deltaic area around Cuttack, the irrigation is mostly done by inundation canals.

2.4 Climatological features of subzone (as contributed by IMD)

2.4.1 Rainfall

2.4.1.1 Annual normal rainfall: The isohyetal map of the annual normal rainfall of the subzone is presented in Plate-6. The isohyetal pattern is cellular in nature, the annual normal rainfall ranging from about 1200 to slightly over 1700 mm.

2.4.1.2 Monthly rainfall distribution: Monthly rainfall distribution at six representative stations viz. Durg and Kathghora in Madhya Pradesh, Cuttack, Bhawanipatna and Jharsuguda in Orissa and Lohardaga in Bihar is illustrated through bar charts appended to the annual normal rainfall map (Plate - 6). In the bar charts alphabets along abscissa indicate names of months whereas heights of rectangles are proportional to normal rainfall of respective months. Value mentioned at the top of each rectangle indicate the month's rainfall as percent of the annual rainfall.

It is brought out in the bar charts that the period June to October constitutes the main rainy season over the subzone. This is because of early onset and late withdrawal of southwest monsoon over the subzone. Normal rainfall for the five months (June - October) at Durg, Kathghora, Cuttack , Bhawanipatna,Jharsuguda and Lohardaga is 89.9 %,91.9 %,85.7 %, 90.8 %, 92.1 % and 86.5 % respectively of the annual rainfall. Further, the rainfall in the months of July and August is considerable and together constitute 45 % to 60 % of the annual rainfall.

2.4.2 Temperature

2.4.2.1 Mean daily temperatures (Annual): Mean daily temperature distribution over the subzone is shown in Plate - 7. The mean daily temperatures are worked out as average of mean maximum and mean minimum temperatures over the year. It may be seen from the map that mean daily temperatures are in the range $27^{o}c$ - $28^{o}c$ over the central belt of the subzone extending Eastwest from Cuttack in Orissa to Raipur in Madhya Pradesh. The mean daily temperatures decrease Northwest as well as Southwest of this belt to less than $24^{o}c$ over parts of the subzone lying in Bihar and adjoining Madhya Pradesh in the North and in Southwest Orissa in the South.

2.4.2.2 Monthly temperature variation at selected stations:

Monthly variations of mean maximum, mean minimum and mean

daily temperatures for six representative stations viz Raipur and Pendra in Madhya Pradesh, Ranchi in Bihar and Sambalpur, Cuttack and Titlagarh in Orissa are shown graphically in Plate - 7, below the map of mean daily temperatures. It may be seen from these that the highest mean maximum temperatures are observed in the month of May at all the six selected stations, their magnitudes being 42.3°c at Raipur, 38.3°c at Pendra, 37.9°c at Ranchi, 42.1°c at Sambalpur, 38.8°c at Cuttack and 41.5°c at Titlagarh. Mean minimum temperatures at all the six selected stations are observed in the month of December with their magnitudes being 13.2°c at Raipur, 10.1°c at Pendra, 9.9°c at Ranchi, 12.2°c at Sambalpur, 15.5°c at Cuttack and 13.2°c at Titlagarh. Mean daily temperatures are highest at all the six selected stations in the month of May.

2.5 Communications

2.5.1 Railways

The following railway sections partly or wholly traverse the area of the subzone.

Sl.No.	Section	Railways
1.	Howrah - Waltair	South-eastern Railway
2.	Nergundi - Talcher	do
3.	Bilaspur - Katni	do
4.	Ranchi - Bondamunda	do
5.	Jharsuguda - Sambalpur	do
6.	Rajkaraswar - Gua	do
7.	Jharsuguda - Bilaspur	do
8.	Raipur - Vizianagram	do
9.	Bilaspur - Howrah	do
10.	Kharagpur - Bhadrak	do
11.	Raipur - Nagpur	do

2.5.2 Roads

The major highways in the subzone are :

Sl.No.	Highway No.	Road section
1.	National Highway No. 6	Nagpur - Howrah
2.	National Highway No. 43	Raipur - Jagdalpur
3.	National Highway No. 5	Cuttack - Visakhapatnam
4.	National Highway No. 42	Sambalpur - Cuttack
5.	National Highway No. 23	Cuttack - Talcher
6.	National Highway No. 54	From NH 5 - Paradip

PART-III

SYNTHETIC UNIT HYDROGRAPH STUDIES

3.1 Synthetic unit hydrograph (SUG)

Hydrometeorological approach has been adopted for developing a regional method for estimating design flood for small and medium catchments in various hydrometeorologically homogeneous subzones. In this approach, the design storm after converting it into effective rainfall (input) is applied to the unit hydrograph (transfer function) to obtain a design flood (basin response). It is possible to develop unit hydrograph if site specific concurrent rainfall- runoff data is available for 3-4 years. Collection of adequate concurrent rainfall - runoff data for every site, is however neither practicable nor economically feasible. In such a situation, the regional method for developing Synthetic Unit Hydrograph (SUG) is resorted to.

SUG in the present study is a unit hydrograph of unit duration for a catchment developed from relations established between physiographic and unit hydrograph parameters of the representative gauged catchments in hydrometeorologically homogenous region (subzone). Data collected and analysed for obtaining subzonal SUG equations are discussed in succeeding paragraphs.

3.2 Data required

For conducting the unit hydrograph studies for development of equations for derivation of SUG, following concurrent rainfall and runoff data for a number of catchments of small and medium size, representatively located in a subzone are required for a period of 5 to 8 years during the monsoon season:

i) Hourly gauge data at the gauging site (bridge site)

ii) Gauge and discharge data observed 2 to 3 times a day at the gauging site.

iii) Hourly rainfall data of raingauge stations in the catchment. Raingauge stations may be self-recording and /or manually operated.

The following catchment details are also required.

iv) Catchment area plans showing the river network, location of raingauge stations and gauge and discharge sites, storages, habitations, forests agricultural and irrigated areas, soils etc.

v) Cross-sections of the river at bridge site (gauging site), upstream and downstream of the bridge site.

vi) Longitudinal section of the river upstream and downstream of the bridge site.

3.3 Data collected

South-eastern railway had observed and collected data at 26 railway bridge catchments having catchment area more than 25 sq.km for a period of 5 to 10 years during 1958-79. The data of 169 bridge years was available for hydrological studies, out of which data of 116 bridge years of 16 catchments was found suitable for developing co-relation between unit hydrograph and physiographic parameters for derivation of SUG.

Additional data for 31 bridge years for 5 bridge sites shown in Table 3.1, were collected by RDSO subsequent to the preparation of the report .

Table 3.1: Additional data for 5 Bridge sites

Sl. no.	Site	Additional data	Bridge years
1.	12 *	1982-94	13
2.	235	1980	01
3.	698 *	1982-94	13
4.	478 **	1980-81	02
5.	25 **	1980-81	02

* Key gauging stations where rainfall and discharge obeservations are continued .

** The data available up to 1979 was not found suitable in earlier study. The additional data received from RDSO was analysed and even this data was not found suitable for UG studies.

Annexure 3.1 shows the name of the stream, railway bridge No., railway section, catchment area, no.of rain gauge stations and period of availability of rainfall-runoff data of 26 bridge catchments having catchment area more than 25 Sq.Km. This also includes additional data of 5 catchments, collected subsequent to the preparation of the report. It can be seen from the Annexure 3.1 that the catchment area of gauge sites lie between 27 to 3108 sq.km.

3.4 Derivation of synthetic unit hydrograph

Procedure to obtain physiographic parameters and unit hydrograph parameters of the catchments and establishing relationships between these parameters to derive SUG is described in the following paragraphs.

3.4.1 Physiographic parameters

The physiographic parameters considered in the present study are catchment area (A), length of main stream (L) length of the main stream from a point near the centre of

gravity of catchment to the bridge site (L_c) and equivalent slope (S), as indicated in Figure -1. These are explained in the following paras.

3.4.1.1 Catchment area (A)

The gauging site is located on a toposheet and the watershed boundary is marked. The area enclosed in this boundary upto the gauging site may be referred to as the catchment area (A).

3.4.1.2 Length of the Main Stream (L)

This implies the longest length of the main river from the farthest watershed boundary of the catchment area to the gauging site.

3.4.1.3 Length of the main stream from a point near the centre of gravity of catchment to the bridge site(Lc)

For finding the centre of gravity of the catchment, usually the boundary of the catchment is cut on a card board, which is then hung in three different directions in vertical planes and the plumb lines are drawn from the point of hanging. The point of intersection gives the centre of gravity of the catchment. The stream may or may not pass through the centre of gravity but the nearest point to the centre of gravity is considered to find the length of the main river from the centre of gravity to the point of study (L_c).

3.4.1.4 Equivalent stream slope (S)

One of the physiographic parameters is slope. The slope may be equivalent or statistical . In the present study equivalent stream slope has been used for developing the SUG relation in place of statistical slope, used in the previous study. Equivalent slope can be computed by the following methods.

(a) Graphical method

Longitudinal section (L-section) of the main stream was prepared from the values of the contours across the stream or the spot levels near the banks with respect to their distances from the point of interest on the L-section such that the areas of the L-section (profile) above and below the line are equal. This line is called equivalent stream slope line.

(b) Analytical method

L-section is broadly divided into 3 to 4 segments representing the broad ranges of the slopes of the segments and the following formula is used to calculate the equivalent slope (S):

$$S = \frac{\sum L_i \, (D_{i-1} + D_i)}{(L)^2}$$

L_i = Length of the ith segment in km.

D_{i-1}, D_i = Elevations of river bed at ith. intersection points of contours reckoned from the bed elevation at points of interest considered as datum and D(i-1) and Di are the heights of successive bed location at contour and intersections.

L = Length of the longest stream as defined in section 3.4.1.2 in km

Physiographic parameters A, L, Lc and S obtained for 16 catchments found suitable for analysis are shown in Annex. 3.2.

3.4.2 Unit hydrograph parameters

3.4.2.1 Scrutiny of data and finalisation of gauge discharge rating curve

Out of the 26 gauged catchments, data of 16 catchments (116 bridge years) was found suitable for the unit hydrograph study contained in the earlier report.

The additional data of 5 catchments viz. 12, 235, 698, 478, and 25 (31 bridge years) was scrutinized through arithmetical checks and gauge and discharge rating curve(s) were drawn on log-log scale. The hourly discharges for the durations of the selected floods were obtained from the rating curves.

3.4.2.2 Selection of floods and corresponding storm events

In the previous study, 101 flood events of 16 catchments were found suitable for U.G. studies.

The general guidelines followed earlier for selecting flood events from the additional data are given below:

i) The flood should not have unduly stagnant water levels.

ii) The selected flood should result from significant rainfall excess not less than 1 cm.

Flood events shown in Table 3.2 were found to be suitable from the additional data collected for Bridge No. 12, 235, 698.These catchments were amongst 16 catchments considered in the previous study. Suitable flood was not found in the additional data collected for Bridge No. 25 and 478 and these catchments were also not considered in the previous study. The catchments considered in the present study are the same catchments found suitable in the previous study. Guidelines followed for selecting flood events in the previous study are adopted for identifying flood events from the additional data.

Table 3.2 : Selected flood events

No.	Site	From data utilised earlier	From additional data	Total
1.	12	3	8	11
2.	235	3	3	6
3.	698	13	17	30

3.4.2.3 Computation of hourly catchment rainfall

As there is no change in raingauge network of 3 catchments (12, 698 and 235), station weights computed earlier were used for obtaining weighted rainfall of the catchment for different flood events.

3.4.2.4 Separation of base flow

The selected flood events of 3 Bridge catchments were plotted on the normal graph paper. The base flow was separated through the normal procedure to obtain direct surface runoff hydrographs and the direct runoff depth over the catchment was computed for each flood event.

3.4.2.5 Computation of Infiltration loss (ϕ-index) and 1-hour effective rainfall units

With the known values of 1-hour catchment rainfall and the direct runoff depth for each flood event, the infiltration loss (constant loss rate) by trials was estimated for selected flood events of 3 Bridge catchments viz. 12, 698 and 235.

3.4.2.6 Derivation of 1-hour unit hydrograph

The studies to derive 1-hour unit hydrograph were confined to only those flood events found suitable in the additional data of 27 bridge catchments viz, 12, 235 and 698. The 1-hour unitgraphs were derived from the rainfall excess hyetograph , obtained by subtracting loss rate from 1-hour rainfall and their corresponding direct runoff hydrographs. Break-up of unit hydrographs derived from suitable flood events from 3 catchments is shown in Table 3.2.

3.4.2.7 Drawing of representative unitgraphs and measuring their parameters

The representative unit hydrograph (RUG) of 3 catchments were derived utilising DGs obtained from the additional data and unit hydrographs derived earlier.

Integrated RUGs of 3 sites have been tested on observed floods. RUGs of remaining 13 sites developed earlier were utilised as such without any modifications.

Following parameters of RUGs as indicated in Figure- 2, of 16 catchments were obtained and are furnished in Annexure 3.3.

a) Time from the centre of unit rainfall duration to the peak of unit hydrograph in hours (t_p).

b) Peak discharge of unit hydrograph in cubic meters per second (Q_p). This is the product of peak discharge per sq km (q_p) and catchment area (A).

c) Base width of unit hydrograph in hours (T_B).

d) Width of unit hydrograph measured at discharge ordinate equal to 50% of Q_p in hours (W_{50}).

e) Width of the U.G. measured in hours at discharge ordinate equal to 75% of Q_p (W_{75}).

f) Width of the rising side of U.G. measured in hours at discharge ordinates equal to 50% of Q_p (W_{R50}).

g) Width of the rising side of U.G. measured in hours at discharge ordinates equal to 75% of Q_p (W_{R75}).

h) Time from the start of rise to the peak of the unit hydrograph (T_m) .This is the summation of t_p and $0.5*t_r$

3.4.3 Establishing relationships between physiographic and representative unitgraph parameters

Linear and non-linear equations were tried for establishing the relationship between RUG parameters and physiographic parameters of the catchments and nonlinear equation as described below was found to be the best fit.

$$Y = C * X^P \quad \text{.....3.4.3.1}$$

where
Y = Dependent variable
X = Independent variable
C = A constant
P = An exponent

Various relationships attempted are shown in Annexure 3.4. The relationship between computed parameter L*Lc//S and U.G. parameter t_p was found to be significant. Unit peak discharge of the U.G.(q_p) was related to t_p. UG Parameters W_{50}, W_{75}, W_{R50}, W_{R75} were related to q_p . The UG parameter T_B could be significantly correlated to t_p. The principle of least square errors was used in the regression analysis to get the relationship in the form of equation 3.4.3.1 to obtain the parameters of the Synthetic unitgraph in an unbiased manner.

The following relationships have been derived for estimating the 1-hr unitgraph parameters in the subzone 3(d).

Table 3.3 : Recommended SUG relations

Sl.No.	Relationship	Equation No.
1.	$t_p = 1.757\ (LLc/\sqrt{S})^{0.261}$	3.4.3.2
2.	$q_p = 1.260\ (t_p)^{-0.725}$	3.4.3.3
3.	$W_{50} = 1.974\ (q_p)^{-1.104}$	3.4.3.4
4.	$W_{75} = 0.961\ (q_p)^{-1.125}$	3.4.3.5
5.	$W_{R50} = 1.150\ (q_p)^{-0.829}$	3.4.3.6
6.	$W_{R75} = 0.527\ (q_p)^{-0.932}$	3.4.3.7
7.	$T_B = 5.411\ (t_p)^{0.826}$	3.4.3.8
8.	$T_m = t_p + t_r/2$	3.4.3.9
9.	$Q_p = q_p * A$	3.4.3.10

Relations developed are shown in Figures 3 to 9. List of catchment and unit hydrograph parameters studied to establish relationships and co-efficients of correlations is given in Annexure-3.4. The 25, 50 and 100 year flood peaks for 16 selected bridges have been computed using the recommended relations given in Table 3.3 and also from the RUGs of these bridges taking storm duration as $t_d = 1.1 * t_p$, as explained in para 5.2 . Annexure 3.5 shows the comparison of flood peaks using SUGs and RUGs. As can be seen from the Annexure, the maximum variation for 50 year flood peak lies between + 37.67% to -34.62 % .

The above relationships are recommended to estimate the parameters of 1-hour Synthetic unitgraph for an ungauged catchment with its known physiographic characteristics A, L, L_c and S.

3.4.4 Derivation of 1-hour synthetic unit hydrograph for an ungauged catchment

Considering the hydro-meteorological homogeneity of subzone, the relations established between physiographic and unitgraph parameters in section 3.4.3 are applicable for derivation of 1-hour synthetic unitgraph for an ungauged catchment in the subzone.

The steps for derivation of 1-hour unitgraph are:

i) Physiographic parameters of the ungauged catchment viz A, L, L_c and S are determined from the catchment area plan.

ii) Obtain tp, q_p, W_{50}, W_{75}, W_{R50}, W_{R75} and T_B substituting appropriate basin/unit hydrograph parameters given in equations 3.4.3.2 to 3.4.3.10.

iii) Plot the parameters of 1-hour unitgraph viz. T_m, T_B, Q_p, W_{50}, W_{75}, W_{850} and W_{875} on a graph paper as shown in illustrative Figure 2 and sketch the unitgraph through these points.

Sum of discharge ordinates of t_r-hr unitgraph is obtained and compared with the value found by using the following equation:

$$\Sigma Q_i = \frac{2.78 * A}{t_r}$$

Where Q_i = discharge ordinates at 1-hour interval (cumecs)

A = Catchment area in sq.km

t_r = Unit duration in hours.

Suitable modifications can be made in falling limb upto W_{50} points, and a smooth unitgraph be drawn.

3.5 Design loss rate

Direct surface runoff is the end product of storm rainfall after infiltration into surface soils, sub-surface and ground besides abstractions like evaporation, evapotranspiration, soil moisture and filling up of surface depressions. It is difficult, rather impossible , to record these various parameters at various representative locations in the catchment except by the analysis of observed storm rainfall and flood events. Conversion of gross storm rainfall units into effective rainfall units for application to unitgraph is normally done by subtraction of constant loss rate (ϕ-index) for the catchment, even though the loss rates in the catchments, a complex phenomena, vary due to soil conditions, soil cover and topography alongwith temporal and spatial variations of storm rainfall.

In the pre-revised edition of the report, the loss rates of 132 events analysed were plotted against the storm durations and an average design loss rate curve , shown in figure 13 was obtained to compute the design loss rate. Attempts were made to modify the curve on the basis of loss rate data of 28 flood events selected from the additional data received recently. As these points lie considerably outside the curve, it was felt that the curve may not be modified on the basis of loss rate values of 28 flood events, obtained from the new data. It is therefore recommended that the loss rate curve , contained in the earlier report and enclosed at Figure 13 may be used for computing the loss rate values for ungauged catchments.

3.6 Design Base flow

Base flow values for 129 flood events inclusive of additional flood events of 3 catchments tabulated in different ranges are shown in Annexure 3.6. Out of 129 flood events, 96 flood events fall under the range of 0.01-0.19 cumecs/sq. km. The average base flow rate of 0.10 cumecs/sq.km may be adopted for estimating base flow for a catchment. The designer may however adopt any other suitable value as per site conditions.

Part-IV

RAINFALL STUDIES

4.1 Introduction

4.1.1: The India Meteorological Department (IMD) has conducted detailed rainfall studies for the subzone. The study covers Depth-Duration-Frequency analysis of available daily/short duration rainfall data in and around the subzone. The design storm components have been derived in the form of (i) 25, 50 and 100-year 24-hour isopluvial maps, (ii) 24 hours to short duration (1 to 23 hours) rainfall ratios, (iii) Time distribution curves for storms of various durations (2 to 24 hours) and (iv) Point to areal rainfall ratios for specific durations (1, 3, 6, 12 and 24 hours). The methodology applied for analysis of each component and the procedure for design storm estimation is discussed in the subsequent paras.

4.1.2: The results of the study serve as basic input for design flood estimation for small and medium catchments.

4.2 Data collected

The following rainfall data for a large number of stations in and around the subzone for as long a period as possible have been collected for the purpose of this study.

4.2.1: Ordinary raingauge (ORG) data (daily rainfall) of 210 stations, 18 maintained by IMD and 192 maintained by the State Governments, in 28 districts - 13 in Orissa, 9 in Madhya Pradesh, 4 in Bihar and 2 in Maharashtra - covering the subzone with 14 districts partly/fully outside the subzone. Of these, 110, 51 and 49 stations have respectively 51-70 years, 31-50 years and 11-30 years record. This was necessary in order to cover the areas where the raingauge network is sparse.

4.2.2: Self recording raingauge (SRRG) data (hourly rainfall) of 28 stations inside the subzone maintained by IMD in 13 districts - 11 in Orissa and 2 in Madhya Pradesh . Of these 6, 7, and 15 stations have respectively 8-16 years (79 station years), 4-7 years (30 station years), and 1-3 years (29 station years) data. All the 28 SRRG stations lie inside the subzone.

Normally RDSO makes available hourly/half hourly concurrent rainfall data in selected bridge catchments for conducting point to areal rainfall studies of the concerned subzone. However, in the present studies the necessity of this data did not arise because of the concurrent SRRG data from a dense network of IMD's stations in some districts of Orissa becoming available.

4.3 Data used

ORG data mentioned in para 4.2.1 above available from

IMD's National Data Centre have been extensively utilised for deriving the first component of the study, viz. preparation of 25, 50 and 100-year isopluvial maps.

SRRG data of all the 28 SRRG stations (138 Station- years) have been used for deriving the components (ii), (iii) and (iv) mentioned under para 4.1.1 above. The data available being vast, appropriate subsets of the data have been utilised for working out different components .

4.4 Depth-Duration-Frequency analysis

4.4.1 Isopluvial maps

For each of the 210 ORG stations in and around the subzone a series of annual maximum one-day rainfall was generated. The 210 station series thus formed were subjected to frequency analysis using Gumbel's extreme value distribution for computing one day rainfall estimates for 25, 50 and 100-year return periods. These daily rainfall estimates (210x3) were converted into any 24-hour rainfall estimates by using the conversion factor of 1.15. For each return period, the 24-hour estimates for 210 stations were plotted on a base map and isopluvials were drawn. The isopluvial maps of 25, 50 and 100-year 24-hour rainfall are shown in Plates 8, 9 and 10 respectively, which can be used to derive 24-hour rainfall estimates for specific return periods at any desired location in the subzone.

4.4.2 Short duration ratios

For each of the 6 SRRG stations inside the subzone having at least 8 years record, the hourly rainfall data were subjected to frequency analysis using partial duration series for computing T-year t-hour rainfall estimates for T = 2, 5, 10, 25 and 50 years and t = 1, 3, 6, 9, 12, 15, 18 and 24 hours. These estimates (6x8x5) were converted into ratios with respect to the corresponding 24-hour estimates. Average ratios (8x5) for the subzone as a whole (mean of 6 stations ratios) were then computed for each T-year t-hour pair. It was noticed that for a specified duration t, the average ratios beyond T=5 years were comparable in magnitude. As such the average ratios (8) corresponding to 10-year t-hour rainfall have been recommended to be adopted uniformly for converting 24-hour rainfall into t-hour rainfall. The 8 conversion ratios for t=1, 3, 6, 9, 12, 15, 18 and 24 hours given below were plotted on a graph and a smooth curve was drawn as shown in graph at Fig. 10 which can be used to derive conversion ratios for any duration t in general, including the intermediate duration (see table alongside graph).

Table No. 4.1: Conversion ratios for different durations

Rainfall Duration (t) in hours	Conversion ratio = 10-year t-hour rainfall / 10-year 24-hour rainfall
1	0.390
3	0.610
6	0.760
9	0.820
12	0.860
15	0.880
18	0.920
24	1.000

Any 25, 50 or 100-year 24-hour point rainfall in the subzone as read from isopluvial maps in Plates 8, 9 and 10 can be converted into corresponding 25, 50 or 100-year t-hour rainfall by multiplying with t-hour ratio as read from the curve in Fig. 10.

4.4.3 Time distribution curves

Based on hourly rainfall data of all the 28 SRRG stations inside the subzone a total of 2688 rainstorms of durations ranging from 2 to 24 hours were analysed and grouped station-wise into the following 5 categories :

1) rainstorms of 2 to 3-hour duration (891 of all stations)

2) rainstorms of 4 to 6-hour duration (787)

3) rainstorms of 7 to 12-hour duration (586)

4) rainstorms of 13 to 18-hour duration (242)

5) rainstorms of 19 to 24-hour duration (182)

For each station , 5 different graphs corresponding to each group of rainstorms were prepared by plotting the cumulative percentage of the total storm rainfall against percentage of the storm duration and the average time distribution curves (28x5) were drawn. Average time distribution curves (5) for the subzone as a whole were then drawn by plotting 28 station curves on the same graph and these are shown in Fig. 11, which can be used to derive the time distribution coefficients of storm rainfall in the subzone for rainstorms of any duration (see Annexure 4.1).

4.4.4 Point to areal rainfall ratios

In the present study, the availability of a fairly dense SRRG network in the subzone in some districts of Orissa made

it possible to adopt the best scientific procedure for deriving point to areal relationship based on SRRG data alone in preference to bridge data.

The hourly rainfall records of 28 SRRG stations inside the subzone were scanned for short durations t =1, 3, 6, 12 and 24 hours to select t-hour representative storms based on consideration of maximum central value and concurrent surrounding data indicating an appreciable gradient. Isohyetal maps of 5 representative storms described hereunder were then prepared using concurrent rainfall values of stations corresponding to the date and time of each representative storm.

Table No. 4.2: Representative storms

Duration (hour)	Station	Rainfall (mm)	Date & time of occurrence (clock hour)	Concurrent data (No of stations)
1	Telkoi	26.0	2.9.78 (02-03)	6
3	Anandpur	54.0	8.8.79 (01-04)	6
6	Telkoi	130.0	2.9.78 (00-06)	6
12	Telkoi	202.4	2.9.78 (00-12)	6
24	Telkoi	244.9	1/2.9.78 (14-14)	6

By planimetering each isohyetal map around the storm centre and plotting the percentage ratios of areal rainfall depths to representative point rainfall against the areas, the best fit curves (5) were drawn as shown in graphs at Fig. 12(a) and 12(b), which can be used to derive the percentage areal reduction factors for converting point rainfall of any duration in the subzone into corresponding areal rainfall for any particular small catchment in the subzone (Annexure 4.2).

4.5 Heaviest rainfall records

4.5.1 ORG data

The highest ever recorded one-day station rainfall (24 hours rainfall ending 0830 hrs of date) along with date of occurrence in each of the 36 districts covering subzone - 3(d) have been compiled from the ORG data and presented in Annexure 4.3. However, in case of districts with stations recording > 35 cm all such stations have been included. Normal annual rainfall for each selected station is also given in the Annexure.

4.5.2 SRRG data

The heaviest storm rainfall in durations of 24, 12, 6, 3 and 1 hour alongwith date and time of occurrence in all the 13 districts covering all the 28 SRRG stations have been compiled from the available autographic records and are presented in Annexure 4.4.

4.6 Procedure for design storm rainfall estimation

For a specified design storm duration T_D hour (time of concentration) for a particular bridge catchment in the subzone, the design storm rainfall and its temporal distribution in the catchment can be computed by adopting the following procedure :

STEP :1 Locate bridge catchment under study on the 50-year, 24-hour isopluvial map in Plate - 8 and obtain the 50-year 24- hour point rainfall value in cm. For a catchment covering more than one isopluvial, compute the average point rainfall.

STEP :2 Read the conversion ratio for storm duration T_D from Fig.10 and multiply the 50-year 24-hour point rainfall in Step-1 to obtain 50-year T_D-hour point rainfall.

STEP :3 Read the areal reduction factor corresponding to storm duration T_D and the given area of catchment from Fig.12(a)/12(b) or Annexure 4.2 and multiply the 50-year T_D -hour point rainfall in Step-2 by this factor to obtain the 50-year T_D-hour areal rainfall over the catchment.

STEP :4 Read the time distribution co-efficients for $1,2,.....(T_{D-1})$ hours corresponding to storm duration T_D from relevant graph in Fig.11 or Annexure 4.1 and multiply the 50- year T_D-hour areal rainfall in Step-3 by these co-efficients to obtain the cumulative depths of $1,2....(T_{D-1})$ hour catchment rainfall.

STEP :5 Obtain the depths of storm rainfall occurring every hour in the bridge catchment by subtraction of the successive cumulative depths of $1,2....(T_{D-1})$ and T_D hours in Step-4.

PART-V

DESIGN FLOOD ESTIMATION

5.1 Criteria and standards in regard to design flood of structures of small and medium catchments

Khosla Committee of Engineers had recommended a design flood of 50-year return period for fixing the waterway of the bridges. The committee had also recommended to design the foundation and protection work for larger discharge by increasing the design flood for waterways by 30% for small catchments up to 500 sq.km, 25 to 20% for medium catchments upto 500 to 5000 sq.km, 20 to 10% for large catchments upto 5000 to 25000 sq.km and less than 10% for very large catchments above 25000 sq.km.

Criteria and standards followed for design flood for bridges, cross-drainage structures and small dams are given below:-

a) Indian Railway Standard Bridges Substructures and Foundation Code revised in 1985 stipulates that all bridges shall be designed with adequate waterway for design discharge. This shall normally be the computed flood with probable recurrence interval of 50 years. However, at discretion of Chief Engineer/Chief Bridge Engineer, if a bridge is likely to have severe consequences, it may be designed for floods with a probable recurrence interval of more than 50 years, while bridges on less important lines or sidings may be designed for floods with a probable recurrence interval of less than 50 years.

b) Indian Road Congress - IRC 5-1985, clause 103 of Section-I "General Features of Design" Specifies that the waterway of a bridge is to be designed for a maximum flood of 50-yr return period. To provide for adequate margin of safety, the foundation and protection works should be designed for larger discharge. The recommended percentage increase over the design discharge specified in clause 103 is same as suggested by the Committee of Engineers.

c) Indian Standard Code of "Practice for design of cross drainage works-IS: 7784 Part-I, 1975" recommends that the waterway for cross drainage works should be designed for a 25 yr return period flood. To provide adequate margin of safety, the foundation and protection works should be designed for larger discharges. The percentage increase over the design discharge recommended in the code is same as suggested by the Committee of Engineers.

d) Central Water Commission's criteria of 1968 specifies that the diversion dams and weirs should be designed for floods of frequency of 50-100 yrs.

e) Indian Standards Guideline for "fixing spillway capacity of dams under clauses 3.1.2 and 3.1.3 of IS :11223- 1985"

recommends 100 yr return period flood as inflow design flood for small dams having either gross storage of the dam between 0.5 and 10 Mm^3 or hydraulic head between 7.5 m and 12 m.

5.2 Estimation of design flood

To obtain design flood of required return period the effective rainfall for design storm duration is to be applied to the unit hydrograph of a catchment.

Procedure for computing design flood peak and design flood hydrograph for T - year return period by SUG approach is as under:

Step-1: Synthetic unit hydrograph

Derive the synthetic unit hydrograph as per section 3.4.4 and tabulate 1 hour U.G. ordinates.

Step-2: Design storm duration

The duration of storm, which causes maximum flow in a river at a specified location is called "Design Storm Duration". The SUG of 16 catchments have been derived using the parameters computed from recommended equations given in Table-3.3. Annexure 5.1 shows the computed UG parameters. The excess rainfall increments for different storm durations T_D=1.1*t_p and T_D = T_B have been obtained for 25, 50 and 100 year return period and applied on SUGs derived to obtain the flood peaks of 25, 50 and 100 year return period. The computed flood peaks are shown in Annexure 5.2. It is seen from the Annexure 5.2 that maximum flood peak has been obtained using the storm duration as 1.1 * t_p for nearly all the catchments.

It is therefore, recommended to adopt the value of T_D as 1.1*t_p. The design engineer may adopt the value of T_D as 1.1*t_p or any other value which gives the maximum value of discharge.

Step-3: Design storm rainfall

i) Adopt suitable design storm duration(T_D) as explained in Step-2.

ii) Obtain design storm rainfall and hourly areal rainfall units vide section 4.6.

iii) Adopt design loss rate as recommended in section 3.5.

iv) Obtain hourly effective rainfall increments by subtracting the design loss rate.

Step-4

a) Design flood peak

i) Arrange 1 hour effective areal rainfall values against the 1 hour U.G. ordinates such that the maximum value

of effective rainfall against the maximum ordinate of U.G., the next lower value of effective rainfall against the next lower U.G. ordinate and so on upto T-hour duration.

ii) Obtain the base flow for the catchment area under study vide section 3.6.

iii) Obtain total surface runoff by summing the product of unit hydrograph ordinates as tabulated in Step- 3 (iv).

iv) Obtain flood peak by adding base flow to total surface runoff as per step- 4 (iii).

b) Design flood hydrograph

For computation of design flood hydrograph, carry out the steps from 1 to 3 and in addition, carry out the following steps.

Step- 5

Reverse the sequence of effective rainfall units obtained in Step- 4(i) to get the critical sequence of the effective rainfall units.

Step- 6

Multiply the first 1- hr effective rainfall with the ordinates of U.G. to get the corresponding direct runoff ordinates. Likewise, repeat the procedure with the rest of the hourly effective rainfall values giving a lag of 1-hr to successive direct runoff ordinate.

Step- 7

Add the direct runoff ordinates at 1- hr interval to get total direct runoff hydrograph.

Step- 8

Add the base flow as given in Step- 4(ii) to the direct runoff ordinates at 1-hr interval in Step-7 to get the 50-year flood hydrograph.

5.2.1 Illustrative example

An example, taking bridge number 385 as ungauged catchment has been worked out for illustrating the procedure to compute 50- year design flood. The catchment plan is enclosed at Fig. A-1.

The particulars of the catchment under study are as follows:

i)	Name of subzone	Mahanadi
ii)	Name of Tributary	Sondur

iii)	Name of Rail section	Raipur - Vijayanagram
iv)	Shape of catchment	Leaf
v)	Location	Lat 20^{o} 04′ 36″ Long 83^{o} 21′ 00″
vi)	Topography	Moderate slope

Step-wise procedure is explained below:

Step- 1: Physiographic parameters

Physiographic parameters obtained are as under :

1)	Area (A) (refer Fig. A-1)	194.00 sq.km
2)	Length of the longest stream (L)	39.36 km
3)	Length of the longest stream from a point opposite to C.G. of catchment to point of study (L_c)	15.13 km
4)	Equivalent stream slope (S) (Refer Annex. 5.3)	4.36 m/km

Step- 2: 1-hr Synthetic unitgraph

Synthetic unit hydrograph parameters as given below were computed using equations in para 3.4.3.

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t^P = 7.50 hr (rounded)

Q_p = 0.29 cum/km.

W_{50} = 7.74 hr

W_{75} = 3.87 hr

W_{R50} = 3.21 hr

W_{R75} = 1.67 hr

T_B = 29.00 hr

Q_p = 56.26 cumecs

Estimated parameters of unitgraph in step- 2 were plotted on a graph paper as shown in Fig. A-2. . The plotted points were joined to draw synthetic unitgraph. The discharge ordinates (Q_i) of the unitgraph at t_i-t_r =1 hr interval were summed up and multiplied by t_r = 1 i.e. Q_i * t_i= 538.89 cumecs as shown in Fig. A - 2 and compared with the volume of 1.00 cm Direct Runoff Depth over the catchment, computed from the formula:

$$Q = (A * d) / (t_i * 3.36)$$

Where A = Catchment area in sq.km

d = 1.0 cm depth

$t_i = t_r$ = 1 hr.(the unit duration of UG)

$$Q = \frac{A * d}{0.36 * t_r} = \frac{194 * 1}{0.36 * 1} = 538.89 \text{ cumecs}$$

Note: In case, $Q_i * t_i$ for the unitgraph drawn is higher or lower than the volume of 1 cm., the falling limb of hydrograph may be suitably modified without altering the points of synthetic parameters.

Step- 3: Estimation of design storm

(a) Design storm duration

The Design Storm Duration (T_D) has been adopted as 1.1 $*t_R$ as this value of storm duration gave higher value of flood peak (refer Step- 2, section 5.2). Rounding of the design storm duration to nearest hour, its value came as 8 hrs.

(b) Estimation of point rainfall and areal rainfall for storm duration

Catchment under study was located on Plate- 8 showing 50 year- 8 hr point rainfall. The point rainfall was found to be 32.00 cm. The conversion factor of 0.780 was read from Figure-10 to convert the 50 year- 24 hour point rainfall to 50 year- 8 hour point rainfall (since T_D = 8 hrs). 50 year-8 hr point rainfall was 24.96 cm.

Areal reduction factor of 0.9144 corresponding to the catchment area of 194 sq.km for T_D = 8 hour was interpolated from Annexure 4.2 or Fig. 12 (8) for conversion of point rainfall to areal rainfall. 50 year-8 hr areal rainfall thus worked out to be 22.82 cm.

The 50 year-8 hour areal rainfall was split into 1- hour rainfall increments using time distribution coefficients given in Annexure 4.1 or Figure 11.

A design loss rate of 0.21 cm/hr as recommended in para 3.5 was applied to get effective rainfall hyetograph.

The Table 5.1 given below gives the hourly effective rainfall increments.

Table - 5.1 : Hourly effective rainfall increments

Duration (hr)	Distribution coeff.	Storm rainfall (cm)	Rainfall increments (cm)	Loss per hr (cm)	Effective rainfall increments (cm)
1	2	3	4	5	6
1	0.48	10.96	10.96	0.21	10.75
2	0.62	14.15	3.20	0.21	2.99
3	0.73	16.66	2.51	0.21	2.30
4	0.81	18.49	1.83	0.21	1.62
5	0.88	20.08	1.60	0.21	1.39
6	0.94	21.45	1.37	0.21	1.16
7	0.98	22.36	0.91	0.21	0.70
8	1.00	22.82	0.46	0.21	0.25

Step- 4: Estimation of base flow

Taking design base flow of 0.10 cumecs per sq.km as recommended in para 3.6, the base flow was estimated to be 19.40 cumecs for the catchment area of 194 sq.km

Step- 5: Estimation of 50- year flood peak

a) Computation of flood peak

For estimation of the peak discharge, the effective rainfall increments were re-arranged against ordinates such that the maximum effective rainfall is placed against the maximum U.G. ordinate, next lower value of effective rainfall against next lower value of U.G. ordinate and so on, as shown in col. (2) and (3) in Table 5.2. Sum of the product of U.G. ordinates and effective rainfall increments gives total direct surface runoff to which base flow is added to get total peak discharge.

Table - 5.2 : 50- year flood peak

Time (hrs)	U.G ordinate (cumecs)	1 hr effec. rainfall (cms)	direct runoff (cumecs)
1	2	3	4
5	30.5	0.25	7.63
6	40.2	1.39	55.88
7	49.0	2.30	112.70
8	56.26	10.75	604.80
9	50.00	2.99	149.50
10	43.80	1.62	70.96
11	37.70	1.16	43.73
12	31.30	0.70	21.91
Total DSRO			1067.10
Base flow			19.40
Total peak discharge			1086.50 cumecs

(b) Computation of design flood hydrograph

Effective rainfall increments shown in col. (3) of Table 5.2 in Step- 5 were reversed to obtain critical sequence as shown below:

Table - 5.3 :Critical sequence of rainfall

Time (hr)	Critical 1-hr effective rainfall sequence (cm)
12	0.79
11	1.16
10	1.62
9	2.99
8	10.75
7	2.30
6	1.39
5	0.25

For computation of design flood hydrograph, the U.G. ordinates were tabulated in col (2) of Annex. 5.4. The critical sequence of effective rainfall increments were entered in col.3 to 10 horizontally. Direct runoff resulting from each of the columns are added horizontally. Direct runoff resulting from each of the effective rainfall depths with the synthetic U.G. ordinate in col.(2) and direct runoff values were entered in columns against each unit with a successive lag of 1 hr since the unit duration of S.U.G. is 1 hr. Direct runoff values are shown in col (3) to (10). Direct runoff values were added horizontally and total direct runoff is shown in col. (11) Adding total base flow of 12.10 m^3/sec. (col.12), design flood hydrograph ordinates (col. 13) were obtained. Design Flood Hydrograph was plotted against time as shown in Fig. A-3. The peak obtained was 1086.50 m^3/s which tallies with the peak shown in Table - 5.2.

5.3 Computation of Design H.F.L.

The Design Engineer has to determine the design High Flood Level' corresponding to adopted design flood for the bridges and cross drainage structures under natural and constricted conditions. This elevation is very important in the analysis for foundations, scour, free board, formation levels, hydraulic forces etc.

Stage discharge relationship is represented by stage vs. discharge rating curve of a river at the point of study. The most acceptable method for establishing stage discharge rating curve is based on observed gauges and discharges covering satisfactorily the lower to upper elevation ranges. Stage discharge relation defines the complex interaction of channel characteristics including cross sectional areas, shape, slope and roughness of bed and banks. The permanent stage discharge relation is a straight line or a combination of straight lines on a logarithmic plotting depending on the channel configuration; a single straight line for a single well defined channel and a combination of two straight lines for

the main channel with its firm portions. The stage discharge relation may be considered more accurate depending on the reliable and adequate observed gauge and discharge data of the river at the point of study. The gauge discharge rating curve so determined may be used for fixing the design HFL corresponding to design flood by extrapolation if necessary.

In the absence of observed gauge and discharge data at the point of study (bridge or cross-drainage structures location), synthetic gauge discharge rating curve has to be constructed by Area-Velocity Method, using the river cross section, slope data and nature of the cross-section. The velocity is computed by the Manning's formula.

Computation of HFL is generally done with the help of Manning's formula in which roughness coefficient ('N') is an important factor affecting the discharge of a river or Nalla. The value of N is highly variable and depends on a number of factors, viz, surface roughness, vegetation, channel irregularity, channel alignments, silting and scouring, obstruction, size and shape of channel, stage and discharge, seasonal change and suspended material and bed load.

The various values of the roughness co-efficient for different types of channel are given in Table 5.6 "Open Channel Hydraulics" by Ven-Te-Chow.

The above procedure pertains to determination of design HFL corresponding to design flood of a river under natural conditions. With the type of structures in position there will generally be a constriction in the waterway. The effect of the constriction by way of raising the design HFL under natural conditions has to be evaluated in the water elevation to arrive at the revised design HFL under constricted conditions. The difference between upstream and downstream water levels corresponding to design flood due to constriction in the waterway may be termed as afflux. There are hydraulic methods for working out the final design HFL due to constriction by the structure. The weir formula or orifice formula of hydraulics is generally used depending on the upstream and downstream depths to estimate the revised design HFL under constricted conditions.

Sometimes it happens that the cross section of river or nalla on the downstream side of a cross drainage structure may be narrow than the cross section at the location of a crossing site.

The flood levels at the proposed structure may also be affected by the high flood levels in the main river joining downstream in proximity of the stream. In such cases, there will be backwater effect due to the narrow gorge of the river as the design flood for the crossing site will not be able to pass through the narrow gorge in the downstream. There will, therefore, be heading up of water in its upstream side which ultimately affects HFL of the river at the crossing site. In the latter case the tributary/stream on which the bridge is located will be under the influence of the backwater effect of the main stream joining downstream. In such cases backwater study may be carried out.

In the absence of any observed levels of water profiles for computing hydraulic gradient, bed gradient of nalla may be considered, after verifying that local depressions are not accounted for and bed gradient is computed on a reasonable length of atleast 300 m. upstream and downstream of the crossing site.

If the crossing site is located across the river/drainage in the unfavorable reach i.e. not complying with the usual requirements of gauge site, the design flood elevation may be computed in a straight reach downstream of the crossing and design flood elevation may be worked out by undertaking backwater studies.

PART-VI

ASSUMPTIONS , LIMITATIONS AND CONCLUSIONS

6.1 Assumptions

It is assumed that 50-year return period storm rainfall produces 50- year flood. Similar is the case for 25-year and and 100-year flood.

A generalised conclusion regarding the base flow and loss rate are assumed to hold good during the design flood event.

6.2 Limitations

The method would be applicable for reasonably free catchments with interception, if any, limited to 20% of the total catchment. For calculating the discharge the total area of the catchment has to be considered.

The generalised values of base flow and loss rate have been assumed to hold good for the whole subzone. The designer may adopt other suitable values of base flow and loss rate as per site conditions.

The data of 16 catchments have been considered for developing a generalised approach. However, for more reliable results , the data of more catchments uniformly distributed would be desirable.

6.3 Conclusions

The methodology for estimating the design flood of 50-yr return period incorporated in the body of the report is recommended for adoption. This also holds good for 25-year flood and 100-year flood.

The report also recommends the adoption of design flood of 25 year and 100 year return periods taking into account the type and relative importance of the structures.

The report is applicable for the catchment areas ranging from 25 sq km to 1000 sq km. Further the report may be used for large catchments upto 5000 sq km based on sound judgment and considering the data of neighbouring catchments also. However, individual site conditions may necessitate special study. Engineer-in-charge at site is advised to take a pragmatic view while deciding the design discharge of a bridge.

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7. Estimation of Design Flood "Recommended Procedures" (September, 1972): Central Water Commission, New Delhi.

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ANNEXURE 1.1

LIST OF HYDRO-METEOROLOGICAL SUB-ZONES

SUB-ZONE	NAME OF SUBZONE (designated earlier)	Name of sub-zone(designated now)	River Basins included is the subzone
1(a)	Luni basin and Thar (Luni and other rivers of Rajasthan and Kutch)	Luni	Luni river and Thar (Luni & other rivers of Rajasthan & Kutch and Banas rivcher)
1(b)	Chambal Basin	Chambal	Chambal river
1(c)	Betwa Basin & other Tributaries	Betwa	Sind, Betwa and Ken rivers and other South Tributaries of Yamuna
1(d)	Sone Basin and Right Bank Tributaries	Sone	Sone & Tons rivers and other South Bank Tributaries of Ganga
1(e)	Punjab Plains including parts of Indus, Yamuna, Ganga and Ramganga Basins	Upper-Indo Ganga Plains	Lower portion of Indus, Chaggar, Sahibi Yamuna, Ganga and Upper portion of Sirsa, Ramganga, Gomti and Sai rivers
1(f)	Ganga plains including Gomti, Ghagra, Gandak, Kosi and other	Middle Ganga Plains	Middle portion of Ganga, Lower portion of Gomti, Ghagra, Gandak, Kosi and middle portion of Mahanadi
1(g)	Lower Ganga Plains including Subarnarekha and other east-flowing rivers between Ganga and Baitarani	Lower Ganga Plains	Lower Portion of Ganga, Hoogli river system and Subarnarekha
2(a)	North Brahmaputra Basin	North Brahmaputra	North bank Tributaries of Brahmaputra river and Balason river
2(b)	South Brahmaputra Basin	South Brahmaputra	South bank Tributaries of Brahmaputra river
2(c)	Barak and others	Barak	Barak, Kalden and Manipur rivers
3(a)	Mahi, including the Dhadhar, Sabarmati and rivers of Saurashtra	Mahi and Sabarmati	Mahi and Sabarmati including Rupen and Machhu, Bhadar, Ozat, Shetranji rivers of Kathiawad Peninsula.

3(b)	Lower Narmada and Tapi Basin	Lower Narmada and Tapi	Lower portion of Narmada, Tapi and Dhadhar rivers
3(c)	Upper Narmada and Tapi Basin	Upper Narmada & Tapi	Upper portion of Narmada and Tapi rivers
3(d)	Mahanadi Basin including Brahmani and Baitarani rivers	Mahanadi	Mahanadi, Baitarani and Brahmani rivers
3(e)	Upper Godavari Basin	Upper Godavari	Upper portion of Godavari Basin
3(f)	Lower Godavari Basin except coastal region	Lower Godavari	Lower portion of Godavari Basin
3(g)	Indravati Basin	Indravati	Indravati river
3(h)	Krishna subzone including Pennar Basin except coastal region	Krishna	Krishna and Pennar rivers except coastal region
3(i)	Kaveri & East flowing rivers except coastal region	Kaveri	Kaveri, Palar and Ponnaiyar rivers except coastal region
4(a)	Circars including east flowing rivers between Mahanadi and Godavari	Upper Eastern Coast	East flowing coastal rivers between Deltas of Mahanadi and Godavari rivers
4(b)	Coromandal Coast including east flowing rivers between Godavari and Kaveri	Lower Eastern Coast	East flowing coastal rivers, Manimukta, South Pennar, Cheyyar, Palar, North Pennar, Munneru, Palleru, Gundalakama and Krishna Delta
4(c)	Sandy Coroman Belt (east flowing rivers between Cauvery and Kanyakumari	South Eastern Coast	East flowng coastal rivers, Manimuthar, Vaigai, Arjuna, Tamraparni
5(a)	Konkan Coast (west flowing river between Tapi and Panaji)	Konkan Coast	West flowing coastal rivers between Tapi and Mandavi rivers
5(b)	Malabar Coast (west flowing rivers between Kanyakumari and Panaji	Malabar Coast	West flowing coastal rivers between Mandavi and Kanyakumari
6	Andaman and Nicobar	Andaman & Nicobar	
7	J & K, Kumaon Hills (Indus Basin)	Western Himalayas	Jhelum, Upper portion of Indus, Ravi and and Beas rivers

ANNEXURE 3.1

LIST OF RAILWAY BRIDGE CATCHMENTS AND AVAILABILITY OF GAUGE & DISCHARGE AND RAINFALL DATA

Sl.No.	Bridge No.	Name of stream	Name of section	LOCATION Longitude Deg.	Min.	Sec.	Latitude Deg.	Min.	Sec.	Catchment area (sq.km.)	No. of rain gauges	Data availability	Catchment years
1	7	Bhadon	Jharsuguda-Titlagarh	21	47	0	84	2	0	3100 *	9	1966-68,70-73	7
2	121	Kelo	Jharsuguda-Bilaspur	21	57	45	83	18	30	1150 *	9	1968-73	6
3	499	Koro	Bondamunda-Ranchi	22	58	24	84	36	24	823 *	7	1967-73	7
4	12 *	Litlagar	Kharagpur-Raipur	22	2	0	82	20	0	468	5	1959-65,82-84	25
5	195	Jira	Sambalpur-Titlagarh	21	14	0	83	38	18	615	5	1971-79	9
6	233	Ranjhor	Sambalpur-Titlagarh	21	7	48	83	35	12	312	4	1975-80	6
7	332 (11)	Puri	Raipur-Kagpur	21	4	36	81	4	48	225	3	1963-74	10
8	385	Sundur	Raipur-Vizianagram	20	6	36	81	31	0	184	3	1964-74	9
9	69	Barai	Jharsuguda-Bilaspur	22	0	36	82	56	42	178	3	1970-74	5
10	59 (8)	Kanwar	Kharagpur-Kagpur	22	1	0	87	53	42	136	3	1964-74	9
11	698 *	Bijra	Bondamunda-Ranchi	22	15	48	84	57	12	113	3	1965-74,82-84	23
12	48	Barajhor	Bargundi-Talcher	20	47	0	85	35	12	109	3	1967-69	3
13	79	Kisindajh	Bargundi-Talcher	20	48	0	85	17	24	67	2	1967-68	2
14	37	Barajhor	Bargundi-Talcher	20	34	36	85	13	48	64	2	1966-67	2
15	154	Kharajhor	Kharagpur-Kagpur	21	31	38	83	41	35	58	2	1966-70	5
16	39 (a)	Dungajhor	Kharagpur-Kagpur	22	1	8	87	25	37	47	2	1961-65	5
17	139	Koro	Rajharaswa-Dua	22	15	18	86	25	0	374	3	1966	1
18	98	Khaljhor	Bhilai-Dhalirajhara	20	10	12	81	17	0	103	3	1966,71-79	9
19	332 (1)	Pitakalia	Kharagpur-Kalyar	21	14	48	86	38	24	179	3	1964-74	9
20	66 (4)	Mallamia	Bilaspur-Katni	22	48	0	81	14	0	154	3	1958-66	8
21	478	Gokarna	Bilaspur-Raipur	22	5	12	82	9	24	144	3	1965-81	17
22	25	Mun	Kharagpur-Puri	20	3	30	85	45	0	132	3	1975-81	7
23	69 (6)	Kargood	Bilaspur-Katni	22	32	24	81	26	42	113	1	1966-67	2
24	176	Bildana	Raipur-Vizianagram	20	10	48	85	32	24	66	2	1967-68	2
25	42	Barjhor	Bargundi-Talcher	20	37	10	85	14	48	49	2	1969-73	5
26	325	Khuragadi	Raipur-Vizianagram	20	23	48	83	8	30	27	1	1965-67,69	4

Note 1:- Bridges from Sl.No.1 to 26 only were found suitable for UG analysis

Note 2:- * These are key gauging sites and hydrological observation are continued

SUBZONE 3 (d) ANNEXURE 3.2

PHYSIOGRAPHIC PARAMETERS OF SELECTED CATCHMENTS

SL.NO.	BR.NO.	C.A. (sq.km)	L (km.)	L_c (km)	SEQ. (mt/km)
1	7	3108	96.60	51.84	0.59
2	121	1150	80.50	38.64	5.03
3	489	823	64.40	25.74	2.74
4	12	666	66.82	25.75	1.14
5	195	615	53.94	28.16	1.64
6	235	312	41.06	21.09	1.62
7	332(ii)	225	30.59	13.52	1.32
8	385	194	39.36	15.13	4.36
9	69	173	35.42	18.50	2.37
10	59(B)	136	28.18	11.26	5.90
11	698	113	26.57	14.40	9.06
12	40	109	19.32	10.46	2.68
13	79	67	17.71	8.45	2.08
14	37	64	17.71	7.24	7.14
15	154	58	12.48	9.65	5.20
16	59(S)	47	13.07	8.29	3.30

ONE HOUR S.U.H. PARAMETERS OF SELECTED CATCHMENTS

S.No.	Gauge No.	t_p (hrs)	Q_p (cumecs)	q_p cum/sq km	t_r (hrs)	T_B (hrs)	W_{50} (hrs)	W_{75} (hrs)	W_{50}/W_{75} (hrs)	W_{87} (hrs)
1	7	16.50	559.44	0.18	1	57	10.97	5.25	6.17	2.60
2	121	12.50	332.00	0.28	1	37	7.00	3.60	3.00	1.80
3	489	8.50	271.59	0.33	1	29	6.00	3.00	2.00	1.50
4	12	15.50	111.70	0.17	1	45	15.50	8.50	4.10	3.40
5	195	10.50	123.00	0.20	1	38	11.20	5.05	4.00	2.30
6	235	11.50	52.50	0.17	1	41	15.40	7.30	3.45	2.18
7	332 (11)	6.50	85.50	0.38	1	21	6.00	2.97	3.00	1.56
8	385	7.50	58.20	0.30	1	24	7.75	4.50	3.20	1.80
9	69	9.50	38.06	0.22	1	31	11.70	5.53	2.87	2.10
10	59 (8)	6.50	40.80	0.30	1	31	6.48	3.48	3.40	1.39
11	696	4.50	52.20	0.46	1	22	4.60	1.60	2.65	1.00
12	48	7.50	20.71	0.19	1	38	12.80	6.85	4.20	2.60
13	79	4.50	27.47	0.41	1	16	6.12	3.74	2.60	1.27
14	37	5.50	24.32	0.38	1	18	6.67	3.40	2.20	1.30
15	154	5.50	25.20	0.40	1	20	5.45	3.32	2.20	1.20
16	59 (5)	5.50	17.39	0.37	1	28	5.30	2.20	2.70	1.20

SUBZONE 3(d) Annexure 3.4

PHYSIOGRAPHIC AND UNIT HYDROGRAPH PARAMETERS STUDIED

Sl.No.	X	Y	A	B	r
1.	$L*L_c/S^{0.5}$	q_p	0.723	-0.163	0.67
2.*	do	t_p	1.757	0.261	0.92
3.*	t_p	q_p	1.260	-0.725	0.88
4.	$L/S^{0.5}$	q^p	0.636	-0.273	0.69
5.	do	t_p	0.636	-0.417	0.89
6.	t_p	W_{50}	1.798	0.726	0.76
7.*	q_p	do	1.974	-1.104	0.96
8.	t_p	W_{75}	0.849	0.749	0.71
9.*	q_p	do	0.961	-1.125	0.91
10.	t_p	W_{R50}	0.922	0.615	0.74
11.*	q_p	do	1.150	-0.829	0.83
12.	t_p	W_{R75}	0.387	0.721	0.86
13.*	q_p	do	0.527	-0.932	0.92
14.*	t_p	T_B	5.411	0.826	0.84

NOTE:

1. Equation is of the form of $Y = A * X^B$
2. Recommended relations for derivation of S.U.G are marked as "*"

SUBZONE 3(d)

ANNEXURE 3.5

COMPARISION OF FLOOD PEAKS BASED ON RUR's AND SUR's

SL.NO.	BR.NO.	Q25 IN CUMECS			Q50 IN CUMECS			Q100 IN CUMECS		
		RUR	SUR	% DIF	RUR	SUR	% DIF	RUR	SUR	% DIF
1	7	9546	8901	+ 7.44	10929	10163	+7.44	12210	11366	+7.42
2	121	4601	3731	+33.31	5089	4133	+33.31	5752	4668	+25.22
3	489	3086	2242	+37.62	3641	2790	+37.62	4218	3064	+37.66
4	12	1516	1685	-10.01	1592	1769	-10.01	1816	2014	-9.81
5	195	2025	2091	- 3.28	2062	2130	-3.28	2327	2406	-3.28
6	255	972	1321	-26.43	1083	1475	-26.63	1192	1624	-26.60
7	332 (1)	1188	913	+30.14	1339	1029	+30.14	1491	1145	+30.16
8	385	998	943	+ 5.79	1149	1086	+5.79	1300	1227	+5.92
9	69	596	688	-13.64	712	825	-13.64	804	932	-13.71
10	59 (b)	595	617	- 4.32	701	740	-4.32	799	835	-4.35
11	698	768	562	+36.37	892	654	+36.37	923	696	+32.54
12	48	371	568	-34.62	400	612	-34.62	429	656	-34.61
13	79	415	373	+11.06	467	421	+11.06	520	468	+11.09
14	37	405	419	- 3.68	458	476	-3.68	513	532	-3.66
15	154	648	642	+1.33	516	510	+1.33	534	547	+1.33
16	59 (a)	282	287	-1.56	331	345	-1.56	369	376	-1.66

SUBZONE 3(d) ANNEXURE-3.6

AVERAGE BASE FLOW RANGES OF OBSERVED FLOOD EVENTS

Sl.No.	Gd.No.	C.A.	0.000 to 0.009	0.010 to 0.090		0.100 to 0.190	0.200 to above	TOTAL
			IN CUMECS PER SQUARE KILOMETERS					
1	7	3108	-	-	4	-	-	4
2	121	1130	-	-	4	-	-	4
3	489	825	2	-	1	1	-	4
4	12	666	-	5	4	2	-	11
5	195	615	-	-	4	3	-	7
6	259	312	-	-	3	3	-	6
7	332 (11)	325	1	3	-	6	-	10
8	385	194	-	-	3	1	1	5
9	69	173	-	1	4	1	2	8
10	59 (d)	136	-	-	3	3	3	9
11	698	113	-	-	9	9	12	30
12	48	109	-	-	1	5	-	6
13	79	67	-	-	4	1	1	6
14	37	64	1	-	4	-	-	5
15	154	58	-	-	2	5	-	7
16	59 (5)	47	-	-	6	-	1	7
TOTAL FLOOD EVENTS			4	9	56	40	20	129

ANNEXURE 4.1

TIME DISTRIBUTION CO-EFFICIENTS (PERCENTAGE) OF CUMULATIVE HOURLY RAINFALL

INTER-MEDIATE HOURS	DESIGN STORM DURATION (HOURS)																								INTER-MEDIATE HOURS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1	100	89	80	70	64	59	56	48	45	43	42	39	38	34	33	31	30	29	28	27	26	25	24	24	1
2		100	94	87	83	78	76	72	69	67	65	63	62	60	59	58	57	56	55	54	53	52	51	50	2
3			100	96	91	87	85	81	79	77	75	74	73	71	70	69	68	67	66	65	64	63	62	61	3
4				100	97	93	92	88	85	84	82	81	80	78	77	76	75	74	73	72	71	70	69	68	4
5					100	97	97	94	92	90	89	88	87	86	85	84	83	82	81	80	79	78	77	76	5
6						100	100	98	98	96	96	95	94	93	92	91	90	89	88	87	86	85	84	83	6
7								100	100	98	98	98	97	96	96	95	94	93	92	91	90	89	88	87	7
8										100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	8
9																									9
10																									10
11																									11
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23																									23
24																									24

TURKEY 3 (8)

ANNEXURE - 4.2

AREAL REDUCTION FACTORS (PERCENTAGE) FOR POINT TO AREAL RAINFALL

CATCHMENT AREA (sq km)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	CATCHMENT AREA (sq km)
3	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	3
50	94.00	95.12	96.25	96.75	97.25	97.75	97.79	97.83	97.87	97.92	97.96	98.00	98.06	98.12	98.19	98.25	98.31	98.38	98.44	98.50	98.56	98.62	98.69	98.75	50
100	89.25	91.00	93.75	93.67	94.50	95.00	95.38	95.67	95.75	95.83	95.92	96.00	96.06	96.12	96.19	96.25	96.31	96.38	96.44	96.50	96.56	96.62	96.69	96.75	100
150	85.25	87.38	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	150
200	81.75	84.12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	200
250	78.50	81.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	250
300	75.50	78.38	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	300
350			79.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	350
400			77.25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	400
450			75.50	77.50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	450
500			74.25	76.25	78.25	80.25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	500
600												[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	600
700												[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	700
800												[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	800
900												[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	900
1000												[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1000
1100												[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1100
1200												[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1200
1300																								80.50	1300
[illegible]																								79.50	[illegible]
[illegible]																								79.25	[illegible]
2000																								78.50	2000

Sub-zone 3(d)

Annexure 4.3

Statistics of Heaviest Rainfall & Annual Normal Rainfall in sub-zone 3(d)

SN	State/District	Station	Heaviest Rainfall > 35cm	Heaviest Rainfall < 35cm	Date of occurance	Annual Normal rainfall in cm
1	2	3	4	5	6	7
	ORISSA					
1.	Sambalpur	1. Sambalpur	58.2	-	19.08.1982	163.4
		2. Padampur	36.8	-	07.09.1939	132.1
		3. Jharsuguda	35.0	-	29.06.1925	161.8
2.	Balasore	4. Chandbali (Obsy.)	51.5	-	16.09.1879	170.9
		5. Bhadrak	42.9	-	20.08.1907	152.5
		6. Soro	40.1	-	19.10.1965	154.4
		7. Balasore	39.9	-	16.07.1987	158.6
		8. Jaleswar	39.4	-	23.07.1894	137.4
		9. Balipal	37.2	-	18.10.1946	150.8
3.	Cuttack	10. Jagatsinghpur	49.9	-	20.07.1889	169.5
		11. Cuttack(Obsy)	41.7	-	10.08.1934	153.9
		12. Kendrapara	40.2	-	27.06.1925	143.7
4.	Puri	13. Puri (Obsy)	48.0	-	21.10.1862	137.3
		14. Gop	35.6	-	06.11.1891	169.3
5.	Mayurbhanj	15. Baripada	46.7	-	12.10.1973	146.7
		16. Karanjia	36.3	-	30.07.1927	165.1
6.	Bolangir	17. Bolangir	40.2	-	20.08.1982	145.8
		18. Sonepur	36.6	-	16.06.1918	140.7
7.	South-Phulbani	19. Dulandapara	39.5	-	15.06.1936	213.9
8.	Keonjhar	20. Anandpur	-	34.3	09.07.1941	145.9
9.	Koraput	21. Koraput	-	33.7	25.06.1914	161.9
10.	Sundergarh	22. Bonaigarh	-	33.4	20.07.1920	165.9
11.	Ganjam*	23. Mohana	-	31.7	10.10.1938	131.8
12.	Kalahandi	24. Bhawanipatna	-	31.1	02.07.1930	145.7
13.	Dhenkanal	25. Pallahara	-	30.7	04.10.1936	178.2
	BIHAR					
14.	Hazaribagh	26. Hunterganj	46.7	-	01.08.1917	131.6
		27. Chatra	37.0	-	02.08.1917	134.4
15.	Palamau*	28. Mahuadwar	36.4	-	27.06.1923	141.3
		29. Garu	35.6	-	20.06.1911	160.3

1	2	3	4	5	6	7
16.	Singhbhum	30. Majhgaon	35.7	-	30.07.1927	153.0
17.	Ranchi	31. Chainpur	-	26.1	06.10.1936	158.6
	MADHAYA PRADESH					
18.	Shahdol*	32. Pushparajgarh	41.9	-	25.06.1946	150.1
		33. Umaria	36.5	-	19.08.1923	137.5
19.	Raipur	34. Raipur	37.0	-	04.08.1910	138.5
20.	Balaghat*	35. Palhera	36.8	-	22.08.1931	164.2
21.	Raigarh	36. Raigarh	36.1	-	10.07.1958	163.9
22.	Durg	37. Dongargarh	35.9	-	01.08.1959	130.6
23.	Mandla*	38. Bichhia	35.9	-	21.09.1926	170.9
24.	Bilaspur	39. Champa(Obey)	-	34.7	26.07.1947	149.9
25.	Sarguja	40. Ambikapur	-	34.2	27.06.1945	165.8
26.	Baster	41. Antagarh	-	30.8	30.06.1959	177.2
	MAHARASHTRA					
27.	Chanda	42. Ghorajheri	40.0	-	19.07.1959	135.6
28.	Bhandara*	43. Pangree	39.5	-	25.07.1937	155.5
		44. Sakoli	38.4	-	26.06.1908	157.2
		45. Bodalkasa	37.6	-	31.08.1947	137.9

Note: Col.2: Districts underlined/asterisked* are/fully outside the sub-zone.

Subzone 3(d) Annexure-4.4

Heaviest 24-hour's & shorter durations rainfall recorded in Subzone 3(d)

STATE/ District	SRRG Station	Highest Storm Rainfall (mm) & Duration (hours)	Date & Time of Occurance (clock hour)
(1)	(2)	(3)	(4)
ORISSA			
1. Keonjhar (5)	1. Telkoi*	245 (24)	1-2.9.78 (14-14)
		202 (12)	2.9.78 (00-12)
		130 (6)	(00-06)
		95 (3	12.8.78 (18-21)
		50 1	(19-20)
2. Dhenkanal (4)	2. Talcher*	236 (24)	12-13.8.76 (14-14)
		113 (6)	13.8.76 (00-06)
		103 (3)	(17-20)
	3. Pallahera	185 (12)	1-2.9.78 (22-10)
	4. Rangoli	80 (1)	2.8.79 (13-14)
3. Cuttack (4)	5. Paradip	234 (24)	8-9.8.74 (12-12)
		219 (6)	29.8.76 (00-06)
	6. Akhuapada	225 (12)	27.8.78 (03-15)
	7. Naraj	158 (3)	1.8.76 (20-23)
		83 (1)	(21-22)
4. Sambalpur (2)	8. Jharsuguda	213 (24)	19-20.8.75 (01-01)
		179 (12)	19.8.75 (11-23)
		149 (6)	13.8.69 (11-17)
		135 (3)	(13-16)
		68 (1)	26.8.75 (04-05)
5. Bilaspur (2)	9. Champa	197 (24)	7-8.8.79 (17-17)
		153 (6)	21-22.8.71 (20-08)
		139 (3)	27.2.71 (07-13)
		139 (1)	(07-10)
		87 (12)	(07-08)
6. Puri (2)	10. Bhubaneshwar	164 (24)	29.7.69 (04-04)
		127 (6)	21-22.6.71 (20-02)
		110 (3)	(23-02)
		83 (1)	23.6.79 (19-20)
	11. Puri	139 (12)	8.8.81 (01-13)
7. Kalahandi (1)	12. Nawapara*	162 (24)	19-20.7.76 (07-07)
		121 (12)	20.7.76 (00-12)
		116 (6)	(01-07)
		82 (3)	(03-06)
		43 (1)	(03-04)

(1)	(2)	(3)		(4)	
8. Balasore (1)	13. Chandbali*	125	(24)	12-13.8.75	(08-08)
		74	(12)	17-18.8.75	(18-06)
		72	(6)	7.8.75	(10-16)
		72	(3)		(10-13)
		50	(1)		(10-11)
9. Sundargarh	14. Panposh*	122	(24)	27-28.7.78	(17-17)
		116	(12)	8-9.8.77	(14-02)
		115	(6)		(19-01)
		89	(3)	8.8.77	(19-22)
		53	(1)	23.8.78	(00-01)
10. Mayurbhanj	15. Thakurmunda*	105	(24)	7-8.8.79	(10-10)
		90	(12)	16-17.4.79	(16-04)
		81	(6)	16.4.79	(16-22)
		70	(3)		(20-23)
		55	(1)		(20-21)
11. Baudh-Khondmals	16. Phulbani*	94	(24)	1-2.8.76	(10-10)
		88	(12)		(16-04)
		63	(6)	27.7.75	(14-20)
		61	(3)		(14-17)
		38	(1)	12.7.75	(14-15)
Madhya Pradesh					
12. Bastar	17. Kanker	235	(24)	17-18.9.80	(15-15)
		176	(12)		(22-10)
		163	(6)	16-17.9.69	(19-01)
		115	(3)	18.9.80	(02-05)
		79	(1)	26.6.74	(23-24)
13. Raigarh	18. Raigarh*	183	(24)	23-24.9.73	(07-07)
		161	(12)		(19-07)
		112	(6)	24.9.73	(00-06)
		85	(3)	9-10.8.74	(23-02)
		42	(1)	10.8.74	(01-02)

Note:

Col (1) Districts underlined are partly outside the subzone and figures in the parenthesis indicate total number of SRRG stations in the district.

Col (2) Stations asterisked* have data for less than five years.

LIST OF SUG PARAMETERS OBTAINED FROM EQUATIONS

SL.NO.	BR.NO.	CA (sq.km.)	t_r (hrs)	q_p (cumec/km²)	W_{50} (hrs)	W_{75} (hrs)	W_{R50} (hrs)	W_{R75} (hrs)	T_B (hrs)	T cm.Vol. (cumecs)	Q_p (cumecs)
1	7	3108	17.50	0.16	14.93	7.33	5.25	2.91	58	8633.33	497.28
2	121	1150	11.50	0.21	11.06	5.56	4.19	2.26	41	3194.44	241.50
3	489	823	10.50	0.23	10.00	5.02	3.89	2.07	38	2286.11	189.29
4	12	666	12.50	0.20	11.67	5.88	4.37	2.36	44	1850.00	133.20
5	195	615	11.50	0.25	9.12	4.57	3.63	1.92	41	1708.33	153.75
6	235	312	9.50	0.25	9.12	4.57	3.63	1.92	35	866.67	78.00
7	332(11)	225	8.50	0.27	8.38	4.19	3.40	1.79	32	625.00	60.75
8	385	194	7.50	0.29	7.74	3.87	3.21	1.67	29	538.89	56.26
9	69	173	8.50	0.27	8.38	4.19	3.40	1.79	32	480.56	46.71
10	59(a)	136	6.50	0.32	6.94	3.46	2.96	1.52	25	377.78	43.52
11	698	113	6.50	0.32	6.94	3.46	2.96	1.52	25	313.89	36.16
12	48	109	6.50	0.32	6.94	3.46	2.96	1.52	25	302.78	34.88
13	79	67	5.50	0.37	5.92	2.94	2.62	1.33	22	186.11	24.79
14	37	64	4.50	0.42	5.14	2.55	2.36	1.18	19	177.78	26.88
15	154	58	4.50	0.42	5.14	2.55	2.36	1.18	19	161.11	24.36
16	59(b)	47	5.50	0.37	5.92	2.94	2.62	1.33	22	130.56	17.39

SUBZONE 3(d) ANNEXURE 5.2

COMPARISION OF QSO USING $T_D = 1.1 * t_p$ & $T_D = T_g$

Sl.No.	SW.No.	C.A. (in sq km.)	QSO (Cumecs) $T_D = 1.1 * t_p$	QSO (Cumecs) $T_D = T_g$
1	7	3108.00	10162.74	9914.07
2	121	1250.00	4132.89	4068.31
3	489	823.00	2790.08	2617.81
4	52	666.00	1768.66	1678.35
5	195	615.00	2136.48	2032.03
6	239	312.00	1475.05	1344.21
7	332(11)	225.00	1029.03	925.01
8	385	194.00	1086.50	973.07
9	69	175.00	825.19	739.98
10	59(8)	156.00	739.97	646.09
11	698	115.00	653.76	564.37
12	48	109.00	612.40	530.56
13	79	67.00	420.79	355.12
14	37	64.00	475.78	386.64
15	154	58.00	509.67	443.51
16	59(5)	47.00	344.75	283.96

COMPUTATION OF EQUIVALENT SLOPE OF BRIDGE CATCHMENT AT 385

Sl. No.	REDUCED DISTANCE		REDUCED LEVEL		LENGTH OF EACH SEG.	HEIGHT ABOVE DATUM	$S_{i-1}+S_i$	$\frac{L_i}{(S_{i-1}+S_i)^2}$
	RD Miles	RD Kms.	RL Feet	RL m	L_i m	S_i m	m	km.² m
1	0.00	0.00	736	224.33	0.00	0.00	0.00	0.00
2	7.50	12.08	850	259.08	12.08	34.75	34.75	419.61
3	10.00	16.10	900	274.32	4.03	49.99	84.74	341.08
4	12.70	20.45	950	289.56	4.35	65.23	115.22	500.86
5	14.50	23.35	1000	304.80	2.90	80.47	145.70	422.24
6	21.00	33.81	1250	381.00	10.47	156.67	237.14	2481.67
7	25.60	36.00	1500	457.20	4.19	232.87	389.54	1630.61
8	24.00	38.64	1750	533.40	0.64	309.07	541.94	349.01
9	24.15	38.88	2000	609.60	0.24	385.27	694.34	167.68
10	24.30	39.12	2250	685.80	0.24	461.47	846.74	284.49
11	24.45	39.36	2500	762.00	0.24	537.67	999.14	241.29
							SUM	6758.54

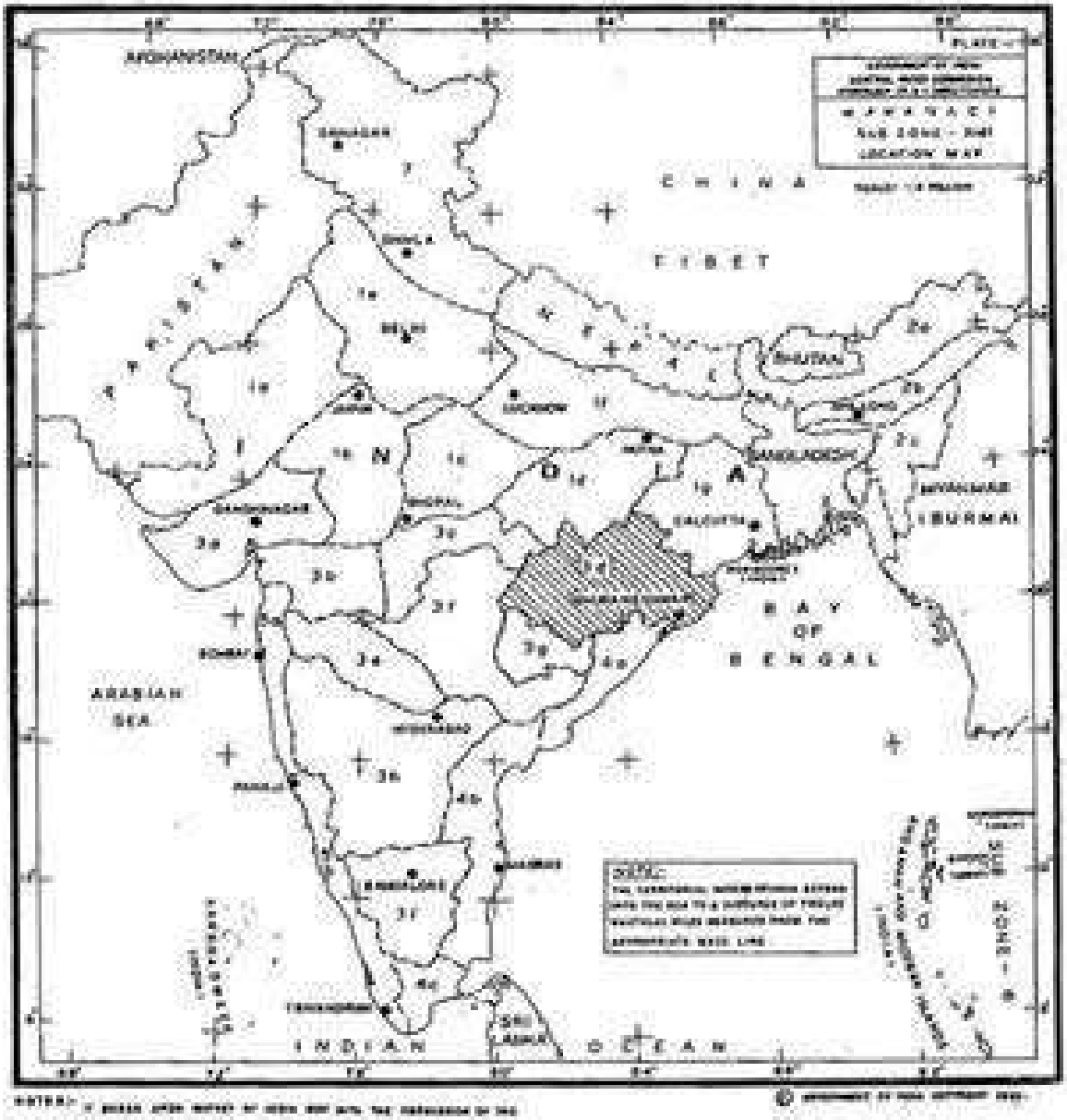
$$S = \frac{L_i * (S_{i-1} + S_i)}{L^2} = \frac{6758.54}{15449.56} = 4.36 \text{ m/km.}$$

DATUM = 736.00 m i.e R . L. of river bed at point of study

SUBZONE 3(a) ANNEXURE 3.4

COMPUTATION OF DESIGN FLOOD HYDROGRAPH OF BRIDGE CATCHMENT NO. 385

TIME (hrs)	U.G. ORDI-NATES	RAINFALL EXCESS IN Cm								TOTAL DRO IN CUMECS	BASE FLOW IN CUMECS	TOTAL FLOW IN CUMECS
		0.70	1.16	1.42	2.99	10.75	2.50	1.39	0.25			
		DIRECT RUNOFF (CUMECS)										
1	2	3	4	5	6	7	8	9	10	11	12	13
0	0.00	0.00								0.00	19.40	19.40
1	3.70	2.59	0.00							2.59	19.40	21.99
2	9.50	[illegible]	[illegible]	0.00						10.66	19.40	30.06
3	15.20	[illegible]	[illegible]	[illegible]	0.00					27.19	19.40	46.59
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00				[illegible]	19.40	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00			[illegible]	19.40	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00		[illegible]	19.40	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	[illegible]	19.40	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
28	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
29	0.00	0.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
			0.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
				0.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
					0.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
						0.00	[illegible]	[illegible]	[illegible]	[illegible]	19.40	[illegible]
							0.00	[illegible]	[illegible]	[illegible]	19.40	[illegible]
								0.00	[illegible]	[illegible]	19.40	[illegible]
									0.00	0.00	19.40	19.40


AFGHANISTAN
CHINA
TIBET
BHUTAN
BANGLADESH
MYANMAR
(BURMA)
BAY
OF
BENGAL
ARABIAN
SEA
INDIAN
OCEAN
SRI
LANKA
NOTE:

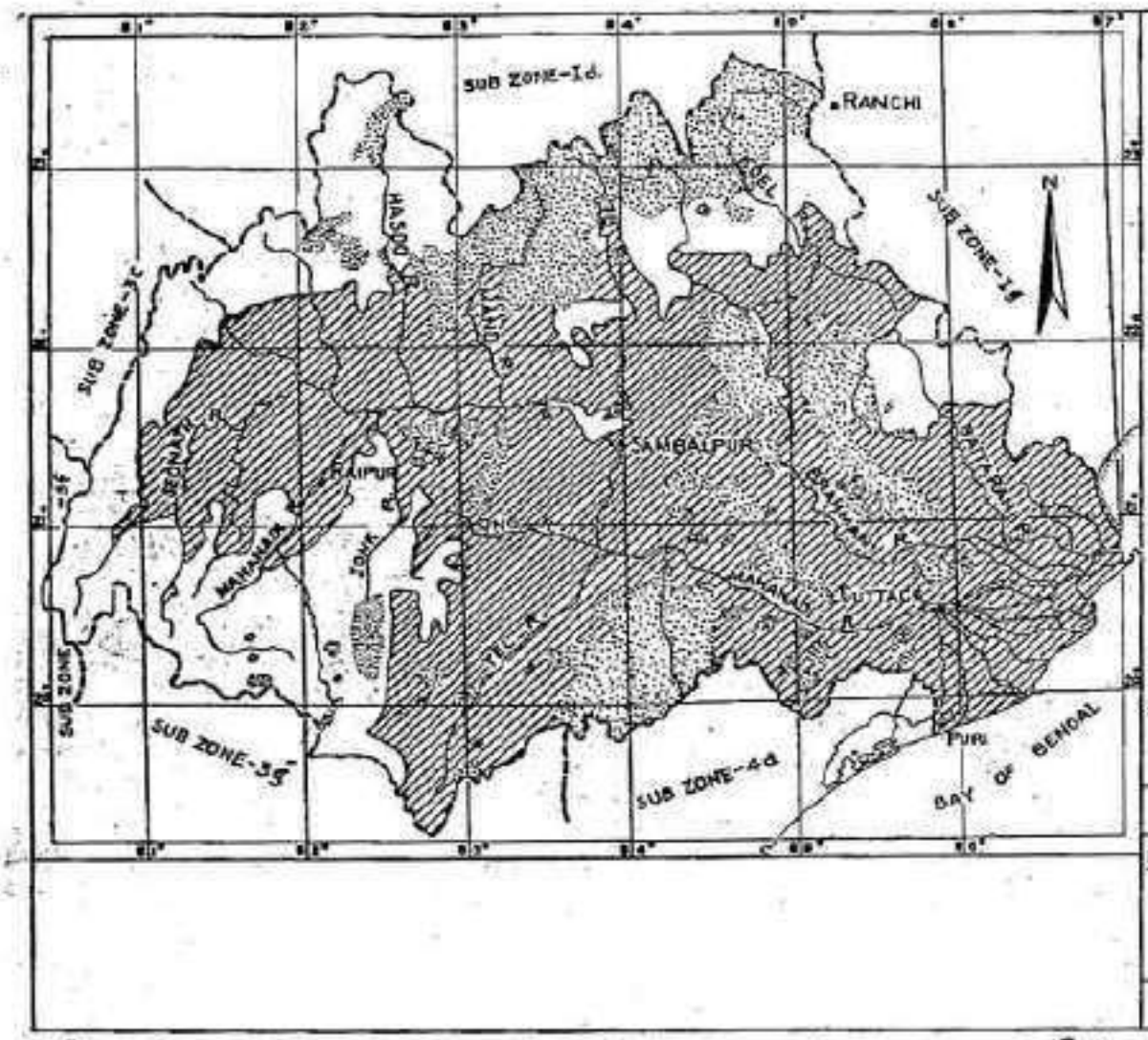


PLATE: 3

REFERENCES

1. EAST COAST .....
2. MOUNTAINS .....
3. GREAT PLAIN .....

NOTE

THIS HAS BEEN DRAWN FROM THE IRRIGATION ATLAS OF INDIA (1972) PLATE NO. 3.

SCALE

50 0 50 100 150
KILOMETRES

25 0 25 50 75 100
MILES

GOVERNMENT OF INDIA
CENTRAL WATER COMMISSION
HYDROLOGY (S.C) DIRECTORATE

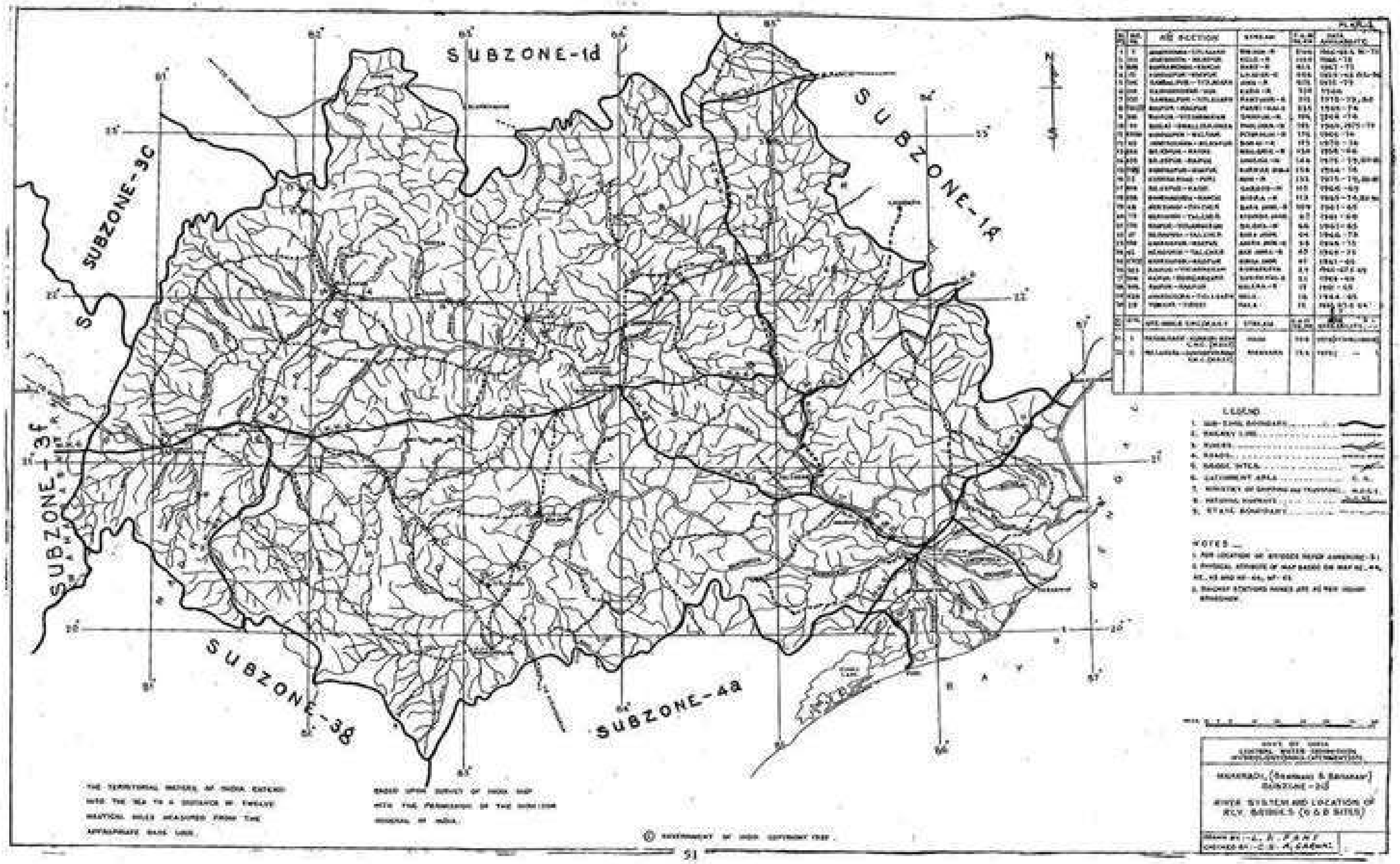
FLOOD ESTIMATION REPORT

MAHANADI SUB ZONE -3 d.

PHYSIOGRAPHY

DRAWN BY:	CHECKED BY:
L. K. PANT	K. K. SINGH

BASED UPON SURVEY OF INDIA MAP WITH THE PERMISSION OF THE SURVEYOR GENERAL OF INDIA.
THE TERRITORIAL WATERS OF INDIA EXTEND INTO THE SEA TO A DISTANCE OF TWELVE NAUTICAL MILES MEASURED FROM THE APPROPRIATE BASE LINE.


SUBZONE-1d
SUBZONE-1A
SUBZONE-3C
SUBZONE-3f
SUBZONE-3B
SUBZONE-4a
LEGEND
NOTES

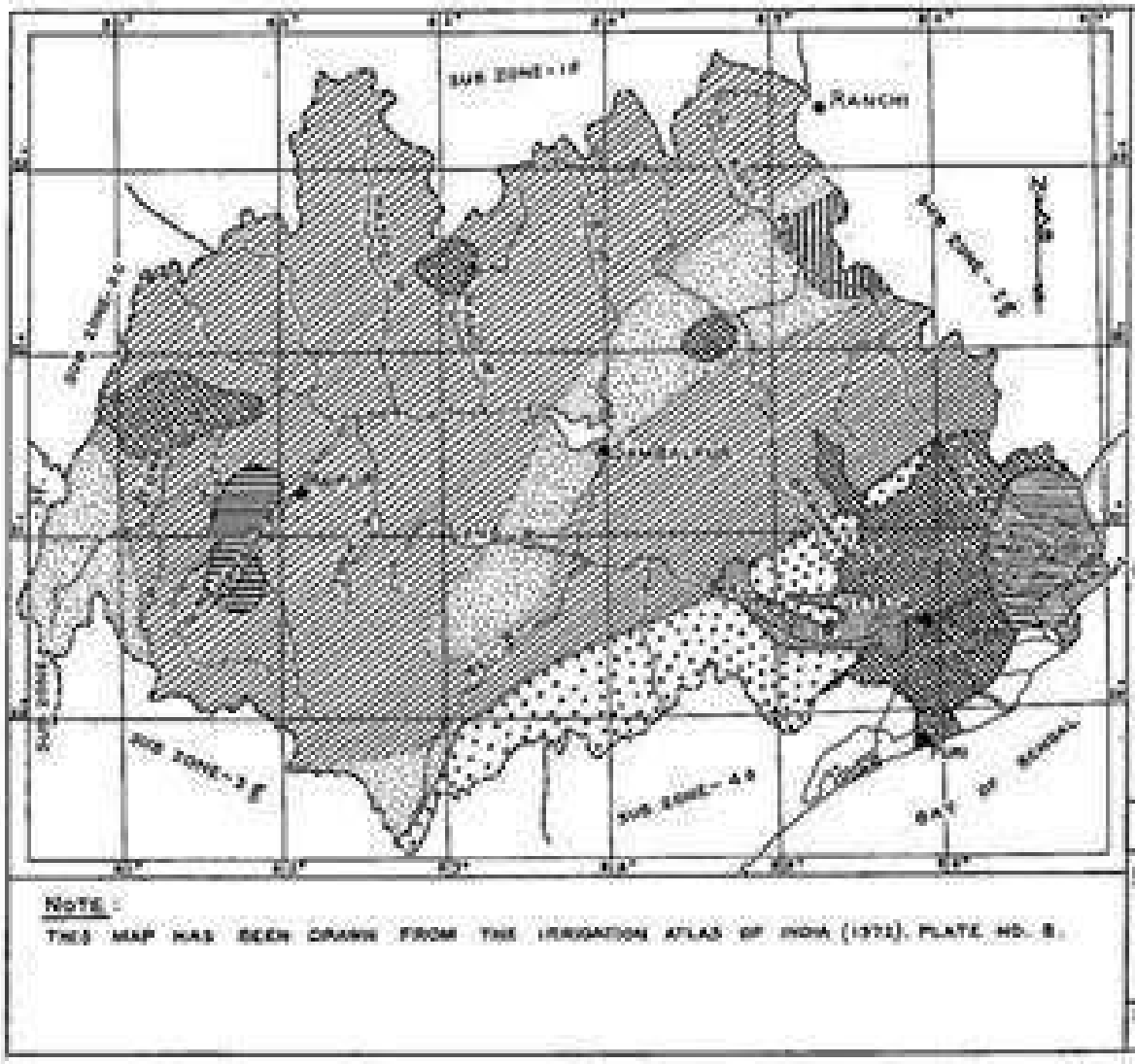


PLATE : 4

REFERENCES :

1. RED SANDY SOIL
2. RED LOAMY SOIL
3. RED & YELLOW SOIL
4. LATERITE SOIL
5. DEEP BLACK SOIL
6. DELTAIC ALLUVIAL SOIL
7. COASTAL SANDY SOIL
8. ALLUVIAL SOIL (RECENT)
9. MIXED RED AND BLACK SOIL
10. TOWNS

SCALE

50 0 50 100 150
KILOMETRES
25 0 25 50 75 100
MILES

GOVERNMENT OF INDIA
CENTRAL WATER COMMISSION
HYDROLOGY (S.C.) DIRECTORATE

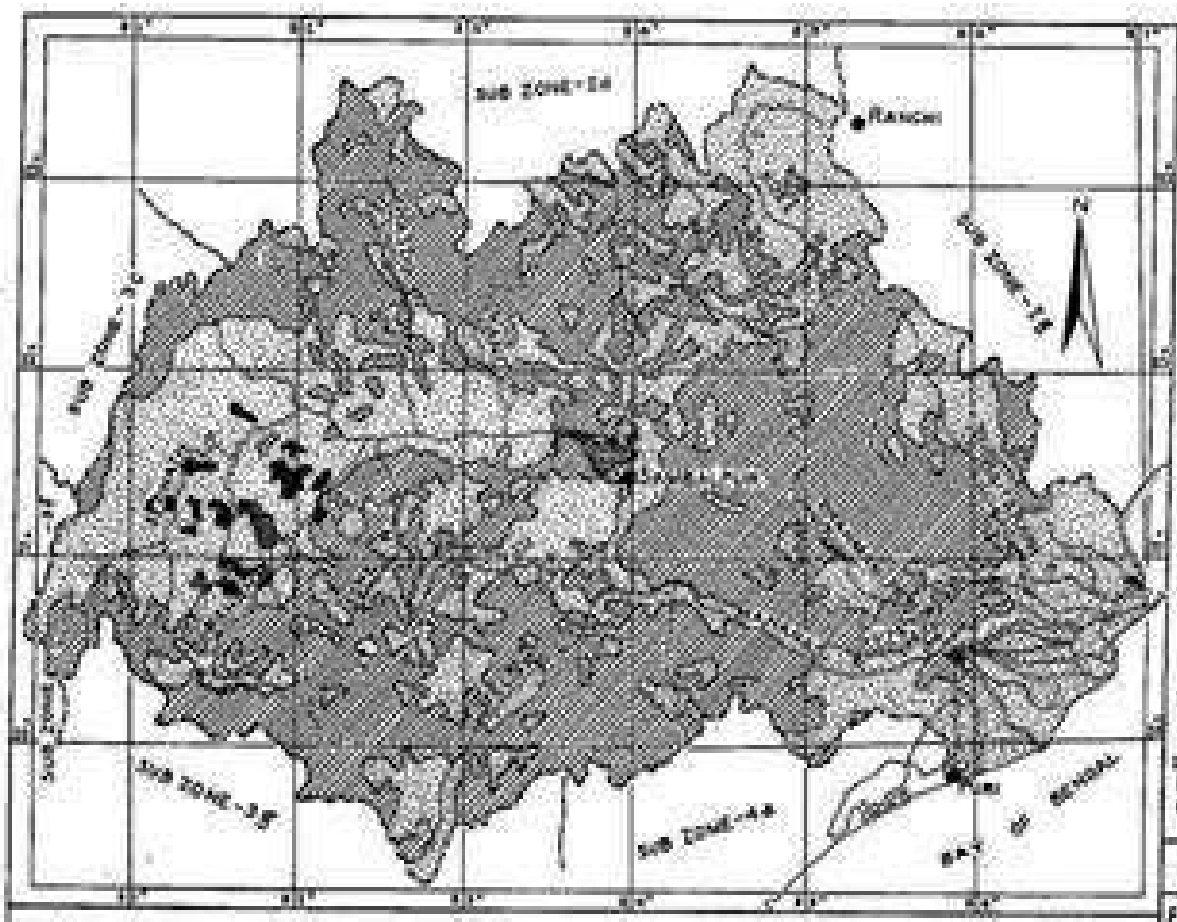
FLOOD ESTIMATION REPORT
MAHANADI SUB ZONE - 3E.

SOIL CLASSIFICATION

DRAWN BY: L. P. MAUTIYAL
CHECKED BY: K. N. ALAM

NOTE :-
THIS MAP HAS BEEN DRAWN FROM THE IRRIGATION ATLAS OF INDIA (1972), PLATE NO. 8.

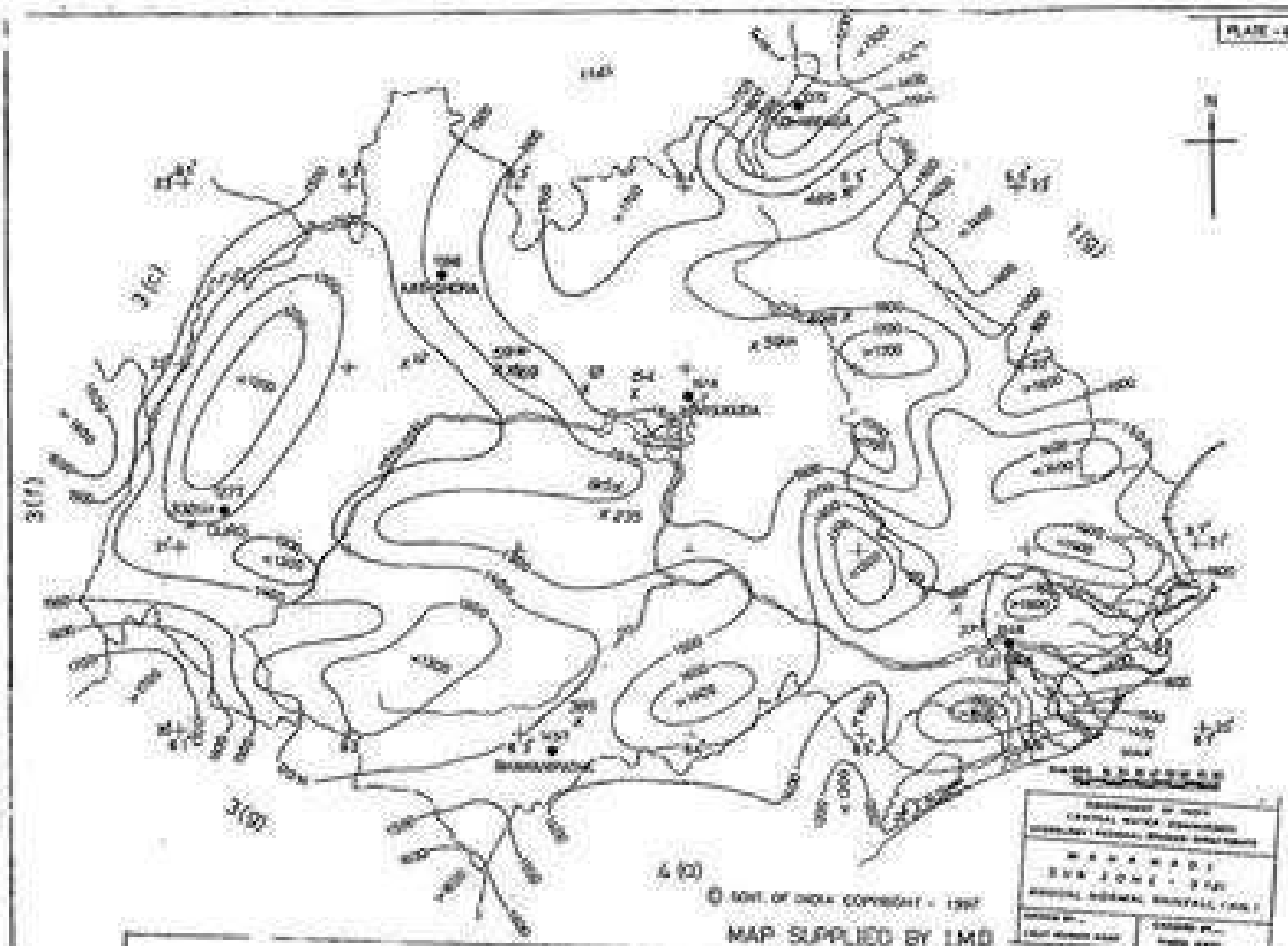
BASED UPON SURVEY OF INDIA MAP WITH THE PERMISSION OF THE SURVEYOR GENERAL OF INDIA.
THE TERRITORIAL WATERS OF INDIA EXTEND INTO THE SEA TO A DISTANCE OF TWELVE NAUTICAL MILES MEASURED FROM THE APPROPRIATE BASE LINE.

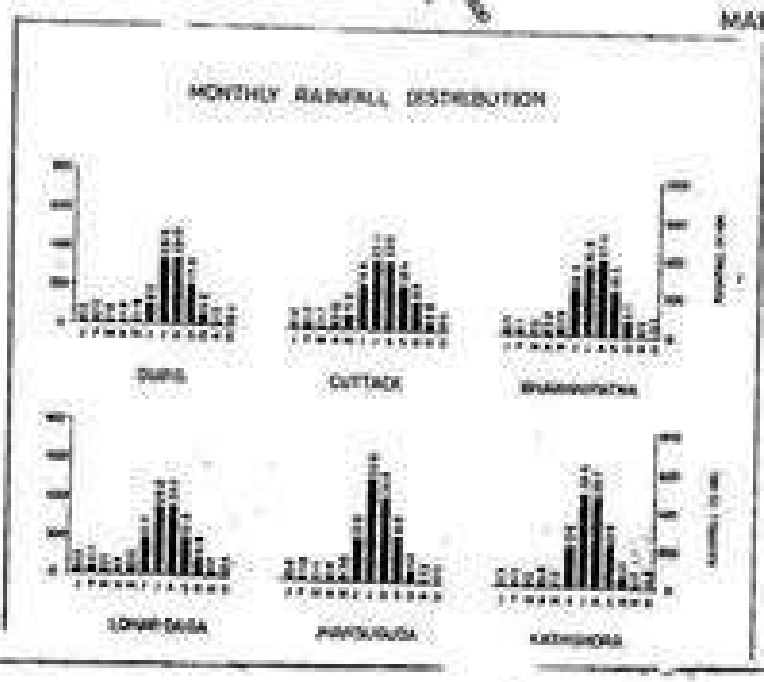


NOTE:
THIS MAP HAS BEEN DRAWN FROM THE IRRIGATION ATLAS OF INDIA. (1972) PLATE NO. 8.

BASED UPON SURVEY OF INDIA MAP WITH THE PERMISSION OF THE SURVEYOR GENERAL OF INDIA.
THE TERRITORIAL WATERS OF INDIA EXTEND INTO THE SEA TO A DISTANCE OF TWELVE NAUTICAL MILES MEASURED FROM THE APPROPRIATE BASE LINE.

PLATE - 4





REFERENCES

1. ISOHYETS IN MM (RAINFALL NORMAL)
2. SUBZONE BOUNDARY
3. TOWNS
4. RAILWAYS
5. BRIDGE SITES

NOTES

1. THE ALPHABETS ALONG ARGOSA INDICATE NAME OF HORIZON.
2. COLUMN HEIGHTS REPRESENT RAINFALL IN MM.
3. FIGURES ABOVE COLUMN INDICATE MONTHLY RAINFALL AS PERCENT OF ANNUAL RAINFALL.
4. RESPONSIBILITY FOR CORRECTNESS OF INTERNAL DETAILS SHOWN ON THE MAP RESTS WITH PUBLISHER.
5. BASED UPON SURVEY OF INDIA WITH PERMISSION OF THE SURVEYOR GENERAL OF INDIA.

THE TERRITORIAL WATERS OF INDIA EXTEND INTO THE SEA TO A DISTANCE OF TWELVE NAUTICAL MILES MEASURED FROM THE APPROPRIATE BASE LINE.

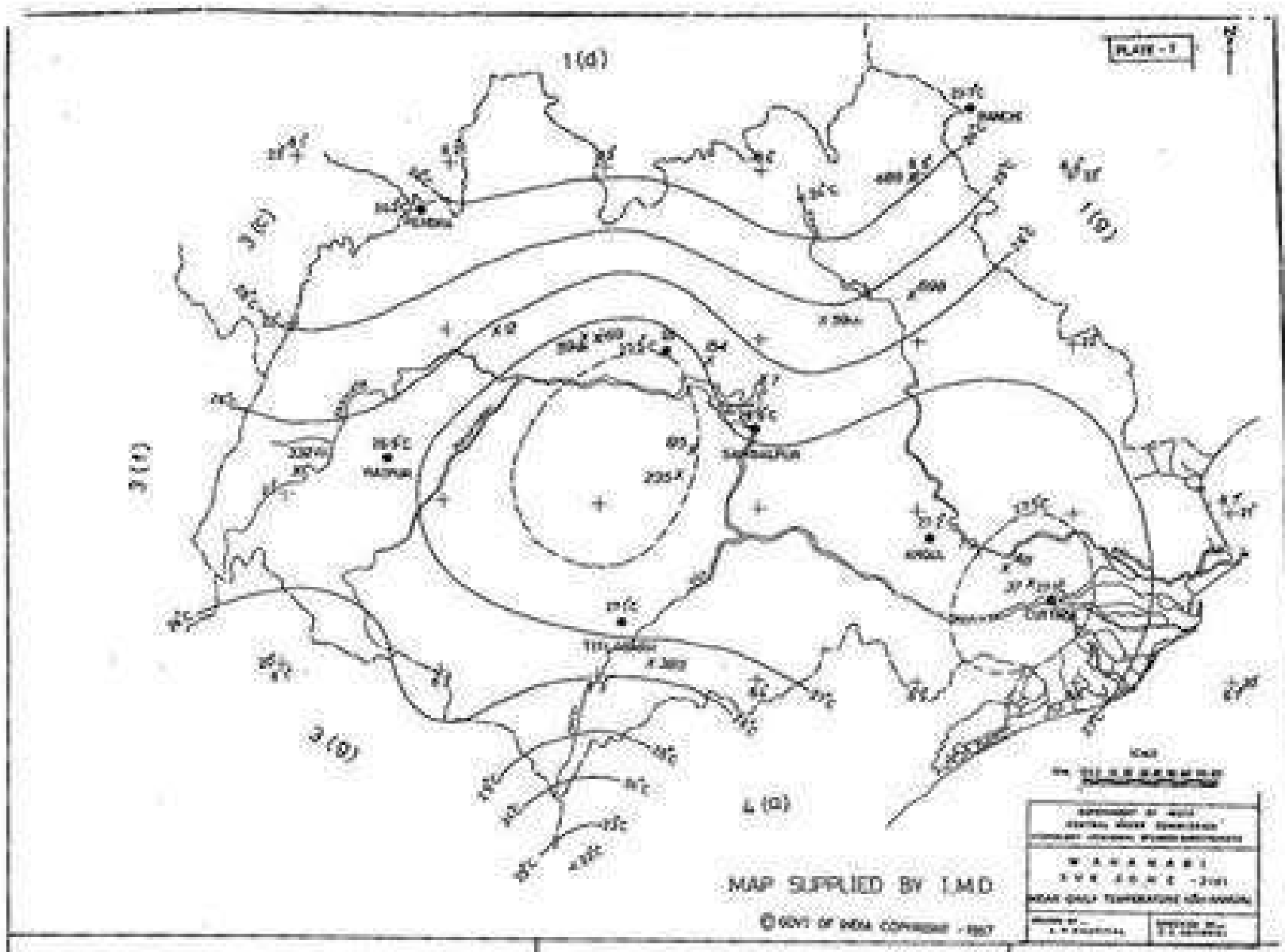


PLATE - 1
1 (d)
3 (c)
3 (b)
4 (a)
NAGPUR
RANCHI
SAMBALPUR
KHOLL
CUTTACK
MAP SUPPLIED BY I.M.D.
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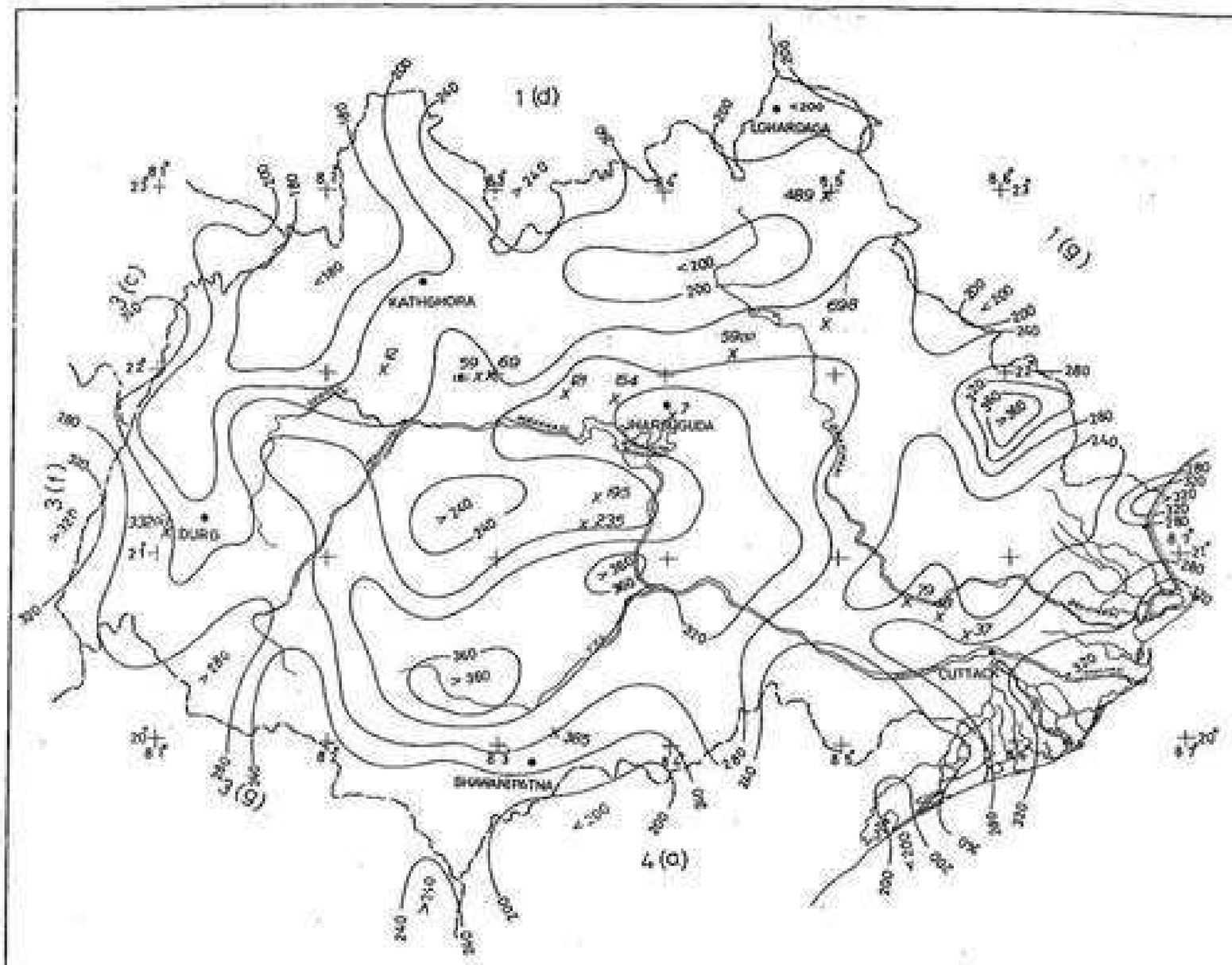
MONTHLY TEMPERATURE VARIATIONS
NAGPUR
PENDRA
RANCHI
SAMBALPUR
CUTTACK
REFERENCES
1. ISOTHERMS (DEGREES CELSIUS)
2. SUBZONE BOUNDARY
3. TOWNS
4. RIVERS
5. RAINGAUGE SITES
NOTES :-
1. RESPONSIBILITY FOR CORRECTNESS OF INTERNAL DETAILS SHOWN ON THE MAP RESTS WITH PUBLISHER.
2. BASED UPON SURVEY OF INDIA MAP WITH PERMISSION OF THE SURVEYOR GENERAL OF INDIA.
THE TERRITORIAL WATERS OF INDIA EXTEND INTO SEA TO A DISTANCE OF TWELVE NAUTICAL MILES MEASURED FROM THE APPROPRIATE BASE LINE.

PLATE - 8



REFERENCES

1. SUBZONE BOUNDARY
2. ISOPLUVIALS
3. TOWNS
4. RIVERS
5. BRIDGE SITES

NOTES

1. FOR LOCATION OF BRIDGE SITES REFERRING 3.1
2. ISOPLUVIAL VALUES OF THIS MAP BASED ON MAP NO. 1C, 1D, 1E, 1F AND 3F, 3G, 4C, 4D
3. THE SYMBOLS + AND X INDICATE THAT RAINFALL VALUE HIGHER THAN TO BE INDICATED INCREASED BY 10 mm

SCALE

0 10 20 30 40 50 60 70 80

NOTE...

ISOPLUVIALS SUPPLIED BY IMD

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CENTRAL WATER COMMISSION
HYDROLOGY (REGIONAL STUDIES) DIRECTORATE

MAHANADI
SUB ZONE - 3 (d)
25 YEAR 24-HOUR RAINFALL (mm)

DRAWN BY ... L. N. RAO

CHECKED BY ... B.K. BISH

THE TERRITORIAL WATERS OF INDIA EXTEND INTO THE SEA TO A DISTANCE OF TWELVE NAUTICAL MILES MEASURED FROM THE APPROPRIATE BASE LINE.

BASED UPON SURVEY OF INDIA MAP WITH THE PERMISSION OF THE SURVEYOR GENERAL OF INDIA

RESPONSIBILITY FOR CORRECTNESS OF INTERNAL DETAILS SHOWN ON THE MAP REMS WITH PUBLISHER

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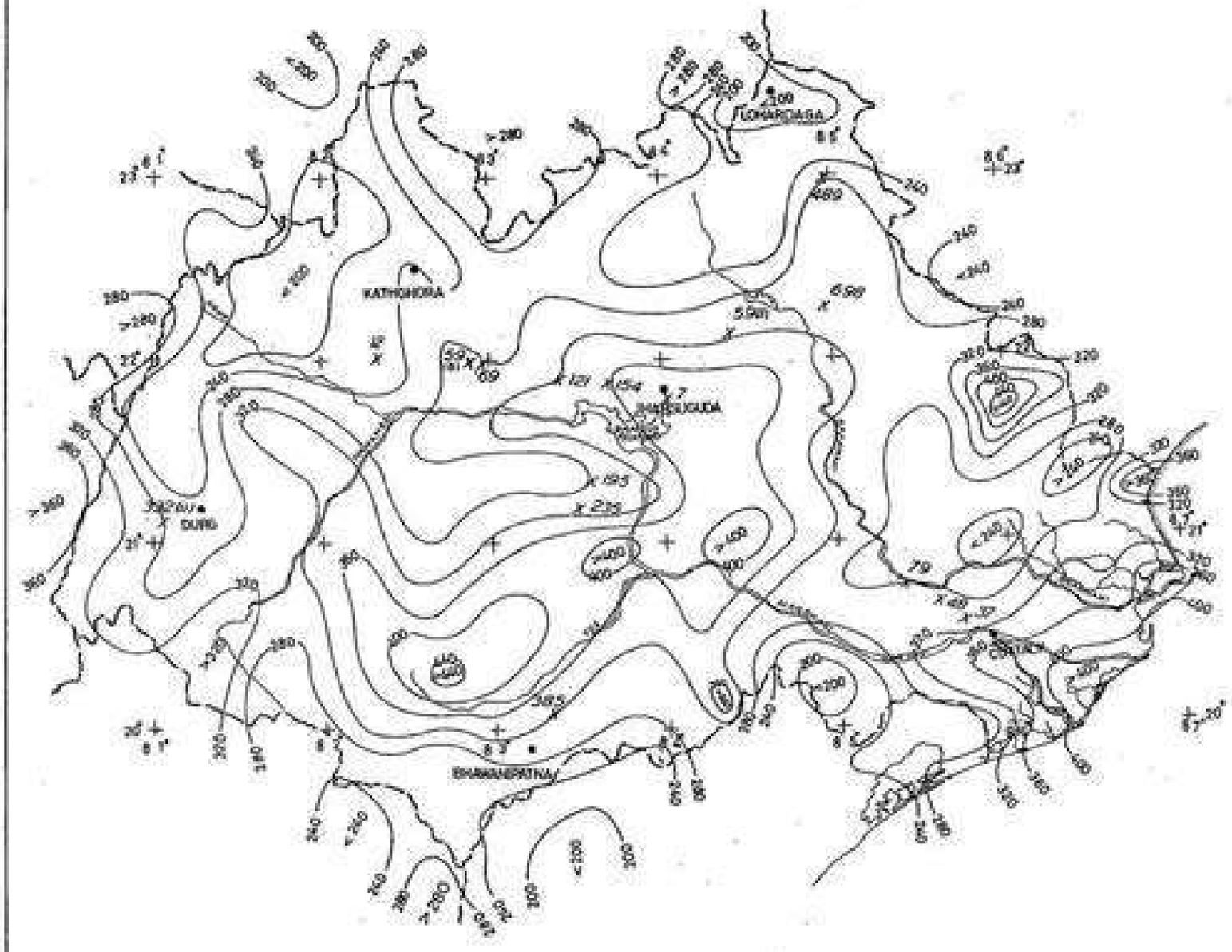
PLATE-9



THE TERRITORIAL WATERS OF INDIA EXTEND INTO THE SEA TO A DISTANCE OF TWELVE NAUTICAL MILES MEASURED FROM THE APPROPRIATE BASE LINE.

BASED UPON SURVEY OF INDIA MAP WITH THE PERMISSION OF THE SURVEYOR GENERAL OF INDIA

RESPONSIBILITY FOR CORRECTNESS OF INTERNAL DETAILS SHOWN ON THE MAP RESTS WITH PUBLISHER.

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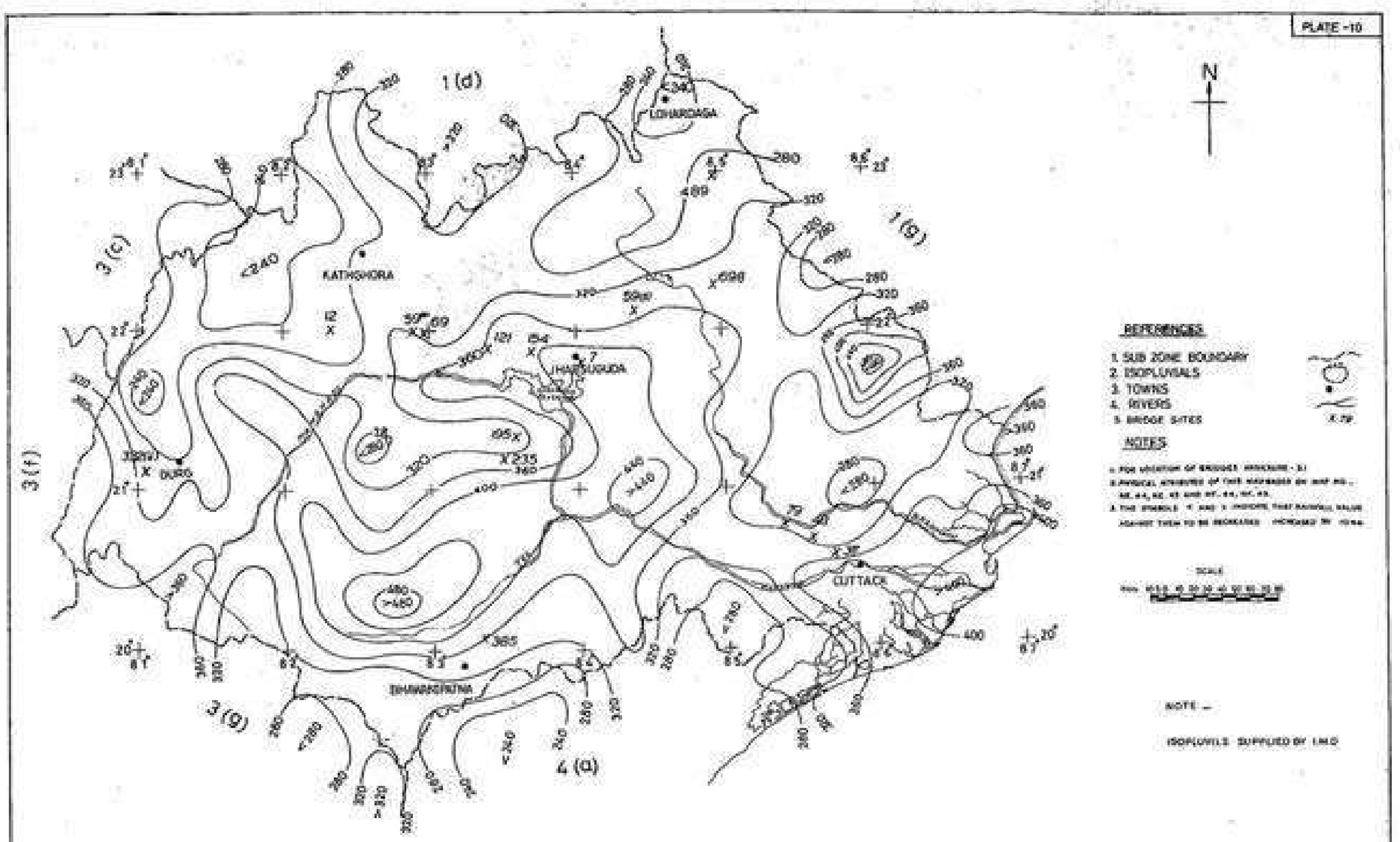
CENTRAL WATER COMMISSION
HYDROLOGY (REGIONAL STUDIES) DIRECTORATE

MAHANADI
SUB ZONE - 3(d)
50 - YEAR 24-HOUR RAINFALL (MM)

DRAWN BY... L.P. BASTIYAL

CHECKED BY... YADAV RAM

PLATE -10



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CENTRAL WATER COMMISSION
HYDROLOGY (REGIONAL STUDIES) DIRECTORATE

MAHANADI
SUB ZONE - 3 (d)
100 YEAR 24-HOUR RAINFALL (mm)

DRAWN BY — LALIT KUMAR PANT

CHECKED BY — VINOD RAINA

THE TERRITORIAL WATERS OF INDIA EXTEND INTO THE SEA TO A DISTANCE OF TWELVE NAUTICAL MILES MEASURED FROM THE APPROPRIATE BASE LINE.

THIS MAP IS UNDER SURVEY OF INDIA MAP WITH THE PERMISSION OF THE SURVEYOR GENERAL OF INDIA

RESPONSIBILITY FOR CORRECTNESS OF INTERNAL DETAILS SHOWN ON THE MAP RESTS WITH PUBLISHER

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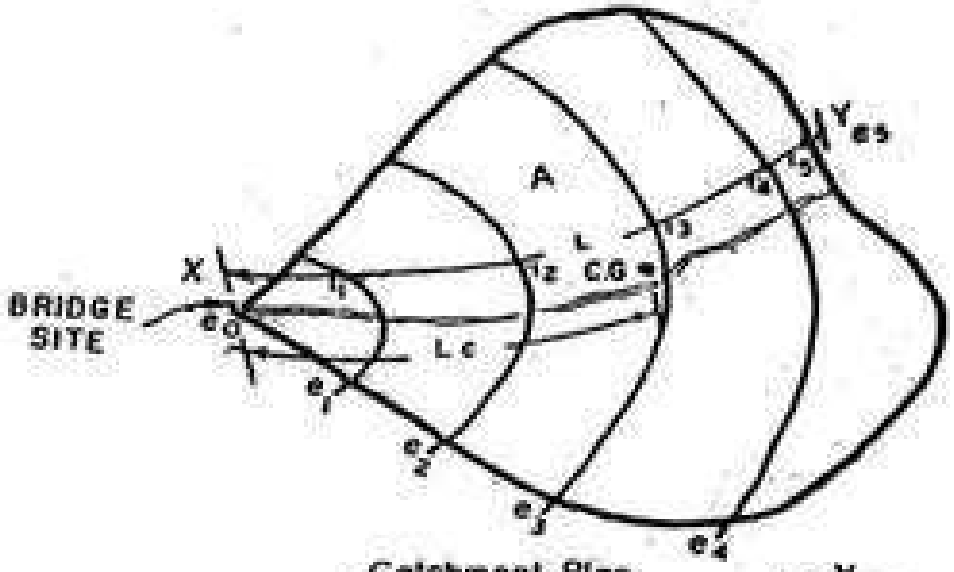
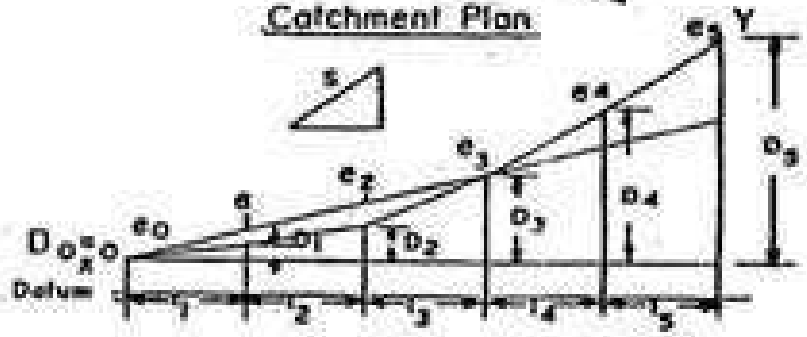
FIG. 1



Catchment Plan



L - Section

$$S = \frac{\sum_{i=1}^{n} [(e_i + e_{i-1}) l_i]}{L^2}$$

where S = Equivalent stream slope (m/km)
L = Length of longest stream course (km)
$l_i = l_1, l_2, l_3, \ldots l_n$ = Segment lengths (km)
$e_i = e_1, e_2, \ldots e_n$ = contour elevation (m)
$D_i = D_0, D_1, D_2, \ldots D_n$
$= [(e_0 + e_0), (e_1 + e_0), (e_2 + e_0) \ldots (e_n + e_0)]$ (m)

A = Catchment area (km²)

Lc = Length of longest stream course from a point opposite the centre of gravity of the catchment to the point of study (Km.)

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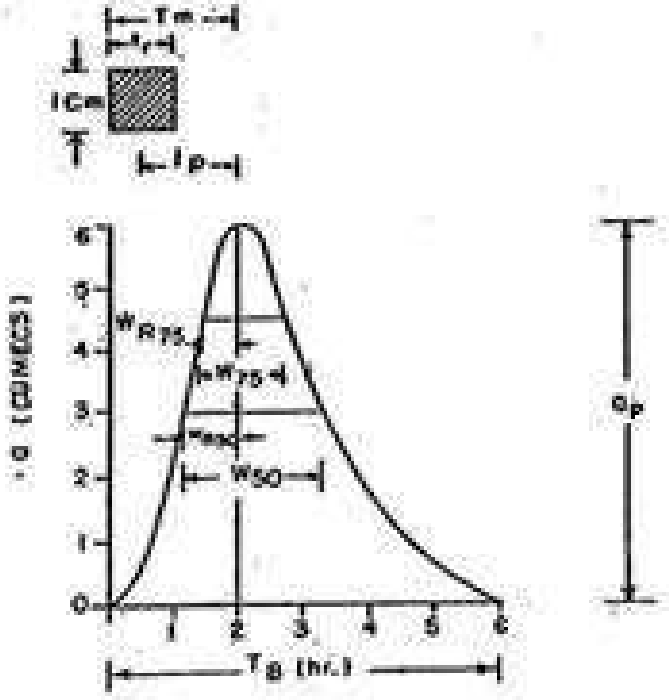
PHYSIOGRAPHIC PARAMETERS

DRAWN L.P. NAUTIYAL | CHECKED C.S. AGARWAL

FIG. - 2



U.G. = Unit Graph

T_r = Unit Rainfall Duration adopted in a specific study (hr.)

T_m = Time from the start of rise to the peak of the U.G (hr.)

Q_p = Peak Discharge of Unit Hydrograph (cumecs)

t_p = Time from the centre of effective rainfall duration to the U.G peak (hr.)

W_{50} = Width of the U.G. measured at 50% of peak discharge ordinate (hr.)

W_{75} = Width of the U.G measured at 75% of peak discharge ordinate (hr.)

W_{R50} = Width of the rising limb of U.G. measured at 50% of peak discharge ordinate (hr.)

W_{R75} = Width of the rising limb of U.G. measured at 75% of peak discharge ordinate (hr.)

T_B = Base width of Unit Hydrograph (hr.)

A = Catchment Area (Sq. km.)

$q_p = Q_p / A$ = Cumec per sq. km.

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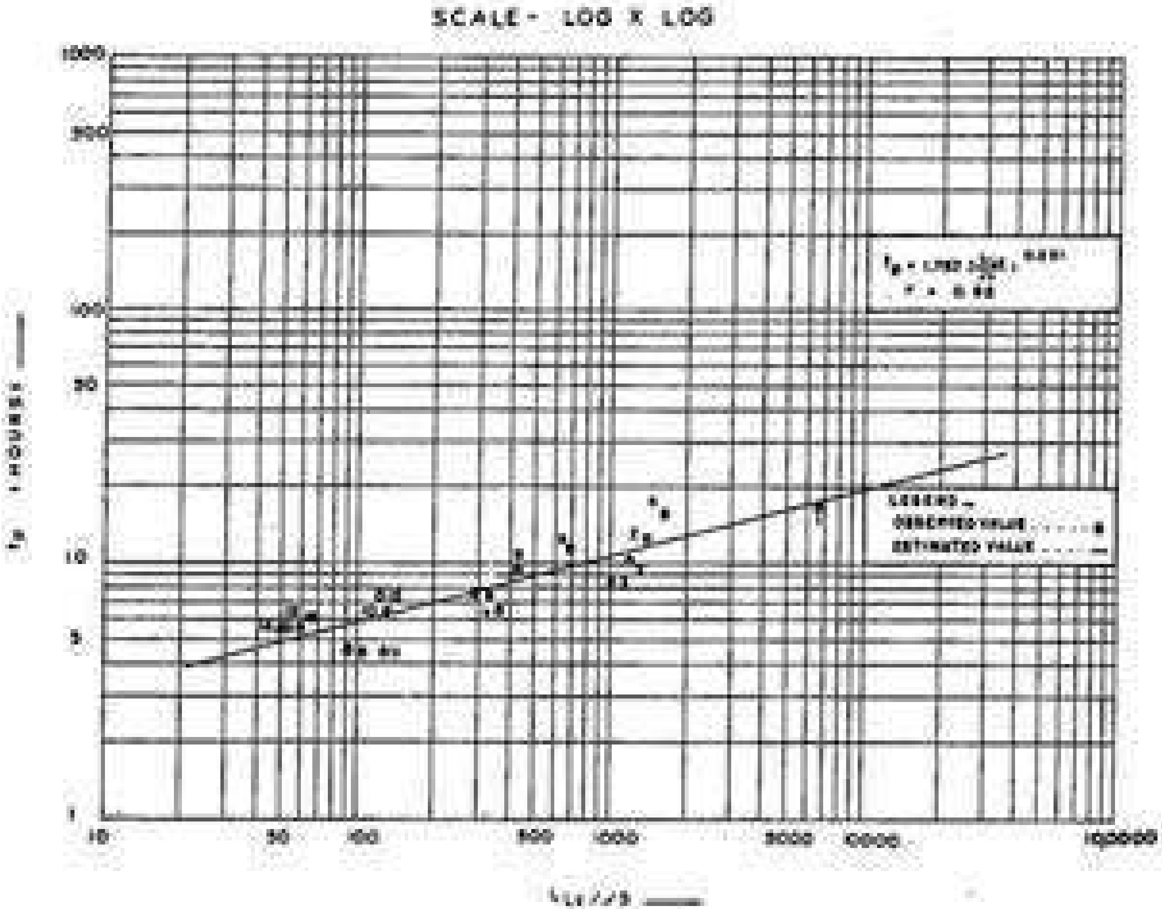
UNIT GRAPH PARAMETERS	
DRAWN BY. L.K. PANT	CHECKED BY. C.S. AGARWAL

FIG. — 3.



Sl. no.	Bridge No.	$\frac{L L_c}{\sqrt{S}}$	t_p Hours	
			Obs. Value	Est. Value
1	7	[illegible]	[illegible]	[illegible]
2	121	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]
4	18	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]
15	[illegible]	[illegible]	[illegible]	[illegible]
16	[illegible]	[illegible]	[illegible]	[illegible]

GOVERNMENT OF INDIA
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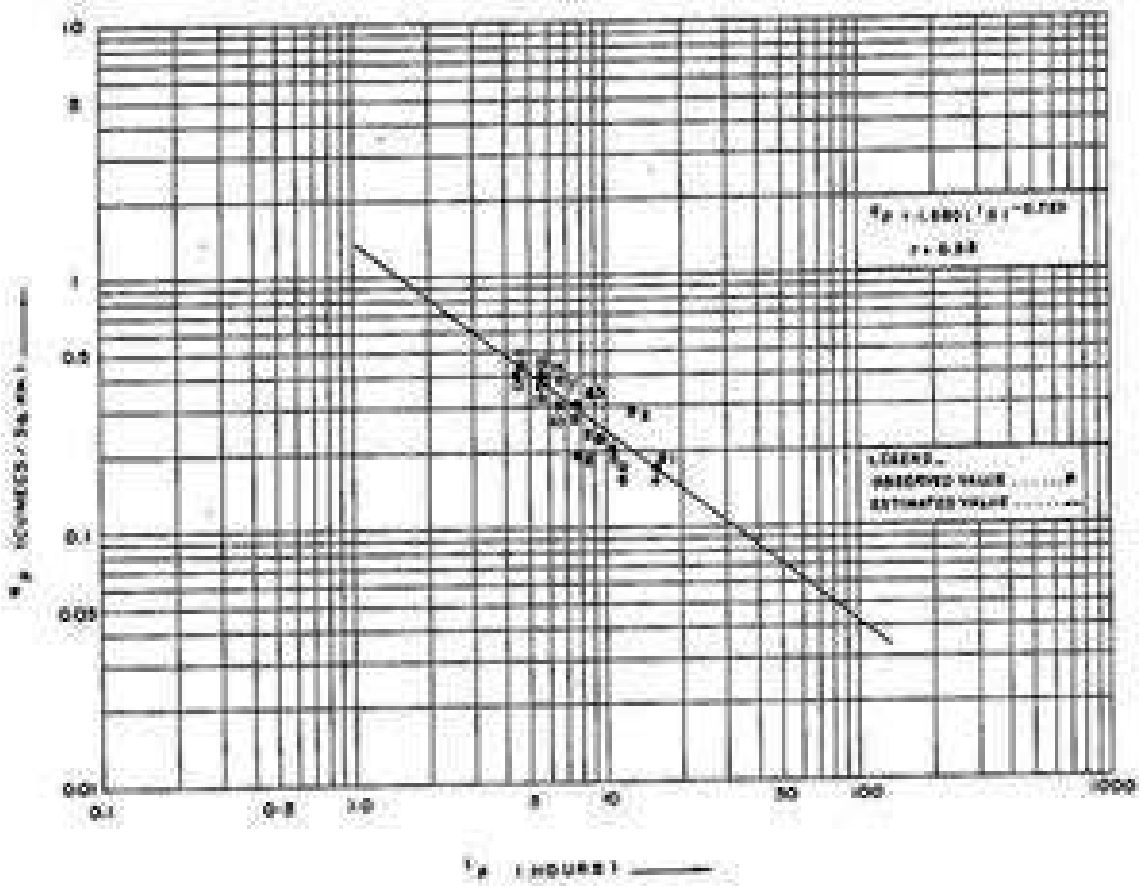
MAHANADI
SUBZONE - 3(d)
RELATION BETWEEN
$L L_c/\sqrt{S}$ AND t_p

DRAWN BY —	CHECKED BY —
L.P. NAUTIYAL	[illegible]

FIG. — A.

SCALE = LOG X LOG



Sl. No.	Gauge No.	^{T}p Hours	^{q}p Cumec/Sq.mi. Observed value	^{q}p Cumec/Sq.mi. Estimated value
1	[illegible]	16.00	0.14	0.14
2	[illegible]	12.00	0.25	0.20
3	[illegible]	8.00	0.33	0.27
4	[illegible]	16.00	0.17	0.17
5	[illegible]	12.00	0.20	0.25
6	[illegible]	11.00	0.17	0.21
7	[illegible]	6.00	0.24	0.25
8	[illegible]	7.00	0.20	0.25
9	[illegible]	5.00	0.25	0.25
10	[illegible]	6.00	0.20	0.25
11	[illegible]	4.00	0.14	0.14
12	[illegible]	7.00	0.14	0.25
13	[illegible]	4.00	0.41	0.42
14	[illegible]	3.00	0.33	0.37
15	[illegible]	3.00	0.43	0.37
16	[illegible]	3.00	0.37	0.37

GOVERNMENT OF INDIA
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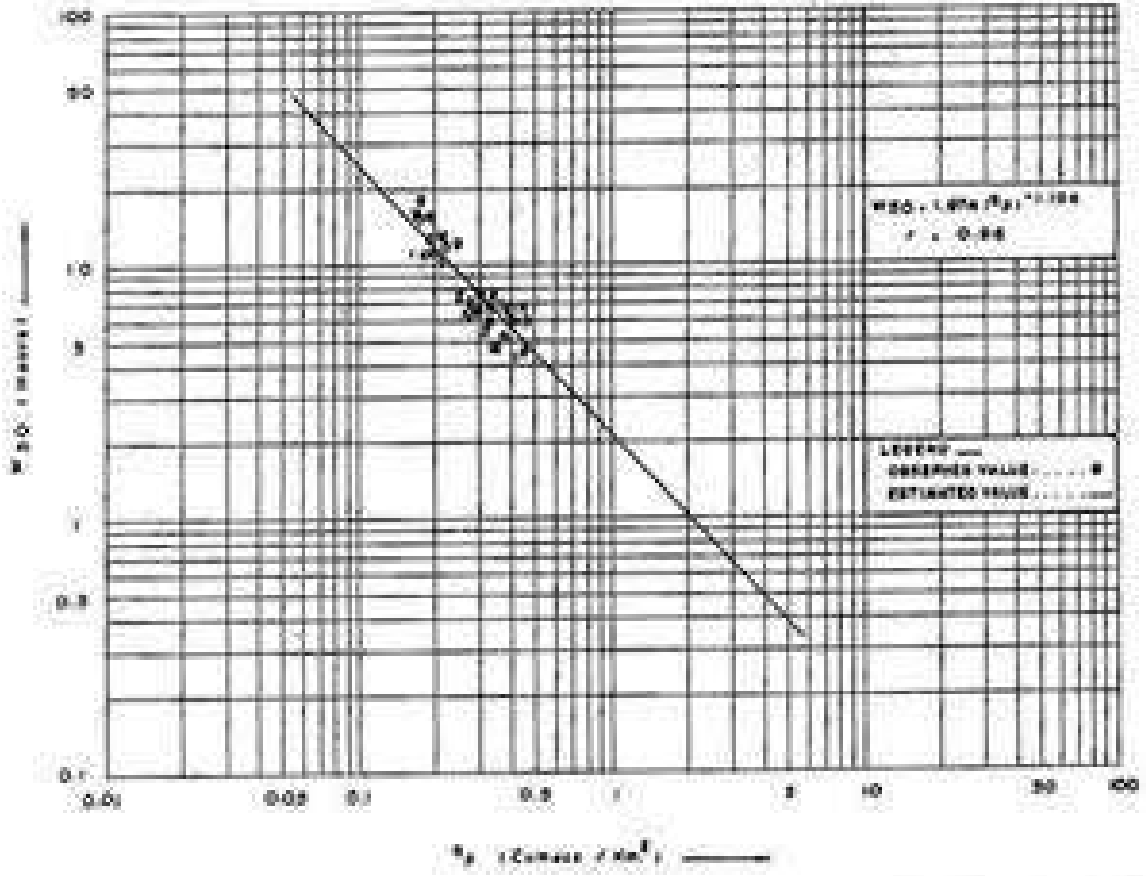
HYDROLOGY (REGIONAL STUDIES) SYS.

MAHANADI
SUB ZONE - 3 (a)
RELATION BETWEEN
^{T}p AND ^{q}p

DRAWN BY :- L. P. KAUTIYAL
CHECKED BY :- C. D. AGARWAL

FIG. — 5.

SCALE - LOG X LOG



Sl. No.	Bridge No.	R_d (Cusecs / Km²)	M_{50} (Hours) Observed Value	M_{50} (Hours) Estimated Value
1	1	0.180	10.51	13.18
2	131	0.280	7.00	8.08
3	488	0.350	6.00	6.78
4	18	0.170	18.00	13.87
5	188	0.200	11.00	11.88
6	838	0.170	16.00	13.87
7	2551(1)	0.380	8.00	6.78
8	848	0.300	7.75	7.48
9	88	0.280	11.70	10.81
10	851(2)	0.300	6.00	7.48
11	848	0.450	4.00	4.89
12	48	0.190	12.00	12.58
13	78	0.410	5.15	5.89
14	57	0.380	8.07	6.78
15	184	0.400	5.41	5.41
16	851(3)	0.570	3.50	3.63

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M A H A N A D I
SUB ZONE - 3 (a)
RELATION BETWEEN
R_d AND M_{50}

DRAWN BY — L. P. KAUSHAL
CHECKED BY — C. S. AGARWAL

SCALE - LOG. X LOG.

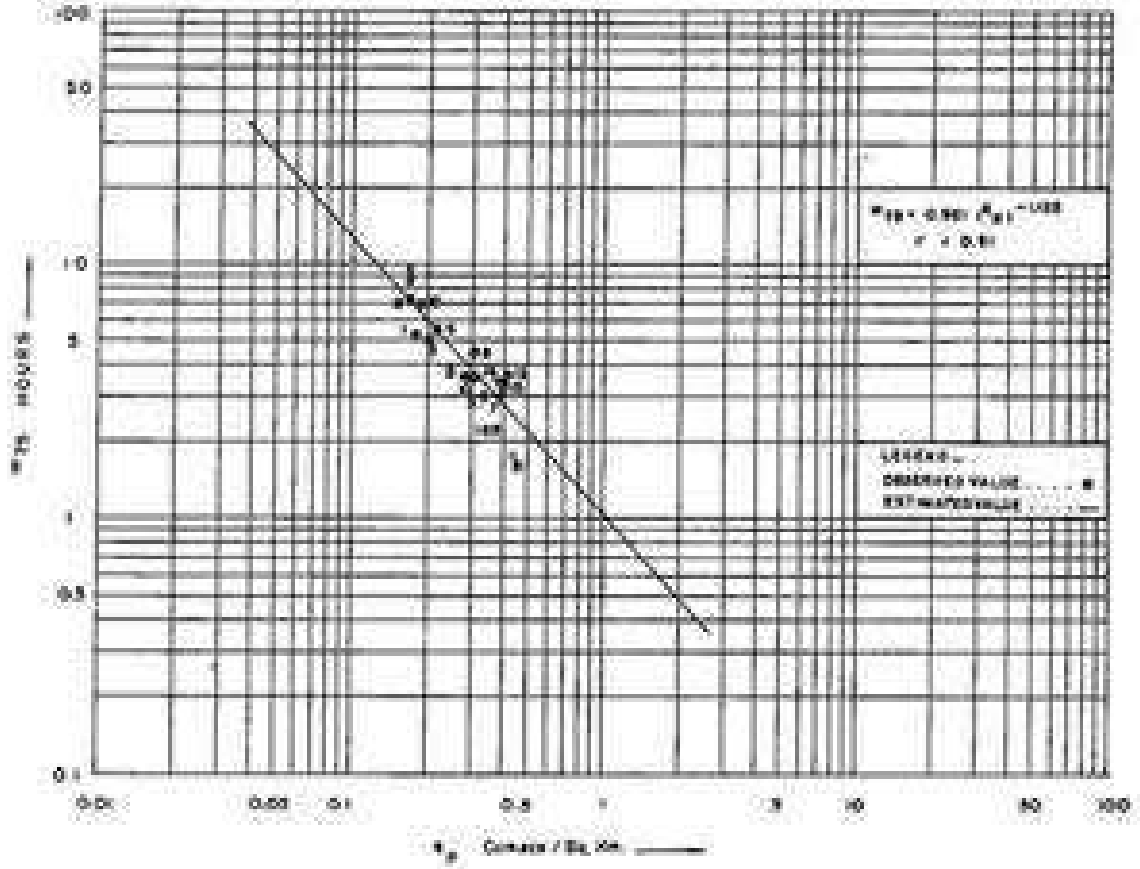


FIG - 6.

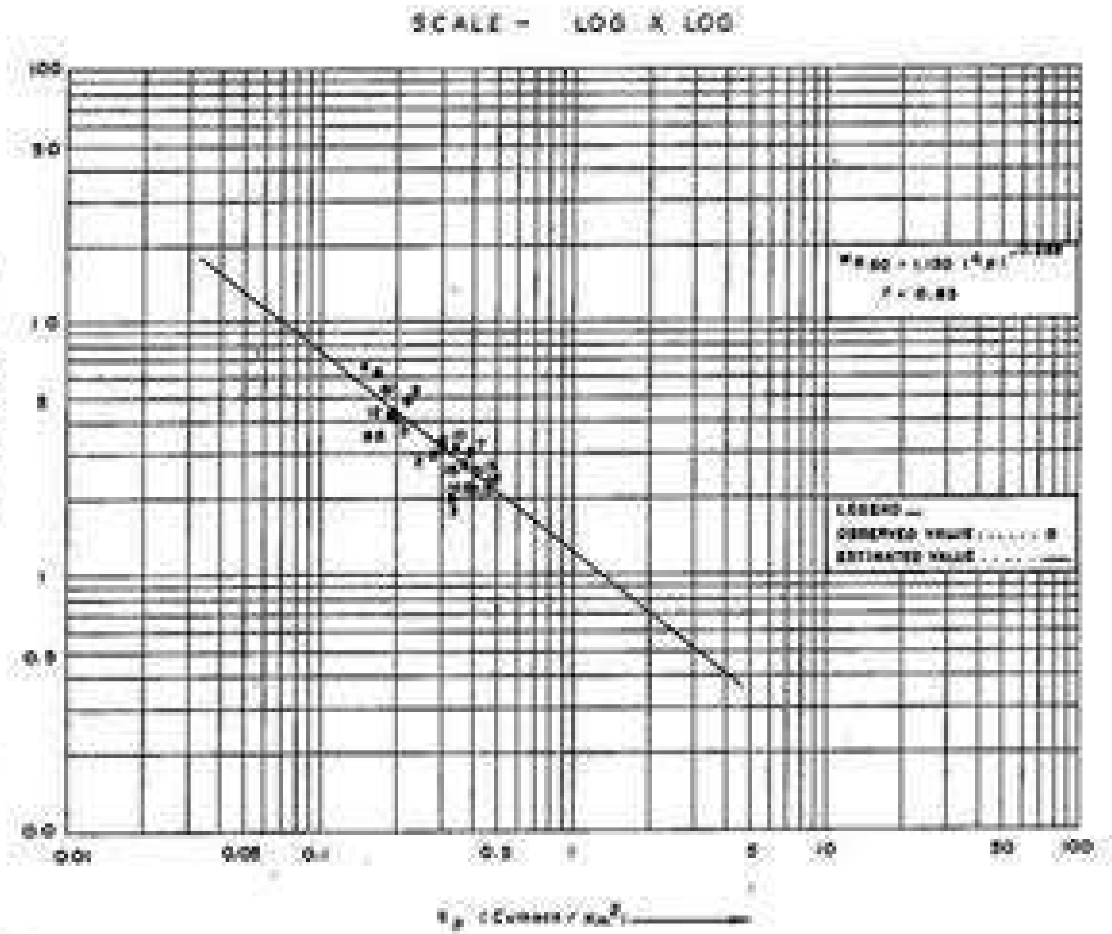
SL. NO.	GAUGE NO.	P_{24} CUM./SQ.KM.	P_{72} HOURS	
			OBS. VALUE	EST. VALUE
1	7	0.18	0.25	0.26
2	151	0.28	2.50	2.03
3	489	0.35	3.00	3.35
4	12	0.17	8.50	7.06
5	198	0.20	5.00	7.40
6	259	0.17	7.30	7.06
7	352 (1)	0.25	2.21	2.84
8	385	0.30	4.20	3.75
9	86	0.22	2.25	2.26
10	89 (2)	0.20	2.48	2.75
11	498	0.48	1.80	2.30
12	48	0.18	2.00	2.22
13	78	0.41	2.76	2.68
14	97	0.38	2.40	2.58
15	156	0.49	2.28	2.48
16	88 (3)	0.37	2.20	2.44

GOVERNMENT OF INDIA
CENTRAL WATER COMMISSION
HYDROLOGY (REGIONAL STUDIES) OTE.

MAHANADI
SUB ZONE - 3 (d)
RELATION BETWEEN
P_{24} AND P_{72}

DRAWN BY :- L.S. PANT
CHECKED BY :- S.S. AGARWAL

FIG. — 7.



Sl. No.	Bridge No.	q_p (Cumecs/Km^2)	W_{R50} (Hours) Obs. Value	W_{R50} (Hours) Esti. Value
1	7	0.180	5.17	4.77
2	151	0.260	3.00	3.30
3	[illegible]	0.330	3.00	3.88
4	12	0.170	5.10	5.00
5	195	0.200	4.06	4.27
6	[illegible]	0.170	[illegible]	5.00
7	332(ii)	0.380	3.00	2.88
8	[illegible]	0.300	3.28	3.18
9	88	0.320	4.27	4.08
10	[illegible]	0.300	3.40	3.18
11	[illegible]	0.480	2.88	2.18
12	48	0.180	4.50	4.88
13	78	0.610	2.60	2.61
14	37	0.380	2.80	3.38
15	134	0.400	2.60	2.48
16	[illegible]	0.370	2.70	3.22

GOVERNMENT OF INDIA
CENTRAL WATER COMMISSION
HYDROLOGY (REGIONAL STUDIES) DTE.

MAHANADI
SUB ZONE – 3 (d)
RELATION BETWEEN
q_p AND W_{R50}

DRAWN BY — L.K. PANT
CHECKED BY — S.S. AGARWAL

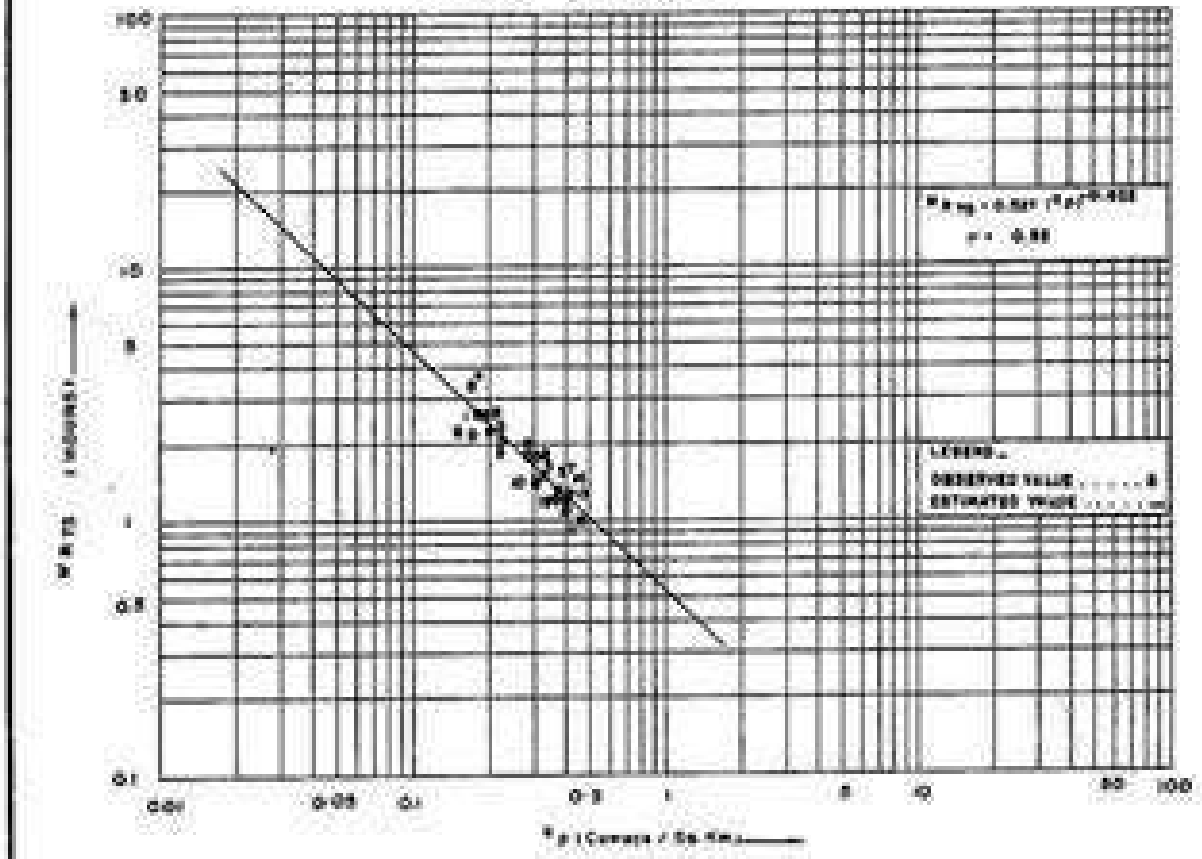


FIG. 8

Sl. No	Bridge No.	q_p (cms/sq.km)	W_{Rp} (HOURS)	
			OBS. VALUE	EST. VALUE
1	7	0.280	2.60	2.60
2	181	0.250	1.80	1.78
3	489	0.330	1.50	1.48
4	18	0.170	2.40	2.78
5	183	0.285	2.30	2.35
6	230	0.170	2.10	2.78
7	238 (D)	0.260	1.60	1.50
8	280	0.300	1.80	1.68
9	99	0.280	2.10	2.16
10	5(B)	0.300	1.30	1.60
11	280	0.460	1.00	1.00
12	40	0.180	2.80	2.40
13	70	0.410	1.67	1.61
14	87	0.380	1.30	1.30
15	199	0.400	1.20	1.24
16	86 (B)	0.370	1.20	1.35

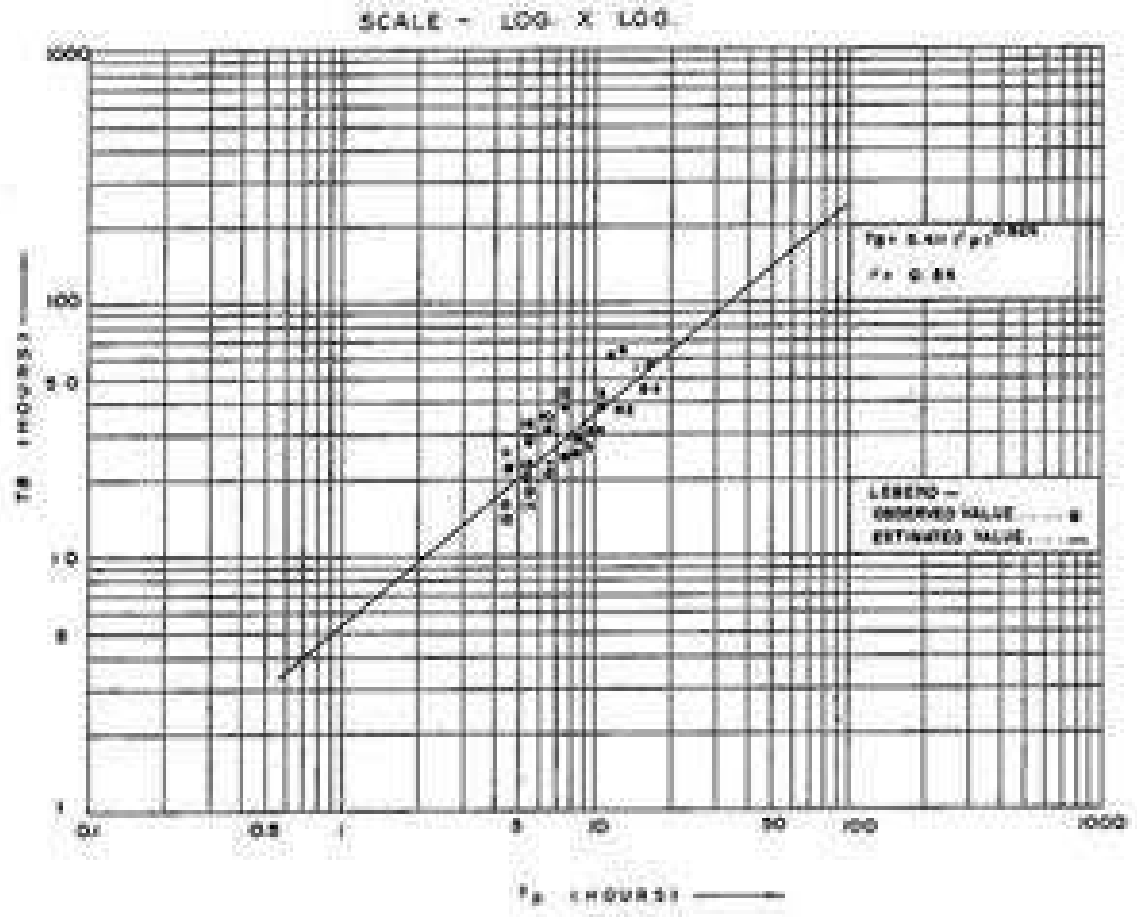
GOVERNMENT OF INDIA
CENTRAL WATER COMMISSION
HYDROLOGY (REGIONAL STUDIES) DTE.

MAHANADI
SUBZONE - 3(a)
RELATION BETWEEN
q_p AND W_{Rp}

DRAWN :- L. K. PANT

CHECKED :- G.S. AGARWAL

FIG - 9



Sr. No.	Bridge No	T_p Hours	T_B Hours	
			Observed Value	Estimated Value
1	7	16.50	37.00	34.77
2	121	16.50	37.00	43.55
3	488	8.50	28.00	31.47
4	15	15.50	46.00	38.01
5	195	10.00	36.00	37.71
6	258	11.50	41.00	40.85
7	252 (1)	8.50	41.00	35.38
8	286	7.50	24.00	25.56
9	66	8.50	31.00	34.72
10	36 (B)	8.50	31.00	26.26
11	498	4.50	23.00	18.73
12	48	7.50	26.00	26.86
13	7.8	4.50	14.00	18.75
14	37	5.50	18.00	22.11
15	184	5.50	20.00	22.11
16	90 (B)	5.50	26.00	22.11

GOVERNMENT OF INDIA
CENTRAL WATER COMMISSION
HYDROLOGY (REGIONAL STUDIES) DTE.

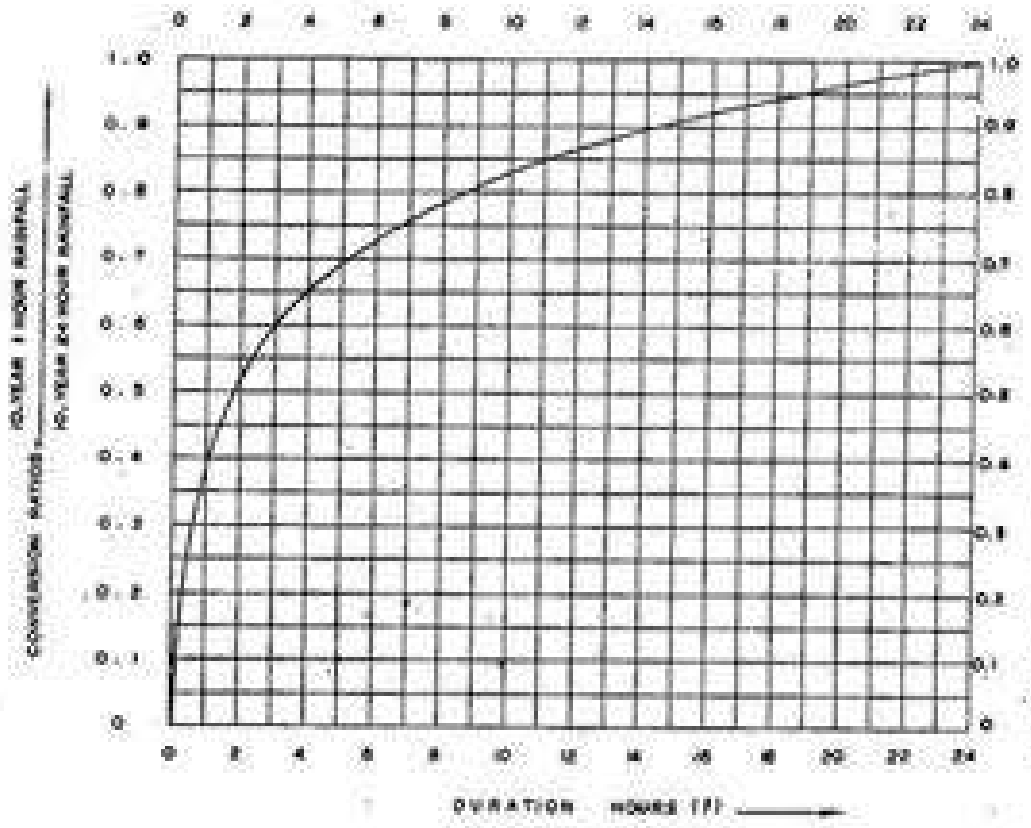
MAHANADI
SUB ZONE- 3 (H)
RELATION BETWEEN
t_p AND T_B

DRAWN BY — L.P. KAUTTAL

CHECKED BY — C.D. AGARWAL

FIG. - 10

RATIOS OF 24 HOURS POINT RAINFALL TO OTHER DURATION RAINFALL



DURATION (HOURS)	RATIOS
1	0.330
2	0.513
3	0.598
4	0.650
5	0.690
6	0.725
7	0.755
8	0.780
9	0.809
10	0.830
11	0.850
12	0.868
13	0.880
14	0.898
15	0.910
16	0.930
17	0.950
18	0.960
19	0.965
20	0.980
21	0.978
22	0.985
23	0.990
24	1.000

NOTE :-

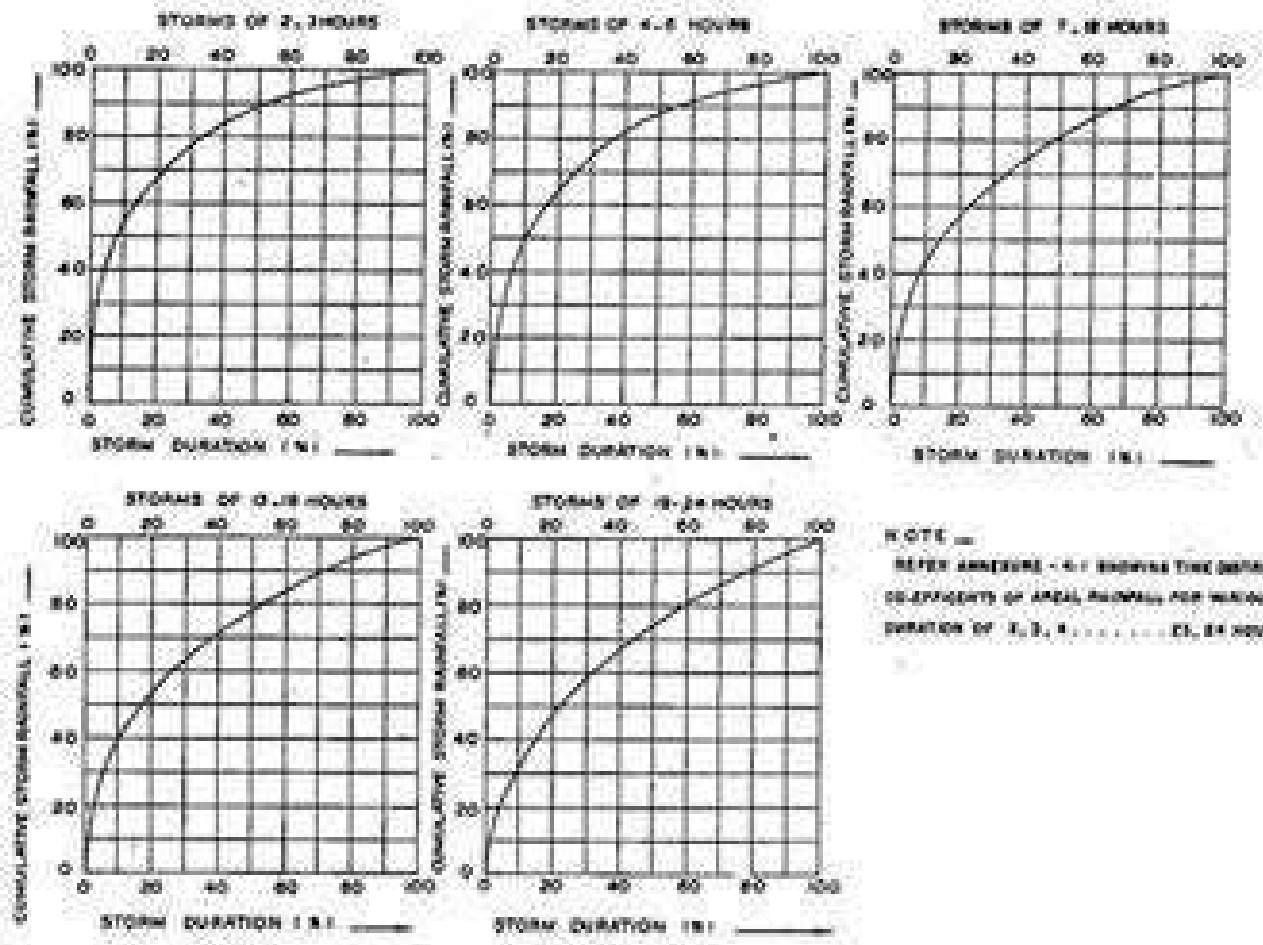
CURVE SUPPLIED BY I.M.D

GOVERNMENT OF INDIA
CENTRAL WATER COMMISSION
HYDROLOGY (REGIONAL STUDIES) DTE.

MAHANADI
SUB ZONE - 3 (E)
DURATION Vs. CONVERSION RATIO

DRAWN BY: L. K. PANT
CHECKED BY: HINDI KAPL

FIG. - II.



NOTE :—

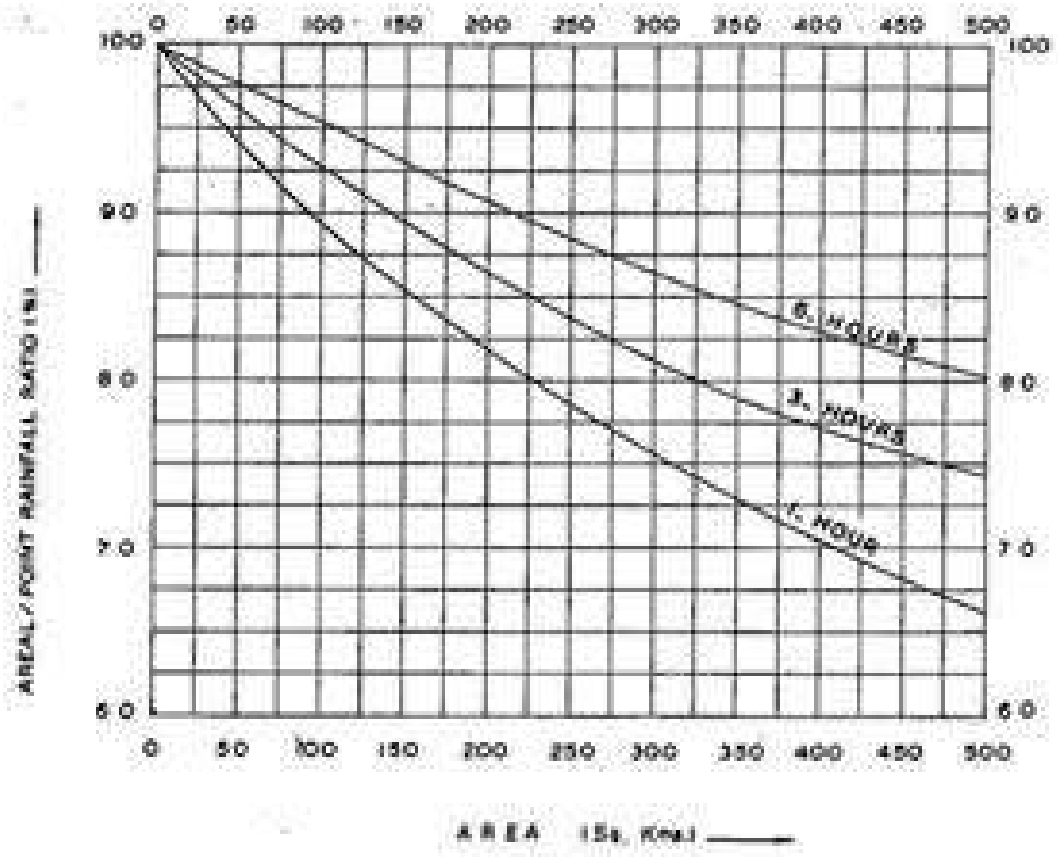
REFER ANNEXURE - 4.1 SHOWING TIME DISTRIBUTION CO-EFFICIENTS OF AREAL RAINFALL FOR VARIOUS DURATION OF 1, 2, 3, 4 ..... 23, 24 HOURS.

NOTE :—

CURVES SUPPLIED BY I.M.D.

GOVERNMENT OF INDIA CENTRAL WATER COMMISSION HYDROLOGY (REGIONAL STUDIES) CTE.	
MAHANADI SUB ZONE - 3(a)	
MEAN AVERAGE TIME DISTRIBUTION CURVES OF STORMS OF VARIOUS DURATION	
DRAWN BY :— L.P. GAUTAM	CHECKED BY :— C.D. AGARWAL

FIG.-2(iii).



NOTE :-

i) REFER ANNEXURE-4-2 FOR AREAL TO POINT RAINFALL RATIOS FOR DURATION FROM 1 TO 24 HOURS.

ii) REFER FIG.-2(ii) AREAL TO POINT RAINFALL RATIO FOR DURATIONS 12-HOURS AND 24-HOURS

NOTE :-

CURVES SUPPLIED BY I.M.D

GOVERNMENT OF INDIA CENTRAL WATER COMMISSION HYDROLOGY (REGIONAL STUDIES) DTE.	
MAHANADI SUB ZONE-3(d) AREAL TO POINT RAINFALL RATIO FOR 1-Hr., 3-Hrs. & 6-Hrs (%)	
DRAWN BY :- L. K. PANT	CHECKED BY :- K. K. AICH

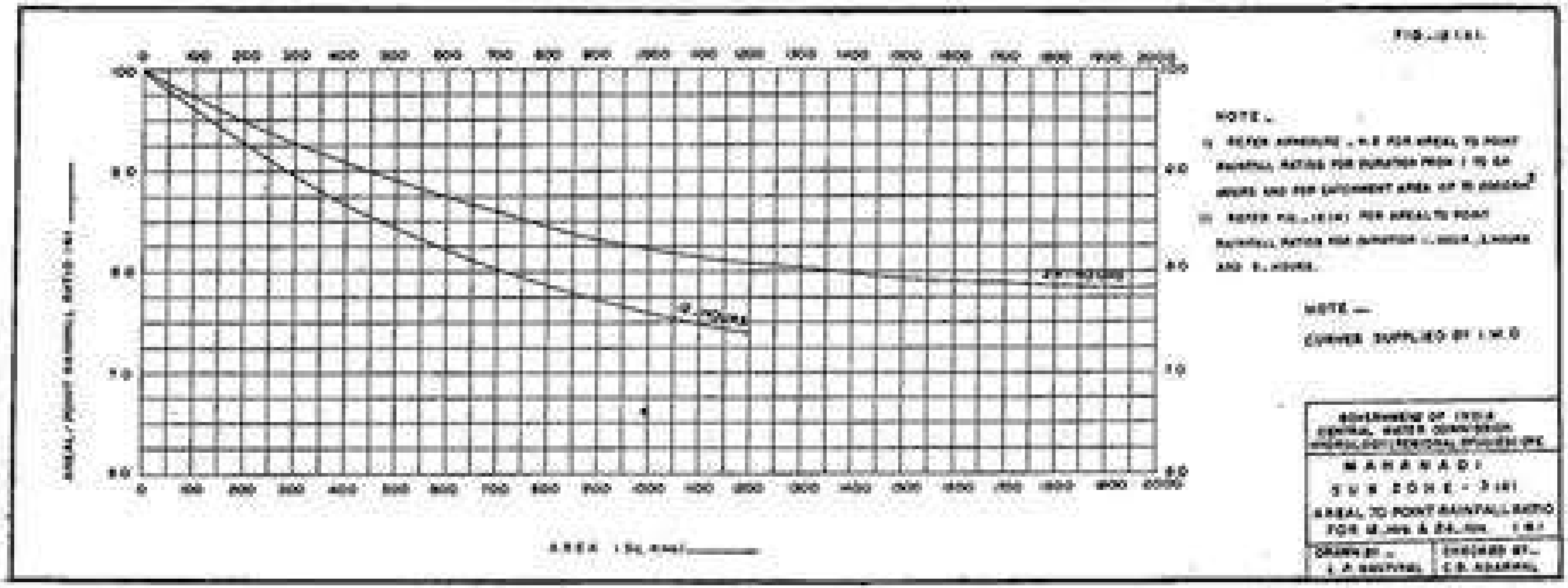
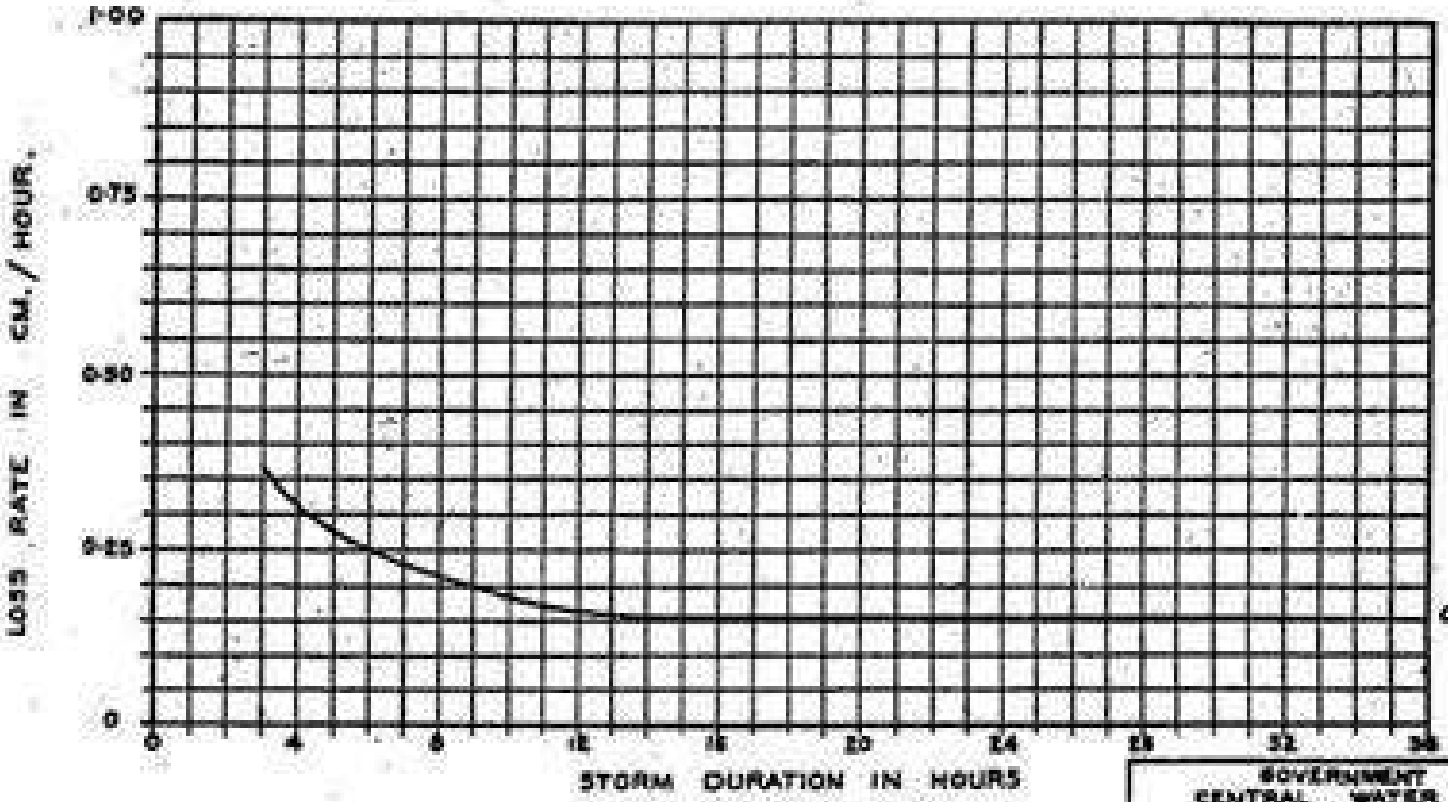


FIG.-12 (d)
NOTE :-
i) REFER ANNEXURE - 4.6 FOR AREAL TO POINT RAINFALL RATIOS FOR DURATION FROM 1 TO 24 HOURS AND FOR CATCHMENT AREA UP TO 10,000 KM²
ii) REFER FIG.-12 (c) FOR AREAL TO POINT RAINFALL RATIOS FOR DURATION 1 HOUR, 3 HOURS AND 6 HOURS.
NOTE —
CURVES SUPPLIED BY I.M.D
12 - HOURS
24 - HOURS
AREAL / POINT RAINFALL RATIO (%)
AREA (SQ. KM.)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
100
90
80
70
60
GOVERNMENT OF INDIA
CENTRAL WATER COMMISSION
MAHANADI
SUB ZONE - 3 (d)
AREAL TO POINT RAINFALL RATIO
FOR 12 HRS & 24 HRS (%)
DRAWN BY -
CHECKED BY -

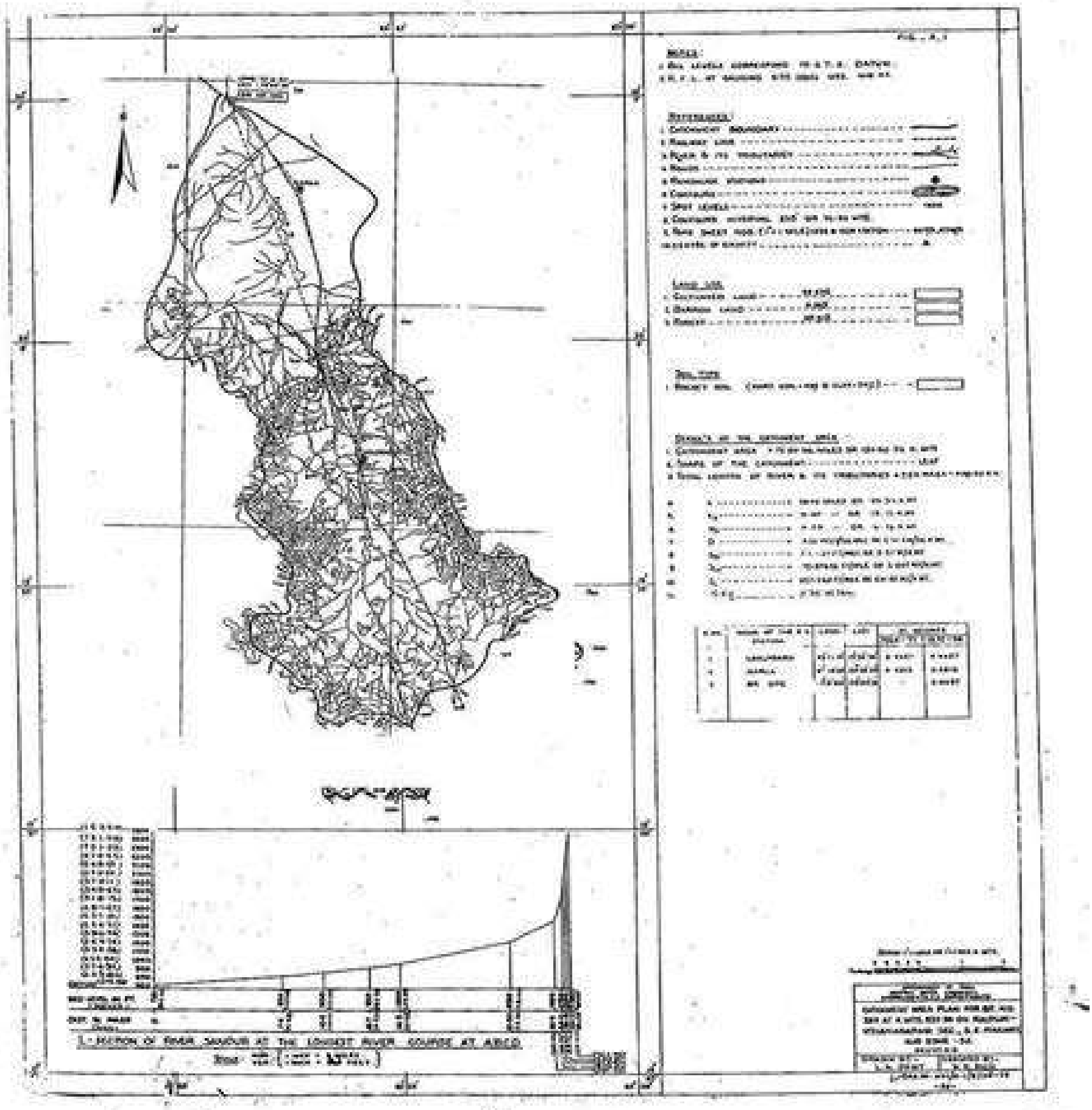
Fig. 13



GOVERNMENT OF INDIA
CENTRAL WATER COMMISSION
HYDROLOGY (S.C.) DIRECTORATE

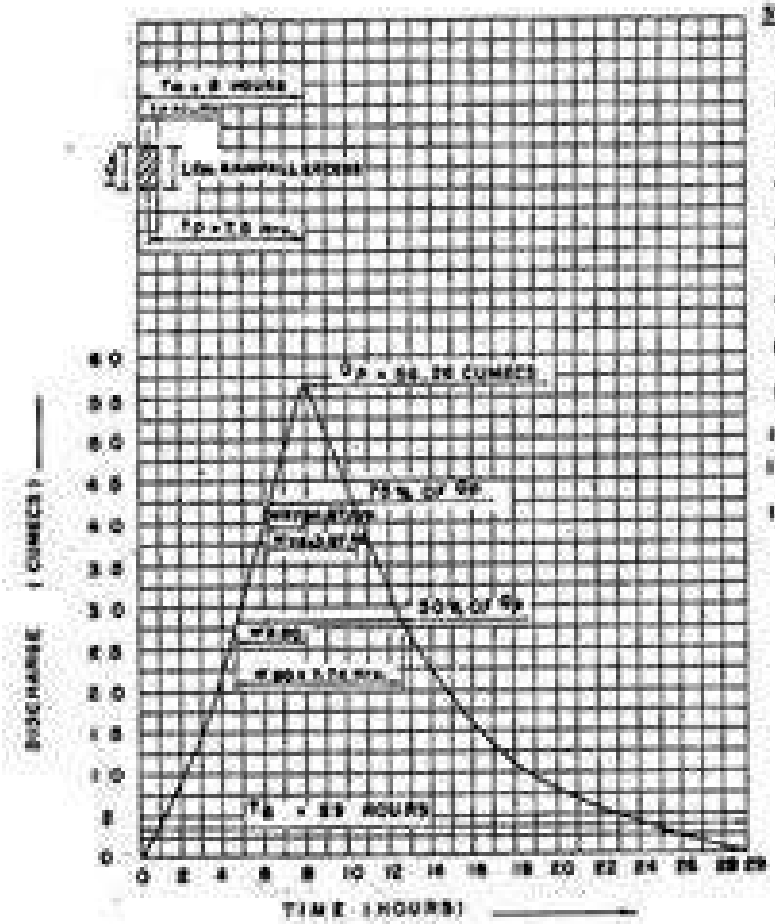
DESIGN LOSS RATE FOR MAHANADI BASIN SUB ZONE-3d.

DRAWN BY:	CHECKED BY:
L.P. NAGPAL	K.K. JAIN



1 - PATTERN OF RIVER DISCHARGE AT THE LOWEST RIVER COURSE AT ABCD

FIG. A. 2



SYNTHETIC UH PARAMETERS

1.	C.AREA	= 194.00 Km^2
2.	T_r	= 1.00 Hr.
3.	Q_p	= 56.38 CUMECS
4.	R_p	= 0.29 CUM./Km^2
5.	T_p	= 7.50 HOURS
6.	T_m	= 8.00 HOURS
7.	T_b	= 89.00 HOURS
8.	W_{50}	= 7.74 HOURS
9.	W_{75}	= 3.87 HOURS
10.	W_{R50}	= 3.21 HOURS
11.	W_{R75}	= 1.87 HOURS
12.	d	= 1.00 Cm.

$$\Sigma Q_1 = \frac{A \times d}{T_r \times 0.36}$$

$$= \frac{194 \times 1.00}{1.00 \times 0.36}$$

= 538.89 CUMECS

1 - HOUR SYNTHETIC U.H. ORDINATES

	Q
0	0.00
1	8.10
2	16.20
3	24.29
4	32.39
5	40.49
6	48.59
7	54.65
8	56.00
9	54.00
10	49.00
11	44.00
12	39.00
13	34.00
14	29.00
15	24.00
16	19.00
17	15.00
18	11.00
19	8.00
20	5.70
21	4.00
22	3.00
23	2.50
24	2.00
25	1.70
26	1.40
27	1.20
28	1.00
29	0.80
30	0.70
31	0.60
32	0.50
33	0.40
34	0.35
35	0.30
36	0.25
37	0.20
38	0.15
39	0.10
40	0.05
41	0.00
TOTAL	538.89 CUMECS

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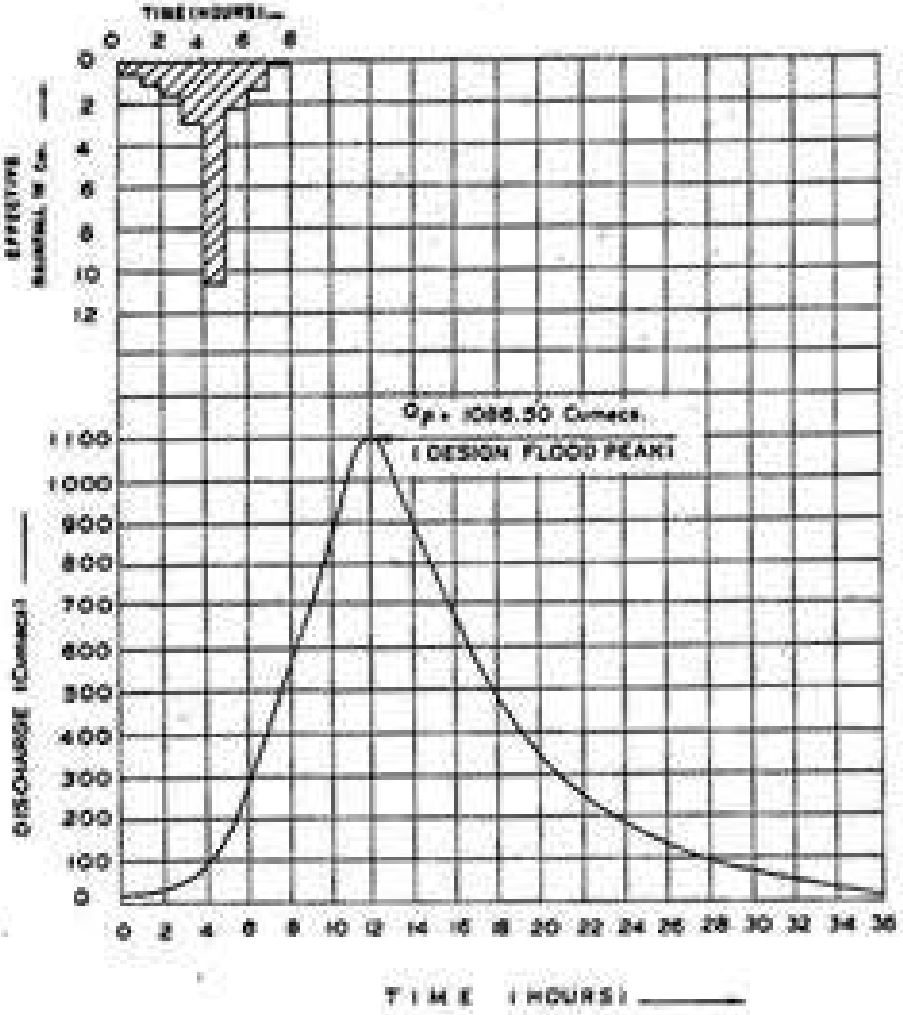
HYDROLOGY (REGIONAL STUDIES) DTE.

MAHANADI
SUB ZONE - 3 (d)
SYNTHETIC UNIT HYDROGRAPH
OF BRIDGE NO - 385.

DRAWN BY -	CHECKED BY -
L. K. PANT	K. K. AICH

FIG. - A.3



NOTE — REFER ANNEXURE-5.4 FOR COMPUTATION OF DESIGN FLOOD HYDROGRAPH.

CATCHMENT AREA = 194.00 Km.^{2}

GOVERNMENT OF INDIA CENTRAL WATER COMMISSION HYDROLOGY (REGIONAL STUDIES) DTE.	
MAHANADI SUB ZONE - 3(d) DESIGN FLOOD HYDROGRAPH OF BRIDGE NO. 385.	
DRAWN BY — L.P. KAUTTAL	CHECKED BY — K. K. AICH

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1.	Shri D.K. Gupta	Director
2.	Shri B. Ray	Meteorologist
3.	Shri S. Das Sharma	Meteorologist
4.	Shri Roop Chand	P.A.
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6.	Shri P.K. Sharma	S.A.
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8.	Shri Gnesh Kumar	S.A.
9.	Shri J.D. Mahato	Adm. Asstt.
10.	Shri Raju Bhargav	Draughtsman

b) Research Design and Standards Organization (Guidance and supervision in data collection)

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3.	Shri A.K. Roy	C.D.A. (R&S)

c) Central Water Commission (Hydrological studies and preparation of report

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4.	Shri Vikas Kumar	Asstt. Director
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14.	Smt. Shashi Gupta	Stenographer
15.	Shri A.K. Varma	Stenographer

LIST OF FLOOD ESTIMATION REPORTS PUBLISHED

A. UNDER SHORT TERM PLAN

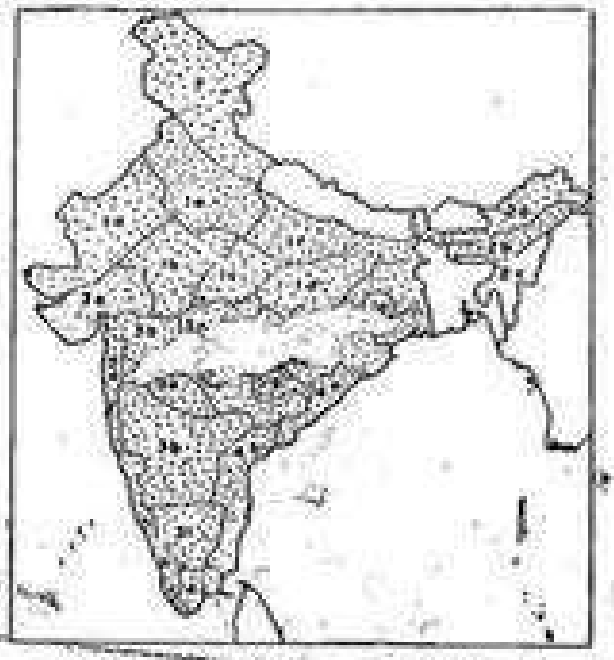
1.	Estimation of Design Flood Peak	(1973)

B. UNDER LONG TERM PLAN

1.	Lower Ganga Plains subzone-1(g)	(1978)
2.	Lower Godavari subzone-3(f)	(1981)
3.	Lower Narmada & Tapi subzone-3(b)	(1982)
4.	Mahanadi subzone-3(d)	(1982)
5.	Upper Narmada & Tapi subzone-3(c)	(1983)
6.	Krishna & Pennar subzone-3(h)	(1983)
7.	South Brahmaputra subzone-2(b)	(1984)
8.	Upper Indo-Ganga Plains subzone-1(e)	(1984)
9.	Middle Ganga Plains subzone-1(f)	(1985)
10.	Kaveri Basin subzone-3(i)	(1986)
11.	Upper Godavari subzone-3(e)	(1986)
12.	Mahi & Sabarmati subzone-3(a)	(1987)
13.	East Coast subzone-4(a),(b) & (c)	(1987)
14.	Sone subzone-1(d)	(1988)
15.	Chambal subzone 1(b)	(1989)
16.	Betwa subzone 1(c)	(1989)
17.	North Brahmaputra subzone 2(a)	(1991)
18.	West Coast Region subzone 5(a) & (b)	(1992)
19.	Luni subzone 1(a)	(1993)
20.	Indravati subzone 3(g)	(1993)
21.	Western Himalayas zone-7	(1994)

C. REVISED UNDER LONG TERM PLAN

1.	Lower Ganga Plains subzone-1(g)	(1994)
2.	Lower Godavari subzone-3(f)	(1995)



STUDIES COMPLETED

STUDIES REVISED

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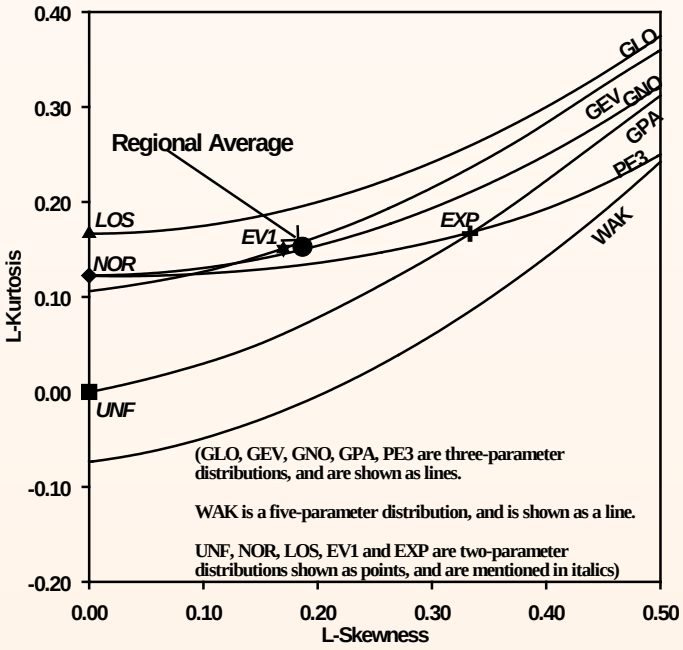

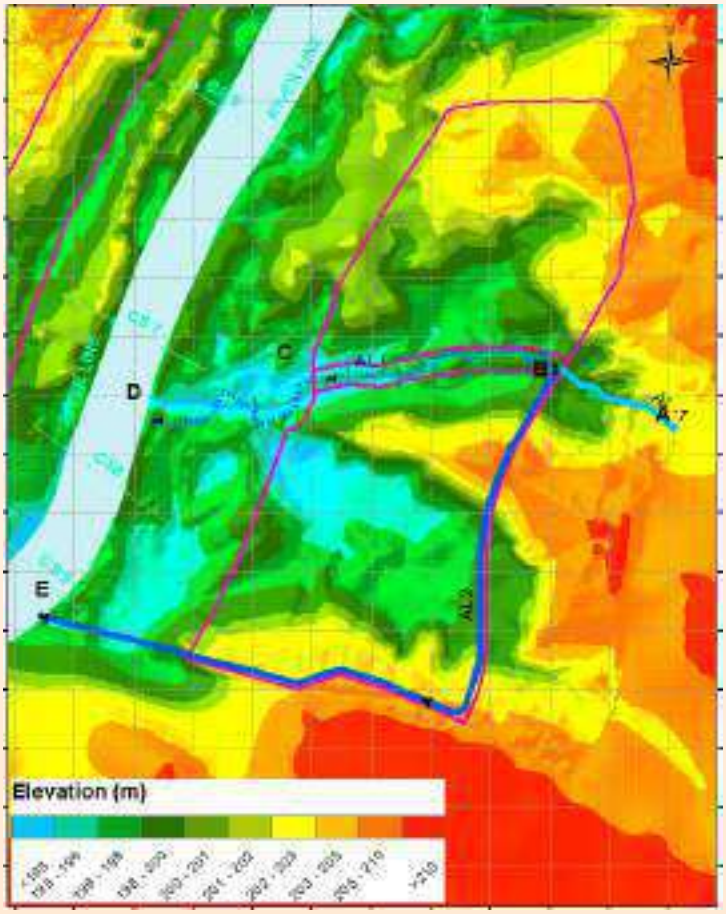

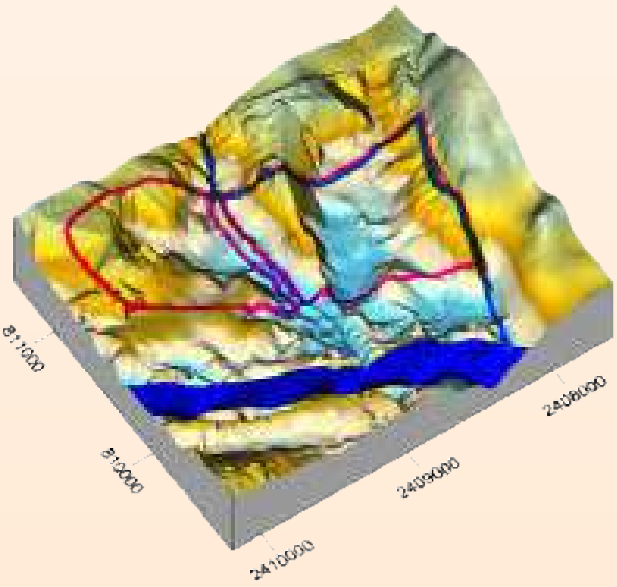

NATIONAL INSTITUTE OF HYDROLOGY
ROORKEE – 247 667, UTTARAKHAND
Website: http://www.nihroorkee.gov.in

ANNEXURE V

WILDLIFE CLEARANCE

परियोजना प्रमुख कार्यालय
तलाबिरा परियोजना
एनएलसी इंडिया लिमिटेड
(पूर्व में नेयवेली लिग्नाइट कॉरपोरेशन लिमिटेड)
(भारत सरकार का 'नवरत्न' उद्यम)
तीसरी मंजिल, त्रिलोक टावर, सरलाकानि चौक,
साखीपडा मार्ग, सम्बलपुर-७६८००१
फोन/फेक्स: ०६६३-२५४८१४२
Email id : gmtalabira.nlc@gmail.com

O/O THE PROJECT HEAD
TALABIRA PROJECT
NLC INDIA LIMITED
(Formerly Neyveli Lignite Corporation Limited)
('Navratna' – A Government of India Enterprise)
3rd Floor Trilok Tower, At- Sarlakani Chowk
Sakhipara Road, Sambalpur-768001
Tel/Fax: 0663- 2548142
Email id : gmtalabira.nlc@gmail.com

Lr. No. CGM/ Talabira Project/ Talabira Project/ 2020/ 158 Date: 27.01.2020

To
The Divisional Forest Officer
Jharsuguda Forest Division
Jharsuguda

Sir,

Sub: NLCIL - Talabira Thermal Power Plant(3x800MW) - Issuance of Wild Life Clearance - Reg
Ref: 1. Lr. No. GM/ Talabira Project/ NTTPP/WLC/2018/420 dtd, 02.08.2018
2. Memo No. 3735 / 4F-FCA (Misc) dtd. 05th Sept, 2018
3. Lr.No.:NLC/GM/ Talabira Project/Wild life/2018/464 dtd. 12.09.2018

Vide reference (1) cited above, NLCIL requested for issuance of Wild Life Clearance/ No Objection for Talabira Thermal Power Plant (4x800 MW) to be set up at site location (Hirma, Kumbhari, Tareikela, Tumbekela & Luhurenkachar villages of Jharsuguda district and Thelkoloi village of Sambalpur district) for the non – presence of National Park, Sanctuary, Elephant/ Tiger Reserve, Migratory Routes/ Wildlife Corridor.

Vide ref. (2) above, Office of the Divisional Forest Officer, Jharsuguda Division to requested the Range Officer, Jharsuguda to submit the detail enquiry report for the same.

Vide ref. (3) cited, following documents (i) Terms of reference (TOR) (ii) Site location on Toposheet (iii) Land Schedule for Talabira Thermal Plant were submitted to the Range Officer, Jharsuguda.

In this regard, it is to inform you that Wild Life Clearance/ No Objection for Sambalpur district has been obtained from Divisional Forest Officer, Sambalpur vide Memo No. 4879 26.09.2018.(Copy enclosed)

It is further submitted that the SIA & EIA public hearings for NLCIL Talabira Thermal Plant, Jharsuguda district have been completed on 13.11.2019 and EIA public hearing for Sambalpur district has been completed on 10.01.2020.

In view of the above, it is requested to issue Wild Life Clearance/ No Objection for Talabira Thermal Power Plant.

Regards,

For NLC India Limited

Project Head/ Talabira Project

Received a copy
01/02/20
NLC

OFFICE OF THE DIVISIONAL FOREST OFFICER,
SAMBALPUR FOREST DIVISION.

E-Mail ID – dfosouthsbp@yahoo.com
Phone/FAX- 0663-2410139

Memo No 4879 Date. 26.09.2018

To,

The General Manager,
Project Head,
Talabira II & III OCP,
NLC India Ltd.

Sub:- NLC Talabira Thermal Power Project- Issue of Wildlife Clearance.
Ref:- Your letter No.286 dt.27.03.2018.

Sir,

As per the report of Asst. Conservator of Forests, I/c Rengali Range in connection with Wildlife Clearance certificate the legal status of land is non-forest land in the applied area. There is no national park, Sanctuary, Elephant/tiger reserve, well defined or notified migratory routes/wildlife corridor within 10 Km of the project site. There is very few sparsely distributed trees mainly of mango and mahul. During the site inspection no direct sighting of wild animals was noticed but many terrestrial birds like pigeon, myna, sparrow etc. were found using the area. No movement of elephants have been reported since recent past.

So the division do not have any objection from the wildlife point of view with the project in the applied area. However, sufficient measures must be taken while disposal of waste and other precautionary measure may be taken while the operation and construction for the safety of avifauna.

Yours faithfully,

25/09/18

Divisional Forest Officer,
Sambalpur Forest Division.

ANNEXURE VI

NON COAL BEARING AREA

सेन्ट्रल माइन प्लानिंग एण्ड डिजाइन इन्स्टीच्युट लिमिटेड
(कोल इण्डिया लिमिटेड की सहायक कम्पनी/ भारत सरकार का एक लोक उपक्रम)
गोन्डवाना प्लेस, काँके रोड, राँची - 834 031, झारखंड (भारत)
Central Mine Planning & Design Institute Limited
(A Subsidiary of Coal India Limited/ Govt. of India Public Sector Undertaking)
Gondwana Place, Kanke Road, Ranchi - 834 031, Jharkhand (INDIA)
Corporate Identity Number – U14292JH1975GOI001223

cmpdi
A Mini Ratna Company

फैक्स / स्पीड डाक द्वारा

पत्रांक : सीएमपीडीआई / बी.डी. / C(932)/ I 2064 दिनांक : 18.10.2017

सेवा में,

Chief General Manager,
Project & Business Development,
NLC India Ltd., Block-I,
Neyvelli – 807 801
Fax – 04142-52645 e-mail : cgm.pbd@nlcindia.com

GM/P & BD
No: 879
Dt: 6.9.17

विषय : **Certification of Non-Coal bearing area for NLCIL proposed pit head coal based thermal power plant at Tareikala and Khumbari villages of Jharsuguda dist. , Odisha for NLC India Ltd. (Job no. 511017101) – Reg. Submission of Report, Bill & Feedback.**

संदर्भ : 1. NLC letter no. NLCIL/CGM/P&BD/OTPP/269/2017 dtd. 27.07.2017
2. CMPDI's offer letter no. CMPDI/BD/A(003) Offer Vol-XXIV/I-1765 dtd. 17.08.2017
3. NLC Work Order no. NLCIL/CGM/PBD/OTPP/NCBA/400/2017 dtd. 18.09.2017
4. CMPDI's letter no. CMPDI/BD/C(932)/I-2019 dtd. 09.10.2017

महोदय,

With reference to your work order dtd. 18.09.2017 received against which an acknowledgement was sent to you vide no. CMPDI/BD/C(932)/I-2019 dtd. 09.10.2017.

Accordingly, the study has been carried out and 05 (five) copies of the report on **"CERTIFICATION OF NON-COAL BEARING AREA FOR NLCIL PROPOSED PIT HEAD COAL BASED THERMAL POWER PLANT AT TAREIKALA AND KHUMBARI VILLAGES OF JHARSUGUDA DIST. , ODISHA FOR NLC INDIA LTD."** is enclosed for your ready reference.

In this context, we are enclosing a bill in duplicate vide invoice no. 20/HQ/SER/18/C39 dtd. 18.10.2017 for an amount of Rs.2,51,104 =00 (Rupees two lakh fifty one thousand one hundred four only) for arranging an early payment.

Now, it is requested to make the payment through e-payment through **SBI COLLECT** :

1) Please go to the link - **https://www.onlinesbi.com//prelogin/collecthome.htm**
A link is also available on Website of CMPDI.
2) Accept the terms & conditions.
3) Choose the state - Choose JHARKHAND
4) Type of Corporation - Select PSU – Choose CMPDI Ltd.
5) Select Payment Category - Select 'SALES ADVANCE' for advance payment and 'SALES BILLS REALISATION' for payment against bills.

We are also enclosing a 'Customer Feedback form' for your overall perception. The duly filled in form may kindly be returned to 'Management Representative (QMS), Management System Division, CMPDI, Ranchi'.

धन्यवाद एवं सदैव अपनी सर्वोत्तम सेवाओं के आश्वासन सहित ।

भवदीय

18/10/17

महाप्रबंधक
(व्यवसाय विकास)

Encl.: As above.

फोन/ Ph : +91 651 2230116 फैक्स/ Fax: +91 651 2232249, 2231447
ईमेल/ email: grmbd.cmpdi@coalindia.in वेबसाइट/ Website :http://www.cmpdi.co.in

CM/DV. 8/11 Dy MS 8/11

NLC INDIA LIMITED

CERTIFICATION OF NON-COAL BEARING AREA FOR NLCIL PROPOSED PIT HEAD COAL BASED THERMAL POWER PLANT AT TAREIKALA AND KHUMBARI VILLAGES OF JHARSUGUDA DIST., ODISHA FOR NLC INDIA LTD.

(Job No. 511017101)

OCTOBER, 2017
EXPLORATION DIVISION
CENTRAL MINE PLANNING & DESIGN INSTITUTE LTD.,
KANKE ROAD, RANCHI, JHARKH AND

CERTIFICATION OF NON-COAL BEARING AREA FOR NLCIL PROPOSED PIT HEAD COAL BASED THERMAL POWER PLANT AT TAREIKALA AND KHUMBARI VILLAGES OF JHARSUGUDA DIST., ODISHA FOR NLC INDIA LTD.
(Job No. 511017101)

CERTIFICATION OF NON-COAL BEARING AREA FOR NLCIL PROPOSED PIT HEAD COAL BASED THERMAL POWER PLANT AT TAREIKALA AND KHUMBARI VILLAGES OF JHARSUGUDA DIST., ODISHA FOR NLC INDIA LTD.
(Job No. 511017101)

1.0 INTRODUCTION

NLC India Limited (NLCIL) proposed to establish a pit head based thermal power plant (Phase I: 2*800 MW) at Tareikala and Khumbari villages of Jharsuguda district, Odisha linked to Talabira II & III mines.

For setting up of same, as per norm, it is required to obtain certification that the area is free from Coal bearing.

In this regard, NLC India Limited has approached CMPDIL for examining the area proposed and requested for confirmation of non-coal bearing area for the tentative plant area.

2.0 INPUT PROVIDED BY NLCIL

The location map showing the area of proposed site.

3.0 OUTPUT

The boundary of nearby coal bearing area along with the geological formation is plotted on WGS84 coordinate system consisting of Latitudes and Longitudes in the map showing the location of proposed pit head coal based thermal power plant at Tareikala and Khumbari villages of Jharsuguda dist., Odisha.

The above plot is enclosed in Plate No-A.

4.0 OBSERVATIONS

From the available data of GSI in large scale, existing coalfield information with CMPDIL and as per the map provided by NLCIL (Plate No-B):

- The proposed thermal power plant plan which was provided by NLCIL has been superimposed on the Ib Valley coalfield boundary plan available in CMPDIL. It has been observed that a part (West, South and South Western part) of the plant falls within the Ib Valley coalfield boundary as shown in the map Plate No-A where the formations are mainly Metamorphic/ Talchir formation which are devoid of coal.

5.0 CONCLUSION

As mentioned in the observation given above that the proposed thermal power plant (Part) is falling within the Ib Valley coalfield. As per the plan available it is showing that the western and southern side of the thermal power plant is lying above the Talchir/ Metamorphic formation which is considered as Non-coal bearing area.

Hence it is concluded that the part of the thermal power plant mentioned above appears to be lying above Talchir/ Metamorphic formation which is considered to be non-coal bearing formation as per the map shown in Plate No-A.

ANNEXURE VII

LAND ACQUISTION

Sushanta Kumar Mohanty, OAS(SAG)
Chief General Manager (Land)

idco | ODISHA NEW OPPORTUNITIES

NO.IDCO/HO/P&A/LA_E-7334/2017/ 24405 dtd. 30/12/2017

To

M/s. NLC India Limited,
Plot No.3087, Chaitanya Nagar, Sambalpur-768001,
(Email id: gmtalabira.nic@gmail.com)

Sub:- Acquisition/alienation of land measuring Ac.1447.14 in favour of the Company to set up a 4x800 MW pit-head thermal power plant with an investment of Rs.23.569.60 crores at Tareikela, Jharsuguda.

Ref:- i) Your letter no.175 dtd.07.10.17.
ii) Letter no.4057 dtd.23.12.2017 of IPICOL

Sir,

With reference to above cited subject I am directed to intimate you that IPICOL has assessed Ac.1447.14 acres of land in your favour for acquisition/alienation of land for establishment of Industries i.e. to set up a 4x800 MW pit-head thermal power plant with an investment of Rs.23.569.60 crores at Tareikela, Jharsuguda vide letter no.4057 dtd.23.12.17 of IPICOL.

Hence, You are therefore requested to identify suitable patch of land measuring Ac.1447.14 in the district of Jharsuguda and furnish the following documents to this office for acquisition/ lease.

1. Detailed Land schedule and land map – One set each
2. Cadastral village Maps (Original) – one copy each
3. Certified copy of ROR's (Original) - one copy each
4. An Undertaking to pay the land cost & as admissible IDCO Admn charges with consent to abide with all the terms and conditions of IDCO for allotment of land.
5. An amount of **Rs.59000/-** (Fifty Nine thousand) only (Rs.50,000/- towards processing fees and Rs.9000/- towards **GST)** to be deposited with IDCO towards the processing fee. The deposit may be made in shape of Bank draft to be drain in favour of "Odisha Industrial Infrastructure Development Corporation", payable at Bhubaneswar or through **RTGS – Bank – State Bank of India, IDCO Tower Branch, IFSC Code – SBI N0007891, Branch Code – 07891, A/C.No.10835304369, MICR – 751002007.**

Cont....p/2

Sushanta Kumar Mohanty, OAS(SAG)
Chief General Manager (Land)

This is for information & necessary action.

Yours faithfully,

Chief General Manager(Land)
IDCO, Bhubaneswar

Memo No. 24406 /Date : 30-12-2017.

Copy to the General Manager(SNLA), IPICOL, IPICOL House for kind information with reference to their letter no.4057 dtd.23.12.2017. He is requested to furnish the original copy of Memorandum & Article of Association submitted by M/s. NLC India Limited as Xerox copy furnished by you is not visible.

Chief General Manager(Land)

O/C

Odisha Industrial Infrastructure Development Corporation
(A Government of Odisha Undertaking)
IDCO, Land Division, IDCO Towers, Janpath, Bhubaneswar - 751022, Odisha, INDIA
☎ +91-0674 2544180, 2540620 | Fax:2542956 / 2541982
✉ cgmland@idco.in/ sushanta.mohanty@idco.in | www.idco.in

ANNEXURE VIII

WATER BALANCE DIAGRAM

EXHIBIT-VII

EVAP. LOSS
100
HIRAKUD RESERVIOR
9150/7200
IN PLANT RESERVOIR
7100
1950/0
210
230
D.M CLARIFIER
210
GRAVITY FILTERS
200
D.M. PLANT
180
POWER CYCLE
EVAP. LOSS
20
20
SLUDGE
10
20
20
SUMP
220
GRAVITY FILTERS
200
POTABLE WATER SYSTEM
20
N.PIT
TO ASH SLURRY SUMP
5 C.O.C.
4725
258000
CONDENSER
I.D C.T.
CW CHANNEL
C.W PUMPS
6890
C.W. CLARIFIER MAIN
CLARIFIED WATER STORAGE TANK
220
180
VENTILATION SYS MAKEUP
6740
6520
150
SLUDGE
TO FGD SYSTEM
40
ACW SYSTEM
12000
PHE
MAKEUP TO MAIN CW
6300
6300
1575
CW BLOWDOWN
FIRE WATER TANK
TO FIRE WATER SYS
140
1950/0
1250
TO FGD SYSTEM
40
20
FROM N.PIT
1990/40
CENTRAL MONITORING BASIN
0/0
TO HORTICULTURE
REFER NOTE 3
MAKEUP TO BAHP
0
ASH WATER TANK
1990
1950
BOT. ASH HANDLING PLANT
ASH SLURRY SUMP
2110
BOTTOM ASH SLURRY PUMPS
2110
150
TO ASH /AUX. COOLING SYSTEM MAKE UP/SERVICE WATER SYSTEM
LETP CLARIFIR
1950
MINE VOID AT A LATER DATE
EVAP. LOSS
160
BOTTOM A S H D Y K E
40
FLY ASH HANDLING PLANT
FLY A S H D Y K E
1950
DECANTED ASH WATER PUMP
175
CHP DUST SUPP SYSTEM
0/0

NOTES

1. VALUES INDICATED IN FLAG ARE WATER FLOW IN Cum/hr
2. WHEREVER VALUES ARE INDICATED UNDER FLAG, FIRST VALUE CORRESPONDS TO FLOW CONSIDERING ASH WATER SYSTEM IN ONCE-THU MODE & THE OTHER IS DURING RECIRCULATION MODE.
3. WHEREVER WATER CONSUMPTION IN SERVICE WATER SYSTEM & CHP DUST SUPPRESSION SYSTEM IS LESS, CW BLOW DOWN WATER TO CMB SHALL INCREASE AND WATER TO BE DRAINED FROM CMB SHALL INCREASE TO THAT EXTENT. ACCORDINGLY, WASTE WATER DISPOSAL SYSTEM WILL BE DESIGNED FOR 325Cum/hr. THIS WATER SHALL BE USED FOR HORTICULTURE AND ZERO DISCHARGE SHALL BE MAINTAINED TO WATER BODIES.
4. DESIGNED COC OF CW SYSTEM IS CONSIDERED TO ABOUT COC 5
5. TREATED SEWAGE SHALL BE USED FOR ASH HANDLING PLANT

FOR FR PURPOSE ONLY

REV	PARTICULARS	DATE	PSE	P&BD	CTO
a	RELEASED FOR FR PURPOSE ONLY	18.12.17			

APPROVED

NLC INDIA LIMITED
(FORMERLY NEYVELI LIGNITE CORPORATION LIMITED)
CREATING WEALTH FOR WELLBEING

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (3x800MW)

	NAME	SIGN.	DATE
CAD/DRAWN	S.R		21.12.17
DESIGNED	Q.A.F		21.12.17
CHECKED	D.M		21.12.17

TITLE:- WATER BALANCE DIGGRAM
SCALE: SCALE:
DRG.NO. NLC IL: 17-18: NTTPP: WBD: DR: 07
REV: a

SHEET SIZE A0

ANNEXURE IX

RISK RESULTS & CONTOURS

NLC JHARSAGUDA - Consequence Results

Scenario Description	Hole size (mm)	Release rate (kg/s)	Release Duration (sec)	Flammable Results														Toxic Results		
				Flash Fire Envelope			Pool Radius (m)	Radiation Effects: Pool Fire Ellipse			Radiation Effects: Jet Fire Ellipse			Radiation Effects: Fire Ball Ellipse				Toxic Effects		
				Furthest Extent in ppm	Distance in meters			Radiation Levels (kW/m2)	Distance in meters		Radiation Levels (kW/m2)	Distance in meters		Radiation Levels (kW/m2)	Distance in meters		ERPG Levels ppm/3600S	Distance in meters	
					2F	5D			2F	5D		2F	5D		2F	5D		2F	5D
500KL LDO Tank	10	0.40	3600	50%	3.4	3.8	11.1	4	43.7	49.0	4	1.7	1.6	4	NA	NA	-	-	-
				100%	3.4	3.8		12.5	19.8	22.9	12.5	NR	NR	12.5	NA	NA	-	-	-
				-				37.5	NR	NR	37.5	NR	NR	37.5	NA	NA	-	-	-
	CR	N/A	N/A	50%	501.6	79.4	177.9	4	318.8	362.4	4	NA	NA	4	NA	NA	-	-	-
				100%	275.4	22.9		12.5	182.9	183.9	12.5	NA	NA	12.5	NA	NA	-	-	-
				-				37.5			37.5	NA	NA	37.5	NA	NA	-	-	-
500KL FO Tank	10	0.45	3600	50%	3.6	4.0	11.6	4	41.4	45.5	4	NR	NR	4	NA	NA	-	-	-
				100%	3.6	4.0		12.5	20.0	22.9	12.5	NR	NR	12.5	NA	NA	-	-	-
				-				37.5	NR	NR	37.5	NR	NR	37.5	NA	NA	-	-	-
	CR	N/A	N/A	50%	26.9	27.8	179.2	4	310.3	344.6	4	NA	NA	4	NA	NA	-	-	-
				100%	26.8	27.7		12.5	185.7	186.9	12.5	NA	NA	12.5	NA	NA	-	-	-
				-				37.5	NR	NR	37.5	NA	NA	37.5	NA	NA	-	-	-

900kg Chlorine Tonner	25	1.06	842	**50%**	NA	NA	N/A	**4**	NA	NA	**4**	NA	NA	**4**	NA	NA	**1**	14964.6	2781.5
				100%	NA	NA		**12.5**	NA	NA	**12.5**	NA	NA	**12.5**	NA	NA	**3**	6803.7	1520.8
				-				**37.5**	NA	NA	**37.5**	NA	NA	**37.5**	NA	NA	**20**	NR	NR
	CR	N/A	N/A	**50%**	NA	NA	N/A	**4**	NA	NA	**4**	NA	NA	**4**	NA	NA	**1**	11948.6	3966.3
				100%	NA	NA		**12.5**	NA	NA	**12.5**	NA	NA	**12.5**	NA	NA	**3**	5584.3	2094.6
				-				**37.5**	NA	NA	**37.5**	NA	NA	**37.5**	NA	NA	**20**	NR	NR
500T Ammonia Storage Vessel	25	8.05	3600	**50%**	32.5	30.2	5.1	**4**	37.6	33.6	**4**	74.8	63.2	**4**	NA	NA	**25**	18817.7	3860.2
				100%	14.1	12.5		**12.5**	31.1	31.8	**12.5**	63.6	52.8	**12.5**	NA	NA	**150**	3818.0	1303.3
				-				**37.5**	NR	NR	**37.5**	NR	NR	**37.5**	NA	NA	**750**	906.0	546.6
	CR	N/A	N/A	**50%**	341.8	467.8	N/A	**4**	NA	NA	**4**	NA	NA	**4**	451.4	451.4	**25**	52513.8	20588.3
				100%	165.8	202.8		**12.5**	NA	NA	**12.5**	NA	NA	**12.5**	134.4	134.4	**150**	10954.9	6095.3
				-				**37.5**	NA	NA	**37.5**	NA	NA	**37.5**	NR	NR	**750**	4110.6	3771.3

LDO Tank (500 KL Capacity)

(i) Flash Fire Envelope

In the event of delayed ignition, vapours of LDO Tank will be generated from the surface of spreading pool and dispersed into the atmosphere towards prevailing wind directions. The distances of LDO vapours within the farthest distance are given below:

Hole size (mm)	Release rate (kg/s)	Release Duration (sec)	Flash Fire Envelope		
			Furthest Extent	Distance in meters	
			in ppm	2F	5D
10	0.40	3600	50%	3.4	3.8
			100%	3.4	3.8
Rupture	N/A	N/A	50%	501.6	79.4
			100%	275.4	22.9

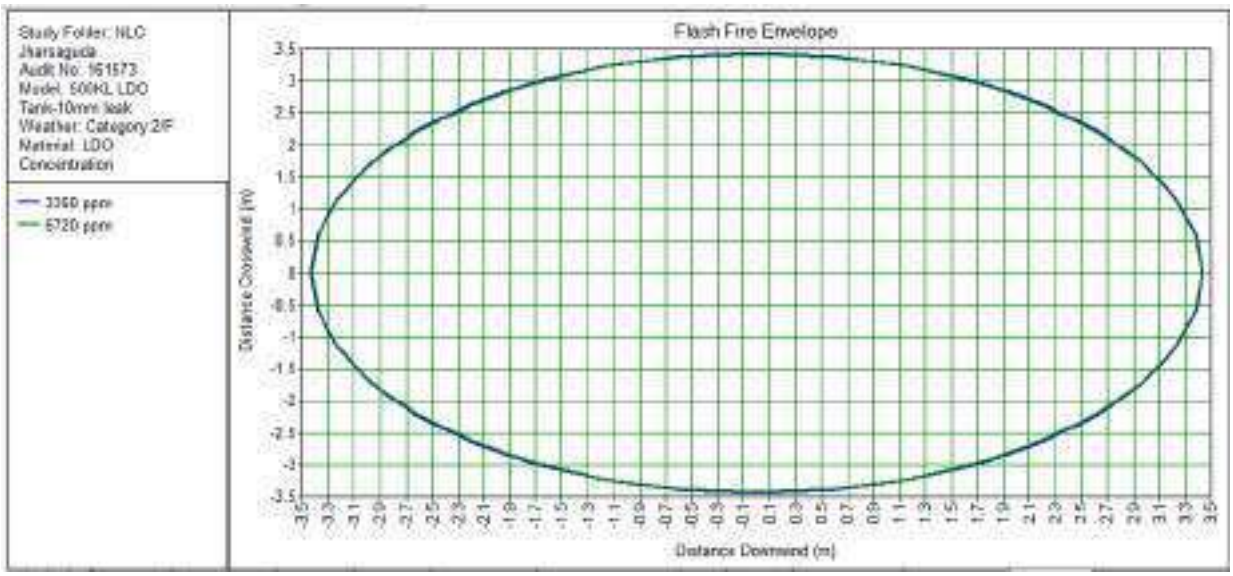

Fig: 1 Flash Fire Envelope for 10mm leak of 500 KL LDO Tank

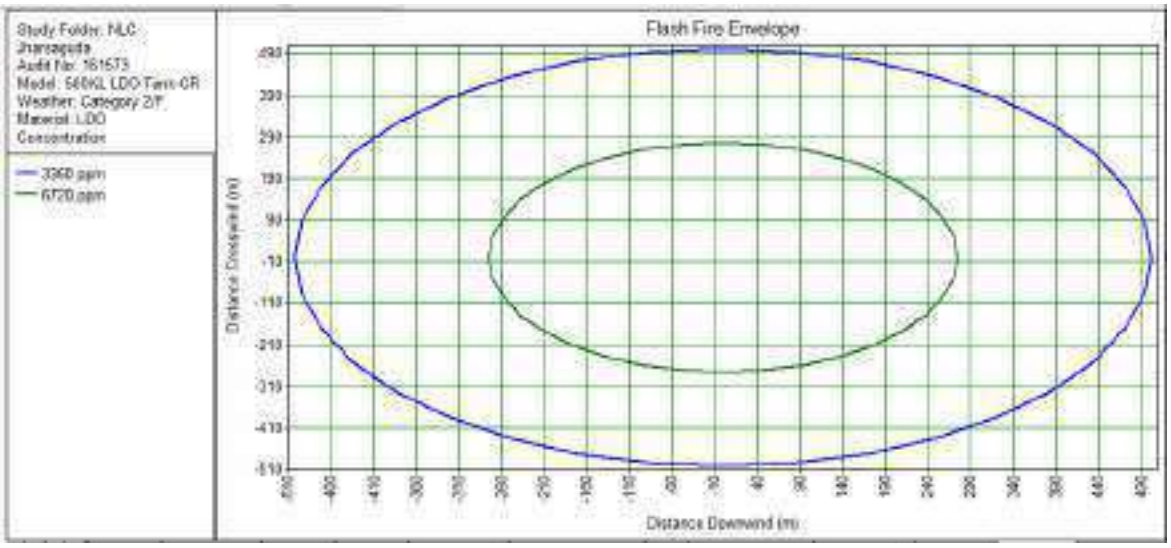

Fig: 2 Flash Fire Envelope for Rupture of 500 KL LDO Tank

Pool Fire Radii

On release of LDO due to leakage in the transfer pipeline, LDO will be spread on ground and spreading pool of LDO will be formed. On early or delayed ignition, spreading pool fire will be observed. On delayed ignition of spreading pool, thermal radiation distances will be as given:

Hole size (mm)	Release rate (kg/s)	Release Duration (sec)	Radiation Effects: Pool Fire Ellipse		
			Radiation Levels	Distance in meters	
			kW/m^2	2F	5D
10	0.40	3600	**4**	43.7	49.0
			12.5	19.8	22.9
			37.5	NR	NR
Rupture	N/A	N/A	**4**	318.8	362.4
			12.5	182.9	183.9
			37.5	NR	NR

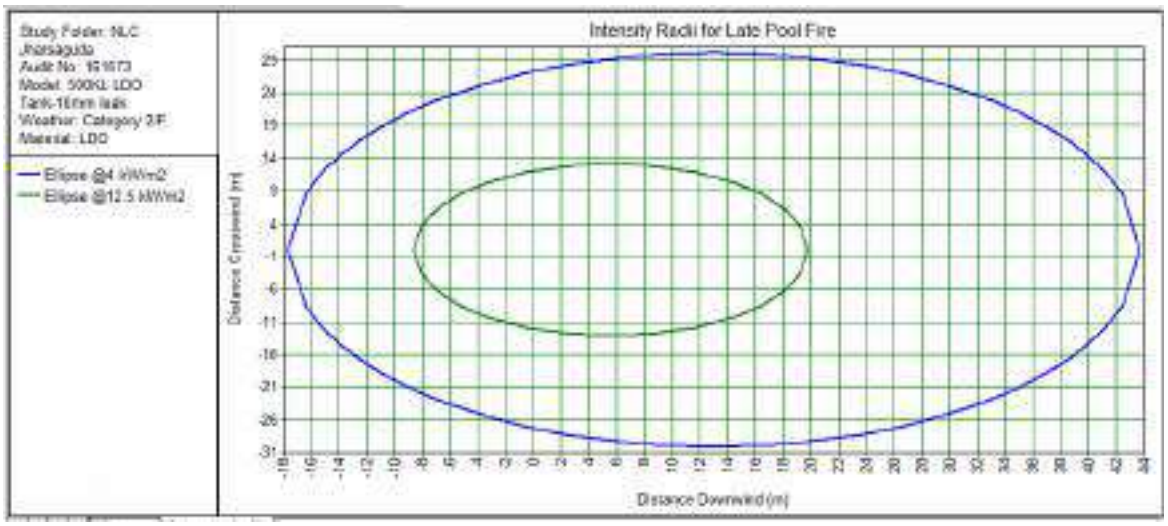

Fig 3: Late Pool Fire Ellipse for 10mm leak of 500KL LDO Tank

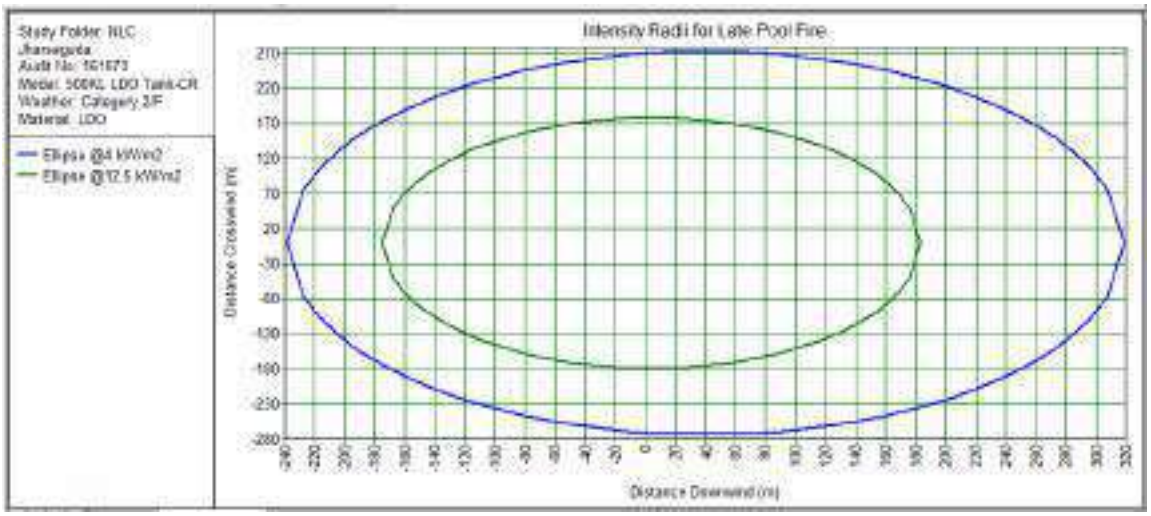

Fig 4: Late Pool Fire Ellipse for Rupture of 500KL LDO Tank

Jet Fire

On release of LDO, jet fire will result in the event of immediate/early ignition of releasing LDO. Thermal radiation distances from Jet fire will be as given below:

Hole size (mm)	Release rate (kg/s)	Release Duration (sec)	Radiation Effects: Jet Fire Ellipse		
			Radiation Levels	Distance in meters	
			kW/m^2	2F	5D
10	0.40	3600	**4**	1.7	1.6

			12.5	NR	NR
			37.5	NR	NR

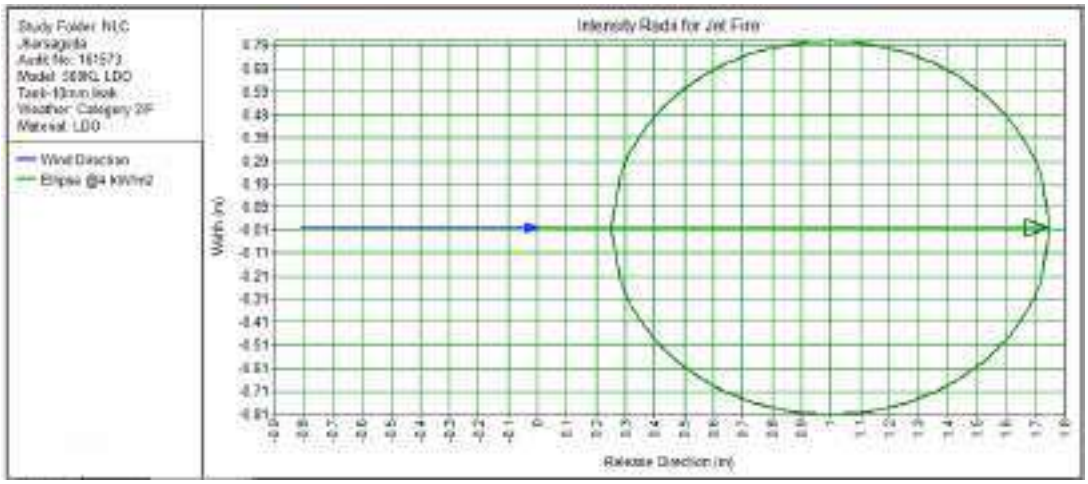

Fig 5: Jet Fire for 10mm Leak of 500KL LDO Tank

FO Tank (500 KL capacity)

(i) Flash Fire Envelope

In the event of delayed ignition, vapours of FO will be generated from the surface of spreading pool and dispersed into the atmosphere towards prevailing wind directions. The distances of FO vapours within the farthest distance are given below:

Hole size (mm)	**Release rate (kg/s)**	**Release Duration (sec)**	**Flash Fire Envelope**		
			Furthest Extent in ppm	**Distance in meters**	
				2F	**5D**
10	0.45	3600	**50%**	3.6	4.0
			100%	3.6	4.0
Rupture	N/A	N/A	**50%**	26.9	27.8
			100%	26.8	27.7

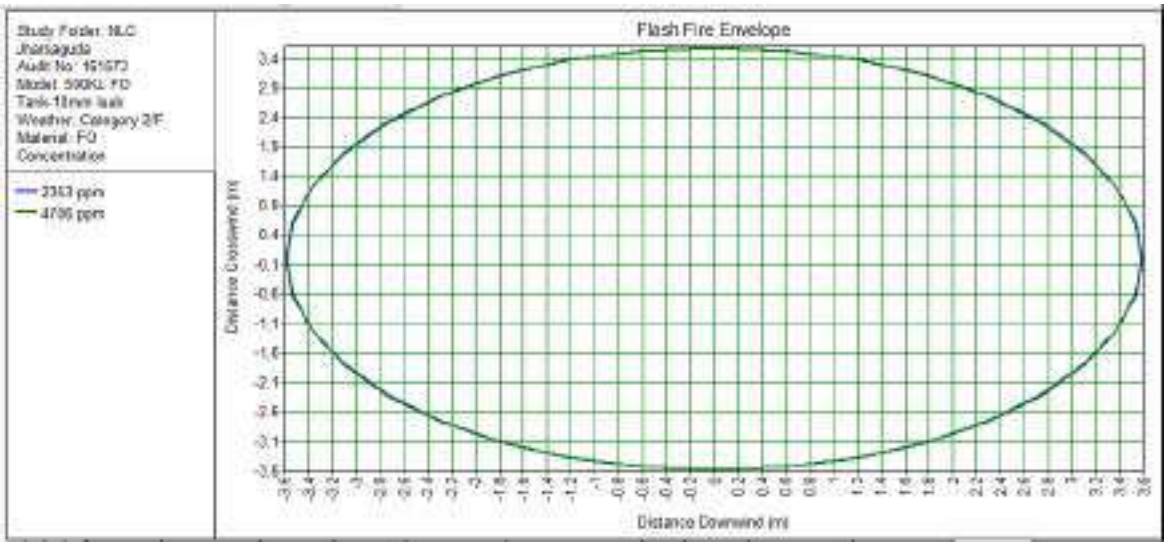

Fig 6: Flash Fire Envelope for 10 mm leak of 500KL FO Tank

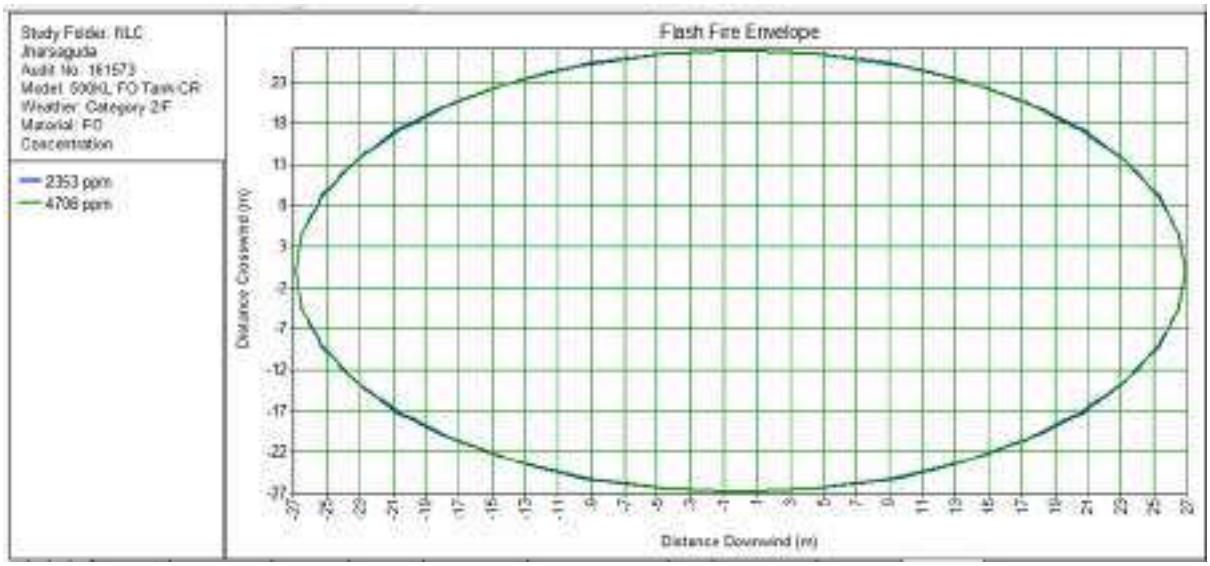

Fig 7: Flash Fire Envelope for Rupture of 500KL FO Tank

(ii) Pool Fire

On release of FO due to leakage in the transfer pipeline, FO will be spread on ground and spreading pool of FO will be formed. On early or delayed ignition, spreading pool fire will be observed. On delayed ignition of spreading pool, thermal radiation distances will be as given:

Hole size (mm)	Release rate (kg/s)	Release Duration (sec)	Pool Fire Envelope		
			Radiation Levels	Distance in meters	
			kW/m^2	2F	5D

10	0.45	3600	**4**	414	45.5
			12.5	20.0	22.9
			37.5	NR	NR
Rupture	N/A	N/A	**4**	310.3	344.6
			12.5	185.7	186.9
			37.5	NR	NR

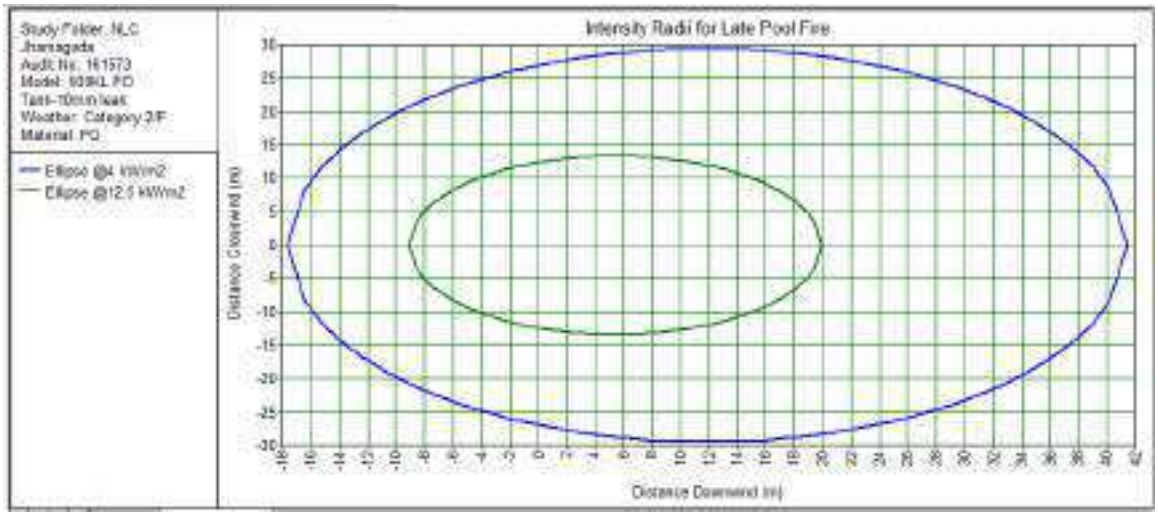

Fig 8: Late Pool Fire Ellipse for 10mm leak of 500KL FO Tank

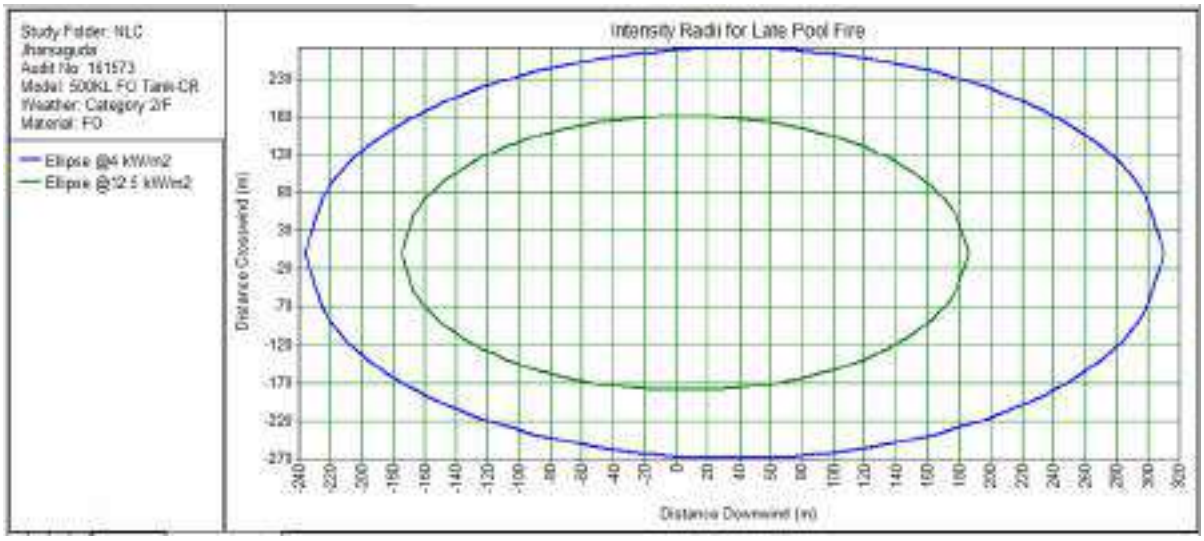

Fig 9: Late Pool Fire Ellipse for Rupture of 500KL FO Tank

Ammonia Storage Vessel (500 T capacity)

(i) Flash Fire Envelope

In the event of delayed ignition, vapours of Ammonia will be generated from the surface of spreading pool and dispersed into the atmosphere towards prevailing wind directions. The distances of Ammonia vapours within the farthest distance are given below:

Hole size (mm)	Release rate (kg/s)	Release Duration (sec)	Flash Fire Envelope		
			Furthest Extent	Distance in meters	
			in ppm	2F	5D
25	8.05	3600	50%	32.5	30.2
			100%	14.1	12.5
Rupture	N/A	N/A	50%	341.8	467.8
			100%	165.8	202.8

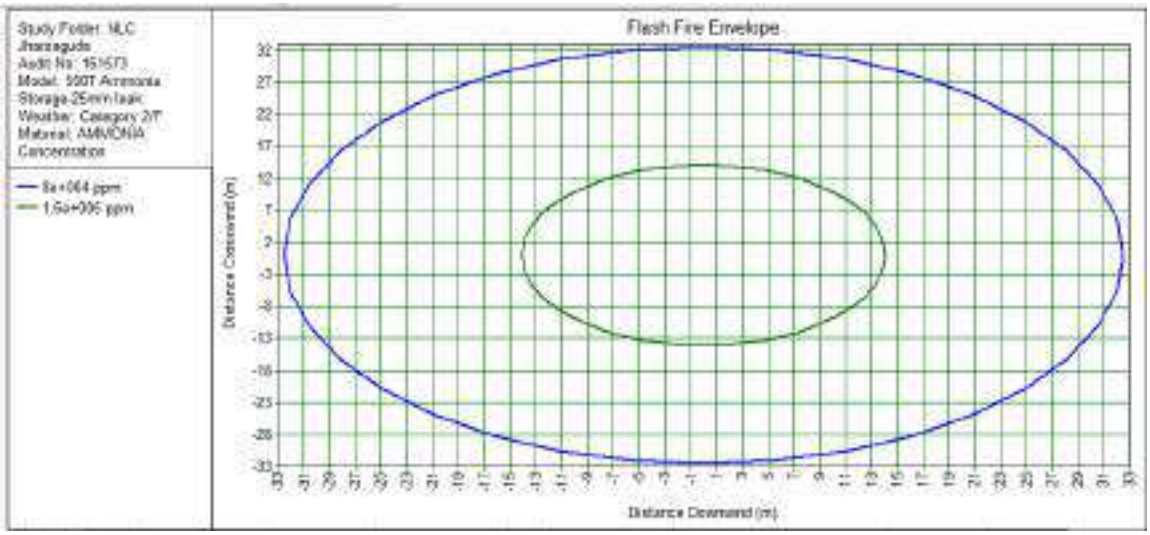

Fig 10: Flash Fire Envelope for 25mm leak of 500T Ammonia Storage Vessel

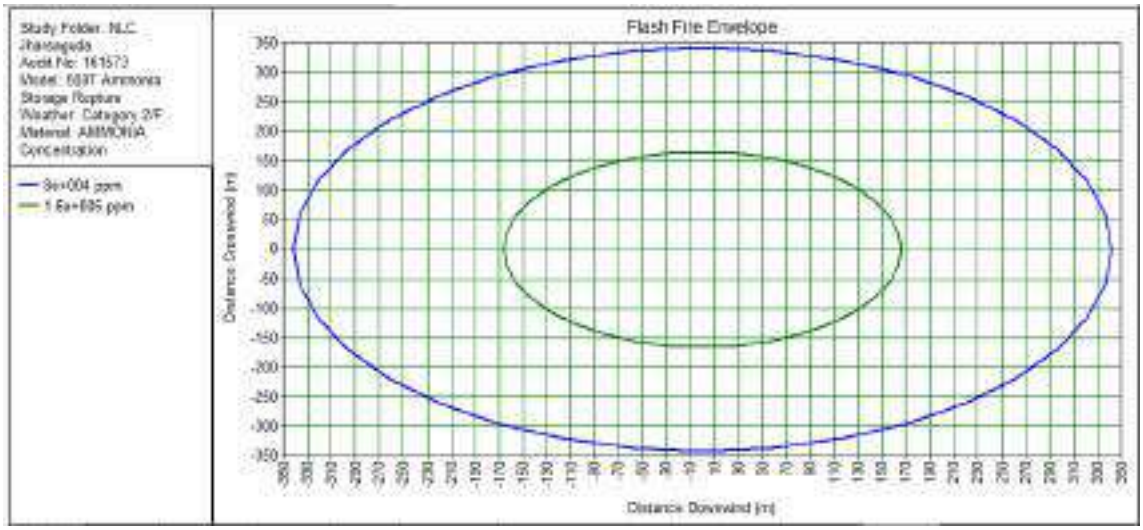

Fig 11: Flash Fire Envelope for Rupture of 500T Ammonia Storage Vessel

(ii) Pool Fire Envelope

On release of Ammonia due to leakage in the transfer pipeline, HSD will be spread on ground and spreading pool of Ammonia will be formed. On early or delayed ignition, spreading pool fire will be observed. On delayed ignition of spreading pool, thermal radiation distances will be as given:

Hole size (mm)	Release rate (kg/s)	Release Duration (sec)	Pool Fire Envelope		
			Radiation Levels	Distance in meters	
			kW/m²	2F	5D
25	8.05	3600	**4**	37.6	33.6
			12.5	31.1	31.8
			37.5	NR	NR

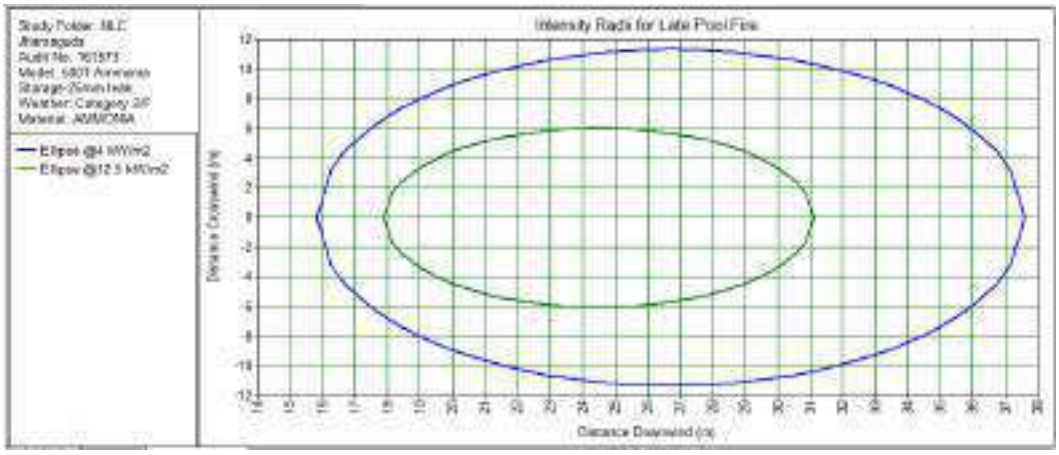

Fig 12: Late Pool Fire for 25mm Leak of 500T Ammonia Storage Vessel

Jet Fire

On release of Ammonia from pump seal in TWD pump house, jet fire will result in the event of immediate/early ignition of releasing Ammonia. Thermal radiation distances from Jet fire will be as given below:

Hole size (mm)	Release rate (kg/s)	Release Duration (sec)	Pool Fire Envelope		
			Radiation Levels	Distance in meters	
			kW/m²	2F	5D
25	8.05	3600	4	74.8	63.2
			12.5	63.6	52.8
			37.5	NR	NR

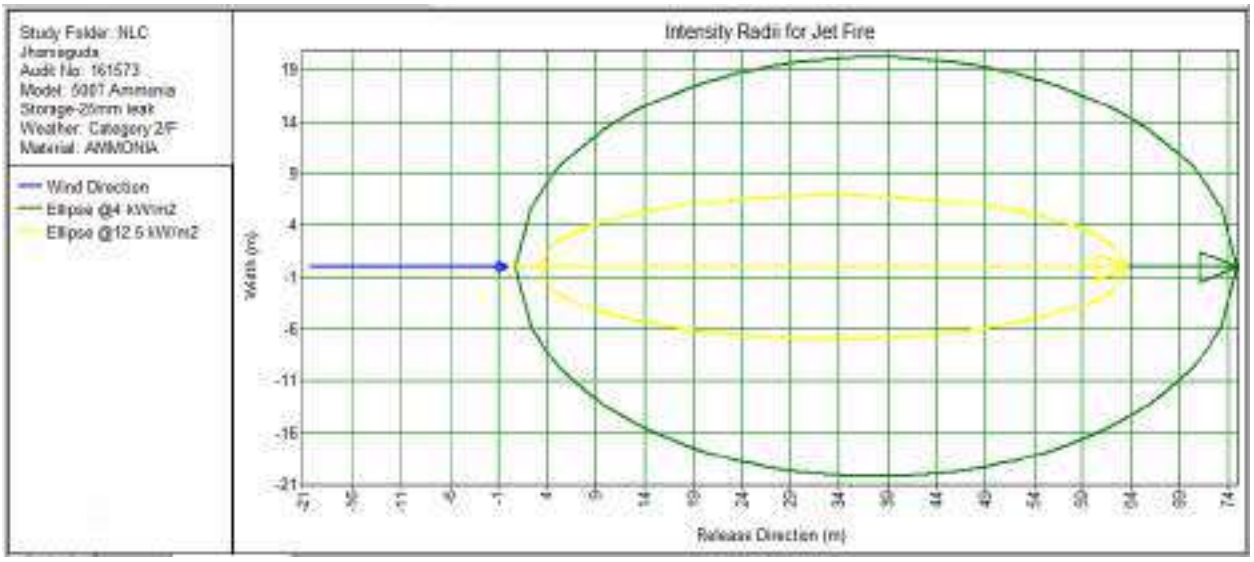

Fig 13: Jet Fire for 25mm Leak of 500T Ammonia Storage Vessel

Fireball

A fireball is an intense spherical fire resulting from a sudden release of pressurized liquid or gas that is immediately ignited. The best known cause of a fireball is a boiling liquid expanding vapor explosion (BLEVE). Fireball duration is typically 5 – 20 seconds. Fireball distances will be as given below,

Hole size (mm)	Release rate (kg/s)	Release Duration (sec)	Pool Fire Envelope		
			Radiation Levels	Distance in meters	
			kW/m²	2F	5D
Rupture	N/A	N/A	4	451.4	451.4
			12.5	134.4	134.4

			37.5	NR	NR

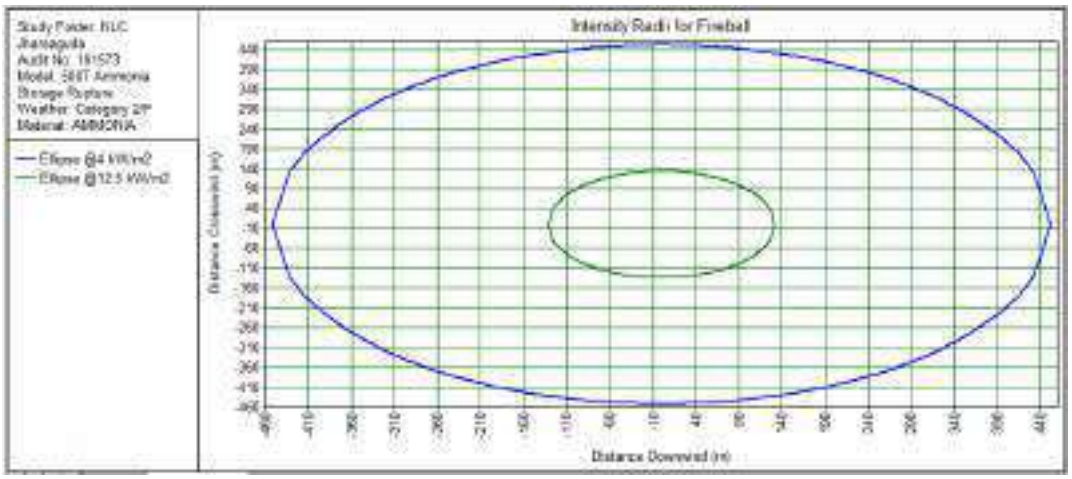

Fig 14: Fire Ball for Rupture of 500T Ammonia Storage Vessel

Over Pressure

When a large quantity of flammable vapor or gas is released, mixes with air to produce sufficient mass in the flammable range and is ignited, the result is a vapor cloud explosion (VCE). Without sufficient air mixing, a diffusion-controlled fireball may result without significant overpressures developing. The speed of flame propagation must accelerate as the vapor cloud burns. Without this acceleration, only a flash fire will result.

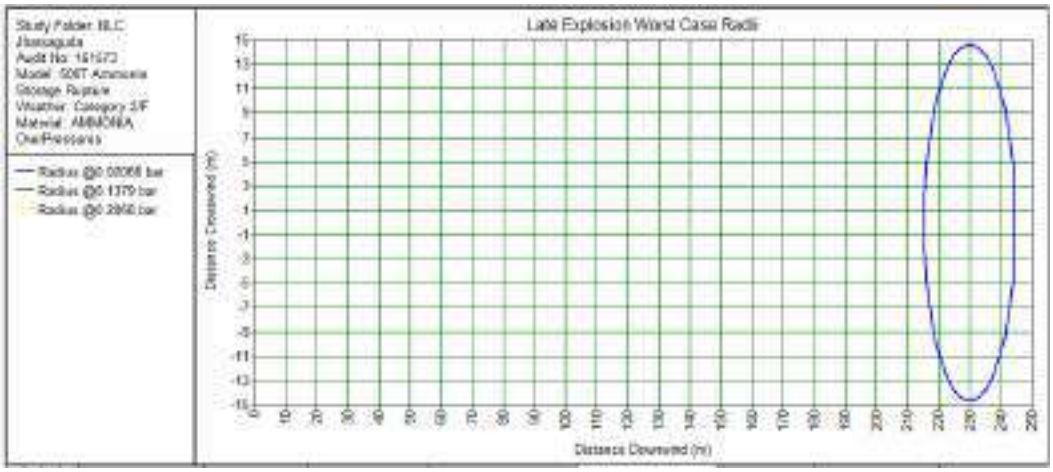

Fig 15: Over pressure Explosion for 500T Ammonia Storage

Toxic Effects

Hole size (mm)	Release rate	Release Duration	Toxic Effects	
			ERPG Levels	Distance in meters

	(kg/s)	(sec)	Ppm/ 3600 S	2F	5D
25	8.05	3600	**25**	18817.7	3860.2
			150	3818.0	1303.3
			750	906.0	546.6
CR	N/A	N/A	**25**	52513.8	20588.3
			150	10954.9	6095.3
			750	4110.6	3771.3

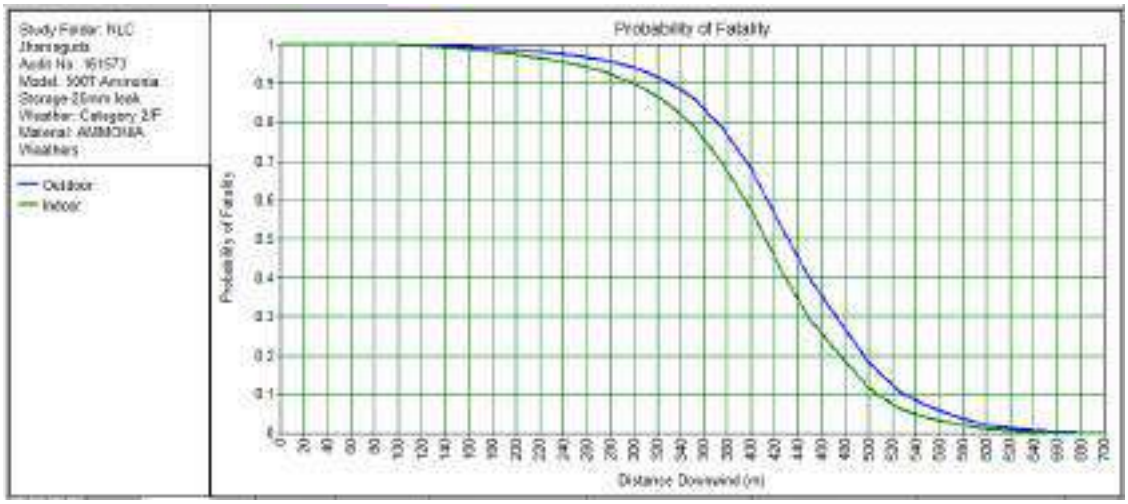

Fig 16: Toxic Case for 25mm Leak of 500T Ammonia Storage Vessel

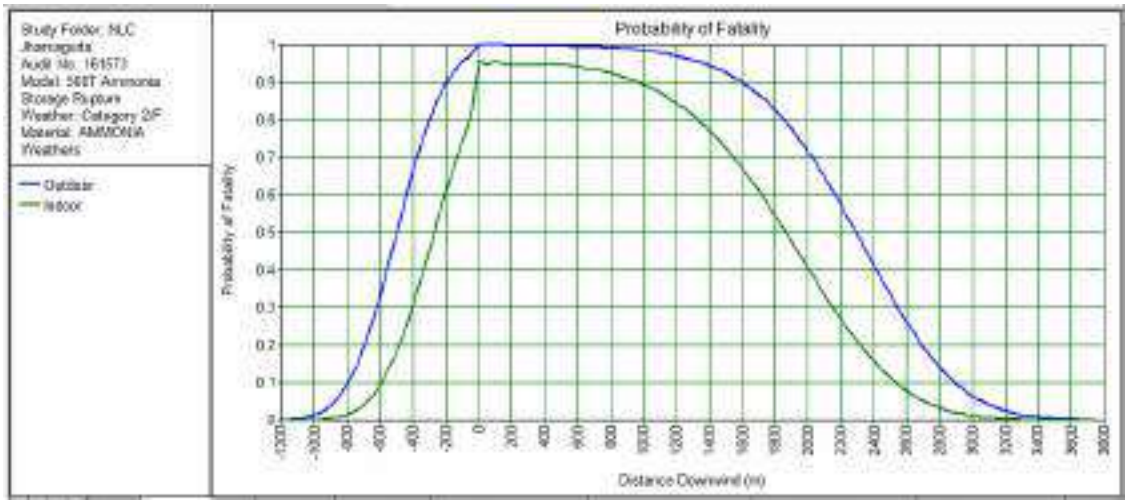

Fig 17: Toxic Case for Rupture of 500T Ammonia Storage Vessel

Chlorine Tonner (900Kg capacity)

Hole size (mm)	Release rate (kg/s)	Release Duration (sec)	Toxic Effects		
			ERPG Levels	Distance in meters	
			Ppm/3600 S	2F	5D
25	1.06	842	1	1	2781.5
			3	6803.7	1520.8
			20	NR	NR
CR	N/A	N/A	1	11948.6	3966.3
			3	5584.3	2094.6
			20	NR	NR

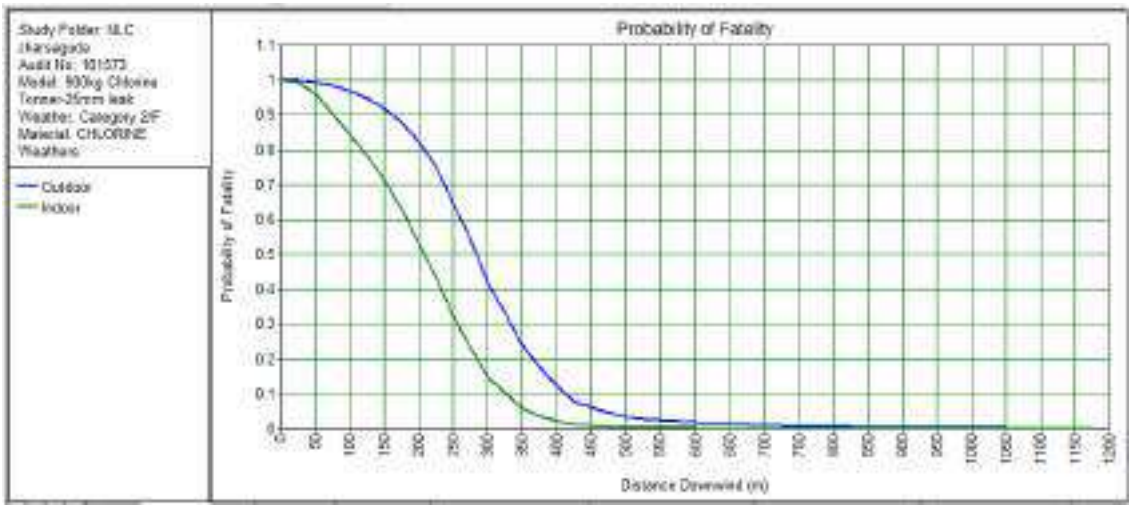

Fig 18: Toxic Case for 25mm Leak of 900Kg Chlorine Tonner

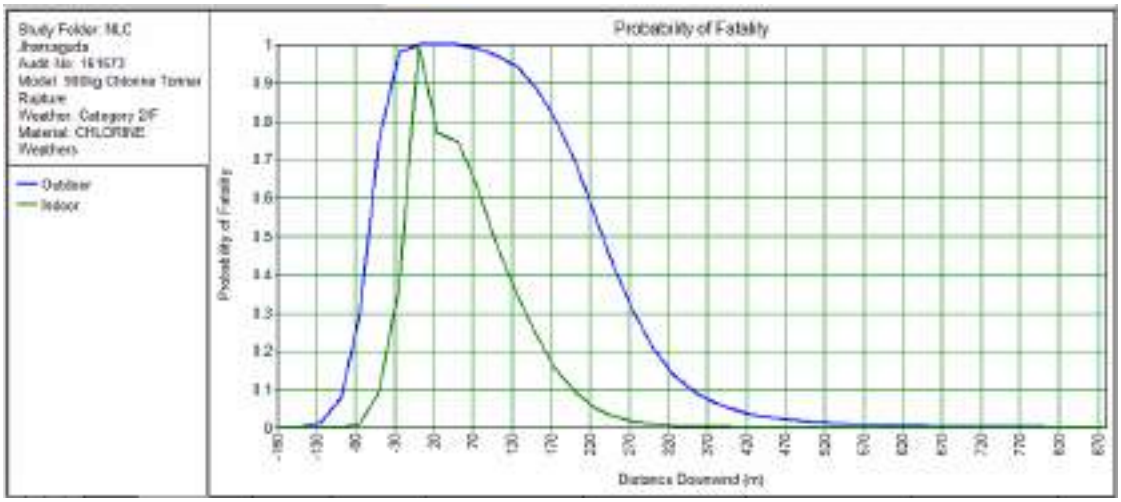

Fig 19: Toxic Case for Rupture of 900Kg Chlorine Tonner

ANNEXURE X

CSR & CER POLICY

NLC INDIA Limited

“Corporate Environmental Policy”

Policy Statement:

NLC INDIA LIMITED IS COMMITTED TO ENVIRONMENT FRIENDLY MINING AND POWER GENERATION BY ADOPTING LATEST POLLUTION CONTROL DEVICES, BEST LAND RECLAMATION PRACTICES , WASTE MINIMISATION CUM UTILISATION TECHNIQUES TO CONSERVE NATURAL RESOURCES, INTEGRATED WATER MANAGEMENT SYSTEM , INTRODUCING CLEAN AND ENERGY EFFICIENT TECHNOLOGIES, COMPLYING WITH STATUTORY REQUIREMENT AND WORK PROACTIVELY TO CONSERVE BIODIVERSITY, MAINTAINING ECOLOGICAL BALANCE THEREBY BRINGING LONGTERM POSITIVE IMPACT ON THE EMPLOYEES AND SURROUNDING COMMUNITY TO ACHIEVE THE GOAL OF SUSTAINABLE DEVELOPMENT.

CORPORATE ENVIRONMENT POLICY

Lignite Mining and thermal power generation are NLC India Ltd's prime activities. Besides, NLC INDIA Ltd diversifies into coal mining, acquisition of coal assets abroad and renewable energy. NLC INDIA Ltd affirms its commitment to produce quality fuel and power with focus on customer satisfaction, pollution control, maintaining a clean and green Environment, conservation of bio diversity and continual improvement of the environment. NLC INDIA Ltd gives top priority towards sustainable development as it leads to economic development in harmony with nature while meeting the needs of present generation without the compromising the requirements of future generations. As socially responsible Corporate citizen though NLC INDIA Ltd was implementing Best environment practices since inception and was bestowed with number of prestigious Environment awards such as Indira Gandhi Vrikshamitra Award, Paryavaran Puraskar awards etc in recognition of its achievement in Environment Field, it came out with a formal 'Corporate Environmental Policy' in July' 2011 as required by MOEF. However the present policy is the amendment of the earlier 2011 Policy and is complimentary to the National Environmental Policy.

This modification in the present policy is the outcome of the experience gained since past five decades, keeping in view the modifications / amendments made from time to time in environmental policies and rules and regulations imposed by MOEF (Ministry of Environment & Forest) and other organisations concerning mine closure, energy conservation, extraction of ground water etc. and also with the objective of revisiting the corporate policy.

NLC INDIA Ltd has dedicated team of Specialised Mining Department and Environmental cell that meticulously plans and implements Eco Restoration activities to convert the deserted mine spoils into green Oasis. The untiring efforts and outstanding achievements of these dedicated team was seen by prominent personalities like Honourable Dr.A.P.J.Abdul Kalam, Former President of India, Additional Secretary, Ministry Coal and Senior CIL officials during their recent visit and they lauded the efforts and innovative methods adopted by the team in bringing back the derelict land near to

original status. In recognition of its outstanding contribution to Eco restoration, Eco care and Environment Protection, Govt of India and other Environment Authorities like MOEF, Council of Power Utilities, KP Goenka Memorial team, Golden Peacock and SCOPE team has bestowed meritorious Environment awards to NLC INDIA Ltd in recognition of its world class standard Eco restoration activities viz, reclamation of the mined out area into afforestation, agriculture, Horticulture, fish culture, Bird sanctuary, Zoo etc. With these efforts, NLC INDIA Ltd has earned a name of Green and reliable mining cum power company in the eyes of the general public and stack holders. NLC INDIA Ltd will continue its efforts in these directions to break its previous records not only in mining and power generation but also in the field of Eco restoration , eco care and environment protection. The present policy is prepared with the aim of sustainable mining and power generation for a better clean and green environment at NLC.

CORPORATE ENVIRONMENT VISION

This Policy has a vision of Green Company with 100% compliance of environmental statutes applicable to integrated lignite / coal mining and thermal power generation. By thinking globally and acting locally NLC INDIA Ltd plays an active role in society to address emerging global environmental issues such as climate change, desertification, biodiversity etc. while committed to economic development.

CORPORATE ENVIRONMENT POLICY

NLC INDIA Ltd is committed to

- ✓ Integrate the interest of the business with environment concern towards sustainable mining and power generation.
- ✓ Implement best Environment Management Practices towards prevention and control of pollution and provide clean environment.
- ✓ Filling the de-coaled area scientifically in accordance with the guidelines of Ministry of Coal.
- ✓ Combat climate change by increasing green cover and taking up CO_2 sequestration projects.
- ✓ Integrate Water Management system based on the principle Reduce, Recycle, Reuse waste water, harvesting of rain water and artificial recharge for a sustainable water resource.
- ✓ Maximize utilization of fly ash, bottom ash ,pond ash and reclaim abandoned ash ponds to green cover.
- ✓ Progressively adopt cleaner and energy efficient technologies.
- ✓ Promote Conservation of biodiversity and natural resources.
- ✓ Regular monitoring to comply with regulatory standards and compliance of statutory requirements.
- ✓ Provide Significant contribution to social and economic development of surrounding community under Corporate Social Responsibility (CSR)
- ✓ Encourage R&D activities to find innovative solutions for continuous improvement in the Environment and related field.
- ✓ Transparency in reporting system by publishing compliance status in the electronic media.
- ✓ Providing adequate funds and qualified personnel in the environment subject for successful Environment Management of Units.
- ✓ Adequate training to employees and public creating awareness and measures to protect health of employees.
- ✓ Strive for continual improvement in our environment performance by setting challenging targets, measuring progress, taking corrective action and communicating environmental information to all concerned.

NLC India Limited

CORPORATE SOCIAL RESPONSIBILITY POLICY

1.0. Prelude :

NLC India Limited (NLCIL), hereinafter referred as "Company" has been carrying out peripheral developmental activities for betterment of communities in the surrounding villages since inception. The company imbibe Corporate Social Responsibility (CSR) as one of its core values as reflected in the company's Vision statement & Values.

Company's Vision - *To emerge as a leading Mining and Power Company, with Social Responsiveness accelerating Nation's growth*

Company's Values

N - National Orientation
L - Learning and Development
C - Commitment for Excellence
I - Innovation and Speed

Company's Objectives

1. To carry out detailed exploration of lignite deposits in and around Neyveli region and also to assist/ carry out similar exploration and exploitation work in other parts of the country, with due attention to quality, economy and efficiency.
2. To Mine Lignite and Coal for generation of Power and other Minor minerals incidental to Mining.
3. To undertake generation of power using Renewable energy sources viz., Solar and Wind.
4. To ensure optimum utilisation of human resources to encourage innovation and creativity with due emphases on productivity, discipline, career growth and quality of life of employees.
5. To extend Consultancy services to other organisation in such areas where NLCIL has required professional expertise.
6. To continue to make efforts towards reclamation of mined out land for afforestation and environment care including rehabilitation of displaced persons as a part of nation building effort.
7. To adopt appropriate strategies for all round development of the Company in physical, financial, environmental and societal spheres as a responsible Corporate Citizen.

1.1 CSR MISSION, OBJECTIVES AND GUIDING PRINCIPLES

1.1.1. CSR Mission Statement:

In alignment with Mission of the company, NLCIL through its CSR initiatives will continue to enhance the quality of life of the less privileged in society by providing necessary infrastructure and to be a credible and transparent organisation striving for the eradication of poverty and maintain ecological balance.

1.2. The objectives of NLCIL CSR Policy are to :

i. Identify & focus education as a priority and take up suitable interventions for betterment of educational facilities at village level.
ii. Concentrate on health, hygiene and environmental up gradation to make village life clean and hygiene.
iii. Educate and encourage village youth to take up self-employment and vocations to eke out livelihood.

iv. Build needed infrastructure to develop the local community enabling them towards sustainable development.
v. Provide support and participate in government efforts in social, economic and environmental development of the less privileged.

1.3. CSR Principle of NLCIL:

NLCIL believes that there is no sustainable alternative to doing business other than by incorporating the principles of profit, people and planet, thus measuring the performance in terms of economic, social and environmental impact (Triple Bottom Line approach).

1.4 CSR THRUST AREAS AND STRATEGIC INITIATIVES:

For purposes of focusing its CSR efforts in a continued and effective manner, the following nine thrust areas have been identified. The thrust areas identified by NLCIL are in

i. Environment Protection
ii. Infrastructure Development
iii. Drinking water/ Sanitation
iv. Healthcare/ Medical facility
v. Community Development
vi. Education
vii. Skill Development / Empowerment
viii. Disaster Management
ix. Arts, culture and sport

1.5 For contributing towards the cause of Environment Protection, NLCIL will support the 3 UN Global Compact Principles pertaining to the Environment as below:
Support a precautionary approach to environmental challenges;
Undertake initiatives to promote greater environmental responsibility;
Encourage the development and diffusion of environmentally friendly technologies.

1.6 NLCIL will dovetail its CSR activities in a manner that it facilitates 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.

2.0 CSR COMMITTEE:

Company shall follow a three tier CSR committee structure. While defining structure the term Region is defined as the operational areas of NLCIL across India.

2.1 Structure:
As per the norms of the government, the Board Level CSR Committee shall consist of three or more Directors, out of which one director shall be Independent director. Yet to ensure ease in operation NLCIL operates with a three tier CSR committee of Board Level CSR Committee, Below Board Level CSR Sub Committee and Regional CSR Committee.

2.1.1 Board Level CSR Committee:
44The committee shall be headed by an Independent Director as its Chairman/Chairperson and the composition of the committee shall be as decided by the Board of Directors from time to time.

2.1.2 Below Board Level CSR Committee:

Corporate Head (CSR)	:	Chairman
Senior Executive (Mines)	:	Member
Senior Executive (Thermal)	:	Member
Senior Executive (Finance)	:	Member

2.1.3 Regional CSR Committee:

Each project (Neyveli, Barsingsar, Talabira and other upcoming new projects) shall have separate Regional CSR Committee.

Unit Head/Project Head	:	Chairman
Finance Head of Unit/Project	:	Member
HR/CSR Head of Unit/Project	:	Member

(For Neyveli Region, Unit Head /CSR will be the Chairman)

2.2 Role of CSR Committee

2.2.1 Role of Regional CSR Committee

2.2.1(1) The Regional CSR Committee after conducting base line survey may prepare service activities or list of projects to be undertaken based on the information gathered.

2.2.1(2) The Regional CSR Committee shall identify possible NGOs and other agencies for taking up CSR activities on behalf of the Company.

2.2.1(3) The Regional CSR Committee may also take the help of professional bodies in the field (NGOs) or other agencies and prepare the plan for CSR activities for the year.

2.2.1(4) The Regional CSR Committee shall liaise with Governmental and other agencies and associate with the NGOs concerned for implementation of proposed activities.

2.2.1(5) The Regional CSR Committee shall meticulously document the CSR programmes, expenditure, procurement etc., and put the information in the public domain.

2.2.1(6) The Regional CSR Committee shall monitor and oversee the implementation of the CSR activities / programmes approved by the Company.

2.3 Below Board Level CSR Sub Committee:

2.3(1) The Below Board Level CSR Sub Committee shall identify the list of projects to be undertaken based on the report submitted by the Regional CSR Committee.

2.3(2) The Below Board Level CSR Sub Committee shall make the information available to the concerned Ministry / Government.

2.3(3) The Below Board Level CSR Sub Committee shall ensure participation of CSR Awards and recognitions.

2.3(4) The Below Board Level CSR Sub Committee shall meet once in a quarter, review the progress of the implementation of CSR activities. The Committee shall also consider the requests of the stake holders so received, if any and recommend as a proposal to Board Level CSR Committee.

2.3(5) The Below Board Level CSR Sub Committee shall also review the continuation or otherwise of the on-going centralized CSR initiatives and identification and adoption of fresh centralized CSR initiatives.

2.3(6) The Below Board Level CSR Sub Committee shall also submit quarterly reports regarding the progress in the implementation of CSR Activities to the Board Level CSR Sub Committee.

2.4 Board Level CSR Committee:

2.4(1) The Board Level CSR Committee shall, formulate and recommend to the Board, a Corporate Social Responsibility Policy which shall indicate the activities to be undertaken by the company as specified in Schedule VII of Companies Act, 2013.

2.4(2) The Board Level CSR Committee shall recommend the amount of expenditure to be incurred on the CSR activities for the year.

2.4(3) The Board Level CSR Committee should meet every 3 years to monitor the Corporate Social Responsibility Policy of the company, The recommendations of which shall be submitted to the Board for its approval and ensure disclose of the contents of such Policy in NLCIL Annual report and also place it on the company's website.

2.5 POWERS FOR APPROVAL

2.5.1 CSR programmes as may be identified by each work centre/corporate office channelizing it through the Regional CSR Committee will be required to be put up to the Below Board Level CSR Committee at the beginning of each financial year. The Below Board Level CSR Committee will then verify the requirements and put up the report to Board Level CSR committee for its approval.

2.5.2 The below Board Level CSR Committee will also ensure on all work orders for the CSR projects / programs undertaken. The Regional CSR Committee will render all needed support to the Below Board Level CSR Committee for initiating the activities.

2.5.3 For meeting the requirements arising out of immediate & urgent situations, CMD is authorized to approve proposals in terms of the empowerment accorded to him in accordance to the Below Board Level CSR Committee.

2.5.4. The Board of NLCIL should ensure that the activities as are included in Corporate Social Responsibility Policy of the company are undertaken by the company. The Board of NLCIL shall ensure that the company spends, in every financial year, at least two percent of the average net profits of the company made during the three immediately preceding financial years, in pursuance of its Corporate Social Responsibility Policy.

2.5.5. Sustainable development policies shall touch upon social issues such as empowerment of the weaker sections, holistic development of backward regions, improvement of the working conditions of labour, etc. Activities undertaken by companies to address basic issues pertaining to health, nutrition, sanitation and education needs of the impoverished communities, for the promotion of skill development, capacity building and inclusive growth of society, are all sustainability activities.

2.5.6.An amount as deemed fit by the Board, may be kept in reserve out of the CSR budget for contributing towards Natural calamity relief work in case of such unfortunate incident taking place in the country. If remained unutilized till the 3rd quarter, this fund may be used for carrying out other CSR activities in the last quarter of the financial year. This however, should not depend upon the CSR budget allocation and will only be accounted while calculating the overall CSR expenditure of NLCIL.

2.5.7. If the company fails to spend such amount, the Board shall, in its report made under clause (o) of sub-section (3) of section 134 of the Act, specify the reasons for not spending the amount.

3.0. CSR Fund:

3.1. It will be ensured that Company spends in every financial year, at least two percent (or the percentage as may be fixed by Government from time to time) of the average net profit of the company made during the three immediately preceding financial years for activities under Corporate Social Responsibility policy. CSR activities/Projects that are to be taken up in the new project areas as mandated would be taken up by accounting the expenditure in the respective projects cost and the same will be over and above the CSR spent by the Company for the respective financial year. Accordingly Company will make a provision for CSR in the project cost itself for new projects.

The regular activities would be undertaken by the company essentially for the social welfare of employees/contract workmen, in and around the surrounding areas of its project sites, by providing an annual budget for the same, which shall not form part of CSR expenditure of the company.

3.2. The stipulated percentage of average net profit is to be spent every year in a manner specified in Section 135 of the Companies Act 2013 and CSR Rules framed there under and further in accordance with the DPE Guidelines.

3.3 The CSR expenditure shall include all expenditure including contribution to corpus, for projects or programs relating to CSR activities approved by the Board on the recommendation of the CSR committee.

3.4. Subject to provisions of sub-section (5) of section 135 of the Companies Act, 2013, the expenditure incurred on CSR projects or programs or activities undertaken in India shall only be considered for the purpose of CSR Rules.

3.4.1 The provisional CSR Budget for every financial year shall be computed based on 2% of the average net profit of the company made during the three immediately preceding Financial years and got approved by the Board before 31st March of every year for commencement of CSR activities from 1st April of the succeeding Financial year.

However, review of the provisional CSR budget will be made after publication of audited net profit for the financial year and final CSR budget shall be computed accordingly as per section 198 of the Companies Act 2013.

3.5 Bifurcation of CSR fund – In context of CSR activities

3.5.1 Company shall earmark 60% of CSR funds for the National Theme being communicated by Govt. of India

3.5.2 The other CSR programs may be identified through structured Baseline survey or Need assessment of the Areas identified by the CSR Committee. The CSR committee may also consider request letters received during the year, duly weighed by an external agency.

3.5.3 In case the baseline identifies CSR requirements in the area which is the CSR theme for the year as directed by the competent authority, in such cases CSR projects undertaken through baseline, request letters or need assessment can also be considered under thematic CSR.

3.5.4 This proportion may vary depending on the directions as may be issued by the Department of Public Enterprises or the Government from time to time.

4.0. Scope of CSR activities and Ratio of CSR spend:

4.1 Company shall give preference to the local areas in selecting the location of CSR activities. The Company shall earmark at least 75% of the CSR fund for carrying out Socially Responsible activities, in the local areas.
Local Areas: Areas within 25 Kms from the boundaries of projects/Mine/Area HQ/Company HQ.

4.2. Company may undertake CSR activities within the State of the project or anywhere in the country with the remaining 25% CSR fund.

4.3. This proportion may vary depending on the directions as may be issued by the Department of Public Enterprises or the Government from time to time.

4.4. Preference will be given to Aspirational Districts (Annexure I of office memorandum, MCA dated 10th Dec'2018). Any further guidelines from Government of India on consideration for Aspirational Districts shall be followed.

5.0. CSR activities:

5.1. The main focus of CSR activities will be on sustainable development, inclusive growth and to address the basic needs of the deprived in surrounding communities. The philosophy and spirit of CSR shall be consistent with the CSR provisions of the Companies Act 2013, Schedule VII of the Act and CSR Rules there under, the Guidelines and the policy directions issued by the Government from time to time. The version of the Schedule VII of the Act as amended up to 30.05.2019 is placed as Appendix-A.

5.2. While selecting CSR activities / projects, it shall be ensured that the activities chosen are relatable to Schedule VII of the Companies Act 2013.

5.3. While selecting CSR programs / activities, priority shall be given to the issues which are of foremost concern in the national development agenda, aiming at inclusive growth and sustainable development, like safe drinking water for all, provisions of toilets especially for girls, health and sanitation, education, skill development etc. The main focus will be to address the basic needs of the deprived, under-privileged and weaker sections of society, which comprise of SC, ST, OBC, Minorities, Old aged, Women / Girl children, physically challenged, etc.

5.4 The budget allocated for CSR and Sustainability activities / projects planned for each financial year is expected to be spent within that year. If due to some reason, the budget of a year remains unutilised, the same would not lapse. Instead, it would be carried forward to the next year for expenditure on CSR and Sustainability activities, which were planned for implementation in the previous year, but could not be completed due to some reason. The surplus arising out of the CSR projects or programmes or activities shall not form part of the business profit of Company.

5.5 Beneficiary Segmentation: The main focus will be to address the basic needs of the deprived, under-privileged and weaker sections of society, which comprise of SC, ST, OBC, Minorities, Old aged, Women / Girl children, physically challenged, etc.

5.6 Identification of CSR activities *at Corporate and work centre level will be done by means of any of the following:*

a) Need Identification/Baseline Studies by professional institutions/agencies.
b) Internal need assessment by cross-functional team at the local level (In case of minor projects)
c) Receipt of proposals/requests from District Administration/local Govt. etc duly weighed by external agency
d) Discussions and request with local representatives/Civic bodies/Citizen's forums/Voluntary Organizations duly weighed by external agency

6.0 CSR Base Line Survey / Need Assessment:

6.1 Company may get a base line / need assessment survey done prior to the selection of any CSR activity, depending upon the need and significance of such CSR Activity.

6.2 Normally the baseline / need assessment survey would be done in consultation with the stakeholders – District Administration, Peoples' representatives, Villagers, Local bodies, NGOs, etc. utilising the spare in-house expertise, resources and capacity.

7.0. CSR Activities Implementation:

7.1 Budget preference will be given to the projects which have to be made sustainable. CSR activities will be undertaken by the Company as projects or programs or activities (either new or ongoing), excluding activities undertaken in pursuance of its normal course of business and all such activities will be executed after following due procedures.

7.2. The Board may decide to undertake its CSR activities recommended by the CSR Committee, through a registered Trust or a registered Society or a Company established under Section 8 of the Companies Act, 2013, either singly or along with its subsidiary or associate company or along with any other company or holding or subsidiary or associate company of such other company or otherwise: Provided that if such trust, society or company is not established by the company either singly or along with its subsidiary or associate company or along with any other company or holding or subsidiary or associate company of such other company shall have an established track record of three years in undertaking similar programs or projects; the company has specified the project or programs to be undertaken through these entities, the modalities of utilization of funds on such projects and programs and the monitoring and reporting mechanism.

7.3 NLCIL may also collaborate with other companies for undertaking projects or programs or CSR in such a manner that the CSR committees of respective companies are in a position to report separately on such projects or programs in accordance with the Companies (CSR Policy) Rules, 2014. Companies Act 2013 and CSR Policy of the Company.

7.4 The Board after getting the recommendations of the CSR committee shall approve the CSR projects and programs which the company plans to undertake in a year, specifying modalities of execution of such projects or programs and implementation of schedules for the same. However, CMD may accord approval to carry out the CSR Activities which are emergent in nature and the details of such activities shall be put up to the CSR Committee and Board for information. The CSR programs and activities approved by the Board or by the CMD as the case may be will be executed through Designated Nodal Officer(s). CGM / Group Head (CSR) will be the Nodal Officer for all the CSR activities of NLCIL and its subsidiary companies.

7.5 The Board level CSR committee shall institute a transparent monitoring mechanism for implementation of the CSR projects or programs or activities undertaken by the company.

7.6 The Board level CSR committee shall monitor process of such projects or programs from time to time. In addition CMD, Director (HR) and other FDs will review the progress of CSR Projects/Programmes on a quarterly basis.

7.7 Company will organise regular dialogue and consultation with key stakeholders namely the State / District Administration / Local Bodies and other Agencies concerned to ascertain their views and suggestions regarding the CSR activities and sustainability initiatives undertaken by the company.

7.8 To ensure the participation of internal stakeholders, an enterprise-wide institutional arrangement will be made, so that the philosophy and spirit of CSR and Sustainability is imbibed by the employees & those involved in the execution or implementation of the programs & activities. Towards this, Organizational and Collaborative Capacity Building programs & activities such as Awareness Training, Seminars and Workshops on CSR and Sustainability may be arranged for / conducted by the company, through Institutions with established track records of at least three financial years.

7.9 This would be pursued on a regular basis or by providing corpus fund for perpetuating such Capacity Building programs & activities, utilizing an amount from the allocated CSR fund within the limits stipulated in the Act, Rules and Guidelines. As per provisions of the Companies (CSR Policy) Rules, 2014, Company may build CSR capacities of their own personnel as well as those of their Implementing agencies through Institutions with established track records of at least three financial years but such expenditure, including expenditure on administrative overheads, shall not exceed five percent of total CSR expenditure of the company in one financial year.

7.10. CMD is authorized to make minor modification in the Corporate Social Responsibility Policy, if any, in the overall interest of the company.

7.11 NLCIL can pool CSR fund set-up by Central Government as prescribed in the companies (CSR Rules, 2014). Contribution to private funds such as those set up by non - Profit Company etc. is not allowed as per CSR rules.

7.12 Any or all provisions of CSR Policy would be subjected to revision/amendment in accordance with the guidelines / regulations on the subject as may be issued from government/ relevant statutory authorities, from time to time.

7.13 PROJECT BASED APPROACH:

7.13.1 NLCIL will follow a project based accountability approach to stress on the long term sustainability, where its action plan will be distinguished as short-term, middle term and long term qualified as:

Short Term – Less than one year

Medium Term – 1 year to 3years

Long Term- more than 3 years

7.13.2 While identifying long term programmes, all efforts must be made to the extent possible to define the following:

a. Programme objectives.
b. Baseline survey – It would give the basis on which the outcome would be measured.
c. Implementation schedules - Timelines Prescribed Responsibilities and authorities

8.0 CSR Impact Assessment:

8.1 Company shall get an impact assessment study done by external agencies of the CSR activities / projects undertaken, provided the threshold value of such activity is more than Rs. 15 Crores.

9.0 Ownership of Assets created in CSR Activities:

9.1 The assets and infrastructure developed / created through CSR fund at locations not being the premises under the control and management of the company will be entrusted to the concerned authorities / stakeholders.

10.0 CSR Reporting:

10.1 A brief outline of company's CSR Policy including overview of the projects or programs proposed to be undertaken / under completion / completed during the financial year shall be included in the Director's Report, as per format prescribed under the CSR Rules.

11.0. Communication Strategy:

11.1 The approved CSR Policy of the company shall be displayed on the company's website, as per the particulars specified in the Annexure to the Companies (CSR Policy) Rules, 2014.

11.2 During important events such as launching a project, completion of a project or inauguration of a facility in the area of CSR, Corporate Communications and Public Relations Division shall give wide publicity to the event through invitation to the media personnel and issue of press release in the print media, TV channels etc.

11.3 The CSR initiatives of the company shall be displayed on the company's website by the Corporate Communications and Public Relations Division.

11.4 The Corporate Head/CSR will be the nodal officer for CSR projects/programmes including Joint Venture and of Subsidiaries. Corporate Communication Division shall also bring out special articles on CSR initiatives of the company in the Corporate House Journal.

11.5 As per SEBI guidelines disclosure of all CSR activities is mandatory. Accordingly, the CSR initiatives of the company shall be included in the Annual Report of the company.

11.6 The Board's report of the company pertaining to the financial year shall include an annual report on CSR containing particulars specified in relevant Annexure.

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APPENDIX-A

The Companies Act 2013

The version of the Schedule VII of the Act

i. Eradicating hunger, poverty and malnutrition

Promoting health care including preventive health care and sanitation, including contribution to the Swatch Bharat Kosh set up by the Central Government for promotion of sanitation

Making available safe drinking water

ii. Promoting education including special education

Employment enhancing vocation skills especially among children, women, elderly and the differently abled

Livelihood enhancement projects

iii. Promoting gender equality, empowering women

Setting up homes and hostels for women and orphans; setting up old age homes, day care centres and such other facilities for senior citizens

Measures for reducing inequalities faced by socially and economically backward groups

iv. Ensuring environmental sustainability, ecological balance

Protection of flora and fauna

Animal welfare

Agro-forestry

Conservation of natural resources

Maintaining quality of soil, air and water including contribution to the Clean Ganga Fund set up by the Central Government for the rejuvenation of river Ganga

v. Protection of national heritage, art and culture including restoration of buildings and sites of historical importance and works of art

Setting up public libraries

Promotion and development of traditional arts and handicrafts

vi. Measures for the benefit of armed forces veterans, war widows and their dependents

vii. Training to promote rural sports, nationally recognized sports, Paralympics sports and Olympic sports

viii. Contribution to the Prime Minister's National Relief Fund or any other fund set up by the Central Government for social-economic development and relief and welfare of the scheduled castes, the scheduled tribes, other backward classes, minorities and women

ix. Contributions of funds provided to technology incubators located within academic institutions which are approved by the Central Government

x. Rural development project

xi. Slum area development (shall mean any area declared as such by the Central Government or any state Government or any other Competent Authority under any law for the time being in force).

xii. Disaster Management, including relief, rehabilitation and reconstruction activities.

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ANNEXURE XI

WATER ALLOCATION LETTER

Annexure - 1B

Government of Odisha
Department of Water Resources
*****

No. 19552 /WR., Date: 4/9/19
WR-MAJH-WRC-0015-2019 (OSWAS File)
Irr.-II-WRC-15/19 (Physical File)

From

Sri Pradeep Kumar Dash, OAS, (SS),
Special Secretary to Government.

To

The General Manager,
Project Head Talabira Project,
M/s NLC India Ltd. Plot No.-3087,
Chaitanaya Nagar, Sambalpur-768001

Sub: Phase wise allocation of 90 cusecs of water from Hirakud Reservoir in favor of M/s NLC India Ltd. near Tareikela, Kumbhari Village, Sambalpur District.

Sir,

I am directed to invite reference on the subject noted above and to say that after careful consideration, Government in Water Resources Department have been pleased to allocate 90 cusecs of water from Hirakud Reservoir to M/s NLC India Ltd. near Tareikela, Kumbhari Village, Sambalpur District in the following phased manner with the terms and conditions mentioned below:-

Phase I- From dated of agreement to March 2023:	13 cusecs
Phase II- April 2023 to Oct 2023:-	18 cusecs
Phase III- November 2023 to June 2024:-	42 cusecs
Phase IV- July 2024 to November 2024:-	60 cusecs
Phase V- December 2024 to June 2026:-	72 cusecs
Phase VI- From July 2026 onwards:-	90 cusecs

Terms & Conditions:-

1. M/s NLC India Ltd. shall make suitable arrangement to take the water from the Irrigation works at which it will be supplied. M/s NLC India Ltd. shall not use the water supplied to him for any purpose other than that which is specified in the schedule.

P.T.O

2. If the water rate/license fees for the aforesaid quantity of water or any part thereof, is not paid on or before the date specified in agreement it shall become payable at once (unless the Government sanctions for special reason an extension of time) and M/s NLC India Ltd. and the sureties shall be liable jointly and severally to pay the same with compound interest at the rate of two percent per mensem from the date of default. All amount due to the Government under terms of these presents shall if not paid in time, be recoverable as a public demand under the Orissa Public Demands Recovery Act, 1962.

3. (i) M/s NLC India Ltd. shall be liable for criminal and civil action if by drawal of water, the rights of any third party are affected and shall indemnify the Government against all claims for damage preferred by person or persons affected by the permission granted.

(ii) M/s NLC India Ltd., shall not without prior permission in writing from the Government lay pipeline Government or communal lands. If the pipe lines have to pass through Government lands permission of the Government for this shall be taken separately which may be granted subject to the protection of rights of Government or community, as the case may be.

(iii) M/s NLC India Ltd. shall not draw or lift water more than the quantity mentioned in the requisition or order and not exceeding the volume mentioned in the Schedule except with the prior approval of the Government. The Executive Engineer shall assess the fees to be charged as per Unit/quantity of water drawn or allocated whichever is higher. If drawal is more than the allocation, a penal rate at six times the rate specified in Schedule-II shall be charged on the quantity of excess drawal, in addition to the normal bill on allocated quantify. The excess drawal is permissible for a maximum period of six months, within which licensee shall have to apply for a higher allocation of water with reason where the licensee fails to so apply for such higher allocation or where the licensee is refused for such higher allocation, the agreement shall be liable to cancellation and the water supplied shall be stopped thereafter.

(iv) The permission granted shall not be deemed to exempt M/s. NLC India Ltd., from liability to payment of water charges lawfully assessable at the rate as may be prescribed by Govt. from time to time.

vi) Government reserves the right to suspend or cancel the permission in case of violation of any of the covenants.

4. M/s NLC India Ltd. at his own cost shall install a Flow Meter or a suitable measuring device for measurement of water drawn or lifted by him from the irrigation water source as per the procedure laid down in rule 23-A(b). The Executive Engineer shall visit the location of drawal or lifting of water, verify the quantities of water drawn or lifted by M/s NLC India Ltd. and ensure such control as may be necessary for administering the drawal or lifting of water. Assessment of water rate shall be made as per the quantity of water drawn or allocated whichever is higher. In case of any defect or non-functioning of the Flow Meter, the licensee shall bring the fact to the notice of the Executive Engineer forthwith and take appropriate steps to remove the defects in the Meter or for replacement thereof within a period of three months and in such cases the fees shall be charged on the quantity of water allocated for the said period of three months or till the defect in the Meter is removed or the Meter replaced, as the case may be, whichever is earlier, and where the licensee fails to bring the defect or non-functioning of the Meter to the notice of the Executive Engineer or fails to remove the defects in the Meter or to replace the same, as the case may be, within a period of three months, the agreement shall be liable to cancellation and thereafter the water supply shall be stopped.

5. M/s NLC India Ltd. shall construct full proof effluent discharge plant before commissioning of the project. For proper test of such effluent there shall be computerized testing system and M/s NLC India Ltd. shall give details of effluent discharged in the natural source (in river or nala).

6. For construction of head works and control mechanism i.e. intake well, pump house and other related facilities, M/s NLC India Ltd. will get the land leased in their favour through IDCO as is done in respect of any other government land required by the industry. IDCO will make available land on long term lease to M/s NLC India Ltd. The continuance of the lease agreement will subject to the condition that the industry shall pay water rates as per prevailing water rate and all other dues of Government and IDCO from time to time.

7. M/s NLC India Ltd. would be required to pay 3 (three) months advance water charges in favour of Executive Engineer concerned in shape of Bank Draft or FDR duly discharged by the company as non-interest bearing security deposit and for 9 (nine) months a Bank Guarantee duly pledged in favour of concerned Executive Engineer. Onus of maintaining the Bank Guarantee lies with the company.

8. In case of water supply for M/s NLC India Ltd. is to be met from a common source through a sharing mechanism, such common infrastructure for drawal of water will be constructed, maintained and operated either by IDCO or Special Purpose Vehicle (SPV) after taking due clearance from IDCO. Water will be supplied to Industry by IDCO/ SPV and they would also be liable for payment of water rate to the Govt. and will in turn have arrangements as similar therein as clauses (6) and (7) detailed earlier.

9. M/s NLC India Ltd. drawing or allocated water from the reservoir for its uses shall sign supplementary agreement with Odisha Hydro Power Corporation Ltd. to compensate the loss of energy generation due to its drawal and the Odisha Hydro Power Corporation Ltd. shall raise demands for compensation of loss of energy generation within first week of every month against the quantity of water drawn or allocated whichever is higher.

10. M/s NLC India Ltd. will not disturb the normal flow of water so that riparian rights in the downstream will be affected and the company shall have no claim on the account.

11. The drawal mechanism for raw water and disposal system of effluent to be established by the industry without disturbing existing eco system and environmental set up.

12. The Rehabilitation and Resettlement Action Plan/ Welfare Action Plan, if so required will be prepared in conformity with the current Orissa Rehabilitation and Resettlement policy and executed by the company at its own cost under the supervision of the Water Resources Department and the Collector of the District.

13. M/s NLC India Ltd. should not claim as a matter of right to get the desired quantity of water during non-monsoon and lean period to meet their full industrial use and the Company has to make adequate storage facility in their own land for supply of water to their plant during such period.
14. The safety design of all the structures lies fully on the company.
15. In case of any dispute/ interpretation required, the decision of the Government in Water Resources Department shall be final.
16. Any surplus power from the Captive Power Plant shall be sold by M/s NLC India Ltd. to GRIDCO or any other entity to be notified by the State Government under mutual acceptable terms & conditions.
17. The allocation of water will automatically lapse if the company does not use the water for the purpose applied for within three years of allotment.
18. This agreement shall be valid for a period of one year from the date of execution subject to the renewal of agreement by the Executive Engineer. For renewal of the agreement, the concerned drawee has to apply minimum three months before the expiry of the agreement.
19. If it is found that the industry is drawing water unauthorisedly before signing the agreement / installation of flow meter, the Executive Engineer will charge a penal rate at six times the normal rate as provided in Schedule-II of the Rule.
20. Government shall be at liberty to review the water allocation unilaterally in case of exigencies.
21. The Executive Engineer or his authorized representative reserves the right to inspect all installations of drawal disposal mechanism during and after construction including intake structure, flow meter and treatment plant.
22. M/s NLC India Ltd. will have to show clearly in water management plan as to what storage facility the company will create for the lean season and to what extent and how the water is going to be recycled which shall be a part of the project report of the unit.
23. M/s NLC India Ltd. may engage at their own cost consultant (s) experienced in the field to take up field investigations, prepare design and drawing to set up the water supply scheme for drawing water from the Irrigation works for their

proposed plant. The actual work will start after approval of the scheme by the competent authority of Water Resources Department who can inspect work during the construction.

24. The exact place for lifting will be decided in consultation with the competent authority of Water Resources Department.

25. Department of Water Resources (DoWR) will not be held responsible for non-availability of water due to dry season, disruption, repair & maintenance of Canal / Reservoir.

26. The agreement to be executed by the Industry / commercial establishment with local authority / Executive Engineer must be approved by the DoWR before drawal of water.

27. M/s NLC India Ltd. will have to adopt water harvesting, rooftop water harvesting, ground water recharge and recycling of waste water measures in its plant premises as per the approved water management plan.

28. M/s NLC India Ltd. shall follow the zero effluent discharge principle and satisfy State Pollution Control Board (SPCB) norms and obtain requisite permissions from the SPCB, Odisha before drawal of operational water.

29. The Company shall deposit @ Rs. 2.5 crores / cusec of water allocated to the Industries in five equal annual installments in coming five years beginning with the current financial year towards Water Conservation Fund (WCF) for construction of Barrages/ Check Dams to improve the water storage capacity in the State for use in lean season with the concerned Executive Engineer as per this Department Resolution No.24011/ WR dated 03.11.2015. The Industry shall enter into an agreement for the purpose of drawal of water each year before which contribution towards Water Conservation Fund (WCF) shall be paid.

30. For bulk supply to Municipalities, Notified Area Councils other local authorities and cluster of villages such industrial, commercial or other establishments shall install separate Flow Meter or measuring device as the case may be at a suitable place along the pipeline to ensure quantum of water supplied to such Municipalities, notified Area Councils, other local authorities

31. and cluster of villages for drinking and washing etc. in addition to installation of the Flow Meter under clause 23-A(1) (b) which shall be treated as industrial or commercial use and license fee for such industrial or commercial use shall be at the rate double the existing rate as provided in item 3 (ii) of Schedule-II.

32. M/s NLC India Ltd. shall abide by the conditions laid down by the competent authority of DoWR during approval of scheme of drawal.

33. Applicable for Hirakud reservoir:

(i) Dumping of earth in reservoir area is not permitted.

(ii) Drawal of water below RL 595 ft. of the reservoir shall not be allowed.

33. M/s NLC India Ltd. shall undertake water utilization audit in every three years and make the report available for scrutiny by the competent authority of DoWR.

34. License fees shall be charged and collected at the rate as specified in the schedule-II per unit or quantity of water actually drawn or allocated whichever is higher and shall be enhanced at the rate of ten percent per annum with effect from the first day of April.

35. The Industry shall have to pay commitment charge which is equivalent to 5% of the cost of unutilized water (Allocated quantity – quantity of water utilized) in addition to payment of usual water rate for quantity of water being utilized as per DoWR Notification No.-13233/ WR Dated 04.06.2016.

36. M/s NLC India Ltd. acquired with the irrigated land for industrial purpose under unavoidable circumstance has to comply with the conditions land down vide DoWR Notification No.-4538 dated 24.02.2016.

37. M/s NLC India Ltd. shall register the project in the IWCRCM website within 7 days of entry, after due execution of agreement with the concerned Executive Engineer of DoWR.

38. In no circumstances, the Industries shall be allowed to drawal ground water for operation purpose.

Yours faithfully,

Special Secretary to Government

PTO

Memo No. 19553 / Dt. 4/9/19 /

Copy forwarded to EIC, WR. / Chief Engineer, Water Services / EE, Main Dam Division, Bural for information & necessary action.

Special Secretary to Government

Memo No. 19554 / Dt. 4/9/19 /

Copy forwarded to Industries Department / Steel & Mines Department / CMD, IPICOL / CMD, IDCO for information & necessary action.

Special Secretary to Government

Memo No. 19555 / Dt. 4/9/19 /

Copy forwarded to Secretary, State Pollution Control Board, Bhubabeswar for information & necessary actjon.

Special Secretary to Government

Memo No. 19556 / Dt. 4/9/19 /

Copy forwarded to the Collector & District Magistrate, Sambalpur for information and necessary action.

Special Secretary to Government

ANNEXURE XII

SOCIAL IMPACT ASSESMENT REPORT

Social Impact Assessment (SIA) Report on Land Acquisition for Establishment of Industries and Allied Activities in Tumbekela,Tareikela, Hirma,Kumbhari and Luhurenkachhar Villages under Jharsuguda Tahasil of Jharsuguda District

Commissioned By
Social Impact Assessment (SIA) Unit
Nabakrushna Choudhury Centre for Development Studies (NCDS), Bhubaneswar

Conducted By
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Social Impact Assessment (SIA) Report on Land Acquisition for Establishment of Industries and Allied Activities in Tumbekela,Tareikela, Hirma,Kumbhari and Luhurenkachhar Villages under Jharsuguda Tahasil of Jharsuguda District

"Development programs that provide irrigation for thirsty lands, energy for growing industries, hospitals and schools within residential areas, and wider roads in clogged downtowns are indisputably necessary. They improve many people's lives and develop both the national and local economies. Nonetheless, these developments can also cause the forced land acquisition and displacement of segments of the local population".

@ Michael M. Cernea, August 1997

SIA Study Team

SIA Unit
Dr. Shibalal Meher, Coordinator, State SIA Unit, Bhubaneswar, Odisha

DCOR Team
Satyanarayan Mohanty, Sibabrata Behera, Pranay Das, ,Gopal Krushna Bhoi, Sukanta Swain, Sarat Dash, Hemant Pradhan, Pabitra Sahoo, Suryamani Mohapatra, Tapas Kandi, Kanaka manjari Rout, Anup Samanta

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Abbreviations

ANM	Auxiliary Nurse Midwife	NREGS	National Rural Employment Guarantee Scheme
AWC	Anganwadi Centre	NTFPs	Non-Timber Forest Products
AWW	Anganwadi Workers	OBC	Other Backward Class
BPL	Below Poverty Line	OD	Open Defecation
CHC	Community Health Centre	PDS	Public Distribution System
CPRs	Common Property Resources	PHC	Primary Health Centre
CSR	Corporate Social Responsibility	PRA	Participatory Rural Appraisal
DHH	District Headquarter Hospital	CPR	Common Property Resources
FGD	Focused Group Discussion	PWD	People with Disabilities
GKS	GaonKalyan Samiti	R&R	Resettlement and Resettlement
GoI	Government of India	RFCTLARR	Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act
GoO	Government of Odisha	SC	Scheduled Caste
HoH	Head of the Household	SDH	Sub-divisional Hospital
ITI	Industrial Training Institutes	SHGs	Self Help Groups
LHV	Lady Health Visitor	SIA	Social Impact Assessment
MIS	Management Information System	SPSS	Statistical Package for Social Science
NCDS	Nabakrushna Choudhury Centre for Development Studies	ST	Scheduled Tribe
SIMP	Social Impact Management Plan	ToR	Terms of Reference

Executive Summary

Land will be acquired to set up industries and allied activities in five villages i.e. Tumbekela, Tareikela, Kumbhari, Hirma and Loharenkachhar of Jharsuguda Tahasil in Jharsuguda district. The proposed project necessitates acquisition of 753.13 acres of private land in the mentioned villages.

NLC India Limited (NLCIL), a Navaratna CPSU under Ministry of Coal, Government of India enterprise has planned to set up its NLC Talabira Thermal Power Project at the above mentioned proposed site. NLC India which was previously known as Neyveli Lignite Corporation is engaged in mining cum power generation since its inception in the year 1956 and has the advantage of its rich experience and expertise in both mining and power generation giving it a unique position in setting up of cost effective power projects. The CPSU has set up and operates many power projects in many states in India and contributed to the social and economic development of the nation for last five decades.
The proposed project NLC Talabira Thermal Power Plant (3x800 MW) has planned to supply power to different states. The home state Odisha is willing to avail 400 MW power from this project.

SIA Study Objectives

The objectives of the SIA were to:

i) Assess whether the proposed land acquisition in the five villages i.e. Tumbekela, Tareikela, Kumbhari, Hirma and Loharenkachhar of Jharsuguda Tahasil in Jharsuguda district serves public purpose.
ii) Estimate the number of affected families, magnitude of loss of land and other assets based on the actual holdings of the families and the number of families among them likely to be displaced physically or occupationally due to the acquisition of the land.
iii) Assess the extent of the land – public and private, houses settlements and other common properties likely to be affected by the proposed acquisition.
iv) Examine whether the extent of land proposed for acquisition is the bare minimum necessity for taking up of the proposed project.
v) Find out whether an alternative site has been considered for the purpose where there is least displacement problem, but the site itself is not suitable for the project.
vi) Study the social impacts of the project by covering both to be displaced as well as affected households due to loss of common property resources (CPRs), socio-economic infrastructures, etc. and the impact of these on the overall costs of the project vis-à-vis the benefits of the project.
vii) Suggest remedial intervention measures by designing appropriate policies and programmes through designing of a social impact management plan or mitigation plan.

SIA Study Methods

The SIA study was carried out applying cross-sectional study design. Keeping the objectives and scope of the study into account, mixed method approach was adopted combining quantitative and qualitative research methods. The overall design and framework of the study was guided by the RFCTLARR act and was developed and executed under the technical guidance of the SIA unit.

The study site for SIA included the village Tumbekela,Tareikela, Hirma,Kumbhari and Luhurenkachhar of Jharsuguda Tahasil in Jharsuguda district where 753.13 acres of private land will be acquired for the proposed project.

The primary data collection methods included:

i) Listing of displaced and affected families was done out of which the survey of 512 families could be done. The survey of the few displaced families could not be done as the SIA study team could not locate or contact the households in spite of several attempts made and refusal of some households.
ii) Focus Group Discussion (FGD) with the men and women of study villages were conducted.
iii) Participatory Rural Appraisals (PRAs) like Social & Resource Mapping, and Seasonality Calendar were carried out in the study villages.

Various secondary data viz. land schedule, Record of Right (RoR), Census-2011 data and village population data from the Anganwadi Centres etc. were collected and analyzed in the report.

SIA Study Findings

Identification of the affected families: The SIA study covered a total of 512 families, which amounts to 291 displaced families and affected 221 affected families. All of these families are RoR holders of their lands and majority of them own the same for generations.

Classifications of displaced and affected families: The 512 original families enumerated in the survey comprised of Major Sons (1013) above 18 years of age, Major Unmarried Daughters above 18 years of age 182) and widows (106).

Only 13 percent (n=38) of the displaced families and 9 percent (n=20) comprises of females head of households, whereas the majority comprises of males. So one tenth of female family members are eligible for the rehabilitation assistance as head of the household as compared to males as head of household.

Acquisition of private lands: The 512 families will lose a total of 753.13 acres of land which includes agriculture and homestead land. Many families will lose their all agricultural lands. This indicates that the land loss intensity would affect their agriculture production & income to a great extent.

Collection and Selling of forest resources: Only member from the affected family i.e. 0.1 percent (1 out of 221) was engaged in the collection and selling of NTFP in the last year preceding the survey.

Educational Level and Skill Training: Only 9.1 percent (n=121) of the displaced family members were illiterates and 6.6 percent (n=92) were literates who could only put their signatures. Here the number of women is much higher than men. Among the displaced family members, 50% of the females were literate but the percentage of illiterates among the females (66.9 percent) was two times higher than the male (33.1 percent).

Similarly 14.4 percent (n=151) of the affected members were illiterates and 6.8 percent (n=71) were literates who could put signatures only. Among the female members, 60.9 percent (n=92) were illiterates and 53.5 (38) were literates in comparison to the male members.

Among the displaced family members, the highest i.e. 20.8 percent (n=291) had below Pre-primary education followed by 13.2 percent (n=184) completed high school education, 12.8 percent (n=179) completed class 8th, 10.2 percent (n=142) completed Primary education. Only 4 percent (n=56) of the displaced family members

attained degree or higher level of educations. The percentage of the displaced family members attained technical education was quite low as only 0.3 percent (n=4) had technical degrees, followed by 0.4 percent (n=5) had Diploma engineering and 0.5 percent (n=7) members had ITI. Only one family member (0.1%) had degree in management. Only 34.2 percent (n=40) female family members were HSC passed out and none of the females had any technical diploma or degree.

The educational status of affected family was similar as of the displaced family. 13.2 percent (n=138) had education below Pre-primary level, 14.1 (n=148) were HSC passed, 11.2 percent (n=118) had education up to Class 8th standards, 8.9 percent (n=93) had graduation and above degrees. 0.8 (n=8) were graduate in engineering, 1.2 (n=13) were engineering diploma holders followed by 0.7 (n=7) has ITI and 0.4 percent (n=4) had management degrees. Among the female, 2 had diploma in engineering and another was an engineering graduate.

Among the displaced family members, 4 members had Bed and 7 had CT and among affected family members, 2 were Bed and 5 CT. There were 10 drivers among displaced family members and 5 among affected family members.

Rehabilitation Assistance: More than one third i.e. 40.9 percent (n=572) of the displaced family members and 39.1 (n=410) of the affected family members were in the adult age group of 18 to 39 years. So a large proportion of the people from the affected category belong to the age group of 18 to 40 years, which is the most economically productive age group.

Agriculture was pursued i.e. 4.9 percent (n=69) by the displaced and 5.1 percent (n=54) by the affected families as their primary occupation during last year preceding the survey. The net income from agriculture was Rs.21, 617 (n=162).
Unlike agriculture wage earning (0.4%, n=5 by the displaced and 1% ,n=11 by the affected family) , more number of the displaced families (16.41%, n=230) and affected families (14.6%, n=153) were engaged in non-farm wage like working in industries, road construction, house construction etc.

Occupation-wise, there is heavy concentration of work force participation in wage earning from farm and non-farm sectors. It has crucial implication in planning for economic rehabilitation of these families who depend on agriculture and allied activities as well as non- firm sector for wage earning and livelihood.

For those, who are nearly 40 years of age, it will certainly pose a lot of challenge at this stage of their lives to switch over to another type of employment.

All i.e. 88.3 percent of the displaced families and 93.7 percent of the affected families opted for cash assistance as the compensation against the acquired land. For the restoration of their income. 13.1% of the displaced families were interested for self-relocation whereas 19.6 percent of the displaced families sought project assistance for restoration of their livelihood.

The majority of the dependents were found to be children and adolescents below 18 years of age, housewives and elderly people in the family.

The analysis reveals that nearly two-third of the displaced and affected family members were dependents, not having any source of income. Among both the displaced and affected families, the number of women in this category was much higher than the men.

Vulnerable groups: Among the displaced families 4.4 (n=62) were widows and 0.9 percent (n=12) were divorcees. Among the affected family member 4.2 percent (n=42) were widows and 0.7 percent (n=7) were divorcee. There were 0.3 percent (n=3) destitute among the affected family in the study area respectively.

Among the displaced, 40.9 percent (119) were from ST category and 16.8 percent (49) were from SC category. Similarly, 42.5 (94) of the affected families were ST and 26.2 percent (58) were from SC category. These categories of population are considered as the weaker sections of the society and there are many poverty alleviations programs being implemented for their elevation from poverty. So special attention may be given during their displacement and restoration of their livelihood thereafter.

13 percent i.e. 38 out of 291 displaced families and 9 percent i.e. 20 out of 221 were headed by females.9.8 percent (137) of the displaced family members and 13 percent (136) from the affected family members were aged / at the age of 60 years or above. The proportion of the aged people in the displaced and affected families was found to be higher than that of the Odisha State (9.3 percent) and the country (8.0 percent).

One of the critical assessments of any R&R policy is that it excludes women to a large extent. Old persons, who are above the age of 60 years, are the ones who are almost certain to nominate another younger member of the family for employment and hence in need of social security support. Experiences in other projects have shown adequate evidences as to how the aged are left in the lurch to fend for themselves once the next generation receives rehabilitation assistance and hence susceptible to high vulnerability.

Tribal Communities: The displaced families consist 40.9 percent (n=119) of the Scheduled Tribes (STs). Similarly the affected families consist 42.5 percent (n=94) of the Scheduled Tribes (STs). Tribal communities are yet another category of vulnerable population, requiring special attention from the project proponents for their rehabilitation.

Community infrastructures: The affected villages lack irrigation sources, safe drinking water sources, pollution etc. Facilities for provision of safe drinking water and water for other purposes is extremely critical for all families who are staying in the affected villages.

The project villages lack proper healthcare and higher educational facilities. Health and educational facilities are other critical requirements of the area.

Social Impact Management or Mitigation Plan: Recommendations

Based on the above findings, the following recommendations may be considered by the project proponent for social impact management or mitigation.

i) Relocation of all interested displaced families to a suitable place or resettlement colony nearer to the proposed project with road connectivity. The people preferred to stay nearby place to the proposed project and did not want to go faraway place.

ii) Some of the villagers from Kumbhari and Gariadihi Kisan Pada opined that they want a residential colony nearer to their present village. When asked about the preferred location and why, they cited a vacant land in front of SMC Power to be converted into the resettlement colony for them. They told that as many of the villagers are working in SMC Power and in other nearby industries/plants and their Panchayat is Hirma where they would collect their PDS ration and other facilities like Old Age Pension, Widow Pension etc. they preferred to stay there. Some of the respondents from Tareikela expressed their views on choice of a patch of land in Badmal village (vacant government land located behind Badmal PS) which would be their suitable place for stay.

iii) There should be health care facility and educational institutions for dependents, community centre (Kalyan Mandap) , temples, market complex, electricity and drinking water supply and pond in the vicinity of the colony.

iv) There should be Anganwadi centres, youth club, Kirtan Mandap (Bhajan Mandali) and play ground in the Resettlement Colonies.

v) People from Tareikela wanted to shift Goddess Samaleswari Temple and Radha Krishna Temple (now they are worshipping) in their Resettlement Colony where as people from Kumbhari wanted to shift their Lord Shiv and Hanuman temple (now worshipping) to the Resettlement Colony.

vi) Availability of Suitable job and employment opportunities in the proposed project to the head of the household/ children/dependents of displaced and affected families.

vii) Formation of a society and involving the dependents of displaced and affected families in various developments work in the proposed project so that they will earn their livelihood. This initiative will benefit the unemployment people from the displaced and affected families who have crossed age limit for job.

viii) Majority of the people of the proposed project area wanted to vacate their homes provided that they would get suitable monetary compensation for their land, houses and immovable assets. According to them the cost of land is highest in the area. So they should be compensated accordingly.

ix) People of Kumbhari and Tareikela own land nearby to/on the bank of the river Bheden in and around their village. The proposed project maps shows exclusion of those patch of land. But the people raised their demand for acquisition of those patch of land as they will face problem in cultivation after their relocation. So the company should acquire that patch of land for tree plantation or any other purpose.

x) Fisherman community from Kumbhari camp locally called as “Majha”/Keuta are earning their livelihood by fishing in Bheden River. So after their displacement, priority should be given to restore their livelihood by other means.

xi) Vocational or skill training of the displaced and affected family members who have educational qualification of more than 8^{th} standard.

xii) Engage the vocationally trained family members in the project or other ancillary units for earning income. More focus may be given to engage the BPL families.

xiii) People from the displaced and affected families should have accessibility for free diagnostic and treatment in modern health care facilities preferably in the company hospital.

xiv) Children/dependents of the displaced and affected families should be given free education in the company managed school. People assumed that the company would establish best school for children of their employees where their children should get admission and free education.

xv) Relocation of Adivasi Kanyashram School of of Kumbhari to the Resettlement colony.

xvi) Provide training and market linkage support to the women family members through Self Help Groups (SHGs) functioning in the resettlement colony and affected area.

xvii) Provide revolving fund support to the women SHGs or link them with the formal financial institutions for availing loan to start individual or group income generating activities.

xviii) Facilitate or provide agriculture extension services to the people of affected villages for adoption of improved agriculture practices, which would increase the productivity and income from agriculture. It will help agriculture carried out by the affected families more remunerative.

xix) Special tree plantation drive should be undertaken in and around the project area. There are large industries like Bhusan Steel & Power, Vedanta Alumina and SMC Power & Steel in nearby areas. People of the proposed project area (both displaced and affected) opined that they were fed up with pollution. The project should take care of the environment so that people of the periphery villages would not suffer from pollution.

xx) The beneficiaries of Old Age and Widow Pension as well as people availing rations under PDS will face problem in getting it after their shift to resettlement colonies. The panchayat office is located in Hirma village. So the authority should address the issue and facilitate the process of availing Social Security Pension and rations to the displaced people.

xxi) Effort may be made to link the left out widows and aged persons with various social security schemes like old age pension scheme, widow pension scheme, ration through PDS, etc.

xxii) Provide resettlement benefits to the people who staying in the displaced villages who do not owned land.

xxiii) The majority of the displaced and affected families opted for cash assistance (apart from the cash compensation they will receive for acquisition of land).

xxiv) Regular health checkup may be conducted in the affected villages to improve maternal and child health & nutrition status, on construction of toilets and stopping open defecation. Mobile health clinic should be rolled out for treatment of the needy in the affected villages.

xxv) People were observed very sentimental when talked about their displacement. They are staying since generations and are emotionally attached to the land and community. They anticipated that they may not stay like the present set up and would miss their kith and keen. So the project authorities should take care of the choice of the people regarding their resettlement.

xxvi) Saplings or seedlings for fruit or non-fruit bearing trees may be provided to the affected families for plantation to compensate the loss of trees owned by the families in the displaced villages. Community plantation drive may be initiated in the affected villages.

xxvii) Last but not the least, people were not against development or set up of industries. If genuine demands of the people are fulfilled, then they would vacate their villages and allow the proposed project authorities to start their construction/activities there.

Concluding Remarks:

To conclude, the SIA study revealed heavy loss of land and income will happen due to the acquisition of land under the project. The adverse effects of the project may be overcome by restoration of livelihood, providing employment opportunities, skill building and vocational training like ITI, Diploma, Computer, Driving, Tailoring etc. for engagement of the displaced and affected family members in the project or various project ancillary units for income and also by promoting income generation skill among the women mass through SHGs like Tailoring, Khali Stitching, Mushroom cultivation etc. with a market linkage support and by taking up community awareness generation on health & nutrition and plantation drive.

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Chapter - I

1. Background & Objectives of the Study

1.1 Introduction

For generation upon generation, dating back thousands of years, mankind has lived within the confines of an agrarian economy. It wasn't until the late eighteenth century that things began to change, as the Industrial Revolution started to take hold and shift the economy from agricultural to industrial. That shift continues today as developing nations industrialize while industrialized nations become more efficient. It's a shift that continues to open up new doors and new problems.

Industrialization is defined as the large-scale introduction of manufacturing into a society. It is sustained economic development based on factory production, division of labor, concentration of industries and population in certain geographical area and urbanization It shifts an underdeveloped agricultural economy focused on human labor to an industrial economy based on machine labor. It's a process whereby individual labor is replaced by mechanized mass production and specialized laborers, which boosts productivity.

The promise of Industrialization enables mankind to do more with less. Instead of one man taking days to plow his field with two bullocks, he can do it in a couple of hours with the help a tractor/tiller that has the power of hundreds of bullocks. That frees up his time to do more work around the farm, and maybe even take a vacation, and it frees up his family so his kids can go to schools and work in professions that require less backbreaking work than he had to do.

Because of industrialization in the U.S., only 2% of the population is comprised of farm and ranch families; this is a remarkable difference compared to 1840, when just 10.5% of the population *didn't* work on a farm. Meanwhile, U.S. farms are doing so much more with less as today's farms produce 262% more food with 2% fewer inputs -- including labor, seeds, feed and fertilizer -- compared to 1950.

Today, industrialization continues in emerging economies, especially in Asia and Africa. In China, for example, 60% of its population farmed in 1960, but now less than 30% of the population is made up of farmers. Despite fewer farmers, food production in the country has tripled since 1978. Moreover, the country now feeds a quarter of the world's population on only 7% of its arable land. In addition to improved production on farms, industrial output has skyrocketed as people have migrated from the farms to the cities to work in factories. This is seen in the stunning rise in China's GDP over the past few decades.

While industrialization has many benefits, it has its pitfalls as well. One of the big pitfalls is the rise in pollution. Another important pitfall is development-induced displacement. Development in actual sense should mean, using the productive resources of the society to improve the living conditions of the poor. On other hand it means economic growth, through the establishment of industries, dams, irrigation projects, highways, hospitals, educational institutions, etc. But the development never goes single handed. For undertaking development projects it is necessary to acquire land from the individuals in the locality where the project is being established. In the process of land acquisition, a sizeable number of affected people lose their homes and hearts and get physically displaced. Thus, development is always accompanied by

forced displacement. Displacement is caused as a result of the development paradigm, causing cultural, and identity crisis for a large number of social categories, in which tribal, backward castes and weaker sections of the society etc. have become the major victims. It is often argued that the establishment of such projects is necessary for the development of our nation. This is true. But the social cost due to displacement needs serious attention of the project authorities. It is disheartening to note that most of the project authorities, whether government or private, give priority to the financial benefit of the project rather than in the interest of the project affected persons.

However, In order to minimize the land acquisition-linked people's misery and increasing greater acceptance of such development initiatives, the Government of India has recently enacted Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act (RFCTLARR) in the year 2013. This new act has replaced all the existing policies of different state governments, including the Odisha Resettlement & Rehabilitation (R&R) policy, 2006 enacted by the Government of Odisha.

1.2 Project Description

Mineral rich Jharsuguda is one of the most industrially developed District of Odisha. Due to concentration of economically important minerals, especially coal, many small and large scale industries have found a conducive environment for their growth and development. Many large industrial houses such as Vedanta, Aditya Birla Group, Bhushan Power and Steel Limited, SMC Power Generation etc. have chosen the district to set up their plants because of availability of raw material, coal, and water as well as rail, road and air connectivity. Jharsuguda District is a beautiful Diaspora of different origins of people from across India which makes it unique & different from other cities in Odisha. Sambalpuri is the dialect of the District.

According to the letter of the Collector & District Magistrate, Jharsuguda district a total of 753.13 acres land is to be acquired from five villages in Hirma Panchayat under Jharsuguda Tahasil namely Hirma, Tumbekela, Tareikela, Kumbhari and Luhurenkachhar for establishment of industries and allied activities affecting around 1064 families.

NLC India Limited (NLCIL), a Navaratna CPSU under Ministry of Coal, Government of India enterprise has planned to set up its NLC Talabira Thermal Power Project at the above mentioned proposed site. NLC India which was previously known as Neyveli Lignite Corporation is engaged in mining cum power generation since its inception in the year 1956 and has the advantage of its rich experience and expertise in both mining and power generation giving it a unique position in setting up of cost effective power projects. The CPSU has set up and operates many power projects in many states in India and contributed to the social and economic development of the nation for last five decades.

Benefits of the Project

The benefits envisaged for this proposed establishment of industries and allied activities are many.

Firstly, Establishment of industries and allied activities will provide direct and indirect employment opportunities to the local population in general and project affected persons in particulars. It will be an engine for employment, wealth and technical skill. It will lead to improved standards of the entire society as a whole and improve the economic conditions.

Secondly, it will help the local people to earn their livelihood/supplement to their income by setting up of shops/selling food and other items near the industrial sites.

Thirdly, infrastructure on health, education, communication etc. will be developed in and around the area and the locals will avail the benefit of these. It leads to prosperity and cause the availability of better and more foods, clothing and gives longer life expectancy.

Fourthly, small and ancillary industries will be set up to cater the need of major industries. The local people will get direct and indirect employment opportunities there also.

Fifthly, Electricity is a basic human need and essential requirement for all facets of our life. Power development is one of the key infrastructure elements for the socio-economic growth of the country. The entire Indian Economy hinges on the availability of reliable and quality power at competitive rates to rural India for its overall growth and to Indian Industry to make it globally competitive. The power sector is in a crucial juncture today. With the implementation of large capacity addition through solar projects, the sector has started showing signs of shift from "regulated & protected" to a market driven environment of business. In addition, the thermal power stations are having the responsibility to comply with more stringent environment norms for sustainable development.

Lastly, the proposed project NLC Talabira Thermal Power Plant (3x800 MW) is to be implemented by NLCIL to supply power to Southern States of Tamil Nadu, Kerala and Puducherry and the home state Odisha. The home state is willing to avail 400 MW power from this project.

1.3 Land Acquisition under the Project

As per the letter of the Collector and District Magistrate, Jharsuguda the proposed establishment of industries and allied activities necessitate acquisition of 753.13 acres of private land in five villages i.e. Tumbekela, Tareikela, Kumbhari, Hirma and Loharenkachhar of Jharsuguda Tahasil in Jharsuguda district.

The details about the number of Record of Right (RoR) holders loosing land, degree of land loss intensity and its impact on the households are presented in the report.

1.4 Legal framework of Social Impact Assessment (SIA) and Social Impact Management Plan (SIMP)

In exercise of the powers conferred by sub-section (1) of Section 109 of the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (RFCTLARR) Act, 2013 (30 of 2013), the State Government has made the following rules for conducting Social Impact Assessment (SIA). The rules for SIA are enacted under Sections 6, 7, 8, 9, 10, 11, 12, 13, 14 and 15 in an Extraordinary issue of the Odisha Gazette No. 331 dated 11thFebruary, 2016 under the notification of the Government of Odisha in Revenue & Disaster Management Department No. 331, dated the 11thFebruary, 2016.

1.5 Need and Relevance of SIA of the Project

The primary objective behind enacting the RFCTLARR act is to restore and improve the standard of living of the families affected under the development projects. Besides payment of compensation, the act makes it mandatory that the displaced and affected families should be provided assistance with the relocation,

resettlement and rehabilitation.

So prior to the acquisition of land under this project i.e. for establishment of Industries and allied activities in village Hirma, Tumbekela, Tareikela, Kumbhari and Loharenkachhar of Jharsuguda Tahasil in Jharsuguda district, it is required under the RFCTLARR act to conduct the Social Impact Assessment (SIA) study. It would help to find out the likely social impact of land acquisition under the project and provide critical inputs for the planning of the relocation, resettlement and rehabilitation of the displaced and affected communities and develop SIMP. The SIA would also enable the project proponent to be fair in compensation and transparency in land acquisition. Thus, the survey of the displaced and affected households is conducted under SIA to gather adequate empirical evidences to enable the project proponents anticipate, identify, and quantify the various impacts and impoverishment risks of acquisition of lands on the displaced and affected households.

1.6 Study Objectives

The objectives of the SIA were to:

viii) Assess whether the proposed land acquisition in the five villages i.e. Hirma,Tumbekela, Tareikela, Kumbhari and Loharenkachhar of Jharsuguda Tahasil in Jharsuguda district serves public purpose.
ix) Estimate the number of affected families, magnitude of loss of land and other assets based on the actual holdings of the families and the number of families among them likely to be displaced physically or occupationally due to the acquisition of the land.
x) Assess the extent of the land – public and private, houses settlements and other common properties likely to be affected by the proposed acquisition.
xi) Examine whether the extent of land proposed for acquisition is the bare minimum necessity for taking up of the proposed project.
xii) Find out whether an alternative site has been considered for the purpose where there is least displacement problem, but the site itself is not suitable for the project.
xiii) Study the social impacts of the project by covering both to be displaced as well as affected households due to loss of common property resources (CPRs), socio-economic infrastructures, etc. and the impact of these on the overall costs of the project vis-à-vis the benefits of the project.
xiv) Suggest remedial intervention measures by designing appropriate policies and programmes through designing of a social impact management plan or mitigation plan.

1.7 Scope of Services

The scope of services under the assignment included:

i) The team/organization consisting of at least one women member shall collect and analyze a range of both quantitative and qualitative data, undertake detailed site visits, use participatory methods such as social mapping, focused group discussions (FGDs), participatory rural appraisal (PRA) techniques and informant interviews by canvassing of a structured interview schedule at the household level to prepare the social impact assessment report.
ii) Involve and seek advice from the official functionaries of all affected Gram Panchayat and Municipalities relating to the conduct of the SIA.

iii) A detailed assessment based on a thorough analysis of all relevant land records and field data and field verification shall be conducted by the SIA organization. The assessment shall include the followings: a) area of impact under the proposed project, land to be acquired and the social, economic, cultural, environmental and other impacts of the project, b) quantity and location of land proposed to be acquired for the project and whether it is the bare minimum requirement for the project, c) whether the land to be acquired is in scheduled area and it is demonstrable last resort, e) nature of the land, present use and classification of land and if it is an agricultural land, its irrigation coverage and cropping pattern, f) impact of the land on food security of the affected families, i) size of holdings, ownership patterns, land distribution, number of residential houses, and public and private infrastructure and assets,

iv) Accurate estimation of the number of affected families and displaced families based on land assessment, land records and field verification by following census enumeration methods for all affected families.

v) Socio-economic and cultural profile of the affected area.

vi) Basing upon data collected from the field and in consultation with the stakeholders, the SIA team/organization shall make identification and assessment of the nature, extent and intensity of the positive and negative social impacts of the project by using cost-benefit analysis method.

vii) Preparation of a social impact management plan (SIMP) containing ameliorative measures to address the negative social impacts of the project identified in the course of SIA study.

viii) The SIA must provide a comprehensive analysis of social costs and benefits to be accrued from the project and the impoverishment risk of the families losing land and getting displaced and the mitigation plan for resettlement and rehabilitation of such displaced and project affected families.

ix) Organization of public hearings through the local administration and land requiring body to disseminate the main findings of the SIA in the affected areas in the local language and to seek feedback on findings, additional information and views for incorporating the same in the final SIA report.

x) Video recording and transcribing of the public hearings, which are to be submitted along with their analysis in the revised SIA report accordingly.

xi) The final SIA report will be prepared both in English and Odia language for distribution to the concerned officials as per the stipulation such as, 4 copies in English for the concerned Collector, Government, Project Implementing Authority and NCDS and 8 copies in Odia for LAO, Tahasildar and Expert Committee members ((2 non-official Social Scientists, 2 representatives of local bodies, 2 experts on rehabilitation and a technical expert on the subject relating to the project)

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Chapter - II

2. Study Methods

2.1 Study Design

The SIA study was carried out applying cross-sectional study design. Keeping the objectives and scope of the study into account, mixed method approach was adopted combining quantitative and qualitative research methods. The overall design and framework of the study was guided by the RFCTLARR act and was developed and executed under the technical guidance of the SIA unit.

2.2 Data Collection under the Study

The SIA study involved data collection from both primary and secondary sources. Details about the steps and methods of data collection are presented hereunder.

2.2.1 Collection of Primary Data

2.2.1.1 Study Sites

The study site for SIA included the village Hirma,Tumbekela, Tareikela and Kumbhari. of Jharsuguda Tahasil in Jharsuguda district where 753.13 acres of private land will be acquired for the establishment of industries and allied activities. People of Loharenkachhar village were migrated to Kumbhari Camp/Colony where the study team met the beneficiaries.

2.2.1.2 Steps and Processes Involved in Data Collection

Data collection under the study involved the following steps and processes:

Consultation and Inception Meeting with the SIA Unit: After the signing of the contract between the SIA unit of NCDS and DCOR Consulting Pvt. Ltd., the DCOR study team had a detailed consultation with the head of the SIA unit on the steps and processes of undertaking the SIA. The activities and timeline under the study were finalized during this discussion, based on which a detailed action plan with the time-line to carry out the study was prepared and submitted to the SIA unit.

Framing of the Study Tools and Finalization: Soon after the preparation of the study plan, the following study instruments were prepared under the guidance of the SIA unit.

i) Structured Interview Schedule for Socio-economic Survey of the Households in the Project Area
ii) Public Consultations and Focus Group Discussion (FGD) Guide
iii) Village Tool for the Infrastructural Survey of the Project Area

The draft study tools were submitted to the SIA unit, which were modified and finalized based on the inputs and feedback of the SIA unit.

Recruitment/Setting-up of the SIA Study team: The study team comprising of the following personnel having prior experience of undertaking socio-economic and resettlement & rehabilitation studies were engaged for the data collection.

i) Satyanarayan Mohanty- Team Leader
ii) Sibabrata Behera - Survey Co-ordination
iii) Pranay Das – Report preparation
iv) Gopal Krushna Bhoi, Sukanta Swain, Sarat Dash, Tapas Kandi, Hemanta Pradhan, Suryamani Pradhan, Pabitra, Kanaka Manjari Rout-Field Supervision and Data Collection
v) Sibabrata Behera and Anup Samanta- Data Analyst

Two female investigators were purposefully recruited in the study team who conducted the community and public consultations with the females in the study villages.

Training and Orientation of the Study Team: A three-days training cum orientation of the study team from February 16 to 18, 2019 was conducted at the DCOR office at Bhubaneswar. The capacity building wing of DCOR imparted the training to the study team on the objectives of SIA, scope of works, methodology and study tools.

Site visit, consultation and information dissemination: Soon after the training, the study team visited the study site and met the key stakeholders of the project e.g. *Sarapanch*, Community Leaders and affected families to build rapport with them and seek their assistance for undertaking the SIA in the project site. During the course of this initial visit to the project site, the study team visited the displaced and affected village and had preliminary interactions with the affected households regarding the SIA of the proposed establishment of industries and allied activities in the area. The information regarding the date of starting the SIA study was communicated to these stakeholders including the displaced and affected families.

Listing of the displaced and affected families: All the families losing land to the project in the project village were listed and their places of residences were located for the household survey. After the list of affected families was prepared, it was validated and finalized with the community leaders, *PRI* members. In total, 291 displaced and 221 affected families of the village were listed for the survey. (Table 1).

Household survey of the displaced and affected families: As per the list, census survey of the affected families was carried out using a structured household socio-economic survey tool. A total 512 families were surveyed in the SIA study. Some families could not be covered primarily because they were staying outside the project area at the time of survey, hence could not be located or contacted in spite of the effort made by the study team. Few families in village Tareikela and Kumbhari refused to cooperate with the study team, hence they could not be surveyed.

Table 1: Village wise number of Displaced and Affected families enumerated under SIA

Name of the Village	No of families enumerated	No of displaced families	No of affected families
Hirma	124	39	85
Kumbhari	163	123	40
Tareikela	136	129	7

Tumbekela	89	0	89
Total	**512**	**291**	**221**

Exploration of extended families: The genealogy of all the affected families was drawn during the household survey, which helped to know the family members and their relationships with each other. This exercise also helped to explore and identify the number and category of extended families there within each affected family e.g. Major Sons above 18 years of age, Unmarried Daughters above 25 years of age, Widows, Orphans, Physically/Mentally challenged, married daughters having RoR, women having RoR and destitute.

Participatory Rural Appraisals (PRAs) of project village: Alongside the household survey, PRAs in the project village were carried out. Following PRA techniques were applied.

a) Social & Resource Mapping: Through this technique, the spatial data of the community were collected and analyzed by drawing maps or diagrams. The study team facilitated the community in such way that they themselves drew their own community map and also sketched various social and economic indicators in the same. Both Social Map and Resource Map were drawn jointly in one map. Legends or symbols were used to show various social and economic indicators in the map. The indicators that were sketched in the map included the places in the village where people lived and how many people lived, house type, caste structure, agriculture land, soil type, vegetation, road, school, drinking water, water facility for other uses, electricity, burial ground, other social infrastructures, etc.

Community and public consultations: After the survey of the families was over, community and public consultations were held by conducting Focused Group Discussions (FGDs) with men and women separately in each of the affected villages. Information pertaining to the perception and awareness of people about the project, perceived benefits, perceived losses, general socio-economic status of the people in the villages etc. were collected. In each FGD, around 6 to 8 people selected from different ages, social and economic groups participated and shared their views. A total of three FGDs was conducted in the project village covered under the SIA.

Infrastructure survey of the project area: Apart from all the above exercises for data collection, existence of various social, cultural and general infrastructures in the project village were collected through a village infrastructural survey tool.

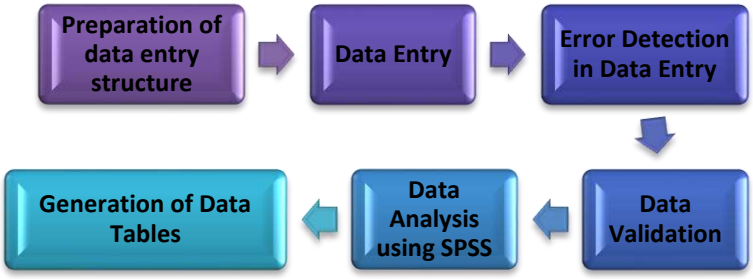
2.2.1.3 Tools & Techniques used for Data Collection

Table 2: Tools and Techniques used for primary data collection

Data Collection Techniques	Data Collection Tools
▸ Family Interview	▸ Structured Household Interview
▸ Focus Group Discussion (FGD) with men and women (separately) for community and public consultations	▸ Checklist for conducting FGD
▸ Infrastructure survey of the project area	▸ Village infrastructure survey tool
▸ Participatory Rural Appraisal (PRA) ◆ Social Mapping ◆ Resource Mapping	▸ PRA guide

2.3 Data Entry, Analysis and Report Preparation

Ethical protocols were followed throughout the data collection. Prior to any interview or FGD conducted, verbal informed consent was obtained from the respondents.



The data collected through different study tools was handled with utmost care and was complied with ethical standards of confidentiality and stored securely in accordance with standard data protection practices. The quantitative data were entered in MS Excel, followed by logical and consistency checks performed by filtering and cleaning the database. The cleaned database was then exported to and analyzed using the Statistical Package for Social Science (SPSS) software. Qualitative data collected during the FGDs and PRA mapping were manually compiled and analyzed. Quantitative and qualitative data were triangulated, analyzed and interpreted in the report.

2.4 Limitations of the Study

The SIA study has the following three limitations, which are more related to the operationalization of the study plan.

i) According to the RFCTLARR act, the SIA study is expected to conduct census survey of all the displaced and affected families losing lands to the project. But, few households could not be located or contacted within the time period of the survey, as they were not residing in the project village/nearby areas at the time of the survey. The team came to know that some people residing in Chhatisgarh state and some from other districts of Odisha owned land who could not be contacted due to lack of address/contact details.

ii) Since the SIA study is conducted before the land acquisition in the project, only the data on the likely impact on the families losing land could be collected. Attribution of impact to the project was not possible at this baseline stage of data collection.

iii) Majority of the people surveyed did not know about the project/industry and the land going to be acquired for the project.

iv) Due to strong opposition from certain sections of the people in the study area, the study team could not interviewed all be openly discussed with the people at public places

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Chapter - III

3. Profile of the Project Area

In this chapter, a detailed report is presented on the profile of five villages i.e. Hirma, Tumbekela, Tareikela, Kumbhari and Loharenkachhar of Jharsuguda Tahasil in Jharsuguda district where families will be affected due to acquisition of land for the establishment of industries and allied activities. Loharenkachhar village is an uninhabited village. The report is based on the information / data presented in the village profile which were captured during a series of village / hamlet level meetings, PRA exercises and focus group discussions carried out with the villagers. In addition, views of some opinion leaders belonging to the villages are also considered. Thus, it is important to bear in mind that the figures shared by villagers are based on their approximation and eye estimation which may not be scientifically accurate and precise, which in fact being one of the limitations of PRA technique. Therefore, it is suggested to refer to the family profile to get more accurate statistics and figures on the socio-economic status of affected families, which were collected during the survey by administering pre-tested structured household questionnaire.

3.1 Profile of Villages

3.1.1 Tumbekela Village

Tumbekela village is located near SMC Power Plant with population of 756. Total geographical area of Tumbekela village was 3 km^2. Jharsuguda is the nearest town and district head quarter of the village which is 10 km distance from Tumbekela. The village comes under Hirma Panchayat.

There were three hamlets (Pada) in the village namely Gourpada, Chamar Pada and Harijan Pada.

Demographics

In the village was home to 756 people, among them 397(52.51%) were males and 359(47.4%) were females. There were 202 households in the village and an average 4 persons live in every family. There were 98 household from SC category, 44 from ST category and 60 from OC category. The population of the village comprised of 192 SC males, 177 SC females, 77 ST males, 75 ST females, 128 OC males and 107 OC females.

General Infrastructure in the village

- There were four tubes well in the village which were used by the villagers for drinking water.
- The village has both Pucca as well as kacha internal road.
- There was electricity connection in the village.
- The village had a cremation ground.
- There was an Anganwadi centre.
- There were two unregistered clubs of the village youths.
- There was a Government Primary School located in the village. For high school, the children were going to nearby Kumbhari and Tareikela village (Saraswati Sishu Mandir).
- The people used to buy their daily needs from the grocery shop located in the main village.
- There were one mason and one washer man in the village.
- There were two ponds in the village.

Social and Cultural Infrastructure

- There was a location for organizing festival in the village.
- One women Self-help group was formed in the village.
- There were Goan Kalyan Samittee (GKS), Mothers Committee, Jaanch Committee and School Management Committee in the village.
- There was Samaleswari Temple in the village.

3.1.2 Tareikela Village

Tareikela village is located in Hirma Panchayat of Jharsuguda district with a population of 631. Total geographical area of Tareikela village is 2 km^2.

Nearest town of the village is Jharsuguda and distance from Tareikela village to Jharsuguda is 12 km.The village comes under Badmal Police station. According to 2011 Census, 0.26 square kilometer (12%) of the total village's area was covered by forest.

There were five hamlets (Pada) namely Bhuyan Pada, Harijan Pada, Gauntia Pada, Bhandarai Pada and Kissan Pada.

Demographics

The village was inhabited by 631 people, among them 319(50.5%) were males and 312 (49.5%) were females. There were 146 households in the village and an average 4 persons lived in every family among whom 50 households belonged to ST families, 20 belonged to SC families and 76 belonged to OC families.

Out of 631, there were 57 SC males, 49 SC females, 116 ST males, 104 ST females, 145 OC males and 159 females in the village.

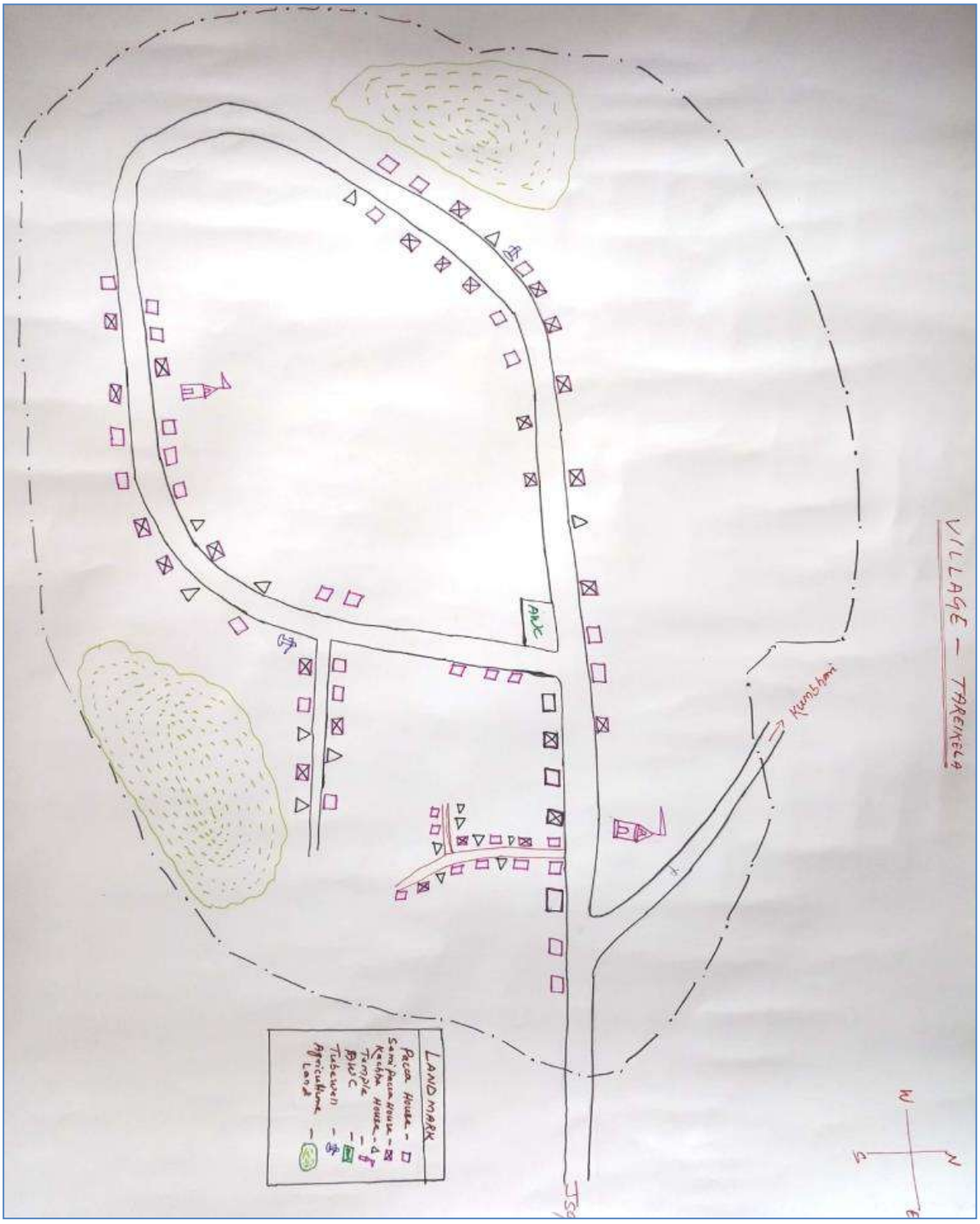
General Infrastructure

- The internal roads inside the village were Pucca road.
- There were four tube wells located in different Padas.
- There were two public ponds and two private ponds in the village used for bathing and other purposes by the villagers.
- The Bheden river flows nearby is used by the people for bathing and fishing purpose.
- There was electricity connectivity to the village.
- There was a cremation ground in the village.
- There was an Anganwadi Centre in the village.
- There was a youth club (non- registered) in the village.
- There was a government Primary School in the village (located in the premises of Kumbhari Kanyashram). Also there was a Saraswati Sishu Mandir run by private management located in the village with hostel for boys and girls.
- There was one grocery shops inside the village to cater the daily needs of the villagers.
- There were two barbers, five masons and four potters in the village.

Social and Cultural Infrastructure

- There was a festive ground in the village.
- There was a Bhajan Mandap where people used to do Bhajan/Kirtan.
- There were four women Self-help Groups and one youth club in the village.
- There is a Goan Kalyan Sammittee (GKS), Mothers Committee and School Management Committee in the village.

- In the village, there were two temples.



3.1.3 Kumbhari Village

Kumbhari village was home to 765 populations. Total geographical area of Kumbhari village is 2 km^2.Population density of the village was 278 persons per km^2.According to the elderly villagers the village was located near the bank of river Bheden. In the year 1960 the villagers shifted their houses adjacent to Tareikela village after their place of residence was submerged with flood water from river Bheden. Some of them told that they were given four decimal of homestead land by the government to rebuild their houses.

Nearest town of the village is Jharsuguda which is 12 km. The village comes under Hirma Panchayat and Badmal Police Station. District head quarter of the village was Jharsuguda. According to 2011 Census 0.37 square kilometer (17%) of the total village's area was covered by forest. There were five hamlets (Pada) in the village namely Kumbhari Camp, Nuapada, Gariadihi, School Pada and Puruna Basti.

Demographics

There were 765 people living in the village, among them 391 (51%) were male and 374 (49%) were female. There were 176 households in the village and an average 4 persons lived in every family. There were 28 households belonging to SC families, 89 ST and 59 belonging to OC families. There were 65 SC males, 63 SC females, 190 ST males, 179 ST females, 136 OC males and 132 OC females in the village.

General Infrastructure

- Out of one and half kilometers of internal road in the village, three roads were Pucca and two were Kachha.
- There were 12 tube wells and two ponds in the village.
- Six tube wells were in the village for drinking water purpose.
- There were six dug wells for irrigation of vegetable cultivation.
- The village has electricity connectivity in all Padas (street) and hamlets.
- There was a cremation ground in the village.
- An Anganwadi Centre was located in the village for pre-school education of children.
- There were two unregistered youth clubs in the village.
- There were four public ponds in the village.
- There was a Government Primary school located in Gariadihi and M.E. School (Kanyashram) run by ST & SC Dept.in Kumbhari.
- Three grocery shops were there to cater the daily needs of the villagers.
- There was a floor mill was in the village.
- There were four barbers, six carpenters, two tailors and twelve masons available in the village during the study time.

Social and cultural Infrastructure

- There were six women Self-help Groups (SHG) formed for empowering of rural women.
- In the village, there were Goan Kalyan Sammittee(GKS),Mothers' Committee, Jaanch Committee and School Management Committee.
- There were two temples (Lord Shiva and Hanuman) in the village. Lord Shiv temple is located near the bank of river Bheden.

3.1.4 Hirma Village

Hirma village, with population of 4369 was the most populous village in the Panchayat. Total geographical area of Hirma village was 5 km^2.Population density of the village was 423 persons per km^2.

Jharsuguda was the nearest town as well as district head quarter of the village and distance from Hirma village to Jharsuguda is 9 km. The village has its own post office. The village comes under Hirma panchayat and was under Badmal Police Station. According to 2011 census, 2.51 square kilometer (24%) of the total village's area was covered by forest.

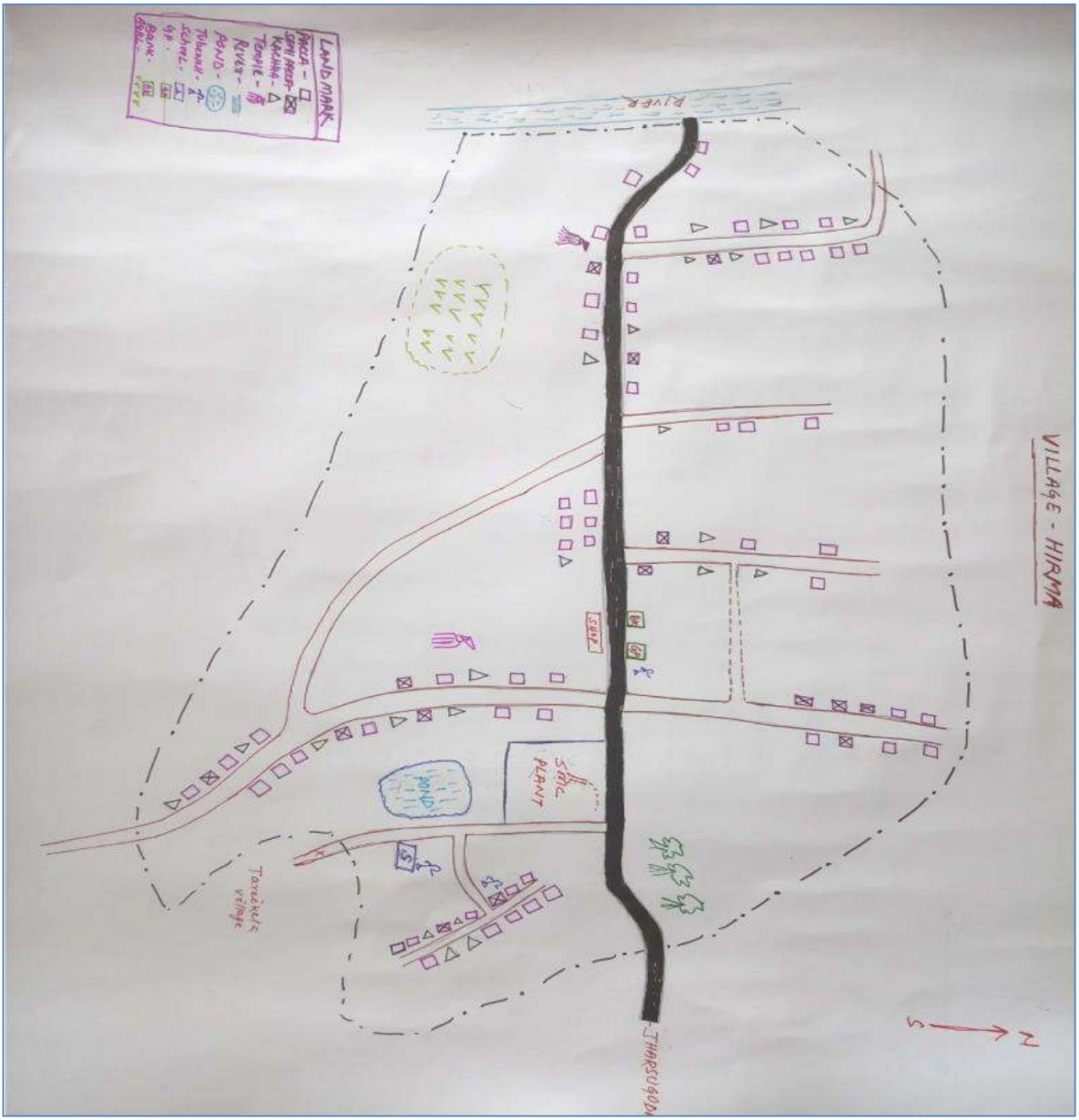
Hirma village had two distant hamlets namely Gariadihi Kissan Pada and Ghungipalli.

Demographics

As per the Census data of 2011, the village was home to 4369 people, among them 2237 (51%) were male and 2132 (49%) were female. There were 1033 households in the village and an average 4 persons lived in every family.

General Infrastructure

- The internal village roads were both pucca as well as kaccha.
- There were ten tube wells and three ponds in the village.
- Bheden River flows nearby of the village where villagers used to take bath and do fishing.
- There was electric connection to the main village as well as the different hamlets.
- There were two cremation grounds in the village.
- There were three Anganwadi Centers located in different parts of the village.
- Hirma was a Panchayat and its office was located in the village.



- There were four community halls located in different parts.
- There was a Post office in Hirma.
- One commercial bank (Allahabad Bank, Hirma Branch) was located inside the Panchayat Office premises in Hirma.
- There were two government Primary Schools and one Secondary School in Hirma.

- One Sub-Centre was located in the village to provide health care facility. People go to Jharsuguda District Head Quarter Hospital (DHH) and private Clinics /Nursing Homes for treatment. A private medicine shop was in the village.
- The village has a veterinary Centre for treatment of domestic animals.
- There was a Kalyan Mandap under construction.
- There was a PDS Distribution Centre in the panchayat office premises besides five grocery shops in the village.
- There were Government Primary, Upper primary and High School in Hirma village.
- There were four Anganwadi Centre in the village.
- A floor mill was located in the village.
- A local quack was staying in the village.
- There were four public ponds in Hirma.

Social and Cultural Infrastructure

- In the village, there was a space for organizing festival and a Bhajan Mandali for Kirtan.
- There were ten women Self-help Groups.
- There were Gaon Kalyan Sammittee(GKS),Mothers' Committee, Jaanch Committee and School Management Committee in Hirma.
- There were two Bhajan mandaps in the village.
- There was a temple for worship for Hindu devotees in the village.

3.1.5 Luhurenkachhar village

Luhurenkachhar village was the uninhabited village in Hirma Panchayat. Total geographical area of Luhurenkachhar village was 1 km. When the study team visited, there were no original villagers found in the village. The people owning land have migrated to nearby locality Kumbhari Colony/camp. Some migrant people working as labours in brisk kiln were found staying there in make shift huts. There were six beneficiaries in the list who owned land in the village, but four of them were residents of Tareikela and Kumbhari.Two of the beneficiaries surveyed from the village list were staying in Kumbhari camp during the study.

Nearest township and district head quarter of the village was Jharsuguda and distance from Luhurenkachhar village to Jharsuguda was 12 km.

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Chapter - IV

4. Socio-economic Profile of Displaced and Affected Families

This chapter of the report presents the social and economic profile of the families who will be displaced and affected. Data collected through the household survey and FGDs are analyzed and presented here. The findings pertaining to the socio-economic profile of the displaced and affected families are structured into the following key sections.

i) Classification of the displaced and affected families
ii) Displaced and affected vulnerable groups e.g. Scheduled Caste (SC), Scheduled Tribe (ST), People with Disabilities (PWD), and Women headed households
iii) Demographic profile of the displaced and affected families e.g. gender, age, sex, family type, etc.
iv) Social profile of the displaced and affected families e.g. marital status, caste/ethnicity, educational status, etc.
v) Economic profile of the affected families e.g. occupations & livelihood; income level; consumption pattern; poverty status; etc.
vi) Health seeking behavior
vii) Decision making & participation at household level

4.1 Displaced and Affected families under the Project and their Classifications

The SIA study enumerated a total of 512 families from the list given for survey of which 291 will be displaced as their residential areas is going to be acquired and 221 families will be affected as their land is going to be acquired for setting up of the proposed industry in the five villages. (Table1). The expected displaced people were residing in village Tareikela, Kumbhari and Gariadihi Kisan Pada (a hamlet of Hirma village) and the expected affected people were from village Tumbekela,Tireikela, Kumbhari and Hirma.

Chart 1: Number of displaced and affected amilies enumerated under SIA

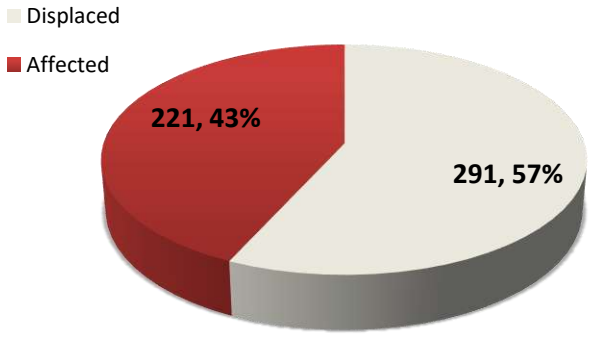


Table 3: Village wise number of Displaced and Affected families enumerated under SIA					
Name of the Village	**No of families enumerated**	**No of displaced families**	**Percentile**	**No of affected families**	**Percentile**
Hirma	124	39	31.5%	85	68.5%
Kumbhari	163	123	75.5%	40	24.5%
Tareikela	136	129	94.9%	7	5.1%
Tumbekela	89	0	0.0%	89	100.0%
Total	**512**	**291**	**62.0%**	**221**	**38.0%**

4.2 Demographic Profile of the Displaced and Affected Families

4.2.1 Gender Classification of the HoH of the Displaced and Affected Families

0nly 13 percent i.e. 38 out of 291 displaced families were headed by females. The rest i.e. 87 percent (n=253) was headed by a male person of their families. Kumbhari village has highest number of households headed by female (n=23)

The proportion of the female-headed households among the 221 affected families (9 percent, n=20) was more or less the same as the displaced families.

Chart 2: Gender classification of the HoH of the displaced and affected families (in %)

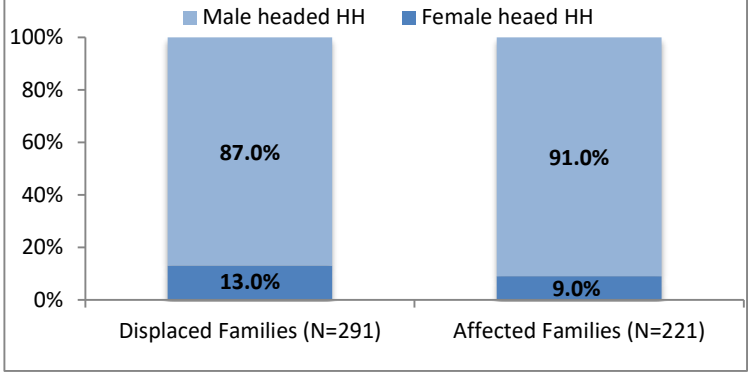


Table 4: Gender classification of the Head of the Household (HoH)				
	Displaced		**Affected**	
Category	**No.**	**%**	**No.**	**%**
Male	253	87%	201	91%
Female	38	13%	20	9%
Total	**291**	**100.0%**	**221**	**100.0%**

Table 5: No. of Households headed by female members village wise				
Village	**Displaced**		**Affected**	
	No	**%**	**No**	**%**
Hirma	8	20.5%	5	5.9%
Kumbhari	16	13.0%	7	17.5%
Tareikela	14	10.9%	1	14.3%
Tumbekela	0	0.0%	7	7.9%
Total	**38**	**13.0%**	**20**	**9.0%**

4.2.2 Family Size of the Displaced and Affected Families

The 291 displaced families identified in the survey consisted of a total of 1399 members, having an average of 5 members per family. The family size ranged from a minimum of 1 to a maximum of 12 members among the displaced family. The modal family size ranged from 3 to 5 members, which was found in more than half i.e. 56.7 percent (n=165) of the displaced families. Next highest i.e. 28.9 percent (n=84) had 6 to 10 members followed by 12.4 percent (n=36) having 1 to 2 members in their respective families and the rest 2.1 percent (n=6) had large family size having 11 or more members only.

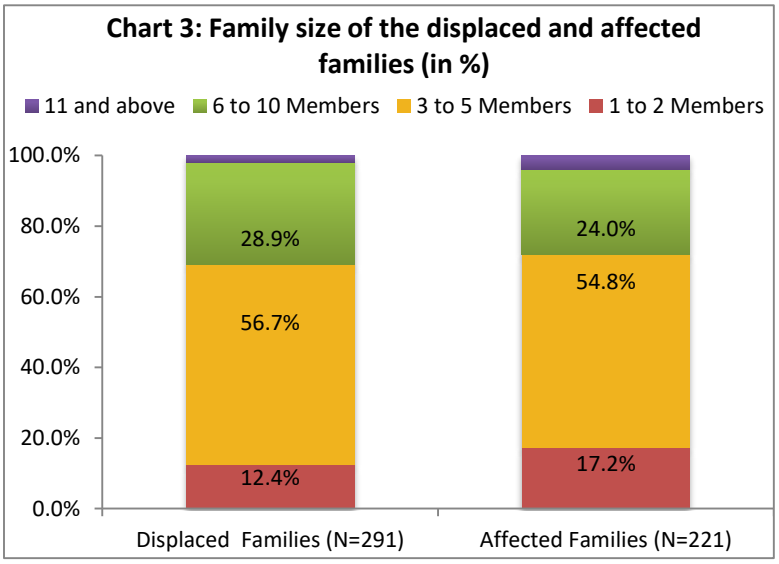


Table 6: Family Size in Displaced Families

Village	1 to 2 Members		3 to 5 Members		6 to 10 Members		More than 11 Members		Total	
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**
Hirma	6	15.4%	19	48.7%	12	30.8%	2	5.1%	39	100.0%
Kumbhari	15	12.2%	71	57.7%	37	30.1%	0	0.0%	123	100.0%
Tareikela	15	11.6%	75	58.1%	35	27.1%	4	3.1%	129	100.0%
Total	**36**	**12.4%**	**165**	**56.7%**	**84**	**28.9%**	**6**	**2.1%**	**291**	**100.0%**

Table 7: Family Size in Affected Families

Village	1 to 2 Members		3 to 5 Members		6 to 10 Members		More than 11 Members		Total	
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**
Hirma	17	20.0%	46	54.1%	20	23.5%	2	2.4%	85	100.0%
Kumbhari	4	10.0%	27	67.5%	7	17.5%	2	5.0%	40	100.0%
Tareikela	1	14.3%	6	85.7%	0	0.0%	0	0.0%	7	100.0%
Tumbekela	16	18.0%	42	47.2%	26	29.2%	5	5.6%	89	100.0%
Total	**38**	**17.2%**	**121**	**54.8%**	**53**	**24.0%**	**9**	**4.1%**	**221**	**100.0%**

In comparison to the displaced families, the average family size of the 121 (54.8%) affected families was found to be relatively equal i.e. 3 to 5 members per family. Like the displaced families, the highest i.e. 54.8 percent (n=121) of the affected families reported having family size of 3 to 5 members.

4.2.3 Gender Classification of the Displaced and Affected Family Members

The 1399 displaced family members comprised of 53.2 percent (n=744) males and 46.8 percent (n=655) females that means there were only 882 females against every 1000 male family members. The sex ratio of the affected family members was quite lower than the Jharsuguda district (1000:977) and the Odisha State (1000:979) reported in Census 2011, which indicates greater gender Inequality in the displaced family members. But as compared to the displaced families, the affected families (1000:898) had little higher sex ratio. There were 47.2 percent (n=554) females as against 52.8percent (n=495) males in the affected family members.

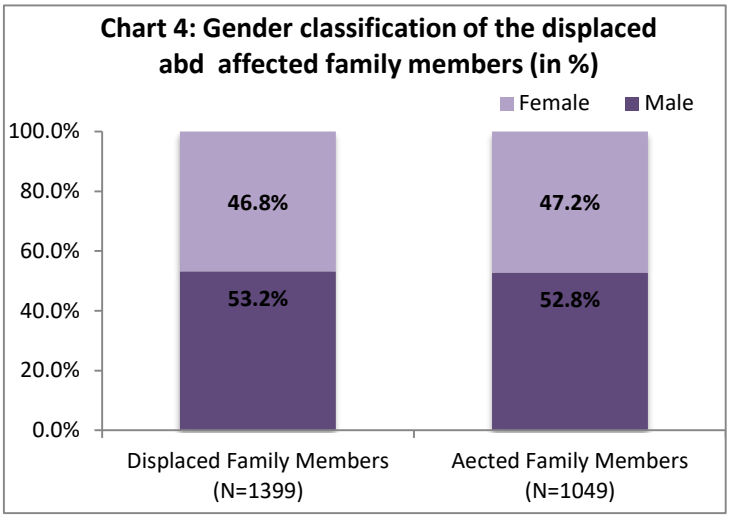


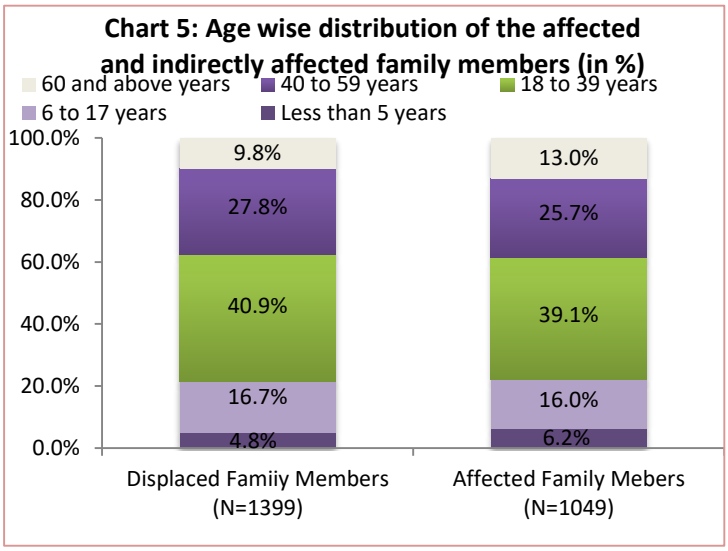
Table 8: Gender classification of the Displaced family members						
Village	**Male**		**Female**		**Total**	
	No	**%**	**No**	**%**	**No**	**%**
Hirma	98	49.2%	101	50.8%	199	100.0%
Kumbhari	300	51.8%	279	48.2%	579	100.0%
Tareikela	346	55.7%	275	44.3%	621	100.0%
Total	**744**	**53.2%**	**655**	**46.8%**	**1,399**	**100.0%**

Table 9: Gender classification of the Affected family members						
Village	**Male**		**Female**		**Total**	
	No	%	No	%	No	%
Hirma	207	52.1%	190	47.9%	397	100.0%
Kumbhari	101	53.2%	89	46.8%	190	100.0%
Tareikela	12	46.2%	14	53.8%	26	100.0%
Tumbekela	234	53.7%	202	46.3%	436	100.0%
Total	**554**	**52.8%**	**495**	**47.2%**	**1,049**	**100.0%**

4.2.4 Age-wise Distribution of the Displaced and Affected Family Members

The age wise distribution of the displaced and affected family members is presented in Chart 7. The highest i.e. 48.88 percent (n=572) of the displaced family members and 39.1 percent (n=410) of the affected family members were in the adult age group of 18 to 39 years, though the proportion of the children in the affected families was higher than the displaced families. Next highest i.e. 27.8 percent (n=389) of the displaced family members and 25.7 percent (n=270) of the affected family members were in adulthood or in the age group of 40 to 59 years. The percentage of family members in the age group of 6 to 17 years was same among the displaced and affected family members (16.7 percent and 16 percent).

The proportion of children population(less than 5 years) in the affected (6.2 percent, n=65) families was higher than the displaced (4.8 percent, n=67) families. The proportion of the aged people in both the displaced and affected families was found to be higher than that of the Odisha State (9.3 percent) and the country (8.0 percent) (Source: Census 2011), which is an indication of better life expectancy enjoyed by both the types of aforesaid family members. So, one in every eleven displaced as well as affected family members was found to be an elderly person, thus, greater sensitivity, care and attention are required from the project authorities for their rehabilitations.



Like the aged members, greater care and attention are required to the children below 5 years, which constituted 4.78 percent (n=67) and 6.19 percent (n=65) of the displaced and affected family members respectively.

Table 10: Age group of the family members

Age group	Displaced		Affected	
	No	%	No	%
Less than 5 years	67	4.78%	65	6.2%
6 to 17 years	234	16.72%	168	16.01%
18 to 39 years	572	40.88%	410	39.08%
40 to 59 years	389	27.8%	270	25.73%
60 and above years	137	9.79%	136	12.96%
Total	**1399**	**100.0%**	**1049**	**100.0%**

Table 11: Age group of displaced family members village wise

Village	Less than 5 Year		6 to 17 Year		18 to 39 Year		40 to 59 Year		More than 60 Year		Total	
	No	%	No	%	No	%	No	%	No	%	No	%
Hirma	17	8.5%	32	16.1%	91	45.7%	42	21.1%	17	8.5%	199	100.0%
Kumbhari	25	4.3%	103	17.8%	234	40.4%	165	28.5%	52	9.0%	579	100.0%
Tareikela	25	4.0%	99	15.9%	247	39.8%	182	29.3%	68	11.0%	621	100.0%
Total	**67**	**4.8%**	**234**	**16.7%**	**572**	**40.9%**	**389**	**27.8%**	**137**	**9.8%**	**1,399**	**1000.0%**

Table 12: Age group of affected family members village wise

Village	Less than 5 Year		6 to 17 Year		18 to 39 Year		40 to 59 Year		More than 60 Year		Total	
	No	%	No	%	No	%	No	%	No	%	No	%
Hirma	25	6.3%	63	15.9%	157	39.5%	93	23.4%	59	14.9%	397	100.0%
Kumbhari	10	5.3%	28	14.7%	77	40.5%	49	25.8%	26	13.7%	190	100.0%
Tareikela	0	0.0%	1	3.8%	12	46.2%	6	23.1%	7	26.9%	26	100.0%
Tumbekela	30	6.9%	76	17.4%	164	37.6%	122	28.0%	44	10.1%	436	100.0%
Total	**65**	**6.2%**	**168**	**16.0%**	**410**	**39.1%**	**270**	**25.7%**	**136**	**13.0%**	**1,049**	100.0%

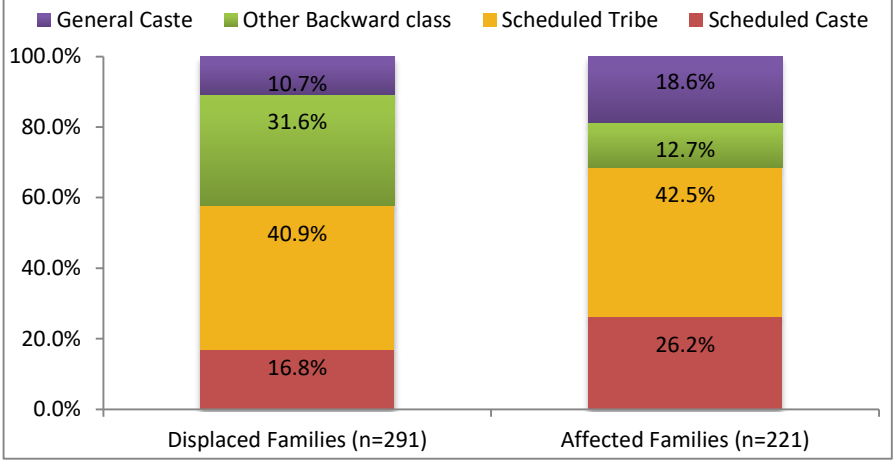
4.3 Social Profile of the Displaced and Affected Families

4.3.1 Caste/Ethnic Composition of the Displaced and Affected Families

The caste/ethnic composition of the displaced families is presented in Chart 8that shows 40.9 percent (n=119) belonged to Scheduled Tribes (ST) communities followed by 31.6 percent (n= 92) Other Backward Class (OBC), 16.8 percent (n=49) Scheduled Caste (SC) and 10.7percent families belonged to General caste communities (n=31).

Among the affected families, the highest i.e. 42.5 percent (n=94) belonged to STs followed by 26.2 percent (n=58) SCs, 18.6 percent (n=41) General Castes and only 12.7 percent (n=28) OBCs. In brief, the SIA found a notable difference in the caste / ethnic background between the displaced and affected families in SC, OBC and GC categories.

Chart 6: Caste/ethnic composition of the displaced and affected families (in %)



The caste/ethnic background of the families also revealed a greater representation of weaker sections (viz. STs and SCs) in the displaced and affected families. Adding together, the STs and SCs constituted more than half i.e. 57.7 percent of the displaced families and two third i.e. 68.7 percent of the affected families covered under the SIA study.

Table 13: Caste wise break-up of Displaced Families

Village	Scheduled Caste		Scheduled Tribe		Other Backward class		General Caste		Total	
	No	%	No	%	No	%	No	%	No	%
Hirma	1	2.6	36	92.3	2	5.1	0	0.0	39	100.0
Kumbhari	24	19.5	41	33.3	53	43.1	5	4.1	123	100.0
Tareikela	24	18.6	42	32.6	37	28.7	26	20.2	129	100.0
Total	**49**	**16.8**	**119**	**40.9**	**92**	**31.6**	**31**	**10.7**	**291**	**100.0**

Table 14: Caste wise break-up of Affected Families

Village	Scheduled Caste		Scheduled Tribe		Other Backward class		General Caste		Total	
	No	%	No	%	No	%	No	%	No	%
Hirma	12	14.1	54	63.5	6	7.1	13	15.3	85	100.0
Kumbhari	2	5.0	16	40.0	13	32.5	9	22.5	40	100.0
Tareikela	3	42.9	2	28.6	0	0.0	2	28.6	7	100.0
Tumbekela	41	46.1	22	24.7	9	10.1	17	19.1	89	100.0
Total	**58**	**26.2**	**94**	**42.5**	**28**	**12.7**	**41**	**18.6**	**221**	**100.0**

4.3.2 Nationality and Religion of the Displaced and Affected Families

All families i.e. 100 percent (n=291) of the displaced families and 100 percent (n=221) of the affected families were Indian Nationals. However, majority 98.6% of the displaced families and 99.5% of the affected families belonged to Hindu religion.

Table 15: Religion of displaced families

Village	Hindu		Christian		Total	
	No	%	No	%	No	%
Hirma	35	89.7	4	10.3	39	100.0
Kumbhari	123	100.0	0	0.0	123	100.0
Tareikela	129	100.0	0	0.0	129	100.0
Total	**287**	**98.6**	**4**	**1.4**	**291**	**100.0**

Table 16: Religion of affected families

Village	Hindu		Muslim		Total	
	No	%	No	%	No	%
Hirma	84	98.8	1	1.2	85	100.0
Kumbhari	40	100.0	0	0.0	40	100.0
Tareikela	7	100.0	0	0.0	7	100.0
Tumbekela	89	100.0	0	0.0	89	100.0
Total	**220**	**99.5**	**1**	**0.5**	**221**	**100.0**

Table 17: Religion of the households surveyed

Category	Hindu		Muslim		Christian		Total	
	No	%	No	%	No	%	No	%
Displaced	287	98.6	0	0.0	4	1.4	291	100
Affected	220	99.5	1	0.5	0	0.0	221	100
Total	**506**	**99.02**	**1**	**0.19**	**4**	**0.78**	**511**	**100**

4.3.3 Marital Status of the Displaced and Affected Family Members

The marital status of the displaced and affected family members is presented in Chart 9.

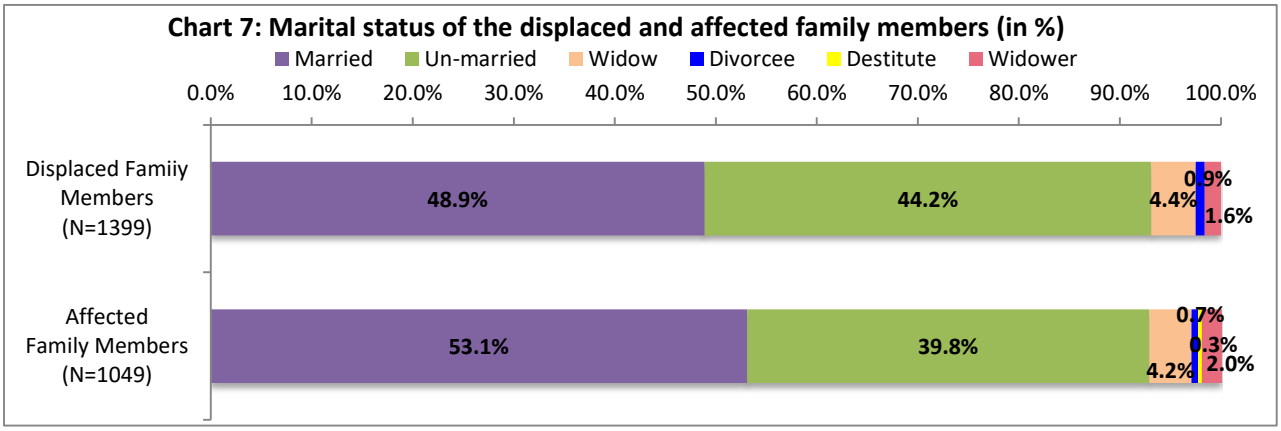
48.9 percent (n=684) of displaced family members were married, followed by 44.2 percent (n=619) of the members who were un-married. It was observed that 4.4 percent (n=62) women from displaced families were widow where as 0.9 percent (n=12) were divorcee. As many as 1.6 percent (n=22) of the displaced family members were widowers.

Among the affected family members, 53.1 percent (n=557) were married and 39.8 percent (n=417) were unmarried. Like the displaced family members, 4.2 percent (n=44) women members of the affected family were widows. It was found that 0.7 percent (n=7) were divorcee, 0.3 percent (n=3) were destitute and 2 percent (n=21) of the affected family members were widowers which are considered highly vulnerable family members as the likely impact of the land acquisition will be greater on them and needs special attention by the project proponent.

Table 18: Marital status of the family members

Category	Displaced		Affected	
	No	%	No	%
Married	684	48.9%	557	53.1%
Un-married	619	44.2%	417	39.8%
Widow	62	4.4%	44	4.2%

Table 18: Marital status of the family members				
Category	**Displaced**		**Affected**	
Divorcee	12	0.9%	7	0.7%
Destitute	0	0	3	0.3%
Widower	22	1.6%	21	2.0%
Total	**1,399**	**100.0%**	**1,049**	**100.0%**



4.3.4 Disability members in Displaced and Affected Families

The table reveals that 9 (0.6%) disabled members were enumerated among 1399 displaced family members whereas there were 12 (1.1%) disabled family members found among 1049 affected family members during the study.

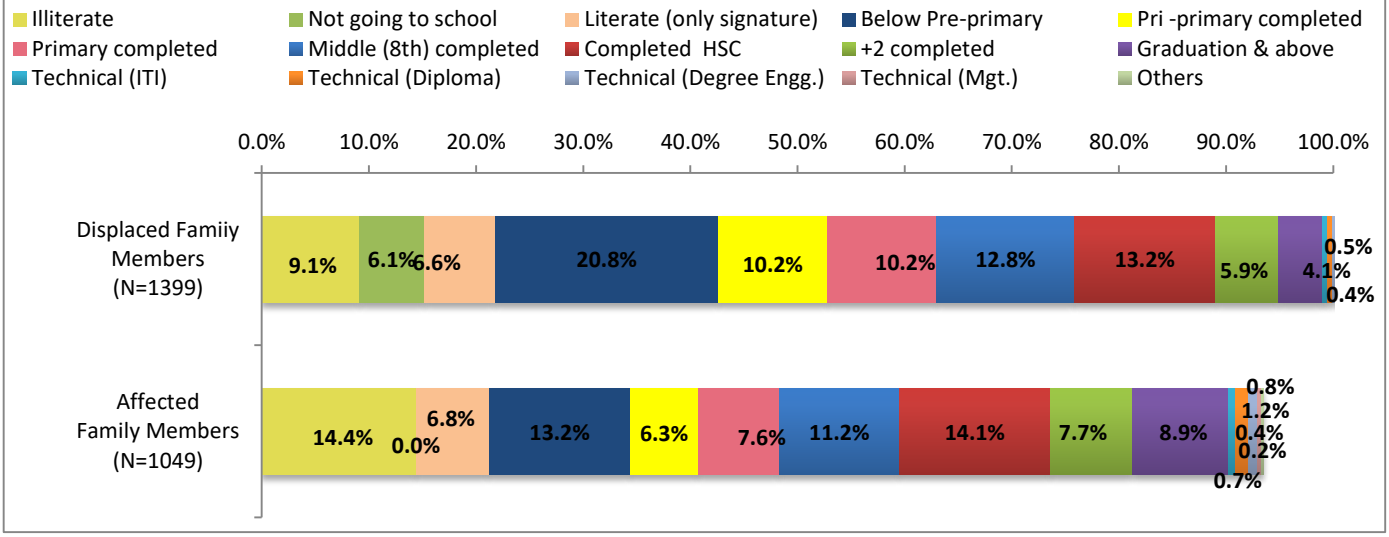
Table 19: Disabled members in the displaced and affected families								
Disabled members in Displaced Families					**Disabled members in Affected Families**			
Village	**Disabled members**	**%**	**Normal members**	**%**	**Disabled members**	**%**	**Normal members**	**%**
Hirma	0	0.0%	198	100.0%	6	1.5%	391	98.5%
Kumbhari	4	0.7%	574	99.3%	0	0.0%	190	100.0%
Tareikela	5	0.8%	615	99.2%	0	0.0%	26	100.0%
Tumbekela	0	0.0%	0	0.0%	6	1.4%	430	98.6%
Total	**9**	**0.6%**	**1,387**	**99.4%**	**12**	**1.1%**	**1,037**	**98.9%**

It is important to note that the vulnerable family members like disabled persons, widows, destitute, and divorcees require greater attention for their economic rehabilitation by the project authorities.

4.3.5 Educational Attainment and Professional Skill of the Displaced and Affected Family Members

Out of the 1399 displaced family members, 6.1 percent (n=86) were not going to school, as most of them were not in the school going age. Of the remaining 1313 displaced family members, 20.8 percent (n=291) had below pre-primary education, 10.2 percent (n=142) pre-primary education,10.2 percent (n=142) primary,12.8 percent (n=179) did middle school (8th class) education,13.2percent (n=184) high school education, 5.9 percent (n=83) completed intermediate education (+2), and only 4 percent (n=56) of the

Chart 8: Educational status of the displaced and affected family members (in %)



affected family members attained degree or higher level of educations. The percentage of the displaced family members attained technical education was quite low as only 0.5 percent (n=7) were ITI pass out, followed by 0.4 percent (n=5) had Diploma engineering and 0.3 percent (n=4) members had B.Tech. As high as 9.1 percent (n=127) of the displaced family members were illiterates and 6.6 percent (n=92) were literates who could only put their signatures.

Similar to the affected family members, 6.6 percent (n=69) out of the 1049 affected family members were not going to school. Of the remaining 980 affected family members,13.2 percent (n=138) below pre-primary,6.6 percent (n=66) of the affected family members completed pre-primary education,7.6 percent (n=80) primary education,11.2 percent (n=118) had middle (8th class) education,14.1 percent (n=148) completed high school ,7.7 percent (n=81) completed intermediate/+2 and only 8.9 percent (n=93) of the affected family members attained degree or higher level of educations which is higher than the displaced family members.14.4 percent (n=151) were illiterates, which was much higher than the displaced family members.6.8 percent (n=71) were just literates or could only put their signatures. The percentage of the affected family member attained technical education was quite low i.e. 1.2 percent (n=13) had diploma in engineering, 0.7percent (n=7) had ITI, followed by 0.4 percent (n=4) had degree in engineering. Only 4 persons (0.4%) were management degree holders.

In a nutshell, the SIA study revealed relatively better educational status of the displaced family members as compared to the affected members. Location of schools in the displaced villages could be the reason of little higher educational level than the affected families. Nonetheless, lack of higher and technical education among the displaced as well as affected family members was reflected from the study findings, which in a way limits their employability or income earning capacity.

The SIA study findings shows that 21.9 percent (n=309) members from the displaced family and 22 percent (n=232) from the affected family discontinued their study due to various factors.

4.3.6 Gender wise Educational Status of the Displaced and Affected Family Members

The gender wise disaggregation of the educational status of the affected family members is presented in Chart 11. It shows, the percentage of illiterates among females (66.0 percent) was two times higher than the males (34.0 percent) of both displaced and affected family members. Coincidentally, the percentage of the literate (signature only) was same among the males (50.0 percent) and females (50.0 percent) of the displaced and affected families. Interestingly, the study findings did not show much difference in the educational level between males and females of the displaced and affected family members. But, it was noticed that there was little difference marked between the males and females in below pre-primary level in displaced family. More or less, similar trend was observed in the educational levels of the male and female members of the affected families. In higher and technical education the percentage of females were

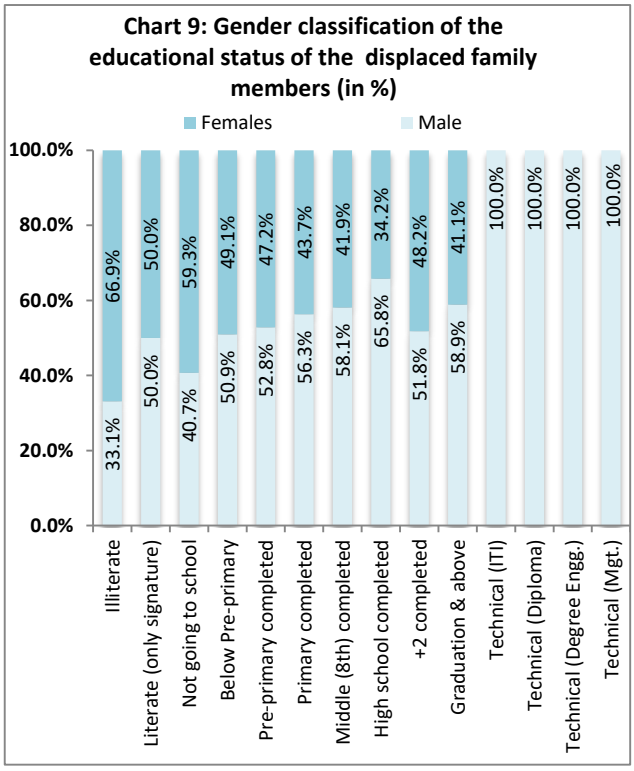


Chart 9: Gender classification of the educational status of the displaced family members (in %)

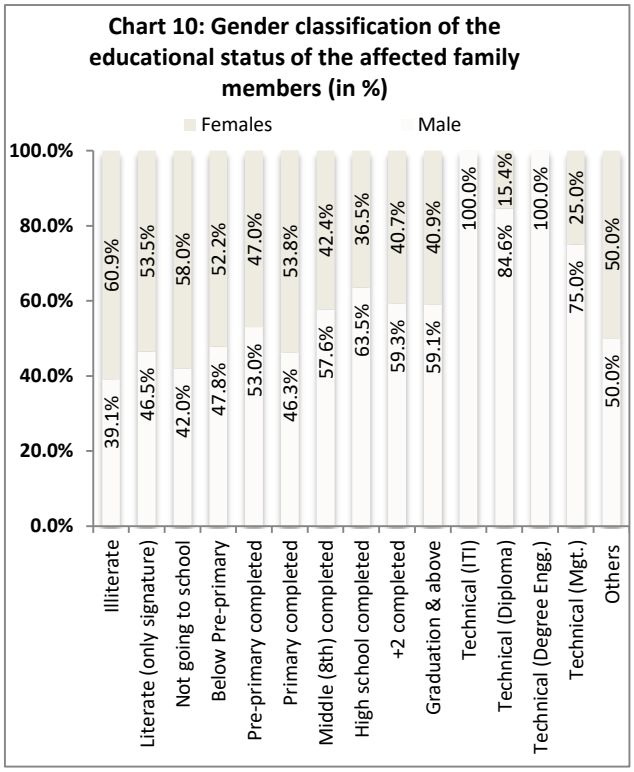


Chart 10: Gender classification of the educational status of the affected family members (in %)

even nil in both the displaced and affected category.

Table 20: Gender Classifications of the Education Status of Displaced Family Members

	Male		Female		Total	
	No	%	No	%	No	%
Illiterate	42	33.1	85	66.9	127	100.0
Literate	46	50.0	46	50.0	92	100.0
Not going to school	35	40.7	51	59.3	86	100.0
Below Pre-primary	148	50.9	143	49.1	291	100.0
Pre-primary completed	75	52.8	67	47.2	142	100.0
Primary completed	80	56.3	62	43.7	142	100.0
Middle (8th) completed	104	58.1	75	41.9	179	100.0

Table 20: Gender Classifications of the Education Status of Displaced Family Members						
	Male		Female		Total	
	No	%	No	%	No	%
High school completed	121	65.8	63	34.2	184	100.0
+2 completed	43	51.8	40	48.2	83	100.0
Graduation & above	33	58.9	23	41.1	56	100.0
Technical (ITI)	7	100.0	0	0.0	7	100.0
Technical (Diploma)	5	100.0	0	0.0	5	100.0
Technical (Degree Engg.)	4	100.0	0	0.0	4	100.0
Technical (Mgt.)	1	100.0	0	0.0	1	100.0
Other	0	0.0	0	0.0	0	0.0
Total	**744**	**53.2**	**655**	**46.8**	**1,399**	**100.0**

Table 21: Gender Classifications of the Education Status of Affected Family Members						
	Male		Female		Total	
	No	%	No	%	No	%
Illiterate	59	39.1	92	60.9	151	100.0
Literate	33	46.5	38	53.5	71	100.0
Not going to school	29	42.0	40	58.0	69	100.0
Below Pre-primary	66	47.8	72	52.2	138	100.0
Pre-primary completed	35	53.0	31	47.0	66	100.0
Primary completed	37	46.3	43	53.8	80	100.0
Middle (8th) completed	68	57.6	50	42.4	118	100.0
High school completed	94	63.5	54	36.5	148	100.0
+2 completed	48	59.3	33	40.7	81	100.0
Graduation & above	55	59.1	38	40.9	93	100.0
Technical (ITI)	7	100.0	0	0.0	7	100.0
Technical (Diploma)	11	84.6	2	15.4	13	100.0
Technical (Degree Engg.)	8	100.0	0	0.0	8	100.0
Technical (Mgt.)	3	75.0	1	25.0	4	100.0
Other	1	50.0	1	50.0	2	100.0
Total	**554**	**52.8**	**495**	**47.2**	**1,049**	**100.0**

Table 22: Education level of the Displaced Family members (Agewise)																	
		Illiterate		Literate (only signature)		Not going to school		Below Pre-primary		Pre-primary completed		Primary completed		Middle (8th) completed		High school completed	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Less than 5 years	Male	5	16.7	1	3.3	22	73.3	2	6.7	0	0.0	0	0.0	0	0.0	0	0.0
	Female	7	18.9	2	5.4	26	70.3	2	5.4	0	0.0	0	0.0	0	0.0	0	0.0
	Total	12	17.9	3	4.5	48	71.6	4	6.0	0	0.0	0	0.0	0	0.0	0	0.0
6 to 17 years	Male	2	1.6	1	0.8	1	0.8	39	31.2	16	12.8	21	16.8	19	15.2	21	16.8
	Female	1	0.9	1	0.9	1	0.9	38	34.9	16	14.7	18	16.5	20	18.3	10	9.2
	Total	3	1.3	2	0.9	2	0.9	77	32.9	32	13.7	39	16.7	39	16.7	31	13.2
18 to 39 years	Male	1	0.3	4	1.3	7	2.2	37	11.7	32	10.1	38	12.0	62	19.6	68	21.5
	Female	6	2.4	9	3.5	16	6.3	44	17.3	27	10.6	24	9.4	38	14.9	41	16.1
	Total	7	1.2	13	2.3	23	4.0	81	14.2	59	10.3	62	10.8	100	17.5	109	19.1

Table 22: Education level of the Displaced Family members (Agewise)																	
		Illiterate		Literate (only signature)		Not going to school		Below Pre-primary		Pre-primary completed		Primary completed		Middle (8th) completed		High school completed	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
40 to 59 years	Male	18	9.0	26	13.0	4	2.0	50	25.0	23	11.5	17	8.5	19	9.5	29	14.5
	Female	36	19.0	28	14.8	7	3.7	47	24.9	21	11.1	16	8.5	16	8.5	11	5.8
	Total	54	13.9	54	13.9	11	2.8	97	24.9	44	11.3	33	8.5	35	9.0	40	10.3
60 and above	Male	16	22.2	14	19.4	1	1.4	20	27.8	4	5.6	4	5.6	4	5.6	3	4.2
	Female	35	53.8	6	9.2	1	1.5	12	18.5	3	4.6	4	6.2	1	1.5	1	1.5
	Total	51	37.2	20	14.6	2	1.5	32	23.4	7	5.1	8	5.8	5	3.6	4	2.9
Total	**Male**	**42**	**5.6**	**46**	**6.2**	**35**	**4.7**	**148**	**19.9**	**75**	**10.1**	**80**	**10.8**	**104**	**14.0**	**121**	**16.3**
	Female	**85**	**13.0**	**46**	**7.0**	**51**	**7.8**	**143**	**21.8**	**67**	**10.2**	**62**	**9.5**	**75**	**11.5**	**63**	**9.6**
	Total	**127**	**9.1**	**92**	**6.6**	**86**	**6.1**	**291**	**20.8**	**142**	**10.2**	**142**	**10.2**	**179**	**12.8**	**184**	**13.2**

Table 23: Education level of the Displaced Family members (Continued)															
		+2 completed		Graduation & above		Technical (ITI)		Technical (Diploma)		Technical (Degree Engg.)		Technical (Mgt.)		Others	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Less than 5 years	Male	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Female	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Total	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
6 to 17 years	Male	5	4.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Female	3	2.8	1	0.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Total	8	3.4	1	0.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
18 to 39 years	Male	33	10.4	20	6.3	7	2.2	4	1.3	4	1.3	0	0.0	0	0.0
	Female	31	12.2	19	7.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Total	64	11.2	39	6.8	7	1.2	4	0.7	4	0.7	0	0.0	0	0.0
40 to 59 years	Male	3	1.5	9	4.5	0	0.0	1	0.5	0	0.0	1	0.5	0	0.0
	Female	5	2.6	2	1.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Total	8	2.1	11	2.8	0	0.0	1	0.3	0	0.0	1	0.3	0	0.0
60 and above	Male	2	2.8	4	5.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Female	1	1.5	1	1.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Total	3	2.2	5	3.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	**Male**	**43**	**5.8**	**33**	**4.4**	**7**	**0.9**	**5**	**0.7**	**4**	**0.5**	**1**	**0.1**	**0**	**0.0**
	Female	**40**	**6.1**	**23**	**3.5**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**
	Total	**83**	**5.9**	**56**	**4.0**	**7**	**0.5**	**5**	**0.4**	**4**	**0.3**	**1**	**0.1**	**0**	**0.0**

Table 24: Education level of the Affected Family members																	
		Illiterate		Literate (only signature)		Not going to school		Below Pre-primary		Pre-primary completed		Primary completed		Middle (8th) completed		High school completed	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Less than 5 years	Male	8	25.0	1	3.1	15	46.9	7	21.9	0	0.0	0	0.0	0	0.0	0	0.0
	Female	8	24.2	1	3.0	18	54.5	4	12.1	1	3.0	0	0.0	0	0.0	0	0.0
	Total	16	24.6	2	3.1	33	50.8	11	16.9	1	1.5	0	0.0	0	0.0	0	0.0
6 to 17	Male	2	2.1	0	0.0	4	4.1	26	26.8	17	17.5	12	12.4	17	17.5	12	12.4
	Female	2	2.8	0	0.0	1	1.4	27	38.0	8	11.3	16	22.5	12	16.9	5	7.0

years	Total	4	2.4	0	0.0	5	3.0	53	31.5	25	14.9	28	16.7	29	17.3	17	10.1
18 to 39 years	Male	5	2.4	2	1.0	5	2.4	13	6.2	9	4.3	16	7.6	29	13.8	48	22.9
	Female	11	5.5	10	5.0	10	5.0	24	12.0	7	3.5	17	8.5	26	13.0	35	17.5
	Total	16	3.9	12	2.9	15	3.7	37	9.0	16	3.9	33	8.0	55	13.4	83	20.2
40 to 59 years	Male	19	13.8	17	12.3	3	2.2	13	9.4	6	4.3	4	2.9	14	10.1	23	16.7
	Female	40	30.3	20	15.2	9	6.8	12	9.1	12	9.1	5	3.8	9	6.8	12	9.1
	Total	59	21.9	37	13.7	12	4.4	25	9.3	18	6.7	9	3.3	23	8.5	35	13.0
60 and above	Male	25	32.5	13	16.9	2	2.6	7	9.1	3	3.9	5	6.5	8	10.4	11	14.3
	Female	31	52.5	7	11.9	2	3.4	5	8.5	3	5.1	5	8.5	3	5.1	2	3.4
	Total	56	41.2	20	14.7	4	2.9	12	8.8	6	4.4	10	7.4	11	8.1	13	9.6
Total	**Male**	**59**	**10.6**	**33**	**6.0**	**29**	**5.2**	**66**	**11.9**	**35**	**6.3**	**37**	**6.7**	**68**	**12.3**	**94**	**17.0**
	Female	**92**	**18.6**	**38**	**7.7**	**40**	**8.1**	**72**	**14.5**	**31**	**6.3**	**43**	**8.7**	**50**	**10.1**	**54**	**10.9**
	Total	**151**	**14.4**	**71**	**6.8**	**69**	**6.6**	**138**	**13.2**	**66**	**6.3**	**80**	**7.6**	**118**	**11.2**	**148**	**14.1**

Table 25: Education level of the Affected Family members (Continued)

		+2 completed		Graduation & above		Technical (ITI)		Technical (Diploma)		Technical (Degree Engg.)		Technical (Mgt.)		Others	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Less than 5 years	Male	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	3.1
	Female	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	3.0
	Total	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	3.1
6 to 17 years	Male	4	4.1	1	1.0	1	1.0	1	1.0	0	0.0	0	0.0	0	0.0
	Female	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Total	4	2.4	1	0.6	1	0.6	1	0.6	0	0.0	0	0.0	0	0.0
18 to 39 years	Male	32	15.2	28	13.3	6	2.9	7	3.3	8	3.8	2	1.0	0	0.0
	Female	27	13.5	30	15.0	0	0.0	2	1.0	0	0.0	1	0.5	0	0.0
	Total	59	14.4	58	14.1	6	1.5	9	2.2	8	2.0	3	0.7	0	0.0
40 to 59 years	Male	10	7.2	25	18.1	0	0.0	3	2.2	0	0.0	1	0.7	0	0.0
	Female	5	3.8	8	6.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Total	15	5.6	33	12.2	0	0.0	3	1.1	0	0.0	1	0.4	0	0.0
60 and above	Male	2	2.6	1	1.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Female	1	1.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	Total	3	2.2	1	0.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	**Male**	**48**	**8.7**	**55**	**9.9**	**7**	**1.3**	**11**	**2.0**	**8**	**1.4**	**3**	**0.5**	**1**	**0.2**
	Female	**33**	**6.7**	**38**	**7.7**	**0**	**0.0**	**2**	**0.4**	**0**	**0.0**	**1**	**0.2**	**1**	**0.2**
	Total	**81**	**7.7**	**93**	**8.9**	**7**	**0.7**	**13**	**1.2**	**8**	**0.8**	**4**	**0.4**	**2**	**0.2**

4.3.7 Technical /Professional Training Attended by the Displaced and Affected Family members

Besides collecting the data on the formal technical and non-technical education attained by the family members, the study also made an attempt to record the kind of technical/professional trainings attended by them, which are presented in the Table. 9 persons from displaced families and 27 from affected families have completed diploma courses in different trades, 7 from displaced and 5 from affected families have completed CT and 4 from displaced family and 2 from affected family completed B.Ed courses. The table shows that in comparison to displaced families, more members from the affected families have completed professional courses like Pharmacy and Computer.

Table 26: Training courses attended by the Displaced and Affected Family Members						
Courses	Displaced Family Members		Affected Family Members		Total	
	No.	%	No.	%	No	%
LHV/ANM	3	5.6	0	0.0	3	2.8
C.T	7	13.0	5	9.4	12	11.2
B.Ed	4	7.4	2	3.8	6	5.6
Computer	7	13.0	15	28.3	22	20.6
Driving	10	18.5	5	9.4	15	14.0
Tailoring	0	0.0	2	3.8	2	1.9
Welder	2	3.7	2	3.8	4	3.7
Pharmacist	0	0.0	4	7.5	4	3.7
Typist	1	1.9	0	0.0	1	0.9
Other	20	37.0	18	34.0	38	35.5
Total	**54**	**100.0**	**53**	**100.0**	**107**	**100.0**

4.4 Economic Profile of the Displaced and Affected Families

4.4.1.1 Productive and Domestic Assets

Many of the displaced and affected families owned domestic and productive assets. Agriculture equipment's like ploughs, bullock carts, Spray sets, pump sets, threshers, power tiller and tractor were owned by the minimum of the displaced and affected families because most of the people were working in industries and due to lack of irrigation facilities, people would not get expected out come from agriculture. It was found that majority of the people from displaced families (n=224) and affected families (n=175) owned By-cycles. Next highest of the affected families owned sewing machine (27 families, 22.1 percent), pump set (7 families, 5.7 percent), sound system (8 families, 6.6 percent), spray pump (13 families, 10.7 percent), etc. Similarly, less number of displaced and affected families owned Sewing machines (n=4 and n=3 respectively). Other productive assets like bus/truck were hardly owned by displaced and affected families.

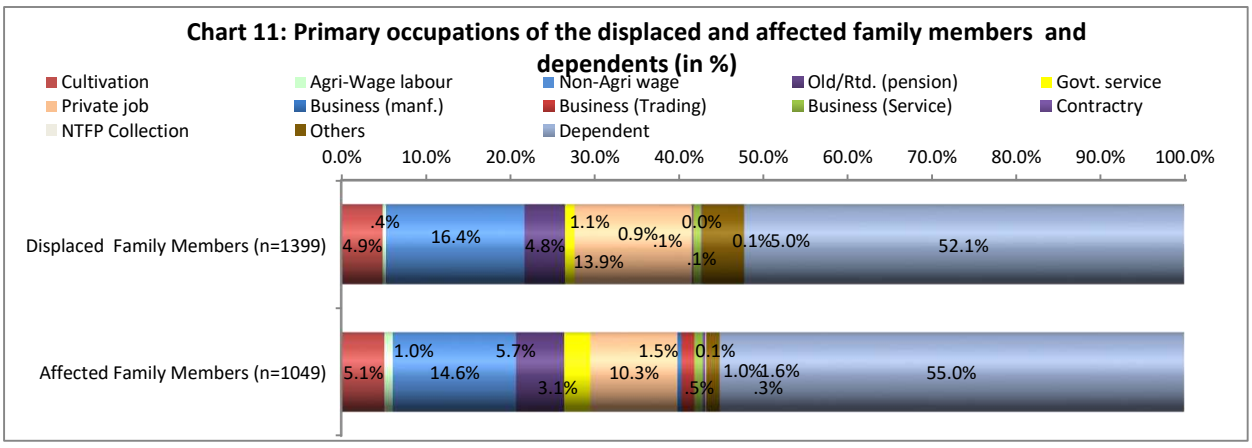
Table 27: Productive and domestic assets owned by the displaced and affected families												
	Displaced						Affected					
	Mean	Median	Minimum	Maximum	Sum	Valid N	Mean	Median	Minimum	Maximum	Sum	Valid N
Ploughs	1	1	1	1	2	2	1	1	1	1	4	4
Bullock Carts	1	1	1	1	2	2	1	1	1	1	1	1
Tractor	1	1	1	1	1	1	1	1	1	1	1	1
Spray pump	1	1	1	1	9	9	1	1	1	1	1	1
Pump Set with/without pipe system	1	1	1	1	7	7	1	1	1	2	5	4
Bicycle	1	1	1	4	285	224	1	1	1	3	204	175
Scooter/Motor-bike	1	1	1	2	146	123	1	1	1	5	148	108
Car / jeep / van	1	1	1	2	8	7	1	1	1	2	14	12

Bus / Truck	1	1	1	2	4	3	1	1	1	1	2	2
Thresher	1	1	1	1	2	2						
Pressure cooker	1	1	1	3	58	52	1	1	1	4	70	56
Power Tiller	1	1	1	1	1	1	1	1	1	1	1	1
Sound System	1	1	1	1	8	8	1	1	1	1	4	4
Sewing Machine	1	1	1	1	4	4	1	1	1	1	3	3
Watch or clock	1	1	1	5	193	133	1	1	1	10	157	108
Chair	3	2	1	10	634	220	3	2	1	10	517	171
Cot/bed	2	2	1	21	407	174	2	2	1	8	261	114
Table	1	1	1	6	177	129	1	1	1	4	167	112
Fan							2	2	2	2	2	1
Color Television							1	1	1	1	1	1
Phone (Landline)	1	1	1	1	1	1						
Kerosene Stove							1	1	1	1	1	1
Air-conditioner	1	1	1	1	1	1						

4.4.2 Occupation & Livelihood

The occupational status of the displaced and affected family members is presented in Chart 13 and 14. Data on both primary and subsidiary occupations as well as dependents were collected under the SIA study, which are analyzed and presented here.

The study findings brought out that only 47.8 percent i.e. 670 out of the 1399 displaced family members and 44.8 percent i.e. 471 out of the 1049 affected family members pursued any occupation for earning an income or livelihood for their family members. More than half i.e. 52.1 percent (n=730) of the displaced family members and 55.1 percent (n=578) of the affected family members were dependent on the income earning members of their respective families for their daily livelihood. Majority of the dependents were found to be children and adolescents below 18 years of age, house wives and elderly people in the family. In brief, the proportion of family members pursuing any occupations and dependents was more or less the same among the displaced and affected family members.



Of the earning family members, the highest i.e. 16.4 percent (n=230) of the total displaced family members and 14.6 percent (n=153) of the total affected family members were earning their livelihood from non-agriculture wage and depended on the same as a primary occupation, though a greater percentage of displaced family members pursued the same occupation as compared to the affected family members.

Apart from these, an additional 13.9 percent (n=195) and 10.3 percent (n=108) of the displaced and affected family members were engaged in private jobs as their primary occupation.

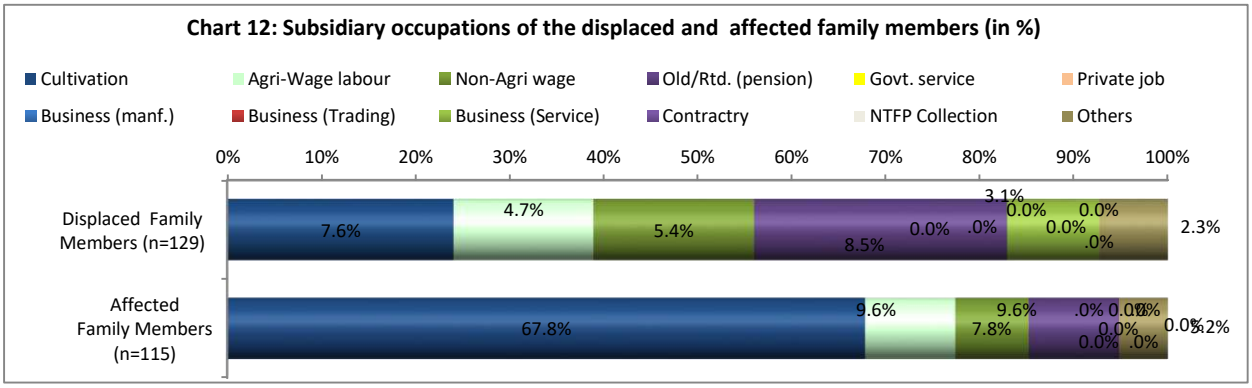
The SIA study found that majority 67.8% percent (n=78) out of 115 affected family members had chosen cultivation as their subsidiary occupation.

Both the agriculture and non-agricultural daily wage laborer pursued by the displaced family members as a primary occupation seemed to be higher than the affected family members.

Subsistence agriculture and availability of regular/daily wage employment opportunities could be the reason why majority of the displaced family members had to depend on occupations other than agriculture and allied activities/ wage earning. The scenario was almost similar among the affected families, where majority of the members were engaged in the same. As there are many steel and power plants located around the proposed project site, employment opportunities are available for the local people to earn their livelihood.

It was also evident from the fact that only a fewer proportion of the displaced and the affected family members pursued as agriculture wage labor, though most of them in both the categories of family members pursued this as a subsidiary occupation (0.42 percent/6 displaced and 1.04 percent/11 affected family members) than the primary occupation (0.35 percent/5 displaced and 1.04 percent/11 affected family members).

Chart 12: Subsidiary occupations of the displaced and affected family members (in %)



The other primary occupations pursued by the displaced family members were government service (1.1 percent, (n=16), retired pension (4.8 percent, n=67), service sector business (0.9 percent, n=13), trading business (0.1 percent, n=2), manufacturing business (0.1 percent, n=1). Similarly, the other primary occupations pursued by the indirectly affected family members were government service (3.1 percent, n=32), retired pension (5.7 percent, n=60), service sector business (1 percent, n=11), trading business (1.5 percent, n=16), manufacturing business (0.5 percent, n=5) and Non-timber Forest Produces (NTFPs) collection (0.1% percent, n=1)

Among the various subsidiary occupations pursued by the family members, a greater number of both the displaced (n=98) and affected (n=78) family members was cultivation, 7 family members from displaced and 9 from affected family pursued non agriculture wage earning as their subsidiary income. Retired pension was pursued as the other subsidiary occupations by the 11 members each of displaced family members and affected family members.

The SIA study also revealed that a significant proportion income earning displaced family members (90.7 percent, 1270 out of 1399 members) did not have any subsidiary occupations. Similarly, 89 percent (934 out of 1049 members) of the affected family members did not have any subsidiary occupations, which depended only on the primary occupations.

Table 28: Main occupation of the family members

	Displaced		Affected		Total	
	No.	%	No.	%	No	%
Cultivation	69	4.9	54	5.1	123	5.0
Agri-Wage labour	5	0.4	11	1.0	16	0.7
Non-Agri wage	230	16.4	153	14.6	383	15.6
Old/Rtd. (pension)	67	4.8	60	5.7	127	5.2
Govt. service	16	1.1	32	3.1	48	2.0
Private job	195	13.9	108	10.3	303	12.4
Business (manf.)	1	0.1	5	0.5	6	0.2
Business (Trading)	2	0.1	16	1.5	18	0.7
Business (Service)	13	0.9	11	1.0	24	1.0
Contractry	2	0.1	3	0.3	5	0.2
NTFP Collection	0	0.0	1	0.1	1	0.0
Dependent	729	52.1	578	55.1	1,307	53.4
Other Specify	70	5.0	17	1.6	87	3.6
Total	**1,399**	**100.0**	**1,049**	**100.0**	**2,448**	**100.0**

Table 29: Subsidiary (<180 days of engagement) of the family members

	Displaced		Affected		Total	
	No.	%	No.	%	No	%
Cultivation	98	76.0	78	67.8	176	72.1
Agri-Wage labour	6	4.7	11	9.6	17	7.0
Non-Agri wage	7	5.4	9	7.8	16	6.6
Old/Rtd. (pension)	11	8.5	11	9.6	22	9.0
Business (Service)	4	3.1	0	0.0	4	1.6
Others	3	2.3	6	5.2	9	3.7
Total	**129**	**100.0**	**115**	**100.0**	**244**	**100.0**

Cost incurred on agriculture: The average annual cost incurred towards cultivation worked out to be Rs.21,312/- per displaced family as compared to Rs.15,982/- per affected family, which included all the explicit costs incurred on agriculture like purchase of seeds, fertilizers, transportation costs and payment to hiring of laborers, etc.

Table 30: Average total cost of cultivation (In last one year) (in Rs.)

Displaced						Affected					
Mean	Median	Minimum	Maximum	Sum	Valid N	Mean	Median	Minimum	Maximum	Sum	Valid N
21,312	8,600	300,000	1,500	2,749,200	129	15,982	9,700	167,000	2,500	1,646,150	103

Net value/income from agriculture production: The net value of agriculture production/income works out to be only Rs.21, 617/- per displaced family and Rs.12, 865/- per affected family after deduction of the explicit costs from the gross average value of the agriculture production. If the total land area brought under cultivation is kept into account, the net value of the agriculture production received was found to be low. Factors such as lack of irrigation, low productivity of lands, decline in soil quality due to increased use of fertilizers, lack of use of modern technologies and hybrid seeds, less importance to cash crop cultivation, etc. are some of the reasons that lead to low agriculture production. Farmers were facing the problem of agriculture labour as people prefer to work in industries than in agriculture. If both the implicit and explicit costs are deducted from the gross value of the agriculture production, one can understand how agriculture is un-remunerative for the affected families in the project area.

Table 31: Net income from cultivation during last one year (Total gross value of production-Total Costs) (in Rs.)

Displaced						Affected					
Mean	Median	Minimum	Maximum	Sum	Valid N	Mean	Median	Minimum	Maximum	Sum	Valid N
21,617	11,000	175,000	1,200	3,502,000	162	12,865	8,800	53,000	1,500	1,595,250	124

Adequacy of agriculture production to meet the household consumption need:

The SIA study attempted to know whether the food grains produced from the agriculture are sufficient to meet their annual household consumption need. More than half i.e. 28.4 percent (46 out of 162) of the displaced families and 33.9 percent (46 out of 20) of the affected families informed that the quantum of food grains produced did not meet their annual consumption need of the entire family. In other words, large proportion of both the affected and indirectly affected families experienced food insecurity due to low returns from agriculture.

Chart 13: Adequacy of agriculture production to meet HH consumption need of affected and indirectly affected families (in %)

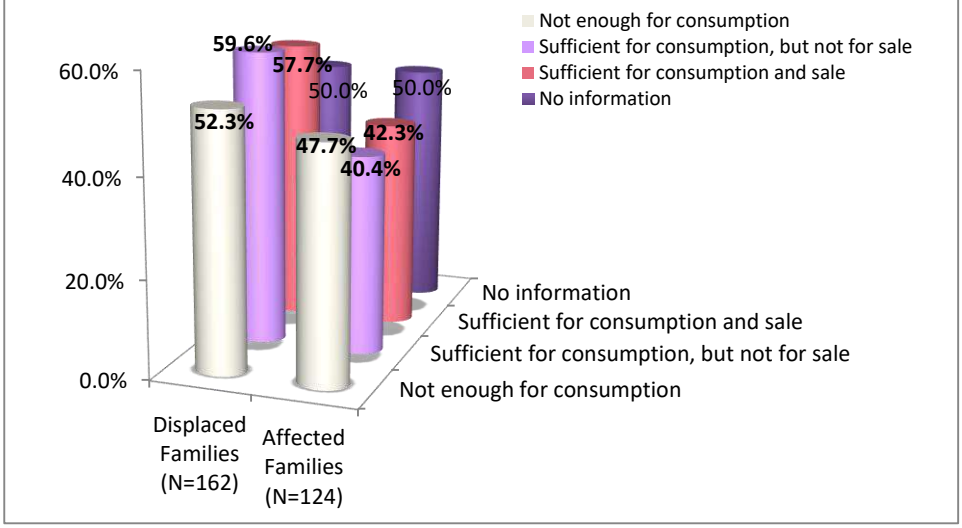


Table 32: Adequacy of Agriculture Production to meet HH Consumption Need						
	Displaced		Affected		Total	
	No	%	No	%	No	%
Not enough for consumption	46	28.4	42	33.9	88	30.8
Sufficient for consumption, but not for sale	59	36.4	40	32.3	99	34.6
Sufficient for consumption and sale	56	34.6	41	33.1	97	33.9
No information	1	0.6	1	0.8	2	0.7
Total	**162**	**100.0**	**124**	**100.0**	**286**	**100.0**

4.4.2.1 Net Annual Income of the Displaced and Affected Families

The net annual income of the 291 displaced families and 221 affected families was calculated by adding the income of each family from different sources. An attempt was made in the study to classify the annual net income of the displaced and affected families into the various income groups, which gives a fair picture of the income level of the families (Chart 17 and 18).

Chart 14: Classification of the net annual income of the displaced families (in %)

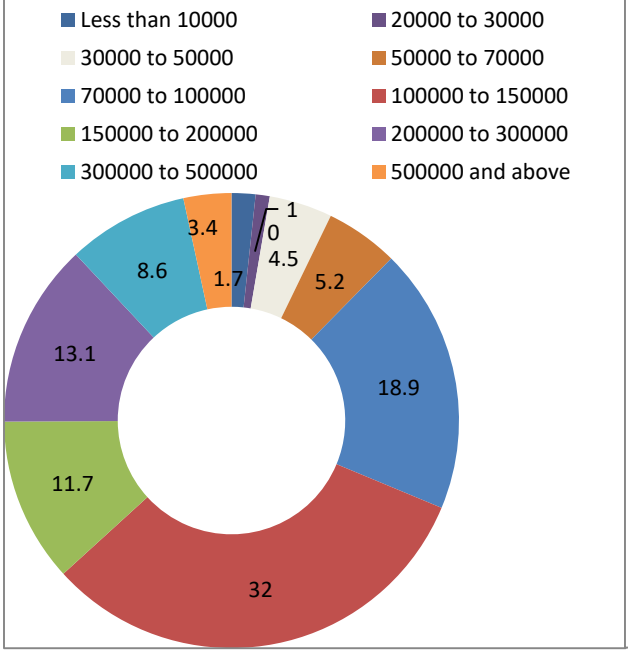


Chart 15: Classification of the net annual income of the indirectly affected Families (in %)

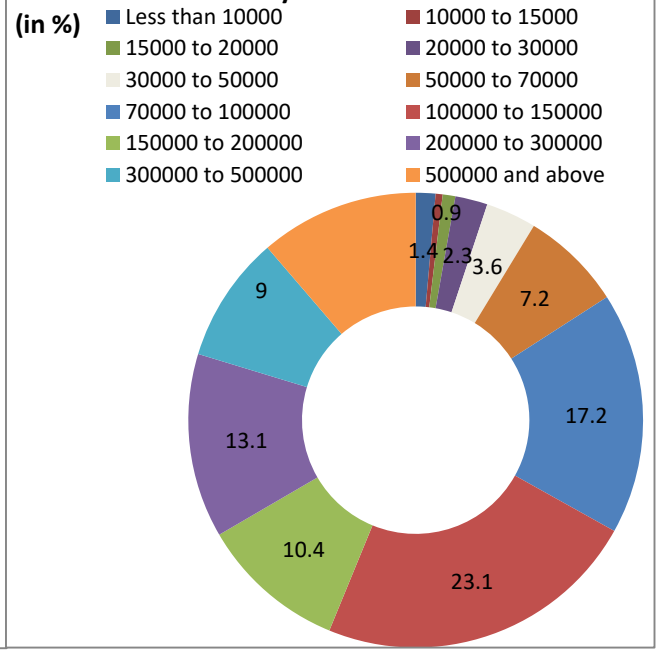


Table 33: Net total income earned from different sources during last one year (in Rs.)				
	Displaced		Affected	
	No.	%	No.	%
Less than 10000	5	1.7	3	1.4
10000 to 15000	0	0.0	1	0.5
15000 to 20000	0	0.0	2	0.9
20000 to 30000	3	1.0	5	2.3
30000 to 50000	13	4.5	8	3.6
50000 to 70000	15	5.2	16	7.2
70000 to 100000	55	18.9	38	17.2
100000 to 150000	93	32.0	51	23.1

150000 to 200000	34	11.7	23	10.4
200000 to 300000	38	13.1	29	13.1
300000 to 500000	25	8.6	20	9.0
500000 and above	10	3.4	25	11.3
Total	**291**	**100.0**	**221**	**100.0**

The maximum i.e. 32 percent (n=93) of the displaced families and 23.1 percent (n=51) of the affected families had a net annual income ranging from Rs.1, 00,000/-to 1, 50, 0000/-. The next highest i.e. 18.9 percent (n=55) of the displaced families and 17.2 percent (n=38) had a net annual income between Rs.70,000/-to Rs.1,00,000, 13.1 percent (n=38) of the displaced families and 13.1 percent (n=29) of the affected families had income ranging from Rs.2,00,000/- to Rs.3,00,000/-, 11.7 percent,(n=34)of the displaced families and 10.4 percent (n=23) of the affected families had Rs.1,50,000/- to Rs.2,00,000/-, 8.6 percent (n=25) of the displaced families and 9 percent of the affected families had Rs.3,00,000 to 5,00,000/-, 5.2 percent (n=15) of the displaced families and 7.2 percent (n=16) of the affected families had net annual income ranging from Rs.50,000/- to Rs.70,000/-. 4.5 Percent (n=13) of the displaced families and 3.6 (n=8) had net annual income of Rs.30, 000 to Rs.50, 000. 1 percent (n=3) of the displaced families had income ranging from Rs.20, 000 to Rs.30, 000. While 1.7 percent (n=5) families was found to be less than Rs.10, 000 where as 3.4 percent (n=10) of the displaced families had income of more than Rs.5,00,000 and above which shows the gap between rich and poor.

The net annual income of 2.3 percent of the affected families has income ranging from Rs.20,000 to Rs.30,000 and 0.9 percent (n=2) had income between Rs15,000 to Rs.20,000, 0.5 percent (n=1) had income ranging from Rs.10,000 to Rs.15,000 per annum. 1.4 percent (n=3) of the indirectly affected families was found to be less than Rs.10,000/-, which requires special attention from the project proponents for their economic rehabilitation. Among the affected families, 11.3 percent (25) had income of more than Rs.5, 00,000 and above.

4.4.3 Consumption Expenditure Pattern of the Displaced and Affected Families

Apart from assessing the income pattern of the families, the monthly expenditure pattern, more specifically, the consumption expenditure of both the displaced and affected families was assessed.

Table 34: Consumption expenditure pattern of the displaced and affected families

	Displaced						Affected					
	Mean	**Median**	**Minimum**	**Maximum**	**Sum**	**Valid N**	**Mean**	**Median**	**Minimum**	**Maximum**	**Sum**	**Valid N**
Food	5378	4000	100	30000	1699400	316	5887	4500	100	35000	1142100	194
Agriculture/Occupation related	2503	1000	100	35000	387970	155	1126	800	100	6000	131776	117
Housing	467	500	50	2000	132533	284	606	400	100	15000	101725	168
Cooking Fuel	521	500	50	1900	164550	316	519	500	100	2000	99100	191
Clothing	586	500	50	24000	182800	312	541	500	50	5000	104899	194
Health	372	200	10	3000	93110	250	597	300	100	10000	104500	175
Education	1117	1000	100	10000	161950	145	1333	1000	0	20000	130600	98
Transport	937	500	100	10000	171500	183	1165	500	0	10000	160800	138
Communication	1598	1000	100	30000	493700	309	1904	1000	100	30000	357950	188
Social functions	606	500	100	10000	179500	296	636	500	20	3000	115770	182

Among the different consumption expenditures made by the families, the highest average monthly expense was made on food by both the displaced (Rs. 5,378/- per displaced family) and affected families (Rs.5,887/- per affected family).

The next highest average monthly expenditure of the displaced families was made on agriculture/occupation related (Rs. 2,503/-/) followed by communication (Rs.1598/-), education related (Rs.1,117/-), transport (Rs.937,/-), social functions (Rs.606/-), clothing (Rs.586/-), cooking fuel (Rs.521/-), and housing (Rs.467/-).

Similar pattern of consumption expenditures was observed among the affected families. Next to food, the average monthly consumption expenditure of the indirectly affected families was incurred on education (Rs.1,410/-) followed by agriculture/occupation related (Rs.1,317/-), transport (Rs.1,257/-), housing (Rs.1,058/-),health (Rs.918/-), social functions (Rs.867/-), cooking fuel (Rs.486/-), clothing (Rs.721/-), and communication (Rs.365/-).

4.4.4 Poor Status of the Displaced and Affected Families

Of the total 291 displaced families, 74.2 percent (n=216) had Ration Cards who were receiving ration under PDS supplied by the government. Slightly lower percentage i.e. 66.5 percent (n=147) of the affected families possessed Ration Card. According to the data collected on social status and income in the SIA study, more than half of the people were from SC and ST categories (57.7 percent the displaced families and 68.7 percent affected families) who are entitled to avail Ration cards under National Food Security Act (NFSA). Also many displaced and affected families had less income which indicates poor economic status of these families. These families are considered as economically vulnerable and require special attention from the project proponent for improvement in their economic status.

Table 35: Families having Ration Card to avail PDS

	Displaced		Affected		Total	
	No	%	No	%	No	%
Yes	216	74.2	147	66.5	363	70.9
No	75	25.8	74	33.5	149	29.1
Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**

4.4.5 Health Needs of the Displaced and Affected Families

Health status of the people is one of the key development areas assessed under the SIA study. People in the study villages were going to different heath facilities for treatment.

Among these health facilities available, there was greater dependence on District Head Quarter Hospital reported by the maximum of the displaced (n=142) and the affected families (n=96) as they were getting better health care facilities there. The next highest i.e. 21 percent (n=61) of the displaced families reported dependence on the PHC whereas 22.2 percent (n=49) of the affected families reported dependence on private clinic for the primary health care.

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Table 36: Nearest formal medical facility available to the families				
	Displaced		Affected	
	No.	%	No.	%
PHC	61	21.0	32	14.5
CHC	19	6.5	26	11.8
District Hospital	142	48.8	96	43.4
Private Clinic	57	19.6	49	22.2
Private Hospital	12	4.1	18	8.1
Total	**291**	**100.0**	**221**	**100.0**

4.5 Access to Services & Facilities

Services and facilities like primary school, secondary school and local market were accessed within a short distance of 1km by the displaced and affected families from their places of residence. The displaced families and affected families had to access the commonly visited health centers within a short distance. But majority of the displaced and affected families informed that they had to travel more than 10 km to avail the services of bigger hospitals in district head quarter i.e. Jharsuguda. Similarly, almost all the displaced and affected families informed that they had to cover 8 to 12km of distance to reach out to the government offices located at the district and block headquarters, whereas the majority could access the Panchayat office in their nearby village.

The majority of the displaced and affected families reported that they accessed the facilities like primary school, secondary school, local market and Panchayat office either by walking or by cycle. The facilities located at distant places viz. District and block offices and hospitals were accessed by either public transport or by their own personal transport.

4.6 Decision Making & Participation at Household Level

Interestingly, the SIA study found a greater participation of men and m in the household decision-makings. The majority i.e. more than 95 percent of the displaced and affected families informed that the household decisions on education of children, health care of children, purchase of assets, day-to-day household activities, social functions and marriages, women to earn for family and land and property were taken jointly by family members of both the genders.

Table 37: Involvement of Women in Decision Making							
		Displaced		Affected		Total	
		Count	%	Count	%	Count	%
Do women of the household participate in decision making processes at community level	Yes	19	6.5	14	6.3	33	6.4
	No	272	93.5	207	93.7	479	93.6
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
Is any woman member of the household a member or office bearer of village / block / Zilla panchayat?	Yes	0	0.0	2	0.9	2	0.4
	No	291	100.0	219	99.1	510	99.6
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
Is any women member of the household works as Anganwadi worker or ANM	Yes	2	0.7	2	0.9	4	0.8
	No	289	99.3	219	99.1	508	99.2
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
Is any woman member of	Yes	124	42.6	80	36.2	204	39.8

the household also a member of any self help groups	No	167	57.4	141	63.8	308	60.2
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
If yes, is that SHG still active	Yes	124	100.0	80	100.0	204	100.0
	No	-	-	-	-	-	-
	Total	**124**	**100.0**	**80**	**100.0**	**204**	**100.0**
Do women of your household make direct economic contribution for your family	Yes	100	34.4	59	26.7	159	31.1
	No	191	65.6	162	73.3	353	68.9
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**

Unlike the household-level decision-makings, the women's participation at the community level decision-making was reported by only 6.5 percent (n=19) and 6.3percent (n=14) of the displaced and affected families respectively. Only 0.9 percent (n=2) of the affected families reported that the women of their families were members or office bearers of village/block/Zilla Panchayat. The woman members of only 0.7 percent (n=2) of the displaced families and 0.9 percent (n=2) of the affected families worked as AWWs or ANMs. The women of only 42.6 percent (n=124) of the displaced families and 36.2 percent (n=80) of the affected families were members of the Self Help Groups (SHGs). But importantly, the women in the displaced families (34.1 percent, n=100) and affected families (26.7 percent, n=59) make direct economic contributions in terms of earning income, assisting in income generation activities, etc. in their families.

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Chapter - V

5. Resettlement & Rehabilitation (R&R) Policy, Legal Framework and R&R Options Preferred by the Displaced and Affected Families

5.1 Resettlement and Rehabilitation (R&R) Policy and Legal Framework: Applicable Laws

In exercise of the powers conferred by sub-section (1) of Section 109 of the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (RFCTLARR) Act, 2013 (30 of 2013), the State Government has made the following rules for the resettlement and rehabilitation of the affected families. The rules for the resettlement and rehabilitation are enacted under Chapter IV/Sections 30 to 47 in an extraordinary issue of the Odisha Gazette No. 331 dated 11thFebruary, 2016 under the notification of the Government of Odisha in Revenue & Disaster Management Department No. 331, dated the 11thFebruary, 2016.

Section 30. Survey and census of displaced and affected families:

(1) The Administrator, Rehabilitation and Resettlement, under the provisions of sub-section (1) of Section 16, shall conduct survey and undertake census of the affected families either by his own staff or by out-sourcing the work to any agency by way of collecting data from the Social Impact Assessment Study report and the Government records and verification of data by field survey and door to door visit of the affected families which shall be completed within a period of sixty days from the date of publication of the preliminary notification.

(2) Where the option of choosing alternative Rehabilitation and Resettlement entitlement is available, option of the affected families shall be obtained during the survey in writing and where the affected family comprised of more than one member, the option shall be obtained from the head of the family.

Section 31. Preparation of draft R and R Scheme:

(1) The Administrator, R and R shall prepare the draft R and R Scheme within a period of sixty days from the date of completion of survey.

(2) Where consent is involved, the draft R and R Scheme shall be prepared by taking into account the negotiated terms and conditions of R and R reached between the Requiring Body and the affected families.

Section 32. Power, duties and responsibilities of the Administrator:

The Administrator shall exercise the powers and perform the duties and have the responsibilities as follows, Namely:—

(a) To conduct a survey and undertake a census of the displaced and affected families in the manner and within the time as provided under these rules;
(b) To prepare a draft R and R scheme;
(c) To publish the draft scheme by the mode provided under these rules;
(d) To make the draft scheme available to the concerned persons and authorities;
(e) To organize and conduct public hearings on the draft scheme;

(f) To provide an opportunity to the requiring Body to make suggestions and comments on the draft scheme;
(g) To submit the draft scheme to the District Collector;
(h) To publish the approved scheme in the affected area;
(i) To help and assist the District Collector in preparing the scheme;
(j) To monitor and supervise the implementation of the rehabilitation award;
(k) To assist in post-implementation audit of R and R; and
(l) To do any other work required to be done for R and R.

Section 34. Publication of approved R and R Scheme in the affected area:

R and R Scheme approved by the Commissioner shall be published by the Administrator, R and R in the same manner as laid down in rule 15.

Section 35. R and R Award:

The District Collector shall make R and R Award for each affected family in accordance with the Second Schedule of the Act or as per the negotiated agreement reached with the affected families where consent is involved and hand over family-wise awards to each affected family in Form–– L.

Section 36. R and R Committee at Project level:

(1) where the proposed acquisition is more than one hundred acres, the Government shall constitute the R and R Committee at the Project Level after publication of the preliminary notification under sub-section (1) of Section 11.

(2) The member-convener, while intimating the date, time and venue of the meeting, shall supply a copy of the draft scheme for R and R to all the members.

(3) The quorum of the meeting shall be not less than two thirds of all members.

(4) The meeting shall be held at least once in every three months.

(5) The first meeting shall be convened before award is made under section 31 and successive meetings will review the payment entitlements and work out the displacement work plan on agreed terms.

(6) After completion of resettlement process, the R and R Committee shall suggest the name of an organization to undertake an independent social audit at the cost payable by the District Collector.

Section 37. Constitution of State Monitoring Committee for R and R:

(1) The State Government shall issue guidelines for the constitution and functioning of a State Monitoring Committee for reviewing and monitoring the implementation of R and R schemes or plans under the Act.
(2) The Committee shall meet at least once in every year to review and monitor implementation of R and R schemes or plans in all projects under the Act.

Section 38. Publication of declaration:

The Secretary to Government of the Department, dealing with the subject matters of land acquisition or his authorized officer on receipt of the sanction estimate from the Department, to which the project relates, shall issue a declaration under sub-section (1) of section 19 along with the summary of draft R&R scheme.

Provided that no such declaration shall be made unless the Requiring Body has deposited the actual amount of acquisition of the land.

Section 39. Fixation of limits for acquisition of agricultural land:

The Government in Agriculture Department shall fix up and separately specify by way of notification the limits of acquisition of irrigated Double cropped land and percentage of the limits of net sown area in any district for acquisition of the agricultural land in aggregate for all projects in that district.

Section 41. Prior consent of Gram Sabha:

In all cases of acquisition or alienation of any land in Scheduled Areas, consent of the concerned Gram Sabha and the Panchayats shall be obtained in Form-M before publication of notification under sub-section (1) of Section 11.

Section 42. Formation of Land Bank:

(1) The State Government may, by notification, form a Land Bank,(a Governmental entity) in charge of local Tahasildar that focuses on the conversion of the Government owned waste land, vacant, abandoned, unutilized acquired lands and tax-delinquent properties into productive use.

(2) To ensure acquisition of minimum amount of land and to facilitate utilization of unutilized public lands including land acquired earlier and not utilized and to ensure food security, the Tahasildar shall maintain a village- wise Land Bank of all Government wasteland, unutilized acquired land and land to be deposited by the Requiring Body in case of acquired irrigated double-cropped land, which shall be made available to the SIA team and expert group as per their requirement.

Section 43. Reversion of acquired land to State:

(1) Land acquired and possession taken over but not utilized within a period of five years from the date of possession shall, in all cases, revert back to the State and deposited in the Land Bank automatically.

(2) The Requiring Body shall deliver possession of the land to the Tahasildar and on failure to deliver the possession and occupation by the Requiring Body the same shall be treated as unauthorized and the Requiring Body shall be evicted in due course of law.

(3) The Land Acquisition Officers shall furnish this information to local Tahasildar at the end of every six months in a calendar year and Tahasildars shall update the database of the Land Bank.

Section 44. Recovery of excess amount:

For the purpose of sub-section (3) of Section 33 the awardees shall furnish an Indemnity Bond to the Land Acquisition Collector for refund of excess amount and in case of any default, or in case of availing benefit fraudulently as mentioned in sub-section (2) of Section 84 or refusal to refund, such amount shall be recovered as arrears of land revenue under the provisions of the Odisha Public Demands Recovery Act, 1962.

Section 45. Web-based Work Flow and Management Information System (MIS) for Land Acquisition and Rehabilitation and Resettlement:

The State Government shall create a dedicated, user-friendly website that may serve as a public platform on which the entire work-flow of each land acquisition case will be hosted, beginning with the notification of the SIA and tracking each step of decision-making, implementation and audit.

Section 46. Land to be taken on lease:

Where land is taken on lease by the State Government under section 104 on consent of the land owners such lease may be for a period of 99years, and thereafter can be renewed.

Section 47. Limits on extent of land for applicability of rehabilitation and resettlement:

The limits on extent of land, beyond which provisions of Rehabilitation and Resettlement under the Act shall apply in cases of purchase by a private company through negotiation with the owner of the land, shall be two hundred (200) acres of dry land or equivalent extent of irrigated or wet lands in rural areas and fifty (50) acres in urban areas subject to any further notification as may be issued by the Government, from time to time.

5.2 Rehabilitation & Resettlement Preferences

An attempt was made in the study to know the Rehabilitation & Resettlement preferences opted by the displaced and affected families for the loss of houses and land under the pro[posed project.

5.2.1 Awareness on the Project

At the time of the SIA study, the majority i.e. 88 percent of the displaced families (258 out of 291) and 88.7 percent of the affected families (196 out of 221) were aware of the proposed project.

Table 38: Awareness on the Proposed Project

	Displaced		Affected		Total	
	No	%	No	%	No	%
Yes	258	88.7	196	88.7	454	88.7
No	2	0.7	6	2.7	8	1.6
Cannot say	31	10.7	19	8.6	50	9.8
Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**

5.2.2 Loss due to the Proposed Project

The people of Tareikela and Kumbhari village and Gariadihi Kisan Pada(one hamlet of Hirma vikllage) knew that they are going to lose assets. They were also very much aware that the loss of assets would affect their livelihoods.

The SIA study enumerated a total of 512 families losing agriculture land.291 families will be losing homestead land to the proposed project.

5.2.2.1 Loss of House / Other Structures

291 families were going to lose house or other structures in two villages and one hamlet.

5.2.2.2 Loss of Income

According to the self-estimation of the displaced and affected families, the land acquisition by the proposed project will reduce their present earning very from family to family depending on their present occupation and ownership of land.

5.2.3 Willingness of the Displaced and Affected Families for Acquisition of Land under the proposed Project

Only 23.7 percent (n=69 out of 291) of the displaced families expressed willingness for acquisition of land. Similarly 22.5 percent (n=46) of the affected families were willing to hand over their land for the proposed project. The other people were not willing for acquisition of their land and houses until they will suitably compensate and rehabilitated.

Table 39: Willingness of the Displaced and Affected Families

	Displaced		Affected		Total	
	No	%	No	%	No	%
Voluntarily	69	23.7	46	20.8	115	22.5
Non-voluntarily	222	76.3	175	79.2	397	77.5
Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**

5.2.4 Option for Resettlement and Rehabilitation

Since people of two villages and one hamlet will be losing their houses as well as agricultural land, the SIA study attempted to know the resettlement assistance required by the affected families. Most of the families wanted to leave their houses provided they receive good compensation against their land and resettlement compensation package.

The majority i.e. 88.3 percent (257 out of 291) of the displaced families and 93.7 percent (207 out of 221) opted for cash assistance (apart from the cash compensation they will receive for acquisition of land) whereas the 19.6 percent i.e. 57 displaced families and 21.7 percent i.e. 48 affected families opted for the project assistance to overcome the adverse effects of the land loss.

Table 40: Willingness of the Displaced and Affected Families

	Displaced		Affected		Total	
	No	%	No	%	No	%
Self-Relocation	38	13.1	6	2.7	44	8.6
Cash for Land loss	257	88.3	207	93.7	464	90.6
Cash for House / Shop loss	33	11.3	8	3.6	41	8.0
Project Assistance	57	19.6	48	21.7	105	20.5
Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**

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Chapter - VI

6. Perceived Social Impacts of the Project

6.1 Framework & Approach to Identify the Social Impacts

One of the main objectives of this study was to assess the likely social impacts of the project by covering both direct land loser households as well as the indirectly affected households due to loss of common property resources (CPRs), socio-economic infrastructures, etc. and the impact of these on the overall costs of the project vis-à-vis the benefits of the project.

Keeping the above objectives in view, the SIA study adopted a 360°approach to understand various kinds of social impacts e.g. i) impact on income & livelihood; ii) impact on culture & social cohesion; iii) impact on health due to the project activities; iv) impact on vulnerable; and v) impact on physical and common property resources that the project may have on the displaced as well as affected families.

Information on the likely social impacts perceived by each displaced and affected households was collected through the household surveys and FGDs. Likert 5-point scaling technique was applied in the household surveys to understand what the likely social impacts are perceived by the families that the upcoming project may have on them. Apart from understanding the household perceptions, FGDs in each village was carried out to understand the community perceptions on the likely social impact of the project.

6.2 Perceived Social Impacts of the Project

The findings on the likely social impacts of the project are structured into the following two sub-sections: i) Household perceptions and ii) Community perceptions, which are further classified under the five key impact assessment parameters mentioned in the previous section.

Perception of Community	Scaling	Displaced		Affected		Total	
		Count	%	Count	%	Count	%
The project will affect my family positively by increasing your socio-economic status	Strongly Disagree	21	7.2	2	0.9	23	4.5
	Disagree	62	21.3	37	16.7	99	19.3
	No Opinion	15	5.2	15	6.8	30	5.9
	Agree	138	47.4	133	60.2	271	52.9
	Strongly Agree	55	18.9	34	15.4	89	17.4
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
The project is good for the local people	Strongly Disagree	9	3.1	0	0.0	9	1.8
	Disagree	51	17.5	26	11.8	77	15.0
	No Opinion	18	6.2	13	5.9	31	6.1
	Agree	153	52.6	134	60.6	287	56.1
	Strongly Agree	60	20.6	48	21.7	108	21.1
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
The project is good for the development of the locality	Strongly Disagree	4	1.4	0	0.0	4	0.8
	Disagree	56	19.2	29	13.1	85	16.6
	No Opinion	17	5.8	8	3.6	25	4.9
	Agree	156	53.6	144	65.2	300	58.6
	Strongly Agree	58	19.9	40	18.1	98	19.1
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
The project will improve transportation and communication facility for my family	Strongly Disagree	10	3.4	0	0.0	10	2.0
	Disagree	82	28.2	51	23.1	133	26.0
	No Opinion	13	4.5	15	6.8	28	5.5
	Agree	145	49.8	128	57.9	273	53.3
	Strongly Agree	41	14.1	27	12.2	68	13.3
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
The project will improve transportation and communication facility for the region and state	Strongly Disagree	1	0.3	0	0.0	1	0.2
	Disagree	65	22.3	44	19.9	109	21.3
	No Opinion	24	8.2	29	13.1	53	10.4
	Agree	159	54.6	131	59.3	290	56.6
	Strongly Agree	42	14.4	17	7.7	59	11.5
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
It will dismiss the distance of our travel route	Strongly Disagree	1	0.3	4	1.8	5	1.0
	Disagree	74	25.4	66	29.9	140	27.3
	No Opinion	56	19.2	35	15.8	91	17.8
	Agree	122	41.9	107	48.4	229	44.7
	Strongly Agree	38	13.1	9	4.1	47	9.2
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
It will enhance local economy	Strongly Disagree	2	0.7	0	0.0	2	0.4
	Disagree	48	16.5	25	11.3	73	14.3
	No Opinion	33	11.3	24	10.9	57	11.1
	Agree	148	50.9	129	58.4	277	54.1
	Strongly Agree	60	20.6	43	19.5	103	20.1
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
It will increase employment opportunity for the local people	Strongly Disagree	7	2.4	0	0.0	7	1.4
	Disagree	30	10.3	17	7.7	47	9.2
	No Opinion	17	5.8	20	9.0	37	7.2
	Agree	173	59.5	136	61.5	309	60.4
	Strongly Agree	64	22.0	48	21.7	112	21.9
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
It will increase the property value of the locality	Strongly Disagree	2	0.7	3	1.4	5	1.0
	Disagree	28	9.6	10	4.5	38	7.4
	No Opinion	16	5.5	10	4.5	26	5.1
	Agree	173	59.5	150	67.9	323	63.1

Perception of Community	Scaling	Displaced		Affected		Total	
		Count	%	Count	%	Count	%
	Strongly Agree	72	24.7	48	21.7	120	23.4
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
My family will incur loss of income due to this project	Strongly Disagree	6	2.1	4	1.8	10	2.0
	Disagree	61	21.0	75	33.9	136	26.6
	No Opinion	19	6.5	23	10.4	42	8.2
	Agree	131	45.0	85	38.5	216	42.2
	Strongly Agree	74	25.4	34	15.4	108	21.1
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
My family will incur loss of house due to this project	Strongly Disagree	6	2.1	15	6.8	21	4.1
	Disagree	70	24.1	123	55.7	193	37.7
	No Opinion	24	8.2	17	7.7	41	8.0
	Agree	122	41.9	41	18.6	163	31.8
	Strongly Agree	69	23.7	25	11.3	94	18.4
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
My family will incur loss of agriculture land due to this project	Strongly Disagree	3	1.0	1	0.5	4	0.8
	Disagree	49	16.8	20	9.0	69	13.5
	No Opinion	9	3.1	14	6.3	23	4.5
	Agree	145	49.8	108	48.9	253	49.4
	Strongly Agree	85	29.2	78	35.3	163	31.8
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
My family will incur loss of business due to this project	Strongly Disagree	18	6.2	26	11.8	44	8.6
	Disagree	177	60.8	146	66.1	323	63.1
	No Opinion	11	3.8	16	7.2	27	5.3
	Agree	52	17.9	25	11.3	77	15.0
	Strongly Agree	33	11.3	8	3.6	41	8.0
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
I am afraid the project will ruin the sustainable livelihood of my family	Strongly Disagree	10	3.4	7	3.2	17	3.3
	Disagree	43	14.8	61	27.6	104	20.3
	No Opinion	30	10.3	17	7.7	47	9.2
	Agree	169	58.1	119	53.8	288	56.3
	Strongly Agree	39	13.4	17	7.7	56	10.9
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
The project will ruin our local forest on which we subsist	Strongly Disagree	6	2.1	9	4.1	15	2.9
	Disagree	106	36.4	73	33.0	179	35.0
	No Opinion	69	23.7	50	22.6	119	23.2
	Agree	80	27.5	76	34.4	156	30.5
	Strongly Agree	30	10.3	13	5.9	43	8.4
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
The project will ruin our common property resources on which the family subsists	Strongly Disagree	4	1.4	4	1.8	8	1.6
	Disagree	65	22.3	56	25.3	121	23.6
	No Opinion	30	10.3	31	14.0	61	11.9
	Agree	157	54.0	112	50.7	269	52.5
	Strongly Agree	35	12.0	18	8.1	53	10.4
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
The project will breakdown our kinship structure and affect our community life	Strongly Disagree	3	1.0	9	4.1	12	2.3
	Disagree	57	19.6	86	38.9	143	27.9
	No Opinion	23	7.9	25	11.3	48	9.4
	Agree	177	60.8	91	41.2	268	52.3
	Strongly Agree	31	10.7	10	4.5	41	8.0
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
I am afraid the project will lead to an increase in crime	Strongly Disagree	12	4.1	9	4.1	21	4.1
	Disagree	49	16.8	51	23.1	100	19.5

Perception of Community	Scaling	Displaced		Affected		Total	
		Count	%	Count	%	Count	%
	No Opinion	20	6.9	22	10.0	42	8.2
	Agree	156	53.6	124	56.1	280	54.7
	Strongly Agree	54	18.6	15	6.8	69	13.5
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
I am worried the project would affect the health status of local people due to increasing pollution	Strongly Disagree	1	0.3	1	0.5	2	0.4
	Disagree	20	6.9	21	9.5	41	8.0
	No Opinion	24	8.2	10	4.5	34	6.6
	Agree	157	54.0	125	56.6	282	55.1
	Strongly Agree	89	30.6	64	29.0	153	29.9
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
I am worried about unforeseen health risks	Strongly Disagree	5	1.7	1	0.5	6	1.2
	Disagree	8	2.7	10	4.5	18	3.5
	No Opinion	20	6.9	8	3.6	28	5.5
	Agree	203	69.8	147	66.5	350	68.4
	Strongly Agree	55	18.9	55	24.9	110	21.5
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
Less pollution will make us all healthier	Strongly Disagree	9	3.1	2	0.9	11	2.1
	Disagree	88	30.2	51	23.1	139	27.1
	No Opinion	36	12.4	22	10.0	58	11.3
	Agree	115	39.5	98	44.3	213	41.6
	Strongly Agree	43	14.8	48	21.7	91	17.8
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
I believe the road project will pose more health risk for the people in its vicinity	Strongly Disagree	8	2.7	2	0.9	10	2.0
	Disagree	53	18.2	23	10.4	76	14.8
	No Opinion	28	9.6	25	11.3	53	10.4
	Agree	167	57.4	135	61.1	302	59.0
	Strongly Agree	35	12.0	36	16.3	71	13.9
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
The project is likely to increase physical and social stress in my family due to increasing pollution and vulnerability of family members to many pollution related diseases	Strongly Disagree	11	3.8	2	0.9	13	2.5
	Disagree	37	12.7	26	11.8	63	12.3
	No Opinion	39	13.4	32	14.5	71	13.9
	Agree	161	55.3	115	52.0	276	53.9
	Strongly Agree	43	14.8	46	20.8	89	17.4
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
Money is a big source of stress for me	Strongly Disagree	16	5.5	2	0.9	18	3.5
	Disagree	47	16.2	38	17.2	85	16.6
	No Opinion	48	16.5	28	12.7	76	14.8
	Agree	140	48.1	125	56.6	265	51.8
	Strongly Agree	40	13.7	28	12.7	68	13.3
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
More youths of the locality shall be vulnerable to drugs and alcohol due to flow of easy money from the project	Strongly Disagree	22	7.6	14	6.3	36	7.0
	Disagree	41	14.1	32	14.5	73	14.3
	No Opinion	52	17.9	42	19.0	94	18.4
	Agree	149	51.2	122	55.2	271	52.9
	Strongly Agree	27	9.3	11	5.0	38	7.4
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
I feel drugs & alcohol are a problem among youth in the locality	Strongly Disagree	21	7.2	11	5.0	32	6.3
	Disagree	39	13.4	41	18.6	80	15.6
	No Opinion	39	13.4	33	14.9	72	14.1
	Agree	165	56.7	128	57.9	293	57.2
	Strongly Agree	27	9.3	8	3.6	35	6.8
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**

Perception of Community	Scaling	Displaced		Affected		Total	
		Count	%	Count	%	Count	%
I have seen co-workers have trouble with alcohol or drugs	Strongly Disagree	23	7.9	14	6.3	37	7.2
	Disagree	48	16.5	35	15.8	83	16.2
	No Opinion	38	13.1	35	15.8	73	14.3
	Agree	162	55.7	131	59.3	293	57.2
	Strongly Agree	20	6.9	6	2.7	26	5.1
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
The project will create numerous business opportunities for my family	Strongly Disagree	34	11.7	14	6.3	48	9.4
	Disagree	153	52.6	101	45.7	254	49.6
	No Opinion	40	13.7	27	12.2	67	13.1
	Agree	52	17.9	61	27.6	113	22.1
	Strongly Agree	12	4.1	18	8.1	30	5.9
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
I am concerned about short term effects to local business	Strongly Disagree	15	5.2	16	7.2	31	6.1
	Disagree	192	66.0	131	59.3	323	63.1
	No Opinion	62	21.3	35	15.8	97	18.9
	Agree	21	7.2	37	16.7	58	11.3
	Strongly Agree	1	0.3	2	0.9	3	0.6
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
I am concerned about long term effects to local business	Strongly Disagree	15	5.2	11	5.0	26	5.1
	Disagree	192	66.0	139	62.9	331	64.6
	No Opinion	54	18.6	35	15.8	89	17.4
	Agree	30	10.3	28	12.7	58	11.3
	Strongly Agree	0	0.0	8	3.6	8	1.6
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
It will create numerous self-owned business opportunities for the locality	Strongly Disagree	13	4.5	12	5.4	25	4.9
	Disagree	174	59.8	114	51.6	288	56.3
	No Opinion	43	14.8	26	11.8	69	13.5
	Agree	49	16.8	48	21.7	97	18.9
	Strongly Agree	12	4.1	21	9.5	33	6.4
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
It will create opportunities for my existing business	Strongly Disagree	19	6.5	21	9.5	40	7.8
	Disagree	218	74.9	136	61.5	354	69.1
	No Opinion	43	14.8	40	18.1	83	16.2
	Agree	10	3.4	22	10.0	32	6.3
	Strongly Agree	1	0.3	2	0.9	3	0.6
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
This will create long term opportunities for my business	Strongly Disagree	21	7.2	21	9.5	42	8.2
	Disagree	207	71.1	132	59.7	339	66.2
	No Opinion	39	13.4	28	12.7	67	13.1
	Agree	22	7.6	35	15.8	57	11.1
	Strongly Agree	2	0.7	5	2.3	7	1.4
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
This will create short term opportunities for my own business	Strongly Disagree	27	9.3	19	8.6	46	9.0
	Disagree	201	69.1	140	63.3	341	66.6
	No Opinion	38	13.1	35	15.8	73	14.3
	Agree	22	7.6	24	10.9	46	9.0
	Strongly Agree	3	1.0	3	1.4	6	1.2
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
This will be good for the local people	Strongly Disagree	24	8.2	8	3.6	32	6.3
	Disagree	49	16.8	25	11.3	74	14.5
	No Opinion	35	12.0	34	15.4	69	13.5
	Agree	158	54.3	119	53.8	277	54.1

Perception of Community	Scaling	Displaced		Affected		Total	
		Count	%	Count	%	Count	%
	Strongly Agree	25	8.6	35	15.8	60	11.7
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
This will be good for the people in and around the Jharsuguda region	Strongly Disagree	21	7.2	9	4.1	30	5.9
	Disagree	43	14.8	47	21.3	90	17.6
	No Opinion	64	22.0	52	23.5	116	22.7
	Agree	150	51.5	101	45.7	251	49.0
	Strongly Agree	13	4.5	12	5.4	25	4.9
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
Out of region business influx will hurt local business	Strongly Disagree	21	7.2	8	3.6	29	5.7
	Disagree	96	33.0	93	42.1	189	36.9
	No Opinion	60	20.6	43	19.5	103	20.1
	Agree	109	37.5	74	33.5	183	35.7
	Strongly Agree	5	1.7	3	1.4	8	1.6
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
This will improve local competition	Strongly Disagree	19	6.5	6	2.7	25	4.9
	Disagree	53	18.2	47	21.3	100	19.5
	No Opinion	57	19.6	39	17.6	96	18.8
	Agree	155	53.3	120	54.3	275	53.7
	Strongly Agree	7	2.4	9	4.1	16	3.1
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
I am concerned that new businesses created as a result of development will displace or harm existing businesses	Strongly Disagree	22	7.6	8	3.6	30	5.9
	Disagree	95	32.6	89	40.3	184	35.9
	No Opinion	71	24.4	52	23.5	123	24.0
	Agree	101	34.7	71	32.1	172	33.6
	Strongly Agree	2	0.7	1	0.5	3	0.6
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
When development is complete it will cause a downward trend in the local economy	Strongly Disagree	19	6.5	16	7.2	35	6.8
	Disagree	92	31.6	99	44.8	191	37.3
	No Opinion	67	23.0	41	18.6	108	21.1
	Agree	111	38.1	63	28.5	174	34.0
	Strongly Agree	2	0.7	2	0.9	4	0.8
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
Proper business planning now could prevent a downward economic trend	Strongly Disagree	19	6.5	10	4.5	29	5.7
	Disagree	77	26.5	100	45.2	177	34.6
	No Opinion	68	23.4	47	21.3	115	22.5
	Agree	125	43.0	63	28.5	188	36.7
	Strongly Agree	2	0.7	1	0.5	3	0.6
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
I believe that the positive overall business impact shall outweigh any negative impacts that may occur.	Strongly Disagree	15	5.2	10	4.5	25	4.9
	Disagree	118	40.5	96	43.4	214	41.8
	No Opinion	60	20.6	57	25.8	117	22.9
	Agree	97	33.3	58	26.2	155	30.3
	Strongly Agree	1	0.3	0	0.0	1	0.2
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
The road project will hurt my investments	Strongly Disagree	29	10.0	16	7.2	45	8.8
	Disagree	178	61.2	145	65.6	323	63.1
	No Opinion	58	19.9	45	20.4	103	20.1
	Agree	25	8.6	15	6.8	40	7.8
	Strongly Agree	1	0.3	0	0.0	1	0.2
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
The road project will hurt certain investments I have	Strongly Disagree	23	7.9	16	7.2	39	7.6
	Disagree	186	63.9	159	71.9	345	67.4

Perception of Community	Scaling	Displaced		Affected		Total	
		Count	%	Count	%	Count	%
	No Opinion	62	21.3	37	16.7	99	19.3
	Agree	20	6.9	9	4.1	29	5.7
	Strongly Agree	0	0.0	0	0.0	0	0.0
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
It is likely there will be investment opportunities for me	Strongly Disagree	15	5.2	15	6.8	30	5.9
	Disagree	192	66.0	139	62.9	331	64.6
	No Opinion	51	17.5	29	13.1	80	15.6
	Agree	32	11.0	36	16.3	68	13.3
	Strongly Agree	1	0.3	2	0.9	3	0.6
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
I foresee short-term opportunities for me (get in/get out)	Strongly Disagree	13	4.5	16	7.2	29	5.7
	Disagree	174	59.8	110	49.8	284	55.5
	No Opinion	75	25.8	58	26.2	133	26.0
	Agree	25	8.6	35	15.8	60	11.7
	Strongly Agree	4	1.4	2	0.9	6	1.2
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
I foresee long-term ongoing investment opportunities for me	Strongly Disagree	15	5.2	14	6.3	29	5.7
	Disagree	172	59.1	107	48.4	279	54.5
	No Opinion	68	23.4	52	23.5	120	23.4
	Agree	31	10.7	42	19.0	73	14.3
	Strongly Agree	5	1.7	6	2.7	11	2.1
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
It will create investment opportunities for local area	Strongly Disagree	10	3.4	4	1.8	14	2.7
	Disagree	54	18.6	35	15.8	89	17.4
	No Opinion	52	17.9	17	7.7	69	13.5
	Agree	155	53.3	129	58.4	284	55.5
	Strongly Agree	20	6.9	36	16.3	56	10.9
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
It will create investment opportunities for region	Strongly Disagree	9	3.1	4	1.8	13	2.5
	Disagree	69	23.7	43	19.5	112	21.9
	No Opinion	53	18.2	23	10.4	76	14.8
	Agree	146	50.2	130	58.8	276	53.9
	Strongly Agree	14	4.8	21	9.5	35	6.8
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
It will create investment opportunities for territorial area	Strongly Disagree	6	2.1	4	1.8	10	2.0
	Disagree	68	23.4	51	23.1	119	23.2
	No Opinion	66	22.7	41	18.6	107	20.9
	Agree	139	47.8	109	49.3	248	48.4
	Strongly Agree	12	4.1	16	7.2	28	5.5
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
This is likely to cause a lack of investment in other sectors	Strongly Disagree	9	3.1	9	4.1	18	3.5
	Disagree	64	22.0	62	28.1	126	24.6
	No Opinion	87	29.9	68	30.8	155	30.3
	Agree	124	42.6	78	35.3	202	39.5
	Strongly Agree	7	2.4	4	1.8	11	2.1
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
This will create a decrease in investments in other communities	Strongly Disagree	6	2.1	11	5.0	17	3.3
	Disagree	90	30.9	92	41.6	182	35.5
	No Opinion	73	25.1	53	24.0	126	24.6
	Agree	122	41.9	62	28.1	184	35.9
	Strongly Agree	0	0.0	3	1.4	3	0.6
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**

Perception of Community	Scaling	Displaced		Affected		Total	
		Count	%	Count	%	Count	%
A decrease in investments in other communities in the long-term	Strongly Disagree	5	1.7	10	4.5	15	2.9
	Disagree	82	28.2	96	43.4	178	34.8
	No Opinion	78	26.8	49	22.2	127	24.8
	Agree	126	43.3	65	29.4	191	37.3
	Strongly Agree	0	0.0	1	0.5	1	0.2
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
A decrease in investments in other communities shall be short-term	Strongly Disagree	6	2.1	11	5.0	17	3.3
	Disagree	98	33.7	103	46.6	201	39.3
	No Opinion	84	28.9	54	24.4	138	27.0
	Agree	102	35.1	53	24.0	155	30.3
	Strongly Agree	1	0.3	0	0.0	1	0.2
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
Development related investments will create new businesses, new jobs, and boost the local economy for the long-term jobs, and boost the local economy for the short-term	Strongly Disagree	6	2.1	3	1.4	9	1.8
	Disagree	60	20.6	46	20.8	106	20.7
	No Opinion	64	22.0	45	20.4	109	21.3
	Agree	151	51.9	105	47.5	256	50.0
	Strongly Agree	10	3.4	22	10.0	32	6.3
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
I believe that the positive overall gains from new investment outweighs any negative impacts that may occur	Strongly Disagree	6	2.1	3	1.4	9	1.8
	Disagree	97	33.3	59	26.7	156	30.5
	No Opinion	57	19.6	69	31.2	126	24.6
	Agree	130	44.7	86	38.9	216	42.2
	Strongly Agree	1	0.3	4	1.8	5	1.0
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
I feel good about the overall investment opportunities that will arise from the development project	Strongly Disagree	6	2.1	7	3.2	13	2.5
	Disagree	78	26.8	52	23.5	130	25.4
	No Opinion	61	21.0	44	19.9	105	20.5
	Agree	125	43.0	104	47.1	229	44.7
	Strongly Agree	21	7.2	14	6.3	35	6.8
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
It will increase human accident	Strongly Disagree	5	1.7	4	1.8	9	1.8
	Disagree	88	30.2	68	30.8	156	30.5
	No Opinion	9	3.1	16	7.2	25	4.9
	Agree	122	41.9	100	45.2	222	43.4
	Strongly Agree	67	23.0	33	14.9	100	19.5
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
It will increase accident of domestic animals	Strongly Disagree	7	2.4	3	1.4	10	2.0
	Disagree	102	35.1	84	38.0	186	36.3
	No Opinion	19	6.5	25	11.3	44	8.6
	Agree	110	37.8	88	39.8	198	38.7
	Strongly Agree	53	18.2	21	9.5	74	14.5
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
It will increase accident of wild animals and species of the nearby forest	Strongly Disagree	6	2.1	3	1.4	9	1.8
	Disagree	107	36.8	95	43.0	202	39.5
	No Opinion	26	8.9	30	13.6	56	10.9
	Agree	104	35.7	79	35.7	183	35.7
	Strongly Agree	48	16.5	14	6.3	62	12.1
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
It will increase disintegration of social cohesion due to this project	Strongly Disagree	4	1.4	2	0.9	6	1.2
	Disagree	148	50.9	130	58.8	278	54.3
	No Opinion	25	8.6	26	11.8	51	10.0

Perception of Community	Scaling	Displaced		Affected		Total	
		Count	%	Count	%	Count	%
	Agree	93	32.0	51	23.1	144	28.1
	Strongly Agree	21	7.2	12	5.4	33	6.4
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
It will cause disruption of cultural integration due to this project	Strongly Disagree	5	1.7	5	2.3	10	2.0
	Disagree	148	50.9	126	57.0	274	53.5
	No Opinion	31	10.7	17	7.7	48	9.4
	Agree	89	30.6	65	29.4	154	30.1
	Strongly Agree	18	6.2	8	3.6	26	5.1
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**
It will increase migration rate	Strongly Disagree	26	8.9	7	3.2	33	6.4
	Disagree	160	55.0	124	56.1	284	55.5
	No Opinion	71	24.4	44	19.9	115	22.5
	Agree	25	8.6	37	16.7	62	12.1
	Strongly Agree	9	3.1	9	4.1	18	3.5
	Total	**291**	**100.0**	**221**	**100.0**	**512**	**100.0**

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Chapter - VII

7. Conclusion and Recommendations for Social Impact Management or Mitigation

Conclusion and Recommendations

While the proposed project i.e. set up of NLC India Talabira Thermal Power Project in Hirma Panchayat in Jharsuguda District will help to bring about overall development of the area and the people, the need of acquiring private and other lands is inevitable for the execution of such development project .In view of acquisition of land, the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (RFCTLARR) Act was enacted by the government in 2013 to address this primary concern of development-induced land acquisition, which leads to displacement, loss of livelihoods, etc. As per the requirements of the act, the Social Impact Assessment (SIA) was carried out to anticipate, identify, and quantify the likely social impact of the project and suggest remedial intervention measures to address all the adverse effects of the project.

The SIA study enumerated a total of 291 displaced and 221 affected families. The families enumerated in the survey comprised of 1013 (41.3 percent) Major Sons above 18 years of age, 108 (4.4 percent) Major Unmarried Daughters above 18 years of age, 106 (7.5 percent) and Widows, 6(4.3 percent).

The SIA study revealed that 9.79 percent (n=137) of the displaced and 12.9 percent (n=136) of the affected family members were above 60 and above years of age. There were 40.8 percent (n=572) of the displaced family and 39 percent (n=410) of the affected family in the adult age group of 18 to 39 years.

It was found that 6.1 percent of the displaced family members were not going to school, as most of them were not in the school going age. 20.8 percent had below pre-primary education, 10.2 percent pre-primary education,10.2 percent primary,12.8 percent did middle school (8th class) education and only 4 percent of the displaced family members attained degree or higher level of educations. The percentage of the displaced family members attained technical education was quite low as only 0.5 percent were ITI pass out, followed by 0.4 percent had Diploma engineering and 0.3 percent (n=4) members had B.Tech. As high as 9.1 percent of the displaced family members were illiterates and 6.6 percent were literates who could put their signatures only.

Among the affected family members, 6.6 percent of the affected family members were not going to school,13.2 percent below pre-primary,6.6 percent of the affected family members completed pre-primary education,7.6 percent primary education, 11.2 percent had middle (8th class) education,14.1 percent completed high school ,7.7 percent completed intermediate/+2 and only 8.9 percent of the affected family members attained degree or higher level of educations which is higher than the displaced family members.14.4 percent were illiterates, ,6.8 percent were literates 0nly. Only few of the affected family members had technical education.1.2 percent of them had diploma in engineering, 0.7percent had ITI and 0.4 percent had degree in engineering.

About 13 percent i.e. 38 out of 291 displaced families and 9 percent i.e. 20 out of 221 were headed by females.9.8 percent (137) of the displaced family members and 13 percent (136) from the affected family members were aged / at the age of 60 years or above. The proportion of the aged people in the displaced

and affected families was found to be higher than that of the Odisha State (9.3 percent) and the country (8.0 percent).

Agriculture was pursued i.e. 4.9 percent by the displaced and 5.1 percent by the affected families as their primary occupation during last year preceding the survey. The net income from agriculture was Rs.21,617 (n=162).

More than half of the affected families' members were dependent on the income-earning members of their respective families for their daily livelihood. The majority of the dependents were found to be children and adolescents below 18 years of age, housewives and elderly people in the family.

People of two villages and one hamlet will lose their agriculture as well as home stead land and villagers of another two villages will lose their agriculture land. This indicates that the land loss intensity would affect their agriculture production & income to a great extent.

The majority i.e. 88.3 percent (257 out of 291) of the displaced families and 93.7 percent (207 out of 221) opted for cash assistance (apart from the cash compensation they will receive for acquisition of land) whereas the 19.6 percent i.e. 57 displaced families and 21.7 percent i.e. 48 affected families opted for the project assistance to overcome the adverse effects of the land loss.

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Based on the above findings, the following recommendations may be considered by the project proponent for social impact management or mitigation.

- Relocation of all interested displaced families to a suitable place or resettlement colony nearer to the proposed project with road connectivity. The people preferred to stay nearby place to the proposed project and did not want to go faraway place.
- Some of the villagers from Kumbhari and Gariadihi Kisan Pada opined that they want a residential colony nearer to their present village. When asked about the preferred location and why, they cited a vacant land in front of SMC Power to be converted into the resettlement colony for them. They told that as many of the villagers are working in SMC Power and in other nearby industries/plants and their Panchayat is Hirma where they would collect their PDS ration and other facilities like Old Age Pension, Widow Pension etc. they preferred to stay there. Some of the respondents from Tareikela expressed their views on choice of a patch of land in Badmal village (vacant government land located behind Badmal PS) which would be their suitable place for stay.
- There should be health care facility and educational institutions for dependents, community centre (Kalyan Mandap) , temples, market complex, electricity and drinking water supply and pond in the vicinity of the colony.
- There should be Anganwadi centres, youth club, Kirtan Mandap (Bhajan Mandali) and play ground in the Resettlement Colonies.
- People from Tareikela wanted to shift Goddess Samaleswari Temple and Radha Krishna Temple (now they are worshipping) in their Resettlement Colony where as people from Kumbhari wanted to shift their Lord Shiv and Hanuman temple (now worshipping) to the Resettlement Colony.
- Availability of Suitable job and employment opportunities in the proposed project to the head of the household/ children/dependents of displaced and affected families.
- Formation of a society and involving the dependents of displaced and affected families in various developments work in the proposed project so that they will earn their livelihood. This initiative will

benefit the unemployment people from the displaced and affected families who have crossed age limit for job.

- Majority of the people of the proposed project area wanted to vacate their homes provided that they would get suitable monetary compensation for their land, houses and immovable assets. According to them the cost of land is highest in the area. So they should be compensated accordingly.
- People of Kumbhari and Tareikela own land nearby to/on the bank of the river Bheden in and around their village. The proposed project maps shows exclusion of those patch of land. But the people raised their demand for acquisition of those patch of land as they will face problem in cultivation after their relocation. So the company should acquire that patch of land for tree plantation or any other purpose.
- Fisherman community from Kumbhari camp locally called as "Majha"/Keuta are earning their livelihood by fishing in Bheden River. So after their displacement, priority should be given to restore their livelihood by other means.
- Vocational or skill training of the displaced and affected family members who have educational qualification of more than 8th standard.
- Engage the vocationally trained family members in the project or other ancillary units for earning income. More focus may be given to engage the BPL families.
- People from the displaced and affected families should have accessibility for free diagnostic and treatment in modern health care facilities preferably in the company hospital.
- Children/dependents of the displaced and affected families should be given free education in the company managed school. People assumed that the company would establish best school for children of their employees where their children should get admission and free education.
- Relocation of Adivasi Kanyashram School of of Kumbhari to the Resettlement colony.
- Provide training and market linkage support to the women family members through Self Help Groups (SHGs) functioning in the resettlement colony and affected area.
- Provide revolving fund support to the women SHGs or link them with the formal financial institutions for availing loan to start individual or group income generating activities.
- Facilitate or provide agriculture extension services to the people of affected villages for adoption of improved agriculture practices, which would increase the productivity and income from agriculture. It will help agriculture carried out by the affected families more remunerative.
- Special tree plantation drive should be undertaken in and around the project area. There are large industries like Bhusan Steel & Power, Vedanta Alumina and SMC Power & Steel in nearby areas. People of the proposed project area (both displaced and affected) opined that they were suffering from pollution. The project should take care of the environment so that people of the periphery villages would not suffer from pollution. People of the area are suffering from pollution. So the project authority should take all necessary measures to minimize all forms of pollution i.e. water, air, land etc.
- The beneficiaries of Old Age and Widow Pension as well as people availing rations under PDS will face problem in getting it after their shift to resettlement colonies. The panchayat office is located in Hirma village. So the authority should address the issue and facilitate the process of availing Social Security Pension and rations to the displaced people.
- Effort may be made to link the left out widows and aged persons with various social security schemes like old age pension scheme, widow pension scheme, ration through PDS, etc.
- Provide resettlement benefits to the people who staying in the displaced villages that do not owned land.

- The majority of the displaced and affected families opted for cash assistance (apart from the cash compensation they will receive for acquisition of land).
- Regular health checkup may be conducted in the affected villages to improve maternal and child health & nutrition status, on construction of toilets and stopping open defecation. Mobile health clinic should be rolled out for treatment of the needy in the affected villages.
- People were observed very sentimental when talked about their displacement. They are staying since generations and are emotionally attached to the land and community. They anticipated that they may not stay like the present set up and would miss their kith and keen. So the project authorities should take care of the choice of the people regarding their resettlement.
- Saplings or seedlings for fruit or non-fruit bearing trees may be provided to the affected families for plantation to compensate the loss of trees owned by the families in the displaced villages. Community plantation drive may be initiated in the affected villages.
- Last but not the least, people were not against development or set up of industries. If genuine demands of the people are fulfilled, then they would vacate their villages and allow the proposed project authorities to start their construction/activities there.

Although the loss of income due to acquisition of agriculture land is not so very high as majority of the displaced and affected family members had different primary and secondary occupations other than cultivation, the project proponent may take following initiatives to provide alternative income earning opportunities to the displaced and affected families.

To conclude, the SIA study revealed major loss of houses, land and income will happen due to the acquisition of land under the project. Two villages and one hamlet will be totally acquired along with land from surrounding areas. The adverse effects of the project may be overcome by relocation of the displaced families to suitable colonies preferably on the choice of the people, skill building, vocational training, engagement of the displaced and affected family members in the project or various project ancillary units for income, by promoting income generation among the youth through formation of a society and women through SHGs, by providing market linkage support, taking special care of the environment and by taking up community awareness generation on health & nutrition and plantation drive.

8. Proceedings of the Public Hearing Meeting:

A Public Hearing on the Draft Report of Social Impact Assessment Study for set up of a 2400 megawatt power plant by NLC India Ltd was held at Gariadihi in front of UP School on 13th November 2019 at 1 PM. In the Public Hearing, the Jharsuguda ADM Mr. Pradip Kumar Sahoo presided over the meeting. Jharsuguda Sub-Collector Mr.Siba Toppo, Project Director, Rehabilitation & Resettlement Ms. Alomani Sethy , Additional Tahasildar of Jharsuguda Tahsil Mr. Golak Bihari Mangaraj and other government officials attended the meeting. Mr. Suresh Chandra Suman, the Project head of NLC India Talabira Power Project and, other officials were present. Villagers of Tareikela, Kumbhari, Tumbekela, Hirma and Luhurenkachhar along with PRI members attended the meeting and shared their views.

In the beginning Mr. Gopal Krushna Bhoi, Specialist R & D, DCOR Consulting, Bhubaneswar gave welcome address and presented the draft report in Odia in front of district administration and local villagers of the above mentioned five villagers who are going to lose their land/house in the establishment of the proposed project. He described the objectives and methods adopted in data collection, findings of the study and suggestions of the respondents and recommendations to mitigate the social impact on the displaced and affected people of the proposed project.

Then hon'ble Chair Person of the meeting invited the villagers of the five said villages to present their views. After that on behalf of NLC India ,Mr. Pratap Maharana, Deputy Manager, HR clarified the queries of the people and presented the views of the company for suitable rehabilitation and resettlement of the displaced and affected people of the proposed project.

As per instruction of the Chair, the following villagers introduced themselves and presented their views:

1. **Sri Rudra Bariha, village – Luhurenkachhar (Now staying in Tareikela**) :
   - i) Survey be carried out again to cover all houses.
   - ii) Good compensation amount for land be given. Rupee one crore to be given for one acre of land.
   - iii) The tribal people residing in our village were allotted four decimal of homestead of land. Again survey be carried out to access the tribal losing their homestead land. Compensation amount of rupee two lakh per decimal for homestead land be given to the land losers.
   - iv) Let Job be given to the boys of the village who are 18 or above years of age .
   - v) School, temples and Mandaps be relocated and the Company to give same quantity of land in the resettlement colonies for displacement of the school, temples and mandapas.
   - vi) Villagers who are attaining 60 years of age be given rupee twenty five lakh and rupee five thousand as monthly pension.
   - vii) Girls of the village who are between 30 to 35 years of age be given rupee twenty five lakhs as they will stay forever with their parents.

2. **Sri Bharat ,village – Kumbhari**
   - i) All land of Kumbhari , Tareikela, Luhurenkachhar and Gariadihi be considered as one type (one Kisam) while paying compensation for land.
   - ii) Rupee one crore be given for one acre of land and rupee two crore for one acre of homestead land.
   - iii) Sons and daughters of the losers of land and houses (displaced) be given permanent employment opportunity.

iv) Those having 50 or above years of age be given rupee twenty five lakh instead of jobs and rupee five thousand per month as pension.

v) The Social Impact Assessment (SIA) Report has not covered all villagers. Those who were not surveyed during SIA study be covered and their information should be included in SIA report.

vi) The displaced people who will lose land and houses be given houses in the Hirma Panchayat area.

vii) Kumbhari, Gariadihi and Tumbekela are revenue villages, so the resettlement colonies to be named as the same revenue villages.

viii) The patta (ROR) of homestead land and house be on the name of the displaced persons. Which will be given in the rehabilitation com=loonies.

ix) The people of village Kumbhari, Tareikela and Gariadihi who are staying since long be given regular employment and allotment of house with all facilities and right (RoR).

x) Girls of the village who are above 30 years of age and could not get married be given all facilities.

xi) Temples, school, Mandap, Sabashram (Tribal School under ST & SC Dept. GoO) and community hall be constructed and given to the villagers in the resettlement colonies.

3. Sri Sripati Panigrahi, village – Tareikela

i) Some landless people are saying in the village since long on land belonging to other persons in the village. Those people be given land with Patta (RoR).

ii) Aged/ elders in the village be identified and given Pension (Bhatta).

4. Sri Sheshadeba Garia, village – Tareikela

i) All land of the village be acquired.

ii) Fare compensation be given for the acquired land.

iii) We are staying together here. So same type of environment and facilities be given in the resettlement colonies.

iv) Family members having 18 years of age be given regular employment.

v) The displaced people be given permanent house with Patta (RoR).

vi) Each displaced family be given a house of at least 2000 sq. feet of built of area.

vii) After displacement, the resettlement colonies be named as Tareikela and Kumbhari and declared as revenue villages.

viii) We do not to live in resettlement colonies. We want to stay in the resettlement colonies be named as our villages.

ix) Resettlement colonies be located within one kilometres from the Plant (proposed plant of NLCIL).

x) Rules and regulations to be made to provide free education to the children of 5 to 18 years of age and be given training and employment opportunities in the Company. Reservation quota in jobs in the Company be there for the dependents of displaced persons forever.

xi) The temples and schools be relocated and given to the villagers.

5. Sri Anil Kumar Kissan, village – Gariadihi :

i) Compensation amount of rupee one crore be given for each acre of land.

ii) Resettlement colonies be provided with 24 hours electricity, water supply and other facilities.

iii) Boys and girls of 18 years and above age be provided with proper training and employment.

iv) The spinsters (who could not marry) having 30 or above years of age be given house, job and all facilities.

v) There be temples, mandaps, school, club and a 200 metres stadium in the resettlement colonies.

6. Sri Madhusudan Kisan, village – Kumbhari :

i) Rupee one crore be given as compensation for one acre of land.

ii) The displaced be given job, house with road connectivity and all facilities.

7. Rohidas, Ward Member, Tumbekela :

i) The left out land within 500 meters of the river bank be acquired.

ii) Rupee one crore be given as compensation for each acre of land.

iii) Unemployed boys and girls be given jobs.

iv) School, colleges and medical facilities be given.

After the conversations of the villagers, the Deputy Manager of NLC India Ltd. Mr. Pratap Maharana presented the objectives of the proposed project with the facilities to be given to the families who are going to lose their land. The additional Tahasildar of Jharsuguda Mr. Mangaraj told the people if anybody still there and interested to talk please come. Then he offered vote of thanks and declared end of the meeting.

***

ANNEXURE XIII

PH MOM & ACTION PLAN

PHOTOGRAPHS OF PUBLIC HEARING

Presence of ADM & Senior Officer of CGWB

Presence of CGWB Executive Officers

Presence of Media

Videography of the entire public hearing

Local people give important speech

Huge gathering of local women

Presence of Old-age people

Presence of farmers

Local people give important speech

Local people give important speech

Local people give important speech

NLC Rpresentatives answering

Junior executives of NLC

Senior support stuff of NLC

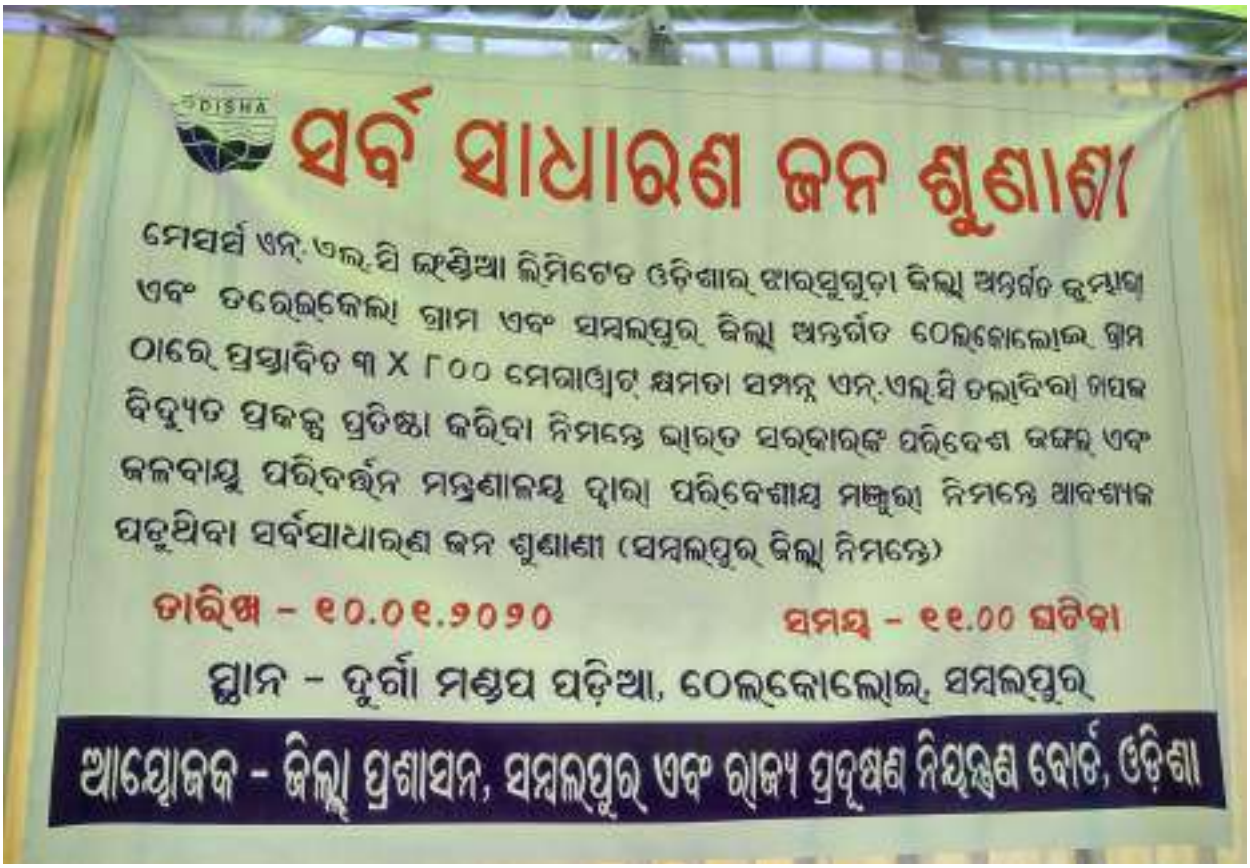
Senior Executive Officers of NLC

Maintained car parking

Safety for fire

Providing drinking water

Location with stage



Public Hearing conducted at Sambalpur VIllage

Fax: [illegible]
Tel: [illegible]
Phone: [illegible]
E-mail: [illegible]
Website: [illegible]

STATE POLLUTION CONTROL BOARD, ODISHA

(DEPARTMENT OF FOREST & ENVIRONMENT, GOVERNMENT OF ODISHA)
Paribesh Bhawan, A/118, Nilakantha Nagar, Unit – VIII,
Bhubaneswar – 751 012, INDIA

No. 1165 / IND-II-PH-811 Date: 31-12-2020

By Regd. Post

To

The Secretary,
Ministry of Environment, Forest and Climate Change,
Govt. of India, Indira Paryavaran Bhawan,
Jorbagh Road, New Delhi

Sub: Proceedings of Public hearing of M/s NLC Talabira Thermal Power Project for establishment of 3x800 MW Power Plant at Khumbhari and Tareikela villages in the district of Jharsuguda and Thelkoloi village in the district of Sambalpur (For Sambalpur District). – regarding

Sir,

Inviting a reference to the above, this is to inform that public hearing of the above mentioned project proposed by **M/s NLC Talabira Thermal Power Project for establishment of 3x800 MW Power Plant** at Khumbhari and **Tareikela villages in the district of Jharsuguda and Thelkoloi village** in the district of Sambalpur (For Sambalpur **District**) was conducted **on 10.01.2020 at 11.00 A.M.** at Durga Mandap Field of village **Thelkoli, Tahsil Rengali in Sambalpur** district in accordance with the Ministry of Environment & Forest, Govt. of India, EIA Notification No. SO-1533(E) dt. 14.09.2006.

As per the above notification, notices inviting comments, views, objection and suggestions from the public in respect of the above project was published in newspapers namely "**The New Indian Express**" and "**Dharitri**" on **04.12.2019**.

Further 4 nos. of representations were received during the public hearing meeting which are enclosed herewith for kind reference and further action during the consideration of environmental clearance.

A copy of the proceedings of the public hearing along with the following documents are enclosed for kind information and necessary action at your end.

1. Video CD of public hearing
2. Statement of issues raised by public hearing meeting and comments of applicant prepared in local language and in English.
3. Copies of the newspaper advertisement
4. List of persons who participated in the public hearing.
5. Views and suggestions from the public received by the Board during the public hearing
6. 4 (four) nos. of representations were received during the public hearing meeting

Yours faithfully,

Encl: As above

31/12/2020

MEMBER SECRETARY

P.T.O....

Memo No 1166 /dt 01.02.2020

Copy along with copy of the proceedings of public hearing forwarded to the Additional Chief Secretary, Forest & Env. Department Govt. of Odisha for information and necessary action.

Encl: As above

MEMBER SECRETARY

Memo No 1167 /dt 01.02.2020

Copy forwarded to the Additional Director, Eastern Regional Office, MoEF&CC Govt of India, A-3, Chandrasekharpur, Bhubaneswar for information and necessary action

MEMBER SECRETARY

Memo No 1168 /dt 01.02.2020

Copy along with copy of proceedings of public hearing forwarded to The Chief General Manager, Project & Business Development, M/s NLC India Ltd., Corporate Office, Block – 1, Neyveli – 607801 for information and necessary action.

Encl: As above

MEMBER SECRETARY

Proceedings of the Public Consultation conducted on 10.01.2020 for M/s. NLC Talabira Thermal Power Project for establishment of 3x800 MW Power Plant at Khumbhari and Tareikela in the district of Jharsuguda and Thelkoloi village in the district of Sambalpur (For Sambalpur District).

A public consultation meeting (public hearing) was held on 10.01.2020 at 11AM at Durga Mandap field of village Thelkoloi of Sambalpur district for the proposed 3x800 MW Power Plant of M/s. NLC Talabira Thermal Power Project. This project is proposed to be established at Khumbhari and Tareikela in the district of Jharsuguda and Thelkoloi village in the district of Sambalpur and this consultation meeting was conducted for Sambalpur district. Sri Lingraj Panda, IAS, Additional District Magistrate, Sambalpur presided over the meeting along with Dr. Satyanarayan Nanda, Asst Env Scientist, State Pollution Control Board, Odisha, Sambalpur. He welcomed the public who were present at the venue for participating in the meeting. Attendance sheets of the members present in the meeting and that of public present inside the venue are annexed as Annexure I and II respectively. 20 persons were present in the meeting and have put their signatures in the attendance sheet. However, about 250 people were present at immediate outside of the public consultation venue and were putting up slogans against the establishment of the said proposed project. In spite of announcements to come inside the meeting venue to put their views, they did not turn up to the meeting. Out of the people present inside, 04 persons intended to deliver their views and their list is annexed as Annexure-III. All those 04 people took part in the deliberations though one of them refused to put his signature. The statement of the public participated in the deliberation is annexed as Annexure-IV. The video recording of the entire proceeding of the public consultation will be forwarded to the Ministry of Environment & Forest, Govt of India, New Delhi as soon along with the written statements of the public & proceeding of the meeting.

At the outset, Dr. Satyanarayan Nanda, Asst Env Scientist of State Pollution Control Board, Sambalpur welcomed all the public present in the meeting. He briefly described the objective of the public consultation conducted as per the provisions of EIA Notification No S.O. 1533(E) of Dt.14th September 2006 of the Ministry of Environment and Forests & Climate Change (MOEF & CC), Government of India and the importance of the actual views of the villagers regarding the project. He also informed that the date, time and venue for conducting this public consultation meeting for Sambalpur district was duly advertised in one Odia daily newspaper, Dharitri, dt.04.12.2019 and in one English daily newspaper, The New Indian Express dt.04.12.2019 following due procedure for intimation

of public. The venue, date and timing of the Public hearing meeting of the said project were also extensively propagated through loudspeaker announcement in the area. Executive summary of the proposed project both in Odia & English were displayed at the meeting venue for ready reference of public and were also distributed among the persons present during the meeting. The executive summary was also made available in the website of State pollution Control Board, Bhubaneswar (www.ospcboard.org).

Addl District Magistrate Sambalpur and Asst Env Scientist explained to public that those who want to participate in the public hearing, may discuss about the environmental impacts of the proposed project and emphasized that their statements should be related to environment & pollution control aspects. The Asst. Env. Scientist then called the project proponent to describe before the public about the details of the project and its impact on surrounding environment.

Sri Pratap Moharana, Deputy Chief Manager, NLC India Limited (NLCIL) stated that NLC India Limited is a Navratna enterprise of Government of India and is a profit making public sector enterprise engaged in mining of lignite and generation of Thermal, Solar & Wind Power in the country. The present worth of NLCIL is Rs.12393.53 crores. Talabira II & III Coal Blocks of Sambalpur district have been allotted to NLCIL in May 2016 by Ministry of Coal, Government of India, for captive use and process is being carried out to commence the mining operation shortly. For captive use of the coal produced from Talabira II & III coal block, Govt of Odisha has approved the proposal of NLCIL to set up a Thermal Power Project (3200 MW) at Tareikela, Jharsuguda on 10th July, 2017. The project will come up in 5 villages with a proposed acquisition of 753.13 Ac of Tenancy land of the area. He further stated that with the establishment of the proposed project there will be increase in power generation in the country and as per plan, it will start generating power and help in meeting the electricity demand of the country from year 2024 onwards. There will be infrastructure development in the surrounding area and small to medium industries will be set up to provide raw materials to proposed project. NLCIL will provide Health care facilities, roads, vocational education, clean drinking water, solar electrical facilities and other infrastructures facilities as per the advice of local Panchayats and District Administration. The company is committed to extend the best rehabilitation & resettlement (R & R) benefits for the people to be displaced and affected due to Talabira II & III OCP and also the thermal power plant. The R & R benefits as approved by RPDAC for Talabira II & III OCP shall be adopted for the proposed thermal power plant too as both the projects belong to NLCIL.

He further stated that the proposed project will have adequate pollution control measures for air pollution control and wastewater treatment. In the construction phase, septic tank and soak pits will be provided at the construction site. Dust suppression will be done by water sprinkling. There will not be any effluent discharge to water bodies. During the operational phase, the plant will meet Zero Liquid Discharge (ZLD) in conformity to MoEF norms. Settling tanks and oil and grease traps will be provided to take care of surface runoff generated in the plant. The plant will have High Concentration Slurry Disposal (HCSD) for ash disposal to the ash pond and that requires less quantity of water. The ash pond will be used for the initial period of 2 to 3 years. Later on, ash disposal shall be shifted to mine void created in Talabira II & III OCP. The ash pond shall then be used as emergency ash pond. The major noise generating sources are the turbines, turbo-generators, compressors, pumps, fans, coal-handling plant etc will have adequate acoustic treatment /equipment design to control the noise level below 90dB (A). Wherever required, the workers will be provided with personal protective equipment such as ear plugs/ ear muffs. The proposed project will also have adequate pollution control measures for air pollution control like high efficiency electrostatic precipitators (ESPs) of 99.9% efficiency to control the particulate emissions. These precipitators will be designed to limit the particulate emission to 30 mg/Nm^3 under all operational conditions. 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. To facilitate wider dispersion of particulate and gaseous pollutants, three numbers single flue concrete chimney of appropriate height above ground level will be provided for this project. 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.

Then the public deliberated on various issues of the project one by one.

After the deliberations were made by the public, Ass. Env Scientist, SPCB, Sambalpur summarized various issues raised by the public and invited the project proponent to offer their views on those issues. Sri Pratap Moharana, Deputy Chief Manager, NLC India Limited placed his views on the issues raised by the Public. NLC India Limited will follow

High Concentration Slurry Disposal (HCSD) system for ash disposal that require less quantity of water by which ash would not fly. There would be zero liquid discharge (ZLD) by which water of nearby water bodies will not be contaminated, for noise pollution at turbines, turbo-generators, compressors, pumps, fans, coal handling plant acoustic Treatment /equipment design will be done to control the noise level below 90dB (A). NLC India Limited would install High efficiency electrostatic precipitators (ESPs) to control the emission of fly ash particles. NLC India Limited will set up Flue Gas Desulphurization (FGD) system to control Sulphur gas emission by the plant.

NLC will invite and accept the constructive suggestions/ advise by the community to control and mitigate environmental issues related to plant in accordance with government norms.

The summary of the views and concerns of the public and the commitments made by the Project Proponent are annexed in Oriya language & English language as **Annexure-V&VI** respectively. The 04 nos. of public representations were received in the written form vide Regional Office, State Pollution Control Board, Sambalpur receipt No.54 dt 10.01.2020, No 55 dt.10.01.2020, No 56 dt.10.01.2020 and No 57 dt.10.01.2020 on the day of public consultation at the venue which are annexed as **Annexure-VII**

Finally the meeting ended with a vote of thanks to the chair and other participants

10.01.2020

Asst. Env. Scientist
State Pollution Control Board,
Odisha, Sambalpur
Asst. Environmental Scientist
Regional Office of State Pollution
Control Board, Sambalpur

10/1/2020

Addl. District Magistrate,
Sambalpur

Additional District Magistrate
Sambalpur

Annexure-I

Members present in the Public consultation conducted on 10.01.2020 at 11.00 AM for M/s. NLC Talabira Thermal Power Project for establishment of 3X800 MW Power Plant at Khumbhari and Tareikela in the district of Jharsuguda and Thelkoloi village in the district of Sambalpur (For Sambalpur District).

Sl No.	Name of the Members	Signature
1.	Sri Lingraj Panda, I A S Addl. District Magistrate, Sambalpur	10/1/2020 Additional District Magistrate Sambalpur
2.	Dr. Satyanarayan Nanda Asst Env Scientist, State Pollution Control Board, Odisha, Sambalpur	10.01.2020 Asst. Environmental Scientist Regional Office of State Pollution Control Board, Sambalpur

Annexure-4

ATTENDANCE SHEET OF THE PARTICIPANTS PRESENT IN THE PUBLIC HEARING MEETING FOR THE ENVIRONMENTAL CLEARANCE IN RESPECT OF M/S. NLC TALABIRA THERMAL POWER PROJECT FOR ESTABLISHMENT OF 3X800 MW POWER PLANT AT: KHUMBHARI AND TAREIKELA IN THE DISTRICT OF JHARSUGUDA AND THELKOLOI VILLAGE IN THE DISTRICT OF SAMBALPUR (FOR SAMBALPUR DISTRICT) HELD ON 10.01.2020 AT 11.00 A.M AT DURGA MANDAP FIELD OF VILLAGE THELKOLI, SAMBALPUR.

Sl. No.	Name of the participants	Address of Participants	Signature
1	P K. Panda	Khinla	
2	Amar Singh	Talabira	
3	S K Chain	Talabira	
4	B. Sa	Talabira	
5	Bheswor Mohanty	Talabira	Mohanty
6	Rajkumar Mark	Talabira	
7	R Gardia	Talabira	
8	L K Sahu	Khinla	
9	M [illegible]	Talabira	
10	[illegible]	Talabira	

11	P. Sahu.	Khinda.	P. Sahu
12	B. Sahu	Lapanga	[illegible]
13	S. [illegible]	"	[illegible]
14	C.S Bose	"	C.S Bose
15	N Sahu	"	N Sahu
16	M Sett	Thelkoli	M Sett
17	Suresh	"	Suresh
18	Sharanya Hazra	ABC Technolab India Pvt. Ltd.	[illegible]
19	Ranjan Patel	Collectorate	[illegible]
20	N [illegible]	Collectorate	[illegible]

Scanned by CamScanner

ATTENDANCE SHEET OF THE PARTICIPANTS DELIBERATED IN THE PUBLIC HEARING MEETING FOR THE ENVIRONMENTAL CLEARANCE IN RESPECT OF M/S. NLC TALABIRA THERMAL POWER PROJECT FOR ESTABLISHMENT OF 3X800 MW POWER PLANT AT: KHUMBHARI AND TAREIKELA IN THE DISTRICT OF JHARSUGUDA AND THELKOLOI VILLAGE IN THE DISTRICT OF SAMBALPUR (FOR SAMBALPUR DISTRICT) HELD ON 10.01.2020 AT 11.00 A.M AT DURGA MANDAP FIELD OF VILLAGE THELKOLI, SAMBALPUR.

Sl. No.	Name of the participants	Address of Participants	Signature
01.	Subrangshu Sahoo	Lapanga	
02.	Santosh Kumar Mishra	Thelkoli	
03	Laxmikanta Seth	Khinda	
04	Sanjib Pradhan		

Annexure-IV

Statement of the Public participated in the deliberation during Public consultation conducted on 10.01.2020 at 11.00 AM for M/s. NLC Talabira Thermal Power Project for establishment of 3×800 MW Power Plant at Khumbhari and Tareikela in the district of Jharsuguda and Thelkoloi village in the district of Sambalpur (For Sambalpur District).

1. **Sri SubrakantaSamal, Lapanga**

   He welcomed the project. He demanded the company to take all possible pollution control measures before operation of the Plant.

2. **Sri Santosh Kumar Nath (Ex- Serviceman), Thelkoloi**

   He claimed that he was saying on behalf of villagers of Thelkoloi village and the villagers are against the project. He further stated that they are opposing this project and are not going to allow NLC India Limited to establish the ash pond

3. **Sri Laxmikanta Seth, Khinda**

   He welcomed the project and stated that as they are living near the proposed project of ash pond adequate pollution control measures should be taken.

   Sri Santosh Kumar Nath (Ex- Serviceman), Thelkoloi

   He again came and stated that Sri Laxmikanta Seth is not residing near the project and he claimed drunk so his name should be deleted from the list of speakers.

4. **Sri Sanjib Pradhan**

   He welcomed the project.

10.01.2020

Asst. Env. Scientist
State Pollution Control Board,
Odisha, Sambalpur

Addl. District Magistrate,
Sambalpur

Additional District Magistrate
Sambalpur

Annexure

ମେସର୍ସ ଏନ୍.ଏଲ୍.ସି. ଇଣ୍ଡିଆ ଲିମିଟେଡ୍ ଓଡ଼ିଶାର ଝାରସୁଗୁଡ଼ା ଜିଲ୍ଲା ଅନ୍ତର୍ଗତ କୁସ୍ତାରା ଓ ତରେଇକେଲା ଗ୍ରାମ ଏବଂ ସମ୍ବଲପୁର ଜିଲ୍ଲା ଅନ୍ତର୍ଗତ ଥେଲକୋଲୋଇ ଗ୍ରାମଠାରେ ୩x୮୦୦ ମେଗାୱାଟ୍ କ୍ଷମତା ସମ୍ପନ୍ନ ଏନ୍.ଏଲ୍.ସି. ତଲାବିରା ତାପଜ ବିଦ୍ୟୁତ ପ୍ରକଳ୍ପ ପ୍ରତିଷ୍ଠା କରିବା ନିମନ୍ତେ ଦୁର୍ଗା ମଣ୍ଡପ ପଡ଼ିଆ, ଥେଲକୋଲୋଇ, ସମ୍ବଲପୁର ନିକଟରେ ତାରିଖ ୧୦.୦୧.୨୦୨୦ ଦିବା ୧୧ ଘଟିକା ସମୟରେ ହୋଇଥିବା ଜନତାଙ୍କ ଦ୍ୱାରା ଉଠାଯାଇଥିବା ବିଭିନ୍ନ ପ୍ରସଙ୍ଗ।

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୧. ଶିଳ୍ପ କର୍ତ୍ତୃପକ୍ଷ ତାପଜ ବିଦ୍ୟୁତ କାରଖାନା ଏବଂ ଆଶପଣ୍ଡରେ ପ୍ରଦୂଷଣ ନିରାକରଣ କରିବା ଉଚିତ୍ ଏବଂ ଜନସାଧାରଣ ଶିଳ୍ପ ଯୋଗୁଁ ଅସୁବିଧା ନହେବା ପାଇଁ ଶିଳ୍ପ କର୍ତ୍ତୃପକ୍ଷର ଯତ୍ନବାନ ହେବା ଉଚିତ୍।

ସର୍ବସାଧାରଣ ସଭାରେ ଜନତାଙ୍କ ଦ୍ୱାରା ଉଠାଯାଇଥିବା
ବିଭିନ୍ନ ପ୍ରସଙ୍ଗ ଉପରେ ଶିଳ୍ପ କର୍ତ୍ତୃପକ୍ଷଙ୍କ ମତାମତ।

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୧. ଶିଳ୍ପ କର୍ତ୍ତୃପକ୍ଷର ସ୍ଥାନୀୟ ଗ୍ରାମବାସୀଙ୍କ ସୁବିଧା ପାଇଁ ତାପଜ ବିଦ୍ୟୁତ ପ୍ରକଳ୍ପ ଏବଂ ଆଶପଣ୍ଡ ରେ ପ୍ରଦୂଷଣ ନିରାକରଣ ପାଇଁ ପ୍ରଦୂଷଣ ନିରାକରଣ ପାଇଁ ପ୍ରସ୍ତାବ ରଖିଛନ୍ତି।

ଡ଼ଃ. ସତ୍ୟନାରାୟଣ ନନ୍ଦ
ସହକାରୀ ପରିବେଶ ବୈଜ୍ଞାନିକ
ରାଜ୍ୟ ପ୍ରଦୂଷଣ ନିୟନ୍ତ୍ରଣ ବୋର୍ଡ଼
ସମ୍ବଲପୁର

ଶ୍ରୀ ଲିଙ୍ଗରାଜ ପଣ୍ଡା (ଆର.ଏ.ଏସ୍.)
ଅତିରିକ୍ତ ଜିଲ୍ଲାପାଳ,
ସମ୍ବଲପୁର

Annexure-VI

Points raised by the public during Public consultation conducted on 10.01.2020 at 11.00 AM for M/s. NLC Talabira Thermal Power Project for establishment of 3×800 MW Power Plant at Khumbhari and Tareikela in the district of Jharsuguda and Thelkoloi village in the district of Sambalpur (For Sambalpur District).

The public raised the following issues and apprehensions for redressal by the project proponent.

1. Proper pollution control measures should be taken in the project so that people should not be affected due to the Project.

Views of Project Proponent on the issues raised by the public during the Public Consultation

1. The proposed project will have adequate pollution control measures for the Power Plant as well as Ash Pond so that people shall not be affected due to the Project.

10.01.2020

Asst. Env. Scientist
State Pollution Control Board,
Odisha, Sambalpur
Asst. Environmental Scientist
Regional Office of State Pollution
Control Board, Sambalpur.

10/1/2020

Addl. District Magistrate,
Sambalpur

Additional District Magistrate
Sambalpur

ପ୍ରାପକେଷୁ

ଆଞ୍ଚଳିକ ଅଧିକାରୀ
ପ୍ରଦୂଷଣ ନିୟନ୍ତ୍ରଣ [illegible] ସମ୍ବଲପୁର

SPC BOARD
No. [illegible]
Date [illegible] 2010
SAMBALPUR

Annexure - VII

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To,
Regional Officer
Pollution Control Board
Cuttack

Sub. Establishment of NLC India Ltd Thermal Power Project (3x660MW) at Village Telkoi - Public Hearing.

Sir,

It is informed that the Public Hearing of NLC India Ltd Thermal Power Project at Village Telkoi is to be conducted by your good office on 6-01-2020 in the regard it is submitted that being a person residing within 2 km radius of the area I welcome the project however, Company Authorities should be instructed to take all necessary steps for reduction of Pollution & Proper R&R benefits shall be provided to the land owners as per the Govt. Guidelines.

This is for your kind information & necessary action.

Yours faithfully

Telkoi
10.01.2020

(SURESH Kumar Munda)

ପ୍ରାପକେଷୁ,
ଆଞ୍ଚଳିକ ଅଧିକାରୀ
[illegible] କାର୍ଯ୍ୟାଳୟ, ସମ୍ବଲପୁର

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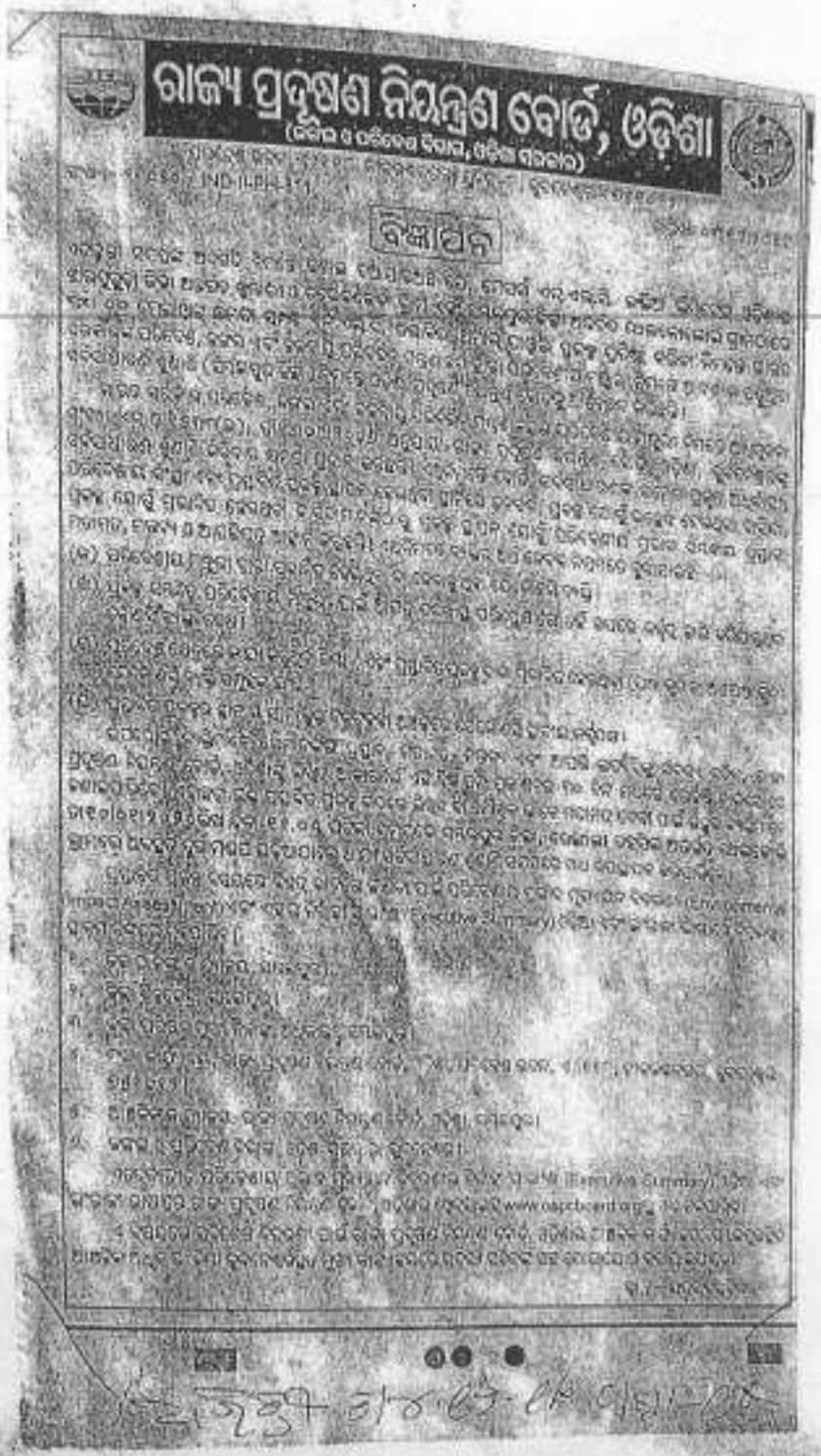

ରାଜ୍ୟ ପ୍ରଦୂଷଣ ନିୟନ୍ତ୍ରଣ ବୋର୍ଡ, ଓଡ଼ିଶା

(ପରିବେଶ ଓ ଜଙ୍ଗଲବାଟ ବିଭାଗ, ଓଡ଼ିଶା ସରକାର)

ବିଜ୍ଞାପନ

STATE POLLUTION CONTROL BOARD, ODISHA

DEPARTMENT OF FOREST & ENVIRONMENT, GOVT. OF ODISHA

Paribesh Bhawan, A/118, Nilakanthanagar, Unit-VIII,
Bhubaneswar-751 012.

No. 1540 / ISO-II-PH-900 Date 19.10.2019

NOTICE

It is brought to the notice of all concerned that **M/s NLC Talabira Thermal Power Project** has proposed to have Environmental Assessment for **establishment of 2x800 MW Power Plant at Khuntbari and Tarekela villages in the district of Jharsuguda and Thelkoloi village in the district of Sambalpur (For Jharsuguda District)** to obtain Environmental Clearance from the Ministry of Environment, Forest and Climate Change, Govt. of India. The proponent has applied to the State Pollution Control Board, Odisha, Bhubaneswar for a Public Hearing.

By virtue of Ministry of Environment, Forests & Climate Change, Government of India Notification, No. S.O. 1533 (E) Dtd. 14.09.2006, the Board has been authorized to conduct environmental public hearing and as such invites suggestions, views, comments and objections on matters relating to environmental aspects of the proposed project from all the persons including bonafide residents, environmental groups and others located at the proposed site / sites of displacement likely to be affected.

For the above purpose, a person shall only mean:

A. Any person who is likely to be affected by the grant of Environmental Clearance.

B. Any person who owns or controls/ran the project with respect to which an application has been submitted for environmental clearance.

C. Any association of persons whether incorporated or likely to be affected by the project and/or functioning in the field of environment.

D. Any local authority within any part of whose local limits is within the neighborhood within the project proposed to be located.

Persons as above who desire to submit their views, comments, objections etc. relevant to the project, may do so in writing within 30 days from the date of publication of this notice addressing the same to the Member Secretary, State Pollution Control Board, Odisha through Registered Post. Besides this, persons interested to submit their views relevant to the proposed project in writing or may also do so during the public hearing to be conducted on **13.11.2019 at 11.00 A.M. at Village Tarekela, in front of Ganeshi UP School near Hirma Village.**

Persons desirous of participating in the public hearing may go through the Environmental Impact Assessment (EIA) / Environmental Management Plan (EMP) of the said project which will be available at the following offices. Copy of the Executive Summary both in English & Odia is also available in the following offices & the same can also be downloaded from the website **www.sepcboard.org** free of cost.

1. District Collector's Office, **Jharsuguda**.
2. District Industries Center, **Jharsuguda**.
3. In the office of the Chief Executive Officer, Zilla Parishad, **Jharsuguda**.
4. In the Head Office of the State Pollution Control Board, Odisha, Paribesh Bhawan, A/118, Nilakanthanagar, Unit-VIII, Bhubaneswar-12.
5. Regional Office, State Pollution Control Board, Odisha, **Jharsuguda**.
6. Department of Forest & Environment (Environment), Govt. of Odisha, Bhubaneswar.

For any further clarification in the matter, the Regional Officer, State Pollution Control Board, **Jharsuguda** or the Member Secretary, State Pollution Control Board, Odisha at Bhubaneswar may be contacted.

Sd/-
SR. ENV. ENGINEER-I-I

STATE POLLUTION CONTROL BOARD, ODISHA

[DEPARTMENT OF FOREST & ENVIRONMENT, GOVT. OF ODISHA]

Paribesh Bhawan, A/118, Nilakanthanagar, Unit-VIII,
Bhubaneswar-751 012

No. 13843/IND-II-PH-811 Date 03.12.2019

NOTICE

It is brought to the notice of all concerned that **M/s NLC Talabira Thermal Power Project** has proposed to have Environmental Assessment for **establishment of 3x800 MW Power Plant at Khumbhari and Tarelkela villages in the district of Jharsuguda and Thelkoloi village in the district of Sambalpur (for Sambalpur District)** to obtain Environmental Clearance from the Ministry of Environment, Forest and Climate Change, Govt. of India. The proponent has applied to the State Pollution Control Board, Odisha, Bhubaneswar for a Public Hearing.

By virtue of Ministry of Environment, Forests & Climate Change, Government of India Notification No. S.O. 1533 (E), Dtd. 14.09.2006, the Board has been authorized to conduct environmental public hearing and as such invites suggestions, views, comments and objections on matters relating to environmental aspects of the proposed project from all the persons including bonafide residents, environmental groups and others located at the proposed site / sites of displacement/sites likely to be affected.

For the above purpose, a person will only mean:

A. Any person who is likely to be affected by the grant of Environmental Clearance.
B. Any person who owns his control over the project with respect to which an application has been submitted for environmental clearance.
C. Any association of persons whether incorporated or likely to be affected by the project and/or functioning in the field of environment.
D. Any local authority within any part of whose local limits is within the neighborhood, wherein the project is proposed to be located.

Persons as above who desire to submit their views, comments, objections etc. relevant to the project, may do so in writing within 30 days from the date of publication of this notice addressing the same to the Member Secretary, State Pollution Control Board, Odisha through Registered Post. Besides this, persons interested to submit their views relevant to the proposed project in writing or orally may also do so during the public hearing to be conducted **on 10.01.2020 at 11.00 A.M. at Durga Mandap Field of village Thelkoli, Tahsil Rengali in Sambalpur district.**

Persons desirous of participating in the public hearing may go through the Environmental Impact Assessment (EIA) / Environmental Management Plan (EMP) of the said project which will be available at the following offices. Copy of the Executive Summary both in English & Odia is also available in the following offices & the same can also be downloaded from the website : **www.ospcboard.org** free of cost.

1. District Collector's Office, **Sambalpur.**
2. District Industries Centre, **Sambalpur.**
3. In the office of the Chief Executive Officer, Zilla Parishad, **Sambalpur.**
4. In the Head office of the State Pollution Control Board, Odisha, Parivesh Bhawan, A/118, Nilakanthanagar, Unit-VIII, Bhubaneswar-12
5. Regional Office, State Pollution Control Board, Odisha, **Sambalpur.**
6. Department of Forest & Environment (Environment), Govt. of Odisha, Bhubaneswar.

For any further clarification in the matter, The Regional Officer, State Pollution Control Board, **Sambalpur** or the Member Secretary, State Pollution Control Board, Odisha at Bhubaneswar may be contacted.

Sd/- MEMBER SECRETARY

PROCEEDING OF THE PUBLIC HEARING HELD ON 13.11.2019 AT 11:00 AM AT VILLAGE TAREIKELA, IN FRONT OF GARIADIHI UP SCHOOL NEAR HIRMA VILLAGE OF JHARSUGUDA DISTRICT, ODISHA OF M/S NLC INDIA LIMITED (NLCIL) FOR TALABIRA THERMAL POWER PROJECT (3X800 MW) AT KUMBHARI AND TAREIKELA VILLAGES IN JHARSUGUDA DISTRICT AND THELKOLOI VILLAGE IN SAMBALPUR DISTRICT.

As scheduled, the public hearing for Talabira Thermal Power Project (3X800 MW) of M/s NLC India Limited (NLCIL) was conducted at village Tareikela, in front of Gariadihi UP School near Hirma village, Jharsuguda on 13.11.2019 at 11.00 AM. Shri Pradeep Kumar Sahoo, Addrtional District Magistrate, Jharsuguda supervised and presided over the Public Hearing Process, assisted by Shri Niranjan Mallick, Regional Officer, State Pollution Control Board (SPCB), Jharsuguda. The State Pollution Control Board (SPCB), Bhubaneswar had advertised in Odia daily - " The Samaj" on 11.10.2019 and in English daily -"The Indian Express" on 11.10.2019. The Public Hearing in respect of the above project stated as per the schedule and the venue decided by the District Magistrate, Jharsuguda in accordance with the EIA Notification S.O.1533(E) dated 14.09.2006. The officers of NLC India Limited (NLCIL), public representatives and people of nearby villages were present. The attendance sheet of the members present in the public hearing is annexed as **Annexure – I** and the attendance sheet of the members delivered their views is annexed as **Annexure – II**

Regarding Public Hearing, notices were displayed/ served in the offices and notice board of Hirma GP. The information about Public Hearing was also given through Public address system in all Project affected villages. OSPCB has uploaded the EIA report & executive summary of the proposed project to OSPCB's website.

At the outset of the meeting, Regional Officer, State Pollution Control Board (SPCB), Jharsuguda welcomed the panel member, the assembled public and press & media. Shri Mallick briefly explained the objective of the proposed Talabira Thermal Power Project and procedure followed for conducting such public meeting as per EIA notification No. S.O. 1533 (E) dated 14.09.2006 of the Ministry of Environment & Forests and Climate Change (MoEF&CC), Govt. of India.

Additional District Magistrate, Jharsuguda, welcomed the SPCB officials of Regional Office, Jharsuguda, Govt. officials as well as Police personals representatives of NLC India Ltd, the villagers and the public of Hirma Panchayat, local people, Press & Media for the Public Hearing. He requested the public to maintain peace & come forward one by one to put their views/ opinion for the project. He invited the public to present their views about the proposed project on environmental consideration only. It has been clarified that the sequence of hearing should be 1st from the people of project affected villages and then the local people, but everybody who wants to give presentation will be allowed.

Additional District Magistrate, Jharsuguda advised the Project Proponent to make a brief presentation about the various aspects of the proposed project to be undertaken, for better understanding of the Public.

On behalf of the project proponent Shri Pratap Maharana, Dy Chief Manager, M/s NLC India Limited briefed in vernacular language (Odia) about the company and presented the Executive Summary of Environmental Impact Assessment /Environmental Management Plan for Talabira Thermal Power Project (3X800 MW) to the public. He also explained the benefits of proposed project along with environmental impact, control and mitigation of same.

The views expressed by various speakers present in the meeting are as follows:

Shri Surendra Sahu, Hirma :

He said that Jharsuguda & IB Valley are coming under the list of CEPI (Comprehensive Environment Pollution Index). As per CPCB, Jharsuguda & IB Valley area have been declared as one of the most critically polluted area in the state. As per Green Peace & Wetland International South Asia report, Jharsuguda is one of area in the state where major SO_2 emitting industries exists. In this report, it has been stated that water quality of Hirakud Reservoir contains high concentration of Fecal Coliform & Total Coliform as well as fluoride concentration is in dangerous level. The pollution level will be further increased if the proposed thermal power project will be established in the Kumbhari Tareikela area. As per the EIA report prepared by NLC India, IB river is located 3.8 Km, Bheden reiver is 0.5 Km & Hirakud

Reservior is 4.3 Km from the proposed project. These rivers are getting polluted due to the already existing industries located nearby. Whether the Govt has carried out any survey regarding the carrying capacity of the area at which such large project will proposed to be established. If the survey has been done, then it shall be placed before the general public otherwise the power plant project should not be allowed in the area If the proposed project will be established, then the nearby rivers and Hirakud reservoir water will be get polluted due to emission of CO_2, NO_2, SO_2 from combustion of coal in the proposed power plant. As the proposed ash pond of the project will be located near the Bheden river, in the future the same will be buried with ash. Apart from that, the forest species in the reserved forest will be diminished due to establishment of the proposed project. Ground water will be also contaminated with fluoride and other toxic element due to such proposed project. He also stated that, in addition to IB & Bheden river, there is one Nalla namely Gadgadi Nalla flowing nearby which confluence with Bheden river, and the same has not been reflected in the EIA report prepared by NLC India Limited. There are also 11 nos. of Ponds exist in the Hirma village at which the proposed project will be established and the same were also not reflected in the EIA. Some other existing units like MCL, SPS Sponge, LN Metaliks are located nearby the proposed power project which were not mentioned in the EIA. No clear figure on rehabilitation, resettlement and employment to the displaced people due to the proposed project has been mentioned in the EIA. Approximately 12000 family of 60 nos. of villages will be affected due to this proposed project. For the sake of Society, environment and economic protection, he finally opposed the proposed thermal power project. He submitted the written representation read out by him before the public hearing panel.

Mr. Ananta, Parivesh Surakshya Janamanch, Jharsuguda:

Shri Ananta introduced himself as a Social Activist and welcomed the public. He requested the panel to cancel the public hearing of the proposed 3x600MW thermal power project. He said that Jharsuguda & IB Valley are coming under the list of CEPI (Comprehensive Environment Pollution Index). As per CPCB, Jharsuguda & IB Valley area have been declared as one of the most critically polluted area in the state. Before completion of his speech local villagers came to the podium and opposed his speech. They also tore his written representation and did not allow to speak further. Executive magistrate along with police personnels controlled the local villagers to maintain peace and discipline After few minutes public hearing

continued normally with intervention of ADM by giving the opportunity to the local affected villagers to speak first and then others.

Shri Rudra Barlha, Luhurenkachhar :

He welcomed the panel and put his views that, if the plant comes, NLC company will acquire complete land of Luhurenkachhar, Tarekela and Kumbhari right up to the bank of river which is left out. He also expressed that, if their demands will not be fulfilled then they will face a lot of problems, both economically & environmentally.

Shri Bharat Koudi, Kumbhari

He welcomed the panel along with the public and stressed upon the effective measures to be taken by the company to control the air and water pollution caused by fly ash generated from the proposed project. He has further stated that if the company wants to acquire land for industrialization they may take all the land instead of leaving 500 meters from river bank as these land will become useless for them due to pollution & distance of their new habitation

Shri Rabindra Rohidas, Tarekela

He told that, since many industries like Vedanta, Bhushan & SMC have already been developed in the nearby area of the proposed site, he is not denying to establish another thermal plant in their village area. But he suggested that the affected people must be provided with the best land rate, Rehabilitation & Resettlement (R&R) benefits and also to acquire the complete land up to the bank of the river at both sides outside of the plant area.

Shri Gorang Jagat, Tarekela

He said that, if the proposed project will come up the nearby river and land will be affected. The river will not be fit for potable use for human consumption. Since many factories already exist all around their village area and there is pollution all around, if another company will be set up there will be no tangible change so it may be done. Govt. should take initiative to take necessary steps to protect the environment from pollution. Also the villagers who will be displaced due to the project should be resettled within the same panchayat area with proper R&R package.

Shri Pitambar Kisan, Ganadihi

He stated that, he does not have any problem with the upcoming project but the left out area (500 meter) from the river bank sides should be acquired fully.

Shri Sriram Garia, Tarcikela

He expressed that, no doubt 100 percent pollution exists in this area. If the coming factory will be established, the administration should take appropriate measures to protect the environment from pollution. Besides the displaced families should be resettled by providing prop: r and better environment.

Shri Madhusudan Kisan, Tareikela

He suggested that, whether factory will be established or not, pollution will bound to happen in view of existing factories. Rather, it is better if the factory comes in the area. He welcomed the proposed thermal power project as they will get displaced to a better environment But in lieu of that, they should provide better land compensation, employment, Rehabilitation & Resettlement and other benefits and facilities like school, colleges and temples

Shri Gorang Kisan, Ganadihi

He urged the media personnel to place the issues regarding pollution in their area before the district administration He also expressed that, if the person gets displaced, what will be the livelihood for their survival. He demanded that, company as well as administration should consider to provide proper infrastructure like road, school, R&R benefits, jobs and also free electricity to the affected villagers. People are unable to cultivate there land due to pollution Hence these should be examined and proper decision to be taken in this matter. Give us five resettlement village with the nomenclature of our existing five village with all facilities

Dilip kumar Badhal, Hirima, Ex-Sarpanch.

He pointed out that the name of the project " Talabira Thermal power Plant ' should be changed first and the same should be named after their Panchayat (Hirma;. The company should establish their office in Hirma Panchayat. Agreement should be made with the displaced villagers that everyone along with their generations should get the employment The people affected by pollution due to the proposed project will be given first priority in employment, contract jobs and other

facilities. Appropriate steps must be taken for free movement of persons near upcoming infrastructural development of the company.

Japamali Bhainsa, Tumbekela

He welcomed the panel along with the public. He expressed that, he used to drink and take bath in clean river water, but now it has been polluted. He cannot go to his 15 acre river bank land as ash is disposed in the surroundings. Though his land is not getting acquired still then he will be most affected by the pollution caused by the project. He also agreed with the earlier views of Dilip Badhai, regarding the name of the project to be in the name of, one of the displaced villages.

Khirod Marai, Kumbhari

He stated that if land will be acquired by the company, then Company should take all land without leaving any land.

Giridhari Kanta, Ex Sarpanch Himma

He welcomed the panel along with the public. He said that, company should provide proper compensation for land displaced person due to the proposed thermal power project. The project authority should also provide houses as it is for the land affected people. Adequate measures must be taken to avoid pollution of the existing water bodies of the villages.

Rambha Dhila, Kumbhari

She introduced herself as a Social Activist and welcomed the public. School arrangement be made for the education for the children of displaced families. Proper resettlement and jobs should be provided to Project Affected Families (PAF's). Proper steps should be taken to protect environment from pollution.

Lal Bihari Seth, Tumbekela

He stated that, employment should be given to the affected people. Open agreement should be done to provide employment, house and road. Project proponent should acquire the entire land of 500m left along the river bank. But the plant should come and he supported the project subject to fulfillment of above conditions.

Jitendra Bhainsa, Tumbakela

He welcomed the proposed project. He suggested that, company should construct Goshala at appropriate place to prevent road accident due to cattles. He also added that, employment should be given to land affected persons with special priority for ladies. The existing local ponds should be renovated by the project authority. Health Camp should be organized for land affected people in the area. Project proponent should provide proper land compensation, service to the PAF's and PDF's and acquire the entire land of 500m left along the river bank. Adequate measures shall be taken to protect the environment from pollution.

Shankar Prasad Birtia, Kumbhari

He expressed that, entire land should be taken up by the Company and they along with the administration should write to the villagers regarding the facilities provided by the project. If one inch of land is left out then they will debar the project and if entire land will be taken then they will welcome the project. Houses and jobs should be provided to the all affected people who are more than 18 yrs of age and education facility should be provided.

Budharam Garla, Kumbhari

He said that, if factory comes then they will lose their homestead land and they will start begging. He opposed the proposed project.

Parsuram Puta, Tumbakela

He told that, the area is already polluted. hence the project authority should take necessary measures to control the pollution

Ranjan Kumar Bhainsa, Kantatikera

He welcomed the public and said that, all the elders have already told about pollution matter and he has nothing to say about this. He also added that the project authority should give priority for employment to the local people basing on their qualification.

ADDL. District Magistrate
JHARSUGUDA

Santanu Panigrahi, Tarelkela

He strongly opposed the establishment of proposed project on the ground that due to the Industries like Vedanta, Bhushan etc the water of the river has been polluted and the people of the area are drinking polluted water also people eating fish from the polluted water of river and their by getting affected by certain diseases. The existing nearby Industries like Vedant & Bhusan are discharging SO_2. NOx and other chemicals to the atmosphere, if further new plant comes then environment will be severely deteriorated. People maintaining their livelihood and depending on forest produce will be largely affected. Soil conservation will be affected.

Vishnu Panigrahi, Tarelkela

We have no knowledge about the environment By establishing new project in this area the environment of this area will be affected badly. We should protect our villages from pollution leaving behind any politics.

Madhav Prasad, Tarelkela

Involvement of any agents should be avoided and each and everyone shall be treated equally. Preventive measures shall be taken for the health care of both humans and cattles

Sudhakar Sah, Hirma

Due to establishment of SMC, Vedanta, Bhushan the environment of this area has already been larg ly affected. No steps were taken by the administration to protect the environmental issues therefore we the people of Sirpura, Badmal and Hirma parchayat should be united to stand for protection of the environment of this area.

Sudhakar Sah being the last speaker, Presiding Officer once again requested if anybody other than the above speakers if interested and Mr. Anant who could not complete his speech to come forward & submit their presentation. But no more person have come forward for giving presentation even after repeated call.

During the Public Hearing all have been given opportunity to express their views on the proposed project Shri Niranjan Mallick, Regional Officer, State

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Pollution Control Board (SPCB), Jharsuguda, recorded the views and concerns expressed, during the Public Hearing. Total 06 nos. of written statements have been received from the public during public hearing which are enclosed with this proceeding.

At the end Sri Pratap Maharana, Dy. Chief Manager on behalf of NLC has given reply to the different points raised by the public and his replies are submitted in a separate statement which is attached herewith as Annexure-III.

Shri Pradeep Kumar Sahoo, Addl. District Magistrate, Jharsuguda who has chaired the Public Hearing, ratified the minutes of meeting along with the views and demands of the public hearing.

At the end, Additional District Magistrate, Jharsuguda thanked all the person present there including the villagers, public representatives, press and media for smooth conducting the public hearing.

Sri Niranjan Mallick
Regional Officer
State Pollution Control Board
Jharsuguda

Regional Officer
State Pollution Control Board
JHARSUGUDA

Sri Pradeep Kumar Sahoo 13.12.19
Additional District Magistrate
Jharsuguda

Addl.District Magistrate
JHARSUGUDA

Annexure - III

STATEMENT OF ISSUES RAISED IN THE PUBLIC HEARING FOR THE PROPOSED TALABIRA THERMAL POWER PROJECT (3X800 MW) OF M/S NLC INDIA LIMITED (NLCIL) AT KUMBHARI AND TAREIKELA VILLAGES IN JHARSUGUDA DISTRICT AND THELKOLOI VILLAGE IN SAMBALPUR DISTRICT HELD ON 13.11.2019 AT 11.00 AM AT VILLAGE TAREIKELA, IN FRONT OF GARIADIHI UP SCHOOL NEAR HIRMA VILLAGE OF JHARSUGUDA DISTRICT.

Shri Pratap Maharana, Deputy Chief Manager during his clarification on the action proposed by the project proponent clarified on the issues of Compensation, R&R, Employment & Environmental impacts raised by the public during deliberation. He also assured that the issues raised during public hearing will be addressed in accordance with applicable rules also clarified on the environmental impacts and proposed management plan proposed for the new project. Shri Pratap Maharana submitted that adequate mitigative pollution control measures will be taken by the project proponent against environmental impacts of the proposed project. The issues raised during the public hearing and the response of Project Proponent were as follows :

Issues raised by the Public		Response of the Project Proponent
1.	Issues concerning to the left out area outside the plant layout situated near the river bank	Boundary of plant layout for the proposed project has been located at a distance of 500 m away from river on both sides in line with the Terms of Reference (ToR) issued by Ministry of Environment, Forest and Climate Change (MoEF&CC). However the demand of the people on this matter will be brought to the notice of higher authorities for appropriate decision.
2.	Issues related to resettlement of the displaced within the same panchayat	As far as possible, the area for the establishment of Rehabilitation & Resettlement (R&R) colony shall be within the same panchayat. Presently, area for R&R colony has been identified in the same Panchayat, Hirma and application for same has already been submitted to district officials.
3.	Issues concerning R&R benefits and land rate	Land rates finalized by the District Collector as per the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (RFCTLARR) Act, 2013 shall be paid by NLCIL. R&R benefits as finalized by the Rehabilitation and Periphery Development Advisory Committee (RPDAC) shall be extended to PAP's by NLCIL. However it shall not be less than the R&R benefits already extended for Talabira II & III OCP of M/s NLCIL, based on the approval of RPDAC for Talabira II & III OCP
4.	Issues concerning infrastructural development	NLCIL will provide all infrastructural facilities at R&R colony such as Road, School,Primary health centre, Post office, Bank , Market, Cremation Site, Community hall, Temple etc and comply with provisions of the RFCTLARR Act, 2013.
5.	Issues concerning water and air pollution.	NLCIL has planned to install Supercritical pulverized fuel combustion technology with advantages of Targeting Higher Efficiency

		Minimum Coal Consumption Environment Friendliness with Reduced Emission **The plant would be designed to meet all the requirements of latest Notifications of MOE&F &CC.** 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. Flue Gas Desulphurization (FGD) system will be installed for controlling and limiting SO2 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. **No effluent would be discharged from the plant to nearest water bodies as the same shall be recycled/ re-used within the plant to meet latest environmental norms of Zero Liquid Discharge (ZLD).** All control measures as given in the EIA-EMP report shall be taken up and implemented fully for control of dust pollution. The public opinions put before has been worthy and steps would be taken for betterment of the environment.

Shri Niranjan Mallik
Regional Officer
SPCB, Jharsuguda

Regional Officer
State Pollution Control Board
JHARSUGUDA

Shri Pradeep Kumar Sahoo
Additional District Magistrate
Jharsuguda

Addl.District Magistrate
Jharsuguda

ତା ୧୯.୧୧.୨୦୧୯ ପୂର୍ବାହ୍ନ ୧୧.୦୦ ଘଣ୍ଟା ସମୟରେ ଝାରସୁଗୁଡା ଜିଲ୍ଲା ର ହୀରମା ପଂଚାୟତ ଅଧିକୃତ ଗରିଆଡିହି ପ୍ରାଥମିକ ସ୍କୁଲ ସମ୍ମୁଖ ପଡିଆରେ M/s NLC India Ltd ଦ୍ୱାରା ତରେଇକେଲା ଓ କୁୟାରୀ ଗ୍ରାମରେ ୩ x ୮୦୦ MW ତାପଜ ବିଦ୍ୟୁତ ପ୍ରକଳ୍ପ ପଡିଥିବା ଜିମଟେ ଝାରସୁଗୁଡା ଜିଲ୍ଲା ର ୫ ଟି ଗ୍ରାମ ର ଯଥା ତରେଇକେଲା , କୁୟାରୀ,ଟୁକୁକେଳା , ହୀରମା ଓ ଲୋହରଟଙ୍ଗାଭା ଗ୍ରାମର ୭୫୩.୧୩ ଏକର ଜମି ଅଧିଗ୍ରହଣ ସକାଶେ ଅନୁଷ୍ଠିତ ପରିବେଶ ମଞ୍ଜୁରୀ ସମ୍ବନ୍ଧୀୟ ଜନଶୁଣାଣୀ ସମୟରେ ପର୍ଯାବରଣ ଜନିତ ସମସ୍ୟା ଉପରେ ଜନସାଧାରଣଙ୍କର ମତାମତ ଓ ପ୍ରକଳ୍ପ କର୍ତ୍ତୃପକ୍ଷଙ୍କ ମନ୍ତବ୍ୟ ର ସଂକ୍ଷିପ୍ତ ବିବରଣୀ ।

ପ୍ରକଳ୍ପ କର୍ତ୍ତୃପକ୍ଷଙ୍କ ତରଫରୁ ଶ୍ରୀ ପ୍ରତାପ ମହାରଣା, ଉପ ମୁଖ୍ୟ ପ୍ରବନ୍ଧନ ଜନସାଧାରଣଙ୍କ ଜମିର ସଠିକ କ୍ଷତିପୂରଣ, ପୁନର୍ବାସ ଓ ଥଇଥାନ, ଚାକିରୀ , ପରିବେଶ ପ୍ରତିତ ସମସ୍ୟା ସମ୍ପର୍କୀୟ ପ୍ରଭାବ ଉପରେ ଉପୋଲବ୍ଧ ସମସ୍ୟା ଉପରେ ପ୍ରକଳ୍ପ କର୍ତ୍ତୃପକ୍ଷ କି କି ପଦକ୍ଷେପ ନେବା ପାଇଁ ପ୍ରସ୍ତାବ ପ୍ରସଥ କରିଛନ୍ତି ତାହାର ସବିଶେଷ ବିବରଣୀ ପ୍ରଦାନ କରିଥିଲେ . ଜନସାଧାରଣଙ୍କୁ ଆଶ୍ୱାସନା ଦେଇ ଥିଲେ ଯେ ପ୍ରକଳ୍ପ ଦ୍ୱାରା ପ୍ରଭାବିତ ଜନସାଧାରଣଙ୍କ ଆଇନ ଅନୁଯାୟୀ ସ୍ୱାର୍ଥ ରକ୍ଷା କରିବେ . ଅଂଚଳର ପରିବେଶ ସୁରକ୍ଷା ତଥା ନିୟନ୍ତ୍ରଣ ପାଇଁ ଆଇନ ଅନୁମୋଦିତ ସମସ୍ତ ପଦକ୍ଷେପ ଗ୍ରହଣ କରିବା ପାଇଁ ସ୍ପଷ୍ଟ କରିଥିଲେ

ଜନସାଧାରଣଙ୍କ ଦ୍ୱାରା ଉପସ୍ଥାପିତ ସମସ୍ୟା		ପ୍ରକଳ୍ପ କର୍ତ୍ତୃପକ୍ଷଙ୍କ ମନ୍ତବ୍ୟ
୧	ପ୍ରସ୍ତାବିତ ପ୍ରକଳ୍ପ ବାହାରେ ନଦୀ କୂଳରେ ଅବସ୍ଥିତ ସମସ୍ତ ଜମି ଅଧିଗ୍ରହଣ କରିବା	ଭାରତ ସରକାରଙ୍କ ଜଙ୍ଗଲ ପରିବେଶ ଓ ଜଳବାୟୁ ପରିବର୍ତ୍ତନ ମନ୍ତ୍ରାଳୟ ର ନିର୍ଦେଶାବଳୀ ଅନୁସାରେ ପ୍ରସ୍ତାବିତ ପ୍ରକଳ୍ପ ର ସୀମା ନଦୀର ଉଭୟ ପାର୍ଶ୍ୱରୁ ୫୦୦ ମିଟର ଛାଡିବାକୁ ପଡୁଅଛି । ମାତ୍ର ଲୋକଙ୍କର ଦାବି ଓ ଆପତି ଅନୁଯାୟ ସମୁଦ୍ର ବିଷୟକୁ ଉପଯିସ୍ତ ଅଧିକାରୀଙ୍କୁ ଅବଗତ କରାଯାଇ ଉଚିତ ନିଷ୍ପତି ଗ୍ରହଣ କରାଯିବ ।
୨	ବିସ୍ଥାପିତ ଲୋକଙ୍କୁ ହୀରମା ପଂଚାୟତ ରେ ପୁନର୍ବାସ ଓ ଥଇଥାନ ସମ୍ବନ୍ଧେ	ବିସ୍ଥାପିତ ଲୋକଙ୍କୁ ଯଥା ସମ୍ଭବ ହୀରମା ପଂଚାୟତ ଅଧୀନରେ ପୁନର୍ବାସ ଓ ଅଥଥାନ କରିବା ନିମନ୍ତେ ପଦକ୍ଷେପ ଗ୍ରହଣ କରାଯାଇ ଅଛି . ଏଥି ସକାଶେ ହୀରମା ଗ୍ରାମରେ ସରକାରୀ ଜମି ଅଧିଗ୍ରହଣ ପାଇଁ ଜିଲ୍ଲା ପ୍ରଶାସନ ଝାରସୁଗୁଡାଙ୍କ ନିକଟରେ ଦରଖାସ୍ତ ଦାଖଲ କରାଯାଇ ଅଛି
୩	ଜମିର ସଠିକ କ୍ଷତିପୂରଣ ଓ ବିସ୍ଥାପିତ ପରିବାରଙ୍କ ସଠିନ ପୁନର୍ବାସ ଓ ଥଇଥାନ ସମ୍ବନ୍ଧେ	ଉଦ୍ଧାୟୋଚିତ କ୍ଷତିପୂରଣ ଅଧିକାର ଏବଂ ଭୂଅର୍ଜନ ପୁନର୍ବାସ ଓ ଥଇଥାନ କ୍ଷେତ୍ରରେ ସ୍ୱଚ୍ଛତା ଆଇନ ୨୦୧୩ ଅନୁଯାୟୀ ଜିଲ୍ଲାପାଳ ଝାରସୁଗୁଡାଙ୍କ ଦ୍ୱାରା ନିର୍ଧାରିତ ଜମିର ମୂଲ୍ୟ ଅନୁଯାୟୀ କ୍ଷତିପୂରଣ ଦେବା ପାଇଁ NLCIL ପ୍ରତିଶ୍ରୁତିବଦ୍ଧ. RPDAC ରେ ବିସ୍ଥାପିତ ତଥା ପ୍ରଭାବିତ ପରିବାରଙ୍କ ପୁନର୍ବାସ ଓ ଥଇଥାନ ସମ୍ବନ୍ଧୀୟ ଯାହାକିଛି ନିଷ୍ପତି ନିଆଯିବ NLCIL ତାହା ପାଳନ କରିବ. ଏହି ସମ୍ବନ୍ଧୀୟ ସୁବିଧା ତଲାବିରା ୨ ଓ ୩ କୋଇଲା ଖଣି ରେ ପ୍ରଭାବିତ ଲୋକଙ୍କ ପାଇଁ RPDAC ଯୋଉ ସୁବିଧା ଦେବା ପାଇଁ ନିଷ୍ପତି ନେଇଛନ୍ତି ସେଥିରୁ କମ ହେବ ନାହିଁ.
୪	ପରିପାର୍ଶ୍ୱିକ ଉନ୍ନୟନ ଓ ଆନୁସଙ୍ଗିକ ସୁବିଧା	NLCIL ପୁନର୍ବାସ କାର୍ଯ୍ୟକ୍ରମରେ ସମସ୍ତ ପ୍ରକାର ଉନ୍ନୟନ ମୂଳକ କାର୍ଯ୍ୟ ତଥା ଆନୁସଙ୍ଗିକ ସୁବିଧା ଯଥା ଶାସ୍ତା, ସ୍କୁଲ, ପ୍ରାଥମିକ ସ୍ୱାସ୍ଥ୍ୟ କେନ୍ଦ୍ର, ପୋଷ୍ଟ ଅଫିସ, ବ୍ୟାଙ୍କ, ତଡାଉ, ସ୍ମଶାନ, କମ୍ୟୁନିଟିହଲ୍ଲ, ମନ୍ଦିର ଇତ୍ୟାଦି ନିର୍ମାଣ କରିବାକୁ ପ୍ରତିଶ୍ରୁତିବଦ୍ଧ ଓ ଉଚ୍ଚଗ୍ରେଡଂଗେ ଦ୍ଧାୟୋଚିତ କ୍ଷତିପୂରଣ ଅଧିକାର ଏବଂ ଭୂଅର୍ଜନ ପୁନର୍ବାସ ଓ ଥଇଥାନ କ୍ଷେତ୍ରରେ ସ୍ୱଚ୍ଛତା ଆଇନ ୨୦୧୩ ରେ ଥିବା ସମସ୍ତ ସୁବିଧା ପ୍ରଦାନ କରିବା ପାଇଁ ସ୍ପଷ୍ଟ କରିଥିଲେ.
୫	ବାୟୁ ଓ ଜଳ ପ୍ରଦୂଷଣ ସମସ୍ୟା ସମ୍ବନ୍ଧୀୟ	NLCIL ଦ୍ୱାରା ପ୍ରସ୍ତାବିତ ଏହି ତାପଜ ବିଦ୍ୟୁତ କେନ୍ଦ୍ର ସୁପର କ୍ରିଟିକାଲ ଫ୍ଲୁଏଡ଼ ଜନ୍ୟୁଏଶନ୍ସ ଟେକ୍ନୋଲୋଜି ଦ୍ୱାରା ପରିଚାଳିତ ହେଉ ଯାଉ। ଦ୍ୱାରା କମ କୋଇଲା ଧୋଇବା , କମ ଏସର୍ଟନ ଓ ପଜିଂକରଣ ମିଶ୍ରଣ ସହିତ ବୃହତ ବିଦ୍ୟୁତ ଉତ୍ପାଦନ ଦକ୍ଷତା ମୁଲ ଅଟେ ।

		ଏହି ପ୍ରକଳ୍ପ ଜଙ୍ଗଲ ପରିବେଶ ଓ ଜଳବାୟୁ ପରିବର୍ତ୍ତନ ମନ୍ତ୍ରାଳୟ ର ନିର୍ଦ୍ଦେଶାବଳୀ ଅନୁସାରେ ତିଆରି ହେବ । ଏହି ପ୍ରକଳ୍ପରେ ଉଚ୍ଚ କ୍ଷମତା ବିଶିଷ୍ଟ electrostatic precipitator (ESPs) ଲାଗିବ ଯାହା ଉଡନ୍ତା ପାଉଁଶ କୁ ୯୯ % ପର୍ଯ୍ୟନ୍ତ ରୋକିପାରିବ. Flue Gas Desuphurization (FGD) ଦ୍ଵାରା ଯେ କୌଣସି ସ୍ଥିତିରେ Sulphur gas emission କୁ ୧୦୦ Microgram କୁ ସୀମିତ କରାଯାଇ ପାରିବ . NOx ନିୟନ୍ତ୍ରଣ କରିବା ପାଇଁ NOx ବର୍ଣ୍ଣର ସ୍ଥାପନ କରାଯିବ. ଯାହାଦ୍ଵାରା ଯେ କୌଣସି ସ୍ଥିତିରେ NOx କୁ ୧୦୦ Microgram କୁ ସୀମିତ କରାଯାଇ ପାରିବ. କୋଇଲା ଗାଡ଼ିମାନଙ୍କ ସ୍ଥାନ , କୋଇଲା ଷ୍ଟକୟାର୍ଡ ଏବଂ ସମସ୍ତ ଧୂଳି ସମ୍ବେଦନଶୀଳ କ୍ଷେତ୍ର ରେ ବହୁଳ ଭାବରେ dust extraction / suppression system ଲଗାଯିବ. ଧୂଳିଗତ ପ୍ରଦୂଷଣ ନିୟନ୍ତ୍ରଣ ନିମନ୍ତେ ପ୍ଲାଣ୍ଟ ର ଚାରିପାଖରେ ସବୁଜ ବଳୟ ସୃଷ୍ଟି କରାଯିବ. ପ୍ରକଳ୍ପ ଦ୍ଵାରା ପ୍ରଦୂଷିତ ଜଳ କୁ କୌଣସି ନଦୀ କିମ୍ବା ନାଳ କୁ ଛଡା ଯିବା ନାହିଁ ,ଏହି ପ୍ରଦୂଷିତ ଜଳ କୁ ବିଶୋଧିତ କରି ପୁନର୍ବାର ପ୍ରକଳ୍ପ କାର୍ଯ୍ୟ ରେ ବ୍ୟବହାର କରାଯିବ ଯାହାକି ପରିବେଶ ନିୟମର Zero Liquid Discharge (ZLD) ଅନ୍ତର୍ଭୁକ୍ତ. EIA - EMP ରିପୋର୍ଟ ରେ ବର୍ଣ୍ଣା ଯାଇଥିବା ସମସ୍ତ ପ୍ରକାର ପ୍ରଦୂଷଣ ନିୟନ୍ତ୍ରଣ ପଦକ୍ଷେପ କୁ ସମ୍ପୂର୍ଣ୍ଣ ଭାବରେ ଲାଗୁ କରା ଯିବ. ଜନସାଧାରଣଙ୍କ ସୁଚିନ୍ତିତ ମତାମତ ଅନୁଯାୟୀ ପରିବେଶର ଉନ୍ନତି ପାଇଁ ସମସ୍ତ ପ୍ରକାର ପଦକ୍ଷେପ ନିଆଯିବ.

ଶ୍ରୀ ନିରଞ୍ଜନ ମଲ୍ଲିକ

ଆଂଚଳିକ ଅଧିକାରୀ (ରାଜ୍ୟ ପ୍ରଦୂଷଣ ନିୟନ୍ତ୍ରଣ ବୋର୍ଡ)

ଝାରସୁଗୁଡା

Regional Officer
State Pollution Control Board
JHARSUGUDA

ଶ୍ରୀ ପ୍ରଦୀପ କୁମାର ସାହୁ

ଅତିରିକ୍ତ ଜିଲ୍ଲାପାଳ, ଝାରସୁଗୁଡା

Addl.District Magistrate
JHARSUGUDA

Public Intended to deliver their views in the Public Hearing of M/s. NLC Talabira Thermal Power Plant for establishment of 3 X 800 MW Power Plant at Kumbhari & Tareikela village in the district of Jharsuguda & Thelkoloi village in the district of Sambalpur on dtd.13.11.2019 at 11.00 AM.

Sl. No.	Name & Address	Signature
1	Ananta, Paritosh Suraksha Jonamanch Srotaf Colony, Industrial Estate, Jharsuguda.	Ananta
2.	Surendra Sahoo, Hirma	[illegible]
3	Rudra Bethria Lohimaskachha	Rondra Barika
4	Bharat Karti Kumbhari	Bhas
5	Rabindra Kalidas Tareikela	Rabindra Kalidas
6	Gouranga Jeyot Tareikela	[illegible]
7	Patambar Kisan Gandhi	Pitambar Kisan
8	Suresh Guda Tareikela	[illegible]
9	[illegible] Kisan Tareikela	[illegible]
10	Gourang Kisan	[illegible]
11	[illegible] Hirma	[illegible]
12	[illegible]	[illegible]
13	[illegible]	[illegible]

Public Intended to deliver their views in the Public Hearing of M/s. NLC Talabira Thermal Power Plant for establishment of 3 X 800 MW Power Plant at Kumbhari & Tareikela village in the district of Jharsuguda & Thelkoloi village in the district of Sambalpur on dtd.13.11.2019 at 11.00 AM

Sl. No.	Name & Address	Signature
14	Rambha Dila, Kumbhari	Rambha Dila
15	Giridhari Kanta, Ex-Sarpanch Harma	
16	Lakhan Lal Seth, Tumbekela	
17	Jitendra Bhoinsa, Tumbekela	
18	Shankar Prasad Bisi'a, Kumbhari	
19	Budhuram Ganiji, Kumbhari	
20	Purusuram Rita, Tumbekela	
21	Santanu Panigrahi, Tumbekela	
22		
23		
24		
25		

(10.

Public present in the Public Hearing of M/s. NLC Talabira Thermal Power Plant for establishment of 3 X 800 MW Power Plant at Kumbhari & Tareikela village in the district of Jharsuguda & Thelkoloi village in the district of Sambalpur on dtd.13.11.2019 at 11.00 AM.

Sl. No.	Name & Address	Signature
1	Jagannath Bhanja Vill: TUMSEKELA P.O. Hirma Dist. Jharsuguda	Jagannath Bhanja
2.	Madhusudan Nag Vill. Tareikela P. Hirma. Dt. Jharsuguda	M.S. Nag
3)	Gouranga Dagut Tareikela	Dagut.
4	Tareikela Hirma Rajiba Lochan Panigrahi	Rajiba Lochan Panigrahi
5	Pankaj Bhue	
6	Rudra prasad panigrahi	
7	Jashobanta Jagadev	
8	Santosh Jagat	
9	Suraj Sahu	
10	Jogeswar Panigrahi	
11	Sudhir Roy	
12	Si Ellg	
13	Sashanka Kisan	

Public present in the Public Hearing of M/s. NLC Talabira Thermal Power Plant for establishment of 3 X 600 MW Power Plant at Kumbhari & Tareikela village in the district of Jharsuguda & Thelkoloi village in the district of Sambalpur on dtd.13.11.2019 at 11.00 AM.

Sl. No.	Name & Address	Signature
13	[illegible]	
14	Umesh Roy	
15	Ashok Besra	
16	Negramani Rabidas	
17	Subrata Rabidas / Tumbeikela	
18	Ramesh Rabidas	
19	Haldhar Rabidas	
20	Jagadish panigrahi / Sripura	
21	Madan Mohan Seth / Sadpara	
22	Jitendra Ku Misra	
23	Bipul Nath	
24	Rabindra Bhoi	
25	Jayram Barik	

Public present in the Public Hearing of M/s. NLC Talabira Thermal Power Plant for establishment of 3 X 800 MW Power Plant at Kumbhari & Tareikela village in the district of Jharsuguda & Thelkoloi village in the district of Sambalpur on dtd.13.11.2019 at 11.00 AM.

Sl. No.	Name & Address	Signature
27	Sanjay Kumar [illegible] Kumbhari	[signature]
28	Ananta, Steel Colony, Industrial Estate, Jharsuguda - 768203	[signature]
29	Dhaneswar Rohidas, Tareikela Jsg.	[signature]
30	Kalyani Shila Sahu Tareikela	[signature]
31	Sriram Garia	[signature]
32	[illegible] Kumbhari	
33	Ramadhar Rout Kumbhari	
34	Kumbhari Manoj Sah	Manoj Sah
35	Kumbhari Hemantaoli	[signature]
36	Kumbhari Nimeam Barek	[signature]
37	Thanaya Horsmy ABC Technologies India Pvt. Ltd.	[signature]

Public present in the Public Hearing of M/s. NLC Talabira Thermal Power Plant for establishment of 3 X 800 MW Power Plant at Kumbhari & Tarelkela village in the district of Jharsuguda & Thelkoloi village in the district of Sambalpur on dtd.13.11.2019 at 11.00 AM.

Sl. No.	Name & Address	Signature
39	Basanth Seth	
40	Lal bihari Seth	L. B. Seth
41	Durga Prasad Ojha	
42.	Babulu Sahu	
43	Upendra Bag	
44	Dasrath Dansena	
45	[illegible]	[illegible]
46	[illegible]	
47	[illegible]	[illegible]
[illegible]	Suraj Dansena	Kandagiri
[illegible]	Pabitra Mohan Kothidar	[illegible]
[illegible]	[illegible]	

Public present in the Public Hearing of M/s. NLC Talabira Thermal Power Plant for establishment of 3 X 800 MW Power Plant at Kumbhari & Tareikela village in the district of Jharsuguda & Thelkoloi village in the district of Sambalpur on dtd.13.11.2019 at 11.00 AM.

Sl. No.	Name & Address	Signature
51	Jitendra Bhoi Tumbekela	Jitendra [illegible]
52	Gopal Jagat Tareikela	[illegible]
53	Bhogi Seth Hirma	Bhogi Seth
54	Dusmanta Ku Thanry Hirma	Dusmanta Ku Thanry
55	Bhagaban Pujhari Roulbandh (Hirma)	[signature]
56	Niranjan Dubey - Hirma	[signature]
57	Bartha Kanta	[signature]
58	Bhoja Rai Sahu	[signature]
59	Bhoj Rai Lihu	BRL MIRDHA
60	Bhagat [illegible] Kumbhari	Bhagat Kumbhari
61	[illegible]	[signature]
62	[illegible]	[illegible]
63	Bhagaban Pradhan Tareikela	Bhagaban Pradhan

Public present in the Public Hearing of M/s. NLC Talabira Thermal Power Plant for establishment of 3 X 800 MW Power Plant at Kumbhari & Tareikela village in the district of Jharsuguda & Thelkoloi village in the district of Sambalpur on dtd.13.11.2019 at 11.00 AM.

Sl. No.	Name & Address	Signature
64		
65	Kumbhari	
66	Shashi Tiwari Hirma	
67	B P Tiwari Hirma	
68	Gouranga Sahu Kabadi	
69		
70		
80		
81		
82		
83		
84		
85		

Public present in the Public Hearing of M/s. NLC Talabira Thermal Power Plant for establishment of 3 X 800 MW Power Plant at Kumbhari & Tareikela village in the district of Jharsuguda & Thelkoloi village in the district of Sambalpur on dtd.13.11.2019 at 11.00 AM.

Sl. No.	Name & Address	Signature
86	Manju Tandiya Badmal	
87	Tapasya Mohanand Badmal	
88	Kalia [illegible]	
89	Rajesh Porel Tumbekela	R.P
90	[illegible] Kumbhari	
91	Gayakisan Koliyadhi	
92	Dilip Kumar Koluhi	
93	Sanjiv Seth Kumbhari	Sanjiv Seth
94	[illegible]	[illegible]
95	[illegible]	[illegible]
96	[illegible]	[illegible]
97	[illegible]	[illegible]
98	[illegible]	[illegible]

Public present in the Public Hearing of M/s. NLC Talabira Thermal Power Plant for establishment of 3 X 800 MW Power Plant at Kumbhari & Tareikela village in the district of Jharsuguda & Thelkoloi village in the district of Sambalpur on dtd.13.11.2019 at 11.00 AM.

Sl. No.	Name & Address	Signature
99	Hemanta Baegar At-Tumbekela	Hemanta Baegar
100	Alok Kr Bhainsa, Tumbekela	Alok
101	Manju Bhainsa At- Tumbekela	Manju Bhainsa
102	Tumbekela	Alok
103	Rahul Kisan	Rahul Kisan
104	Jagannath Gagan (Tumbekela	Jagan
105	[illegible]	[illegible]
106	Meghanad [illegible] Tumbekela	[illegible]
107	Somu Bosh	Somu
108	[illegible]	[illegible]
109	[illegible]	
110	Manoj Majhi	[illegible]
111	Jitendra Baegar	Baegar

Public present in the Public Hearing of M/s. NLC Talabira Thermal Power Plant for establishment of 3 X 800 MW Power Plant at Kumbhari & Tareikela village in the district of Jharsuguda & Thelkoloi village in the district of Sambalpur on dtd.13.11.2019 at 11.00 AM.

Sl. No.	Name & Address	Signature
112	Agasthi Kumar Kelo Hirma	[illegible]
113	Sonu Jeedhan Gichi	
114	Ajay Kisan	Ajay Kisan
115	Kesab Jageet Tarukela	K. Jageet
116	Shashee Kanta Hirma	Shashee Kanta
117	Gourav Kumar Birla Kumbhari	Gourav Kumar Birla
118	Brajrajan Lakhikh.	[illegible]
119	Hari Ram [illegible] [illegible]	[illegible]
120	Chakrapani Rout Tareikela	[illegible]

Public present in the Public Hearing of M/s. NLC Talabira Thermal Power Plant for establishment of 3 X 800 MW Power Plant at Kumbhari & Tareikela village in the district of Jharsuguda & Thelkoloi village in the district of Sambalpur on dtd.13.11.2019 at 11.00 AM.

Sl. No.	Name & Address	Signature
121	Tukuni Kandi Kumbhari	[thumb impression]
122	Sukanti Dhurua Kumbhari	[thumb impression]
123	Rebati Beriha Kumbhari	[illegible]
124	Rambha Dila Kumbhari	Rambha Dila
125	Santa Kandi Kumbhari	[illegible]
126	Bidyadhar Bhoi Kumbhari	[illegible]
127	Gajanan Bhoi Kumbhari	[illegible]
128	Naresh [illegible] Tareikela	Naresh [illegible]
129	[illegible]	[illegible]
130	[illegible]	[illegible]
131	[illegible]	[illegible]
132	[illegible]	[thumb impression]
133	[illegible]	[illegible]

Public present in the Public Hearing of M/s. NLC Talabira Thermal Power Plant for establishment of 3 X 800 MW Power Plant at Kumbhari & Tareikela village in the district of Jharsuguda & Thelkoloi village in the district of Sambalpur on dtd.13.11.2019 at 11.00 AM.

Sl. No.	Name & Address	Signature
134	Deepak Rout, Kumbhari	Rout
135	Panchanan Kohue Kumbari	Panchanan Kohue
136	Subash Mirdha Gram Dihi	Subash Mirdha
137	[illegible]	[illegible]
138	Padmalochan Bhoi (Tareikela)	Padmalochan Bhoi
139	Umesh Naik, Kumbhari	Umesh Naik
140	[illegible]	[illegible]
141	Ravi [illegible]	[illegible]
142	[illegible]	[illegible]

Public present in the Public Hearing of M/s. NLC Talabira Thermal Power Plant for establishment of 3 X 800 MW Power Plant at Kumbhari & Tareikela village in the distnct of Jharsuguda & Thelkoloi village in the district of Sambalpur on dtd.13.11.2019 at 11.00 AM.

Sl. No.	Name & Address	Signature
143	Nilamadhab Shah, Shiva Pada, Kantapali	Nilamadhab Shah
144	Bidyadhar Bhoi, Khuntbahal	
145	Radheshyam Seth, Tareikela	
146	Radhecharan Garia, Garidehi	
147	Ushakiran, Garidehi Kisan Para	
148	Ratnakar Kisan, Garudehi Kisan Para	
149	Kailyacani Kisan, Kisan Para Garudehi	
150	Dukhi Kisan, Garudehi Kisan	
151		
152		
153		
154		
155		

Public present in the Public Hearing of M/s. NLC Talabira Thermal Power Plant for establishment of 3 X 800 MW Power Plant at Kumbhari & Tareikela village in the district of Jharsuguda & Thelkoloi village in the district of Sambalpur on dtd.13.11.2019 at 11.00 AM.

Sl. No.	Name & Address	Signature
165	Rajeev Barai, Gariadehi	राजीव बरई
166	Akash Kisan, Gariadehi Tareikela.	Akash Kisan
167	K. Jagat, Khuntbari	K. Jagat
168	Madhav Kisan, Gariadehi	Madhav Kisan
169	Purna Chandra Kisan, Tareikela	Purna Ch. Kisan

Public present in the Public Hearing of M/s. NLC Talabira Thermal Power Plant for establishment of 3 X 800 MW Power Plant at Kumbhari & Tareikela village in the district of Jharsuguda & Thelkoloi village in the district of Sambalpur on dtd.13.11.2019 at 11.00 AM.

Sl. No.	Name & Address	Signature
170	Prabhat Ekka At-Kumbhari	Prabhat Ekka
171	Minaketan Dhurua At - Kumbhari	Minaketan Dhurua
172	[illegible]	[illegible]

NLC Talabira Thermal Power Project for establishment of 3 X 800 MW Power Plant at Khumbhari and Tareikela in the district of Jharsuguda and Thelkoloi village in the District of Sambalpur (For Sambalpur District).

Time bound action plan for issues raised during the public hearing:

S.NO.	Public Hearing Queries	Response by (NLCIL)	Action plan
	Shri Surendra Sahu, Hirma		
1	He said that Jharsuguda & IB Valley are coming under the list of CEPI (Comprehensive Environment Pollution Index). As per CPCB, Jharsuguda & IB Valley area have been declared as one of the most critically polluted area in the state. As per Green Peace & Wetland International South Asia report, Jharsuguda is one of area in the state where major 802 emitting industries exists. In this report, it has been stated that water quality of Hirakud Reservoir contains high concentration of Fecal Coliform & Total Coliform as well as fluoride concentration is in dangerous level. The pollution level will be further increased if the proposed thermal power project will be established in the Kumbhari Tareikela area. As per the EIA report prepared by NLC India. IB river is located 3.8 Km. Bheden river is 0.5 Km & Hirakud Reservior is 4.3Km from the proposed project. These rivers are getting polluted due to the already existing industries located nearby. Whether the Govt has carried out any survey regarding the carrying capacity of the area at which such large project will propose to be established. If the survey has been done, then it shall be placed before the general public otherwise the power plant project should not be allowed in the area. If the	• NLCIL shall take all measures to reduce the pollution from proposed Thermal power project as per MoEF&CC guidelines. No water shall discharge in any water bodies and maintain ZLD. • As HCSD concept of ash disposal is being adopted the slurry gets hardened after disposal, and hence no pollution of river due to any possible breach is envisaged. Also as per norms the min distance of 500m is left between the river body & ash dyke. • The Nalla passing through proposed Ash Dyke shall be remodelled and diverted as per NIH Roorkee report. • Existing Ponds in the plant area are shown in the area plan drawing in EIA report. • Total Number of Project Affected Families (PAF) and Project Dispalced Families (PDF) in the Thermal power project site is already covered in the EIA report. • NLCIL will provide all infrastructural facilities at R&R colony such as Road, school, Primary health center, Post Office, Bank, Market, cremation site, community hall, Temple etc. • The unit has proposed sanitation facilities during construction	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant. • R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.

	proposed project will be established, then the nearby rivers and Hirakud reservoir water will be get polluted due to emission of C02, N02, S02 from combustion of coal in the proposed power plant. As the proposed ash pond of the project will be located near the Bheden river, in the future the same will be buried with ash. Apart from that, the forest species in the reserved forest will be diminished due to establishment of the proposed project. Ground water will be also contaminated with fluoride and other toxic element due to such proposed project. He also stated that, in addition to 1B & Bheden river, there is one Nalla namely Gadgadi Nalla flowing nearby which confluence with Bheden river, and the same has not been reflected in the EIA report prepared by NLC India Limited There are also 11 nos. of Ponds exist in the Hirma village at which the proposed project will be established and the same were also not reflected in the EIA. Some other existing units like MCL, SPS Sponge, and LN Metallics are located nearby the proposed power projects which were not mentioned in the EIA. No clear figure on rehabilitation, resettlement and employment to the displaced people due to the proposed project has been mentioned in the EIA. Approximately 12000 family of 60 nos. of villages will be affected due to this proposed project. For the sake of Society, environment and economic protection, he finally opposed the proposed thermal power project. He submitted the written representation read out by him	phase with soak pit& septic tanks/Bio Toilets to prevent contamination. During Operation Phase, STP will be installed so that the treated sewage water meet the standards prescribed by regulatory authorities for recycling. The liquid effluents from ETP will be collected and treated/ Recycled generally as per design Philosophy. • The back wash water of Pre Treatment (PT) plant will be collected and recycled back to CW system clarifier. • The sludge from clarifier of water PT plant will be collected and sent to ash slurry sump for disposal to ash dyke. • Cooling water system blowdown would be used for coal dust suppression system Ash handling plant and FGD system excess CW blowdown will pass through system for reuse. • A coal silting pond particles from coal handling plant waste & Decanted water will be pumped back to the coal dust suppression system. • An Ash Management scheme will be implemented consisting of dry collection of ash, supply of ash to Brick/ Paver Manufacturers for utilization. • NTTPP unit has already included latest technologies in respect of wastewater treatment to achieve Zero Liquid Discharge (ZLD), Flue Gas De-Sulphurisation system for Sox control, high efficiency Electrostatic precipitators for	

		fugitive dust control, selective catalyst reduction for reduction of NOx. In addition to this, dense green belt will be developed all along our project boundaries which will lead to reduction of Air Pollution. NLCIL will ensure Zero Liquid Discharge Scheme, High Efficiency Electro-Static Precipitators (ESPs) of 99.9% & Fly ash management scheme to protect Water, Air & Soil contamination respectively. • As per the latest notification of MoEF& CC, with the installation of FGD, the height of chimney to be kept as per the Standards.	
	Mr. Ananta, Parivesh Surakshya ,lanamanch, Jharsuguda		
2	**Shri. Ananta** introduced himself as a Social Activist and welcomed the public. He requested the panel to cancel the public hearing of the proposed 3x800MW thermal power project. He said that Jharsuguda & IB Valley are coming under the list of CEPI (Comprehensive Environment Pollution Index). As per CPCB, Jharsuguda & IB Valley area have been declared as one of the most critically polluted area in the state. Before completion of his speech, local villagers came to the podium and opposed his speech. They also tore his written representation and did not allow to speak further. Executive magistrate along with police personnel's controlled the local villagers to maintain peace and discipline. After few minutes public hearing continued normally with intervention of ADM by giving the opportunity to the local affected villagers to speak first & then others.	• All control measures as given in the EIA-EMP report shall be taken up and implemented fully for control of pollution. • Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF.	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant.

	Shri. Rudra Bariha, Luhurenkachhar		
3	He welcomed the panel and put his views that, if the plant comes, NLC company will acquire complete land of Luhrenkachhar, Tariekela and Kumbhari right up to the bank of river which is left out. He also expressed that; if their demands will not be fulfilled then they will face a lot of problems, both economically and environmentally.	• Land rates finalized by the District collector as per the Right to Fair compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (RFCTLARR) Act. 2013 will be paid by NLCIL. • R&R benefits as finalized by the Rehabilitation and periphery development Advisory committee (RPDAC) will be extended to PAPs by NLCIL.	• R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy. • Approach road for villagers along with construction of boundary wall shall be made 6 months before operation of the plant outside the plant boundary for use of the villagers.
	Shri Bharat Koudi, Kumbhari		
4	He welcomed the panel along with the public and stressed upon the effective measures to be taken by the company to control the air and water pollution caused by the flyash generated from the proposed project. He has further stated that if the company wants to acquire land for industrialization they may take all the land instead of leaving 500 meters from river bank as these land will become useless for them due to pollution & distance of their new habitation.	• All control measures as given in the EIA-EMP report shall be taken up and implemented fully for control of pollution. • Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF.	• Approach road for villagers along with construction of boundary wall shall be made 6 months before operation of the plant outside the plant boundary for use of the villagers.
	Shri Rabindra Rohidas, Tareikela		
5	He told that, since many industries like Vedanta, Bhushan & SMC have already been developed in the nearby area of the proposed site, he is not denying to establish another thermal plant in their village area. But he suggested that the affected people must be provided with the best land Rate, Rehabilitation & Resettlement (R&R) benefits and also to acquire the complete land up to the	• Land rates finalized by the District collector as per the Right to Fair compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (RFCTLARR) Act. 2013 will be paid by NLCIL. • R&R benefits as finalized by the Rehabilitation and periphery development Advisory committee (RPDAC) will be extended to PAPs by NLCIL.	• R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.

	bank of the river at both sides outside of the plant area.		
	Shri Gorang Jagat, Tareikela		
6	He said that, if the proposed project will come up the nearby river and land will be affected. The river will not be fit for potable use for human consumption. Since many factories already exist all around their village area and there is pollution all around, if another company will be set up there will be no tangible change so it may be done. Govt. should take initiative to take necessary steps to protect the environment from pollution. Also the villagers who will be displaced due to the project should be resettled within the same panchayat area with proper R&R package.	• Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF. • NLCIL will ensure Zero Liquid Discharge Scheme & Fly ash management scheme using HCSD scheme to protect land, water & air contamination. • R&R benefits as finalized by the Rehabilitation and Periphery Development Advisory Committee (RPDAC) will be extended to PAPs by NLCIL. • NLCIL will provide all infrastructural facilities at R&R colony such as Road, school, Primary health center, Post Office, Bank, Market, cremation site, community hall, Temple etc. • The location of R&R is under discussion with State Govt. and care should be taken for PAP colony is in same panchayat subject to the approval & allotment from the Government.	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant. • R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.
	Shri Pitambar Kisan, Gariadihi		
7	He stated that, he does not have any problem with the upcoming project but the left out area (500 meter) from the river bank sides should be acquired fully.	• All control measures as given in the EIA-EMP report shall be taken up and implemented fully for control of pollution. • Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF.	• Approach road for villagers along with construction of boundary wall shall be made 6 months before operation of the plant outside the plant boundary for use of the villagers.
	Shri Sriram Garia, Tareikela		

8	He expressed that, no doubt 100 percent pollution exists in this area. If the coming factory will be established the administration should take appropriate measures to protect the environment from pollution. Besides the displaced families should be resettled by providing proper and better environment.	• Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF. • NLCIL will ensure Zero Liquid Discharge Scheme & Fly ash management scheme using HCSD scheme to protect land, water & air contamination. • R&R benefits as finalized by the Rehabilitation and Periphery Development Advisory Committee (RPDAC) will be extended to PAPs by NLCIL. • NLCIL will provide all infrastructural facilities at R&R colony such as Road, school, Primary health center, Post Office, Bank, Market, cremation site, community hall, Temple etc. • The location of R&R is under discussion with State Govt. and care should be taken for PAP colony is in same panchayat subject to the approval & allotment from the Government.	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant. • R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.
	Shri Madhusudan Kisan, Tareikela		
9	He suggested that, whether factory will be established or not, pollution will bound to happen in view of existing factories. Rather, it is better if the factory comes in the area. He welcomed the proposed thermal power project as they will get displaced to a better environment. But in lieu of that, they should provide better land compensation, employment, Rehabilitation & Resettlement and other benefits and facilities like school, colleges and temples	• Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF. • NLCIL will ensure Zero Liquid Discharge Scheme & Fly ash management scheme using HCSD scheme to protect land, water & air contamination. • R&R benefits as finalized by the Rehabilitation and Periphery Development Advisory	• R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.

		Committee (RPDAC) will be extended to PAPs by NLCIL. • NLCIL will provide all infrastructural facilities at R&R colony such as Road, school, Primary health center, Post Office, Bank, Market, cremation site, community hall, Temple etc. • The location of R&R is under discussion with State Govt. and care should be taken for PAP colony is in same panchayat subject to the approval & allotment from the Government.	
	Shri Gorang Kisan, Gariadihi		
10	He urged the media personnel to place the issues regarding pollution in their area before the district administration. He also expressed that, if the person gets displaced, what will be the livelihood for their survival. He demanded that, company as well as administration should consider to provide proper infrastructure like road, school, R&R benefits, and jobs and also free electricity to the affected villagers. People are unable to cultivate there land due to pollution. Hence these should be examined and proper decision to be taken in this matter. Give us five resettlement villages with the nomenclature of our existing five villages with all facilities.	• As far as possible, the area for Rehabilitation & Resettlement (R&R) establishment shall be within the same Panchayat. Presently area for R&R establishment has been identified in the same Panchayat, Hirma and application for same has already been submitted to District Officials. The Location shall be finalized as per the land allotment by state Government.	• R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.
	Dilip kumar Badhai, Hirima, Ex-Sarpanch.		
11	He pointed out that the name of the project " Talabira Thermal power Plant " should be changed first and the same should be named after their Panchayat (Hirma). The company should establish their office in Hirma Panchayat. Agreement should be made with the	• NLCIL will provide all infrastructural facilities at R&R colony such as Road, school, Primary health center, Post Office, Bank, Market, cremation site, community hall, Temple etc.	• R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.

	displaced villagers that everyone along with their generations should get the employment. The people affected by pollution due to the proposed project will be given first priority in employment, contract jobs and other facilities. Appropriate steps must be taken for free movement of persons near upcoming infrastructural development of the company.	• As far as possible, the area for Rehabilitation & Resettlement (R&R) establishment shall be within the same Panchayat. Presently area for R&R establishment has been identified in the same Panchayat, Hirma and application for same has already been submitted to District Officials. The name of Project is "NLC Talabira Thermal Power Project" and submitted to other Government Departments earlier and approvals already obtained. Currently, NLCIL is providing temorary employment through contract agencies with minimum wages protection and about 50% of the vacancies arising in various contract works are alotted to Project Affected Persons (PAPs) based on qualifications. In addition to that, monetary assitance will also be provided in leiu of Employment, as per the R&R policy/act announced by the appropriate state Government. • Approach road for villagers along with construction of boundary wall shall be made 6 months before operation of the plant outside the plant boundary for use of the villagers.	
	Japamali Bhainsa, Tumbekela		
12	He welcomed the panel along with the public. He expressed that, he used to drink and take bath in clean river water, but now it has been polluted. He cannot go his 15 acre river bank land as ash is disposed in the surroundings. Though his land is not getting acquired still then he will be most affected by pollution	• It is hereby informed that 100% fly ash will be utilized as per MoEF& CC fly ash notification. • The name of Project "NLC Talabira Thermal Power Project" and submitted to other Government Departments earlier and approvals already obtained.	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant.

	caused by the project. He also agreed with the earlier views of Dilip Badhai, regarding the name of the project to be in the name of one of the displaced villages.	• Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF. • Approach road for villagers along with construction of boundary wall shall be made 6 months before operation of the plant outside the plant boundary for use of the villagers.	
	Khirod Marai, Kumbhari		
13	He stated that if the land will be acquired by the company, then company should take all land without leaving any land	• Taking over of additional land between the Bedhan river and the presently identified Land in the plant layout will be decided as per discussions in the RPDAC meeting.	• Approach road for villagers along with construction of boundary wall shall be made 6 months before operation of the plant outside the plant boundary for use of the villagers.
	Giridhari Kanta, Ex Sarpanch Hirma		
14	He welcomed the panel along with the public. He said that, company should provide proper compensation for land displaced person due to the proposed thermal power project. The project authority should also provide houses as it is for the land affected people. Adequate measures must be taken to avoid pollution of the existing water bodies of the villages.	• Pl Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF. • NLCIL will ensure Zero Liquid Discharge Scheme & Fly ash management scheme using HCSD scheme to protect land, water & air contamination. • R&R benefits as finalized by the Rehabilitation and Periphery Development Advisory Committee (RPDAC) will be extended to PAPs by NLCIL. • NLCIL will provide all infrastructural facilities at R&R colony such as Road, school, Primary health center, Post Office,	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant. • R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.

		Bank, Market, cremation site, community hall, Temple etc. • The location of R&R is under discussion with State Govt. and care should be taken for PAP colony is in same panchayat subject to the approval & allotment from the Government.	
	Rambha Dhila, Kumbhari		
15	She introduced herself as a Social Activist and welcomed the public. School arrangement be made for the education for the children of displaced families. Proper resettlement and jobs should be provided to Project Affected Families (PAF's). Proper steps should be taken to protect environment from pollution.	• As per EIA report itself, CER fund of Rs. 3 Crores (Approx.) will be utilized towards Education & skill development. • Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF.	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant.
	Lal Bihari Seth, Tumbekela		
16	He stated that, employment should be given to the affected people. Open agreement should be done to provide employment, house and road. Project proponent should acquire the entire land of 500m left along the river bank. But the plant should come and he supported the project subject to fulfillment of above conditions.	• Currently, NLCIL is providing temporary employment through contract agencies with minimum wages protection and about 50% of the vacancies arising in various contract works are allotted to Project Affected Persons (PAPs) based on qualifications. As HCSD concept of ash disposal is being adopted the slurry gets hardened after disposal, and hence no pollution of river due to any possible breach is envisaged. Also as per norms the min distance of 500m is left between the river body & ash dyke.	• R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.
	Jitendra Bhainsa, Tumbekela		
17	He welcomed the proposed project. He suggested that, company should construct Goshala at appropriate place to prevent road accident due to cattles.	• Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF.	• It will be implemented in appropriate stage during construction phase 6 months prior to

	He also added that, employment should be given to land affected persons with special priority for ladies. The existing local ponds should be renovated by the project authority. Health Camp should be organized for land affected people in the area. Project proponent should provide proper land compensation, service to the PAF's and PDF's and acquire the entire land of 500m left along the river bank. Adequate measures shall be taken to protect the environment from pollution.	• Medical facilities and other infrastructural facilities will be created and fund of Rs.5 Crores (Approx.) for the same has been allocated under CER Programme. Health Camp will be organized by NLCIL. Mobile medical van already in operation in the affected villages. NLCIL will provide all infrastructural facilities at R&R colony such as Road, school, Primary health center, Post Office, Bank, Market, cremation site, community hall, Temple etc.	commissioning of the plant. • R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.
	Shankar Prasad Birtia, Kumbhari		
18	He expressed that, entire land should be taken up by the Company and they along with the administration should write to the villagers regarding the facilities provided by the project. If one inch of land is left out then they will debar the project and if entire land will be taken then they will welcome the project. Houses and jobs should be provided to the all affected people who are more than 18 yrs of age and education facility should be provided.	• As per EIA report itself, CER fund of Rs. 3 Crores (Approx.) will be utilized towards Education & skill development. • Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF. Currently, NLCIL is providing temporary employment through contract agencies with minimum wages protection and about 50% of the vacancies arising in various contract works are allotted to Project Affected Persons (PAPs) based on qualifications. As HCSD concept of ash disposal is being adopted the slurry gets hardened after disposal, and hence no pollution of river due to any possible breach is envisaged. Also as per norms the min distance of 500m is left between the river body & ash dyke.	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant. • R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.
	Budharam Garia, Kumbhari		

19	He said that, If factory comes then they will lose their homestead land and they will start begging. He opposed the proposed project.	• Pl refer response as per Sr. No. 15 above	• R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.
	Parsuram Puta, Tumbekela		
20	He told that, the area is already polluted; hence the project authority should take necessary measures to control the pollution.	• Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF.	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant.
	Ranjan Kumar Bhainsa, Kantatikera		
21	He welcomed the public and said that, all the elders have already told about pollution matter and he has nothing to say about this. He also added that the project authority should give priority for employment to the local people basing on their qualification.	• NLCIL will support/ Provide skill development programmes for PAPs to enhance expertise on priority areas. As per EIA report itself, CER fund of Rs. 3 Crores (Approx.) will be utilized towards Education & skill development. • Currently, NLCIL is providing temporary employment through contract agencies with minimum wages protection and about 50% of the vacancies arising in various contract works are allotted to Project Affected Persons (PAPs) based on qualifications.	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant.
	Santanu Panigrahi, Tareikela		
22	He strongly opposed the establishment of proposed project on the ground that due to the industries like Vedanta, Bhushan etc the water of the river has been polluted and the people of the area are drinking polluted water also people eating fish from the polluted water of river and their getting affected by certain diseases. The existing nearby industries like Vedanta& Bhushan are discharging SO_2, NO_x and other chemicals to the atmosphere, if further	• NTTPP unit has already included latest technologies in respect of wastewater treatment to achieve Zero Liquid Discharge (ZLD), Flue Gas De-Sulphurisation system for Sox control, high efficiency Electrostatic precipitators for fugitive dust control, selective catalyst reduction for reduction of NOx. • In addition to this, dense green belt will be developed all along	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant.

	new plant comes then environment will be severely deteriorated. People maintaining their livelihood and depending on forest produce will be largely affected. Soil conservation will be affected.	our project boundaries which will lead to reduction of Air Pollution. NLCIL will ensure Zero Liquid Discharge Scheme, High Efficiency Electro-Static Precipitators (ESPs) of 99.9% & Fly ash management scheme to protect Water, Air & Soil contamination respectively. • Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF.	
	Vishnu Panigrahi, Tareikela		
23	We have no knowledge about the environment. By establishing new project in this area the environment of this area will be affected badly. We should protect our villages from pollution leaving behind any politics.	• NTTPP unit has already included latest technologies in respect of wastewater treatment to achieve Zero Liquid Discharge (ZLD), Flue Gas De-Sulphurisation system for Sox control, high efficiency Electrostatic precipitators for fugitive dust control, selective catalyst reduction for reduction of NOx.	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant.
	Madhav Prasad, Tareikela		
24	Involvement of any agents should be avoided and each and every one shall be treated equally. Preventive measures shall be taken for the health care of both humans and cattle's.	• As per EIA report itself, CER fund of Rs. 7.5 Crores (Approx) will be Utilized towards Health & Sanitation. Air & water pollution control measures shall be as detailed in the EIA report shall be provided to meet latest environmental norms by MOEF. • Pl refer response as per Sr. No. 01 above	• It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant. • R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.
	Sudhakar Sah, Hirma		
25	Due to establishment of SMC, Vedanta, Bhushan the environment of this area has already been largely affected. No steps were taken by the administration	• NTTPP unit has already included latest technologies in respect of wastewater treatment to achieve Zero Liquid Discharge (ZLD), Flue	

	to protect the environmental issues therefore we the people of Sirpura, Badmal and Hirma panchayat should be united to stand for protection of the environment of this area. Sudhakar Sah being the last speaker, Presiding Officer once again requested if anybody other than the above speakers if interested and Mr. Anant who could not complete his speech to come forward & submit their presentation. But no more person have come forward for giving presentation even after repeated the call.	Gas De-Sulphurisation system for Sox control, high efficiency Electrostatic precipitators for fugitive dust control, selective catalyst reduction for reduction of NOx.	

Reply to proceedings of the Public Consultation held on 13.11.2019 at 11.00 AM village Tarkeikela, in front of Gariadihi up school near Hirma village of Jharsuguda District, Odisha for M/s. NLC Talabira Thermal Power Project for establishment of 3 X 800 MW Power Plant at Khumbhari and Tareikela in the district of Jharsuguda and Thelkoloi village in the district of Sambalpur (For Sambalpur District).

Time bound action plan for issues raised during the public hearing:

S. No.	Questions by the Participants	Response by (NLCIL)	Time Bound Action Plan
	Sri Subrakanta Samal Lapanga		
1.	He welcome the project .He demanded the company to take all possible pollution control measure before operation of the plant.	• Proposed project is based on supercritical technology meeting all the environmental norms. • NTTPP unit has already included latest technologies in respect of wastewater treatment to achieve Zero Liquid Discharge (ZLD), Flue Gas De-Sulphurisation system for Sox control, high efficiency Electrostatic precipitators for fugitive dust control, selective catalyst reduction for reduction of NOx.	It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant. R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.
	Sri Santosh Kumar Nath (Ex Serviceman) Thelkoloi		
2.	He claimed that he was saying on half of Villagers of Thelkoloi village and the villages are against the project. He further stated that they are opposing this project and are not going to allow NLC India Limited to establish the ash pond. He further stated that they are opposing this project and are not going to allow NLC India Limited to establish the ash pond.	• Proposed project is based on supercritical tech meeting all the environmental norms. • As HCSD concept of ash disposal is being adopted the slurry gets hardened after disposal, and hence no pollution of river due to any possible breach is envisaged. Also as per norms the min distance of 500m is left between the river body & ash dyke. The ash pond area has been realigned such that village remains outside the boundary.	It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant.
	Sri Laxmikanta Seth , Khinda		

3.	He welcome the project and stated they are living near the proposed project of ash pond adequate pollution control measure should be taken.	• Proposed project is based on supercritical tech meeting all the environmental norms. • NTTPP will be established with clean Technology leading to prevention and control of pollution. • NTTPP unit has already included latest technologies in respect of wastewater treatment to achieve Zero Liquid Discharge (ZLD), Flue Gas De-Sulphurisation system for Sox control, high efficiency Electrostatic precipitators for fugitive dust control, selective catalyst reduction for reduction of NOx.	It will be implemented in appropriate stage during construction phase 6 months prior to commissioning of the plant. R&R benefits will be done as per RPDAC guidelines and will be completed immediately after approval of policy.
4	**Sri Sanjib Pradhan**		
	He Welcomed the project	• Proposed project is based on supercritical tech meeting all the environmental norms. • NTTPP will be established with clean Technology leading to prevention and control of pollution.	

ANNEXURE XIV

MARKETING OF FLYASH

Confidential

Report On

MARKET SURVEY OF ASH UTILIZATION & MARKETING OF FLY ASH

For

Neyveli Lignite Corporation India Limited, Talabira

SAMBALPUR, ODISHA - 768212

Submitted by

National Productivity Council
(Under Ministry of Commerce & Industry, Govt. Of India)
A/7, Surya Nagar, Bhubaneswar – 751003, Odisha
Ph-0674-2397381/26
npcbbs@bsnl.in

ACKNOWLEDGEMENT

We wish to place on record our sincere thanks to the management of M/s Neyveli Lignite Corporation India Limited, Talabira, sambalpur, Odisha for giving us the opportunity to conduct a study on "Market Survey of Ash Utilization & Marketing of Fly Ash" of NLCIL, Talabira Super Thermal Power Plant (3x800MW). We sincerely thank Shri. K. Ganesan, Chief General Manager, for having entrusted the study to us. We also place on records our special thanks to Sh. Vijayakumar, Deputy General Manager (Project & Business Devlopment).

We are grateful to Sh. Mahendra Kumar, Deputy General Manager (Project & Business Devlopment) for providing us the valuable coordination during the study and ensuring that the study is carried out as per the schedule.

We acknowledge the valuable time & effort spared and the timely provision of the information & data by all the Officers and Staff of the plant during the study.

We also credit all the employees for their cooperation to the NPC team during the study.

Bhubaneswar

G. Saravanan
Regional Director

Table of Contents

1. EXECUTIVE SUMMARY:

NLCIL Talabira Super Thermal Power Project (3 x 800 MW) is located at Kumbhari & Tareikela village of Jharsugada District and Thelkolai village of Sambalpur District, Odisha. It is estimated that about 5 MTPA ash would be produced in the power generation process.

This study on Fly Ash Utilization for NLCIL , Talabira was carried out by National Productivity Council, Bhubaneswar. This study was carried to idebtife the potential for 100% percent ash utilization in next 5 years according to guidelines of MoEF & CPCB.

The Fly ash consumption potential was determined by the following process

- Scope of the work limited to vicinity district of Jharsuguda district including Jhashpur, Raiagrah district of neighboring state Chattisgarh.
- The survey report base on the collection of the data related to Fly Ash from primary source and secondary source.
- Analysis starts with Discussions with conducted with the NLCIL incumbents.
- Consumption potential was determined based on one or combination of the factors like consumption in cement industry, brick industry, and in mine void filling and reclamation of the low line area etc.
- Collection of the data regarding the cement unit, fly ash bricks, void mine, ongoing and purpose government infrastructure from the entire agency involved in all the activities, for the specified level of organization.
- NPC consultants conducted detailed visit in respective state, central agencies and wherever applicable.

These are the below sector wise details with maximum fly ash potential:

Si. No		Amount Of Fly Ash Consumption in MT Below 100KM	Amount Of Fly Ash Consumption in MT between 100KM to 300KM	Amount Of Fly Ash Consumption in MT Beyond 300KM	Amount Of Fly Ash Consumption in MT
1	Ash Utilization in Cement Industry	1320000	5180000	3550000	10050000
2	Ash Utilization in				

	Construction sector				
a.	Orissa	33416462.5		848949884	882366347
b.	Chhattisgarh	350380			350380
3	Aerated Autoclaved Concrete (AAC)		150000	4900000	5050000
4	Abandoned/Void Coal Mines		6974646		6974646
5	Road Project in Odisha		11073458	4018609	15092067
6	Ash Utilization in Hydro project		129166		129166
7	Advanced Product			175000	175000
8	Low Lying Area	59000			59000
Cumulative Amount					**920228606**

ANNEXURE XV

LULC OF

NLCIL

LULC

1.1 Objective

The objective of the study is to prepare FAE report for the EIA report based on the following guidelines provided by MoEF&CC:

- Present status of land component of the environment including Standard ToR points for the project within the study area covering 25 km radial distance around the project site for conventional chemical pollutants.
- Identification of forest land, agricultural land, waste land, water bodies etc. in the area of interest.
- Identification, quantification, prediction and evaluation of significant impacts from the proposed project during construction and operation phases.
- Preparation of an Environmental Management Plan (EMP) to be adopted for mitigation of anticipated adverse impacts, if any.

1.2 Methodology

The various steps involved in Environmental Impact Assessment study of the proposed production enhancement plant are divided into the following phases:

- Identification of significant environmental parameters and to study the existing status within the impact zone with respect to land use component of the environment.
- Study of various activities of the proposed project and to identify the area's leading to impact/change in environmental quality.
- Identification/Prediction of impacts for the identified activities and to study levels of impact on various environmental components.
- Evaluation of impacts after superimposing the predicted impacts over the baseline quality.
- Formulation of Environmental Management Plan for implementation in the proposed project.

The scope of study includes a detailed characterization of baseline environment in an area of 25 km radius with the plant site as the center for Land Environmental. For the present study the plant site is considered as core zone and the area lying within 25 km radius from the plant site is considered as buffer zone. The details of methodology work plan

in the 25 km study area under individual components of environment are as follows:

1.2.1 Land Environment

- Study the land for proposed project activities and land use breakup
- Topography, land use, vegetation in the study area

Land use Pattern-Remote Sensing data

The basic purpose of land use pattern and classification in an EIA study is to identify the manner in which different parts of land area is utilized or not utilized. Remote sensing data provides reliable accurate baseline information for land use mapping as it is a rapid method of acquiring up-to-date information of over a large geological area.

Studies on land use aspects of eco-system play an imperative role in identifying susceptible issues and to take appropriate action to uphold ecological equilibrium in the region. The main objective of this section is to provide a baseline status of the study area covering 10 km radius around the proposed plant site so that temporal changes due to the industrial activities on the surroundings can be assessed in future.

The objectives of Land use Pattern are to:

- Determine the present Land use pattern
- Analyze the impacts on Land use due to the proposed plant site in the study area
- Study area with proposed unit as epicenter 10 km radius from the core area of 5.45 Ha boundaries is considered for land use study.

Satellite Data: The Satellite IRS P-6 LISSIV images are obtained from National Remote Sensing Centre (NRSC) Hyderabad.

Methodology: The overall methodology **(Fig.1.1)** adopted and followed to achieve the objectives of the present study involves the following:

- Collection of source data of Survey of India (SOI) toposheets. These are the main inputs for the preparation of essential layers
- Satellite data of IRS P-6 LISSIV sensor is geometrically corrected and enhanced using principal component method and nearest neighborhood resampling technique
- Preparation of basic themes like layout map, transport & settlement map and contour map from the source data. Then updating of layout map, transport map and drainage map from the satellite image by visual interpretation

- Essential maps (related to natural resources) like Land use / Land cover map are prepared by visual interpretation of the satellite imagery. Visual interpretation is carried out based on the image characteristics like tone, size, shape, pattern, texture, location, association, background etc. in conjunction with existing maps/ literature
- Preliminary quality check and necessary corrections are carried out for all the maps prepared
- All the maps prepared are converted into soft copy by digitization of contours and drainages. In that process editing, labeling, mosaicking, quality checking, data integration etc. are done, finally Land use areas are measured in Sq.km.

3.4.5 Land use Map Analysis

Land use Map Analysis carried out based on the image color, texture, Tone etc. Following steps are used to analyze the Land use pattern of project site:

- Collection of scanned toposheet and Geo-reference the scanned image using the available coordinates
- Collection of IRS LISS IV images and made fused and blended the images for color combinations using Image interpreter-Utilities and Layer stack option available in ERDAS
- Identification Area of interest (AOI) and made a buffer of 10 km radius.
- Enhance the Fused and blended LISS IV image using the Spatial, Radiometric and Temporal options in ERDAS
- Rectified the LISS IV image using Geo-referencing technique, Toposheet to get UTM coordinate system
- Subset the LISS images and Toposheet using 10 km buffer AOI
- Automatic classifications done for LISS IV images using maximum iterations and number of options in unsupervised classification options
- Created the signature file by selecting the more samples of different features with AOI on Unsupervised classification image
- Visual interpretation and supervised classification mixed with recoding practice
- Verified through the QC / QA and finalized the data.

3.4.5.1 Spatial Data from SOI Topographical Sheets

Creating a GIS spatial database is a complex operation, and is the heart of the entire work; it involves data capture, verification and structuring processes. Raw

geographical data are available in many different analogue and digital form such as toposheets, aerial photographs, satellite imageries and tables. Out of all these sources, the source of toposheets is of much concern to natural resource scientist and an environmentalist.

In the present study, the essential maps generated from SOI topographical maps. Using the topographical maps, the drainage map and contour Map were also developed. The maps are prepared to a certain scale and with attributes complying with the requirement of terms of reference (ToR). The location of entities on the earth's surface is then specified by means of an agreed co-ordinate system. For most GIS, the common frame of co-ordinate system used for the study is UTM co-ordinates system. All the maps are first Geo-referenced. The same procedure is also applied on remote sensing data before it is used to prepare the Essential maps.

Map showing site location, canals, Lakes, drains are connected .There is a road network connecting built-up areas and industries. As the terrain conditions are red and brown in color with Sand stone texture and flat terrain and also there is a drainage network around the site location, there is no chance of flooding. Hence risk factors are less. No National parks and wild life sanctuaries located in the study area. **There are reserved forests within 25km.**

3.4.5.2 Contour Map and Elevations of Study Area

The contours in Toposheet have been digitized in the GIS environment and assigned the respective elevation values in meters with reference to the mean sea level. Using the SRTM (Shuttle Radar Topography Mission) data, the elevation values has been verified. Thereafter final contour map has been prepared with combination of Toposheet and SRTM with contour interval of 10 m. Project site contours vary from 200 m to 210 m above MSL and the study area contours vary from 170 m to 390 m above MSL. From the project site the high range hill area were observed towards North West direction and the lowest contours were observed in South direction. While the remaining areas showed variations with respect to contours. Contour Map and Elevations of Study Area is presented in **Fig 1.3.**

3.4.5.3 Topography (Digital Elevation Model)

A digital elevation model (DEM) is a digital representation of ground surface topography or terrain **(Fig.1.4).** It is also widely known as a digital terrain model (DTM). A DEM can be represented as a raster (a grid of squares, also known as a height map when representing elevation) or as a triangular irregular network. The proposed plant location is shown in that Relief map. For the relief study of the area very higher quality SRTM (Shuttle

Radar Topography Mission) and DEM is downloaded. These DEMs of the Terra represents elevation at a 30 m resolution.

3.4.5.4 Land use land cover statistics of buffer zone

The area is mostly covered with Agricultural crop land around 47 % respectively of the total area. Which is taken up for cultivation but is temporarily allowed to rest, un-cropped for one or more season, but not less than one year. Thus, total cultivable land is 47 %.The Airport area is with 1 %, Other class is Roads within the study area 8%, Around the Agricultural crop edges the Settlement (Built-up area) is located and occupies around 5%, and Industry area are around 3% of the total study area. It is an area of human habitation developed due to non-agricultural use and that has a cover of buildings, transport and communication, utilities in association with water, vegetation and vacant lands. The proposed expansion project is on the adjacent of Industry / Built-up land and does not have any significant impact on the surrounding villages and habitation. The water bodies cover 14% of the total area. The water bodies cover Bhedar River, Hirakhund Reservoir, etc... Forest area is 10% and these area have a very prominent signature and can be seen as almost Dark blue and light blue in the satellite image. The statistical break-up of the land use classes of buffer zone are presented in **Table 1.1** and depicted in **Fig. 1.5.**

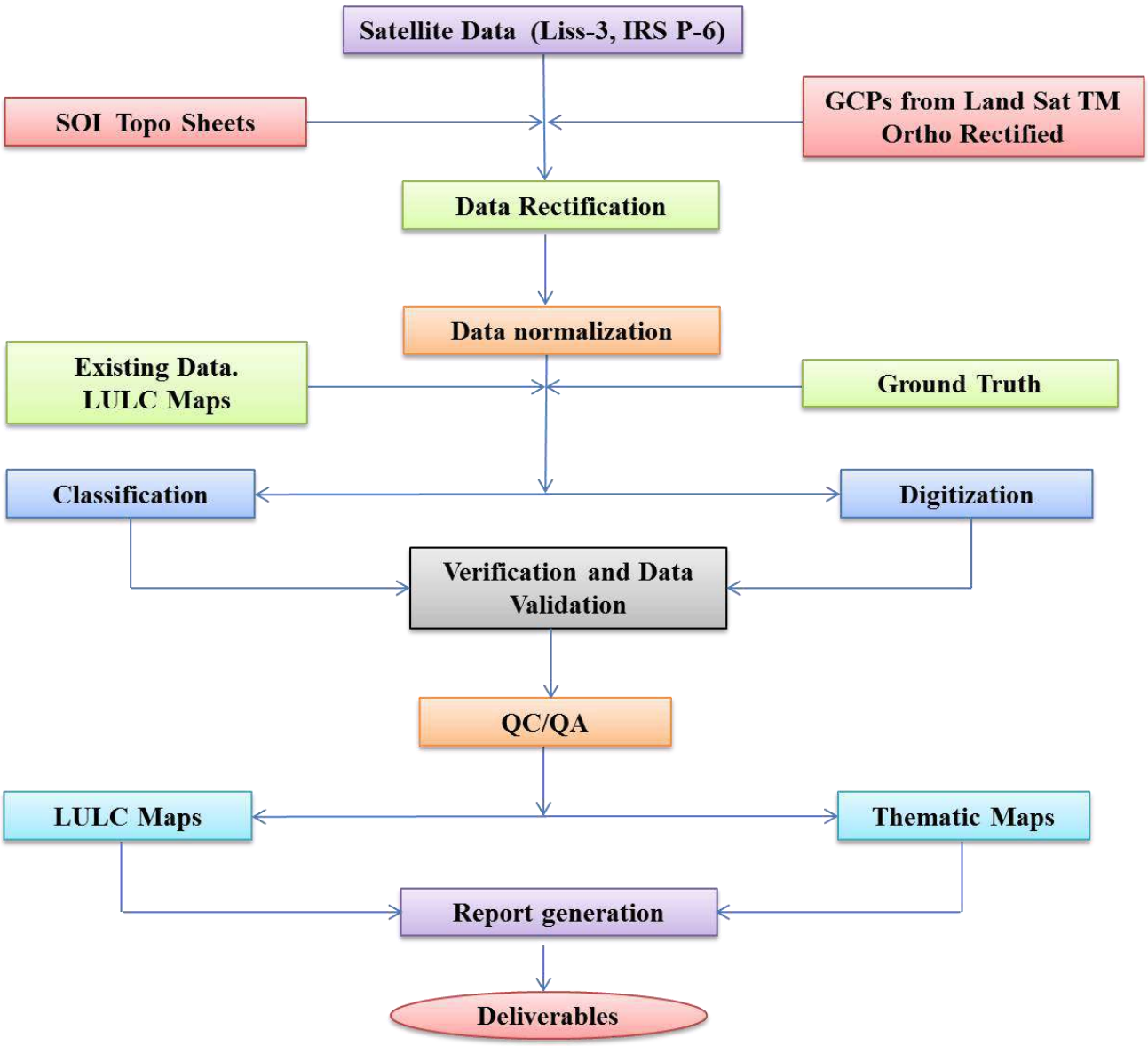


Fig. 1.1: Flow Chart of Methodology

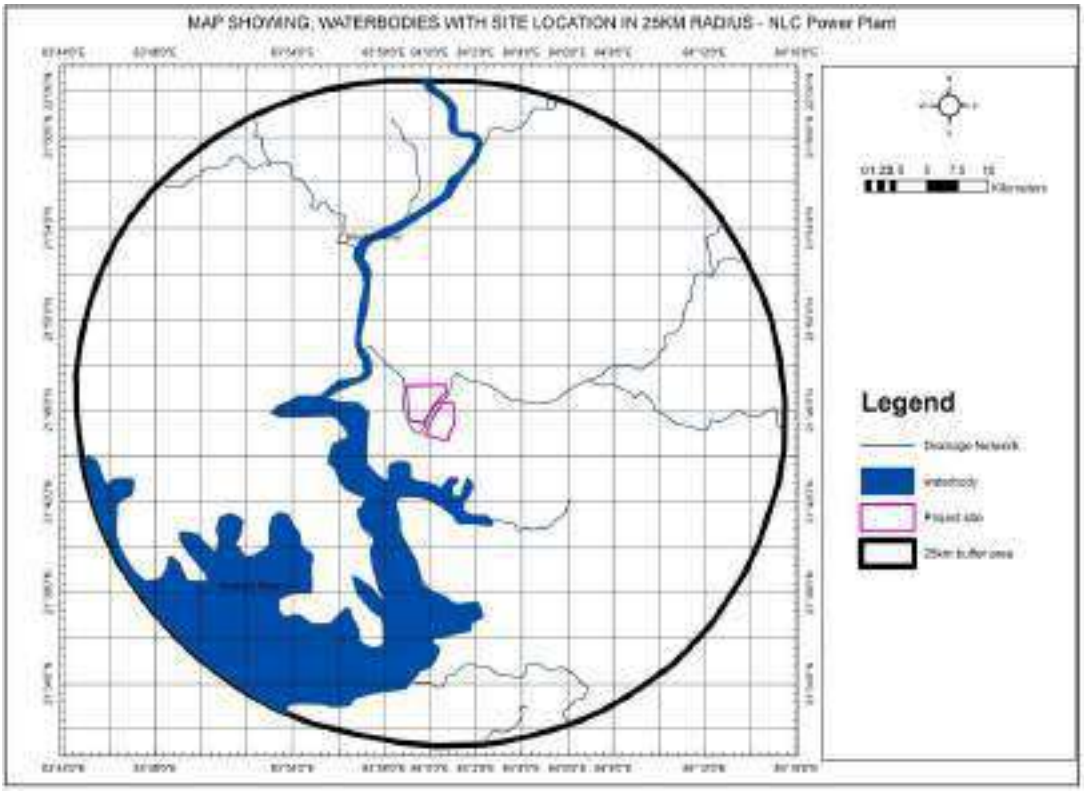


Fig. 1.2: Map Showing Water bodies, Drainage in Study Area

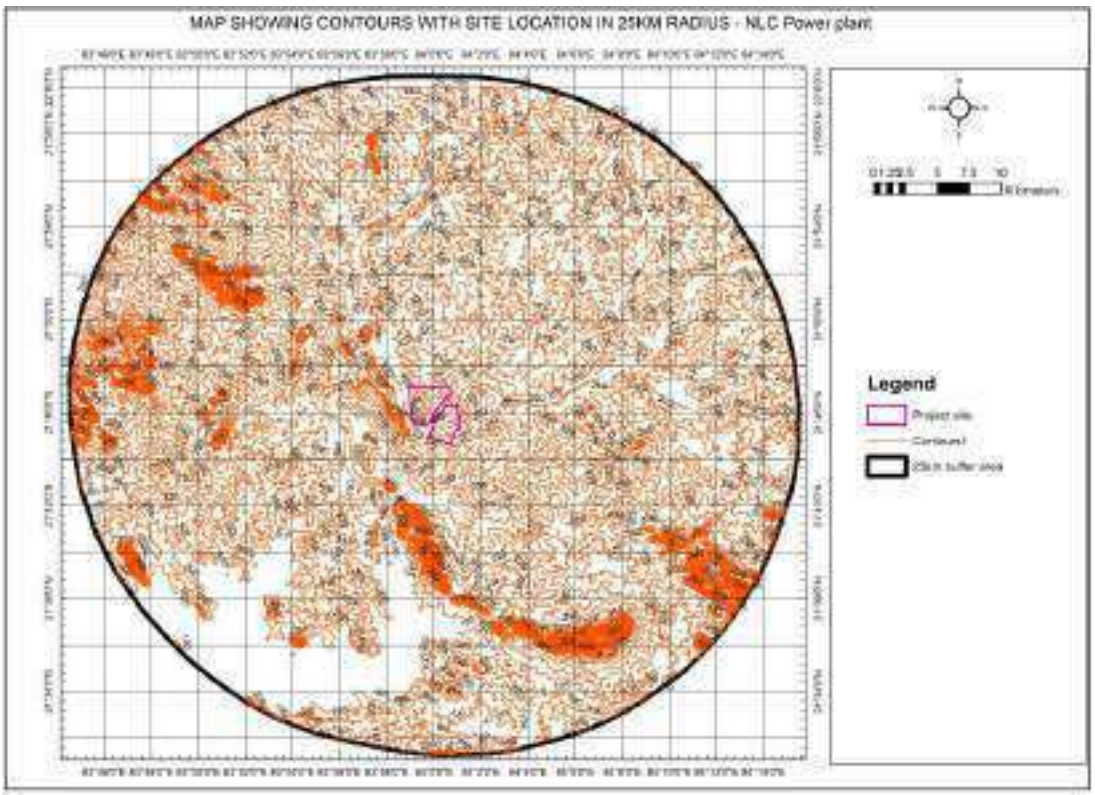


Fig. 1.3 Map Showing Contours with Site Location in Study Area

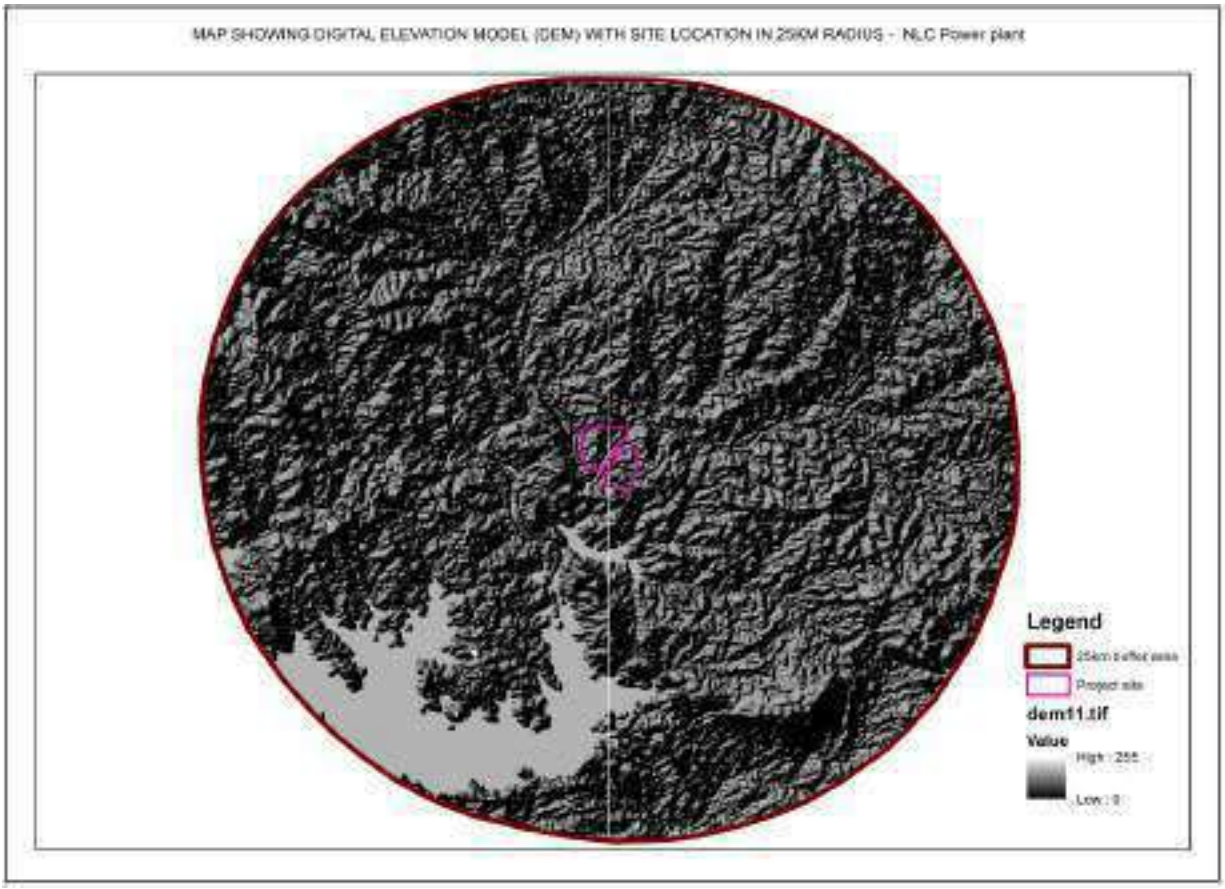


Fig. 1.4: Map Showing Digital Elevation Model in Study Area

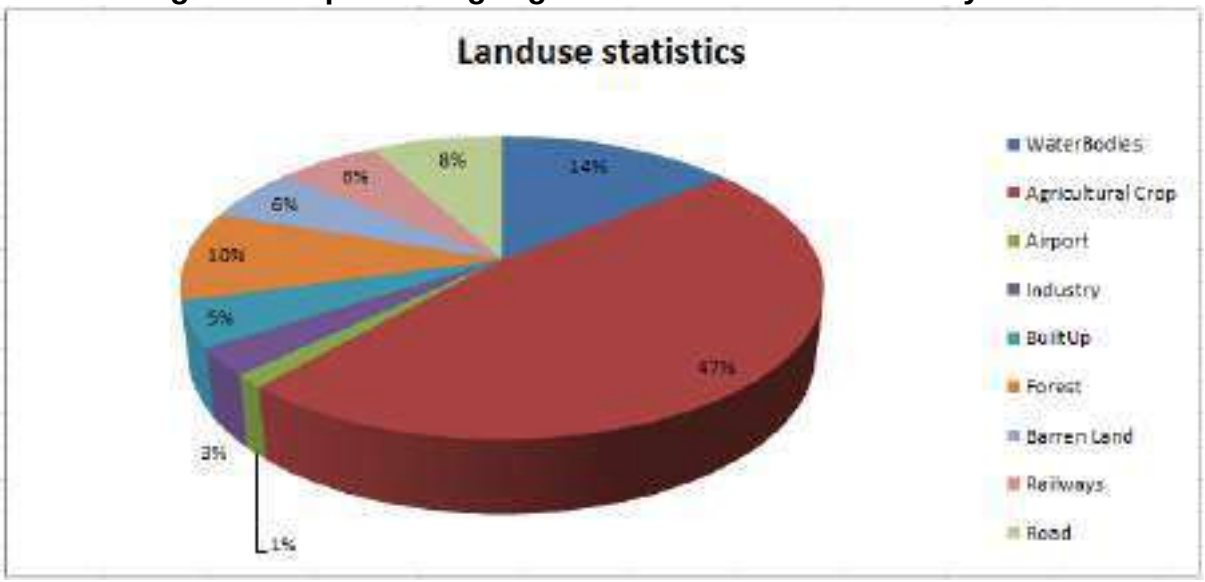


Fig. 1.5: Graphical Presentation of Land Use Statistics

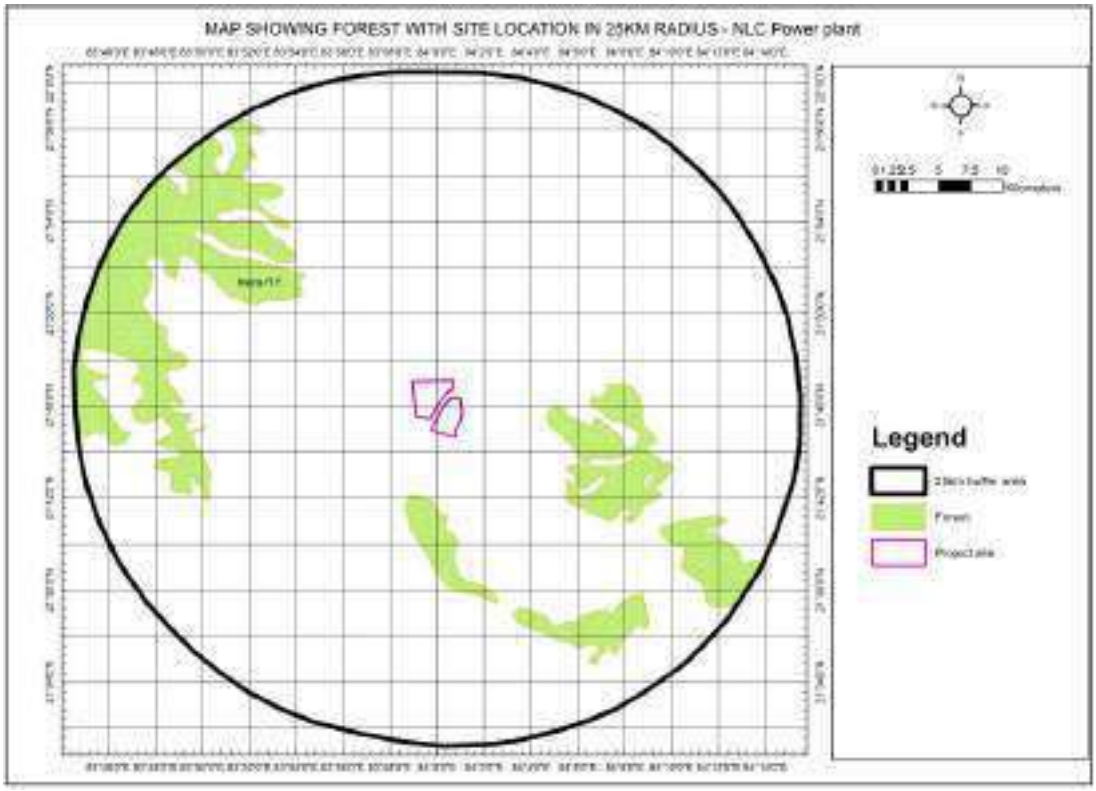


Fig. 1.4 Map Showing Reserve Forest with Site Location in Study Area

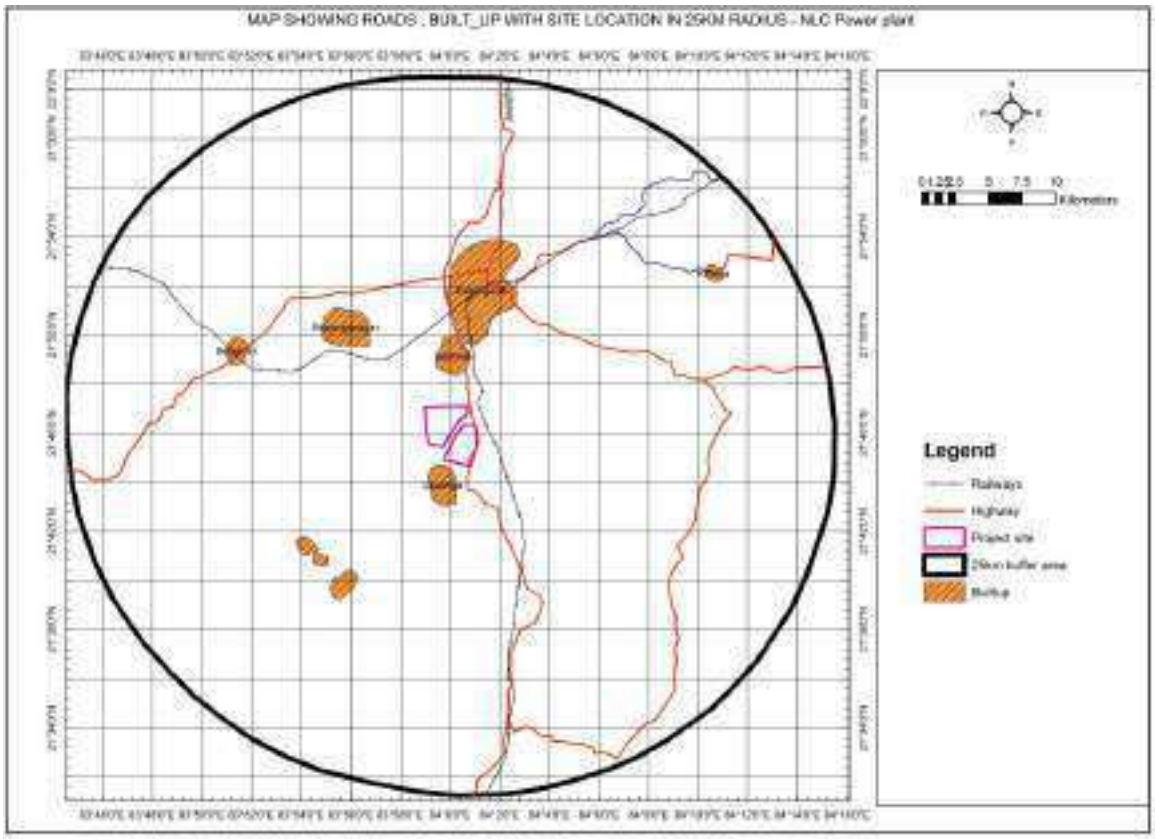


Fig. 1.4 Map Showing roads & built up area with Site Location in Study Area

Table 1.1: Land Use Land Covers Statistics of Buffer Zone

SL No	LULC_Class	Area (Ha)	Area (%)
1	WaterBodies	32400.00	14%
2	Agricultural Crop	108065.00	47%
3	Airport	3100.00	1%
4	Industry	6900.00	3%
5	BuiltUp	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%

Prediction of Impacts during Construction Phase

Land Environment

Any construction of infrastructure within Industry area will lead to permanent change in land use pattern at the site as a direct impact. No major changes in land use pattern will occur due to the project activities.

The construction activities will result in loss of topsoil and earthen material to some extent in the plant premises. However, it is proposed to use the soil and earthen material in existing greenbelt development. No solid or hazardous waste will be generated during construction thus no impact on soil environment is likely. There is no adverse impacts on soil in the surrounding area are anticipated.

Impact on Land Use

The proposed Construction area is red and brown in colour with sand stone texture and low undulations terrain. Hence, there is a impact on change in land use i.e. Excavation / reclamation process to be made. There is a mud road is existing and that requires to be convert CC / Tar. There is no ecologically sensitive area within 10km of radial distance from proposed project boundary. No wildlife sanctuaries, National parks, Tiger or elephant reserves exist in 10km radius. Also no migration route of avifauna present in 10 km radius.

There will be a land cutting or filling activity is involved during construction / operation of the plant as the site is mostly rocky and undulated land in the extension land and hence the land degradation is envisaged.

Summary of Anticipated Impacts during Operation Phase

Discipline	Potential Impacts	Probable Source	Mitigation Measures	Remarks
Land	Change in land use	Open land to Builtup	Suggested to develop green belt around plant	--

Environmental Management Plan

The Environmental Management Plan (EMP) is required to ensure sustainable development in the study area of the proposed expansion plant, hence it needs to be an all-encompassing plan for which the plant authorities, Government, regulating agencies like Pollution Control Board etc., working in the region and more importantly the population of the study area need to extend their cooperation and contribution.

The management action plan aims at controlling pollution at the source level to the maximum possible extent with the available and affordable technology followed by treatment measures before they are discharged/recycled/reused. Specifically, the EMP lays stress on key environmental aspects with mitigation measures and issues of the expansion project during construction and operation phase by:

- Identifying potential environmental impacts
- Recommending mitigation measures for the negative impacts
- Identifying opportunities for enhancement measures
- Upgrading the organizational framework for operating environmental management system and other functions of the expansion project by assigning roles and responsibilities for existing environmental monitoring and management
- Formulating Environmental Action Plans (EAPs) which specify mitigation, periodic and annual monitoring activities during expansion project implementation and operation.

The potential environmental impacts from the proposed expansion project are identified and the magnitude of these impacts also predicted.

In order to minimize these adverse impacts and to ensure that the environment in and around the project site as well as the neighboring population is well protected; an effective EMP is developed for construction phase as well as operation phase of the project.

Construction Phase

In the proposed project, major construction activities are involved, including construction of buildings. Major site levelling, grading, transportation of the construction material are involved. However, the construction phase impacts are temporary, short term and localised phenomena except the permanent change in local landscape and land use pattern of the existing project site and additional land.

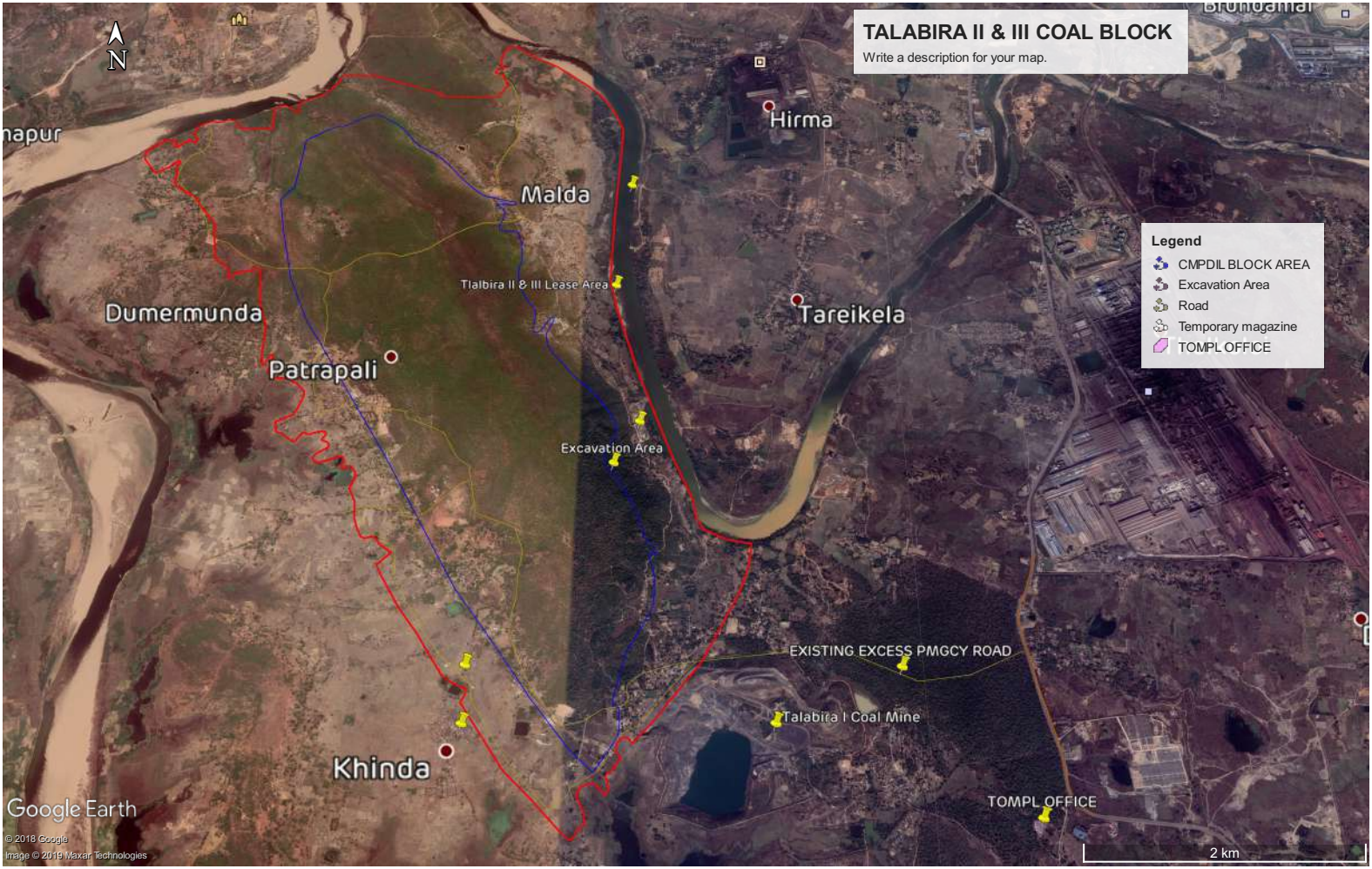
Land Environment

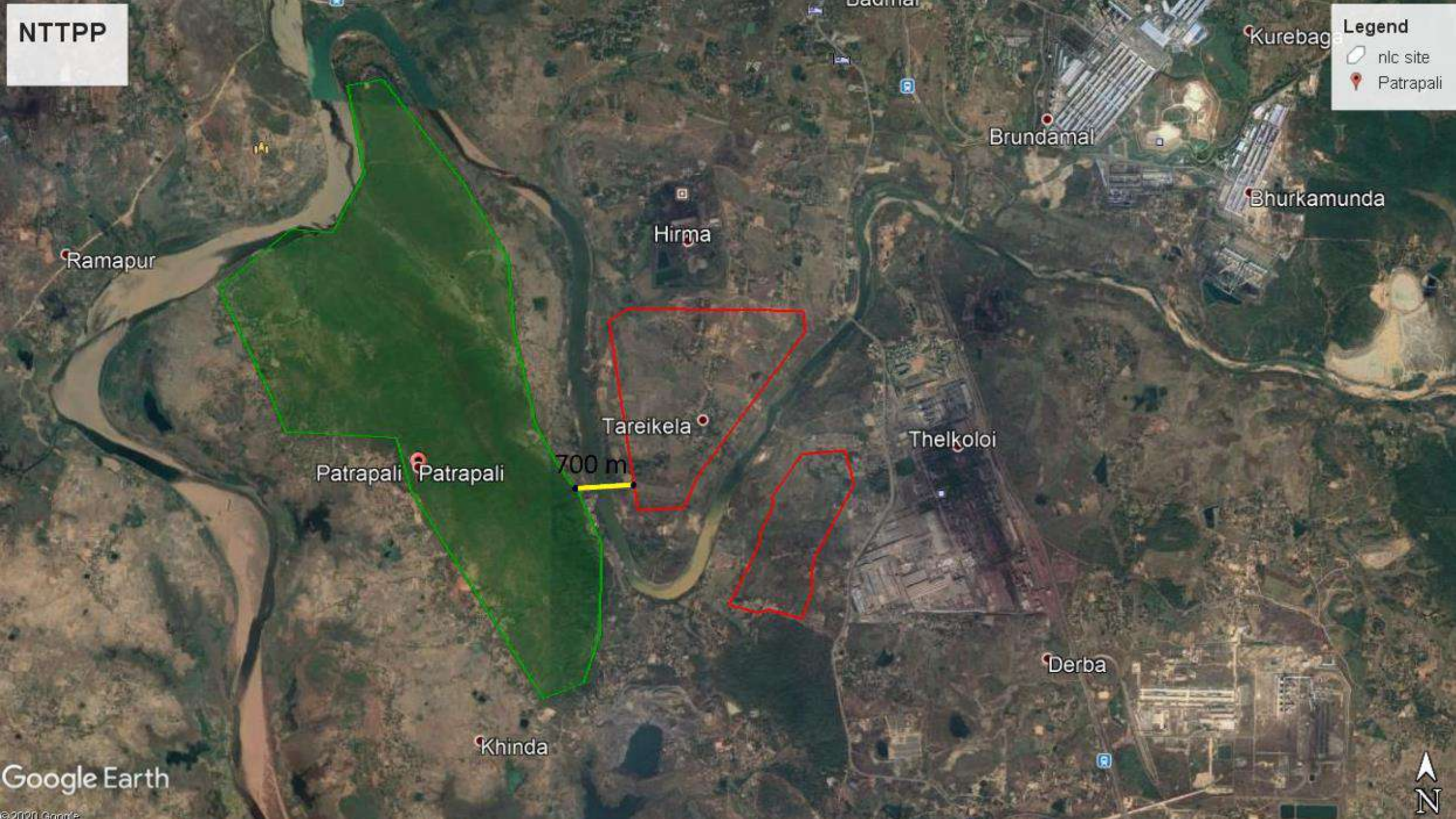
As mentioned, site levelling and grading activities are involved in the project site. However, the following measures will be adopted for management of local land use:

- As soon as construction is completed, the surplus earth if any will be utilized to fill up the low lying areas, the rubbish is to be cleared and all un-built surfaces be reinstated

ANNEXURE XVI

MAPS SHOWING PATRAPALI RESERVE FOREST

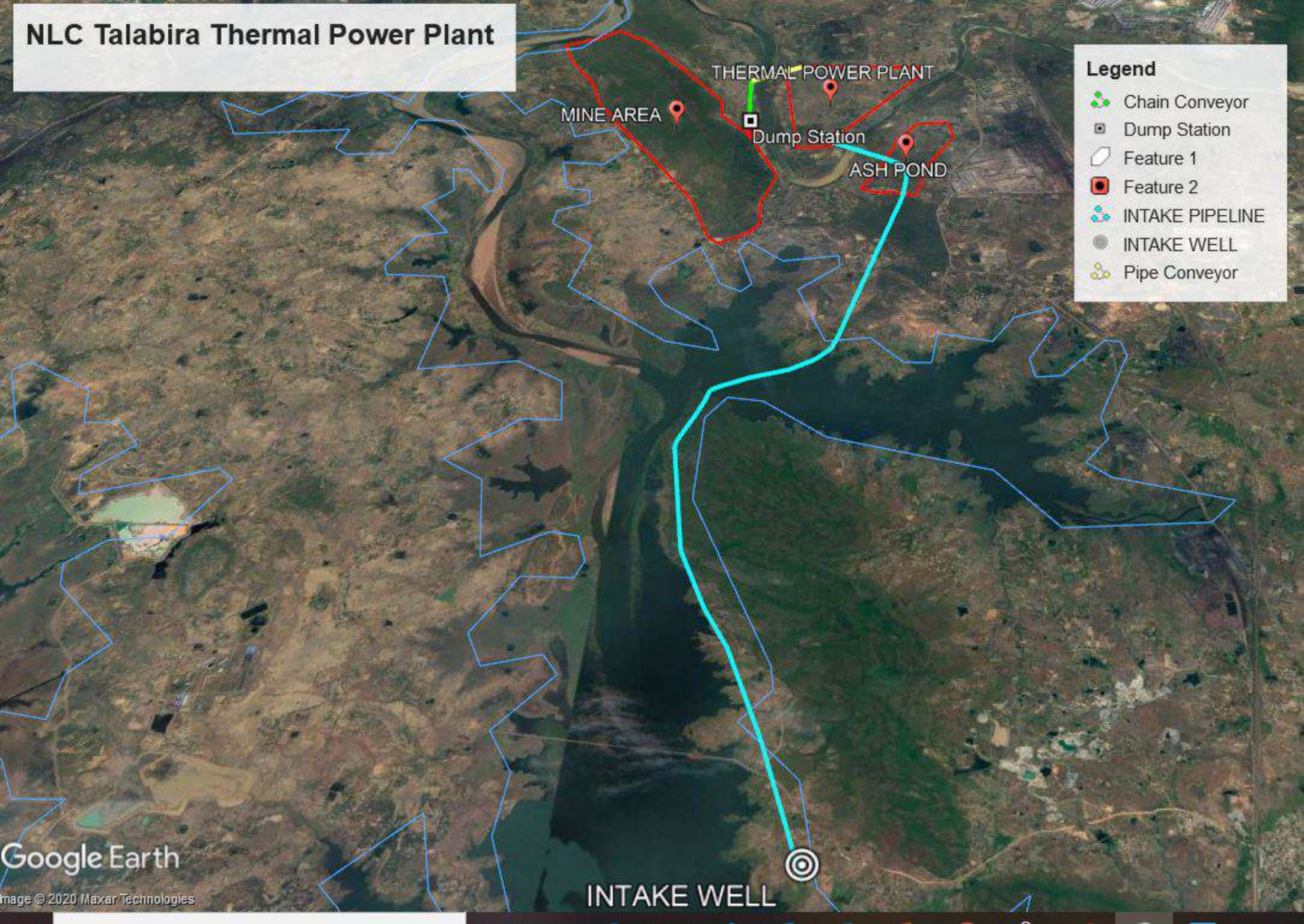

TALABIRA II & III COAL BLOCK
Write a description for your map.
N
napur
Hirma
Malda
Talbira II & III Lease Area
Dumermunda
Tareikela
Patrapali
Excavation Area
Legend
CMPDIL BLOCK AREA
Excavation Area
Road
Temporary magazine
TOMPL OFFICE
EXISTING EXCESS PMGCY ROAD
Talabira I Coal Mine
Khinda
TOMPL OFFICE
Google Earth
© 2018 Google
Image © 2019 Maxar Technologies
2 km


NTTPP
Legend
nlc site
Patrapali
Kurebaga
Brundamal
Bhurkamunda
Hirma
Ramapur
Tareikela
Thelkoloi
Patrapali
Patrapali
700 m
Derba
Khinda
Google Earth
N

ANNEXURE XVII

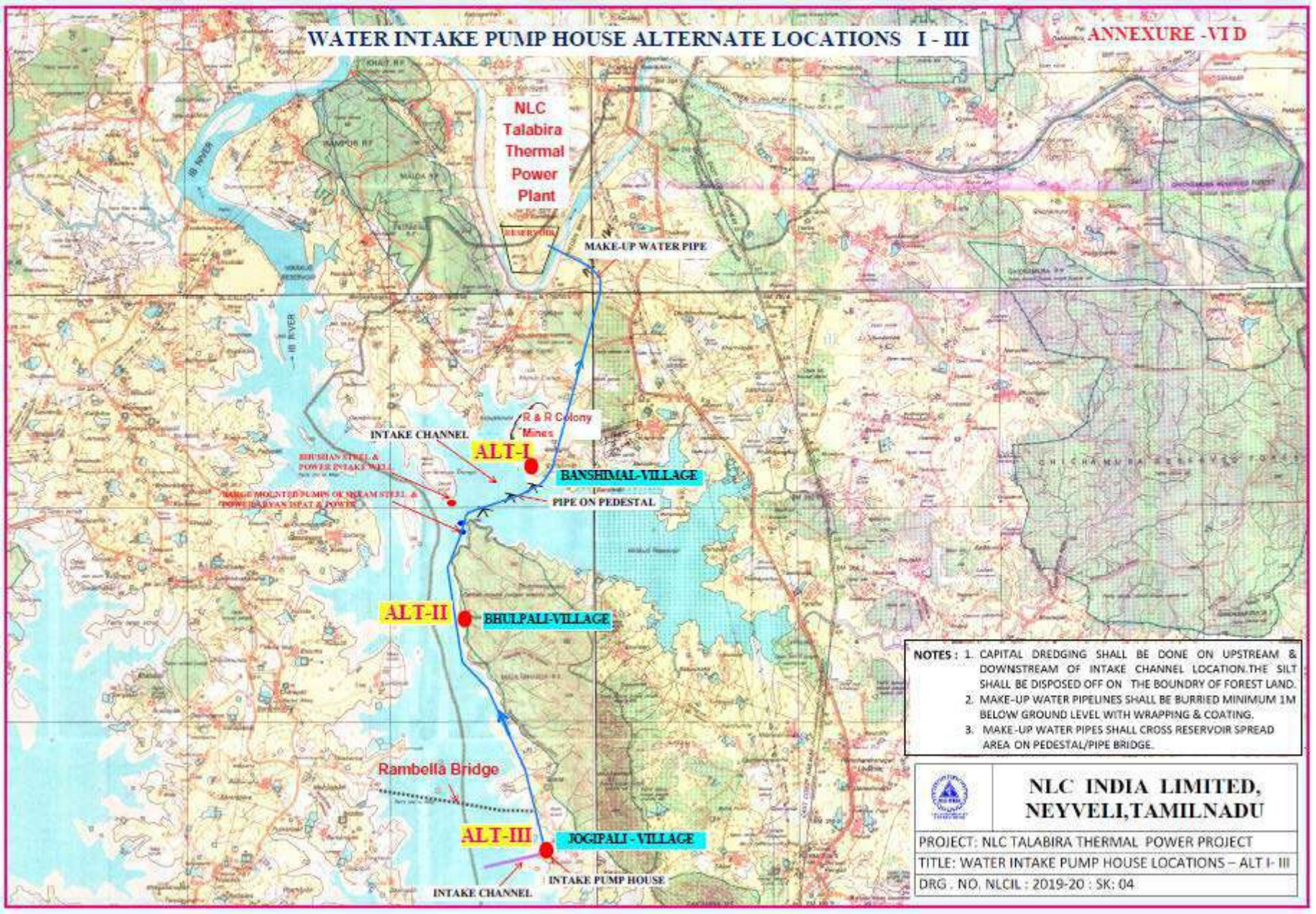
WATER INTAKE POINT & ROUTE MAP

NLC Talabira Thermal Power Plant



WATER INTAKE PUMP HOUSE ALTERNATE LOCATIONS I - III

ANNEXURE -VI D



NOTES :

1. CAPITAL DREDGING SHALL BE DONE ON UPSTREAM & DOWNSTREAM OF INTAKE CHANNEL LOCATION.THE SILT SHALL BE DISPOSED OFF ON THE BOUNDRY OF FOREST LAND.
2. MAKE-UP WATER PIPELINES SHALL BE BURRIED MINIMUM 1M BELOW GROUND LEVEL WITH WRAPPING & COATING.
3. MAKE-UP WATER PIPES SHALL CROSS RESERVOIR SPREAD AREA ON PEDESTAL/PIPE BRIDGE.

NLC INDIA LIMITED, NEYVELI,TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT
TITLE: WATER INTAKE PUMP HOUSE LOCATIONS – ALT I- III
DRG . NO. NLCIL : 2019-20 : SK: 04

ANNEXURE XVIII

COAL LINKAGE DOCUMENT

Through e-mail/Speed Post

No. 103/01/2016/NA (Part)
Government of India
Ministry of Coal

I Wing, First Floor, Shastri Bhawan
New Delhi, Dated: 12th January, 2018

To

The Chairman,
NLC India Limited,
Block-1, Neyveli-607 801,
Cuddalore District, Tamil Nadu

Subject: Corrigendum No. 3 to the Allotment Order dated 2nd May 2016 in respect of Talabira II & III coal mine.

Sir,

I am directed to refer to the subject mentioned above and to forward herewith Corrigendum No. 3 dated 12th January, 2018 (in original) to the Allotment order No. 103/01/2016/NA dated 2nd May 2016 in respect of Talabira II & III coal mine.

Encl: As above

Yours faithfully,

(N.K. Singh)
Dy. Secretary to the Govt. of India

Copy forwarded, inter-alia, for information to:-

1. The Coal Controller, Coal Controller Organization, Kolkata, West Bengal
2. CSO(BA-II/US-I/CTD), Ministry of Coal
3. The CMD, Coal India Limited
4. The CMD, SCCL

16/1/18

F. No. 103/01/2016/NA (Part)
Government of India
Ministry of Coal
O/o the Nominated Authority

F- Wing, First Floor, Shastri Bhawan, New Delhi

Corrigendum No. 3 to the Allotment order no. 103/01/2016/NA dated 02nd May 2016.

In re: Talabira II & III Coal Mine (the "mine")

Dated: January 17th 2018

In favour of: **NLC India Limited** incorporated in India under the Companies Act, 1956 with corporate identity number L93090TN1956GOI003507, whose registered office is at First Floor, No. 8, Mayor Sathyamurthy Road, FSD, Egmore Complex of Food Corporation of India, Chetpet, Chennai 600031, India (the "Allottee")

WHEREAS, The Nominated Authority has, in accordance with provisions of the Coal Mines (Special Provisions) Act, 2015 (the Act") and the Coal Mines (Special Provisions) Rules 2014 (the "Rules") issued Allotment order No. 103/01/2016/NA dated 02nd May 2016.

WHEREAS, The Corrigendum No. 1 to the Allotment order was issued on 07.09.2016 w.r.t. exclusion of NUPPL, Ghatampur TPP End Use Plant from the list of End Use Plants and change in name of the Company from Neyveli Lignite Corporation Limited to NLC India Limited

WHEREAS, The Corrigendum No. 2 to the Allotment order was issued on 30.09.2016 w.r.t modification of Annexure 3 to Allotment Order with regard to Environment Clearance.

WHEREAS M/s NLC India Limited has requested for inclusion of the Talabira TPP(3200/4000 MW) power plant by excluding the Sirkazhi TPP(Phase I & II) power plant as the Specified End Use Plant in respect of Talabira II & III coal mine.

WHEREAS The Ministry of Coal vide its O.M. dated 30.11.2017 , while conveying the direction of the Central Government, has directed the Nominated Authority to issue necessary amendment to the Allotment order in respect of Talabira II & III coal mine.

WHEREAS Considering such request, the deed of 3rd Amendment to the Allotment Agreement in respect of the Talabira II & III coal mine has been signed on 12.01.2018

AND WHEREAS necessary modification in the Allotment order dated 02nd May 2016 needs to done with regard to the End Use Plants of the Talabira II & III coal mine.

NOW THEREFORE, following corrigendum to the Allotment order is issued:

1. For utilisation in: End Use Plants situated at i) Tuticorin, Tamil Nadu and ii) Jharsuguda, Odisha, as more particularly described below (the "End Use Plant")

Sl. No.	Name of Specified End Use Plant	Address	Configuration (MW*)	Capacity (MW*)
1	NTPL TPS	Tutucorin, Tutucorin Dt, Tamil Nadu	2 x 500	1000
2	**Talabira TPP**	**Jharsuguda Jharsuguda Dt, Odisha**	**4x800/5x800**	**3200/4000**

(N.K. Sudhansu)
Nominated Authority

INDIA NON JUDICIAL

Government of National Capital Territory of Delhi

e-Stamp

सत्यमेव जयते

Certificate No.		IN-DL74832205966753Q
Certificate Issued Date	:	11-Jan-2018 03:41 PM
Account Reference	:	IMPACC (IV)/ d732103/ DELHI/ DL-DLH
Unique Doc. Reference	:	SUBIN-DLDL73210352800389864916Q
Purchased by	:	NOMINATED AUTHORITY MINISTRY OF COAL
Description of Document	:	Article 5 General Agreement
Property Description	:	Not Applicable
Consideration Price (Rs.)	:	0 (Zero)
First Party	:	NOMINATED AUTHORITY MINISTRY OF COAL
Second Party	:	NLC INDIA LIMITED FORMERLY NEYVELI LIGNITE CORPN L
Stamp Duty Paid By		NOMINATED AUTHORITY MINISTRY OF COAL
Stamp Duty Amount(Rs.)	:	500 (Five Hundred only)

Please Write or Type below this line

THE DEED OF THIRD AMENDMENT TO THE ALLOTMENT AGREEMENT BY AND BETWEEN THE PRESIDENT OF INDIA AND NLC INDIA LIMITED IN RESPECT OF PAI ABIRA II & III COAL MINE

This Stamp paper forms an integral part of this deed of third amendment to Allotment Agreement

This Second Amendment to the Allotment Agreement ("**Amendment Agreement**") is made on this ... day of ... between:

PARTIES

1. **The President of India**, acting through the Central Government represented by the Nominated Authority appointed under Section 9 of the Coal Mines (Special Provisions) Act, 2015 (the "**Nominated Authority**")

2. **NLC India Limited** (Erstwhile Neyveli Lignite Corporation Limited) incorporated in India under the Companies Act, 1956 with corporate identity number L93090TN1956GOI003507, whose registered office is at First Floor, No. 8, Mayor Sathyamurthy Road, ESD, Egmore Complex of Food Corporation of India, Chetpet, Chennai 600031, India (the "**Allottee**")

BACKGROUND

A. The Allotment Agreement dated March 31, 2016 as amended by First Amendment Agreement dated August 16, 2016 and Second Amendment Agreement dated December 6, 2016 (the "**Original Agreement**") was entered into between the Nominated Authority and the Allottee in respect of Talabira II & III Coal Mine.

B. Subsequent to the execution of the Original Agreement, it has been decided to exclude Talabira TPP and exclude Sirkazini TPP(Phase I & II) from the list of end use plants of Talabira II & III coal mine. Accordingly, certain clauses of the Original Agreement are required to be amended.

C. The Nominated Authority is pleased to permit amendment of the Original Agreement.

D. Accordingly, in terms of Clause 2(e) 8 of the Original Agreement, the Nominated Authority and the Allottee are entering into this Amendment Agreement to record certain amendments to the Original Agreement.

NOW THEREFORE, in consideration of the mutual covenants, terms and conditions and understandings set forth in this Amendment Agreement and the Original Agreement, and other good and valuable consideration the adequacy of which are hereby mutually acknowledged, the parties, with the intent to be legally bound hereby agree as follows:

1. **DEFINITIONS AND INTERPRETATION**

The definitions and rules of interpretation as specified in the Original Agreement shall apply to this Amendment Agreement.

2. AMENDMENTS

2.1 Schedule B (titled Particulars of the Specified End-Use Plant) of the Original Agreement is hereby substituted with the revised Schedule B as provided below:

S. No.	Name of Specified End Use Plant	Address	Configuration (MW*)	Capacity (MW*)
	NTPL TPS	Tuticorin, Tuticorin Dt. Tamil Nadu	2 x 500	1000
-	Talabira TPP	Jharsuguda Jharsuguda Dt. Odisha	4x800/ 5x800	3200/4000

MW: Mega Watt

3. CONTINUING OBLIGATIONS

The Original Agreement and all terms and conditions of the Original Agreement shall continue to remain valid, operative, binding, subsisting, enforceable and in full force and effect save and except to the extent amended by this Amendment Agreement, and the Original Agreement shall always be read in conjunction with this Amendment Agreement.

4. MISCELLANEOUS

4.1 The provisions of Clause 25 of the Original Agreement (*Governing Law and Dispute Resolution*) and Clause 26 of the Original Agreement (*Miscellaneous*), shall *mutatis mutandis* apply to this Amendment Agreement and shall be deemed to be incorporated by reference.

4.2 This Amendment Agreement shall become effective on the date on which execution of this Amendment Agreement by both the Allottee and the Nominated Authority is completed.

IN WITNESS WHEREOF, the Parties have caused this Agreement to be duly executed by their duly authorised representatives on the date and year written herein at New Delhi.

The Nominated Authority	NLC India Limited
Name: N.K. Sudhansu Date: January 12, 2018	Name: Ratna Chowdhury Designation: Regional Manager Date: January 12, 2018 Duly authorized to execute this Agreement pursuant to resolution passed by the Board of Directors of NLC India Limited

ANNEXURE XIX

LAND USE PLAN PLAN & REVENUE STATUS OF NLTPP

Land Use Plan- NLC Talabira Thermal Power Project

Sl.No	Types of Land	Jharsuguda					Total (In Ac)	Sambalpur	Grand Total (in Ac)
		Name of Villages						Name of Village	
		Luharenkachhar	Tumbakela	Tareikela	Kumbhari	Hirma		Thelkoloi	
1	**Agriculture**	39.55	37.41	226.12	330.97	86.66	**720.71**	286.405	**1007.115**
2	**Homestead**	0	5.56	8.32	6.21	11.04	**31.13**	2.725	**33.855**
3	**Wasteland**	5.02	0.13	7.38	14.7	41.12	**68.35**	34.3	**102.65**
4	**Grazing/Gochar**	0	0	1.32	8.64	0	**9.96**	1.8	**11.76**
5	**Water Bodies**	0	1.81	2.87	15.34	5.38	**25.4**	10.5	**35.9**
6	**Communal (Road etc)**	0	1.24	13.36	7.13	3.07	**24.8**	5.53	**30.33**
Total		**44.57**	**46.15**	**259.37**	**382.99**	**147.27**	**880.35**	**341.26**	**1221.61**

ଘରୋଇ ଜମି ଅନୁସୂଚୀ
ଗ୍ରାମ-ଠେଲକୋଇଲି
ଥାନା -କତରବଗା
ତହସିଲ-ରେଙ୍ଗାଲି
ଜିଲ୍ଲା -ସମ୍ବଲପୁର

କ୍ର.ନଂ	ଖାତା ନଂ	ପ୍ଲଟ ନଂ.	ମୋଟ ରକବା (ଏକରରେ)	ପ୍ରସ୍ତାବିତ ହେଉଥିବା ରକବା (ଏକରରେ)	ବିବରଣ	ଭୂମି ମାଲିକଙ୍କ ନାମ	ମାଟି
୧	୮	୬୯୫	୦.୨୫୦	୦.୨୫୦	ଚାଷ.ଯୋ	ଅନୁଚ୍ଛାୟା ପଧାନ ସ୍ୱା- ଜଗିହର ପଧାନ ଫଟିର ପଧାନ , ଗଣେଶ୍ୱର ପଧାନ ପିତା-ବାମଦେବ ପଧାନ , ଗୌତ ପଧାନ , ଜଲଜତି ପଧାନ ପିତା - ବୟାଜିଧି ପଧାନ, ଆଶାଇତା ପଧାନ ସ୍ୱା-ନରସିଂହ ପଧାନ , ଚତ୍ରଧର ପଧାନ ,ଚତୁର୍ଭୁଜ ପଧାନ , ଚିଇଉଜନ ପଧାନ ପିତା- ନରସିଂହ ପଧାନ	ବୁଇଗା
		୭୦୮	୦.୧୫୦	୦.୧୫୦	ଘା.ଯୋ		
		୭୦୮(ପୁ)	୦.୪୫୦	୦.୨୭୦	ଆ.ଯୋ		
		୭୦୭(ପୁ)	୦.୪୩୦	୦.୧୫୦	ମା.ଯୋ		
		୮୦୪(ପୁ)	୦.୦୮୦	୦.୦୪୦	ଆ.ଯୋ		
		୮୩୬(ପୁ)	୦.୨୦୦	୦.୮୦୦	ଆ.ଯୋ		
		୮୩୫	୦.୨୦୦	୦.୧୨୦	ମା.ଯୋ		
		୮୪୫	୦.୩୮୦	୦.୩୮୦	ଆ.ଯୋ		
		୮୫୧	୦.୧୩୦	୦.୧୩୦	ଚାଷ.ଯୋ		
		୮୫୫	୦.୪୨୦	୦.୪୫୦	ଘା.ଯୋ		
		୨୨୩୭(ପୁ)	୦.୩୫୦	୦.୨୯୦	ଆ.ଯୋ		
		୨୨୩୩(ପୁ)	୦.୫୫୦	୦.୩୫୦	ଚାଷ.ଯୋ		
		୨୨୩୫(ପୁ)	୦.୨୦୦	୦.୧୨୦	ଆ.ଯୋ		
		୨୩୮୨	୦.୩୩୦	୦.୩୩୦	ଚାଷ.ଯୋ		
		୨୩୨୦	୦.୦୮୦	୦.୦୮୦	ଚାଷ.ଯୋ		
		୨୪୨୦	୦.୦୫୦	୦.୦୫୦	ଘା.ପା-୨		
		୨୪୫୮	୦.୩୨୦	୦.୩୨୦	ଆ.ଯୋ		
		୨୨୦୫	୦.୦୨୦	୦.୦୨୦	ଚାଷ.ଯୋ		
		୨୨୩୫	୦.୦୨୦	୦.୦୨୦	ମା-ପା-୨		
		୨୨୩୬	୦.୦୨୦	୦.୦୨୦	ମା-ପା-୨		
		୨୫୨୧	୦.୨୫୦	୦.୨୫୦	ମା.ଯୋ		
		୨୨୩୬(ପୁ)	୦.୪୦୦	୦.୨୩୦	ଚାଷ.ଯୋ		
		୨୨୪୨(ପୁ)	୦.୨୫୦	୦.୨୫୦	ଆ.ଯୋ		
		୨୨୫୫	୦.୦୮୦	୦.୦୮୦	ମା-ପା		
		୨୫୮୮	୦.୨୫୫	୦.୦୫୦	ବାଡି.ଯୋ		
୨	୫୦	୨୫୮୩	୦.୫୦୦	୦.୫୦୦	ଘା.ପା-୨	ଅଭିମନ୍ୟୁ ନାଥ ପିତା -ତ୍ରିଲୋଚନ ନାଥ	ବୁଇଗା
		୨୨୨୦	୦.୦୭୦	୦.୦୫୦	ମା.ଯୋ		
		୨୨୨୫	୦.୩୩୦	୦.୩୩୦	ଘା.ପା-୨		
୩	୫୨	୫୨୫	୦.୩୭୫	୦.୩୨୦	ଘା.ପା-୨	ଅଭିମନ୍ୟୁ ନାଥ ପିତା -ତ୍ରିଲୋଚନ ନାଥ ଜଗନ୍ନାଥର ନାଥ , ଦୁଇମୋହନ ନାଥ , ଗାୟାଧରଲୁଉ ନାଥ , ପିତା - ବୃଜ ନାଥ , ସଉସ୍ୱତୀ ନାଥ ,ସ୍ୱା-ବୃଜ୍ଜ ନାଥ	ବୁଇଗା
		୨୨୮୪	୦.୦୯୫	୦.୦୯୦	ମା.ଯୋ		
		୨୨୯୦	୦.୦୫୦	୦.୦୫୦	ମା.ଯୋ		
		୨୨୯୨	୦.୨୩୦	୦.୨୩୦	ମା.ଯୋ		
		୨୫୦୮	୦.୦୮୦	୦.୦୮୦	ମା-ଘା-ପା-୨		
		୨୫୦୫	୦.୦୨୦	୦.୦୨୦	ଘା-ପା-ପା-୨		
		୨୫୫୫	୦.୦୮୦	୦.୦୮୦	ମା-ପା-ପା-୨		
		୨୫୫୪	୦.୦୩୦	୦.୦୩୦	ମା-ଘା-ମା-୨		
		୨୫୨୯	୦.୦୩୦	୦.୦୩୦	ମା-ପା		
		୨୨୫୦	୦.୦୩୦	୦.୦୩୦	ମା.ଯୋ		

Land Acquisition Inspector
Collectorate, Sambalpur

Land Acquisition Officer
SAMBALPUR

କ୍ର.ନଂ	ଖାତା ନଂ	ପ୍ଲଟ ନଂ.	ମୋଟ ରକବା (ଏକରରେ)	ଅଧିଗ୍ରହଣ ହେଉଥିବା ରକବା (ଏକରରେ)	କିସମ	ଜମି ମାଲିକଙ୍କ ନାମ	ଜାତି
୪	୧୩	୧୧୨୪	୦.୧୩୦	୦.୧୩୦	ମା.ସା	ଅଭିମନ୍ୟୁ ନାଥ ପିତା -ତ୍ରିଲୋଚନ ନାଥ କରୁଣାକର ନାଥ , ରାଧାବଲ୍ଲଭ ନାଥ .ପିତା - କୃଷ୍ଣ ନାଥ , ଗଉତୁଣୀ ପାଣିଗ୍ରାହୀ ପିତା-ଅଲରାମ ନାଥ	ବ୍ରାହ୍ମଣ
		୧୪୫୦	୦.୨୪୦	୦.୨୪୦	ଆ.ସା		
		୧୧୬୪	୦.୮୬୦	୦.୮୬୦	ମା.ପା-୨		
		୧୧୭୭	୦.୮୧୦	୦.୮୧୦	ଆ.ସା		
		୧୧୭୮	୦.୨୮୦	୦.୨୮୦	ଅ.ସା		
		୧୧୨୦	୦.୩୨୦	୦.୩୨୦	ଆ.ସା		
		୧୧୨୧	୦.୨୨୦	୦.୨୨୦	ଆ.ସା		
		୧୧୨୨	୦.୪୧୦	୦.୪୧୦	ଆ.ସା		
		୧୧୨୪	୦.୩୨୦	୦.୩୨୦	ଆ.ସା		
		୧୧୮୩	୦.୦୪୦	୦.୦୪୦	ବା.ସା		
		୧୧୬୧/୩୪୩୧	୦.୬୧୦	୦.୬୧୦	ମା.ସା		
		୧୧୬୩/୩୪୬୧	୦.୨୨୦	୦.୨୨୦	ମା.ସା		
		୧୨୪୧/୩୪୬୦	୦.୨୬୦	୦.୨୬୦	ଆ.ସା		
		୧୨୧୧/୩୪୪୧	୦.୩୧୦	୦.୩୧୦	ବେ.ସା		
		୧୧୨୨/୩୪୬୨(ଗ)	୦.୩୮୦	୦.୩୮୦	ମା.ସା		
		୧୧୨୮/୩୪୬୦(ଖ)	୦.୨୮୦	୦.୧୮୦	ବା.ପା-୨		
		୧୧୨୮/୩୪୬୪(ଖ)	୦.୧୨୦	୦.୧୨୦	ବା.ପା-୨		
		୧୧୬୪/୩୪୨୮	୦.୨୨୦	୦.୨୨୦	ମା.ପା-୨		
		୧୧୬୪/୩୪୨୦	୦.୧୪୦	୦.୧୪୦	ମା.ପା-୨		
		୧୧୨୦/୩୪୨୨	୦.୦୪୦	୦.୦୪୦	ଆ.ସା		
		୧୧୨୦/୩୪୨୩	୦.୧୨୦	୦.୧୨୦	ଆ.ସା		
		୧୧୮୩/୩୪୨୪	୦.୧୩୦	୦.୧୩୦	ବା.ସା		
		୨୧୮୩/୩୪୨୮	୦.୦୬୦	୦.୦୬୦	ବା.ସା		
		୧୨୪୦/୩୬୧୬	୦.୦୨୦	୦.୦୨୦	ବା-ଡିସା		
		୧୨୧୧/୩୬୨୨	୦.୦୪୦	୦.୦୪୦	ବାଗିଚା		
		୧୧୮୪/୩୬୨୧	୦.୦୨୦	୦.୦୨୦	ବା.ସା		
୫	୨୫	୨୩୪	୧.୬୬୦	୧.୬୬୦	ବା.ସା	ଅର୍ତତ୍ରାଣ ପାଣି,ଘାସିରାମ ପାଣି, ପିତା-ଝଗେଶ୍ୱର ପାଣି	ବ୍ରାହ୍ମଣ
		୧୧୪୪	୦.୨୨୦	୦.୨୨୦	ବେ.ସା		
		୧୧୪୬	୧.୪୩୦	୧.୪୩୦	ଆ.ସା		
		୧୧୬୨	୦.୧୨୦	୦.୧୨୦	ବେ.ସା		
		୧୧୭୩	୦.୧୬୦	୦.୧୬୦	ମା.ସା		
		୧୨୨୨	୦.୧୪୦	୦.୧୪୦	ମା-ବା-ପା-୨		
		୧୨୮୧/୩୩୪୧	୦.୦୪୦	୦.୦୪୦	ମା.ସା		
୬	୧୧	୨୧୨	୦.୩୬୦	୦.୩୬୦	ବା.ସା	ଗୋବର୍ଦ୍ଧନ ପଧାନ , ପିତା -ଇଶ୍ୱର ପଧାନ ଫକିର ପଧାନ , ପିତା-ବାମଦେବ ପଧାନ , ଅନୁପ୍ଲାୟ ପଧାନ ,ସ୍ୱ ।-ହରିହର ପଧାନ ଦୟାନିଧି ପଧାନ .ପିତା -ଇମ୍ବୋଦର ପଧାନ ମୁକ୍ତେଶ୍ୱର ପଧାନ , ବିଜେ ପଧାନ , ପିତା-ଛାଲ ପଧାନ ସାଉରେନ୍ଦ୍ରି ପଧାନ , ସ୍ୱା-କେଶବ ପଧାନ, ତ୍ରିବିକ୍ରମ ପଧାନ , ପିତା - କେଶବ ପଧାନ ଚମାର ପଧାନ , ପିତା-ସାଗର ପଧାନ ବରୁଣ ପଧାନ .ପିତା-ହାରାବାନ୍ଧ ପଧାନ	କୁଲତା
		୮୧୩	୦.୨୩୦	୦.୨୩୦	ବା.ସା		
		୮୧୨	୦.୦୮୦	୦.୦୮୦	ବେ.ସା		
		୮୩୨	୦.୬୩୦	୦.୬୩୦	ଆ.ସା		
		୮୪୦	୦.୦୪୦	୦.୦୪୦	ବେ.ସା		
		୧୧୮୦	୦.୦୧୦	୦.୦୧୦	ମା.ସା		
		୧୧୮୨	୦.୨୧୦	୦.୨୧୦	ଆ.ସା		
		୧୧୮୭	୦.୬୨୦	୦.୬୨୦	ଆ.ସା		
		୧୩୩୨	୦.୧୧୦	୦.୧୧୦	ବା.ସା		
		୧୩୪୦	୦.୦୪୦	୦.୦୪୦	ବା.ସା		
		୧୩୪୨(ଖ)	୦.୧୬୦	୦.୦୬୦	ବା.ସା		
		୧୪୩୪	୦.୨୪୦	୦.୨୪୦	ବା.ସା		
		୧୪୬୬	୦.୧୦୦	୦.୧୦୦	ଆ.ସା		
		୨୬୮୬	୦.୩୧୦	୦.୩୧୦	ବା.ପା-୨		
		୧୨୩୬	୦.୦୪୦	୦.୦୪୦	ମା-ପା-୨		
		୧୨୧୧	୦.୦୬୦	୦.୦୬୦	ମାପା-୨		

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Collectorate,Sambalpur

Land Acquisition Officer
SAMBALPUR

କ୍ର.ନଂ	ଖାତା ନଂ	ପ୍ଲଟ ନଂ.	ମୋଟ ରକବା (ଏକରରେ)	ଅଧିଗ୍ରହଣ ହେଉଥିବା ରକବା (ଏକରରେ)	କିସମ	ଭୂମି ମାଲିକଙ୍କ ନାମ	ଜାତି
୭	୨୦	୨୦୨	୦.୯୮୦	୦.୯୮୦	ବା.ସା	ଗୋବର୍ଦ୍ଧନ ପଧାନ, ପିତା - ଈଶ୍ୱର ପଧାନ ଲାଭ ପଧାନ, ସ୍ୱା- ପୂର୍ନିୟା ପଧାନ। ସାଇରେନ୍ଦ୍ରି ପଧାନ, ସ୍ୱା- କେଶବ ପଧାନ ତ୍ରିବିକ୍ରମ ପଧାନ ପିତା-କେଶବ ପଧାନ କୁଳନେନ ପଧାନ, ସ୍ୱା-ମୃତ୍ୟୁଞ୍ଜୟ ପଧାନ ସୁଭଦ୍ରା ବାଣିକ ,ପିତା- ରତନ ପଧାନ ମୁରାରି ସାହୁ , ପିତା-ସାଉଟୁକ ସାହୁ	କୁଲତା
		୨୬୫	୦.୧୦୦	୦.୧୦୦	ଆ.ସା		
		୨୬୨	୦.୧୨୦	୦.୧୨୦	ଆ.ସା		
		୨୯୩	୦.୩୪୦	୦.୩୪୦	ବା.ସା		
		୮୨୨(ପ୍ଲ)	୦.୧୯୦	୦.୨୦୦	ଆ.ସା		
		୯୦୧	୧.୨୮୦	୧.୨୮୦	ମା.ସା		
		୯୦୨(ପ୍ଲ)	୦.୨୮୦	୦.୨୨୦	ମା.ସା		
		୯୦୨	୦.୨୨୦	୦.୨୨୦	ମା.ସା		
		୯୫୧	୦.୫୩୦	୦.୫୩୦	ବେ.ସା		
		୧୩୧୪	୦.୯୩୦	୦.୯୩୦	ବା.ସା		
		୧୩୧୬	୦.୩୨୦	୦.୩୨୦	ବା.ସା		
		୧୪୩୩	୦.୦୮୦	୦.୦୮୦	ବା.ସା		
		୧୪୩୬	୦.୦୪୦	୦.୦୪୦	ବା.ସା		
		୧୪୪୪	୦.୦୪୦	୦.୦୪୦	ବେ.ସା		
		୧୪୪୬	୦.୧୩୦	୦.୧୩୦	ମା.ସା		
		୧୪୪୫	୦.୧୨୦	୦.୧୨୦	ମା.ସା		
		୧୫୩୮	୦.୦୮୦	୦.୦୮୦	ମା-ଖ-ପା-୨		
		୧୫୩୧	୦.୦୪୦	୦.୦୪୦	ମା-ଖ-ପା-୨		
		୧୬୪୨	୦.୦୪୦	୦.୦୪୦	ମା-ଖ-ପା-୨		
		୧୭୨୦	୦.୦୩୦	୦.୦୩୦	ବା-ଖ-ପା-୨		
		୧୦୨(ପ୍ଲ)	୧.୦୨୦	୦.୨୮୦	ଆ.ସା		
		୧୦୮(ପ୍ଲ)	୦.୩୬୦	୦.୧୬୦	ଆ.ସା		
		୧୧୦(ପ୍ଲ)	୦.୨୨୦	୦.୧୬୦	ଆ.ସା		
		୨୦୨୨	୦.୧୦୦	୦.୧୦୦	ବେ.ସା		
		୨୦୨୮	୦.୦୨୦	୦.୦୨୦	ବେ.ସା		
		୨୬୧୪	୦.୦୬୦	୦.୦୬୦	ମା.ସା		
		୨୬୧୬	୦.୦୨୦	୦.୦୨୦	ମା.ସା		
		୨୨୪୨	୦.୦୪୦	୦.୦୪୦	ଆ.ସା		
୮	୨୩	୨୦୬	୦.୩୩୦	୦.୩୩୦	ଆ.ସା	ଅପୂର୍ବ ସା, ପି- ଭବାଗର ପଧାନ ନୀଳାବତୀ ବିଶ୍ୱାଳ, ଯଶୋଦା ପଧାନ, ପି- ଜୟନାରାୟଣ ସାହୁ, ସରୋଜ ପଧାନ (ପୋଷ୍ୟପୁତ୍ର) ପି- ସୌଦାଗର ପଧାନ	କୁଲତା
		୨୧୦	୦.୧୪୦	୦.୧୪୦	ବା.ସା		
		୮୯୮	୦.୦୮୦	୦.୦୮୦	ବେ.ସା		
		୧୨୧୪	୦.୨୦୦	୦.୨୦୦	ଆ.ସା		
		୨୨୧୬	୦.୧୦୦	୦.୧୦୦	ଆ.ସା		
		୨୨୦୪	୦.୦୮୦	୦.୦୮୦	ବେ.ସା		
		୨୨୦୬	୦.୦୮୦	୦.୦୮୦	ବେ.ସା		
		୧୩୨୬/୩୨୨୧(ପ୍ଲ)	୦.୨୨୦	୦.୧୫୦	ବେ.ସା		
		୧୩୧୫	୦.୧୦୦	୦.୧୦୦	ବେ.ସା		
		୧୩୪୩	୦.୧୬୦	୦.୧୬୦	ବା.ସା		
		୧୪୩୦	୦.୧୬୦	୦.୧୬୦	ବା.ପା-୨		
		୧୪୩୨	୦.୧୨୦	୦.୧୨୦	ବା.ସା		
		୧୪୩୨	୦.୧୬୦	୦.୧୬୦	ମା.ସା		
		୧୪୩୨	୦.୧୪୦	୦.୧୪୦	ମା.ସା		
		୧୬୨୧	୦.୦୮୦	୦.୦୮୦	ମା.ସା		
		୧୬୩୩	୦.୦୪୦	୦.୦୪୦	ମା-ପା-୨		
		୧୬୪୪	୦.୦୨୦	୦.୦୨୦	ମା-ପା-୨		
		୧୬୧୬	୦.୦୨୦	୦.୦୨୦	ବା-ଖ-ପା-୨		
		୨୬୬୧	୦.୦୪୦	୦.୦୪୦	ମା-ପା-୨		
୯	୩୨	୮୧୨	୦.୨୧୦	୦.୨୧୦	ବା.ସା	କେତକୀ ପଧାନ, ସ୍ୱା- ମୁକ୍ତେଶ୍ୱର ପଧାନ	କୁଲତା
		୮୪୬	୦.୦୬୦	୦.୦୬୦	ବା.ସା		
		୮୫୨	୦.୨୫୦	୦.୨୫୦	ବା.ସା		
		୯୦୩	୦.୦୬୦	୦.୦୬୦	ମା.ସା		
		୧୧୮୨	୦.୨୨୦	୦.୨୨୦	ଆ.ସା		
		୧୩୨୧	୦.୯୮୦	୦.୯୮୦	ବେ.ସା		
		୧୩୨୨(ପ୍ଲ)	୦.୭୬୦	୦.୧୨୦	ବେ.ସା		
		୧୩୨୩	୦.୦୮୦	୦.୦୮୦	ବେ.ସା		
		୧୪୬୮	୦.୧୨୦	୦.୧୨୦	ଆ.ସା		
		୨୬୮୬/୩୨୨୨	୦.୪୧୦	୦.୪୧୦	ମା.ପା-୨		
		୧୬୪୧	୦.୦୬୦	୦.୦୬୦	ମା-ଖ		
		୧୬୬୨	୦.୦୧୦	୦.୦୧୦	ମା-ଖ		
		୨୭୬୦	୦.୦୬୦	୦.୦୬୦	ମା.ସା		
୧୦	୩୨	୨୭୨୬	୦.୦୨୦	୦.୦୨୦	ବା-ଖ-ପା-୨	କେଶବ ପଧାନ , ସ୍ୱା- ମୃତ୍ୟୁଞ୍ଜୟ ପଧାନ	କୁଲତା
୧୧	୩୮	୧୨୦୨	୦.୨୩୦	୦.୨୩୦	ମା-ଖ-ପା-୨	କେଶବ ପଧାନ , ସ୍ୱା- ମୃତ୍ୟୁଞ୍ଜୟ ପଧାନ, ମୁକ୍ତେଶ୍ୱର ପଧାନ, ବିଜେ ପଧାନ, ପି- ଲାଲ ପଧାନ	କୁଲତା
୧୨	୪୩	୧୩୨୬	୦.୧୨୦	୦.୧୨୦	ବା.ସା	ରାହାସବିହାରି ନାଏକ, ମେଘନାଦ ନାଏକ, ପି-ସୁରେଶ ନାଏକ	ବ୍ରାହ୍ମଣ
		୧୨୬୨	୦.୨୧୦	୦.୨୧୦	ବା.ସା		
		୧୨୩୧	୦.୦୬୦	୦.୦୬୦	ମା.ସା		

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Collectorate, Sambalpur

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କ୍ର.ନଂ	ଖାତା ନଂ	ପ୍ଲଟ ନଂ.	ମୋଟ ରକବା (ଏକରରେ)	ଅଧିଗ୍ରହଣ ହେଉଥିବା ରକବା (ଏକରରେ)	କିସମ	ଭୂମି ମାଲିକଙ୍କ ନାମ	ଜାତି
୧୩	୪୬	୮୮୬	୦.୩୫୦	୦.୩୩୦	ମା.ସା	ଗୋପାଳଜି ପାଣି, ଶଙ୍କର ପ୍ରସାଦ ପାଣି, ପି-ଅନ୍ତ ପାଣି, ବିନୋଦବିହାରୀ ପାଣି ପି-ସଂସାର ପାଣି, ଭାସ୍ୱେଶ୍ୱରୀ ପାଣି, ସ୍ୱା-ଦୈତାରୀ ପାଣି, ମୃତ୍ୟୁଞ୍ଜୟ ପାଣି, ଆଶୁତୋଷ ପାଣି ପି-ଦୈତାରୀ ପାଣି, ଦୀନବନ୍ଧୁ ପାଣି, ଉପେନ୍ଦ୍ର ପାଣି, ସୁରେନ୍ଦ୍ର ପାଣି, ପି-ଲୋକେଶରାମ ପାଣି	ବ୍ରାହ୍ମଣ
		୯୨୬	୦.୨୦୦	୦.୨୦୦	ବେ.ସା		
		୯୨୮	୦.୨୬୦	୦.୨୬୦	ମା.ସା		
		୯୩୦	୦.୪୩୦	୦.୪୩୦	ଅ.ସା		
		୯୩୧	୦.୨୩୦	୦.୨୩୦	ବେ.ସା		
		୧୧୯୩	୦.୦୬୦	୦.୦୬୦	ଘଡି		
		୧୧୪୬	୦.୪୪୦	୦.୪୪୦	ଅ.ସା		
		୧୧୪୭	୦.୧୫୦	୦.୧୫୦	ମା.ସା		
		୧୧୪୮	୦.୨୩୦	୦.୨୩୦	ବେ.ସା		
		୧୧୪୯	୧.୧୩୦	୧.୧୩୦	ବା.ସା		
		୧୧୬୦	୦.୨୬୦	୦.୨୬୦	ମା.ସା		
		୧୧୬୫	୦.୩୪୦	୦.୩୪୦	ମା.ସା		
		୧୧୩୪	୦.୫୬୦	୦.୫୪୦	ବେ.ସା		
		୧୨୪୩	୦.୩୪୧	୦.୩୪୦	ଅ.ସା		
		୧୮୪୨	୦.୨୮୦	୦.୨୮୦	ଅ.ସା		
		୯୩୨/୩୪୩୨	୦.୬୦୦	୦.୬୦୦	ବା.ସା		
		୧୧୩୪/୩୪୫୪	୧.୦୨୦	୧.୦୨୦	ବେ.ସା		
		୧୧୪୦/୩୬୪୪	୦.୩୨୦	୦.୩୨୦	ବା.ସା		
୧୪	୫୨	୧୧୪୮	୦.୧୮୦	୦.୧୮୦	ବେ.ସା	ଗୋପାଳଜି ପାଣି, ଶଙ୍କର ପାଣି, ପି-ଅନ୍ତ ପାଣି	ବ୍ରାହ୍ମଣ
୧୫	୫୭	୪୮୦	୦.୧୧୦	୦.୧୧୦	ମା.ସା	ବମାର ତ୍ରିପାଠୀ, ପି-ଚିନ୍ତାମଣି ତ୍ରିପାଠୀ	ବ୍ରାହ୍ମଣ
		୮୨୪	୦.୨୮୦	୦.୨୮୦	ଅ.ସା		
		୮୪୩	୦.୩୬୦	୦.୩୬୦	ମା.ସା		
		୮୪୫	୦.୪୮୦	୦.୪୮୦	ମା.ସା		
		୮୬୯	୦.୪୬୦	୦.୪୬୦	ବେ.ସା		
		୮୬୧	୦.୬୬୦	୦.୬୬୦	ବେ.ସା		
		୮୬୭	୨.୦୧୦	୨.୦୧୦	ବା.ସା		
		୮୬୬	୦.୪୧୦	୦.୪୧୦	ବେ.ସା		
		୮୬୬	୦.୮୩୦	୦.୮୩୦	ଅ.ସା		
		୧୪୧୦	୦.୩୦୦	୦.୩୦୦	ମା-ଖ		
		୧୪୦୬	୦.୧୬୦	୦.୧୬୦	ବେ.ସା		
		୧୪୦୪	୦.୧୨୦	୦.୧୧୦	ମା.ସା-୨		
		୨୪୦୨	୦.୦୬୦	୦.୦୬୦	ମା.ସା-୨		
		୧୬୦୪/୩୨୬୮	୦.୦୬୦	୦.୦୬୦	ମା.ସା		
		୧୬୨୩	୦.୦୩୦	୦.୦୩୦	ମା-ସା-୨		
		୧୪୬୨	୦.୦୩୦	୦.୦୩୦	ମା-ଖ		
		୧୨୮୮	୦.୦୧୦	୦.୦୧୦	ମା-ସା-୨		
		୧୨୩୮	୦.୦୩୦	୦.୦୩୦	ମା.ସା		
୧୬	୫୮	୪୬୬	୦.୫୨୦	୦.୫୨୦	ମା.ସା	ଅଜିତ ତିହାଡି, ପି-ସନ୍ତୋଷ ତିହାଡି, ଲଳିତ ତ୍ରିପାଠୀ, ପି-ଜାନାର୍ଦ୍ଦନ ତ୍ରିପାଠୀ	ବ୍ରାହ୍ମଣ
		୧୨୦(ଯୁ)	୧.୬୪୦	୧.୧୪୦	ବେ.ସା		
		୧୨୨୦	୦.୪୧୦	୦.୪୧୦	ବେ.ସା		
		୧୬୦୧	୦.୪୮୦	୦.୪୮୦	ବେ.ସା		
		୧୬୦୦	୦.୬୦୦	୦.୬୦୦	ବେ-ସା-୨		
		୧୬୧୦	୧.୦୦୦	୧.୦୦୦	ବା.ସା-୨		
		୧୬୨୪	୦.୨୨୧	୦.୨୨୦	ବା.ସା-୨		
		୧୬୨୬	୦.୨୬୦	୦.୨୬୦	ବା.ସା-୨		
		୧୬୨୮	୦.୮୦୦	୦.୮୦୦	ବା.ଖ		
		୧୮୬୧	୦.୧୨୦	୦.୧୨୦	ମା.ସା		
		୧୬୦୨	୦.୨୧୦	୦.୨୧୦	ବେ.ସା		
		୧୨୬୩	୦.୦୩୦	୦.୦୩୦	ବାଗିଆ		
		୧୨୮୨	୦.୧୨୦	୦.୧୨୦	ଅ.ଖ		
		୧୬୦୮(ଯୁ)	୦.୪୬୦	୦.୨୮୦	ମା.ସା		
		୧୨୮୪	୦.୦୧୦	୦.୦୧୦	ଅ.ଖ		
		୧୮୦୧	୦.୧୮୦	୦.୧୮୦	ମା-ଖ-ସା-୨		
		୧୨୨୨	୦.୦୮୦	୦.୦୮୦	ବାଗିଆ		

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Collectorate, Sambalpur

Land Acquisition Officer
SAMBALPUR

କ୍ର.ନଂ	ଖାତା ନଂ	ପ୍ଲଟ ନଂ.	ମୋଟ ରକବା (ଏକରରେ)	ଅଧିଗ୍ରହଣ ହେଉଥିବା ରକବା (ଏକରରେ)	କିସମ	ଜମି ମାଲିକଙ୍କ ନାମ	ଜାତି
୧୭	୪୦	୮୩୩	୦.୮୧୦	୦.୮୧୦	ମା.ଯା	ଚମାର ପଧାନ, ପି-ସାଗର ପଧାନ, ଖାଇ ଦାଣ୍ଡିକ, ପି-ସାଗର ଦାଣ୍ଡିକ	କୁଳତା
		୮୯୯	୦.୧୨୦	୦.୧୨୦	ବେ.ଯା		
		୯୦୦	୦.୮୬୦	୦.୮୬୦	ବେ.ଯା		
		୧୧୯୩	୧.୧୨୦	୧.୧୨୦	ଅ.ଯା		
		୧୨୦୨	୦.୪୪୦	୦.୪୪୦	ବେ.ଯା		
		୧୨୯୩	୦.୨୯୦	୦.୨୯୦	ବେ.ଯା		
		୧୨୯୮	୦.୫୯୦	୦.୩୯୦	ବେ.ଯା		
		୧୩୨୪(ଖ)	୦.୩୩୦	୦.୩୦୦	ବେ.ଯା		
		୧୩୨୯	୦.୨୨୦	୦.୨୨୦	ବା.ଯା		
		୧୩୪୮	୦.୧୭୦	୦.୧୭୦	ବା.ଯା-୨		
		୧୩୬୬	୦.୭୦୦	୦.୭୦୦	ଅ.ଯା		
		୧୩୬୭	୦.୨୯୦	୦.୨୯୦	ମା.ଯା		
		୧୩୭୪	୦.୨୯୦	୦.୧୧୦	ବା.ଯା-୨		
		୧୪୩୮(ଖ)	୦.୩୬୦	୦.୨୧୦	ମା.ଯା		
		୧୪୮୬	୦.୦୮୦	୦.୦୮୦	ଅ.ଯା		
		୭୮୭	୦.୧୬୦	୦.୧୬୦	ଅ.ଯା		
		୭୦୦	୦.୭୪୦	୦.୭୪୦	ବା.ଯା		
		୭୦୭	୧.୧୨୦	୧.୧୨୦	ଅ.ଯା		
		୭୨୧	୦.୭୪୦	୦.୭୪୦	ବା.ଯା		
		୭୨୪	୧.୦୨୦	୧.୦୨୦	ଅ.ଯା		
		୭୨୬	୦.୩୧୦	୦.୩୧୦	ବେ.ଯା		
		୭୨୦	୦.୬୪୦	୦.୬୪୦	ଅ.ଯା		
		୧୬୨୯	୦.୦୮୦	୦.୦୮୦	ଅ.ଯା		
		୧୭୩୨	୦.୦୪୦	୦.୦୪୦	ମା-ଯା-୨		
		୧୭୪୩	୦.୦୩୦	୦.୦୩୦	ମା-ଯା-୨		
		୧୮୦୨	୦.୨୧୦	୦.୨୧୦	ବେ-ଯା-୨		
		୨୦୩୮(ଖ)	୧.୦୧୦	୧.୦୭୦	ମା.ଯା		
		୨୭୧୭	୦.୦୨୦	୦.୦୨୦	ଓଲି-ଯାଲି-୨		
୧୮	୬୦	୧୭୭୯	୦.୦୭୦	୦.୦୭୦	ମା-ଯା-୨	ଚମାର ନାଥ, ପି-ଲୋକନାଥ ନାଥ	ବ୍ରାହ୍ମଣ
୧୯	୫୧	୨୨୨	୦.୨୮୦	୦.୨୮୦	ବା.ଯା-୨	କନକଲତା ନାଥ, ସ୍ୱା- ଚମାର ନାଥ, ତପସ୍ୱିନୀ ନାଥ, ପଙ୍କଜିନୀ ନାଥ, ସନ୍ତୋଷିନୀ ନାଥ, ସୁଧୀର ନାଥ, ପି-ଚମାର ନାଥ, ବୈଷ୍ଣବ ନାଥ, ଭଗବାନ ନାଥ, ନରେନ୍ଦ୍ର ନାଥ, କୁଞ୍ଜ ନାଥ, କ୍ଷୀରୋଦିନୀ ନାଥ, ପି-ବିଭବର ନାଥ, ଲୁଗା ନାଥ ସ୍ୱା- ବିଭବର ନାଥ	ବ୍ରାହ୍ମଣ
		୧୧୧୭	୦.୬୪୦	୦.୬୪୦	ଅ.ଯା		
		୧୧୧୮	୦.୧୪୦	୦.୧୪୦	ମା.ଯା		
		୧୧୧୯	୦.୦୨୦	୦.୦୨୦	ବା.ଯା		
		୧୨୦୦	୦.୬୭୦	୦.୬୭୦	ବେ.ଯା		
		୧୨୦୧	୦.୦୨୦	୦.୦୨୦	ମା.ଯା		
		୧୨୦୬	୧.୦୨୦	୧.୦୨୦	ମା.ଯା		
		୧୩୬୦	୦.୧୬୦	୦.୧୬୦	ବା.ଯା-୨		
		୧୩୬୭	୦.୨୪୦	୦.୨୪୦	ବା.ଯା-୨		
		୧୭୨୨	୦.୦୬୦	୦.୦୬୦	ମା-ଯା-୨		
		୨୨୮୩	୦.୦୧୦	୦.୦୧୦	ଅ.ଯା		
		୧୭୨୦	୦.୦୮୦	୦.୦୮୦	ମା-ଯା-୨		
୨୦	୬୭	୭୮୪	୦.୮୪୦	୦.୮୪୦	ଅ.ଯା	ଚୈତନ୍ୟ ବିଶ୍ୱାଳ, ପି-ନୀଳ ବିଶ୍ୱାଳ	କୁଳତା
		୭୦୯	୦.୨୬୦	୦.୨୬୦	ବା.ଯା		
		୮୧୦	୦.୨୦୦	୦.୨୦୦	ଅ.ଯା		
		୮୧୧	୦.୩୦୦	୦.୩୦୦	ବେ.ଯା		
		୮୩୯	୦.୦୮୦	୦.୦୮୦	ବେ.ଯା		
		୮୪୦	୦.୧୧୦	୦.୧୧୦	ବା.ଯା		
		୧୨୦୩	୦.୩୪୦	୦.୩୪୦	ବେ.ଯା		
		୧୨୧୭	୦.୨୦୦	୦.୨୦୦	ବେ.ଯା		
		୧୩୨୪	୦.୦୬୦	୦.୦୬୦	ବେ.ଯା		
		୧୩୨୭	୦.୦୮୦	୦.୦୮୦	ବେ.ଯା		
		୧୬୨୦	୦.୦୪୦	୦.୦୪୦	ମା.ଯା		
		୧୩୩୦	୦.୨୦୦	୦.୨୦୦	ବେ.ଯା		
		୧୩୩୧(ଖ)	୦.୬୦୦	୦.୩୩୦	ଖା.ଯା		
		୧୩୪୧	୦.୧୩୦	୦.୧୩୦	ଖା.ଯା		
		୧୪୪୭	୦.୨୪୦	୦.୨୪୦	ମା.ଯା		
		୧୭୩୧	୦.୦୪୦	୦.୦୪୦	ମା-ଯା-୨		
		୧୭୪୧	୦.୦୧୦	୦.୦୧୦	ମା-ଯା-୨		
		୧୭୧୭	୦.୦୧୦	୦.୦୧୦	ବାଡ଼ି		
		୧୭୬୩	୦.୦୩୦	୦.୦୩୦	ମା-ଯା-୨		
୨୧	୨୦	୮୮୨	୦.୨୦୦	୦.୨୦୦	ବେ.ଯା	ଭଗେଦରାମ ପାଣି, ପି-ଶୁଭ ପାଣି	ବ୍ରାହ୍ମଣ
		୮୬୭/୩୩୨୪	୦.୦୮୦	୦.୦୮୦	ଅ.ଯା		
		୮୨୨/୩୩୩୦	୦.୧୬୦	୦.୧୬୦	ବା.ଯା		
		୧୧୪୪/୩୩୪୩	୦.୩୨୦	୦.୩୨୦	ଅ.ଯା		
		୧୧୭୧/୩୩୩୭	୦.୦୧୦	୦.୦୧୦	ବେ.ଯା		
		୨୭୨୨/୩୩୩୯	୦.୦୧୦	୦.୦୧୦	ମା.ଯା		

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Collectorate, Sambalpur

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କ୍ର.ନଂ	ଖତା ନଂ	ପ୍ଲଟ ନଂ.	ମୋଟ ରକବା (ଏକରରେ)	ଅଧିକୃତ ହେବାକୁଥିବା ରକବା (ଏକରରେ)	ବିବରଣ	ଭୂମି ମାଲିକଙ୍କ ନାମ	ଜାତି
୨୨	୫୯	୨୫୦୮	୦.୦୫୦	୦.୦୫୦	ଗେ-ପା-୨	ଲଳିତ ତ୍ରିପାଠୀ, ପି-ଜୀବର୍ଦ୍ଧନ ତ୍ରିପାଠୀ	ବ୍ରାହ୍ମଣ
		୨୩୨୫	୦.୦୫୦	୦.୫୫୦	ବା.ପା-୨		
		୨୬୮୨	୦.୬୯୦	୦.୦୯୦	ମା-ପା		
		୨୫୬୮	୦.୦୩୦	୦.୦୩୦	ମା-ପା		
୨୩	୬୨	୮୮୧	୦.୦୨୦	୦.୨୯୦	ମା.ପା	ଚପିସା ଗଣ୍ଡା, ପି-ବାଟି ଗଣ୍ଡା	ଗଣ୍ଡା
		୮୮୩/୯୫୩୫	୦.୦୮୦	୦.୦୮୦	ମା.ପା		
୨୪	୬୬	୪୭୦	୦.୦୫୦	୦.୦୫୦	ମା.ପା	ଯଜ୍ଞସେନା ଦାସ, ସ୍ୱା- ଲଳିତ କୁମାର ଦାସ, ଉମେଶ କୁମାର ଦାସ, ପି-ଲଳିତ କୁମାର ଦାସ	ବ୍ରାହ୍ମଣ
		୪୭୧	୦.୦୫୦	୦.୦୫୦	ମା.ପା		
		୨୬୦୯	୦.୬୮୦	୦.୦୮୦	ମା.ପା		
		୨୯୨୫	୦.୫୦୦	୦.୫୦୦	ମା.ପା-୨		
		୨୭୨୮	୦.୦୦୦	୦.୦୦୦	ମା-ପା-ପା-୨		
		୨୬୩୫	୦.୦୮୦	୦.୦୮୦	ବାରଣି		
		୨୬୦୦	୦.୦୬୦	୦.୦୫୦	ମା.ପା		
୨୫	୬୮	୦୦୧	୫.୦୬୦	୫.୦୬୦	ଦେ.ପା	ଧନେଶ୍ୱର ନାୟକ ପି-ବିଶ୍ୱବନ୍ଧୁ ନାୟକ, ବିଶ୍ୱ ନାୟକ, ପି-ବଳରାମ ନାୟକ	ଭୂୟାଁ
୨୫	୫୦	୦୦୨୩	୦.୦୫୫	୦.୦୫୫	ବା-ପା	ଦମୟନ୍ତୀ ଧର, ସ୍ୱା- ନବଘନ ଧର	ବ୍ରାହ୍ମଣ
୨୫	୫୦	୨୫୨୫	୦.୦୨୦	୦.୦୨୦	ମା.ପା	ଦମୟନ୍ତୀ ଧର, ସ୍ୱା- ନବଘନ ଧର, ଖେଡି ଧର, ଆର୍ତ୍ତତ୍ରାଣ ଧର, ଭାଇକୁମାର ଧର, ଜଲି ଧର, ରାଜେଶ୍ୱରୀ ଧର, ପି-ରାଇପତି ଧର	ବ୍ରାହ୍ମଣ
		୨୨୨୫	୦.୫୫୦	୦.୫୨୦	ମା.ପା		
		୨୬୫୫	୦.୦୫୦	୦.୦୫୦	ମା.ପା		
		୨୦୦୨	୦.୦୯୦	୦.୦୯୦	ମା.ପା		
		୨୦୦୩/୩୨	୦.୦୦୦	୦.୦୨୦	ମା.ପା-୨		
		୨୬୩୪	୦.୦୪୯	୦.୦୪୦	ମା.ପା		
		୨୬୦୮	୦.୦୨୦	୦.୦୨୦	ମା-ପା-୨		
୨୮	୬୨	୨୮୨୦	୦.୦୦୦	୦.୦୦୦	ମା.ପା	ନାରାୟଣ ସେଠ, ପି-ବାଟି ସେଠ	ବେନିଆ
୨୯	୬୫	୪୭୮	୦.୫୯୦	୦.୫୯୦	ମା.ପା	ନାରାୟଣ ପିଣ୍ଡାଳି ଓ ତ୍ରିପାଠୀ, ପି-ଉମ୍ବୋଦାର ତ୍ରିପାଠୀ	ବ୍ରାହ୍ମଣ
		୨୪୨୫	୦.୨୮୦	୦.୨୮୦	ଦେ.ପା		
		୨୭୨୨	୦.୨୩୦	୦.୨୩୦	ମା.ପା-୨		
୩୧	୬୫	୪୭୫	୦.୨୪୦	୦.୨୪୦	ମା.ପା	ନିତ୍ୟାନନ୍ଦ ଦାସ, ପି-କୃଷ୍ଣ ଦାସ	ବ୍ରାହ୍ମଣ
		୨୫୮୯	୦.୨୩୦	୦.୨୩୦	ମା.ପା		
		୨୪୦୨	୦.୪୫୦	୦.୪୫୦	ଦେ.ପା		
		୨୮୦୦	୦.୦୪୦	୦.୦୪୦	ଦେ.ପା		
		୨୨୦୪	୦.୦୩୦	୦.୦୩୦	ମା.ପା		
		୨୨୨୪	୦.୨୨୦	୦.୨୨୦	ମା.ପା-୨		
		୨୬୨୦	୦.୦୭୦	୦.୦୭୦	ମା-ପା-ପା-୨		
୩୨	୬୯	୨୫୮୨	୦.୨୫୦	୦.୨୫୦	ବା.ପା	ନିରଞ୍ଜନ ଧର ପି-କୁଦଦେବ ଧର	ବ୍ରାହ୍ମଣ
୩୨	୮୦	୨୨୨୦	୦.୨୩୦	୦.୨୩୦	ବା.ପା-୨	ଜଗଦୀଶ ନାୟକ, ପି-ଚୁଡାମଣି ନାୟକ	ବ୍ରାହ୍ମଣ
୩୩	୮୨	୨୮୨୫/୩୨	୦.୨୨୦	୦.୪୫୦	ମା.ପା	ଦୁଆଦେଇ ସେଠ ପି-ଧାଗି ସେଠ	ଧୁବା

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ସ୍ଥ.ନଂ	ଖାତା ନଂ	ପ୍ଲଟ ନଂ.	ମୌଜିକ ରକବା (ଏକରରେ)	ଅଧିକୃତ ହେଉଥିବା ରକବା (ଏକରରେ)	ବିବରଣ	ଭୂମି ମାଲିକଙ୍କ ନାମ	ସାହି
୩୫	୮୬	୯୩୨୯	୦.୫୪୦	୦.୫୪୦	ଚଢ.ପା	ପଂଚାନନ ସାହୁ ପିତା-ଘଣି ସାହୁ, ଅନୁଜାୟା ସାହୁ, ସ୍ୱ.- ଗଣେଶ ସାହୁ, ମଙ୍ଗଲା ସାହୁ, ପିତା-ଅରକ୍ଷିତ ସାହୁ	କୁଇଡା
		୯୦୪	୦.୬୨୦	୦.୬୨୦	ଆ.ପା		
		୮୭୨	୨.୩୯୦	୨.୩୯୦	ବା.ପା		
		୮୬୫	୦.୬୮୦	୦.୬୮୦	ବା.ପା		
		୮୬୬	୦.୬୪୦	୦.୬୪୦	ଚଢ.ପା		
		୮୬୮	୦.୯୫୦	୦.୯୫୦	ମା.ପା		
		୮୭୦	୦.୬୮୦	୦.୬୮୦	ବା.ପା		
		୯୫୬	୦.୬୮୦	୦.୬୮୦	ବା.ପା		
		୯୫୮	୦.୬୮୦	୦.୬୮୦	ଚଢ.ପା		
		୯୫୯	୦.୬୯୦	୦.୬୯୦	ବା.ପା		
		୯୫୫୮	୭.୪୩୦	୭.୪୩୦	ଆ.ପା		
		୯୫୬୯	୭.୭୦୫	୭.୭୦୫	ଆ.ପା		
		୯୫୬୭	୦.୩୭୦	୦.୩୭୦	ମା.ପା		
		୯୫୭୦	୭.୬୬୦	୭.୬୬୦	ମା.ପା		
		୯୫୮୮	୦.୪୩୦	୦.୪୩୦	ଆ.ପା		
		୯୫୭୯	୦.୬୭୦	୦.୬୭୦	ବା-ପା		
		୯୫୭୩	୦.୦୭୦	୦.୦୭୦	ମା.ପା		
		୯୫୭୫	୦.୭୦୦	୦.୭୦୦	ଚଢ-ପା-୨		
		୯୫୭୫/୩୫୪୮	୦.୭୫୦	୦.୭୫୦	ବା.ପା		
		୯୫୫୭/୩୫୪୯	୭.୨୪୦	୭.୨୪୦	ବା.ପା		
		୯୫୫୭/୩୫୫୦	୭.୭୦୦	୭.୭୦୦	ବା.ପା		
		୯୫୮/୩୫୫୧	୦.୦୫୦	୦.୦୫୦	ଚଢ.ପା		
		୯୫୭୦/୩୫୫୨	୦.୩୦୦	୦.୩୦୦	ବା-ପା		
		୯୫୩/୩୫୪୩	୦.୦୫୦	୦.୦୫୦	ବା-ପା		
		୯୫୯୩	୦.୦୫୦	୦.୫୫୦	ମା.ପା		
		୯୫୫୯	୦.୦୮୦	୦.୦୮୦	ମା-ଆ		
		୯୫୭୫	୦.୯୨୦	୦.୯୨୦	ମା-ପା-୨		
		୯୫୫୪	୦.୦୩୦	୦.୦୩୦	ଦାରିଖା-ପା-୨		
		୯୯୦୪(ପୁ)	୦.୨୦୦	୦.୯୫୦	ବା.ପା-୨		
		୯୫୭୯	୦.୦୫୦	୦.୦୫୦	ମା-ପା-୨		
୩୬	୮୭	୮୫୨	୦.୬୨୦	୦.୬୨୦	ବା.ପା	ସୁରେନ୍ଦ୍ର ନାଥ, ଠାକୁର ନାଥ, ପିତା-ପଟିତୁମୋହନ ନାଥ, ଜାଲୀଚରଣ ପଣ୍ଡା, କାମାକ୍ଷା ପଣ୍ଡା, ପିତା-ଗୋବିନ୍ଦ ପଣ୍ଡା	ଠାକୁଣ
		୮୮୫	୦.୫୩୦	୫.୯୩୦	ମା.ପା		
		୮୫୫/୩୩୩୯	୦.୯୫୦	୦.୯୫୦	ଚଢ.ପା		
		୯୯୫୫/୩୩୩୨	୦.୩୪୦	୦.୩୪୦	ଆ.ପା		
		୯୯୫୯/୩୩୩୫	୦.୦୯୦	୦.୯୯୦	ଚଢ.ପା		
		୯୫୮୯	୦.୦୫୦	୦.୦୫୦	ମା-ପା		
୩୭	୮୫	୯୯୫୫	୦.୫୯୦	୦.୫୯୦	ଚଢ.ପା	ପବିତ୍ର ନାଥ, ଭଜାନନ ନାଥ, ପିତା-ଜାତିକ ନାଥ, ଉଗବତୀ ନାଥ, ସ୍ୱା- ଜାତିକ ନାଥ	ଠାକୁଣ
		୯୯୭୦	୦.୫୨୦	୦.୫୨୦	ମା.ପା		
		୯୯୩୨	୦.୨୯୦	୦.୨୯୦	ମା.ପା		
୩୭	୮୯	୯୫୮	୦.୩୩୦	୦.୩୩୦	ମା.ପା	ପବିତ୍ର ନାଥ, ଜିତ ନାଥ, ପିତା-ଜାତିକ ନାଥ, ଭଗବତୀ ନାଥ, ସ୍ୱା- ଜାତିକ ନାଥ, ଇନ୍ଦୁମତି ନାଥ, ସ୍ୱା- ଶ୍ରୀଦତ୍ତ ନାଥ, ଚତୁର୍ଭୁଜ ନାଥ, ପିତା- ବଡ ନାଥ	ଠାକୁଣ
		୯୭୩୭	୦.୬୮୦	୦.୬୮୦	ବା.ପା-୨		
		୯୭୫୦	୦.୦୮୦	୦.୦୮୦	ମା-ପା		
		୯୭୦୦	୦.୦୭୦	୦.୦୭୦	ମା-ପା-୨		
		୯୭୫୨	୦.୦୫୦	୦.୦୫୦	ମା-ପା-୨		
୩୮	୯୭	୮୭୨	୦.୫୨୦	୦.୫୨୦	ଚଢ.ପା	ଫକୀରମୋହନ ଦାସ ପିତା-ବୈଦ୍ୟନାଥ ଦାସ	ଠାକୁଣ
		୯୯୨୯	୦.୯୩୦	୦.୯୩୦	ବା.ପା		
		୮୫୨/୩୩୦୨	୦.୨୫୦	୦.୨୫୦	ଆ.ପା		
		୮୭୨/୩୩୦୨	୦.୨୫୦	୦.୨୫୦	ବା.ପା		
		୮୭୨/୩୩୦୦	୦.୩୦୯	୦.୩୦୯	ବା.ପା		
		୯୯୫୫/୩୩୪୪	୦.୯୮୦	୦.୯୮୦	ଆ.ପା		
		୯୫୫୫/୩୩୪୮	୦.୦୩୦	୦.୦୩୦	ମା.ପା		
		୯୭୮୯/୩୩୪୦	୦.୦୪୦	୦.୦୪୦	ମା.ପା		
୩୯	୯୮	୪୭୦	୦.୩୩୦	୦.୩୩୦	ମାପା	ବନବୁରି ପାତୀ, ପିତା-ବୁବଧର ଥର	ଠାକୁଣ
		୯୪୨୫	୦.୦୫୦	୦.୦୫୦	ମା.ପା		
		୯୪୫୨	୭.୦୨୦	୦.୦୨୦	ମା.ପା		
		୯୫୮୦	୦.୦୨୦	୦.୦୨୦	ଚଢ.ପା		
		୯୫୮୪	୦.୨୩୦	୦.୨୩୦	ବା.ପା-୨		
		୯୫୩୩	୦.୦୮୦	୦.୦୮୦	ମା.ପା		
		୯୫୭୯	୦.୦୮୦	୦.୦୮୦	ମା-ପା		
		୯୫୨୨	୦.୦୩୫	୦.୦୩୦	ମା-ପା		

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ସ୍ତ୍ର.ନଂ	ମୌଜା ନଂ	ପ୍ଲଟ ନଂ.	ମୋଟ ରକବା (ଏକରରେ)	ଅଧିକୃତ ହେଉଥିବା ରକବା (ଏକରରେ)	ଜିବନ	ଭୂମି ମାଲିକଙ୍କ ନାମ	ଜାତି
୬୨	୨୯	୬୫୨	୦.୦୨୦	୦.୦୨୦	ଆ.ଘା	ବରୁଣ ପଧାନ, ପି-ହରଚନ୍ଦ ପଧାନ	କୁଳତା
		୬୫୯	୦.୦୨୦୦	୦.୦୨୦୦	ଆ.ଘା		
		୬୮୫	୦.୦୮୦	୦.୦୮୦	ମା.ଘା		
		୬୮୦	୦.୩୫୦	୦.୩୫୦	ଆ.ଘା		
		୬୯୮	୦.୦୫୦	୦.୦୫୦	ବା.ଘା		
		୬୯୨	୦.୮୫୦	୦.୮୫୦	ବା.ଘା		
		୮୫୨	୦.୦୦୦	୦.୦୦୦	ବେ.ଘା		
		୮୪୮	୦.୦୮୦	୦.୦୮୦	ବେ.ଘା		
		୮୪୫	୦.୦୮୦	୦.୦୮୦	ବା.ଘା		
		୮୫୭	୦.୦୯୦	୦.୦୯୦	ବା.ଘା		
		୮୫୯	୦.୦୧୦	୦.୦୧୦	ବା.ଘା		
		୦୦୭୬	୦.୭୫୦	୦.୭୫୦	ବା.ଘା		
		୦୦୭୭	୦.୦୮୦	୦.୦୮୦	ବେ.ଘା		
		୦୦୭୮	୦.୨୪୦	୦.୨୪୦	ବେ.ଘା		
		୦୦୮୯	୦.୫୭୦	୦.୫୭୦	ମା.ଘା		
		୦୦୯୦	୦.୩୨୦	୦.୩୨୦	ଆ.ଘା		
		୦୫୫୫	୦.୦୨୦	୦.୦୨୦	ମା.ଘା		
		୦୦୭୨/୩୨୫୫	୦.୬୦୦	୦.୬୦୦	ବା.ଘା		
		୦୫୦୬	୦.୦୭୦	୦.୦୨୦	ମା.ଘା		
		୦୫୦୭	୦.୦୫୦	୦.୦୫୦	ମା-ଘା-୨		
		୦୫୦୮	୦.୦୫୦	୦.୦୨୦	ମା-ଘା		
		୦୫୦୫	୦.୦୨୦	୦.୦୨୦	ବାଡ଼ିଆ-ଘା-୨		
		୦୫୫୧(ପୁ)	୦.୫୦୦	୦.୦୨୦	ମା.ଘା		
		୦୫୫୬	୦.୦୨୦	୦.୦୨୦	ମା.ଘା		
୬୦	୦୦୯	୬୫୫	୦.୬୮୦	୦.୬୮୦	ଆ.ଘା	ବଂଶୀ କୁମୁରା, ମାନସୀ କୁମରା, ପି-ଜଗା କୁମୁରା, କୁଲଧର କୁମୁରା, ପି-ଭଗା କୁମୁରା, ମାଲତୀ କୁମୁରା, ସ୍ୱା- ରାଜା କୁମୁରା, ଅଇଁଠା କୁମୁରା , ପି-ତିନା କୁମୁରା, ନବ କୁମୁରା, ପି--ରାମସିଂହ କୁମୁରା	ଗଣ
		୦୫୫୭	୦.୬୮୦	୦.୬୮୦	ମା.ଘା		
		୬୪୮/୩୪୩୫	୦.୫୮୦	୦.୫୮୦	ଆ.ଘା		
		୬୪୮/୩୪୩୮	୦.୫୦୦	୦.୫୦୦	ଆ.ଘା		
		୬୪୮	୦.୦୨୦	୦.୦୨୦	ଆ.ଘା		
୬୧	୦୧୨	୦୨୩୨	୦.୨୪୦	୦.୨୪୦	ଆ.ଘା	ଚାଉଁ ପାହୁ, କୁଜା ପାହୁ, ପି-ବିପଳ ପାହୁ	ବୁବତା
		୦୨୩୬(ପୁ)	୦.୪୨୦	୦.୪୦୦	ବା.ଘା		
		୦୨୮୨	୦.୦୨୦	୦.୦୨୦	ଆ.ଘା		
		୦୨୪୯	୦.୦୮୦	୦.୦୮୦	ବା.ଘା		
		୦୨୯୨	୦.୦୨୦	୦.୦୨୦	ମା-ଘା		
		୦୨୯୨	୦.୦୫୦	୦.୦୫୦	ମା.ଘା		
		୦୨୦୯	୦.୦୫୦	୦.୦୫୦	ବାଡ଼ିଆ		
୬୨	୦୧୭	୦୨୨୨	୦.୩୫୦	୦.୩୫୦	ବା.ଘା-୨	ନୀଳାମ୍ବର ନାୟକ, ବିସମ୍ଭର ନାୟକ, ପିଣ୍ଡାପ୍ରସ ନାୟକ, ପି-ଶଙ୍କିର୍ତନ ନାୟକ, ଜାନକୀ ନାୟକ, ସ୍ୱା- ଶଙ୍କିର୍ତନ ନାୟକ, ତ୍ରିନାଥ ବେଟିଆ, ପି-ଜିଧି ବେଟିଆ, ଜନାର୍ଦନ ନାୟକ, ସୁକାନ୍ତି ସେଠ, କମଲା ଜାଗୋ, ପି-ଅଇଁଠା ନାୟକ	ଜେଉଟ
		୦୨୮୬	୦.୪୫୦	୦.୪୫୦	ମା.ଘା		
		୦୨୮୬/୩୫୪୮	୦.୩୫୦	୦.୩୫୦	ମା.ଘା		
		୦୨୮୬	୦.୦୫୦	୦.୦୫୦	ମା-ଘା-୨		
୬୫	୦୧୯	୦୨୦୩	୦.୩୮୦	୦.୩୮୦	ଜେ-ଘା-୨	ବିପିନ ବେହେରା, ପୂର୍ଣମାସୀ ବେହେରା, ପି-ହଜାରି ବେହେରା, ପଦ୍ମ ବେହେରା, ପି-ପ୍ରହଲାଦ ବେହେରା, ସତ୍ୟାନନ୍ଦ ବେହେରା, ପି-ଜିଧି ବେହେରା	ଗ୍ରାହୁଗ
		୦୨୦୭	୦.୦୨୦	୦.୦୨୦	ବା.ଘା-୨		
		୦୨୦୩	୦.୪୫୦	୦.୪୫୦	ଜେ-ଘା-୨		
		୦୨୦୫	୦.୫୪୦	୦.୫୪୦	ମା.ଘା-୨		
		୦୨୦୬	୦.୪୫୦	୦.୪୫୦	ବା.ଘା-୨		
		୦୨୦୯	୦.୫୦୦	୦.୫୦୦	ମା.ଘା		
		୦୨୦୫	୦.୦୨୦	୦.୦୨୦	ମା.ଘା		
		୦୨୦୫	୦.୩୫୦	୦.୩୫୦	ଜେ-ଘା-୨		
		୦୨୦୫	୦.୩୫୦	୦.୩୫୦	ମା.ଘା-୨		
		୦୨୦୫/୩୫୪୫	୦.୦୮୦	୦.୦୮୦	ମା.ଘା		
		୦୨୦୫/୩୫୪୫	୦.୨୦୦	୦.୨୦୦	ମା.ଘା		
		୦୨୦୩/୩୫୪୫	୦.୪୨୦	୦.୪୨୦	ବା.ଘା-୨		
		୦୨୦୪/୩୫୪୫	୦.୨୦୦	୦.୨୦୦	ମା.ଘା-୨		
		୦୨୦୨	୦.୦୫୦	୦.୦୫୦	ମା.ଘା		
		୦୨୨୦	୦.୦୮୦	୦.୦୮୦	ମା-ଘା-୨		
		୦୨୨୬	୦.୦୨୦	୦.୦୨୦	ମା-ଘା-୨		
		୦୨୫୫	୦.୦୨୦	୦.୦୨୦	ମା-ଘା-୨		
		୦୨୦୫	୦.୦୫୦	୦.୦୫୦	ମା-ଘା-୨		
୬୬	୦୧୩	୦୩୩	୦.୬୮୦	୦.୬୦୦	ବା.ଘା	ଜୀର୍ଜନ ମାଝି, ପି-ଚିନ୍ତୁ ମାଝି	Gond
		୦୦୦୨	୦.୪୫୦	୦.୪୫୦	ମା.ଘା-୨		
		୧୯୦୨(ପୁ)	୦.୩୫୦	୦.୩୦୦	ମା.ଘା-୨		
		୦୦୨୫	୦.୩୫୦	୦.୩୫୦	ମା.ଘା-୨		

Land Acquisition Inspector
Collectorate,Sambalpur

Land Acquisition Officer
SAMBALPUR

କ୍ର.ନଂ	ଖତା ନଂ	ପ୍ଲଟ ନଂ.	ମୋଟ ଜରିବା (ଏକରରେ)	ଅଧିକୃତ ହେବାକୁଥିବା ଜରିବା (ଏକରରେ)	ଜିଲ୍ଲା	ଭୂମି ମାଲିକଙ୍କ ନାମ	ମାଟି
୪୨	୧୯୨	୪୨୫	୦.୧୬୦	୦.୧୬୦	ମା.ଘା	କୃଷ୍ଣାନୁ ନାଥ, ପି-ଯୁଧିଷ୍ଠିର ନାଥ, ଗାଙ୍ଗାଧରୀ ନାଥ, ପି-ତାନମାଳା ନାଥ, ସୁରେଶ୍ୱରୀ ନାଥ, ସ୍ୱା- ତାନମାଳା ନାଥ. ସତିଚାନନ୍ଦ ନାଥ, ନିତ୍ୟାନନ୍ଦ ନାଥ, ପି-ପଞ୍ଚମେଶ୍ୱର ନାଥ, ମୁରଲୀଧର ନାଥ, ସୁରେଶ୍ୱର ନାଥ, ପି-ବୁଦ୍ଧେଶ୍ୱର ନାଥ	ବ୍ରାହ୍ମଣ
		୧୬୨୨(ପୂ)	୦.୨୩୦	୦.୦୨୦	ଜା.ଘା		
		୧୪୮୦	୦.୦୫୦	୦.୦୫୦	ଚେ.ଘା		
		୧୪୮୨	୦.୦୫୦	୦.୦୫୦	ଚେ.ଘା		
		୧୪୨୯	୦.୧୦୦	୦.୧୦୦	ଚେ.ଘା		
		୧୮୬୨	୦.୨୮୦	୦.୨୮୦	ମା.ଘା		
		୧୮୫୪	୦.୨୦୦	୦.୨୦୦	ମା.ଘା		
		୧୫୨୫	୦.୦୨୦	୦.୦୨୦	ମା.ଘା		
		୧୫୨୫	୦.୦୨୦	୦.୦୨୦	ମା.ଘା		
		୧୫୦୫	୦.୦୫୦	୦.୦୫୦	ମା-ପା-୨		
		୧୫୦୩	୦.୦୨୦	୦.୦୨୦	ମା-ପା-୨		
		୧୫୦୫	୦.୦୬୦	୦.୦୬୦	ମା-ପା-୨		
		୧୫୦୬	୦.୦୬୦	୦.୦୬୦	ମା-ପା-୨		
		୧୮୮୫	୦.୦୨୦	୦.୦୨୦	ଚେ-ପା-୨		
		୧୫୬୬	୦.୦୬୦	୦.୦୬୦	ମା-ପା-୨		
୪୮	୧୯୮	୧୯୨୨	୦.୬୭୦	୦.୬୭୦	ମା.ଘା	କୃଷ୍ଣାନୁ ନାଥ, ପି-ଯୁଧିଷ୍ଠିର ନାଥ, ସୁରେଶ୍ୱରୀ ନାଥ, ସ୍ୱା- ତାନମାଳା ନାଥ. ସତିଚାନନ୍ଦ ନାଥ, ନିତ୍ୟାନନ୍ଦ ନାଥ, ପି-ପଞ୍ଚମେଶ୍ୱର ନାଥ, ମୁରଲୀଧର ନାଥ, ସୁରେଶ ନାଥ, ପି-ବୁଦ୍ଧେଶ୍ୱର ନାଥ	ବ୍ରାହ୍ମଣ
		୧୯୨୯	୦.୦୨୮୦	୦.୦୨୮୦	ମା.ଘା		
		୧୯୫୦	୦.୦୨୮୦	୦.୦୨୮୦	ଆ.ଘା		
		୧୯୫୯	୦.୩୪୦	୦.୩୪୦	ଆ.ଘା		
		୧୯୫୪	୦.୩୦୦	୦.୩୦୦	ଚେ-ପା-୨		
		୧୫୨୯	୦.୩୫୦	୦.୩୫୦	ଜା.ଘା-୧		
		୧୫୨୯	୦.୩୦୦	୦.୩୦୦	ଘା.ଘା		
		୧୯୪୫/୩୪୪୨	୦.୨୨୦	୦.୨୨୦	ମା.ଘା		
		୧୪୫୦/୩୪୪୫	୦.୨୪୦	୦.୨୪୦	ଆ.ଘା		
		୧୯୨୨/୩୪୪୦(ପୂ)	୦.୫୨୦	୦.୫୦୦	ମା.ଘା		
		୧୯୮୩/୩୪୨୫	୦.୦୫୦	୦.୦୫୦	ଘା.ଘା		
		୧୯୮୩/୩୪୫୫	୦.୦୪୦	୦.୦୪୦	ଘା.ଘା		
		୧୯୮୬/୩୪୮୦	୦.୦୬୦	୦.୦୬୦	ଚେ.ଘା		
		୧୯୮୮/୩୪୨୬(ପୂ)	୦.୫୬୦	୦.୨୫୦	ଘା-ଘା		
		୧୯୮୮/୩୪୫୫(ପୂ)	୦.୮୫୦	୦.୨୫୦	ଘା-ଘା		
		୧୯୨୫	୧.୮୪୦	୧.୮୪୦	ଆ.ଘା		
		୧୬୨୨	୦.୦୪୦	୦.୦୫୦	ବାଲିଆ		
		୧୬୨୮	୦.୨୪୦	୦.୨୪୦	ବାଲିଆ		
		୧୬୨୯	୦.୦୫୦	୦.୦୫୦	ବାଲିଆ		
		୧୫୪୦/୩୫୨୪	୦.୦୨୦	୦.୦୨୦	ବାଲିଆ		
୪୯	୧୨୩	୨୫୦	୦.୧୩୦	୦.୧୩୦	ମା.ଘା	ଗୋରାପି ସାହୁ, ସ୍ୱା- ଜଗବାନ ସାହୁ, ବଳଧର ସାହୁ, ପୁଷ୍ପାଞ୍ଜଳି ସାହୁ, ଗାଦାଞ୍ଜଳି ସାହୁ, ପି-ଜଗବାନ ସାହୁ, ଉଜିଆବତୀ ସାହୁ, ସ୍ୱା- ଗୋବର୍ଦ୍ଧନ ସାହୁ, ରେବତୀ ସାହୁ, ସ୍ୱା- ସୁଭଦେବ ସାହୁ	ତୁରତା
		୨୨୨	୦.୪୨୦	୦.୪୨୦	ଜା.ଘା		
		୨୫୧	୦.୩୨୦	୦.୩୨୦	ଆ.ଘା		
		୨୫୨	୦.୦୮୦	୦.୦୮୦	ଘା-ଘା		
		୧୩୮୩	୦.୨୫୦	୦.୨୫୦	ଆ.ଘା		
		୧୩୯୨	୦.୦୮୦	୦.୦୮୦	ମା.ଘା		
		୧୩୯୨	୦.୦୮୦	୦.୦୮୦	ମା.ଘା		
		୧୩୯୩	୦.୦୮୦	୦.୦୮୦	ମା.ଘା		
		୧୩୯୫	୦.୦୩୦	୦.୦୩୦	ମା.ଘା		
		୧୩୯୬	୦.୦୯୦	୦.୦୯୦	ମା.ଘା		
		୧୩୯୭	୦.୦୫୦	୦.୦୫୦	ମା.ଘା		
		୧୩୯୯	୦.୦୫୦	୦.୦୫୦	ମା.ଘା		
		୧୩୮୬	୦.୦୨୦	୦.୦୨୦	ମା.ଘା		
		୧୩୮୭	୦.୨୨୦	୦.୨୨୦	ମା.ଘା		
		୧୩୮୬/୩୫୨୯	୦.୦୨୦	୦.୦୨୦	ମା-ପା-୨		
		୧୩୫୮	୦.୦୨୦	୦.୦୨୦	ମା.ଘା		
		୧୩୫୯	୦.୨୨୦	୦.୨୨୦	ମା.ଘା		
		୧୩୯୦	୦.୦୨୦	୦.୦୨୦	ବାଲି.ଘା		
		୧୩୯୩	୦.୦୨୮	୦.୦୨୦	ବାଲି.ଘା		
		୧୩୫୩	୦.୦୯୦	୦.୦୯୦	ମା.ଘା		
		୧୩୩୬	୦.୦୬୦	୦.୦୬୦	ଚେ.ଘା		
		୧୩୫୨	୦.୧୦୫	୦.୧୦୦	ଆ.ଘା		
		୧୩୩୬	୦.୧୦୫	୦.୧୦୦	ମା.ଘା		
		୧୩୫୬	୦.୦୨୫	୦.୦୨୦	ମା.ଘା		
		୧୩୫୫	୦.୦୨୯	୦.୦୨୦	ମା.ଘା		

Land Acquisition Inspector
Collectorate, Sambalpur

Land Acquisition Officer
SAMBALPUR

କ୍ର.ନଂ	ଖତା ନଂ	ପ୍ଲଟ ନଂ.	ମୋଟ ରକବା (ଏକରରେ)	ଅଧିକୃତ ହେବାକୁଥିବା ରକବା (ଏକରରେ)	ବିବରଣ	ଭୂମି ମାଲିକଙ୍କ ନାମ	ସାହି
୫୦	୦୨୫	୫୬୮	୦.୦୫୦	୦.୦୫୦	ବା.ପା- ୨	ଗୋଲାପି ସାହୁ, ସ୍ୱା- ଜଗବନ୍ଧୁ ସାହୁ, ହଲଧର ସାହୁ, ପୁଷ୍ପାଞ୍ଜଳି ସାହୁ, ଘାଟାଞ୍ଜଳି ସାହୁ, ପି-ଜଗବନ୍ଧୁ ସାହୁ	ବୁଢ଼ତା
		୫୭୬	୦.୩୫୦	୦.୩୫୦	ବା.ପା		
		୫୫୨	୦.୩୩୦	୦.୩୩୦	ଆ.ପା		
		୨୨୪୬(ପୁ)	୯.୩୮୦	୯.୦୦୦	ଆ.ପା		
		୨୨୮୦	୦.୬୨୦	୦.୬୨୦	ଆ.ପା		
		୨୨୯୦	୦.୦୮୦	୦.୧୮୦	ମା.ପା		
		୨୨୯୨	୦.୦୨୦	୦.୦୨୦	ମା.ପା		
		୨୨୦୬	୦.୨୫୦	୦.୨୫୦	ବା.ପା- ୨		
		୨୨୦୮	୦.୦୫୧	୦.୦୫୦	ବା.ପା- ୨		
		୨୨୫୩	୦.୦୨୦	୦.୦୨୧	ଆ.ପା		
		୨୨୭୫	୦.୦୫୦	୦.୦୫୦	ମା.ପା- ୨		
		୨୨୭୯	୦.୨୮୧	୦.୨୮୧	ମା.ପା		
		୨୨୭୨	୦.୨୧୦	୦.୨୩୦	ମା.ପା		
		୨୨୭୫	୦.୦୫୦	୦.୦୫୦	ମା-ପା- ୨		
		୨୨୪୩	୦.୦୪୦	୦.୦୪୦	ମା-ପା- ୨		
		୨୨୫୫	୦.୦୪୭	୦.୦୪୦	ମା-ପା- ୨		
		୨୨୯୦	୦.୦୨୦	୦.୦୨୦	ବା-ବା-ପା- ୨		
୫୨	୦୨୫	୨୦୫	୦.୦୮୦	୦.୦୮୦	ମା.ପା	ଉତ୍ତରାମ ପଧାନ, ପ.-ଫକିର ପଧାନ	ବୁଢ଼ତା
		୨୩୦	୦.୨୩୦	୦.୨୩୦	ବା.ପା		
		୨୪୫୦	୦.୦୮୦	୦.୦୮୦	ଆ.ପା		
୫୩	୦୨୫	୨୫୨୩	୦.୦୪୦	୦.୦୪୦	ମା-ପା- ୨	ଉଉବତିଆ ସାହୁ, ପି-ମୁନୁ ସାହୁ.	ବୁଢ଼ତା
୫୩	୦୨୯	୨୫୫୯	୦.୦୫୦	୦.୦୫୦	ମା.ପା- ୨	ରଞ୍ଜସେନୀ ଦାସ ସ୍ୱା- ଉଲିତ କୁମାର ଦାସ, ରମେଶ କୁମାର ଦାସ, ପି- ଉଲିତ କୁମାର ଦାସ	ବ୍ରାହ୍ମଣ
୫୪	୦୨୯	୨୩୫୩	୦.୨୫୦	୦.୨୫୦	ବା.ପା- ୨	ମାୟଦତୀ ନାୟକ ସ୍ୱା-ଦୁଖୁ ନାୟକ ରାମକୃଷ୍ଣ ନାଥ ପିତା-ସୁତ୍ରୀ ନାଥ	ବ୍ରାହ୍ମଣ
		୨୨୮୦	୦.୦୩୦	୦.୦୩୦	ମା-ପା- ୨		
		୫୫୨	୦.୨୩୦	୦.୨୩୦	ମା.ପା		
୫୫	୦୨୫	୨୦୬୯	୦.୦୦୦	୦.୦୦୦	ମା.ପା- ୨	ସୌଦାମିନୀ କୁମୁରା, ସ୍ୱା- ଉସିଆ କୁମୁରା, ତରୁଣୀ କୁମୁରା, ସଗୋଡିନୀ କୁମୁରା, ମୋଡିନୀ କୁମୁରା, ମଝାଲିନୀ କୁମୁର, କ୍ଷୀରୋଦ କୁମୁରା, ପି-ଉସିଆ କୁମୁରା	ଗଣ୍ଡ
୫୫	୦୨୫	୫୫୦	୦.୪୫୦	୦.୪୫୦	ବା.ପା	ମୁକ୍ତେଶ୍ୱର ପଧାନ, ପି-ଛାଲ ପଧାନ	ବୁଢ଼ତା
୫୨	୦୨୫	୫୫୪	୦.୦୮୦	୦.୦୮୦	ଆ.ପା	ମୁକ୍ତେଶ୍ୱର ପଧାନ, ଶଙ୍କର ପଧାନ, ସାବିତ୍ରୀ ପାତ୍ର, ଦ୍ରୌପଦୀ ଖମାରି, ନିଲାମଣର ପଧାନ, ପି-ମୁକ୍ତେଶ୍ୱର ପଧାନ, ଜେତକୀ ପଧାନ, ସ୍ୱା-ମୁକ୍ତେଶ୍ୱର ପଧାନ, ଗୋପେଶ୍ୱରୀ ପଧାନ, ମହାଦେବ ପଧାନ, ପି-ବିନ୍ଦେ ପଧାନ, ନିଦିତା ପଧାନ, ପି-ବଳ୍ଲଭ ପଧାନ	ବୁଢ଼ତା
		୫୫୭	୦.୦୮୦	୦.୦୮୦	ଆ.ପା		
		୮୦୫	୦.୨୮୦	୦.୨୮୦	ବା.ପା		
		୮୦୬	୦.୦୮୦	୦.୦୮୦	ଜେ.ପା		
		୮୦୭	୨.୦୫୦	୨.୦୫୦	ଜେ.ପା		
		୮୪୮	୦.୬୫୦	୦.୬୫୦	ଜେ.ପା		
		୮୦୮(ପୁ)	୦.୬୮୦	୦.୭୫୦	ମା.ପା		
		୨୨୦୨	୦.୨୨୦	୦.୨୨୦	ଆ.ପା		
		୨୨୦୬	୦.୨୦୦	୦.୨୦୦	ଆ.ପା		
		୨୨୨୦	୦.୨୦୦	୦.୨୦୦	ବା.ପା		
		୨୨୨୨	୦.୫୩୦	୦.୫୩୦	ବା.ପା		
		୨୨୨୩	୦.୪୩୦	୦.୪୩୦	ବା.ପା		
		୨୨୨୫	୦.୦୭୦	୦.୦୭୦	ଆଡି		
		୨୨୨୬	୦.୨୪୦	୦.୨୪୦	ଜେ.ପା		
		୨୨୨୭	୦.୨୫୦	୦.୨୫୦	ଆ.ପା		
		୨୪୫୫	୦.୦୫୭	୦.୧୫୫	ମା.ପା		
		୨୨୭୨	୦.୦୮୦	୦.୦୮୦	ମା.ପା		
		୮୦୮/୪୨୪୪	୦.୦୫୦	୦.୦୫୦	ମା.ପା		
		୨୨୨୫/୫୦୮୫	୦.୦୮୦	୦.୦୮୦	ଆ.ପା		
		୨୪୫୭	୦.୦୨୦	୦.୦୧୦	ମା-ପା- ୨		
		୨୨୫୫	୦.୦୨୦	୦.୦୨୦	ମା-ବା		
		୨୨୫୬	୦.୦୨୦	୦.୦୨୦	ମା-ପା		
		୨୨୨୭	୦.୧୫୦	୦.୧୫୦	ମା.ପା		
		୨୨୮୮	୦.୦୮୦	୦.୧୩୦	ମା.ପା		
		୨୨୨୫	୦.୨୩୦	୦.୨୩୦	ଆ.ପା		
		୨୨୨୦	୦.୦୨୦	୦.୦୨୦	ବାଲିଆ-ପା- ୨		
		୨୨୫୫	୦.୦୨୦	୦.୦୨୦	ମା-ପା- ୨		

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Collectorate, Sambalpur

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କ୍ର.ନଂ	ଖାତା ନଂ	ପ୍ଲଟ ନଂ.	ମୋଟ ରକବା (ଏକରରେ)	ଅଧିକୃତ ହେବାକୁଥିବା ରକବା (ଏକରରେ)	ବିବରଣ	ଭୂମି ମାଲିକଙ୍କ ନାମ	ଗାଁ
୬୮	୯୩୯	୪୭୯	୦.୫୨୦	୦.୫୨୦	ଗା.ପା	ମୁରଲୀଧର ଦାସ, ପି-ଜାତିକ ଦାସ	ବ୍ରାହ୍ମଣ
		୯୪୮୬	୦.୦୮୦	୦.୦୮୦	ବେ.ପା		
		୯୪୮୮	୦.୯୪୦	୦.୯୪୦	ବେ.ପା		
		୯୪୯୧	୦.୫୮୦	୦.୫୮୦	ଗା-ପା		
		୯୪୯୩	୦.୯୩୦	୦.୯୩୦	ବେ.ପା		
		୯୫୦୮	୦.୦୮୦	୦.୦୮୦	ଗା.ପା-୨		
		୯୫୧୦	୦.୯୨୦	୦.୯୨୦	ଗା.ପା-୨		
		୯୪୮୫	୦.୦୯୦	୦.୦୯୦	ଗା-ପା		
		୯୫୭୨	୦.୦୨୦	୦.୦୨୦	ଗା-ପା		
		୯୫୭୮	୦.୦୩୦	୦.୦୩୦	ଗା-ପା		
		୯୫୦୩(ପୁ)	୦.୫୪୦	୦.୨୩୦	ବା.ପା-୨		
		୯୫୭୦	୦.୦୫୦	୦.୦୫୦	ଗା-ପା		
୫୯	୯୫୦	୯୯୪୨	୯.୫୫୦	୯.୫୫୦	ବା.ପା	ମୌଥିକା ନାଥ, ପି-ନରୁଣାଚର ନାଥ	ବ୍ରାହ୍ମଣ
୭୦	୯୫୪	୭୦୩	୦.୩୨୦	୦.୩୨୦	ଆ.ପା	ଉତ୍ତମା ଦତେଇ, ପି-ସୁର୍ଯ୍ୟମଣି ସାହୁ, ସୁମିତ୍ରା ପଧାନ ସ୍ୱା- ଉପେନ୍ଦ୍ର ପଧାନ	କୁଲତା
		୯୩୬	୦.୦୨୦	୦.୦୨୦	ଗା.ପା		
		୯୩୬	୦.୯୮୦	୦.୯୮୦	ବା.ପା		
		୯୪୩	୯.୫୫୦	୯.୫୫୦	ଆ.ପା		
		୯୪୬	୦.୬୮୦	୦.୬୮୦	ବା.ପା		
		୯୫୫	୦.୬୯୦	୦.୬୯୦	ବା.ପା		
		୯୫୮	୦.୦୨୦	୦.୦୨୦	ବା.ପା		
		୯୪୮୮	୦.୯୫୦	୦.୯୫୦	ବେ.ପା		
		୯୪୯୦	୫.୦୯୦	୫.୦୯୦	ବା.ପା		
		୯୪୯୯	୦.୭୦୦	୦.୭୦୦	ବା.ପା		
		୯୪୯୯	୦.୬୯୦	୦.୬୯୦	ଆ.ପା		
		୯୪୯୬	୦.୩୦୦	୦.୩୦୦	ଗା.ପା		
		୯୫୮୬	୦.୨୪୦	୦.୨୪୦	ବା.ପା-୨		
		୯୮୨୦	୦.୩୦୦	୦.୩୦୦	ବେ-ପା-୨		
		୯୮୨୬	୦.୩୫୦	୦.୩୫୦	ଗା.ପା-୨		
		୯୪୨୯	୦.୬୯୦	୦.୬୯୦	ଆ.ପା		
		୯୪୨	୦.୨୪୦	୦.୨୪୦	ବା-ପା		
		୯୪୦୯	୦.୦୦୦	୦.୦୦୦	ଗା-ପା-୨		
୭୧	୯୪୪	୪୯୦	୦.୪୨୦	୦.୪୨୦	ବା.ପା-୨	ଉତ୍ତମ ସାହୁ, ପି-ନାରାୟଣ ସାହୁ	କୁଲତା
		୪୯୩	୦.୨୦୦	୦.୨୦୦	ଆ.ପା		
		୯୫୫	୦.୩୯୦	୦.୩୯୦	ବା.ପା		
		୯୫୬୦	୦.୨୩୦	୦.୨୩୦	ଗା.ପା		
		୯୩୮୨	୦.୨୯୦	୦.୨୯୦	ଆ.ପା		
		୯୩୯୪	୦.୦୨୦	୦.୦୨୦	ଗା.ପା		
		୯୪୦୫	୦.୦୭୦	୦.୦୭୦	ବା.ପା-୨		
		୯୪୦୯	୦.୦୮୦	୦.୦୮୦	ବା.ପା-୨		
		୯୪୪୭	୦.୦୪୦	୦.୦୪୦	ଗା.ପା-୨		
		୯୪୪୯	୦.୦୨୦	୦.୦୨୦	ବେ-ପା-୨		
		୯୪୫୫	୦.୦୮୦	୦.୦୮୦	ଗା.ପା-୨		
		୯୪୫୬	୦.୦୫୦	୦.୦୫୦	ଗା-ପା-୨		
		୯୪୯୦	୦.୦୨୦	୦.୦୨୦	ଗା.ପା		
		୯୪୯୨	୦.୦୨୦	୦.୦୨୦	ଗା.ପା		
		୯୪୯୫	୦.୦୨୦	୦.୦୨୦	ଗା-ପା-୨		
		୯୪୯୭	୦.୦୨୦	୦.୦୨୦	କାଲିଭ-ପା-୨		
୭୨	୯୫୨	୯୩୩୫	୦.୩୨୦	୦.୩୦୦	ବା.ପା	ଇନ୍ଦ୍ର ପାଲ, ପି-ନାଳାମ୍ବର ପାଲ	ବ୍ରାହ୍ମଣ
		୯୪୫୦	୦.୫୨୦	୦.୫୨୨	ଗା.ପା		
		୯୪୫୩	୦.୦୦୦	୦.୦୦୦	ବେ.ପା		
		୯୪୬୩	୦.୦୫୦	୦.୦୫୦	ବା.ପା		
		୯୪୮୫	୦.୦୫୦	୦.୦୫୦	ବେ.ପା		
		୯୪୮୯	୦.୦୨୦	୦.୦୨୦	ଗା.ପା		
		୯୪୫୫/୩୪୦୨	୦.୨୨୦	୦.୨୫୦	ବା.ପା		
		୯୩୮/୩୪୦୫	୦.୩୦୦	୦.୩୦୦	ବେ.ପା		
		୯୪୦୭	୦.୦୦୦	୦.୦୦୦	ଗା.ପା		
		୯୪୦୫	୦.୦୦୦	୦.୦୦୦	ଗା.ପା		
		୯୪୫୫/୩୪୦୩	୦.୦୨୦	୦.୦୨୦	ବାଲି.ପା		
		୯୪୫୫/୩୪୦୨	୦.୦୦୦	୦.୦୯୦	ଗା.ପା		
		୯୪୦୭	୦.୦୨୦	୦.୦୨୦	ଗା.ପା		
		୯୪୦୩	୦.୨୪୦	୦.୨୪୦	ଗା.ପା		
୭୩	୯୫୦	୯୨୩	୦.୦୮୦	୦.୦୮୦	ଗା.ପା	ରାମଚନ୍ଦ୍ର ତ୍ରିପାଠୀ, ପି-ବିଦ୍ୟାମଣି ତ୍ରିପାଠୀ	ବ୍ରାହ୍ମଣ
		୯୨୪	୦.୦୨୦	୦.୦୨୦	ଗା.ପା		
		୯୫୫/୩୩୭୦	୦.୦୦୦	୦.୦୦୦	ବା-ପା		
୭୪	୯୫୯	୯୨୪୭	୦.୦୨୦	୦.୨୨୦	ଗା.ପା	ରାମଚନ୍ଦ୍ର ତ୍ରିପାଠୀ, ଇନ୍ଦ୍ରଜ ତ୍ରିପାଠୀ, ପି-ବିଦ୍ୟାମଣି ତ୍ରିପାଠୀ	ବ୍ରାହ୍ମଣ

Land Acquisition Inspector
Collectorate, Sambalpur

Land Acquisition Officer
SAMBALPUR

କ୍ର.ନଂ	ଖାତା ନଂ	ପ୍ଲଟ ନଂ.	ମୋଟ ରକବା (ଏକରରେ)	ଅଧିଗ୍ରହଣ ହେଉଥିବା ରକବା (ଏକରରେ)	କିସମ	ଭୂମି ମାଲିକଙ୍କ ନାମ	ଜାତି
୨୫	୧୫୨	୨୨୨	୦.୨୩୯	୦.୨୩୯	ବା.ପା-୨	ରାମଚନ୍ଦ୍ର ତ୍ରିପାଠୀ, ଲକ୍ଷ୍ମଣ ତ୍ରିପାଠୀ, ପି-ଚିନ୍ତାମଣି ତ୍ରିପାଠୀ, ବସୁମତୀ ତ୍ରିପାଠୀ, ସ୍ଵା- ଚିନ୍ତାମଣି ତ୍ରିପାଠୀ, ଶଶିଭୂଷଣ ତ୍ରିପାଠୀ, ପି-ନୀଳମଣି ତ୍ରିପାଠୀ, ମାଳବତୀ ତ୍ରିପାଠୀ, ସ୍ଵା- ନୀଳମଣି ତ୍ରିପାଠୀ	ବ୍ରାହ୍ମଣ
		୯୪୪(ଗ)	୦.୬୦୦	୦.୨୮୦	ଘ.ସା		
		୯୪୬	୦.୧୯୦	୦.୧୯୯	ବେ.ସା		
		୧୨୦୨	୦.୨୨୦	୦.୨୨୦	ବେ-ପା-୨		
		୧୨୧୧	୦.୪୩୦	୦.୪୩୦	ବା.ପା-୨		
		୧୨୨୩	୦.୬୩୦	୦.୬୩୦	ବା.ପା-୨		
		୧୧୨୧	୦.୩୨୦	୦.୩୨୦	ଘ.ସା		
		୧୨୨୧	୦.୦୮୦	୦.୦୮୦	ମା-ପା-୨		
		୧୫୨୬	୦.୦୯୦	୦.୦୯୯	ମା-ଘା		
		୧୨୮୧	୦.୦୨୦	୦.୦୨୦	ମା-ପା-୨		
		୧୨୬୬	୦.୧୨୦	୦.୧୨୦	ମା-ପା-୨		
		୧୧୧୦(ଗ)	୦.୨୯୦	୦.୩୪୦	ବା ପା-୨		
		୧୨୨	୦.୧୪୦	୦.୧୪୦	ବେ.ସା		
		୧୨୦(ଗ)	୩.୪୨୦	୩.୪୨୦	ବେ.ସା		
		୧୨୧(ଗ)	୦.୦୨୦	୦.୦୨୦	ଜଳ		
		୧୨୨(ଗ)	୦.୩୩୦	୦.୧୬୦	ମୁଣ୍ଡା		
		୧୫୦୫(ଗ)	୦.୫୨୦	୦.୧୮୦	ମା.ସା		
		୧୬୧	୦.୧୨୦	୦.୧୨୦	ବା-ସା		
		୧୮୧(ଗ)	୦.୧୩୦	୦.୧୬୦	ବା-ସା		
		୧୨୪(ଗ)	୦.୧୮୦	୦.୧୩୦	ବେ.ସା		
		୧୮୦୦	୦.୧୨୦	୦.୧୨୦	ବା-ଘା-ପା-୨		
		୧୨୨୪	୦.୦୨୦	୦.୦୨୦	ମା-ପା-୨		
		୧୨୮୪	୦.୦୧୦	୦.୦୧୦	ବଗିଚା-୨		
		୧୨୨୪	୦.୦୨୦	୦.୦୨୦	ବା-ଘା-ପା-୨		
୨୬	୧୫୩	୨୨୨	୧.୫୦୦	୧.୫୦୦	ଘ.ସା	ରାମଚନ୍ଦ୍ର ତ୍ରିପାଠୀ, ଲକ୍ଷ୍ମଣ ତ୍ରିପାଠୀ, ପି-ଚିନ୍ତାମଣି ତ୍ରିପାଠୀ, ଶଶିଭୂଷଣ ତ୍ରିପାଠୀ, ପି-ନୀଳମଣି ତ୍ରିପାଠୀ	ବ୍ରାହ୍ମଣ
		୨୪୧	୦.୫୪୦	୦.୫୪୦	ମା.ସା		
		୨୨୩	୦.୨୧୦	୦.୨୧୦	ବା.ସା		
୨୭	୧୨୩	୪୨୨	୦.୨୬୦	୦.୨୬୦	ମା.ସା	ଲୁଚା ଧର, ପି-ଘାସି ଧର	ବ୍ରାହ୍ମଣ
		୧୩୧୨	୦.୨୨୦	୦.୨୨୦	ବା.ପା-୨		
		୧୩୫୧	୦.୦୬୦	୦.୦୬୦	ବେ.ସା		
		୧୩୨୦	୦.୧୬୦	୦.୧୬୦	ବେ.ସା		
		୧୩୨୧	୦.୦୨୦	୦.୦୨୦	ବେ.ସା		
		୧୩୨୩	୦.୦୧୦	୦.୦୧୦	ବେ.ସା		
		୧୩୨୪	୦.୧୨୦	୦.୧୨୦	ବେ.ସା		
		୧୩୨୬	୦.୦୬୦	୦.୦୬୦	ବେ.ସା		
		୧୩୨୨	୦.୦୬୦	୦.୦୬୦	ବେ.ସା		
		୧୩୨୮	୦.୦୮୦	୦.୦୮୦	ବେ.ସା		
		୧୩୧୨	୦.୪୬୦	୦.୪୬୦	ବେ-ପା-୨		
		୧୩୧୮	୦.୦୨୦	୦.୦୨୦	ବେ-ପା-୨		
		୧୩୧୦	୦.୨୩୦	୦.୨୩୦	ବେ-ପା-୨		
		୧୪୦୦	୦.୨୪୦	୦.୨୪୦	ବେ-ପା-୨		
		୧୪୦୪	୦.୫୪୦	୦.୫୪୦	ମା.ପା-୨		
		୧୪୧୨	୦.୨୧୦	୦.୨୧୦	ବା.ପା-୨		
		୧୪୧୩	୦.୧୬୦	୦.୧୬୦	ବା.ପା-୨		
		୧୪୧୬	୧.୨୦୦	୧.୨୦୦	ବା.ପା-୨		
		୧୪୧୮	୦.୨୨୦	୦.୨୨୦	ବା.ପା-୨		
		୧୪୧୧(ଗ)	୦.୩୪୦	୦.୧୮୦	ବା.ପା-୨		
		୧୪୮୧	୦.୦୨୦	୦.୦୨୦	ବେ.ସା		
		୧୪୦୨	୦.୦୨୦	୦.୦୨୦	ବେ.ସା		
		୧୪୧୮	୦.୧୨୦	୦.୧୨୦	ବେ.ସା		
		୧୫୦୦	୦.୧୨୦	୦.୧୨୦	ବେ.ସା		
		୧୫୦୧	୦.୧୧୦	୦.୧୧୦	ମା.ସା		
		୧୫୦୨	୦.୦୩୦	୦.୦୩୦	ମା.ସା		
		୧୫୮୨(ଗ)	୦.୩୨୦	୦.୨୪୦	ବା.ପା-୨		
		୧୫୮୮(ଗ)	୧.୧୬୦	୧.୦୧୦	ବା.ପା-୨		
		୧୫୮୦(ଗ)	୦.୩୨୦	୦.୨୦୦	ମା.ପା-୨		
		୧୬୯୦	୦.୪୬୦	୦.୪୬୦	ମା.ପା-୨		
		୧୬୯୧	୦.୩୪୦	୦.୩୪୦	ମା.ପା-୨		
		୧୬୯୩	୦.୨୦୦	୦.୨୦୦	ମା.ପା-୨		
		୧୮୬୩	୦.୨୦୦	୦.୨୦୦	ମା.ସା		
		୧୮୬୬	୦.୨୦୦	୦.୨୦୦	ମା.ସା		
		୧୮୬୭	୦.୨୪୦	୦.୨୪୦	ମା.ସା		
		୧୮୭୨	୦.୦୨୦	୦.୦୨୦	ବା.ପା-୨		
		୧୮୭୮	୦.୦୬୦	୦.୦୬୦	ବେ-ପା-୨		
		୧୮୮୨	୦.୦୪୦	୦.୦୪୦	ବେ-ପା-୨		
		୧୬୨୨	୦.୦୩୦	୦.୦୩୦	ମା-ଘା		
		୧୬୮୨	୦.୦୪୦	୦.୦୪୦	ମା-ପା-୨		
		୧୬୮୩	୦.୦୨୦	୦.୦୨୦	ମା-ପା-୨		
		୧୨୮୪	୦.୦୬୦	୦.୦୬୦	ମା-ପା-୨		
		୧୨୦୮	୦.୦୬୦	୦.୦୬୦	ମା-ପା-୨		
		୧୨୩୦	୦.୦୬୦	୦.୦୬୦	ମା-ପା-୨		
		୧୨୪୮	୦.୦୨୦	୦.୦୨୦	ମା.ସା		
		୧୬୨୪	୦.୦୩୦	୦.୦୩୦	ମା-ଘା		
		୧୬୨୩	୦.୦୨୦	୦.୦୨୦	ମା-ଘା		
		୧୮୮୫	୦.୨୨୦	୦.୨୨୦	ମା.ସା		
		୧୨୦୩	୦.୦୬୦	୦.୦୬୦	ମା-ପା-୨		
୨୮	୧୨୪	୧୪୨୫	୦.୦୨୦	୦.୦୨୦	ବା.ସା	ଲୁଚା ଧର, ସ୍ଵା- ନିରଞ୍ଜନ ଧର	ବ୍ରାହ୍ମଣ
		୧୪୪୮(ଗ)	୦.୧୮୦	୦.୨୨୦	ମା.ସା		
		୧୪୪୦(ଗ)	୦.୨୦୦	୦.୨୦୦	ଘ.ସା		

Land Acquisition Inspector
Collectorate,Sambalpur

Land Acquisition Officer
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କ୍ର.ନଂ	ଖତା ନଂ	ପ୍ଲଟ ନଂ.	ମୋଟ ଜରିବା (ଏକରରେ)	ଅଧିକୃତ ହେଉଥିବା ଜରିବା (ଏକରରେ)	ବିବରଣ	ଭୂମି ମାଲିକଙ୍କ ନାମ	ଜାତି
୫୧	୦୨୫	୦୩୫୨	୦.୩୧୦	୦.୩୧୦	ଆ.ପା	ଶକ୍ତି କୁନ୍ଡର, ପି-ଯୋଗୀ କୁଆଁରି, କୁଞ୍ଜ କୁଆଁରି, ନାରାୟଣ କୁଆଁରି, ପି-ପବିତ୍ର କୁଆଁର, କୋଇେନ କୁଆଁରି, ପି-ତିତାମଣି କୁଆଁରି	ଗଣ୍ଡ
୫୨	୦୨୬	୭୦୯	୦.୨୪୦	୦.୨୪୦	ଗା.ପା	ସମାରୁ ପ୍ରଧାନ, ପି-ଚୁଙ୍ଗା ପ୍ରଧାନ	ଗଣ୍ଡ
		୦୩୧୨	୦.୫୨୦	୦.୫୨୦	ଜା-ପା		
		୦୩୦୯ (ନୂ)	୨.୮୨୦	୦.୨୭୦	ଜା-ପା		
		୦୩୦୫(ନୂ)	୦.୫୮୦	୦.୦୭୦	ଚେ.ପା		
		୦୨୩୦(ନୂ)	୦.୮୮୦	୦.୧୨୦	ଚେ.ପା		
		୦୨୦୭(ନୂ)	୦.୨୪୦	୦.୦୨୦	ମା.ପା-୨		
		୦୩୦୨/୩୫୮୨	୦.୦୭୦	୦.୦୨୦	ବା.ପା		
୫୯	୦୨୬	୦୨୬	୦.୫୦୦	୦.୫୦୦	ଚେ.ପା	ଶଶିଭୂଷଣ ତ୍ରିପାଠୀ, ପି-ନୀଳମଣି ତ୍ରିପାଠୀ	ବ୍ରାହ୍ମଣ
		୦୨୧	୦.୩୭୦	୦.୩୭୦	ଚେ.ପା		
		୦୪୦୩(ନୂ)	୦.୪୫୦	୦.୩୫୦	ବା.ପା-୨		
		୦୪୦୩(ନୂ)	୦.୪୮୦	୦.୨୨୦	ବା.ପା-୨		
		୦୪୦୫	୦.୦୮୦	୦.୦୮୦	ବା.ପା-୨		
		୦୪୦୨	୦.୦୮୦	୦.୦୮୦	ବା.ପା-୨		
		୦୪୦୪	୦.୦୫୦	୦.୦୫୦	ବା.ପା-୨		
		୦୪୦୮	୦.୦୨୦	୦.୦୨୦	ବା.ପା		
୬୦	୦୨୮	୬୫୦	୦.୨୧୦	୦.୨୧୦	ଆ.ପା	ଶଶିଭୂଷଣ ତିହାରି, ପି-ନୀଳମଣି ତିହାରି, ମଳବତୀ ତିହାରି, ସ୍ୱା-ନୀଳମଣି ତିହାରି	ବ୍ରାହ୍ମଣ
		୨୨୯	୦.୦୫୦	୦.୦୫୦	ଆ.ପା		
		୨୨୫	୦.୨୧୦	୦.୨୧୦	ବା.ପା-୨		
		୧୫୬୮	୦.୫୩୦	୦.୫୩୦	ମା.ପା		
		୧୨୦୫	୦.୨୨୦	୦.୨୨୦	ମା.ପା-୨		
		୧୫୧୦	୦.୦୫୦	୦.୦୫୦	ମା.ପା		
		୧୨୮୪	୦.୦୫୦	୦.୦୫୦	ମା-ପା-୨		
		୧୨୫୯	୦.୦୨୦	୦.୦୨୦	ମା.ପା		
୬୩	୦୨୮	୮୮୮	୦.୪୫୦	୦.୪୫୦	ମା.ପା	ଶିବଶଙ୍କର ତ୍ରିପାଠୀ, ସିତାନାଥ ତ୍ରିପାଠୀ ପି-ଇଶ୍ୱର ତ୍ରିପାଠୀ	ବ୍ରାହ୍ମଣ
		୨୨୯	୦.୦୨୦	୦.୦୨୦	ଚେ.ପା		
		୨୫୭୧	୦.୬୩୦	୦.୦୩୦	ମା-ପା		
		୧୫୮୦	୦.୦୫୦	୦.୦୫୦	ମା-ପା		
		୧୫୨୨	୦.୧୫୦	୦.୧୫୦	ଚେ.ପା		
		୧୫୦୫	୦.୧୧୦	୦.୧୧୦	ମା.ପା-୨		
		୧୫୫୫	୦.୦୩୦	୦.୦୩୦	ମା-ପା-୨		
		୧୨୮୨	୦.୦୨୦	୦.୦୨୦	ମା-ପା-୨		
		୧୨୩୫	୦.୦୨୦	୦.୦୨୦	ମା.ପା		
		୧୨୫୮	୦.୦୨୦	୦.୦୨୦	ମା-ପା-୨		
୬୪	୦୨୪	୧୨୬୦	୦.୨୫୦	୦.୨୫୦	ମା.ପା	ପୂରଥ କୁମାର ନାଥ, ପି-ଦୁଧୁରାମ ନାଥ	ବ୍ରାହ୍ମଣ
		୧୨୮୮	୦.୨୦୦	୦.୨୦୦	ବା.ପା		
୬୫	୦୨୫	୧୨୫୧	୦.୦୫୦	୦.୦୫୦	ମା.ପା	ସୋମନାଥ ନାଥ, ପି-ଇଶ୍ୱରପତି ନାଥ	ବ୍ରାହ୍ମଣ
		୧୨୫୫	୦.୦୨୦	୦.୦୨୦	ବାଲି.ପା		
୬୬	୦୨୫	୧୦୫୯	୦.୩୫୦	୦.୩୫୦	ଚେ.ପା	ସୋମନାଥ ନାଥ, ଟିକେଶ୍ୱର ନାଥ, ପି-ଇଶ୍ୱରପତି ନାଥ	ବ୍ରାହ୍ମଣ
		୧୨୦୦	୦.୦୨୦	୦.୦୨୦	ମା-ପା-୨		
୬୭	୦୨୬	୪୫୫	୦.୦୫୦	୦.୦୫୦	ମା.ପା	ସୋମନାଥ ନାଥ, ଟିକେଶ୍ୱର ନାଥ, ପି-ଇଶ୍ୱରପତି ନାଥ, ବିଦ୍ୟାଧର ନାଥ, ଦାଦାମୁର ନାଥ, ପି-ପରୀକ୍ଷିତ ନାଥ	ବ୍ରାହ୍ମଣ
		୨୨୨	୦.୨୮୦	୦.୨୮୦	ବା.ପା-୨		
		୨୮୧	୦.୪୩୦	୦.୪୩୦	ବା.ପା-୨		
		୨୦୧	୦.୨୮୦	୦.୨୮୦	ଆ.ପା		
		୨୦୩	୦.୦୫୦	୦.୦୫୦	ବା.ପା		
		୧୦୫	୦.୨୫୦	୦.୨୫୦	ବା.ପା		
		୨୦୨	୦.୦୨୦	୦.୦୨୦	ବା.ପା		
		୮୮୫	୧.୪୦୦	୧.୪୦୦	ଆ.ପା		
		୦୩୪୦	୦.୫୫୦	୦.୫୫୦	ବା.ପା-୨		
		୦୩୬୦	୦.୦୫୦	୦.୦୫୦	ଚେ.ପା		
		୦୩୭୦	୦.୦୨୦	୦.୦୨୦	ଜଳା		
		୦୩୬୦	୦.୫୫୦	୦.୪୫୦	ବା.ପା-୨		
		୦୩୬୮	୦.୦୨୦	୦.୦୨୦	ଜଳା		
		୦୩୫୦	୦.୨୩୦	୦.୨୩୦	ଚେ.ପା		
		୦୪୦୪	୦.୩୪୦	୦.୩୪୦	ବା.ପା-୨		
		୦୪୮୩	୦.୦୫୦	୦.୦୫୦	ଚେ.ପା		
		୦୪୦୬	୦.୦୪୦	୦.୦୪୦	ଚେ.ପା		
		୦୪୫୪	୦.୦୦୦	୦.୦୦୦	ମା-ପା		
		୦୪୫୯	୫.୫୯୦	୦.୦୨୯	ମା-ପା		
		୦୪୫୯	୦.୦୫୦	୦.୦୫୦	ମା-ପା-୨		
		୦୪୦୫	୦.୦୫୦	୦.୦୫୦	ମା-ପା-୨		
		୦୪୭୦	୦.୨୨୦	୦.୨୨୦	ବା.ପା-୨		
		୦୪୦୨	୦.୦୮୧	୦.୦୮୧	ମା-ପା-୨		
		୦୪୩୨	୦.୦୨୦	୫.୨୨୫	ମା.ପା		
		୦୪୫୮	୦.୦୫୫	୦.୦୫୦	ମା-ପା-୨		
୬୮	୦୨୨	୮୨୦	୦.୭୦୦	୦.୫୦୫	ଆ.ପା	ସୋମନାଥ ନାଥ, ଟିକେଶ୍ୱର ନାଥ, ପି-ଇଶ୍ୱରପତି ନାଥ, ବିଦ୍ୟା ନାଥ, ନାଦାମୁର ନାଥ, ପି-ପରୀକ୍ଷିତ ନାଥ, ପୁଣି ନାଥ, ପି-ମିଠୁ ନାଥ	ବ୍ରାହ୍ମଣ

Land Acquisition Inspector
Collectorate, Sambalpur

Land Acquisition Officer
SAMBALPUR

କ୍ର.ନଂ	ଖତା ନଂ	ପ୍ଲଟ ନଂ.	ମୋଟ ରକବା (ଏକରରେ)	ଅଧିକୃତ ହେଉଥିବା ରକବା (ଏକରରେ)	ଜିଲ୍ଲା	ଭୂମି ମାଲିକଙ୍କ ନାମ	ମାଟି
୫୯	୦୦୮	୮୨୨	୦.୦୮୦	୦.୦୮୦	ସେ.ଘା		
		୮୫୫	୦.୮୦୫	୦.୮୦୫	ଘା.ଘା	ସୋମନାଥ ନାଥ, ଟିକେଶ୍ୱର ନାଥ, ପି-ଲକ୍ଷ୍ମୀପତି ନାଥ, ବିଦ୍ୟା ନାଥ, ନୀଳାମ୍ବର ନାଥ, ପି-ପରୀକ୍ଷିତ ନାଥ, ପୁରଣବାସୀ ପଣ୍ଡା , ପି-ରାମଚନ୍ଦ୍ର ନାଥ	ବ୍ରାହ୍ମଣ
		୮୫୨	୦.୩୪୦	୦.୩୪୦	ଆ.ଘା		
		୮୫୩	୦.୨୦୦	୦.୨୦୦	ସେ.ଘା		
୫୮	୦୦୮	୦୪୫୩	୦.୨୪୯	୦.୨୪୯	ମା.ଘା		
		୦୪୭୦	୦.୬୯୦	୦.୬୯୦	ମା-ଖା.ପା.୨		
		୦୪୦୫(ପୁ)	୦.୨୮୦	୦.୨୬୦	ମା.ଘା		
		୦୪୦୮(ପୁ)	୨.୦୬୦	୦.୨୮୦	ବା.ପା-୨		
		୦୪୮୨	୦.୬୦୯	୦.୬୯୯	ବା.ପା-୨		
		୦୪୫୯/୩୪୫୦	୯.୩୨୦	୯.୩୨୦	ମା.ଘା		
		୦୪୫୯/୩୪୫୩	୦.୫୯୦	୦.୫୯୦	ଆ.ଘା		
		୦୪୫୦/୩୪୫୬	୦.୦୪୦	୦.୦୪୦	ଆ.ଘା		
		୦୪୦୫/୩୪୫୭	୦.୩୦୦	୦.୩୦୦	ସେ.ଘା	ସୋମନାଥ ନାଥ, ଟିକେଶ୍ୱର ନାଥ, ପି-ଲକ୍ଷ୍ମୀପତି ନାଥ, ବିଦ୍ୟା ନାଥ, ପି-ପରୀକ୍ଷିତ ନାଥ, ଅଶୋକ ନାଥ, ବିହ୍ନୀପ ନାଥ, ପ୍ରଫୁଲ୍ଲ ନାଥ, ପି-ନୀଳାମ୍ବର ନାଥ, ପୁଣି ପଣ୍ଡା, ପି-ରାମଚନ୍ଦ୍ର ପଣ୍ଡା	ବ୍ରାହ୍ମଣ
୮୦	୨୦୦	୦୪୦୯/୩୪୫୮	୦.୨୨୦	୦.୨୨୦	ସେ.ଘା		
		୦୪୦୮/୩୪୫୮	୦.୨୨୦	୦.୨୨୦	ସେ.ଘା		
		୦୪୦୮/୩୪୬୩	୦.୩୫୦	୦.୩୫୦	ଜା-ଘା		
		୦୪୦୨/୩୪୬୬	୦.୦୬୦	୦.୦୬୦	ବା.ପା		
		୦୪୦୪/୩୪୬୬	୦.୫୩୦	୦.୫୩୦	ମା.ଘା		
		୦୪୦୪/୩୪୬୯	୦.୨୦୦	୦.୨୦୦	ମା.ଘା		
		୦୪୭୬/୩୪୬୧	୬.୦୮୦	୬.୦୮୦	ଆ.ଘା		
		୦୪୬୦	୦.୦୭୦	୦.୦୬୦	ଜାଉଁଳା		
		୦୪୭୮/୩୪୭୩	୦.୦୫୦	୦.୦୫୦	ଜାଉଁଳା		
		୦୪୦୨/୩୪୮୦	୦.୨୦୦	୦.୨୦୦	ଜା-ଘା		
		୦୪୭୦/୩୪୭୫	୦.୦୫୦	୦.୦୫୦	ଜାଉଁଳା		
୮୧	୨୦୧	୦୩୫୪	୦.୩୫୦	୦.୩୫୦	ବା.ପା	ବିବ୍ୟଲୋଚନ ପାଲ, ପି-ହରି ପାଲ, ସିଦ୍ଧେଶ୍ୱର ପାଲ, ସ୍ୱା- ଗଡ ପାଲ. ଉମା ପାଲ, ଗଣେଶ ପାଲ, ପି-ଗଜ ପାଲ	ବ୍ରାହ୍ମଣ
		୦୪୫୮(ପୁ)	୦.୦୨୦	୦.୩୫୦	ଘା.ଘା		
		୦୪୮୨	୦.୫୦୦	୦.୫୦୦	ଜେ.ପା		
		୦୪୫୨	୦.୫୯୦	୦.୫୯୦	ବା.ପା		
		୦୪୫୩	୦.୦୨୦	୦.୦୨୦	ବା.ପା		
		୦୪୬୦	୦.୨୪୦	୦.୨୪୦	ଜେ.ପା		
		୦୪୬୪	୦.୦୪୦	୦.୦୪୦	ବା.ପା		
		୦୪୬୫	୦.୩୪୦	୦.୩୪୦	ବା.ପା		
		୦୪୬୬	୦.୦୩୦	୦.୦୩୦	ବା.ପା		
		୦୪୮୫	୦.୩୨୦	୦.୩୨୦	ଜେ.ପା		
		୦୮୬୪/୩୩୮୯	୫.୫୯୦	୫.୫୯୦	ଘା.ଘା		
		୦୬୬୩	୦.୦୨୦	୦.୦୨୦	ମା-ଘା		
		୦୫୫୮	୦.୦୮୦	୦.୦୮୦	ମା-ଘା		
		୦୫୬୫	୦.୦୨୦	୦.୦୨୦	ମା-ଘା		
		୦୫୦୫	୦.୦୮୦	୦.୦୮୦	ମା.ଘା		
		୦୫୫୮	୦.୦୦୦	୦.୦୦୦	ମା-ଘା		
୮୨	୨୦୫	୬୮୧	୧.୬୯୦	୧.୬୯୦	ଆ.ଘା	ଉତ୍ତେକୃଷ୍ଣ ପଧାନ, ରାଧେଶ୍ୟାମ ପଧାନ, ପି-ରାଜେଶ୍ୱର ପଧାନ	କୁଇତା
		୬୮୮	୦.୨୫୦	୦.୨୫୦	ମା.ଘା		
		୬୮୦	୦.୦୪୦	୦.୦୪୦	ଘା.ଘା		
		୬୦୫	୦.୦୬୦	୦.୦୬୦	ବା.ପା		
		୬୦୦	୦.୫୦୦	୦.୫୦୦	ଆ.ଘା		
		୦୪୦୫/୩୭୮୮(ପୁ)	୦.୨୭୦	୦.୨୭୦	ମା-ଘା		
		୦୩୦୮	୦.୦୯୦	୦.୦୯୦	ଜେ.ପା		
		୦୩୫୫	୦.୦୯୦	୦.୦୯୦	ବା.ପା		
		୦୪୬୩	୦.୦୬୦	୦.୦୬୦	ବା.ପା		
		୦୪୬୬	୦.୦୬୦	୦.୦୬୦	ମା-ପା-୨		
		୦୪୬୦	୦.୦୫୦	୦.୦୫୦	ମା.ଘା		
		୦୪୫୫	୦.୦୮୦	୦.୦୮୦	ମା-ପା-୨		
		୦୪୭୧	୦.୦୩୦	୦.୦୩୦	ଜେ.ପା		
		୦୪୭୭	୦.୦୩୦	୦.୦୩୦	ମା-ପା-୨		
୮୩	୨୦୬	୦୩୮୦(ପୁ)	୦.୦୦୧	୦.୦୫୦	ବା.ପା	ଜିଶୋରୀ ଧଉ, ସ୍ୱା- ଉଧନାରାୟଣ ଧଉ, ପଦ୍ମିନୀ ନାଥ, ସ୍ୱା- ଯୋଗୀ ନାଥ, ପଦ୍ମଲୋଚନ ଧଉ, ଦିବ୍ୟଲୋଚନ ଧଉ, ପି-ଉଧନାରାୟଣ ଧଉ, ଯଶୋଦତ୍ତ ଧଉ, ଇଛନ ଧଉ, ପୁନାଡି ନାଥକ, ପି-ଜମ୍ବୁନାରାୟଣ ଧଉ	ବ୍ରାହ୍ମଣ
		୦୩୫୫	୦.୮୮୫	୦.୮୮୦	ବା.ପା-୨		
		୦୩୫୬	୦.୨୪୦	୦.୨୪୦	ବା.ପା-୨		
		୦୩୫୬(ପୁ)	୦.୧୨୦	୦.୦୮୦	ବା.ପା-୨		
		୦୩୫୯	୦.୩୨୯	୦.୩୨୯	ବା.ପା-୨		
		୦୩୯୦	୦.୦୭୯	୦.୦୭୦	ମା-ପା-୨		
		୦୮୭୩	୦.୩୫୦	୦.୩୫୦	ମା.ପା-୨		
		୦୮୮୦	୦.୦୬୦	୦.୦୬୦	ମା.ପା-୨		
		୦୮୮୨	୦.୦୪୬	୦.୦୪୬	ମା.ପା-୨		
		୦୩୫୦	୦.୦୪୦	୦.୦୪୦	ବେ-ପା-୨		
		୦୦୭୭	୦.୦୭୦	୦.୦୭୦	ମା-ଘା		
		୦୫୫୩	୦.୦୪୦	୦.୦୪୦	ମା-ପା-୨		
		୦୫୭୦	୦.୦୦୫	୦.୦୦୫	ମା-ପା-୨		

Land Acquisition Inspector
Collectorate, Sambalpur

Land Acquisition Officer
SAMBALPUR

କ୍ର.ନଂ	ଖାତା ନଂ	ପ୍ଲଟ ନଂ.	ମୋଟ ରକବା (ଏକରରେ)	ଅଧିଗ୍ରହିତ ହେଉଥିବା ରକବା (ଏକରରେ)	କିସମ	ଜମି ମାଲିକଙ୍କ ନାମ	ଜାତି
୮୫	୨୯୯	୧୯୯୯(ପ୍ଲେ)	୨.୫୫୦	୨.୫୯୦	ମା.ପା-୨	କପିଲ ମାଳୀ, ପି-ଦୁଇଣା ଗୁଣ୍ଡ ମାଳୀ, ହେମନ୍ତ ମାଳୀ, ସୁମନ୍ତ ମାଳୀ, କୃଷ୍ଣାନ୍ତ ମାଳୀ, ନଳିନ ତଣ୍ଡିଆ, ମନାନ ଲୋଠି, ପି-କେଶବ ମାଳୀ, କୁନ୍ତଳ ମାଳୀ, ସ୍ୱା- କେଶବ ମାଳୀ, ସହଦେବ ମାଳୀ, ରଶ୍ମିକାନ୍ତ ମାଳୀ, ଭୂମିସୁତା ମାଳୀ, ପି-କୈଳାଶ ମାଳୀ, କେଶି ବେବା, ପି-କର୍ଣ୍ଣ ଗଣ୍ଡା, ଜାଲାନ୍ଧ୍ରି ଦୀପ, ପି-କର୍ଣ୍ଣ ଗଣ୍ଡା, କସ୍ତୁରୀ ମାଳୀ, ସ୍ୱା- କପିଳ ମାଳୀ, ପ୍ରମୋଦ ମାଳୀ, ପି-କପିଳ ମାଳୀ, ପୁଷ୍ପାଞ୍ଜଳି ମାଳୀ, ଗୀତାଞ୍ଜଳି ମାଳୀ, ପଦ୍ମିନୀ ମାଳୀ, ପି-କପିଳ ମାଳୀ	ଗଣ୍ଡା
		୨୩୯୯(ପ୍ଲେ)	୯.୫୩୦	୦.୨୪୬	ବା-ଘା		
୮୬	୨୯୩	୧୯୬୨	୨.୯୬୦	୨.୯୬୦	ମା.ଘା	ଶ୍ରୀ ରଘୁନାଥ ମହାପ୍ରଭୁ ବିଜେ ନିଜ ଗାଁ ମାର୍ଫତ ଟ୍ରଷ୍ଟି ବୋର୍ଡ, ପୀତବାସ ମିଶ୍ର, ପି-ରାମଚନ୍ଦ୍ର ମିଶ୍ର, ସୋମନାଥ ନାଥ, ପି-ଲକ୍ଷ୍ମୀପତି ନାଥ, ଜା- ବ୍ରାହ୍ମଣ, ଇଶ୍ୱର ପଧାନ, ପି-କୁଳି ପଧାନ, ରଘୁମଣି ପଧାନ, ପି- ଦଦ ପଧାନ, ଜା- କୁଳତା, ଶଶିଭୂଷଣ ତ୍ରିପାଠୀ, ପି-ନୀଳମଣି ତ୍ରିପାଠୀ, ଜା- ବ୍ରାହ୍ମଣ	ଟ୍ରଷ୍ଟ ବୋର୍ଡ
		୪୪୯	୦.୦୬୦	୦.୦୬୦	ଦେ.ଘା		
୮୭	୨୯୪	୧୬୯୨	୦.୨୯୦	୦.୨୯୦	ବା.ପା-୨	ଉପେନ୍ଦ୍ର ମିଶ୍ର, ଭୋପେନ୍ଦ୍ର ମିଶ୍ର, ପା.- ସିନିବାସ ମିଶ୍ର, ନରେନ୍ଦ୍ର ମିଶ୍ର, ସୁରେଶ ମିଶ୍ର, ପ୍ରଫୁଲ୍ଲ ମିଶ୍ର, ପି-ପୀତବାସ ମିଶ୍ର, ହୃଷୀକେଶ ମିଶ୍ର, ଶ୍ରୀପତି ମିଶ୍ର, ଇଶ୍ୱର ଚନ୍ଦ୍ର ମିଶ୍ର, ସୋମନାଥ ମିଶ୍ର, ପି-ରାମଚନ୍ଦ୍ର ମିଶ୍ର, ଭୂପେନ୍ଦ୍ର ମିଶ୍ର, ଯତୀନ୍ଦ୍ର ମିଶ୍ର, ପି-ବଳଭ ମିଶ୍ର, ସତ୍ୟବତୀ ମିଶ୍ର, ସ୍ୱା- ରାମଚନ୍ଦ୍ର ମିଶ୍ର	ବ୍ରାହ୍ମଣ
		୧୬୨୩	୦.୨୨୦	୦.୨୨୦	ବେ-ପା-୨		
		୧୬୯୮	୦.୪୨୦	୦.୪୨୦	ବା.ପା-୨		
		୧୬୨୪	୦.୮୮୦	୦.୮୮୦	ଘରବାଡି		
୮୮	୨୯୦/୨୦	୮୪୬	୦.୦୬୦	୦.୦୬୦	ବା.ଘା	ଚୈତନ୍ୟ ବିଶ୍ୱାଳ ,ପି-ନୀଳ ବିଶ୍ୱାଳ	କୁଳତା
୮୯	୨୯୦/୨୬	୮୪୯	୦.୦୬୦	୦.୦୬୦	ଦେ.ଘା	ନବୀନ କିଶୋର ନାଥ, ପି-ଶଶିଭୂଷଣ ନାଥ	ବ୍ରାହ୍ମଣ
		୬୯୯	୦.୧୨୯	୦.୧୨୦	ବା.ଘା		
		୬୯୨	୦.୨୨୦	୦.୨୨୦	ବା.ଘା		
		୮୨୦	୦.୧୨୦	୦.୧୨୦	ଦେ.ଘା		
୯୦	୨୯୦/୩୧	୬୨୩	୦.୧୨୯	୦.୧୨୯	ମା.ଘା	ଫକିର ମୋହନ ଦାସ, ପି-ବୈକୁଣ୍ଠନାଥ ଦାସ	ବ୍ରାହ୍ମଣ
		୧୨୦୧/୩୨୧୬	୦.୪୩୦	୦.୪୩୦	ମା.ଘା		
		୧୨୦୬/୩୨୧୨	୦.୧୩୦	୦.୧୩୦	ମା.ଘା		
୯୧	୨୯୦/୩୨	୧୯୯୯/୩୨୧୮	୦.୦୬୦	୦.୦୬୦	ପଡିଆ	କୀର୍ତ୍ତନ ମାଝି, ପି-ବିଷ୍ଣୁ ମାଝି	ଗଣ୍ଡ
		୧୯୯୨	୦.୩୬୦	୦.୩୬୦	ବା.ଘା		
		୧୦୯୬/୩୨୧୯	୦.୪୬୦	୦.୪୬୦	ମା.ଘା		
୯୨	୨୯୦/୩୯	୧୩୨/୩୨୩୬	୦.୬୦୦	୦.୬୦୦	ବା.ଘା	ଗୋପାଳଜି ପାଣି, ଶଙ୍କର ପାଣି, ପି-ଅନ୍ତରାମ ପାଣି	ବ୍ରାହ୍ମଣ
		୧୬୦୦	୦.୦୮୦	୦.୦୮୦	ମା.ପା-୨		
		୧୬୦୨/୩୨୨୯	୦.୨୯୦	୦.୨୯୦	ବା.ପା-୨		
		୧୯୬୨	୦.୬୮୦	୦.୬୮୦	ବେ-ପା-୨		
		୧୯୬୩	୦.୧୮୦	୦.୧୮୦	ମା.ପା-୨		
୯୩	୨୯୦/୪୦	୧୪୨୬/୩୨୩୨	୦.୬୨୦	୦.୬୨୦	ବା-ଘା	ସ୍ନେହଲତା ପାଣି, ପି-ଗୋପାଳଜି ପାଣି	ବ୍ରାହ୍ମଣ
୯୪	୨୯୦/୪୯	୧୯୬୨	୦.୨୨୦	୦.୨୨୦	ଦେ.ଘା	ଗୋପାଳଜି ପାଣି, ପି-ଅନ୍ତରାମ ପାଣି	ବ୍ରାହ୍ମଣ
୯୫	୨୯୦/୪୨	୧୩୫	୦.୨୦୦	୦.୨୦୦	ମା.ଘା	ଲିଙ୍ଗରାଜ ସାହୁ, ପି-ପଂଚାନନ ସାହୁ	କୁଳତା
		୧୩୮	୦.୮୨୦	୦.୮୨୦	ବା.ଘା		
୯୬	୨୯୦/୪୨	୧୨୪/୩୨୪୨	୦.୪୨୦	୦.୪୨୦	ମା.ଘା	ମନବୋଧ ଦରତ, ପି-ବେଣୁଧର ଦରତ	ଗଣ୍ଡ
		୧୨୬	୦.୧୨୦	୦.୧୨୦	ଦେ.ଘା		
		୧୨୨	୦.୦୮୦	୦.୦୮୦	ଦେ.ଘା		
		୧୨୮	୦.୩୧୦	୦.୩୧୦	ବା-ଘା		
୯୭	୨୯୦/୬୦	୧୩୬୪	୦.୨୩୦	୦.୨୩୦	ମା.ଘା	ମୁକ୍ତେଶ୍ୱର ପଧାନ, ପି-ଲାଲ ପଧାନ	କୁଳତା
		୧୩୬୩	୦.୨୮୦	୦.୨୮୦	ଦେ.ଘା		
		୧୩୨୨	୦.୨୪୦	୦.୨୪୦	ଦେ.ଘା		
		୧୩୬୨/୩୨୪୮	୦.୬୬୦	୦.୬୬୦	ବା.ପା-୨		
୯୮	୨୯୦/୬୩	୧୧୨୩	୦.୧୪୦	୦.୧୪୦	ଅ.ଘା	ଡିଲେ ନାୟକ, ପି-ସୁରଥ ନାୟକ	ଗଣ୍ଡ
୯୯	୨୯୦/୬୬	୧୧୨୩/୩୨୨୦	୦.୧୨୦	୦.୧୨୦	ଅ.ଘା	ମିଶ୍ରୁ ରୋହିଦାସ, ପି-ପଲାଉ ରୋହିଦାସ	ଚମାର
୧୦୦	୨୯୦/୨୯	୧୧୨୩/୩୨୨୬	୧.୦୦୦	୧.୦୦୦	ଅ.ଘା	ଦୀର୍ଥ ଭାରତ, ପି-ବଳରାମ ଭାରତ	ଗଉଡ
୧୦୧	୨୯୦/୨୪	୧୪୨୨/୩୩୨୧(ପ୍ଲେ)	୦.୨୩୦	୦.୨୦୦	ଅ.ଘା	ଶଶିଭୂଷଣ ତ୍ରିପାଠୀ, ପି-ନୀଳମଣି ତ୍ରିପାଠୀ	ବ୍ରାହ୍ମଣ
୧୦୨	୨୯୦/୨୨	୨୨୮/୩୨୨୨	୦.୬୦୦	୦.୬୦୦	ବା.ପା-୨	ଚନ୍ଦ୍ର ଶେଖର ତ୍ରିପାଠୀ, ପି-ଶଶିଭୂଷଣ ତ୍ରିପାଠୀ	ବ୍ରାହ୍ମଣ
		୧୨୨୨	୦.୦୯୦	୦.୦୯୦	ବାଲିଗି-ପା-୨		
୧୦୩	୨୯୦/୨୨	୨୨୬	୦.୬୩୦	୦.୬୩୦	ବା.ପା-୨	କୃଷ୍ଣବଲ୍ଲଭ ତ୍ରିପାଠୀ, ପି-ଶଶିଭୂଷଣ ତ୍ରିପାଠୀ	ବ୍ରାହ୍ମଣ
୧୦୪	୨୯୦/୨୯	୨୨୮/୩୨୨୯	୦.୬୩୦	୦.୬୩୦	ବା.ପା-୨	ଶ୍ରୀପତି ଶେଖର ତ୍ରିପାଠୀ, ପି-ଶଶିଭୂଷଣ ତ୍ରିପାଠୀ	ବ୍ରାହ୍ମଣ
୧୦୫	୨୯୦/୮୨	୧୨୦	୦.୧୩୦	୦.୧୩୦	ବା.ଘା	ହରିଶ ଚନ୍ଦ୍ର କୁଅଁର, କୃଷ୍ଣ ଚନ୍ଦ୍ର କୁଅଁର, ପି-କୃଷ୍ଣ କୁଅଁର	ଗଣ୍ଡ

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କ୍ର.ନଂ	ମୌଜା ନଂ	ପ୍ଲଟ ନଂ.	ମୋଟ ପରିମାଣ (ଏକରରେ)	ଅଧିକୃତ ହେବାକୁଥିବା ପରିମାଣ (ଏକରରେ)	ଶ୍ରେଣୀ	ଭୂମି ମାଲିକଙ୍କ ନାମ	ଜାତି
୦୧୫	୨୯୦/୧୦	୮୨୨	୦.୦୮୫	୦.୦୮୦	ଚେ.ଘା	ସୋମନାଥ ନାଥ, ପି-ଲକ୍ଷ୍ମଣଠି ନାଥ, ଅକ୍ଷୟ କୁମାର ନାଥ, ପ୍ରଦୀପ କୁମାର ନାଥ, ପ୍ରଭାତ କୁମାର ନାଥ, ପି-ଟିକେଶ୍ୱର ନାଥ, ସରୋଜିନୀ ନାଥ, ସ୍ୱା- ଟିକେଶ୍ୱର ନାଥ, ବିଦ୍ୟାଧର ନାଥ, ପି-ପରମ୍ଭୁତ ନାଥ, ଅଶୋକ କୁମାର ନାଥ, ବିହ୍ନାପ କୁମାର ନାଥ, ପ୍ରଫୁଲ କୁମାର ନାଥ, ପି-ନାଳାମ୍ବର ନାଥ, କୁମୁଦିନୀ ନାଥ, ସ୍ୱା- ନାଳାମ୍ବର ନାଥ, ପୁରଣବାସୀ ପଣ୍ଡା, ପି-ରାମଚନ୍ଦ୍ର ପଣ୍ଡା	ବ୍ରାହ୍ମଣ
		୮୨୩	୦.୦୩୦	୦.୦୨୦	ଚେ.ଘା		
		୮୨୪	୦.୦୫୦	୦.୦୫୦	ବା.ଘା		
		୮୨୨(ପୁ)	୦.୬୨୦	୦.୬୨୦	ମା.ଘ		
୦୧୫	୨୧୦/୨୨	୫୧୨୨	୦.୫୮୦	୦.୫୮୦	ବା.ଘା-୨	ସୋମନାଥ ନାଥ, ପି-ଲକ୍ଷ୍ୟପତି ନାଥ	ବ୍ରାହ୍ମଣ
୦୧୮	୨୧୦/୨୨	୨୮୫୮	୦.୦୨୧	୦.୦୨୧	ମା.ଘା	ଚିତନ୍ୟ ବିଶ୍ୱାଳ, ପି-ନାଢ଼ ବିଶ୍ୱାଳ	ଭୁଜତା
		୨୫୧୯	୦.୨୦୦	୦.୨୦୦	ମା-ଘା		
୦୧୯	୨୧୫/୨୫	୨୫୦୮/୩୫୮୫	୦.୨୦୦	୦.୨୦୦	ବା.ଘା-୨	ସୁଚାରି ନାୟକ, ସ୍ୱା- ଜଗଦୀଶ ନାୟକ	ବ୍ରାହ୍ମଣ
୦୨୦	୨୧୫/୨୦୪	୨୫୮୦	୦.୦୫୦	୦.୦୫୦	ମା-ଘା-୨	ଚମାରୁ ନାଥ, ପି-ଗୋକଳନାଥ ନାଥ	ବ୍ରାହ୍ମଣ
୦୨୧	୨୧୫/୧୫୫	୨୨୨୦	୦.୦୫୦	୦.୦୫୦	ଚେ.ଘା	ଆଦିତ୍ୟ କୁମାର ନାଥ ,ପିତା-ସୁରେଶ କୁମାର ନାଥ	ବ୍ରାହ୍ମଣ
		୨୧୩୫	୦.୦୩୦	୦.୦୩୦	ବା.ଘା		
		୨୨୨୨	୦.୦୫୦	୦.୦୫୦	ଚେ.ଘା		
୦୨୨	୨୧୦/୧୫୮	୫୨୫/୩୨୦୫	୦.୨୫୦	୦.୨୫୦	ବା.ଘା-୨	ବିବେଣୀ ତ୍ରିପାଠୀ ,ପିତା-ଚମାରୁ ତ୍ରିପାଠୀ	ବ୍ରାହ୍ମଣ
୦୨୮	୨୧୦/୧୨୯	୨୨୨୨	୦.୦୨୫୦	୦.୦୫୦	ବା.ଘା-୨	ଅଜି ବାସ ,ପିତା-ଘଣିଆ ପାସ	ବ୍ରାହ୍ମଣ
୦୨୫	୨୧୦/୧୨୨	୨୨୦୨/୩୫୦୫(ପୁ)	୦.୩୨୦	୦.୨୩୦	ମା.ଘା	ସୁଜାତି ନାୟକ, ସ୍ୱା-ଜଗଦୀଶ ନା, ବା-ପାଲାଙ୍କ	ବ୍ରାହ୍ମଣ
		୨୮୨୦/୩୫୦୫	୦.୩୨୦	୦.୩୨୦	ଚେ.ଘା		
୦୨୫	୨୧୦/୨୨୮	୨୩୫୦/୩୫୦୩	୦.୫୨୦	୦.୫୨୦	ବା.ଘା-୨	ତ୍ରିନାଥ ଚରଣିଆ,ପିତା-ନିଧି ଚେଉଟିଆ	ଜେଜଟ
		୫୫୨/୩୫୦୫	୦.୨୫୦	୦.୨୫୦	ବା.ଘା-୨		
୦୨୫	୨୨୦/୧୨୫	୮୨୫	୦.୦୦୦	୦.୦୦୦	ଚେ.ଘା	ହେମାବତୀ ସୁନାନ,ସ୍ୱା-ଦଳମୟୀ ସୁନାନି ,ବା-ଭୁବନାମାନ	ଗଣ୍ଡା
		୮୨୬	୦.୦୫୦	୦.୦୫୦	ଆ.ଘ		
୦୨୬	୨୧୦/୧୨୫	୨୨୩୫(ପୁ)	୦.୫୫୦	୦.୫୫୦	ଆ.ଘ	ତୀର୍ଥ ଜାନ୍ତ ,ପିତା-ବଳରାମ ଜାନ୍ତ	ଗରଡ
		୨୨୩୫	୦.୦୩୦	୦.୦୩୦	ଆ.ଘ		
୦୨୮	୨୧୦/୧୨୮	୨୩୩୮(ପୁ)	୦.୦୫୦	୦.୦୨୦	ଜା.ଘା	ହରିପ୍ରିୟା ନାଥ,ସ୍ୱା-ସୁରେଶ ଚନ୍ଦ୍ର ନାଥ	ବ୍ରାହ୍ମଣ
		୨୨୪୦(ପୁ)	୦.୩୮୦	୦.୨୨୦	ବା.ଘା		
୦୨୯	୨୧୦/୨୩୫	୨୨୨୦/୩୨୦୮	୦.୫୨୦	୦.୫୨୦	ବା.ଘା-୨	ସରୋଜିନୀ ନାଥ,ସ୍ୱା-ଟିକେଶ୍ୱର ନାଥ, ଯଜ୍ଞସେନୀ ନାଥ, ଅକ୍ଷୟ ନାଥ ,ପ୍ରଦୀପ କୁମାର ନାଥ, ପ୍ରଭାତ କୁମାର ନାଥ, ପିତା-ଟିକେଶ୍ୱର ନାଥ	ବ୍ରାହ୍ମଣ
		୨୨୩୭/୩୨୨୨	୦.୦୨୦	୦.୦୨୦	ବା-ଘା		
୧୨୦	୨୧୨/୧୫୦	୨୦୦୨/୩୫୫୦(ପୁ)	୦.୦୫୦	୦.୦୫୦	ମା.ଘା	ସାତାରାମ ବଡେଇ , ଛୋଟୁ ବଡେଇ ,ପିତା-ଗିରିଧାରୀ ବଡେଇ	ଜେଜଟ
		୨୦୨୫/୩୨୨୨	୦.୦୩୦	୦.୦୩୦	ମା.ଘା		
୦୨୯	୨୧୨/୧୨୯	୨୩୫୮	୦.୨୦୦	୦.୨୦୦	ଚେ.ଘା	ନିରଞ୍ଜନ ଧଉ ,ପିତା-ଜେଣୁଧର ଧଉ	ବ୍ରାହ୍ମଣ
		୨୨୨୦	୦.୦୫୦	୦.୦୫୦	ଚେ.ଘା		
		୨୫୮୦	୦.୩୦୦	୦.୩୦୦	ଆ.ଘ		
୦୨୦	୨୧୨/୧୨୫	୨୨୨୨/୩୫୨୨	୦.୦୫୦	୦.୦୫୦	ବାଲି-ଘା	ଦିଲୀପ କୁମାର ନାଥ ,ପିତା-ନୀଳାମ୍ବର ନାଥ	ବ୍ରାହ୍ମଣ
୦୨୩	୨୧୨/୧୨୯	୨୨୫୨/୩୫୩୫	୦.୫୫୦	୦.୫୫୦	ମା.ଘା	ଦଶରଥ ଜାନ୍ତ ,ପିତା-ଉଦେଇଲ ଜାନ୍ତ	ଗରଡ
୦୨୦	୨୧୦/୧୨୫	୨୫୨୦	୨.୨୩୦	୨.୨୩୫	ବା.ଘା	ଘାଣ୍ଟି ପାଣି , ସ୍ୱା-ଶଙ୍କର ପାଣି	ବ୍ରାହ୍ମଣ
୦୨୫	୨୧୦/୧୭୦	୭୧୨	୦.୫୨୦	୦.୪୨୦	ମା.ଘା	ଉଚ୍ଚ ଇଂରାଜୀ ବିଦ୍ୟାଳୟ ଠେଲକୋଇଲି ତରଫରୁ ସେକ୍ରେଟାରୀ ଉଚ୍ଚ ଇଂରାଜୀ ବିଦ୍ୟାଳୟ ଠେଲକୋଇଲି	ବ୍ରାହ୍ମଣ
		୨୨୨୩	୦.୫୨୦	୦.୫୨୦	ମା.ଘା		
		୨୨୨୪	୨.୦୨୦	୨.୦୨୦	ମା.ଘା		
		୨୨୨୫	୦.୩୨୦	୦.୩୨୦	ଆ.ଘ		
		୭୦୨/୩୨୨୩	୦.୪୨୦	୦.୪୨୦	ମା.ଘା		
୦୨୦	୨୨୦/୨୫୨	୨୨୧	୦.୩୨୦	୦.୩୨୦	ବା.ଘା	ଉମେଶ ଗୋହିଦାଶ ,ପିତା-ବୁଧୁ ଗୋହିଦାଶ	ଚମାରୁ
		୨୫୨/୩୫୨୫	୦.୨୦୦	୦.୨୦୦	ବା.ଘା		
୦୨୨	୨୨୦/୧୨୫	୮୫୨	୦.୦୨୦	୦.୦୨୦	ବା.ଘା	ଜେଣୁଧର ପଧାନ ,ପିତା-ଅଣ୍ଟି ପଧାନ, ବା-ଖୁଣ୍ଡା	ଭୁଜତା
		୮୫୨	୦.୨୨୦	୦.୨୨୦	ଆ.ଘ		
		୮୫୨	୦.୦୨୦	୦.୦୨୦	ଆ.ଘ		
		୮୫୨	୦.୫୨୦	୦.୫୨୦	ବା.ଘା		
		୮୦୨	୦.୨୨୦	୦.୨୨୦	ମା.ଘା		
		୮୨୨	୦.୨୨୦	୦.୨୨୦	ଚେ.ଘା		
		୮୨୨(ପୁ)	୦.୨୦୦	୦.୨୨୦	ଆ.ଘ		

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କ୍ର.ନଂ	ଖାତା ନଂ	ପ୍ଲଟ ନଂ.	ମୋଟ ରକବା (ଏକରରେ)	ଅଧିକୃତ ହେଉଥିବା ରକବା (ଏକରରେ)	ବିବରଣୀ	ଭୂମି ମାଲିକଙ୍କ ନାମ	ଜାତି
୯୫୫	୨୯୦/୫୦୫	୯୭୦୨/୪୯୮୩	୦.୯୨୯	୦.୯୧୦	ବା.ପା-୨	କୃଷ୍ଣ ଚନ୍ଦ୍ରର ତ୍ରିପାଠୀ , ପି- ଶଶୀ ଭୂଷଣ ତ୍ରିପାଠୀ ବା -ଠେଲକୋଳି	ବ୍ରାହ୍ମଣ
		୯୭୪୯	୦.୦୫୦	୦.୦୨୦	ପା.ପା		
		୯୭୦୨/୪୯୮୪	୦.୯୦୦	୦.୯୧୦	ବା.ପା-୨		
୯୫୫	୨୯୦/୪୨୩	୯୭୩୩	୦.୨୫୦	୦.୨୫୦	ବା.ପା	ସନ୍ତୋଷ କୁମାର ସିଂ, ପି-ଦୁଧ୍ୟା ସିଂ , ବା -ବ୍ରଜରାଜନଗର, ଝାଗରପୁଟା	ଉତ୍କଳୀୟ
		୯୭୩୩/୪୨୦୧	୦.୨୫୦	୦.୨୬୦	କେ.ପା		
		୯୩୭୨/୪୨୦୨	୦.୨୫୦	୦.୨୫୦	କେ.ପା		
୯୫୮	୨୯୦/୪୨୬	୯୯୦୩/୪୨୪୫	୦.୨୪୦	୦.୨୪୦	ବା-ପା	ଗୁଲାମ ମୁସ୍ତଫା, ପି -ଜୁର୍ବାନ ଅଲି	ମୁସଲିମ
୯୫୯	୨୯୦/୪୨୯	୯୯୦୩/୪୨୪୬	୦.୦୪୦	୦.୦୪୦	ବା-ପା	ବେଦ୍ୟନାଥ ପ୍ରଧାନ, ପି- ଗୁରୁର ଗାୟ	ଯାଦବ
୯୫୦	୨୯୦/୪୨୦	୯୯୦୩/୪୨୪୫	୦.୦୪୦	୦.୦୪୦	ବା-ପା	ରାମ ସୁମାର ଯାଦବ ,ପି- ଶଙ୍କର ଯାଦବ, ବା- ଭୂଷଣ ଟାଉନସିପ ,ଠେଲକୋଳି	ଯାଦବ
୯୫୯	୨୯୦/୪୨୪	୯୭୭୮	୦.୦୨୦	୦.୦୨୦	ଘରବାଡି	ଧୀରେନ୍ଦ୍ର କୁମାର ପ୍ରଧାନ, ପି - ଭକ୍ତରାମ ପ୍ରଧାନ ,ବା- ଉଚ୍ଚାବୀଗା	କୁଇତା
		୯୭୮୦	୦.୦୯୦	୦.୦୯୦	ଘରବାଡି		
୯୫୭	୨୯୦/୪୨୫	୯୭୭୯	୦.୦୫୦	୦.୦୫୦	ଘରବାଡି	ଉମାକାନ୍ତ ନାଥ ,ପି- ଯୋଗେନ୍ଦ୍ର ନାଥ , ବା -ଉଚ୍ଚାବୀଗା	ବ୍ରାହ୍ମଣ
		୯୭୮୯	୦.୦୯୦	୦.୦୯୦	ଘରବାଡି		
୯୫୩	୨୯୦/୪୨୬	୯୯୦୨/୪୨୭୫	୦.୨୦୦	୦.୧୦୦	ଘରବାଡି	ନରେନ୍ଦ୍ର ସିଂ ସଙ୍ଗୀତ ପିତା-ଚତ୍ରଗାନ ସଙ୍ଗୀତ	ଖାଟ
୯୫୨	୨୯୦/୪୮୦	୯୯୮୫/୪୨୭୪	୦.୨୦୦	୦.୨୦୦	ବେ-ପା-୨	ମହମ୍ମଦ ନଦିମ ଅନୱାର ,ପି-ଆତି ହାସନ, ବା -ସରହ ମଥରମ୍ମଦ ଗଞ୍ଜ , ବିଜାଉ	ମୁସଲିମ
୯୫୫	୨୯୦/୪୮୩	୯୯୯୩/୪୨୭୫	୦.୦୫୫	୦.୦୫୫	ଘରବାଡି	ଶଙ୍କୁ କୁମାର ସାହୁ ,ପି- ବିରେନ୍ଦ୍ର ସାହୁ , ବା- ଠେଲକୋଳି	ବୁଡିଆ
୯୫୪	୨୯୦/୪୮୨	୯୯୩୯/୪୨୭୮	୦.୨୨୦	୦.୨୨୦	ଘରବାଡି	ବଳରଙ୍ଗଳି ବୁରମା , ପି -ସି , ଓ , ଜି ବୁରମା ,ବା - ବିପଳିମା	ପୁନାରି
୯୫୫	୨୯୦/୪୮୭	୯୯୩୯/୪୨୭୯	୦.୨୨୦	୦.୨୨୦	ଘରବାଡି	ବୁଦ୍ଧାଙ୍କ କୁମାର ବାରିକ , ପି- ଉମେଶ ବାରିକ , ବା -ତାରୋପାଣି	କୁଲଗା
୯୫୩	୨୯୦/୪୮୬	୯୭୩୯	୦.୨୯୦	୦.୨୯୦	ଘରବାଡି	ମହମ୍ମଦ ମୁନ୍ନୁଟୁଲା , ପି -ମହମ୍ମଦ ଖଲିଲ , ବା -ଖୁଣ୍ଟଲା ବାହାଲ, କୁଚିଣ୍ଡା ,ସମ୍ବଲପୁର	ମୁସଲିମ
୯୫୦	୨୯୦/୫୦୫	୯୯୮୬/୪୨୦୨	୦.୦୫୦	୦.୦୬୦	ଘରବାଡି	ବେଦ୍ୟନାଥ ଭୋଇ ପିତା-ବୈଷ୍ଣବ ଭୋଇବା -ନେହାଲପୁର ଜଡକ	ଗୋପାଳ
୯୫୦	୨୯୦/୫୦୫	୯୯୮୬/୪୨୦୩	୦.୦୮୦	୦.୦୮୦	ଘରବାଡି	ବେଦ୍ୟନାଥ ଭୋଇ ପିତା-ବୈଷ୍ଣବ ଭୋଇବା -ନେହାଲପୁର ଜଡକ	ଗୋପାଳ
୯୫୯	୨୯୦/୫୦୫	୯୯୮୬/୪୨୦୪	୦.୨୨୦	୦.୨୨୦	ବେ-ପା-୨	ପୂର୍ଣ୍ଣ ପ୍ରକାଶ ଗାୟ ଚନ୍ଦ୍ର ପ୍ରକାଶ ଗାୟ ପିତା-ଗାମଲଦିତ ଗାୟ ବା-ଜାଣାପୁରଥାନା-ଚିପତ୍ତ ,ଆଳମପଡ	ବ୍ରାହ୍ମଣ
୯୫୨	୨୯୦/୫୦୩	୯୭୨୦/୪୭୯୫	୦.୦୧୦	୦.୦୧୦	ଘରବାଡି	ଫଣିର ମୋହନ ଦାଶ ,ପିତା-ବୈକୁଣ୍ଠ ଦାଶ	ବ୍ରାହ୍ମଣ
୯୫୮	୨୯୦/୫୨୦	୯୯୦୨/୪୭୯୨	୦.୦୦୮	୦.୦୦୮	ବା-ପା	ମଞ୍ଜୁ ସାହୁ ,ସ୍ୱା- ଶଙ୍କୁ କୁମାର ସାହୁ	ଗୁଡିଆ
୯୫୪	୨୯୦/୫୨୦	୯୮୩୫/୪୭୯୦	୦.୦୪୦	୦.୦୪୦	ଘରବାଡି	ପ୍ରବୀପ କୁମାର ସାହୁ , ପିତା-ଲୁଜ୍ଜ ସାହୁ	କୁଲତା
୯୫୭	୨୯୦/୫୦୦	୯୮୩୫/୪୭୯୨	୦.୦୩୦	୦.୦୩୦	ଘରବାଡି	ସରୋଜ ପ୍ରଧାନ ପିତା-ସଉଦାଗର ପ୍ରଧାନ	କୁଲତା
୯୫୫	୨୯୦/୫୦୯	୯୮୩୫/୪୭୯୩	୦.୦୩୦	୦.୦୩୦	ଘରବାଡି	ଉତ୍ତରମ ସାହୁ, ପିତା-ଭଦ୍ଦର ସାହୁ	କୁଲତା
୯୫୫	୨୯୦/୫୦୨	୯୮୩୫/୪୭୯୩	୦.୦୪୦	୦.୦୪୦	ଘରବାଡି	ଉର୍ମିଲା ବଡେଇ, ସ୍ୱା -ସାହେବ ବଡେଇ	କୁଲତା
୯୫୮	୨୯୦/୫୦୩	୯୮୩୫/୪୭୯୪	୦.୦୩୦	୦.୦୩୦	ଘରବାଡି	ଧୀରେନ୍ଦ୍ର ପ୍ରଧାନ ,ପିତା-ଚମାରୁ ପଧାନ	କୁଲତା
୯୫୯	୨୯୦/୫୦୪	୯୮୩୫/୪୭୯୫	୦.୦୪୦	୦.୦୪୦	ଘରବାଡି	ନରେନ୍ଦ୍ର ସାହୁ ,ପିତା-ଗଙ୍ଗାଧର ସାହୁ	କୁଲତା
୯୬୦	୨୯୦/୫୦୬	୯୮୩୫/୪୭୯୬	୦.୦୨୦	୦.୦୨୦	ଘରବାଡି	ଦେବେନ୍ଦ୍ର କୁମାର ସାହୁ , ପିତା-ଗଙ୍ଗାଧର ସାହୁ	କୁଲତା
୯୬୧	୨୯୦/ ୫୦୫	୯୮୩୨/୪୭୨୬	୦.୦୩୦	୦.୦୩୦	ଘରବାଡି	ସୁରେନ୍ଦ୍ର ଖେଠ ,ପିତା-ସମାରୁ ଖେଠ	ଘୋଡା
୯୬୨	୨୯୦/୫୩୬	୯୮୩୨/୪୭୨୭	୦.୦୪୦	୦.୦୪୦	ଘରବାଡି	ବନବାସି ନାଥ , ପିତା-ଘୋମନାଥ ନାଥ	ବ୍ରାହ୍ମଣ
୯୬୩	୨୯୦/୫୩୭	୯୮୩୨/୪୭୨୮	୦.୦୨୦	୦.୦୨୦	ଘରବାଡି	ପିତାପ କୁମାର ନାଥ, ପିତା-ନୀଳାମ୍ବର ନାଥ	ବ୍ରାହ୍ମଣ
୯୬୪	୨୯୦/୫୩୫	୯୮୩୨/୪୭୨୯	୦.୦୫୦	୦.୦୫୦	ଘରବାଡି	ପ୍ରଭାତ ନାଥ , ଅକ୍ଷୟ ନାଥ ପିତା-ଜିଜେଶ୍ୱର ନାଥ	ବ୍ରାହ୍ମଣ
୯୬୫	୨୯୦/୫୩୮	୯୮୩୨/୪୭୩୦	୦.୦୫୦	୦.୦୫୦	ଘରବାଡି	ଅଶୋକ କୁମାର ନାଥ ,ପିତା-ନୀଳାମ୍ବର ନାଥ	ବ୍ରାହ୍ମଣ
୯୬୬	୨୯୦/୫୪୦	୯୯୫୩/୪୭୩୩	୦.୦୩୦	୦.୦୩୦	ପା.ପା	ମୁନୁ ନାୟକ ,ପିତା-ଅଖତମା ନାୟକ	ଗଣ

Land Acquisition Officer
Collectorate, Sambalpur

Land Acquisition Officer
Sambalpur

କ୍ର.ନଂ	ଖାତା ନଂ	ପ୍ଲଟ ନଂ.	ମୋଟ ରକବା (ଏକରରେ)	ଅଧିକୃତ ହେଉଥିବା ରକବା (ଏକରରେ)	ଜିଲ୍ଲା	ଭୂମି ମାଲିକଙ୍କ ନାମ	ମାଟି
୧୬୮	୨୯୦/୧୮୮	୧୩୮୫	୦.୩୫୦	୦.୩୫୦	ଗ.ପା	ଇଶ୍ୱର ସାହୁ ,ପିତା-ନାରାୟଣ ସାହୁ	ବୁଦ୍ଧତା
		୧୩୫୦	୦.୧୧୦	୦.୧୧୦	ମା.ପା		
		୨୫୫/୩୫୨୯	୦.୨୧୦	୦.୨୦୫	ଗା-ପା		
		୨୫୨୭	୦.୦୯୦	୦.୦୯୦	ମା.ପା		
		୨୫୨୫	୦.୦୨୦	୦.୦୨୦	ମା.ପା		
୧୨୦	୨୯୦/୧୮୯	୧୫୦୯/୩୫୨୯	୦.୧୨୦	୦.୧୨୦	ଗ-ପା	ଲଲିତ କୁମାର ତ୍ରିପାଠୀ ,ପିତା-ଭାବର୍ଦ୍ଧନ ତ୍ରିପାଠୀ	ବ୍ରାହ୍ମଣ
୧୩୦	୨୯୦/୨୦୨	୮୮୩	୦.୩୫୦	୦.୩୫୦	ମା.ପା	ସୁରେନ୍ଦ୍ର ସୁନାନି ,ପିତା-ତପିଶ ସୁନାନି	ଗଣ୍ଡା
୧୩୧	୨୯୦/୨୦୫	୧୨୫୩	୦.୨୫୦	୦.୨୫୦	ଗା-ପା-୨	ଦେବେଶୀ ତ୍ରିପାଠୀ ,ଚମାରୁ ତ୍ରିପାଠୀ	ବ୍ରାହ୍ମଣ
୧୩୨	୨୯୦/୨୦୦	୮୫୫	୦.୧୫୦	୦.୧୫୦	ଆ.ପା	ଦେବେଶୀ ତ୍ରିପାଠୀ ,ଚମାରୁ ତ୍ରିପାଠୀ	ବ୍ରାହ୍ମଣ
		୮୪୫	୦.୦୫୦	୦.୦୫୦	ବେ.ପା		
		୧୩୨	୦.୫୨୦	୦.୫୨୦	ବା.ପା		
		୮୫୨/୩୩୨୮	୦.୩୮୦	୦.୩୮୦	ବା.ପା		
୧୩୩	୨୯୦/୨୩୯	୫୬୮	୦.୦୮୦	୦.୦୮୦	ବା.ପା	ଘାଘାସ ବିହାରୀ ନାୟକ ,ପି -ଯୁଧିଷ୍ଠିର ନାୟକ	ବ୍ରାହ୍ମଣ
		୨୮୫	୦.୨୫୦	୦.୨୫୦	ବା-ପା		
		୧୫୦୨/୩୫୮୩	୦.୨୦୦	୦.୨୦୦	ମା.ପା		
		୧୨୫୯	୦.୦୫୦	୦.୦୫୦	ମା-ପା-୨		
୧୩୫	୨୯୦/୨୩୨	୧୨୨୩/୩୨୮୫	୦.୧୧୦	୦.୧୧୦	ମା-ପା-୨	ରାମ ପ୍ରସାଦ ପ୍ରଧାନ ,ଇଶ୍ୱର ପ୍ରଧାନ ,ପି-ବଦ୍ରୁଣ ପ୍ରସାଦ	ବୁଦ୍ଧତା
୧୩୬	୨୯୦/୨୩୬	୧୩୮୬	୦.୨୫୦	୦.୨୫୦	ବାଲି	ଖାମରୋପାଲ ଜୁଆଁର, ପି- ଚମାରୁ ଜୁଆଁର	ଚଷ
		୧୮୫୮	୦.୦୫୦	୦.୦୫୦	ମା ପା-୨		
		୧୮୮୧	୦.୦୫୦	୦.୦୫୦	ବେ ପା		
		୧୮୨୨	୦.୧୦୦	୦.୧୦୦	ମା.ପା		
		୧୮୨୩(ପୁ)	୦.୧୨୦	୦.୨୨୦	ମା.ପା		
		୧୮୮୮	୦.୦୨୦	୦.୦୨୦	ମା.ପା		
		୧୮୨୪	୦.୦୮୦	୦.୦୮୦	ମା.ପା		
		୧୮୮୯	୦.୦୩୦	୦.୦୩୦	ମା.ପା		
୧୩୫	୨୯୦/୨୩୯	୧୨୫/୩୫୨୩	୦.୨୨୦	୦.୨୨୦	ମା.ପା	ଜୈରାଶ ଚନ୍ଦ୍ର ଲୋଧା ,ପି-ମହାଦେବ ଲାଳ ଲୋଧା ,ବା - ଝାରସୁଗୁଡା	ଅଗ୍ରଖାଲ
		୧୨୯୦/୩୫୦୫	୦.୦୫୦	୦.୦୫୦	ବେ.ପା	ବାଇନ ,ଜିହ୍ନା -ଝାରସୁଗୁଡା	
୧୩୭	୨୯୦/୨୪୮	୮୭୩	୦.୦୨୦	୦.୦୫୦	ବା.ପା	ଭରତ ଛୋଇ ,ପି- ନରେନ୍ଦ୍ର ଛୋଇ	ଘଡ
		୮୭୫	୦.୦୩୦	୦.୧୩୦	ବା.ପା		
		୭୦୮/୩୮୦୨	୦.୦୨୦	୦.୦୨୦	ବା.ପା		
୧୩୮	୨୯୦/୨୮୨	୮୨୫	୦.୨୨୦	୦.୨୦୦	ମା.ପା	ଇନ୍ଦ୍ରା ବଡାଇ ,ସ୍ୱା -ରାମେଶ୍ୱର ବଢେଇ ,ବା ବେଇପାହାଡ ,ଆମ୍ବା - ପିଟଲିପାଳି ,ଝାରସୁଗୁଡା	ବୁଦ୍ଧତା
୧୩୯	୨୯୦/୩୫୦	୧୫୦୮/୪୦୮୫	୦.୦୨୦	୦.୦୨୦	ମ-ଜ-ପା-୨	ଓଡୋଡିନୀ ନାଥ ,ସ୍ୱା -ଟିକେଶ୍ୱର ନାଥ , ଅକ୍ଷୟ କୁମାର ନାଥ, ପ୍ରଭାତ ନାଥ ,ପି- ଟିକେଶ୍ୱର ନାଥ , ମାଇଆଲି ନାଥ ,ସ୍ୱା -ପ୍ରତାପ ନାଥ , ମାନସ ନାଥ ,ଛୋଟା ନାଥ ,ପି- ପ୍ରତାପ ନାଥ	ବ୍ରାହ୍ମଣ
୧୪୦	୨୯୨/୩୫୦	୨୮୩	୬.୩୫୦	୪.୩୨୦	ଆ.ପା	ମଦିମା ଧରୁଆ ,ସ୍ୱା -ଟୁ ଜମଣି ଧରୁଆ ଓ ସାଙ୍ଗର , ସୁଶାଇ ଧରୁଆ,ଲକ୍ଷ୍ମଣ ଧରୁଆ ,ସୌଭାଗିନୀ ନାୟକ ,ଚପିଲ ଧରୁଆ ,ପଙ୍କଜିନୀ ସିଂ,ଗୀତାଞ୍ଜଳି ଧରୁଆ ,ପି- ବୁଜମଣି ଧରୁଆ ଓ ସାଙ୍ଗର	ଚାଷ
		୨୩୨୩	୦.୨୮୦	୦.୨୮୦	ବା.ପା		
		୧୫୫୭	୦.୨୮୦	୦.୨୮୦	ବା.ପା		
		୧୫୨୭	୦.୧୩୦	୦.୧୩୦	ମା.ପା		
		୧୫୬୮	୦.୨୨୦	୦.୨୨୦	ମ-ଜ-ପା-୨		
୧୪୧	୨୯୦/୩୫୯	୧୨୮୨	୦.୨୮୦	୦.୨୮୦	ମା.ପା	ଘାଧୁଆ ଅଗ୍ରଖାଲ ,ସ୍ୱା -ରାଜେଶ ଅଗ୍ରଖାଲ , ଯୋଗେଶ ଅଗ୍ରଖାଲ ,ଜଗିତା ଅଗ୍ରଖାଲ, ପି -ରାଜେଶ ଅଗ୍ରଖାଲ ,ବା -ଜଖର ମାର୍ଗ ,ସମ୍ବଲପୁର	ଓଡିଶୀ
		୧୨୮୩	୦.୨୦୦	୦.୦୦୦	ଆ.ପା		
୧୪୨	୨୯୦/୩୦୦	୧୫୧୨	୦.୦୫୦	୦.୦୫୦	ମା.ପା	ସରୋଜିନୀ ନାଥ ,ସ୍ୱା -ଟିକେଶ୍ୱର ନାଥ ଅକ୍ଷୟ କୁମାର ନାଥ ,ପ୍ରଭାତ ନାଥ, ପି -ଟିକେଶ୍ୱର ନାଥ ମାଇଆଲି ନାଥ ,ସ୍ୱା -ପ୍ରତାପ ନାଥ	ବ୍ରାହ୍ମଣ
		୧୫୨୯	୦.୦୫୦	୦.୦୫୦	ମ-ଜ-ପା-୨		
୧୪୩	୨୯୦/୫୦୦	୧୨୩୭/୫୧୫୨	୦.୦୫୦	୦.୦୫୦	ବାଲି-ପା	ନିତ୍ୟାନନ୍ଦ ଦାସ ,ପି-କୃଷ୍ଣ ଚନ୍ଦ୍ର ଦାସ , ବା -ଗେଣ୍ଡାଜୋଳା	ବ୍ରାହ୍ମଣ
୧୪୫	୨୯୦/୫୦୯	୧୨୩୫/୫୧୫୨	୦.୧୨୦	୦.୦୨୦	ବାଲି-ପା	ରୁକୁଣା ନାଥ ,ସ୍ୱା -ନିତ୍ୟାନନ୍ଦ ନାଥ	
୧୪୫	୨୯୦/୫୦୩	୨୫୮/୫୧୫୦	୦.୧୩୦	୦.୧୩୦	ବା.ପା	ସନ୍ତୋଷ କୁମାର ପ୍ରଧାନ ,କୃଷ୍ଣ ଚନ୍ଦ୍ର ପ୍ରଧାନ ,ପି-ଜଗମୋହନ ପ୍ରଧାନ	ବୁଦ୍ଧତା
		୮୩୫/୫୧୫୩	୦.୨୨୦	୦.୨୨୦	ମା.ପା		
		୮୩୭/୫୧୫୪	୦.୩୮୦	୦.୩୮୦	ଆ.ପା		
		୮	୦.୪୦୦	୦.୪୦୦	ବେ.ପା		
		୨୩୩୩/୫୧୬୮	୦.୨୨୦	୦.୨୨୦	ବେ.ପା		
		୧୩୨୦/୫୧୬୨(ପୁ)	୦.୨୫୪	୦.୨୩୦	ବେ.ପା		
		୨୩୨୩/୫୧୮୦	୦.୦୫୦	୦.୦୫୦	ବା.ପା		

Land Acquisition Inspector
Collectorate,Sambalpur

Land Acquisition Officer
SAMBALPUR

କ୍ର.ନଂ	ଖାତା ନଂ	ପ୍ଲଟ ନଂ.	ମୋଟ ରକବା (ଏକରରେ)	ଅଧିକୃତ ହେଉଥିବା ରକବା (ଏକରରେ)	କିସମ	ଭୂମି ମାଲିକଙ୍କ ନାମ	ଜାତି
୯୭୭	୨୯୦/୬୫୩	୯୮୩୨/୬୬୩୫	୦.୦୩୦	୦.୦୩୦	ଘରବାରି	ଶଶିଭୂଷଣ ନାଥ ,ପିତା-ବିଦ୍ୟାଧର ନାଥ	ବ୍ରାହ୍ମଣ
୯୭୮	୨୯୦/୬୬୧	୧୧୨୧/୨୨୫୮	୦.୨୦୦	୦.୨୦୦	ମା-ପା	ନାରାୟଣ କୁମୁରା , ବୃନ୍ଦାବନ କୁମୁରା , ଶଶିଭୂଷଣ କୁମୁରା ପିତା-ମହାଦେବ କୁମୁରା	ଗଣ
		୬୨୩/୮୨୭୭	୦.୨୫୦	୦.୨୫୦	ବା-ଶା		
୯୭୯	୨୯୦/୬୬୭	୨୯୨୧/୪୪୬୫	୦.୨୦୦	୦.୨୦୦	ମା-ପା-୨	ନୀଳାମ୍ବର କୁମୁରା	ଗଣ
୯୮୦	୨୯୦/୬୬୩	୭୨୧	୦.୦୭୦	୦.୦୨୦	ବା.ଘା-୨	କିରାତର କୁମୁର , ପିତା-ପାଣିକ କୁମୁରା	ଗଣ
		୧୧୨୧/୨୨୬୭	୦.୧୯୦	୦.୨୦୦	ମା.ଘା-୨		
		୭୨୧/୩୬୩୫	୦.୦୫୦	୦.୦୫୦	ବା.ଘା-୨		
୯୮୧	୨୯୦/୬୬୬	୯୮୩୪/୬୬୮୯	୦.୦୫୦	୦.୦୫୦	ଘରବାରି	ରାମ ପ୍ରସାଦ ପ୍ରଧାନ , ପିତା-ବରୁଣ ପଧାନ	କୁଲତା
୯୮୨	୨୯୦/୬୬୬	୯୮୩୪/୬୬୮୭	୦.୦୨୦	୦.୦୨୦	ଘରବାରି	ପ୍ରମୋଦ କୁମାର ପଧାନ , ପିତା-ଡମାର ପଧାନ	କୁଲତା
୯୮୩	୨୯୦/୬୬୬	୯୮୩୫/୬୬୮୩	୦.୦୧୦	୦.୦୧୦	ଘରବାରି	ତ୍ରିବିକ୍ରମ ପଧାନ , ପିତା-କେଶବ ପଧାନ	କୁଲତା
୯୮୪	୨୯୦/୬୬୮	୯୮୩୪/୬୬୮୪	୦.୦୫୦	୦.୦୫୦	ଘରବାରି	ମହାଦେବ ପଧାନ , ପିତା-ବିଜେ ପଧାନ	କୁଲତା
୯୮୫	୨୯୦/୬୯୩	୦୭୩/୪୫୦୮	୦.୪୩୦	୦.୪୩୦	ମା.ଘା	ଗୋକୁଳାନନ୍ଦ ପାଉଲେ ,ପିତା-ସନ୍ତୋଷ ପାଉଲେ	ଗଣ
		୦୭୪/୪୫୦୯	୦.୦୩୦	୦.୦୩୦	ମା.ଘା		
		୦୭୪/୪୫୧୦	୦.୧୫୦	୦.୧୫୦	ମା.ଘା		
		୦୭୨	୦.୩୩୦	୦.୩୩୦	ବେ.ଘା		
୯୮୬	୨୯୦/୬୯୪	୧୨୦୬/୩୭୮୦	୦.୩୨୦	୦.୩୨୦	ଘରବାରି	ଅମୂଲ୍ୟ ନାୟକ ,ପିତା-ପ୍ରଫୁଲ୍ଲ ନାୟକ	ବ୍ରାହ୍ମଣ
୯୮୭	୨୯୦/୭୦୨	୧୧୮୬	୦.୨୦୦	୦.୨୦୦	ବେ-ପା-୨	ସୁଜାତା ମିଶ୍ର, ସ୍ୱା-ସୁବୋଧ କୁମାର ଶତପଥୀ ,ବା-ଜଗଦା , ରାଉରକେଲା	ବ୍ରାହ୍ମଣ
୯୮୮	୨୯୦/୭୦୬	୧୦୮୪/୩୭୮୨	୦.୦୫୦	୦.୦୫୦	ମା.ଘା	ସୁବୋଧ କୁମାର ଶତପଥୀ , ପିତା-ମଧୁସୂଦନ ଶତପଥୀ	ବ୍ରାହ୍ମଣ
୯୮୯	୨୯୦/୭୧୧	୧୦୦୩/୨୨୫୨	୦.୧୪୨	୦.୧୪୨	ଦୋ-ଘା	ଏକବଲ ହୁସେନ, ପିତା-ରୋଶନ ଅଲି	ମୁସଲିମ
୯୯୦	୨୯୦/୭୨୩	୧୧୮୬	୦.୨୦୦	୦.୨୦୦	ଅ.ଘା	ସୁବାସ ତ୍ରିପାଠୀ ,ପିତା-ବିଦେଶୀ ତ୍ରିପାଠୀ	ବ୍ରାହ୍ମଣ
୯୯୧	୨୯୦/୭୨୪	୯୮୬୨/୬୭୩୬	୦.୦୫୦	୦.୦୫୦	ଅ.ଘା	ସୁବ୍ରତ କୁମାର ପଣ୍ଡା ,ପି:ମଙ୍ଗରାଜ ପଣ୍ଡା. ଜା: ବ୍ରାହ୍ମଣ ,ବା: ଜଗଦାଡ଼	ବ୍ରାହ୍ମଣ
୯୯୨	୨୯୦/୭୨୮	୯୮୬୬/୬୭୩୨	୦.୦୫୦	୦.୦୫୦	ଅ.ଘା	ରାଜେନ୍ଦ୍ର ଦାସ ପି:ମୁରଲୀ ଦାସ ଜା: ବ୍ରାହ୍ମଣ ବା: ଠେଙ୍ଗକୋଲୋନୀ ।	ବ୍ରାହ୍ମଣ
୯୯୩	୨୯୦/୭୨୨	୯୮୬୨/୬୭୩୨	୦.୦୮୦	୦.୦୮୦	ଅ.ଘା	ବୁଧୁଆ ସିଂହ ,ପିତା-ଗୌରାଙ୍ଗ ସିଂହ	ଖଣ୍ଡାୟତ
୯୯୪	୨୯୦/୭୨୯	୯୮୬୬/୬୭୩୯	୦.୦୫୦	୦.୦୫୦	ଅ.ଘା	ବୃନ୍ଦାବନ ସ୍ୱାଇଁ , ପିତା-ଦୀନବନ୍ଧୁ ସ୍ୱାଇଁ	ଖଣ୍ଡାୟତ
୯୯୫	୨୯୦/୭୨୨	୯୮୬୬/୬୬୩୮	୦.୦୫୦	୦.୦୫୦	ଅ.ଘା	ଲକ୍ଷ୍ମୀମଣି ନାୟକ , ପିତା-ନଟବର ନାୟକ	ଖଣ୍ଡାୟତ
ସର୍ବମୋଟ			୩୧୧.୪୦୦	୨୮୯.୮୩୦			

Land Acquisition Inspector
Collectorate,Sambalpur

Land Acquisition Officer
SAMBALPUR

ANNEXURE XX

WATER SUSTAINABILITY REPORT

WATER SUSTAINABILITY REPORT – HIRAKUD RESERVOIR

Hirakud Dam is built across the Mahanadi River, about 15 kilometres (9.3 mi) from Sambalpur in the state of Odisha in India. Behind the dam extends a lake, **Hirakud Reservoir**, 55 km (34 mi) long. It is one of the first major multipurpose river valley projects started after India's independence. The dam was constructed to avoid damage of crops due to floods and also to maintain and regulates flows in the Mahanadi River. The water storages in the reservoir helps to distribute water to the industries in the downstream as per the allocation methodologies prescribed by government.

In the context of allocation of water to the proposed 3x800 MW NLC Talabira Thermal Power Project (NTTPP) to be established by NLCIL at Kumbhari & Tharaikela Tehsil in Jharsuguda District & Ash dyke in Thelkoloi Villages Sambalpur District., an attempt has been made to understand the availabilities of Hirakud reservoir water by verifying the past storage capacities for continuous supplies to NLCIL without interrupting the power generation. Collected extensive secondary data and reviewed available literature, for understanding in-depth the factors shaping water allocations and use, to check realities of water availability 'vs' water allocations. In this water sustainability report, studied about the subject of inter-sectoral water allocations, specifically water allocations between agriculture, the largest sectoral user of water, and industry, which has a significant and growing share for the quantum of water actually used in each of these sectors in the Mahanadi Basin.

Hirakud Reservoir:

The Hirakud project holds tremendous importance for irrigation and also to supply water to many industries in Odisha. It is situated in Sambalpur district on the Mahanadi river, the Hirakud dam was completed in 1957 and has been supplying water for irrigation since then. As per the literature, Water from Hirakud reservoir at a later stage was allocated to various industries, primarily for mineral processing and coal fired thermal power plants in Jharsuguda and Sambalpur districts. Storage capacities of Hirakud Reservoir and allocations are discussed in the following sections.

Water Resources – Availability in Hirakud Reservoir basin

The Mahanadi Basin lies almost entirely within the states of Chhattisgarh and Odisha, in Central and Eastern India. The river Mahanadi starts out near Pharsiya village in the hilly, largely tribal, forested regions of Southern Chhattisgarh and initially flows in a northern direction, down into the plains of Central Chhattisgarh, before veering east towards the state of Odisha, where it flows down into the plains, flanked both on the northern and southern sides by forested zones, and then into its large delta region before meeting the Bay of Bengal. The river drains a basin of about 142,000 km2 which is one of the larger river basins in peninsular India. The Seonath (also known as Shivnath) is the Mahanadi's largest tributary, joining the river in the plains; the Hasdeo and Mand are also major tributaries that flow north to south and join the Mahanadi in Chhattisgarh. The Ib, Ong, Tel and Jonk rivers join the Mahanadi in the state of Odisha. The Tel and Ib rivers are the second and third largest tributaries of the Mahanadi, respectively, with the Tel joining on the right bank of the Mahanadi, downstream of the Hirakud reservoir and the Ib joining upstream of the Hirakud, on the left bank.

Characteristics of the Mahanadi Basin :

Total Area	About 141,589 Sq. Km
Length of River	851 Km
Average Annual Runoff	66.8 BCM
Major Tributaries	Seonath, Hasdeo Mand, lb, Ong, Tel and Jonk
Major water resource	Hirakud Reservoir, kMahanadi Reservoir Complex (Ravishankar Sagar, Murrum Silli, Dudhawa Reservoirs.
Rainfall	1291 mm
Crops	Rice, Gram, Khesari
Irriation	76 Projects (22 major and 54 medium)
Major Industries, Industrial Zones	Thermal Power, Iron and Stell, Minning (Coal and Bauxite)

Source : CWC 2011 & 2012, MoWR2014

Analysis of In flows :

The average annual flow in the Mahanadi is estimated to be 66.88 BCM and the average annual flow at Tikarpara, the last gauging station in the basin, is 47.5 BCM.10 Of this total annual average flow, about 50 BCM is said to be utilisable (Central Water Commission, 2013, p. 5). When taking into account the population of the Mahanadi river basin, the per capita utilisable water is much higher than other major peninsular rivers such as the Godavari, Krishna and Cauvery rivers. By modeling estimates, the annual natural flows (if storage reservoirs were absent) was estimated at about 77 BCM for 1972 and 81 BCM for 2003 (Dadhwal, Aggarwal & Mishra, 2010). In comparison, the 2007 Jeyaseelan report, by the Government of Odisha (GoO), suggests that the average annual flows add up to 59.16 BCM (29.90 BCM from the catchment in Odisha and 29.26 BCM from Chhattisgarh's catchment) (Water Resource Department, GoO, 2007). Of this, 32.2 BCM (average value up to 2013-14) is the annual inflow into the Hirakud reservoir, which lies just within Odisha near the Chhattisgarh border. Based on the rainfall in the catchment area has fallen over the years, it was identified that, since 2006-07 monsoon inflows have averaged only 24.7 BCM. Non-monsoon inflows have increased over the years and now average about 4 BCM. This could possibly be due to upstream land use changes, changes in reservoir elevation-capacity curves (i.e. parameters used to measure inflow).

Surface water Availability and Storage :

River	Catchment Area (km^2)	Average water resources potential (in BCM)	Utilisable Surface Water Resources (in BCM)	Surface Water Storages (in BCM) including projects under construction
Mahanadi	**141,589**	**66.88**	**50**	**14.46**

Source : Central Water Commission 2013

As per the study conducted by Indian Institute of Technology (IIT) estimates a 10 per cent reduction in annual flows in the Mahanadi river basin as a result of precipitation changes since 1951 (Ghosh et al., 2016). Though the annual flows have reduced the increasing

frequency of extreme rainfall events and reducing forest cover act as drivers that contribute to increased runoff. Based on IIT studies and future projections based on precipitation projections showed that monthly runoff in September, for example, is expected to increase by an average of 38 per cent during 2075–2100 and runoff in April would decrease by 32.5 per cent by 2050–2075 (Asokan & Dutta, 2008). Another study which uses a hydrological model to estimate the effect of change in land cover on flows, found that changing land cover, primarily from forest cover to agriculture, can be attributed to have increased flows by 4.5 per cent in the time period 1972–2003 in the Mahanadi Basin (at Mundali in the delta) (Dadhwal et al., 2010). Based on the period of data considered, it shows a very marginal decline in the long term annual runoff. When disaggregate this trend seasonally, it indicates substantial decrease in monsoon runoff and an increase in the non-monsoon runoff. This could be a consequence of increased storage in reservoirs which is released in the non-monsoon season. Hence, Hirakud reservoir will get good inflows even small decline in long term annual runoff, and it indicates supply of allocated water to the industrial use, may not be have an impact for receiving the required quantum of inflows into the reservoir for further distribution.

Industrial Water Allocations :

According to the secondary data about number of industries in the Mahanadi Basin based on the environmental clearances by the Ministry of Environment and Forests, the total amount of water in the Mahanadi basin allocated to large industries is about 1130 MCM in Chhattisgarh and 944 MCM in Odisha. As per the details available, below table indicates the availability of water for industrial allocation.

Surface water Availability	50000 MCM of utilizable water
Irrigation use	13,715 MCM (27.4%) of utilizable water
Industrial use	2,074 MCM (4%) of utilizable water.

Source : CWC 2013

The amount to 2074 MCM of water for industrial use or about 4 per cent of the total utilisable surface water in the Mahanadi Basin. About 1661 MCM (80 per cent) of water is allocated to

thermal power generation alone, an increase from 364 MCM in 2007. This water is allocated for an estimated 55 gigawatt (GW) of thermal capacity in total, although not all of this thermal power capacity has been commissioned yet. The current thermal power capacity in both states stands at about 23 GW (some of this thermal capacity is located outside the Mahanadi Basin). Hence current Actual Water Use for thermal power in the Mahanadi Basin may be well below 1661 MCM. Besides thermal power another 413 MCM is allocated towards the iron and steel industry. A smaller percentage of this is also meant for aluminum industries.

It is estimated based on the literature data and analyse the storage capacities and utilization pattern, based on that water allocations in the Mahanadi Basin for surface water, would rise from current 13715 MCM to 20572 MCM by 2040. For industrial water allocations, the projections are fully depending on future thermal power project establishment in India. If solar power were to prevent more new allocations of water to thermal power, as it has been seen in past years, then the future water use for thermal power may not rise above the currently allocated figure of 1661 MCM. Hence, it is anticipating that releasing the water 7200 m^3/hour (sanctioned by Government Authorities) water from Hirakud Reservoir to the proposed Thermal power project of capacity 3x800 MW NLC Talabira Thermal Power Project (NTTPP) to be established at Kumbhari & Tharaikela Tehsil in Jharsuguda District & Ash dyke in Thelkoloi Villages Sambalpur District by NLCIL is possible for generating the power.